

# Introduction to Derivative Instruments

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Slides on book: John C. Hull, "Options, Futures, and Other Derivatives", Pearson ed.

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## Chapter 2

## Specification of a 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; and
  - ▶ When it can be delivered.

## Table of Content

### Chapter 2: Mechanics of Futures Markets

- 1 Specification
- 2 Convergence of Futures Price to Spot Price
- 3 Daily Settlement
- 4 Operation of Margins
- 5 Example of a Futures Trade
- 6 Clearing House and Clearing Margins
- 7 Market Quotes
- 8 Collateralization in OTC Markets
- 9 Delivery, Types of Traders, and Types of Orders
- 10 Forward Contracts vs Futures Contracts

## Convergence of Futures Price to Spot Price

- As the delivery period for a futures contract is approached, the futures price converges to the spot price of the underlying asset.
- To see why this is so, we first suppose that the futures price is above the spot price during the delivery period.
  - ▶ Traders then have a clear arbitrage opportunity:
    - ★ 1. Sell (i.e., short) a futures contract
    - ★ 2. Buy the asset
    - ★ 3. Make delivery.
  - ▶ As traders exploit this arbitrage opportunity, the futures price will fall.
- Suppose next that the futures price is below the spot price during the delivery period.
  - ▶ Companies interested in acquiring the asset will find it attractive to enter into a long futures contract and then wait for delivery to be made.
  - ▶ As they do so, the futures price will tend to rise.

## Convergence of Futures Price to Spot Price

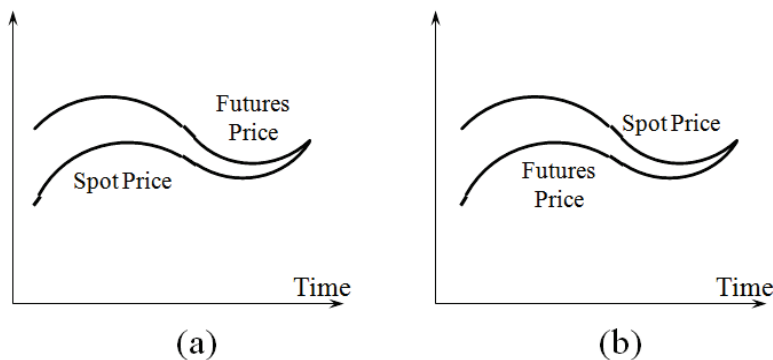


Figure: 2.1. Relationship between futures price and spot price as the delivery period is approached: (a) Futures price above spot price; (b) futures price below spot price.

## Operation of Margins

- One of the key roles of the exchange is to organize trading so that contract defaults are avoided.
- This is where margins come in.
- A **margin** is cash or marketable securities deposited by an investor with his 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.
- The **daily settlement** or **marking to market** is the practice by which at the end of each trading day, the margin account is adjusted to reflect the investor's gain or loss.

## Daily Settlement

- Whereas a forward contract is settled at the end of its life, a futures contract is settled daily.
  - ▶ At the end of each day, the investor's gain (loss) is added to (subtracted from) the margin account, bringing the value of the contract back to zero.
  - ▶ A futures contract is in effect closed out and rewritten at a new price each day.
- Daily price limits
  - ▶ to prevent large price movements from occurring because of speculative excesses.
- Position limits
  - ▶ the maximum number of contracts that a speculator may hold
    - ★ to prevent speculators from exercising undue influence on the market.

## Operation of Margins

- The **initial margin** is the amount that must be deposited at the time the contract is entered into.
- The **maintenance margin** ensures that the balance in the margin account never becomes negative.
  - ▶ It is usually about 75% of the initial margin.
  - ▶ If the balance in the margin account falls below the maintenance margin, the investor receives a margin call and is expected to top up the margin account to the initial margin level by the end of the next day.
  - ▶ If the investor does not provide the variation margin, the broker closes out the position.
    - ★ Closing out a futures position involves entering into an offsetting trade.
    - ★ Most contracts are closed out before maturity.
- The margin requirements are the same on short futures positions as they are on long futures positions.

