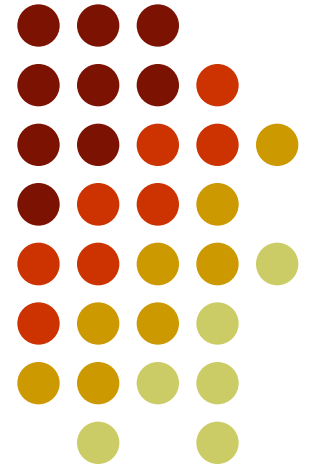




Introduction

Derivatives



Derivatives



A derivative is an instrument whose value depends on the values of other more basic underlying variables

- Futures Contracts
- Forward Contracts
- Swaps
- Options

Why Derivatives Are Important



- Derivatives play a key role in **transferring risks in the economy**
- There are **many underlying assets**: stocks, currencies, interest rates, commodities, debt instruments, electricity, insurance payouts, the weather, etc.
- **Many financial transactions** have embedded derivatives
- The **real options** approach to assessing capital investment decisions, which values the options embedded in investments using derivatives theory, has become widely accepted

How (why?) 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

How Derivatives Are Traded



- On exchanges such as the Chicago Board Options Exchange (CBOE)
- In the over-the-counter (OTC) market where traders working for banks, fund managers and corporate treasurers contact each other directly

The OTC Market Prior to 2008



- Largely unregulated
- Banks acted as market makers quoting bids and offers
- Master agreements usually defined how transactions between two parties would be handled
- But some transactions were handled by central counterparties (CCPs). A CCP stands between the two sides to a transaction in the same way that an exchange does

Since 2008...



- OTC market has become regulated. Objectives:
 - Reduce systemic risk
 - Increase transparency
- In the U.S and some other countries, standardized OTC products must be traded on swap execution facilities (SEFs) which are similar to exchanges
- CCPs must be used for standardized transactions between dealers in most countries
- All trades must be reported to a central registry

The Lehman Bankruptcy



- 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 transactions outstanding with about 8,000 counterparties
- Unwinding these transactions has been challenging for both the Lehman liquidators and their counterparties

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 (CME Globex)
- Intercontinental Exchange
- NYSE Euronext
- Eurex
- BM&FBovespa (Sao Paulo, Brazil)

<https://openmarkets.cmegroup.com/3656/innovate-to-advance-20-years-of-globex>

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 is becoming an increasingly important part of the market

Examples of Futures Contracts



Agreement to:

- buy 100 oz. of gold @ US\$1750/oz. in December
- sell £62,500 @ 1.5500 US\$/£ in March
- sell 1,000 bbl. of oil @ US\$85/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 @ \$1,750 per oz in April
- April: the price of gold is \$1,825 per oz

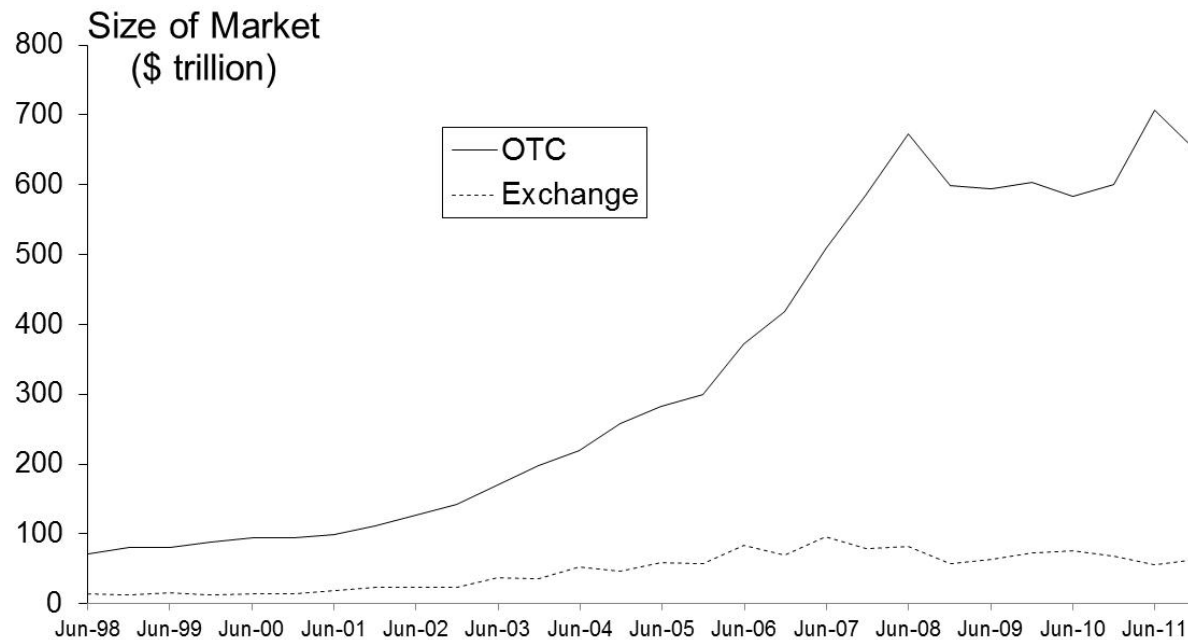
What is the investor's profit or loss?

