



Financial market institutions

14. Pricing of Futures and Options Contracts



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Topics to be covered

- Derivatives
- Types of traders
- The risk management process
- Leverage
- Financial engineering



Derivatives

- A derivative is a financial instrument whose value derives from the value of something else.
- Question: Is a barrel of oil a derivative?
- Consider an agreement/contract between A and B:
If the price of a oil in one year is greater than \$50 per barrel, A will pay B \$10.
If the price of a oil in one year is less than \$50, B will pay A \$10.
- Question: Is this agreement a derivative?



Derivatives

Why might A and B make such an agreement?

1. To hedge or reduce risk.

Suppose A is an oil producer and B is a refinery.

A will earn \$10 if the price of oil goes down.

B will earn \$10 if the price of oil goes up.

2. To speculate on the price of oil.

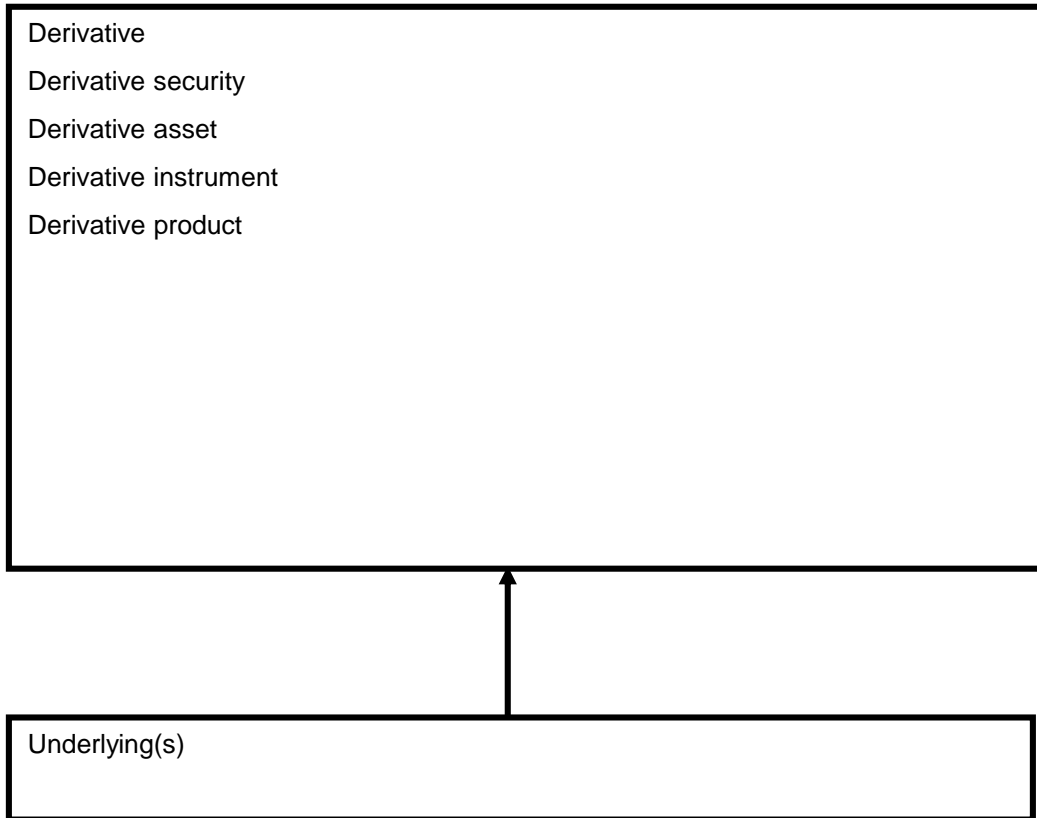


Derivatives

- A derivative is a financial instrument whose value derives from the value of something else, generally called the **underlying(s)**.
- Underlying: a barrel of oil, a financial asset, an interest rate, the temperature at a specified location.



Derivatives





Derivatives

Example	Underlying
Stock option, such as option on the stock of Nortel Networks	A stock, such as the stock of Nortel Networks
Stock index option, such as an option on the S&P 100 index	A portfolio of stocks, such as the portfolio of stocks comprising the S&P 100 index
Treasury bill futures contract	A Treasury bill
Foreign currency forward contract	A foreign currency
Gold futures contract	Gold
Futures option on gold	A gold futures contract
Weather derivative	Snowfall at a specified site

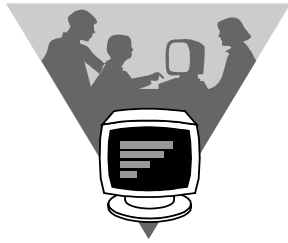


Derivative markets

- Have a long history.
- Futures markets: date back to the Middle Ages.
- Options markets: date back to 17th century Holland.
- Last 35 years: extraordinary growth worldwide.
- Today: derivatives are used to manage risk exposures in interest rates, currencies, commodities, equity markets, the weather.



