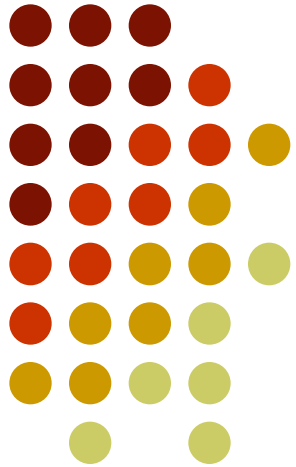
Introduction

Chapter 1



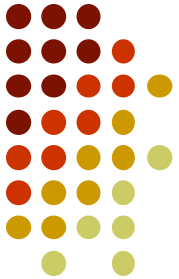
The Nature of Derivatives

- A derivative is an instrument whose value depends on the values of other more basic underlying variables
- Derivatives play a key role in transferring risks in the economy

Examples of Derivatives

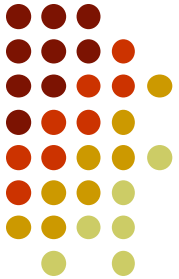
- Futures Contracts
- Forward Contracts
- Swaps
- Options

Ways Derivatives are Used



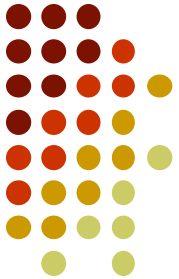
- To hedge risks
- To speculate (take a view on the future direction of the market)
- To lock in an arbitrage profit
- To change the nature of a liability
- To change the nature of an investment without incurring the costs of selling one portfolio and buying another

Futures Contracts



- A futures contract is an agreement to buy or sell an asset at a certain time in the future for a certain price
- By contrast in a spot contract there is an agreement to buy or sell the asset immediately (or within a very short period of time)

Exchanges Trading Futures

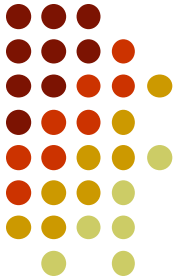


- CME Group
- Intercontinental Exchange
- Euronext
- Eurex
- BM&FBovespa (Sao Paulo, Brazil)
- National Stock Exchange of India
- China Financial futures Exchange
- and many more (see list at end of book)

Futures Price

- The futures prices for a particular contract is the price at which you agree to buy or sell at a future time
- It is determined by supply and demand in the same way as a spot price

Electronic Trading



- Traditionally futures contracts have been traded using the open outcry system where traders physically meet on the floor of the exchange
- This has now been largely replaced by electronic trading and high frequency (algorithmic) trading has become an increasingly important part of the market

Examples of Futures Contracts

Agreement to:

- buy 100 oz. of gold @ US$1100/oz. in December
- sell £62,500 @ 1.5500 US$/£ in March
- sell 1,000 bbl. of oil @ US$40/bbl. in April

Terminology

- The party that has agreed to buy has a long position
- The party that has agreed to sell has a short position