## Example of a Futures Trade

- An investor takes a long position in two December gold futures contracts on June.
  - ▶ Contract size is 100 oz;
  - ▶ futures price is US\$1250;
  - ▶ initial margin requirement is US\$6,000/contract (US\$12,000 in total);
  - ▶ maintenance margin is US\$4,500/contract (US\$9,000 in total).
- Suppose, for example, that by the end of the first day the futures price has dropped by \$9 from \$1,250 to \$1,241.
  - ▶ The investor has a loss of \$1,800 ( $= 200 \times \$9$ ), because the 200 ounces of December gold, which the investor contracted to buy at \$1,250, can now be sold for only \$1,241.
  - ▶ The balance in the margin account would therefore be reduced by \$1,800 to \$10,200.

## Example of a Futures Trade A Possible Outcome

Day	Trade Price (\$)	Settle Price (\$)	Daily Gain (\$)	Cumul. Gain (\$)	Margin Balance (\$)	Margin Call (\$)
1	1,250.00				12,000	
1		1,241.00	-1,800	-1,800	10,200	
2		1,238.30	-540	-2,340	9,660	
....		....	....	....	....	
6		1,236.20	-780	-2,760	9,240	
7		1,229.90	-1,260	-4,020	7,980	4,020
8		1,230.80	180	-3,840	12,180	
....		....	....	....	....	
16	1,226.90		780	-4,620	15,180	

- On Day 7, the balance in the margin account falls \$1,020 below the maintenance margin level ( $7,980 < 9,000$ ).
  - ▶ This drop triggers a margin call from the broker for an additional \$4,020 to bring the account balance up to the initial margin level of \$12,000.

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- **Table 2.1** Operation of margins for a long position in two gold futures contracts.

- ▶ The initial margin is \$6,000 per contract, or \$12,000 in total;
- ▶ The maintenance margin is \$4,500 per contract, or \$9,000 in total;
- ▶ The contract is entered into on Day 1 at \$1,250 and closed out on Day 16 at \$1226.90.

### Exercise (6)

A trader buys two July futures contracts on frozen orange juice. Each contract is for the delivery of 15,000 pounds. The current futures price is 160 cents per pound, the initial margin is \$6,000 per contract, and the maintenance margin is \$4,500 per contract.

a) What price change would lead to a margin call?

### Solution (6)

### Exercise (6)

b) Under what circumstances could \$4,000 be withdrawn from the margin account?

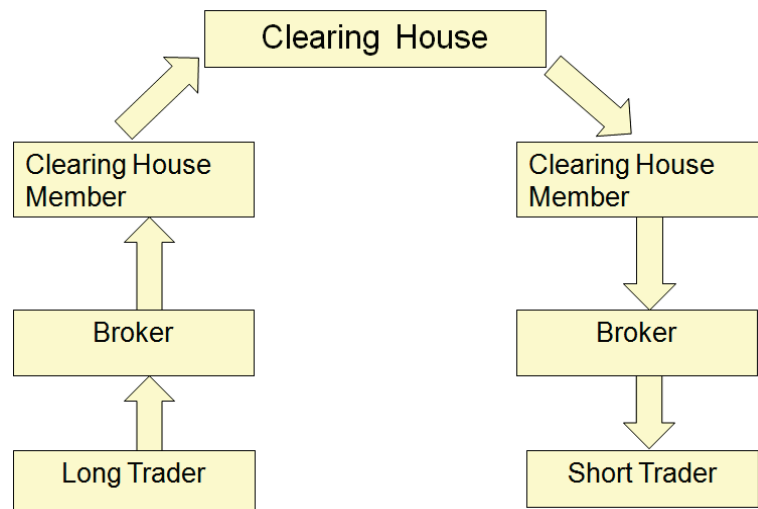
### Solution (6)

## Clearing House and Clearing Margins

- A **clearing house** acts as an intermediary in futures transactions.
  - ▶ It guarantees the performance of the parties to each transaction.
  - ▶ The main task of the clearing house is to keep track of all the transactions that take place during a day, so that it can calculate the net position of each of its members.
- Just as an investor is required to maintain a margin account with a broker, the broker is required to maintain a margin account with a clearing house member and the clearing house member is required to maintain a margin account with the clearing house. The latter is known as a **clearing margin**.

