# Amity School of Business

BBA, Semester

Financial Derivative

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# Forwards and futures

# Difference between forwards and future contracts

- forward and futures contracts have the same function : both types of contracts allow people to buy or sell a specific type of asset at a specific time at a given price.
- futures contracts are exchange-traded and, therefore, are standardized contracts
- Forward contracts, on the other hand, are private agreements between two parties and are not standardized

# Difference between forwards and future contracts

- Because forward contracts are private agreements, there is always a chance that a party may default on its side of the agreement
- Futures contracts have clearing houses that guarantee the transactions, which drastically lowers the probability of default to almost never.

# Difference between forwards and future contracts

- Secondly, the specific details concerning settlement and delivery are quite distinct
- For forward contracts, settlement of the contract occurs at the end of the contract.
- Futures contracts are marked-to-market daily, which means that daily changes are settled day by day until the end of the contract

# Difference between forwards and future contracts

- Forward contracts, on the other hand, only possess one settlement date.
- settlement for futures contracts can occur over a range of dates.
- Lastly, because futures contracts are quite frequently employed by speculators, who bet on the direction in which an asset's price will move, they are usually closed out prior to maturity and delivery usually never happens On the other hand, forward contracts are mostly used by hedge$ that want to eliminate the volatility of an asset's price, and delivery of the asset or cash settlement will usually take place.

# Options VS forwards & futures

- 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

# Forward Contracts

- Forward contracts are similar to futures except that they trade in the over-the-counter market
- Forward contracts are particularly popular on currencies and interest rates
- Forward contract have zero mark to market value at inception

# Forward Contracts

- One of the parties assumes a *long position*, the other party assumes a *short position*: the seller – who has the short position –will deliver some quantity of a commodity or financial instrument to a buyer –who has the long position –on a specific date.
- long position is in which an asset is purchased or owned; Short position is in which an asset must be delivered to another party at a future date.
- No obligation exist to standardize the forwards contact.

# Terminologies

- Spot price – The ***spot price*** or ***spot*** rate of a commodity, a security or a currency is the ***price*** that is quoted for immediate (***spot***) settlement (payment and delivery)
- Strike Price – is the price of contract at which it will be traded at the time of maturity

# Foreign exchange quotes for GBP on June 3 2003

| | Bid | Offer |
|---|---|---|
| Spot | 1.6281 | 1.6285 |
| 1-month forward | 1.6248 | 1.6253 |
| 3-month forward | 1.6187 | 1.6192 |
| 6-month forward | 1.6094 | 1.6100 |

Bank GBP Buying price in dollars is **BID** and bank GBP selling price in dollars is **OFFER**