Derivative markets



The over-the-counter (OTC) market



The exchanges
(listed in Hull, page 543)



Derivatives

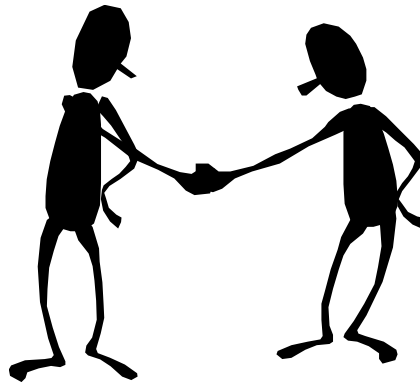
- Basic instruments:
 - Forward contracts
 - Options
- Hybrid instruments:
 - Futures contracts
 - Swaps



Derivatives

- Derivatives are contracts, agreements between two parties: a buyer and a seller.

Buyer



Seller



Forward contract

- A forward contract is an agreement between two parties, a buyer and a seller, to exchange an asset at a later date for a price agreed to in advance, when the contract is first entered into.
- We call this price the delivery price.
- Trades in the OTC market.



Futures contract

- A futures contract is an agreement between two parties, a buyer and a seller, to exchange an asset at a later date for a price agreed to in advance, when the contract is first entered into.
- We call this price the futures price.
- Trades on a futures exchange.



Options

- An option gives the buyer the right, but not the obligation, to buy/sell the underlying at a later date for a price agreed to in advance, when the contract is first entered into.
- We call this price the strike/exercise price.
- The option buyer pays the seller a sum of money called the option price or premium.
- Trades OTC or on an exchange.



Types of options

- Call option: an option to buy the underlying at the strike price
- Put option: an option to sell the underlying at the strike price



Pricing derivatives

- All current methods of pricing derivatives utilize the notion of arbitrage.
- **Arbitrage**: a trading strategy that has some probability of making profits without any risk of loss.
- Arbitrage pricing methods derive the prices of derivatives from conditions that preclude arbitrage opportunities.



Uses of derivatives

- Derivatives can be used by individuals, corporations, financial institutions, and governments to reduce a risk exposure or to increase a risk exposure.



Traders of derivatives

- Hedgers
- Speculators
- Arbitrageurs



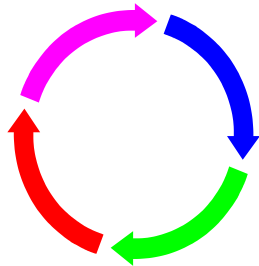
Risk management

- Risk management (RM) is the process by which various risk exposures are identified, measured, and controlled.



Risk management process

1. Identify a company's current risk profile and set a target risk profile.
2. Achieve the target risk profile by coordinating resources and executing transactions.
3. Evaluate the altered risk profile.





RM process – phase 1

- Decompose corporate assets and liabilities into risk pools: interest rate, foreign exchange, crude oil.
- Develop market scenarios and test the impact of these on the values of the risk pools and on the value of the company as a whole. This determines the company's “value at risk”.
- Develop a target risk profile, which may or may not include a complete elimination of risk.



RM process – phase 2

- This is the implementation phase.
- Many companies centralize their risk management activities.
 - This allows for coordination and avoids unnecessary transactions.

Division 1

Exposed **long** to Japanese interest rates.

Has bank account in yen.

Division 2

Exposed **short** to Japanese interest rates.

Has floating rate loan in yen.



RM process – phase 3

- This is the evaluation phase.
- Key questions to consider:
 - Has the firm's risk profile changed?
 - Is the current risk profile still appropriate?
 - What new economic and market scenarios should be considered in the next iteration?



Risk management

- Derivatives allow firms to:
 - Separate out the financial risks that they face.
 - Remove or neutralize the risk exposures they do not want.
 - Retain or possibly increase the risk exposures they want.
- Using derivatives, firms can transfer, for a price, any undesirable risk to other parties who either have risks that offset or want to assume that risk.