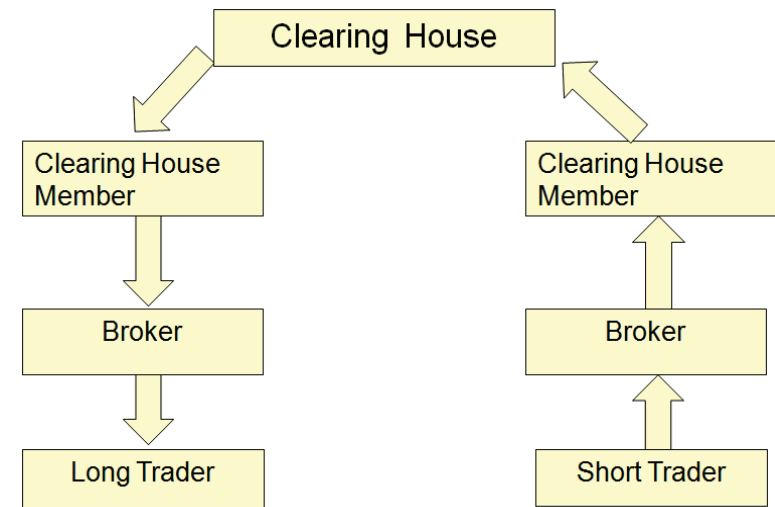
## Clearing House and Clearing Margins

### Margin Cash Flows When Futures Price Decreases



## Clearing House and Clearing Margins

### Margin Cash Flows When Futures Price Increases



### Exercise (7)

At the end of one day a clearing house member is long 100 contracts, and the settlement price is \$50,000 per contract. The original margin is \$2,000 per contract. On the following day the member becomes responsible for clearing an additional 20 long contracts, entered into at a price of \$51,000 per contract. The settlement price at the end of this day is \$50,200. How much does the member have to add to its margin account with the exchange clearing house?

### Solution (7)

## Market Quotes

	Open	High	Low	Settle	Change	Volume	Open Int
Jul 2018	70.06	71.70	69.21	71.51	2.76	6,315	388,902
Aug 2018	71.25	72.77	70.42	72.54	2.44	3,746	115,305
Dec 2018	74.00	75.34	73.17	75.23	2.19	5,055	196,033
Dec 2019	77.01	78.59	76.51	78.53	2.00	4,175	100,674
Dec 2020	78.50	80.21	78.50	80.18	1.86	1,258	70,126

- The fifth number is the change in the settlement price from the previous day (which is not in this table as rows correspond to months).

## Market Quotes

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### • Table 2.2 Crude Oil Trading on May 26, 2018

- ▶ The first three numbers in each row show the *opening price*, the *highest price* achieved in trading during the day, and the *lowest price* achieved in trading during the day.
- ▶ The fourth number is the *settlement price*. This is the price (just before the final bell each day) used for calculating daily gains and losses and margin requirements.

## Market Quotes

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- The final two columns show the *trading volume* for the day and the *open interest* at the end of the previous day.
  - ▶ The **trading volume** is the number of contracts traded.
  - ▶ The **open interest** is the number of contracts outstanding, that is, the number of long positions or, equivalently, the number of short positions.
  - ▶ Observe that if a party A replaces a party B in 14 positions (i.e., B sells at A 14 futures), then trading volume increases by 14 while open interest does not change.

## Collateralization in OTC Markets

- Credit risk has traditionally been a feature of the over-the-counter markets.
  - ▶ There is always a chance that the party on the other side of an OTC trade will default.
  - ▶ It is interesting that, in an attempt to reduce credit risk, the OTC market has adopted, or has been compelled to adopt, some of the procedures used by exchanges.

## Collateralization in OTC Markets

- *Collateralization* has been used in OTC markets for some time and is similar to the practice of posting margin in futures markets.
  - ▶ Consider two companies, A and B, that have entered into an OTC derivatives transaction such as a *forward*.
  - ▶ The contract is not settled daily, as in the case of futures.
  - ▶ A collateralization agreement applying to the transaction might involve the transaction being valued each day.
  - ▶ If, from one day to the next, the value of the transaction to company A increases by a positive amount  $X$  (so that the value to company B decreases by  $X$ ), company B is required to pay  $X$  to company A.
  - ▶ The payments are a security deposit designed to ensure that obligations will honored. Interest is paid on cash collateral.
  - ▶ If B defaults, A is entitled to take possession of the collateral.

