

Futures markets

Goals:

- Understand how futures are specified
- Analyze the margin procedure
- Review delivery options, types of orders, and regulation of futures
- Introduce the concepts of credit and systemic risk

Relevant literature:

- Hull, Chapter 2
- CME guide (<http://www.cmegroup.com/education/files/a-traders-guide-to-futures.pdf>)

Futures

- Futures are contractual agreements to buy or sell a specific asset at a later point of time for some predetermined price
- They are available on a wide range of assets
- They are exchange traded and settled daily
- A futures contract can be closed out on any day by entering into an opposite position
- In practice, most contracts are closed out before maturity
 - No exchange occurs in the end
 - The assets are neither sold nor bought

Forwards

- Forwards are also contractual agreements to buy or sell a specific asset at a later point of time for some predetermined price
- They are available on a wide range of assets
- However, forwards are only traded over the counter

Forward contracts

A **forward contract** is an agreement to pay a specified delivery price K at a delivery date T for the asset whose price at time t is S_t .

The **forward price** $For_S(t, T)$ of this asset at time t is the value of K that makes the forward contract have *no-arbitrage* price zero at time t .

Forward price

Let $B(t, T)$ be the price at time t of a zero-coupon bond paying 1 at time T .

$$For_S(t, T) = \frac{S_t}{B(t, T)}, \quad 0 \leq t \leq T.$$

Suppose an agent

- Sell a forward contract with delivery date T and delivery price K ;
- Short $\frac{S_t}{B(t, T)}$ zero-coupon bonds and use S_t to buy one share of asset.

At time T :

- Delivery the asset and receive K ;
- Cover the bond $\frac{S_t}{B(t, T)}$.

The agent is left with $K - \frac{S_t}{B(t, T)}$.

If the cost is zero to enter a forward position, K must be the same as $\frac{S_t}{B(t, T)}$.

Future contracts

Consider a time interval $[0, T]$ and subintervals $0 = t_0 < t_1 < \dots < t_n = T$.

Consider a future contract with futures price $Fut_S(t, T)$.

If any agent holds a long futures position between time t_k and t_{k+1} , then at time t_{k+1} , she receives a payment

$$Fut_S(t_{k+1}, T) - Fut_S(t_k, T).$$

This is called **marking to margin**.

At time T ,

$$Fut_S(T, T) = S_T.$$

Futures prices $Fut_S(t, T)$ is determined so that each payment $Fut_S(t_{k+1}, T) - Fut_S(t_k, T)$ has “expected” value zero.

Futures price reflects current market expectation of the delivery price $S(T)$.