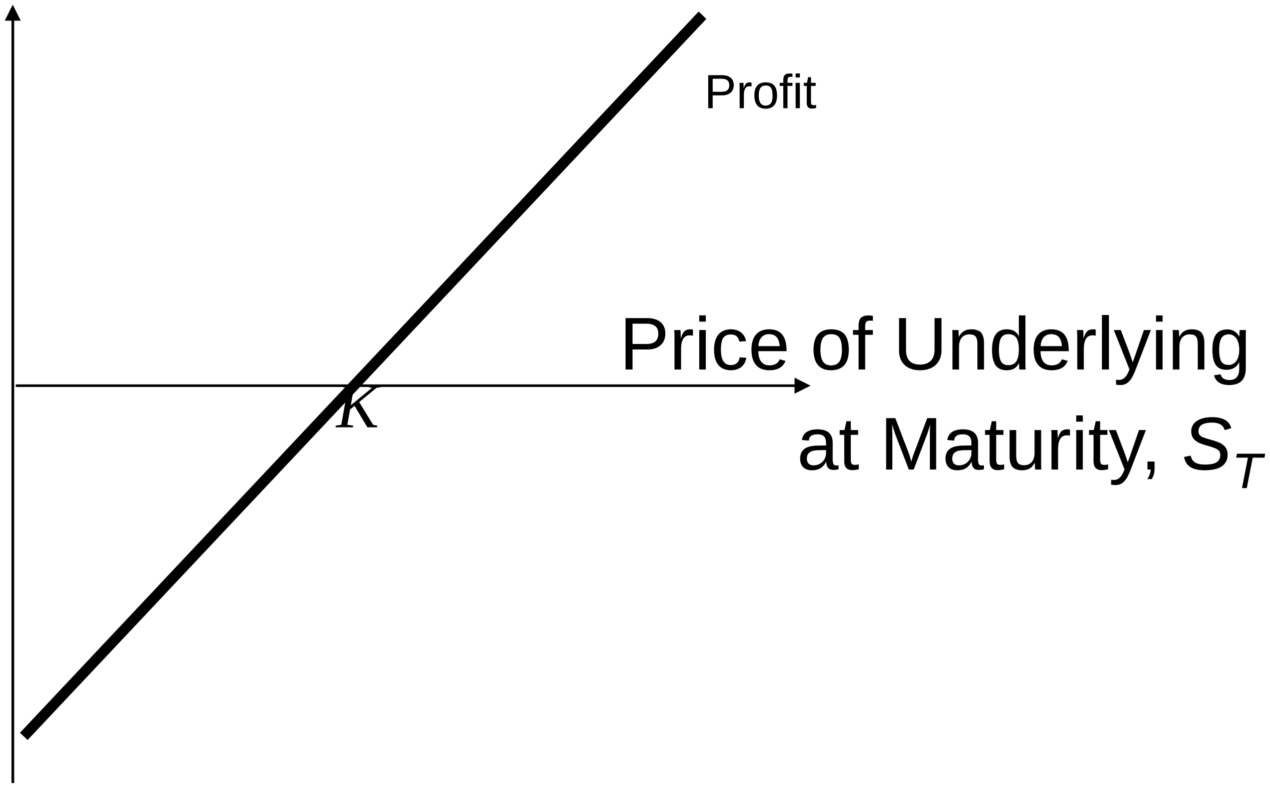
# Forward price

- 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

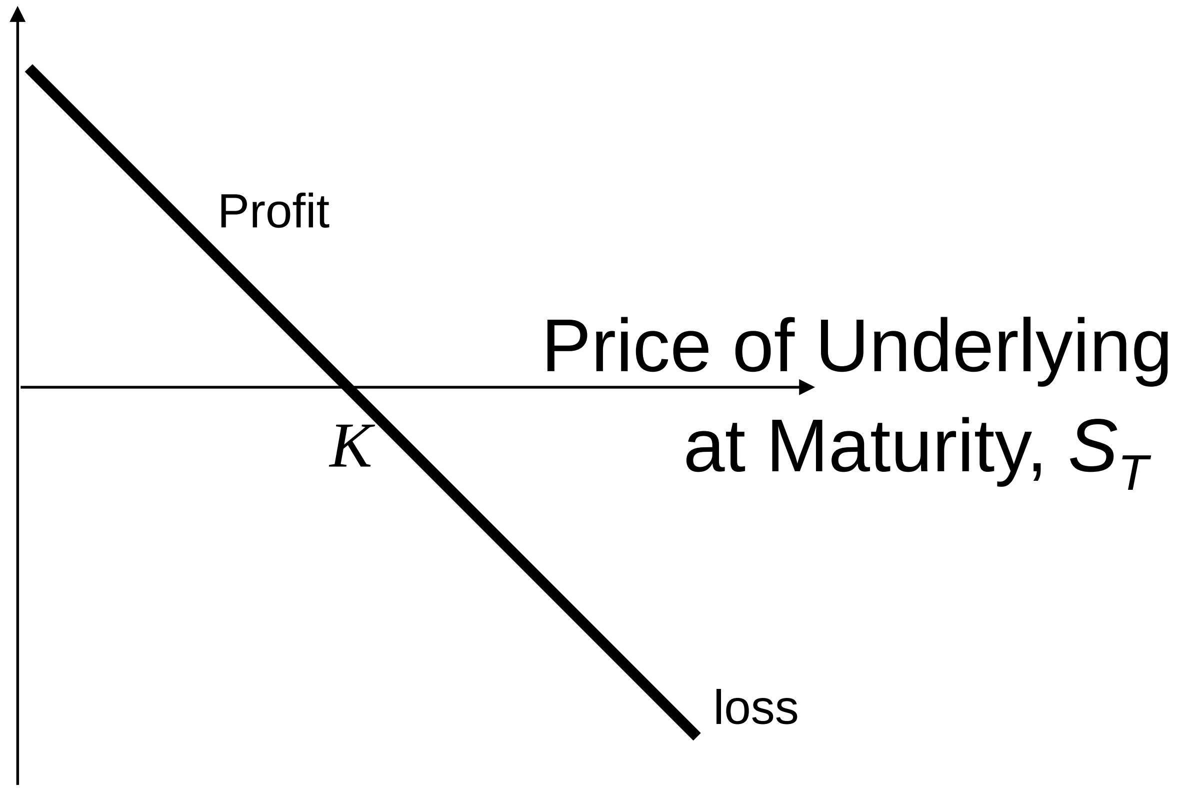
# Example

- On June 3, 2003 the treasurer of a corporation enters into a long forward contract to buy £1 million in six months at an exchange rate of 1.6100
- This obligates the corporation to pay $1,610,000 for £1 million on December 3, 2003
- What are the possible outcomes?

# Profit from long forward position



# Profit from short forward position



# Gold an arbitrage opportunity

Suppose that:

- The spot price of gold is Rs300
- The 1-year forward price of gold is Rs340
- The 1-year Rs interest rate is 5% per annum

Is there an arbitrage opportunity?

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# Forward price of gold

If the spot price of gold is $S$ and the forward price 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, $S = 300$, $T = 1$, and $r = 0.05$ so that investor take a loan of 300 for buying gold and purchases a contract to sell gold after a year.He pays the below amount with interest after a year.

$$F = 300(1+0.05) = 315$$

He sells the gold at a price of Rs340 thus getting him an arbitrage opportunity of Rs25

# Gold Example

- For gold

$$F_0 = S_0(1 + r)^T$$

(assuming no storage costs)

- If $r$ is compounded continuously instead of annually

$$F_0 = S_0 e^{rT}$$

# Futures contract

- Agreement to buy or sell an asset for a certain price at a certain time
- The futures contract is an *anonymous* agreement that facilitates further trading prior to the stipulated delivery date.
- Similar to forward contract
- Whereas a forward contract is traded OTC, a futures contract is traded on an exchange
- The identity of the party who takes the other side (short/long) is irrelevant.

# Futures contract

- Contracts are standardized with respect to quantity, grade, date and location.
- Unlike forward contracts, futures contracts are *marked to market* at the end of every trading date.
- The flows of cash into and out of the *margin account* exist to minimize performance risk.

# Terminology

- **Reverse trading/closing out position**: most futures contracts do not involve the actual delivery of the product, traders enter into **reversing trades** prior to the maturity of the contract. This means that most of the contacts are *offset* (or *closed out* or *liquidated*) with the **clearing house** before the delivery date.
- Example:The New Delhi investor who bought a July Wheat futures contract on March 5 can close out the position by selling one July Wheat futures contract on April 20. The Kanpur investor who sold a July contract on March 5 can close out the position on by buying one July contract on April 20. In each case, the investor’s total gain or loss in determined by the change in the futures price between March 5 and April 20.