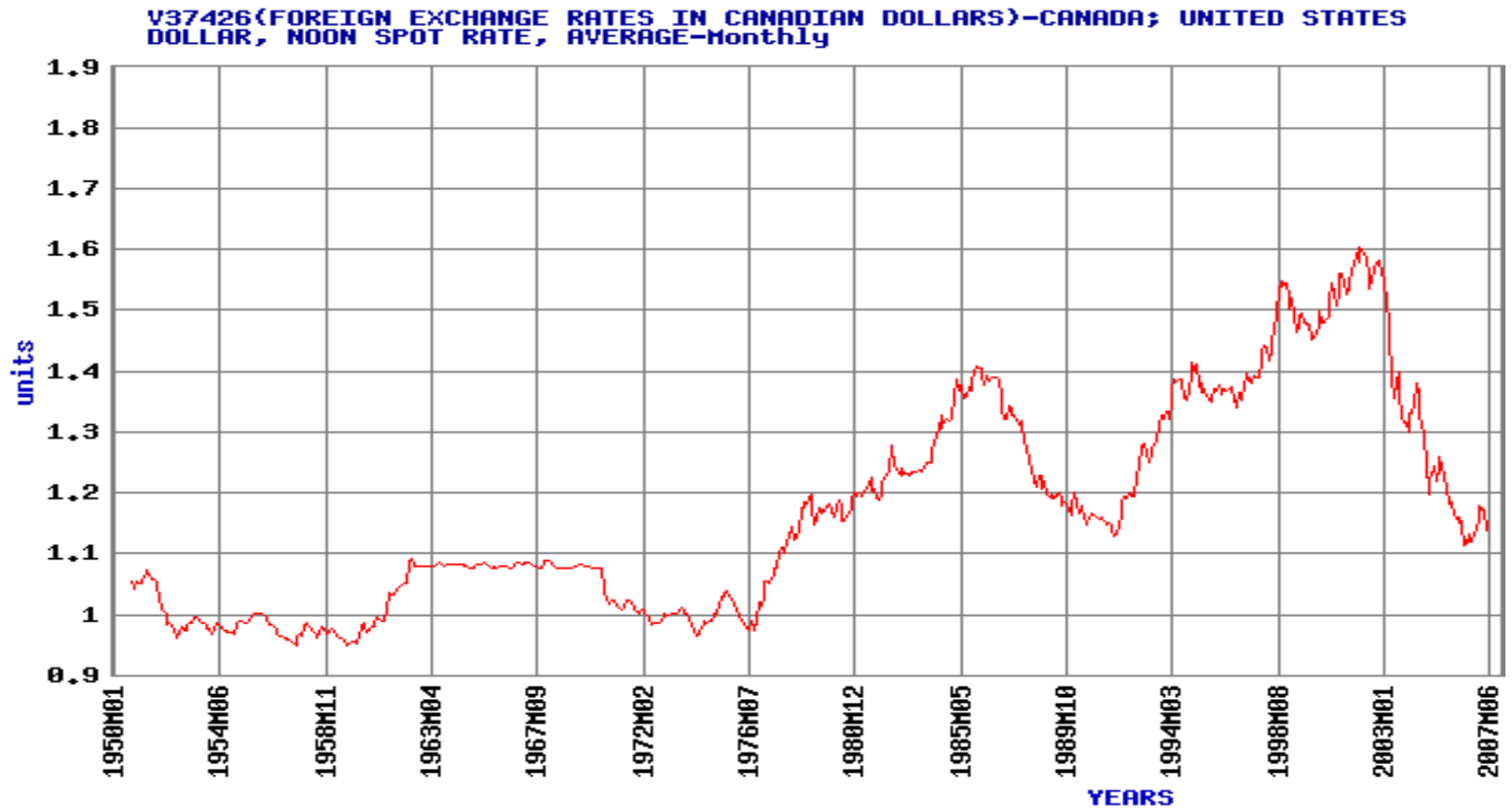


Risk management

- Risk management has gained prominence in the last 35 years:
 - Increased market volatility.
 - Deregulation of markets.
 - Globalization of business.