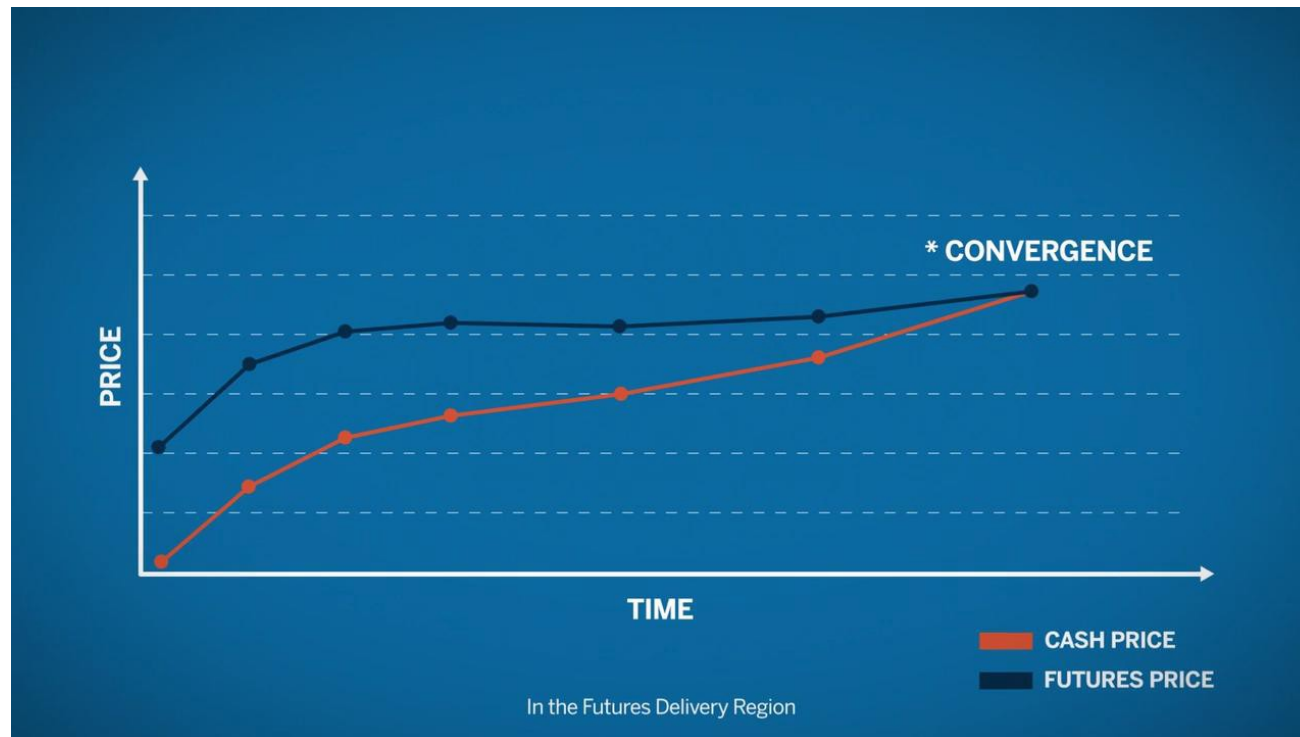
Convergence of futures prices

- What do you think occurs to the futures price as we approach the expiration of the contract?

Convergence of futures prices

- As $T - t \rightarrow 0$, the futures price will converge to the market price of the underlying asset
 - Unless severe unexpected news arrive, the price of a stock changes only little over short periods of time
 - If the time until maturity is short ($T - t \approx 0$), then we expect the stock price S_t to be very similar to the price of the stock at maturity S_T (that is, $S_t \approx S_T$)
 - As a result, entering a futures at time t with maturity T for a price of $F_t = S_t e^{r(T-t)}$ is only possible if $F_t \approx S_t \approx S_T$. Otherwise, it may be better to just invest in the stock market and avoid the futures market

Convergence of futures prices



Patterns of futures prices

- Futures prices reflect expectations about future spot prices
 - If the futures price is higher than the current spot price, the markets expect the spot price to rise
- When the futures price increases with the maturity of the contract, we talk of **normal markets** (or contango)
- When the futures price decreases with the maturity of the contract, we talk of **inverted markets** (or normal backwardation)

Market orders

- If you want to enter a long position in a futures, you can go to an exchange and buy a futures contract at the currently traded futures price
- In this sense, you do not get to determine the futures price at which you are entering your futures contract

Market orders

- Still, there will often be a futures price F_t^{ask} for long positions and F_t^{bid} for short positions
 - The difference is known as the *bid-ask spread*
 - When submitting a market order to buy, you enter a long position on a futures contract with the futures price F_t^{ask}
 - When submitting a market order to sell, you enter a short position on a futures contract with the futures price F_t^{bid}
- Why do you think there is a bid-ask spread?