# Margins

- A margin is cash or marketable securities deposited by an investor with his or her broker
- The balance in the margin account is adjusted to reflect daily settlement
- Margins minimize the possibility of a loss through a default on a contract
- To revalue (an asset, liability, financial instrument, etc) to the current market price, as distinct from historical cost. Marking to market is an important risk-management procedure in financial sectors such as derivatives, where small price movements can result in large exposures to loss. Marking a portfolio of derivatives to market shows the value of the portfolio

# Margins

- Initial margin  - amount that must be deposited with the intermediary
- Maintenance margin – a lower limit of the margin account.
- Variation margin – extra fund added to account

# Problem

- On September 1 a trader contacts his broker and asks to buy a wheat future. Suppose the contract size is 10 quintals and the current future price is Rs 600 per quintal. The broker asks the trader to deposit Rs600 as margin money. As per the prices in the market, draw out the margin movement of the trader if the lower limit is 500

# Problem

| Trading day | Future prices | daily gain (Loss) | Margin account balance | margin call |
|---|---|---|---|---|
| 2 | 600 | | | |
| 3 | 598.8 | | | |
| 4 | 593.6 | | | |
| 5 | 594 | | | |
| 6 | 589.5 | | | |
| 9 | 588 | | | |
| 10 | 579 | | | |
| 11 | 577 | | | |
| 12 | 584 | | | |
| 13 | 576 | | | |
| 16 | 570 | | | |
| 17 | 572 | | | |
| 18 | 566 | | | |
| 19 | 567 | | | |
| 20 | 569 | | | |
| 23 | 567 | | | |
| 24 | 564.5 | | | |
| 25 | 565 | | | |
| 26 | 566 | | | |
| 27 | 567 | | | |

# Delivery

- If a futures contract is not closed out before maturity, it is usually settled by delivering the assets underlying the contract. When there are alternatives about what is delivered, where it is delivered, and when it is delivered, the party with the short position chooses.
- A few contracts (for example, those on stock indices and Eurodollars) are settled in cash
- Party with the short position files for “Notice of intention to deliver” with the exchange.

# Futures contract

- Available on a wide range of assets
- Exchange traded
- Specifications need to be defined:
  - What can be delivered,
  - Where it can be delivered, &
  - When it can be delivered
- Settled daily

# Some terminologies

- Open interest: the total number of contracts outstanding
  - equal to number of long positions or number of short positions
- Settlement price: the price just before the final bell each day
  - used for the daily settlement process
- Volume of trading: the number of trades in 1 day

# Some terminologies

- Marked to market – it is settled every day according to the market prices.
- Price limit – Exchange derives a price band in which a derivative can fluctuate. If the upper price is touched it is termed as limit up.

# Example of futures contract

Agreement to:

- buy 100 oz. of gold @ \$400/oz. in December (NYMEX)
- sell £62,500 @ 1.5000 \$/£ in March (CME)
- sell 1,000 bbl. of oil @ \$20/bbl. in April (NYMEX)

# Options vs forward and Future

- 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

# Example of futures trade

- An investor takes a long position in 2 December gold futures contracts on June 5
  - contract size is 100 .
  - futures price is $600
  - margin requirement is $2,000/contract ($4,000 in total)
  - maintenance margin is $1,500/contract ($3,000 in total)

# Possible outcome

| Day | Futures Price ($) | Daily Gain (Loss) ($) | Cumulative Gain (Loss) ($) | Margin Account Balance ($) | | Margin Call ($) | | |
|---|---|---|---|---|---|---|---|---|
| | 600.00 | | | 4,000 | | | | |
| 5-Jun | 597.00 | (600) | (600) | 3,400 | | 0 | | |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | | ⋮ | | |
| 13-Jun | 593.30 | (420) | (1,340) | 2,660 | + | 1,340 | = | 4,000 |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | | ⋮ | < | 3,000 |
| 19-Jun | 587.00 | (1,140) | (2,600) | 2,740 | + | 1,260 | = | 4,000 |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | | ⋮ | | |
| 26-Jun | 592.30 | 260 | (1,540) | 5,060 | | 0 | | |

# Speculations with futures

- A speculator in 3rd November expects the market to be strengthning for Rs/$ exchange rate in 2 months. He has two options first - he buys $20,000 from the spot market in hope that it can be sold in future date. Another possibility is to buy four futures of $5000 each for 25 December.