## Collateralization in OTC Markets

- Traditionally transactions have been cleared bilaterally in OTC markets
- Since the 2007-2009 crisis, governments in the US and elsewhere have passed legislation requiring clearing houses to be used for some OTC. transactions.

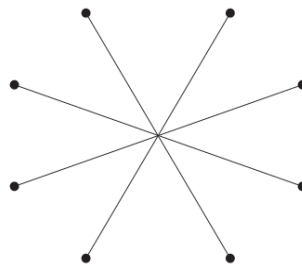
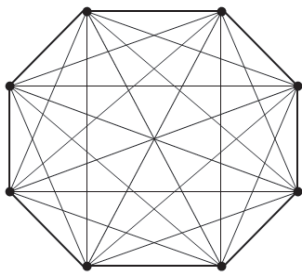


Figure: Bilateral Clearing (left) vs Central Clearing House (right)

## Delivery, Types of Traders, and Types of Orders

### Delivery

- If a futures contract is not closed out before maturity, it is usually settled by delivering the assets underlying the contract.
- Some financial futures, such as those on stock indices, are settled in cash because it is inconvenient or impossible to deliver the underlying asset.
  - ▶ E.g., in the case of the futures contract on the S&P 500, delivering the underlying asset would involve delivering a portfolio of 500 stocks.

## Delivery, Types of Traders, and Types of Orders

### Types of Traders

- There are two main types of traders executing trades:
  - ▶ **futures commission merchants** (FCMs) are following the instructions of their clients and charge a commission for doing so;
  - ▶ **locals** are trading on their own account.
- Individuals taking positions, whether locals or the clients of FCMs, can be categorized as hedgers, speculators, or arbitrageurs, as discussed in Chapter 1.

## Delivery, Types of Traders, and Types of Orders

### Types of Orders

- The simplest type of order placed with a broker is a **market order**.
  - ▶ It is a request that a trade be carried out immediately at the best price available in the market.
- A **limit order** specifies a particular price.
  - ▶ The order can be executed only at this price or at one more favorable to the investor.
- A **stop-loss order** also specifies a particular price.
  - ▶ It is executed at the best available price once a bid or offer is made at that particular price or a less-favorable price.
  - ▶ It then limits the loss that can be incurred.
- A **stop-limit order** is a combination of a stop order and a limit order.

## Delivery, Types of Traders, and Types of Orders

### Types of Traders

- Speculators can be classified as *scalpers*, *day traders*, or *position traders*.
  - ▶ **Scalpers** are watching for very short-term trends and attempt to profit from small changes in the contract price.
    - ★ They usually hold their positions for only a few minutes.
  - ▶ **Day traders** hold their positions for less than one trading day.
    - ★ They are unwilling to take the risk that adverse news will occur overnight.
  - ▶ **Position traders** hold their positions for much longer periods of time.
    - ★ They hope to make significant profits from major movements in the markets.

## Delivery, Types of Traders, and Types of Orders

### Types of Orders

- A **market-if touched order** is executed at the best available price after a trade occurs at a specified price or at a price more favorable than the specified price.
  - ▶ It is designed to ensure that profits are taken if sufficiently favorable price movements occur.
- A **discretionary order** is traded as a market order except that execution may be delayed at the broker's discretion in an attempt to get a better price.
- A **time-of-day order** specifies a particular period of time during the day when the order can be executed.
- An **open order** is in effect until executed or until the end of trading in the particular contract.
- A **fill-or-kill order**, as its name implies, must be executed immediately on receipt or not at all.

## Forward Contracts vs Futures Contracts

- A *forward contract* is traded in the OTC market and there is no standard contract size or standard delivery arrangements.
  - ▶ A single delivery date is usually specified.
  - ▶ It is settled at the end of the life of the contract so the whole gain or loss is realized at the end.
  - ▶ It is usually held to the end of its life.
- A *futures contract* is a standardized contract traded on an exchange.
  - ▶ A range of delivery dates is usually specified.
  - ▶ It is settled daily so the gain or loss is realized day by day.
  - ▶ It is usually closed out prior to maturity.