Limit orders

- This is because different investors enter markets for different reasons
- A speculator may suspect that there are some people that would like to trade at a much higher futures price than currently traded in the market
- Instead of going around searching for counterparties (such as would occur in a forward market and which would be costly), exchanges offer the possibility to submit an order to wait until an interested counterparty shows up
- These orders are known as *limit orders*

Limit orders

- In futures markets, you could submit a limit order to enter a long position on a futures at a futures price $F > F_t^{\text{ask}}$ or a short position at a futures price $F < F_t^{\text{bid}}$
- These orders go into the *limit book* of the exchange which keeps track of all limit orders that are submitted
- If, say, you have a long position with a limit futures price of F^{buy} and somebody else enters a short position with a limit futures price of F^{sell} then you would transact if $F^{\text{buy}} \geq F^{\text{sell}}$
- Because there are many orders in the limit book, long transactions only occur at the best ask price and short transactions only occur at the best bid price
- Difference between bid and ask prices in the limit book yield a bid-ask spread

Different types of orders

There are types of orders that can be submitted to an exchange:

[https://www.cmegroup.com/education/courses/
things-to-know-before-trading-cme-futures/
futures-order-types.html](https://www.cmegroup.com/education/courses/things-to-know-before-trading-cme-futures/futures-order-types.html)

These orders can be used for different purposes (hedge, speculate, arbitrage activities, etc)

Specifications of a futures contract

- The asset
 - May be a commodity, a financial asset, or any other standardized product
 - The futures price depends on the quality of the asset
- The contract size
 - Specifies the amount of the asset that has to be delivered
 - Standardized sizes as they are traded in exchanges

Delivery

- Futures contracts specify what happens when the futures contract expires and a transaction is meant to take place
- If a futures contract is not closed out before maturity, it is usually settled by delivering the assets underlying the contract by the specified date at the specified location
- When there are alternatives about what is delivered, where it is delivered, and when it is delivered, the party with the short position has the right of choice
- Some contracts (for example, those on stock indices and currencies) are settled in cash

[https://www.cmegroup.com/education/courses/
introduction-to-futures/
understanding-futures-expiration-contract-roll.html](https://www.cmegroup.com/education/courses/introduction-to-futures/understanding-futures-expiration-contract-roll.html)

Specifications of a futures contract

- Delivery months
 - Standard contracts at major exchanges have delivery months of March, May, July, September, and December
 - Trading of futures ceases a few days before delivery
- Price quotes
 - Quotes depend on the asset
 - E.g.: Quotes on Treasury bond and Treasury note futures are quoted in dollars and thirty-seconds of a dollar

Specifications of a futures contract

NYMEX WTI Light Sweet Crude Oil futures at CME

Contract Size	1,000 barrels
Minimum Tick	\$0.01 per barrel
Dollar Value of One Tick	\$10 U.S. Dollars
Product Symbol	CL
Trading Hours	Sunday - Friday 5:00pm - 4:00pm CT with a 60-minute break each day at 4:00pm CT
Contract Months	All
Trading Venue	CME offers electronic trading almost 24 hours /6 days a week
Options Available	Quarterly, Monthly, Weekly

Physical delivery

Specifications of a futures contract

E-mini S&P 500 Futures at CME

Contract Size	\$50 x S&P 500 Index
Minimum Tick	0.25 index points
Dollar Value of One Tick	\$12.50 U.S. Dollars
Product Symbol	ES
Trading Hours	Sunday - Friday 5:00p.m. - 4:00p.m. CT with a trading halt from 3:15p.m. - 3:30p.m. CT; Daily Maintenance period Monday - Thursday 4:00p.m. - 5:00p.m.
Contract Months	Nearest five months in the quarterly cycle (Mar, Jun, Sep, Dec)
Options Available	Quarterly, Monthly, Weekly (Monday, Wednesday, Friday)

Cash settlement

Specifications of a futures contract

VIX futures on CBOE

Key Specifications for VIX® Futures and Options		
	VIX Futures	
Exchange	Cboe Futures Exchange (CFE)	
Year of Introduction	2004	
Ticker	VX and VX01 through VX53	
Multiplier	\$1,000	
Global Trading Hours (Chicago time Monday-Friday)	5:00 p.m. (previous day) to 8:30 a.m. and 3:30 p.m. to 4:00 p.m.	
Regular Trading Hours (Chicago time Monday-Friday)	8:30 a.m. to 3:15 p.m.	
Expiration and Settlement	Usually on a Wednesday morning (30 days before a Friday settlement for SPX options)	