Example

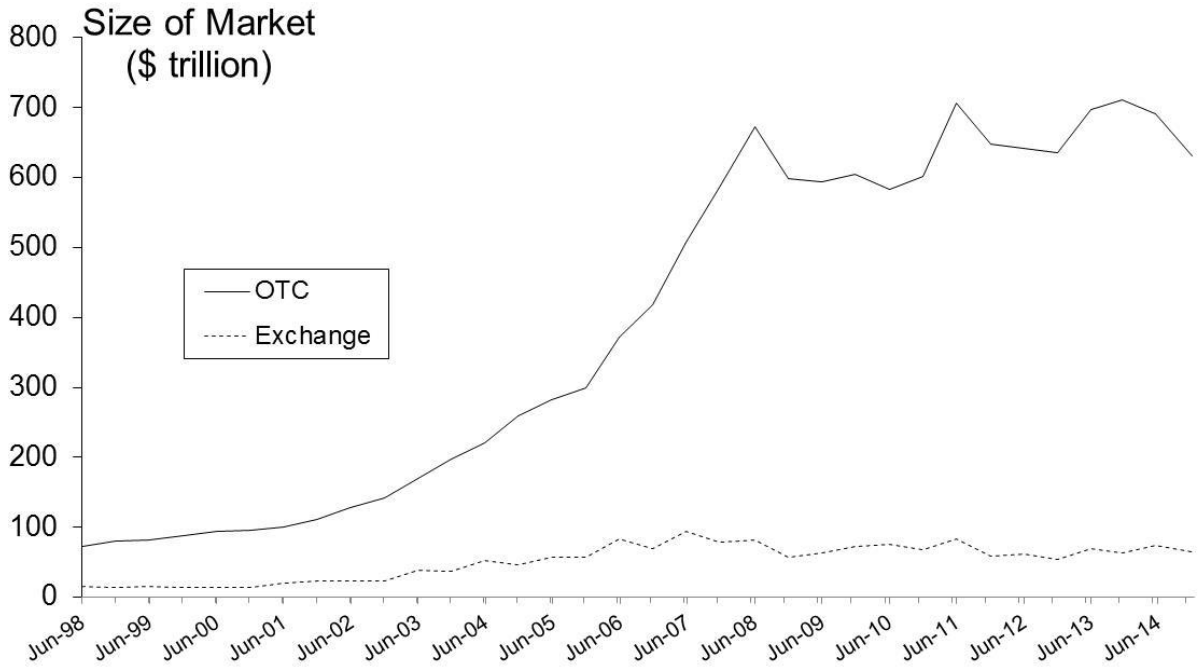
- January: an investor enters into a long futures contract to buy 100 oz of gold @ $1,100 per oz in April
- April: the price of gold is $1,175 per oz

What is the investor's profit or loss?

Over-the Counter Markets

- The over-the counter market is an important alternative to exchanges
- Trades are usually between financial institutions, corporate treasurers, and fund managers
- Transactions are much larger than in the exchange-traded market

Size of OTC and Exchange-Traded Markets



Source: Bank for International Settlements. Chart shows total principal amounts for OTC market and value of underlying assets for exchange market

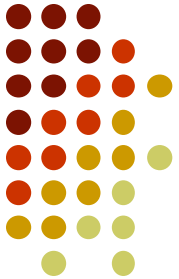
The Lehman Bankruptcy case

- Lehman's filed for bankruptcy on September 15, 2008. This was the biggest bankruptcy in US history
- Lehman was an active participant in the OTC derivatives markets and got into financial difficulties because it took high risks and found it was unable to roll over its short term funding
- It had hundreds of thousands of OTC derivatives transactions outstanding with about 8,000 counterparties
- Unwinding these transactions has been challenging for both the Lehman liquidators and their counterparties

New Regulations for OTC Market

- The OTC market is becoming more like the exchange-traded market. New regulations introduced since the crisis mean that
  - Standard OTC products traded between financial institutions must be traded on swap execution facilities
  - A central clearing party must be used as an intermediary for standard products when they are traded between financial institutions
  - Trades must be reported to a central registry

Systemic Risk



- New regulations were introduced because of concerns about systemic risk
- OTC transactions between financial institutions lead to systemic risk because a default by one large financial institution can lead to losses by other financial institutions…

Forward Contracts

- Forward contracts are similar to futures except that they trade in the over-the-counter market
- Forward contracts are popular on currencies and interest rates

Forward Price

- The forward price for a contract is the delivery price that would be applicable to the contract if were negotiated today (i.e., it is the delivery price that would make the contract worth exactly zero)
- The forward price may be different for contracts of different maturities

Foreign Exchange Quotes for USD/GBP exchange rate on May 13, 2015

	Bid (Bank is ready to buy GBP at)	Offer (Bank is ready to sell GBP at)
Spot	1.5746	1.5750
1-month forward	1.5742	1.5747
3-month forward	1.5736	1.5742
6-month forward	1.5730	1.5736

Example

- On May 13, 2015 the treasurer of a corporation might enter into a long forward contract to sell £100 million in six months at an exchange rate of 1.5730
- This obligates the corporation to pay £100 million and receive $157.30 million on December 13, 2015
- What are the possible outcomes?