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



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

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 must be traded on swap execution facilities
 - A central clearing party must be used as an intermediary for standard products
 - Trades must be reported to a central registry



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 (as shown by the table)

Foreign Exchange Quotes for USD/GBP exchange rate (June 22, 2012)



	Bid	Offer
Spot	1.5585	1.5589
1-month forward	1.5582	1.5587
3-month forward	1.5579	1.5585
6-month forward	1.5573	1.5580

Example



- On June 22, 2012 the treasurer of a corporation might enter into a long forward contract to sell £100 million in six months at an exchange rate of 1.5573
- This obligates the corporation to pay £100 million and receive \$155.73 million on December 22, 2012
- 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

(June 25, 2012 Stock Price: bid 561.32, offer 561.51)



Strike Price (\$)	July Bid	July Offer	Sept Bid	Sept Offer	Dec Bid	Dec Offer
520	46.50	47.20	55.40	56.80	67.70	70.00
540	31.70	32.30	41.60	42.50	55.30	56.20
560	20.00	20.40	30.20	30.70	44.20	45.00
580	11.30	11.60	20.70	21.20	34.50	35.30
600	5.60	5.90	13.50	13.90	26.30	27.10

Google Put Option Prices

(June 25, 2012 Stock Price: bid 561.32, offer 561.51)



Strike Price (\$)	July Bid	July Offer	Sept Bid	Sept Offer	Dec Bid	Dec Offer
520	5.00	5.30	13.60	14.00	25.30	26.10
540	10.20	10.50	19.80	20.30	32.80	33.50
560	18.30	18.70	28.10	28.60	41.50	42.30
580	29.60	30.00	38.40	39.10	51.80	52.60
600	43.80	44.40	51.10	52.10	63.50	64.90

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



Hedge Funds

- Hedge funds are not subject to the same rules as mutual funds and cannot offer their securities publicly.
- Mutual funds must
 - disclose investment policies,
 - makes shares redeemable at any time,
 - limit use of leverage
- Hedge funds are not subject to these constraints.