"The VIX Index settlement process is patterned after the process used to settle A.M.-settled S&P 500 Index options. The final settlement value for VIX futures and options is determined on the morning of their expiration date (usually a Wednesday) through a Special Opening Quotation ("SOQ") of the VIX Index using the opening prices of a portfolio of SPX options that expire 30 days later. The opening prices of these options are determined through Cboe's proprietary auction mechanism (Hybrid Opening System or HOSS). By providing market participants with a mechanism to buy and sell SPX options at the prices that are used to calculate the final settlement value for VIX derivatives, the VIX Index settlement process is 'tradable.' "

Specifications of a futures contract

- Price limits and position limits
 - In many exchanges, futures price movements are restricted
 - Many times, investors are also restricted on the number of positions they may hold
- Limits help with keeping markets functioning smoothly

[https://www.cmegroup.com/education/courses/
introduction-to-futures/price-limits-price-banding.html](https://www.cmegroup.com/education/courses/introduction-to-futures/price-limits-price-banding.html)

Mistakes when placing futures orders

- Understanding the correct specification of futures orders is important in order to avoid making mistakes when placing an order
- Wrong orders may cause you large losses
- They may also affect the entire market by pushing it in a direction that is not necessarily anticipated by other market participants
- When you place a wrong order, it is not guaranteed that your order can be cancelled

<http://on.wsj.com/1ur00xp>







Goldman's erroneous trades on 08/21/2013


Terminology

Futures prices are published in many newspaper and online using the following terminology

- **Open interest:** the total number of contracts outstanding; equal to number of positions carried over to the next day
- **Settlement price:** the last trading price just before the final bell each day used for the daily settlement process
- **Change:** indicates the change in the settlement price from the previous day
- **Volume of trading:** the number of trades in one day

Quotes

Month	Options	Charts	Last	Change	Prior Settle	Open	High	Low	Volume	Hi / Low Limit	Updated
SEP 2018	OPT		2872.75	-6.25	2874.75	2875.00	2885.00	2865.00	1,647,915	3017.00 / 2730.00	13:02:39 CT 09 Sep 2018
DEC 2018	OPT		2877.75	-6.00	2879.25	2882.50	2889.75	2869.50	35,216	3022.00 / 2735.00	13:02:28 CT 09 Sep 2018
MAR 2019	OPT		2887.50	-3.25	2886.50	2889.50	2894.00	2877.75	1,455	3029.00 / 2742.00	13:02:37 CT 09 Sep 2018
JUN 2019	OPT		2900.00	+1.00	2895.00	2890.25	2900.00	2890.25	2	3037.50 / 2750.50	13:02:26 CT 09 Sep 2018
SEP 2019	OPT		2895.00	-7.00	2898.25	2900.00	2900.00	2895.00	6	3041.00 / 2754.00	13:02:03 CT 09 Sep 2018
DEC 2019	OPT		-	-	-	-	-	-	0	No Limit / No Limit	-

Legend: [OPT](#) Options  Price Chart
 [? About This Report](#)

Quotes for the S&P 500 E-mini futures contract on the CME on Sep 9, 2018. Closing value of the S&P 500 on Friday, Sep 7: 2871.68.

Margins

- A margin is cash or marketable securities deposited by an investor with her broker on a **margin account**
- The balance in the margin account is adjusted to reflect daily settlement
 - If the futures earns money, the margin balance rises
 - If the futures loses money, the margin balance falls
- Initially, the investor is required to deposit an **initial margin**
- If the margin account balance falls below a **maintenance margin** level, the investor is required to deposit enough money to reach the initial balance again

Example of a possible futures trade

- An investor takes a long position in 2 December gold futures contracts on June 5
 - The contract size is 100 oz.
 - The futures price is \$1250 per ounce
 - The initial margin requirement is \$6,000/contract (\$12,000 in total)
 - Maintenance margin is \$4,500/contract (\$9,000 in total)

Example of a possible futures trade

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 margin balance falls below the maintenance margin, so the investors has to deposit cash into the account to bring the margin balance back to the initial margin

Clearing houses

- Since futures are only traded on exchanges, they can only be bought or sold through brokers who work at the exchanges
 - For example, Fidelity, TD Ameritrade, Robinhood, ...
- Each broker carries several order books from his investors
- In order to protect the investors from the default of a broker, brokers are also required to keep margin accounts at a **clearing house**

Clearing House

A **clearing house** acts as an intermediary in futures transactions.