Options

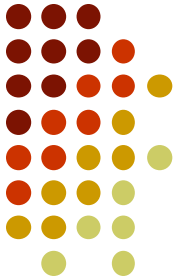
- A call option is an option to buy a certain asset by a certain date for a certain price (the strike price)
- A put option is an option to sell a certain asset by a certain date for a certain price (the strike price)

American vs European Options

- An American option can be exercised at any time during its life
- A European option can be exercised only at maturity

Google Call Option Prices (May 13, 2015

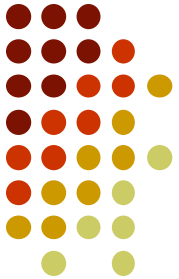
Stock Price: bid 532.20, offer 532.34)



Strike Price ($)	June Bid	June Offer	Sept Bid	Sept Offer	Dec Bid	Dec Offer
475	57.90	61.80	66.00	68.90	73.50	76.50
500	34.80	37.10	45.90	47.90	54.90	56.60
525	16.70	17.30	30.40	31.30	40.20	41.10
550	5.60	6.20	18.60	19.40	28.10	29.00
575	1.55	1.80	10.50	11.30	18.80	20.20

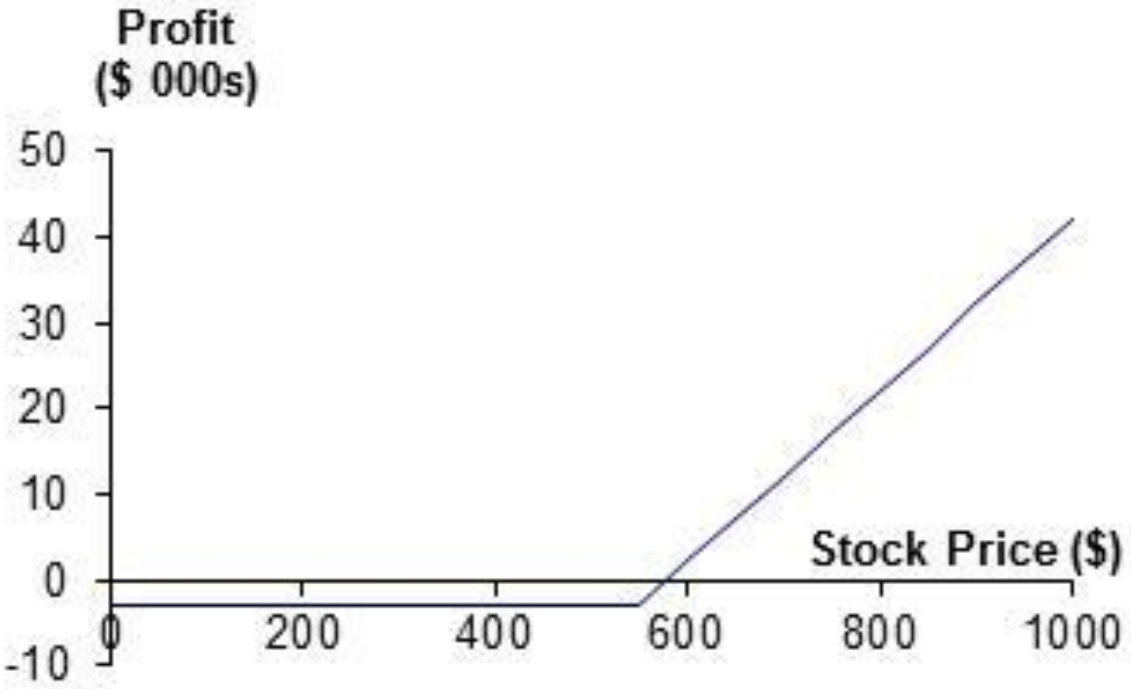
Google Put Option Prices (June 25, 2015

Stock Price: bid 532.20, offer 532.34)

