

Managing Price Risk

- Motivation
- Forwards and Futures
 - definitions and examples
 - valuation
 - hedging
- Options
 - definitions and examples
 - a bit of valuation
 - hedging

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Dresser Industries

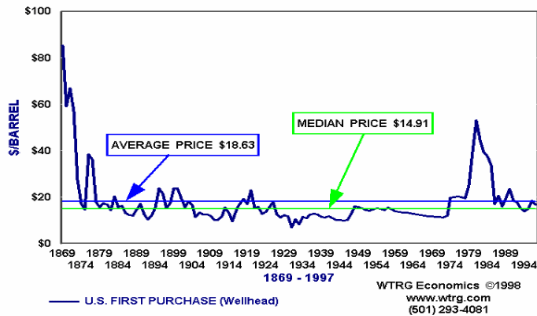
- Dresser Industries manufactures oil producing equipment.
- In 1986, world oil prices plummeted by 50%, which was disastrous for oil producers.
- Demand for Dresser's equipment decreased.
 - Operating profits dropped from \$292M to \$139M.
 - Capital spending decreased from \$122M to \$71M.
 - Dresser stock price fell from \$24 to \$14.
- Oil prices remain a significant source of risk.

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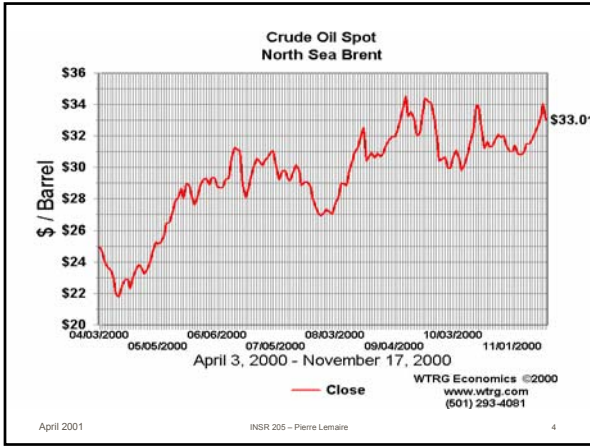
CRUDE OIL PRICES
1996 DOLLARS



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Derivative Assets

- A *derivative asset* is an asset with payoff that is derived from the value of some *underlying asset*.
 - Buying = Longing (benefit if asset value increases)
 - Selling = Shorting (benefit if asset value decreases)
- Types of Derivatives
 - forwards and futures
 - put options and call options
 - swaps, swaptions, floors, caps

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Forward Contracts

- With a *forward contract*, two parties agree to exchange a real or financial asset on a prearranged date for a prespecified price.
 - real or financial asset
 - prearranged date
 - prespecified price
- Long positions hedge price increase in the underlying asset. Short positions hedge price decreases.

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Forward Contract Example

- Suppose a U.S. firm owes Swiss supplier 1M Swiss francs in 3 months.
 - Converting to francs exposes the firm to exchange rate risk that can be hedged by longing a forward.
 - Bank agrees to sell 1M francs in 3 months at exchange rate of 1.25 SF per U.S. dollar.
 - After 3 months, firm gives bank \$800,000 and receives $1M = (800,000)(1.25)$ Swiss francs.
- If rates fell to 1.2, firm would require \$833,333 to purchase 1M Swiss francs.

Properties of Forwards

- *Linearity.* The gain of one party is directly offset by the loss of the other.
- *No Money Down.* At initiation, there is no money exchanged.
- *Settlement.* At maturity, funds exchange based on terms of contract. This introduces credit risk, since the other party may not meet obligation.
- *Customization.* Forwards are private OTC agreements customized to parties preferences.

Future Contracts

- A *futures contract* is similar to a forward contract with a few important differences.
- *Exchange Traded.* Futures trade on organized exchanges with standardized terms, amounts, and maturity dates.
- *Settlement.* Each day, the net position is marked to market, and daily settlement procedures have parties pay losses on a daily basis.

Valuing Futures Example

- You possess 100 ounces of gold which trades today for \$400 per ounce, or \$40,000. A buyer wishes to purchase your gold in 3 months.
 - \$40,000 would generate \$800 in interest during the 3 months.
 - Storing gold costs \$5 for 3 months.
 - 100 ounces of gold can be insured for \$10.
- Future price is around \$40,815.
 - $40,815 = 40,000 + 800 + 5 + 10$.

Valuing Futures Example

- Suppose 3 month future price is \$42,000.
- Then there is an arbitrage opportunity:
 - sell 1 contract obligating delivery of gold in 3 months
 - buy 100 ounces of gold and store for 3 months
 - after 3 months, delivery bought gold to honor the futures contract obligation
 - profit is \$1,185 = $42,000 - 40,815$
- Similar argument demonstrates that future price can not be less than \$40,815.