  $S_1$ : *Initial* Asset Price =47

  $F_1$ : Initial Futures Price = 46.5

  $F_2$ : Final Futures Price = 47.5

  $S_2$ : Final Asset Price = 48

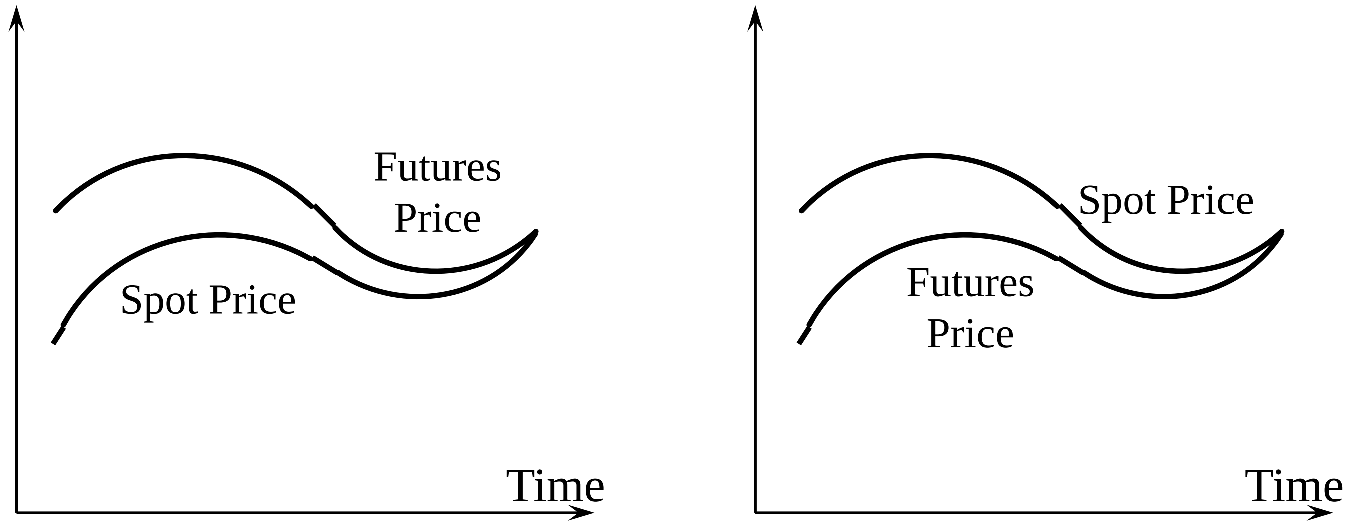
# Other key points regarding futures

- They are settled daily
- Closing out a futures position involves entering into an offsetting trade
- Most contracts are closed out before maturity

# Collatralization in otc market

- It is becoming increasingly common for contracts to be collateralized in OTC markets
- They are then similar to futures contracts in that they are settled regularly (e.g. every day or every week)

# Convergence of future to spot




(a) (b)

# Forward contract vs Future contract

| FORWARDS | FUTURES |
| --- | --- |
| Private contract between 2 parties | Exchange traded |
| Non-standard contract | Standard contract |
| Usually 1 specified delivery date | Range of delivery dates |
| Settled at end of contract | Settled daily |
| Delivery or final cash settlement usually occu$ | Contract usually closed out prior to maturity |
| Some credit risk | Virtually no credit risk |

# Argument against hedging

- Shareholders are usually well diversified and can make their own hedging decisions
- It may increase risk to hedge when competitors do not
- Explaining a situation where there is a loss on the hedge and a gain on the underlying can be difficult

# Basis risk

- Basis is the difference between the spot and futures price
- Basis = spot – future
- Basis strengthening of basis – spot increases more than the future price
- Basis weakening – future price more than the spot.