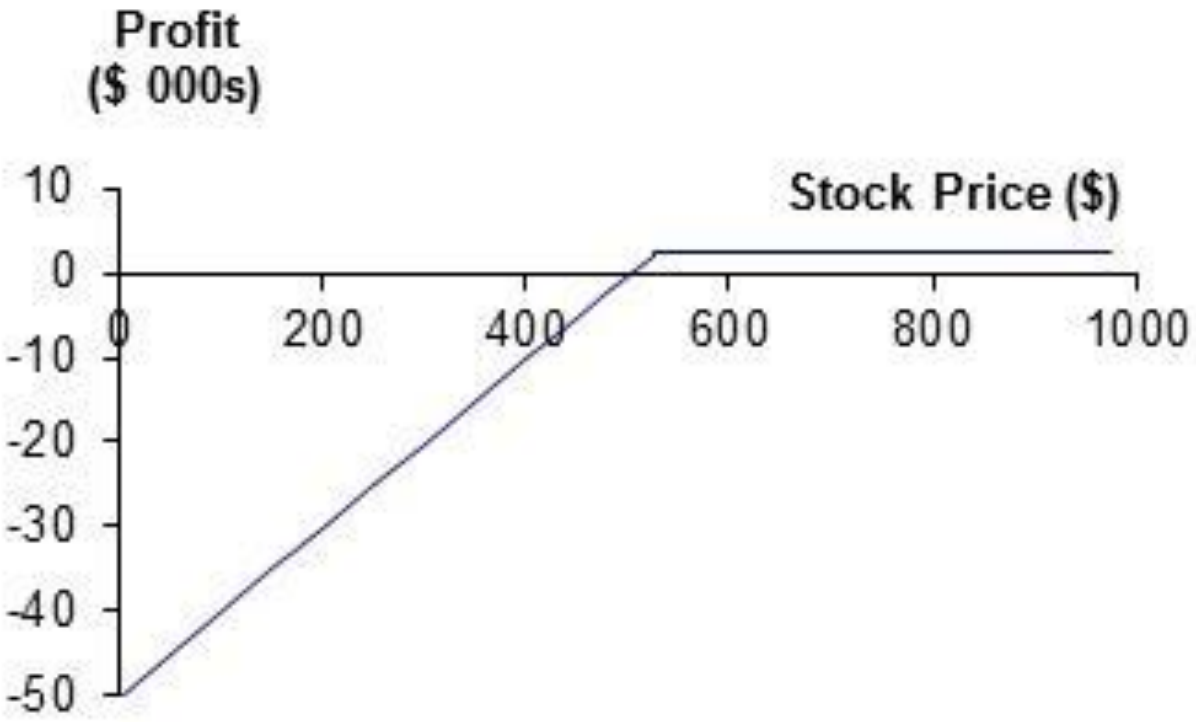


Strike Price ($)	June Bid	June Offer	Sept Bid	Sept Offer	Dec Bid	Dec Offer
475	0.95	1.05	5.50	9.20	12.50	15.20
500	2.95	3.30	13.00	13.80	21.30	22.10
525	9.40	9.90	22.40	23.20	31.30	32.00
550	22.90	24.40	35.20	36.40	44.10	45.00
575	42.70	45.80	51.90	53.50	59.70	61.00

Net profit from purchasing a contract consisting of 100 December call options with a strike price of $550 for $29 per option



Net profit from selling a contract consisting of 100 September put options with a strike price of $525 for $22.40 per option