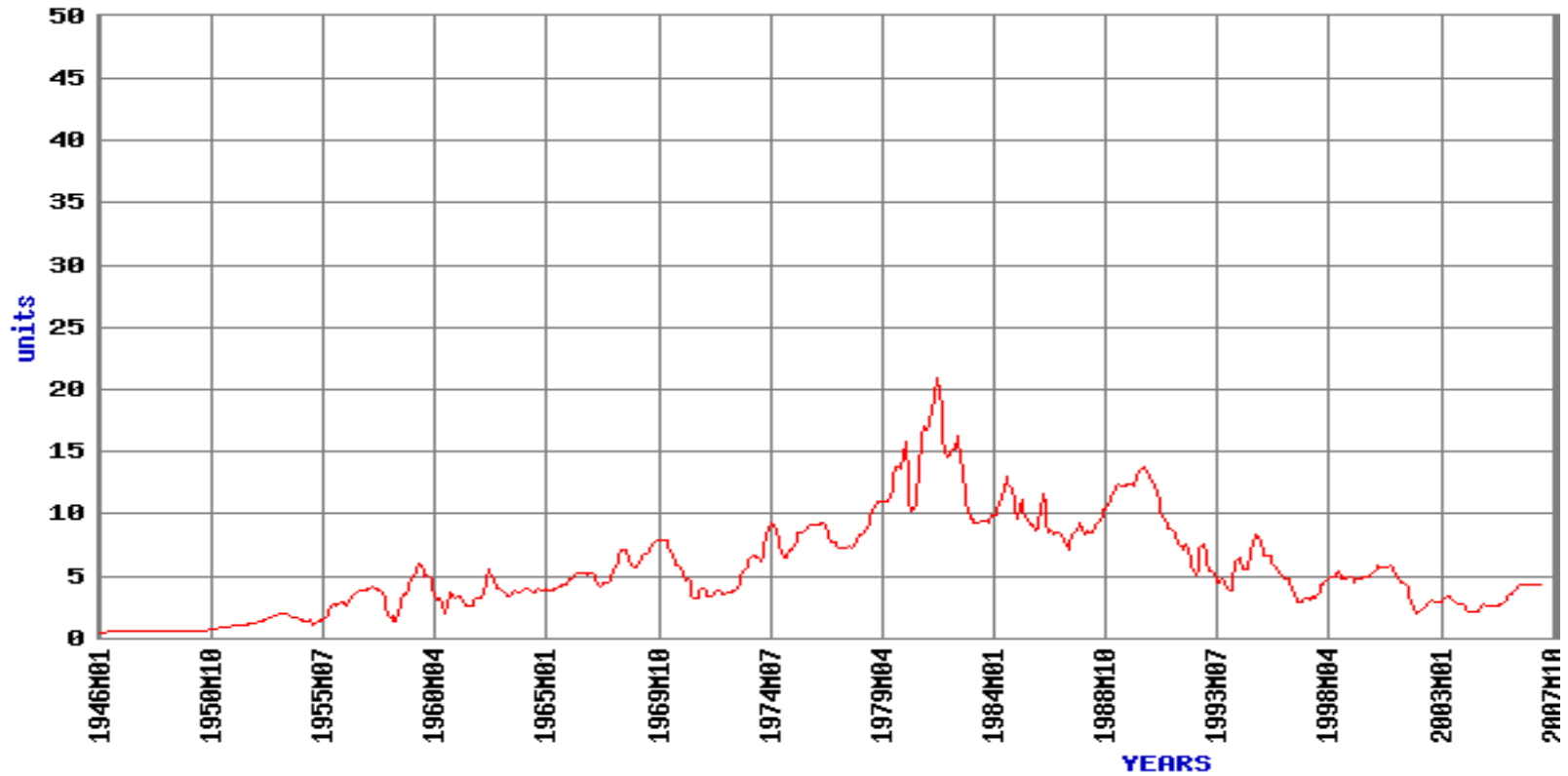
USD-CAD exchange rate





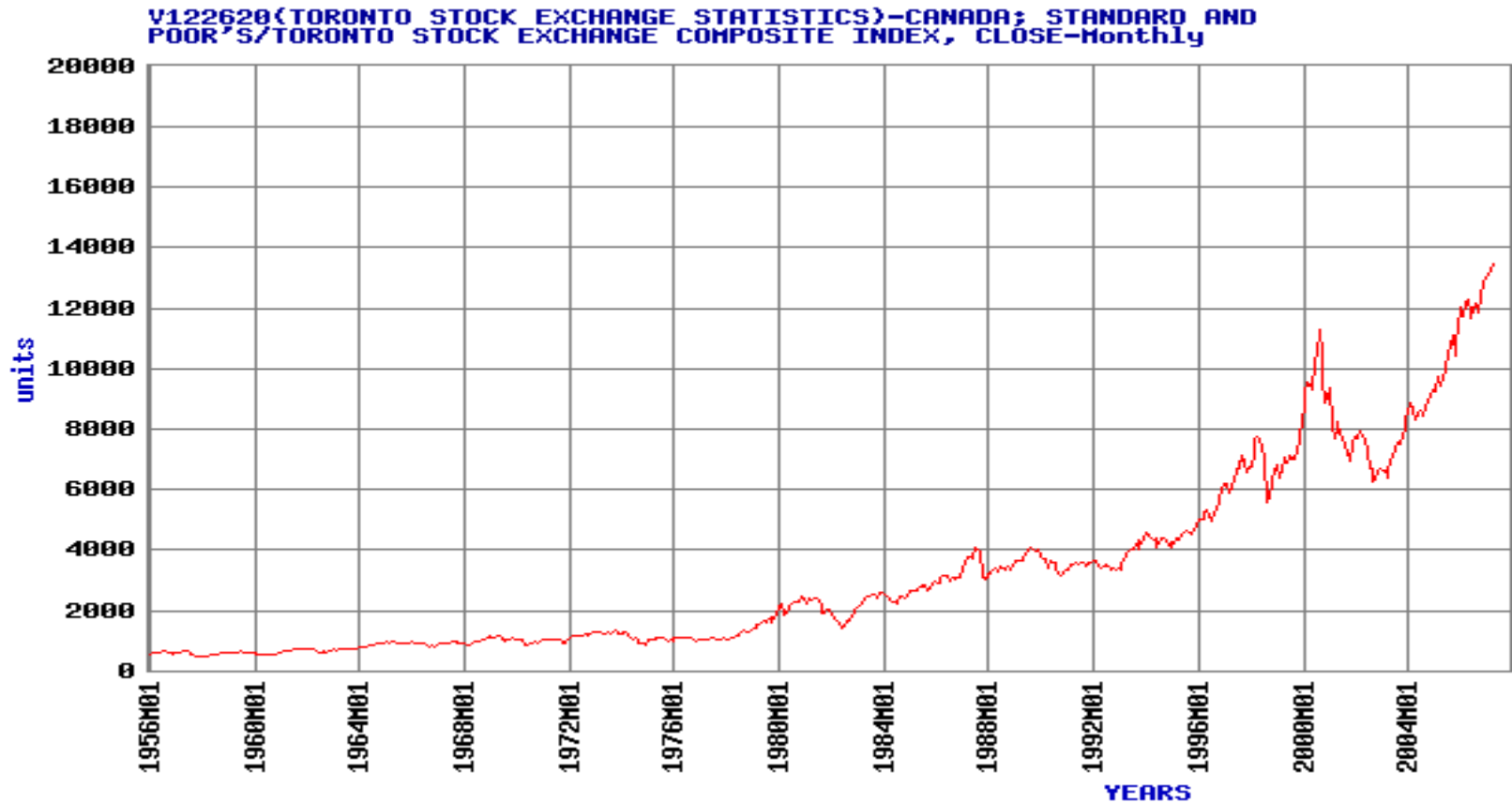
91-day Treasury bill rate

V122484(FINANCIAL MARKET STATISTICS, LAST WEDNESDAY UNLESS OTHERWISE STATED)-CANADA; TREASURY BILL AUCTION - AVERAGE YIELDS: 3 MONTH, AVERAGE AT VALUES-Monthly