# Long and short hedge

- A long futures hedge is appropriate when you know you will purchase an asset in the future and want to lock in the price
- A short futures hedge is appropriate when you know you will sell an asset in the future and want to lock in the price

# Long hedge

- We define

  $S_1$ : *Initial* Asset Price = 2.5

  $F_1$ : Initial Futures Price = 2.2

  $F_2$ : Final Futures Price = 2

  $S_2$ : Final Asset Price = 1.9

- If you hedge the future purchase of an asset by entering into a long futures contract then

Effective Cost of Asset=$S_2 - (F_2 - F_1) = F_1$ + Basis

# Short hedge

- Again we define

  $S_1$ : *Initial* Asset Price = 2.5

  $F_1$ : Initial Futures Price = 2.2

  $F_2$ : Final Futures Price = 2

  $S_2$ : Final Asset Price = 1.9

- If you hedge the future sale of an asset by entering into a short futures contract then

Price Realized=$S_2 + (F_1 - F_2) = F_1$ + Basis

- Again we define

  $F_1$ : Initial Futures Price

  $F_2$ : Final Futures Price

  $S_2$ : Final Underliers Price

  $S_2$*: Final Asset Price

- If you hedge the future sale of an asset by entering into a short futures contract then

Price Realized $= S_2^* + (F_1 - F_2)$

$= F_1 + (S_2 - F_1) + (S_2^* - S_2)$

# Problem

- On June 8 company decides to buy 20,000 barrels of crude oil in October. Oil contracts size is 1,000 barrels. The company thus took a long future of December. The future price of is $18 per barrel. On 10 November the company decides to buy the crude oil. It therefore closes the contract, the spot price is $20 and future price as $19.10 per barrel.

# Cross hedging

- The hedging technique when the asset hedged is different from the underlying asset.
- Hedge ratio is the ratio of the size of position taken in futures contract to the size of exposures. When the asset is same in both case then the ratio is 1.

# Optimal hedge ratio

Proportion of the exposure that should optimally be hedged is

$$h = \rho \frac{\sigma_S}{\sigma_F}$$

where

$\sigma_S$ is the standard deviation of $\Delta S$, the change in the spot price during the hedging period,

$\sigma_F$ is the standard deviation of $\Delta F$, the change in the futures price during the hedging period

$\rho$ is the coefficient of correlation between $\Delta S$ and $\Delta F$.

# Coefficient of correlation

$$\rho = \frac{n\sum xy - \left(\sum x\right)\left(\sum y\right)}{\sqrt{n\left(\sum x^2\right) - \left(\sum x\right)^2}\sqrt{n\left(\sum y^2\right) - \left(\sum y\right)^2}}$$

$$\sigma = \sqrt{\frac{\sum x_i^{\ 2}}{n-1} - \frac{\left(\sum x_i\right)^2}{n(n-1)}}$$

# Optimal number of contract

- N – size of position being hedged (units)
- Q – Size of one future contract
- N* - optimal number of futures contract for hedging.
- Face value of Futures contract needed = $h^* N$
- The number of futures contract needed = $h^* \frac{N}{Q}$

# Problem

- A company expects to purchase 2 million gallons of jet fuel in a month. Since futures of jet fuel is not available the company plans to use heating oil futures @ 2000 gallon per contract.

| Month | Change in future price of heating oil per gallon | Change in jet fuel prices per gallon |
|---|---|---|
| 1 | 0.021 | 0.029 |
| 2 | 0.035 | 0.020 |
| 3 | -0.046 | -0.044 |
| 4 | 0.001 | 0.008 |
| 5 | 0.044 | 0.026 |
| 6 | -0.029 | -0.019 |
| 7 | -0.026 | -0.010 |
| 8 | -0.029 | -0.007 |
| 9 | 0.048 | 0.043 |
| 10 | -0.006 | 0.011 |
| 11 | -0.036 | -0.036 |
| 12 | -0.011 | -0.018 |
| 13 | 0.019 | 0.009 |
| 14 | -0.027 | -0.032 |
| 15 | 0.029 | 0.023 |