Hedging With Futures

- Suppose a jewelry manufacturer will need to buy gold from a supplier next month (Dec).
- If gold prices rise, the jeweler will be forced to purchase the gold at a higher price.
- Gold currently costs \$250 per ounce.
- Carrying costs are \$5 per month.
- A March gold future currently sells for \$270.
- No December gold future exists.

Hedging With Futures

- In order to hedge the December spot price of gold, the jeweler buys the March gold future
 - If prices rise to \$270 in one month, the jeweler will have to pay \$20 extra to purchase the supply of gold.
 - At a spot price of \$270 in December, the price of the March future will increase to \$285. The jeweler makes \$15 on the gold future, providing a partial offset to the loss on purchasing the supplies.
- Over time, the future price converges to the spot price.

Financial Options

- A *call option* gives the owner the right, but not the obligation, to purchase a specified asset at a specified price on or before a specified date.
 - specified asset
 - specified price = strike
 - specified date = expiration
- A *put option* gives the owner the right, but not the obligation, to sell a specified asset at a specified price on or before a specified date.

Example - Buying a Call

- Suppose an investor buys a call option to purchase 100 shares of IBM common stock under the following conditions:
 - current date: 01/01/01
 - current price: \$138
 - strike price: \$140
 - exercise date: 06/30/00
 - option price: \$5
- Initial cost of contract is \$500.

Example - Buying a Call

- Scenario 1- IBM stock rises to \$155 at 06/30.
 - investor exercises option
 - gain on option is \$1,500 = $(155-140)*100$
 - total payoff is \$1,000 = $1,500 - 500$
- Scenario 2- IBM stock falls to \$135 at 06/30.
 - investor does not exercise option
 - total payoff is -\$1,000

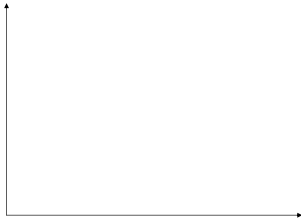
Payoff on a Options

- Notation
 - C = value of a the call option
 - P = value of the put option
 - S = value of underlying stock
 - K = strike price
 - * denotes values at maturity
- $C^* = \max(S^* - K, 0)$
- $P^* = \max(K - S^*, 0)$

Payoff on a Call Option



Payoff on a Put Option



Properties of Options

- o *Non-Linearity.* Since the owner is not obligated to exercise the option, payoffs are asymmetrical.
- o *Money Down.* At initiation, an option premium is paid from buyer to seller.
- o *Settlement.* Options are settled at exercise, when money potentially changes hands.
- o *Customization.* Options are available both OTC and on formal exchanges.

Valuing Options

- o $C^* = \max(S^* - K, 0)$
- o $P^* = \max(K - S^*, 0)$

Increase in	Call Option	Put Option
value of asset	increases	decreases
exercise price	decreases	increases
time to maturity	increases	increases
interest rates	increases	decreases
volatility of asset	increases	increases

McDonald's Call Spread E.g.

- o A price index of lean hogs exists which serves as the underlying asset in many options.
- o McDonald's enters into the following 2 contracts:
 - Purchase 100 call options with a strike of .50, where each option pays off \$1M per index point. This transaction costs \$1M.
 - Sell 100 call options with a strike of .60 for a total price of \$750,000.
 - The initial cost of the position is \$250,000.

McDonald's Call Spread E.g.



McDonald's Call Spread E.g.



Delta Hedging

- It is often impossible to find an option with cash flows that perfectly meet the desired hedging specifications.
 - timing, strike price, underlying asset
- A *delta-neutral portfolio* is insensitive to small changes in the price of the underlying stock.
 - Combination of stock and options

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Delta Hedging

- The delta of a portfolio represents the change in portfolio value that occurs given a small change in the price of the underlying stock.
 - Portfolio delta is linear combination of the deltas of the options and the stock.
 - The delta of a long (short) position in stock is 1 (-1).
 - The delta of a long (short) position in option is Δ ($-\Delta$).
- Call options have positive deltas and put options have negative deltas.

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Delta Hedging - Example

- Suppose an investor owns 1,200 shares of Exxon stock and would like to hedge the position.
- A call option on 100 shares of Exxon has a delta of .6.
- By shorting 20 Exxon call options, the investor produces a delta neutral portfolio.
- Solve the following equation for N

$$1,200*(1) + 100*N*(.6) = 0$$

$$\rightarrow N = -20$$

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Delta Hedging - Example

- If the price of the stock increases by \$1
 - gain of \$1,200 on stock
 - loss of \$1,200 = $20 \times 100 \times (.6)$ on options sold
- If the price of the stock decreases by \$1
 - loss of \$1,200 on stock
 - gain of \$1,200 = $20 \times 100 \times (.6)$ on options sold
- Delta-hedging is only an approximation but demonstrates the value of options in hedging price risks.

Managing Price Risks - Takeaways

- Price risks are extremely important.
- Derivatives provide a loss financing mechanism for hedging price risk.
- Derivatives
 - definitions
 - valuation
 - hedging
 - examples