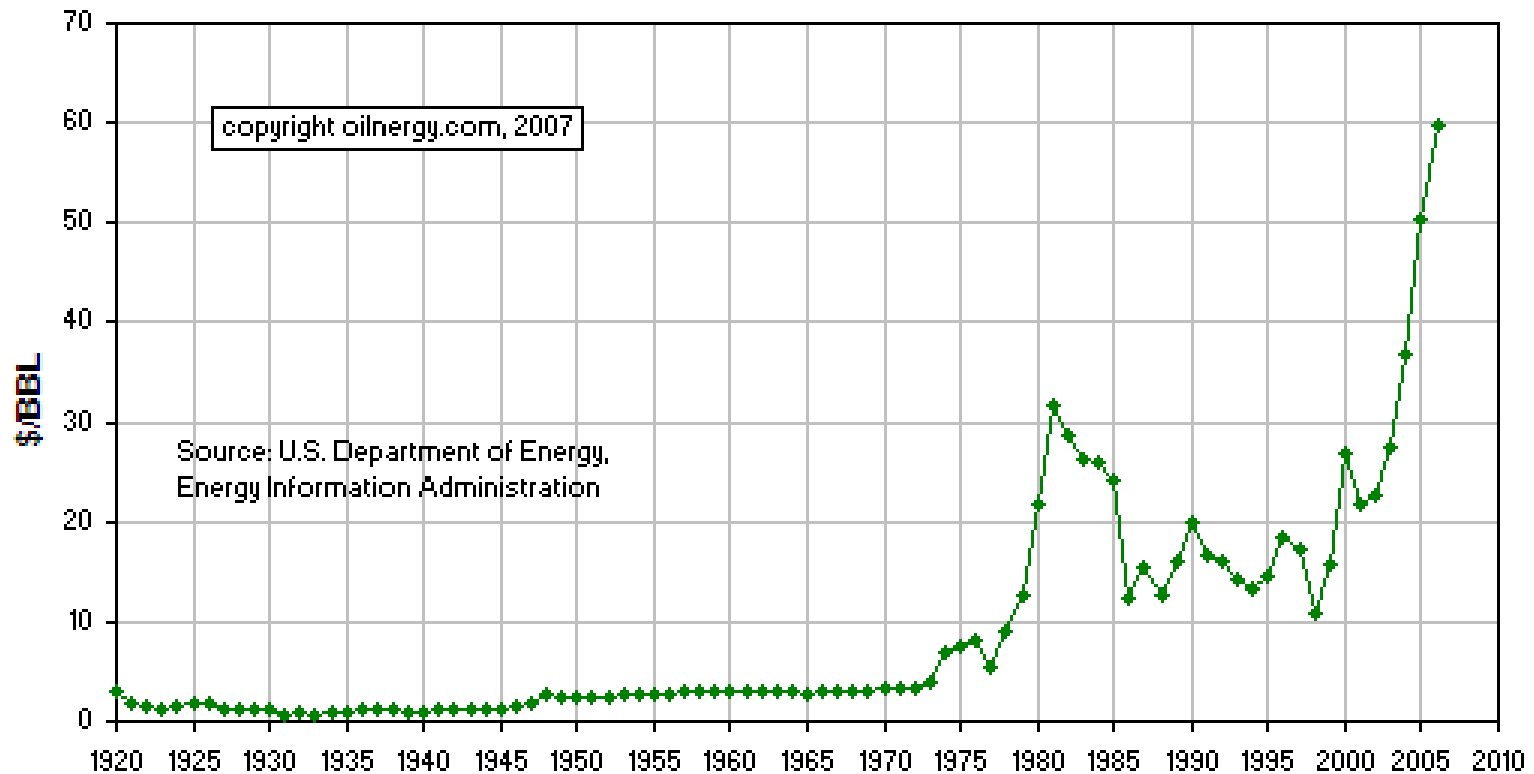
Toronto stock exchange index





Oil price

U. S. First Purchaser's Crude Oil Price





Risk management

- The proliferation of derivatives allows firms to:
 - Efficiently manage a great variety of risks.
 - To manage those risks in a variety of different ways.



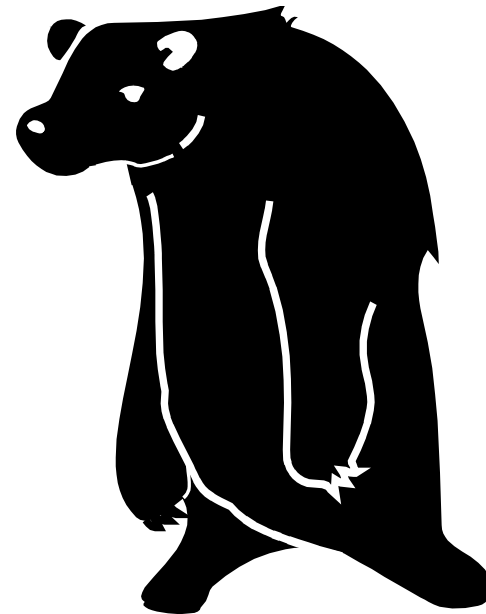
Example

- Consider a British fund manager with a portfolio of U.S. equities.
- If he buys IBM shares, he is exposed to three risks:
 - Prices in the U.S. equity market generally.
 - The price of IBM stock specifically.
 - The dollar/sterling exchange rate.



Example

- He is bearish about:
 - The dollar's medium-term prospects.
 - The overall U.S. stock market.





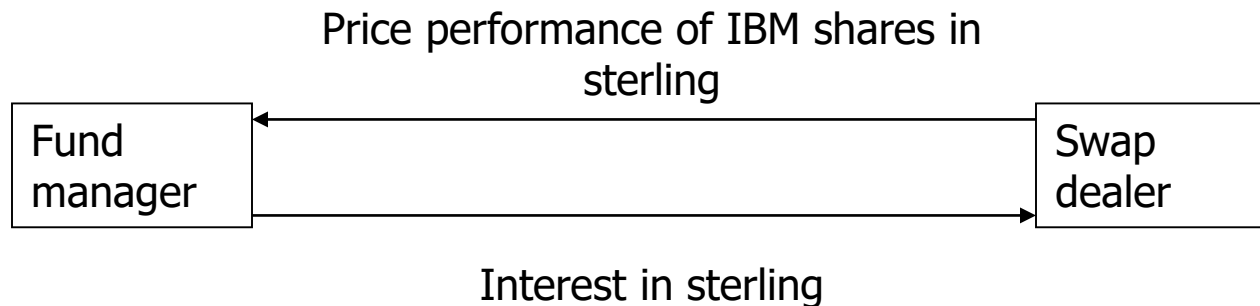
Example

- To hedge the currency risk, he could sell dollars under the terms of a forward contract.
- To hedge the market risk, he could short futures contracts on the S&P 500 index.
- He would be left with exposure to IBM's share price only.