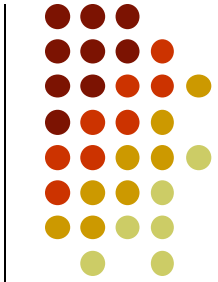
Exchanges Trading Options

- Chicago Board Options Exchange
- International Securities Exchange
- NYSE Euronext
- Eurex (Europe)
- and many more (see list at end of book)

Options vs Futures/Forwards

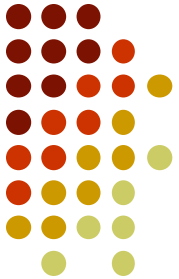
- A futures/forward contract gives the holder the obligation to buy or sell at a certain price
- An option gives the holder the right to buy or sell at a certain price

Three Reasons for Trading Derivatives: Hedging, Speculation, and Arbitrage



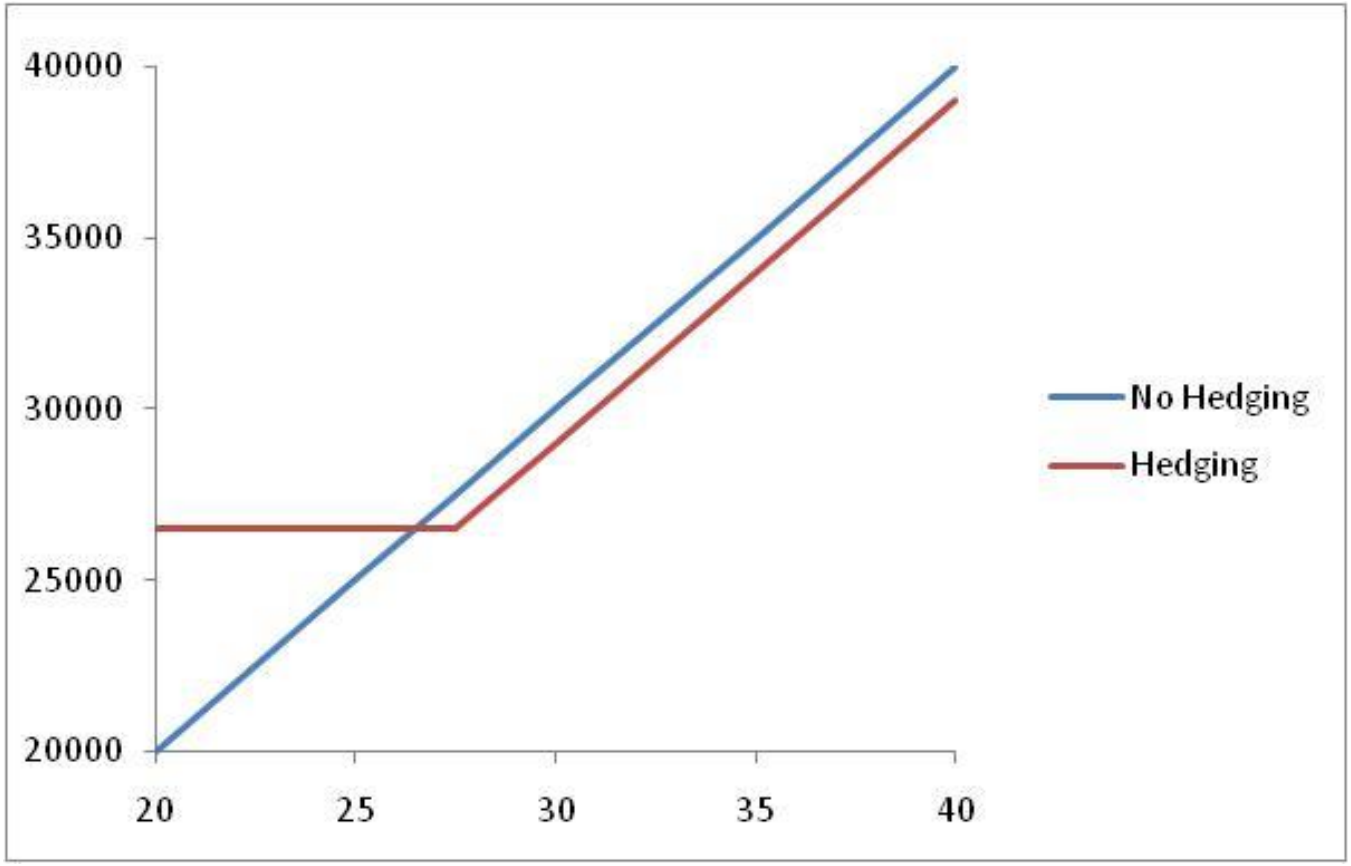
- Hedge funds trade derivatives for all three reasons
- When a trader has a mandate to use derivatives for hedging or arbitrage, but then switches to speculation, large losses can result.