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



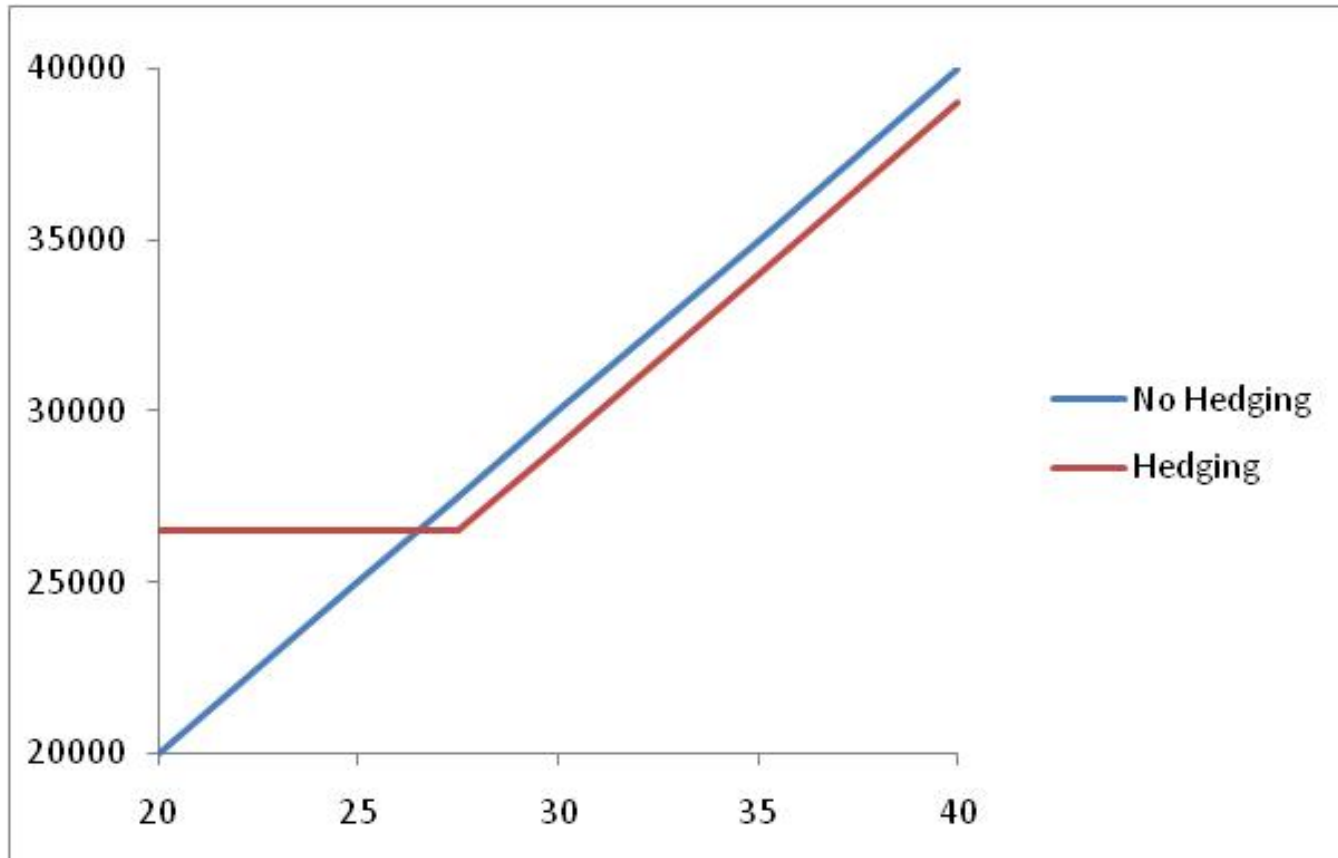
- Hedge funds trade derivatives for all three reasons
- When a trader has a mandate to use derivatives for hedging or arbitrage, but then switches to speculation, large losses can result.

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\$1,700 per ounce
 - The quoted 1-year futures price of gold is US\$1,800
 - The 1-year US\$ interest rate is 5% per annum
 - No income or storage costs for gold
- Is there an arbitrage opportunity?

2. Gold: Another Arbitrage Opportunity?



- Suppose that:
 - The spot price of gold is US\$1,700
 - The quoted 1-year futures price of gold is US\$1,680
 - The 1-year US\$ interest rate is 5% 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, $S=1700$, $T=1$, and $r=0.05$ so that

$$F = 1700(1+0.05) = 1,785$$

1. Oil: An Arbitrage Opportunity?



Suppose that:

- The spot price of oil is US\$80
- The quoted 1-year futures price of oil is US\$90
- The 1-year US\$ interest rate is 5% per annum
- The storage costs of oil are 2% per annum
- Is there an arbitrage opportunity?

2. Oil: Another Arbitrage Opportunity?



- Suppose that:
 - The spot price of oil is US\$80
 - The quoted 1-year futures price of oil is US\$75
 - The 1-year US\$ interest rate is 5% per annum
 - The storage costs of oil are 2% per annum
- Is there an arbitrage opportunity?