Example

- But the same result could be achieved in another way: an equity swap denominated in sterling.





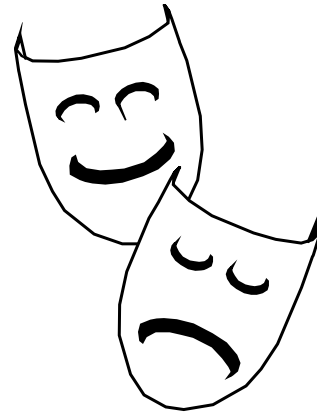
Preferred derivatives

Type of Risk	Preferred Derivative
Foreign exchange risk	Forward contracts
Interest rate risk	Swaps
Commodity price risk	Futures contracts
Stock market risk	Options



Leverage

- Leverage is the ability to control large dollar amounts of an underlying asset with a comparatively small amount of capital.
- As a result, small price changes can lead to large gains or losses.
- Leverage makes derivatives:
 - Powerful and efficient
 - Potentially dangerous





Leveraging with futures

- A speculator believes interest rates are going to fall.
- To realize a gain, she might:
 - Buy bonds worth, say, \$1 million.
 - Buy Treasury bond futures for the purchase of \$1 million of Treasury bonds.
- To buy the bonds, she needs \$1 million.
- To buy the Treasury bond futures, she needs initial margin of about \$15,000.
- She gains the same exposure in both cases. That is, she stands to realize an equivalent gain/loss should interest rates fall/rise.



Leveraging with options

- It is May.
- The price of Nortel Networks stock is \$28.30.
- A December call option on Nortel stock with a \$29 strike price is selling for \$2.80.
- A speculator thinks the stock price will rise.
- To make a profit, the speculator might:
 - Buy, say, 100 shares of Nortel stock for \$2,830.
 - Buy 1,000 options (10 option contracts) for \$2,800, (roughly the same amount of money).



Leveraging with options

- Suppose the speculator is right. The stock price rises to \$33 by December.

Strategy	Profit
Buy the stock	$((\$33 - \$28.30) \times 100)$ $= \$470$
Buy options	$((\$33 - \$29) \times 1,000 - \$2,800)$ $= \$1,200$



Leveraging with options

- Suppose the speculator is wrong. The stock price falls to \$27 by December.

Strategy	Loss
Buy the stock	$((\$28.30 - \$27) \times 100)$ $= \$130$
Buy options	\$2,800



Lessons in risk management

- Barings Bank
 - Long-Term Capital Management
 - Amaranth Advisors LLC
 - Bank of Montreal
-
- Hull, chapter 23, “Derivative Mishaps and What We Can Learn from Them”