Hedging Examples



- A US company will pay £10 million for imports from Britain in 3 months and decides to hedge using a long position in a forward contract
- An investor owns 1,000 shares currently worth $28 per share. A two-month put with a strike price of $27.50 costs $1. The investor decides to hedge by buying 10 contracts ….

Value of Shares with and without Hedging



Speculation Example

- An investor with $2,000 to invest feels that a stock price will increase over the next 2 months. The current stock price is $20 and the price of a 2-month call option with a strike of $22.50 is $1
- What are the alternative strategies?

Arbitrage Example

- A stock price is quoted as £100 in London and $152 in New York
- The current exchange rate is 1.5500
- What is the arbitrage opportunity?

1. Gold: An Arbitrage Opportunity?

- Suppose that:
  - The spot price of gold is US$1,100 per ounce
  - The quoted 1-year futures price of gold is US$1,200
  - The 1-year US$ interest rate is 2% per annum
  - No income or storage costs for gold
- Is there an arbitrage opportunity?

The Futures Price of Gold

If the spot price of gold is S & the futures price is for a contract deliverable in T years is F, then

$$F = S(1+r)^T$$

where r is the 1-year (domestic currency) risk-free rate of interest.

In our examples, S=1100, T=1, and r=0.02 so that

$$F = 1100(1+0.02) = 1122$$

1. Gold: An Arbitrage Opportunity?

- Sell the futures and expect to receive US$1200 one year later.
- Borrow $1100 now to acquire gold, pay back $1100 (1 + 0.02) = $1122 a year later.
- Total cost = $1122 < $1200 to be received.
- Close out all positions by delivering the gold (or cash) to honor the future contract.
- At maturity of the future contract, guaranteed riskless profit = $78.

2. Gold: Another Arbitrage Opportunity?

- Suppose that:
  - The spot price of gold is US$1,100
  - The quoted 1-year futures price of gold is US$1,050
  - The 1-year US$ interest rate is 2% per annum
  - No income or storage costs for gold
- Is there an arbitrage opportunity?

1. Oil: An Arbitrage Opportunity?

Suppose that:

- The spot price of oil is US$40
- The quoted 1-year forwards price of oil is US$50
- The 1-year US$ interest rate is 2% per annum
- The storage costs of oil are 1% per annum

- Is there an arbitrage opportunity?

1. Oil: An Arbitrage Opportunity?

- Sell the forward and expect to receive US$50 one year later.
- Borrow $40 now to acquire oil, pay back $40 (1 + 0.02) = $40.8 a year later. Also, need to spend $0.4 as storage cost.
- Total cost = $41.2 < $50 to be received.
- Close out all positions by delivering the oil to honor the forward.
- At maturity of the forward contract, guaranteed riskless profit = $4.67.

2. Oil: Another Arbitrage Opportunity?

- Suppose that:
  - The spot price of oil is US$40
  - The quoted 1-year forward price of oil is US$35
  - The 1-year US$ interest rate is 2% per annum
  - The storage costs of oil are 1% per annum
- Is there an arbitrage opportunity?

Tasks for the next class:

- Read Chapter 1 and Chapter 2
- Provide complete answers for bonus (slides 37 and 40)