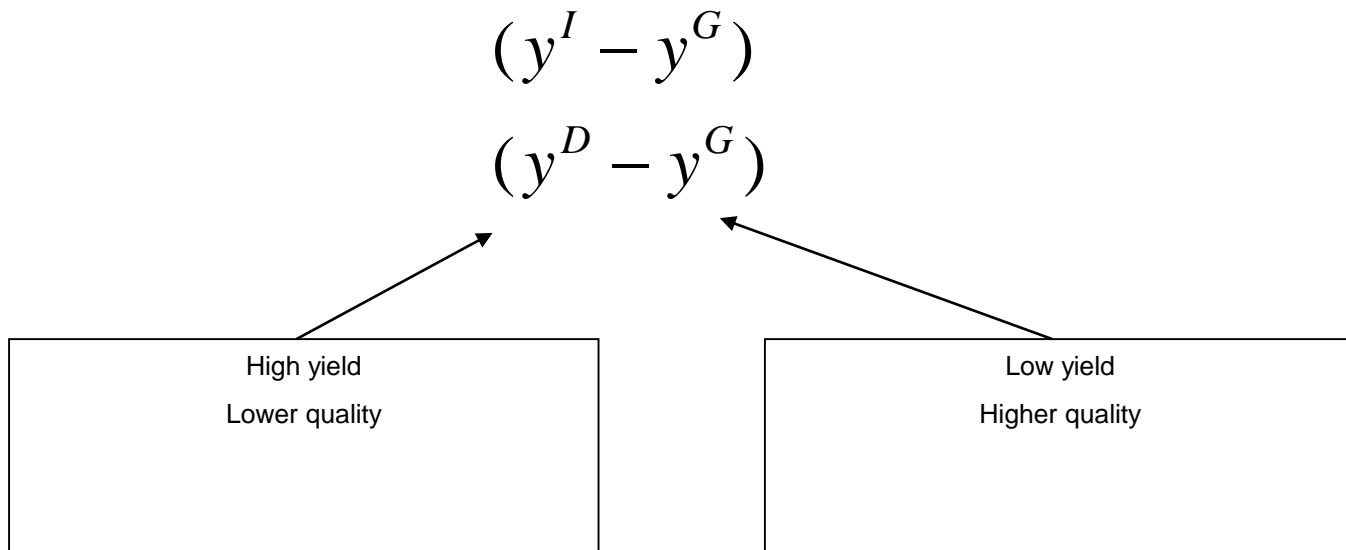
Barings Bank

- British investment bank, founded in 1763.
- 1803: Negotiated the purchase of Louisiana by the U.S. from Napoleon.
- Queen of England was a client.
- 1995: was wiped out when a trader (Nick Leeson) ran up losses of close to \$1 billion trading derivatives.
- Lesson: Monitor employees/traders closely.



Long-Term Capital Management

- A hedge fund that sought very high returns by undertaking investments that were often highly risky.
- Bet: yield spreads would narrow





Long-Term Capital Management

- August 1998: Russian government default
- Flight to quality and spreads widened
- Highly leveraged positions lead to large losses, about \$4 billion
- Bail out
- Lessons:
 - Do not ignore liquidity risk.
 - Beware when everyone else is following the same trading strategy.
 - Carry out scenario analysis and stress tests.



National Post, March 1, 2006

- “U.S. central bankers are again getting nervous about the huge US\$300-trillion global derivatives markets”.
- Until recently, derivatives held mainly by banks.
- Hedge funds becoming major players.
 - Trade in the OTC market.
 - Trades are largely unregulated.
- Concerns:
 - Closing out positions when markets are under stress.
 - Potential damage to banking system.



Amaranth Advisors LLC

- September 2006: The Connecticut-based hedge fund lost about \$6.5 billion trading natural gas derivatives.
- In 2005, the fund had made considerable money on natural gas “spread trades”:
 - A cold winter in 2004.
 - An active hurricane season in 2005.
 - Political instability in oil-producing countries.
- In 2006, a similar scenario did not materialize.
- Fuelled concern about “regulatory black hole”.



Bank of Montreal

- May 2007: Reported losses of \$680 million betting on the natural gas market.
- BMO reported:
 - Its commodity trading team “did not operate according to standard BMO business practices”.
 - “In the future in the (commodity) portfolio we will only engage in the amount of market-making activity required to support the hedging needs of our oil and gas producing clients.”
 - “the bank has revised its risk management procedures.”



Financial engineering

- Weather derivatives
- Steel futures
- Canadian crude futures



Steel futures

Issues:

1. Many types of steel – presents difficulties in defining the underlying asset.
2. Fewer supply shocks as compared to gold and oil. Hence the price of steel is more stable. Implies less demand from hedgers and lower speculative profits to be earned from trading the contract.



Steel futures

Update, spring 2007:

- LME continues to assess interest in the contract.

“Since the LME last considered steel futures in 2003, the steel industry has gone through a number of changes which have further highlighted the need for reliable price risk management solutions.

The industry has undergone radical restructuring; it has become more global, more efficient and more financially viable. Events have resulted in high prices, supply disruptions and increased volatility, all elements which the existence of futures contracts can help the industry to manage.”



Canadian crude futures

- In late 2004, four Canadian producers – EnCana, Petro-Canada, Canadian Natural Resources Ltd., and Talisman Energy Inc. – created a heavy oil blend called **Western Canadian Select**.
- They entered into negotiation with NYMEX for a **heavy crude futures contract**.
- Crude production from Alberta's oil sands is expected to triple to 3 million barrels a day by 2015.
- June 2007: Calgary-based NetThruPut Inc. announced that, in July, it would offer **basis swap contracts** for:
 - Canadian light, sweet synthetic crude.
 - Western Canadian Select.



Canadian crude futures

- There is now a **3-way race** to offer Canadian crude derivatives and futures contracts:
 - NetThruPut will offer basis swap contracts from the beginning of July.
 - NYMEX and the Montreal Exchange are starting a new energy exchange in Calgary, called Carex, expected to offer a **Western Canadian Select futures contract**, among other products. Expected to be operational in later 2007.
 - TSX Group plans to offer a heavy crude contract at the NGX electricity and natural gas exchange in Calgary.



Next class

- Futures and forward markets



REFERENCE AND SOURCE

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