It guarantees the performance of parties to each transaction.

Clearing house member is required to provide to the clearing house **initial margin**.

At the end of each day, if in total the transactions have lost money, the member is required to provide **variation margin**; if there has been a gain, the member receives variation margin.

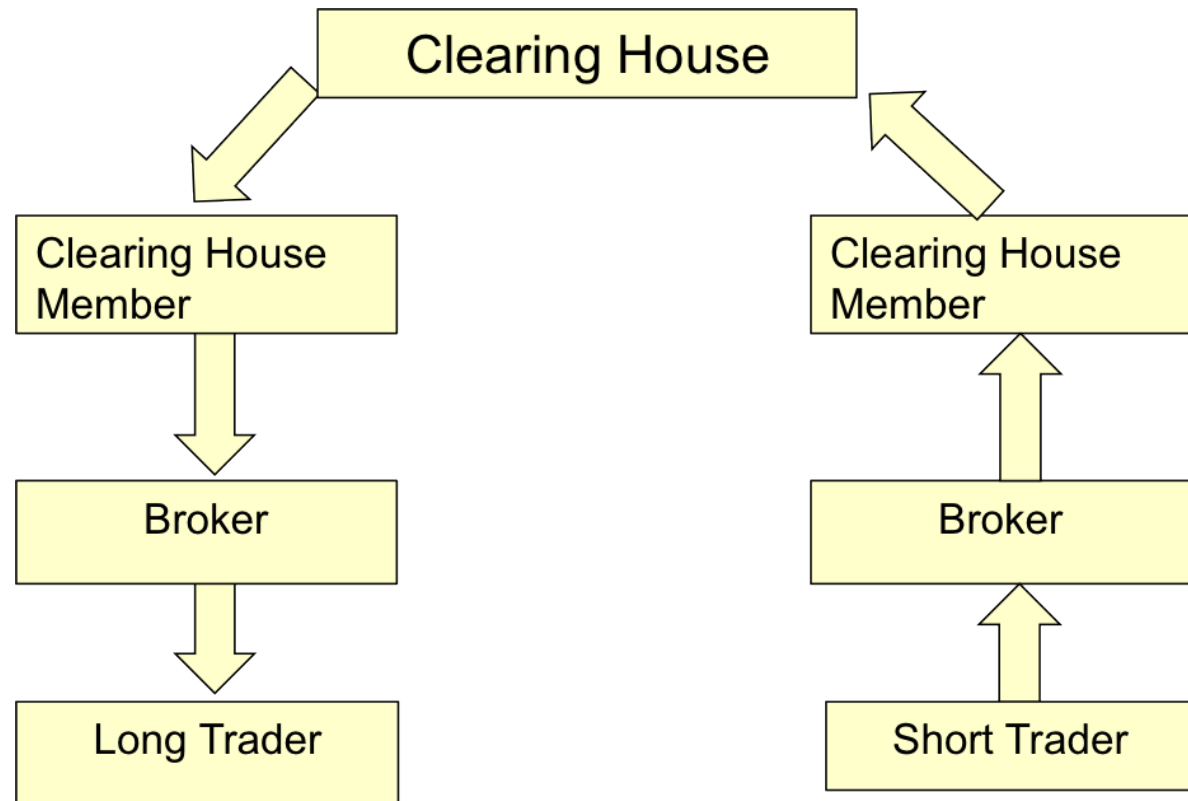
Initial margin requirements are calculated on a net basis rather than a gross basis.

For example, a member has two clients: one with long position in 20 contracts, the other with a short position in 15 contracts. The initial margin is calculated on the basis of 5 contracts.

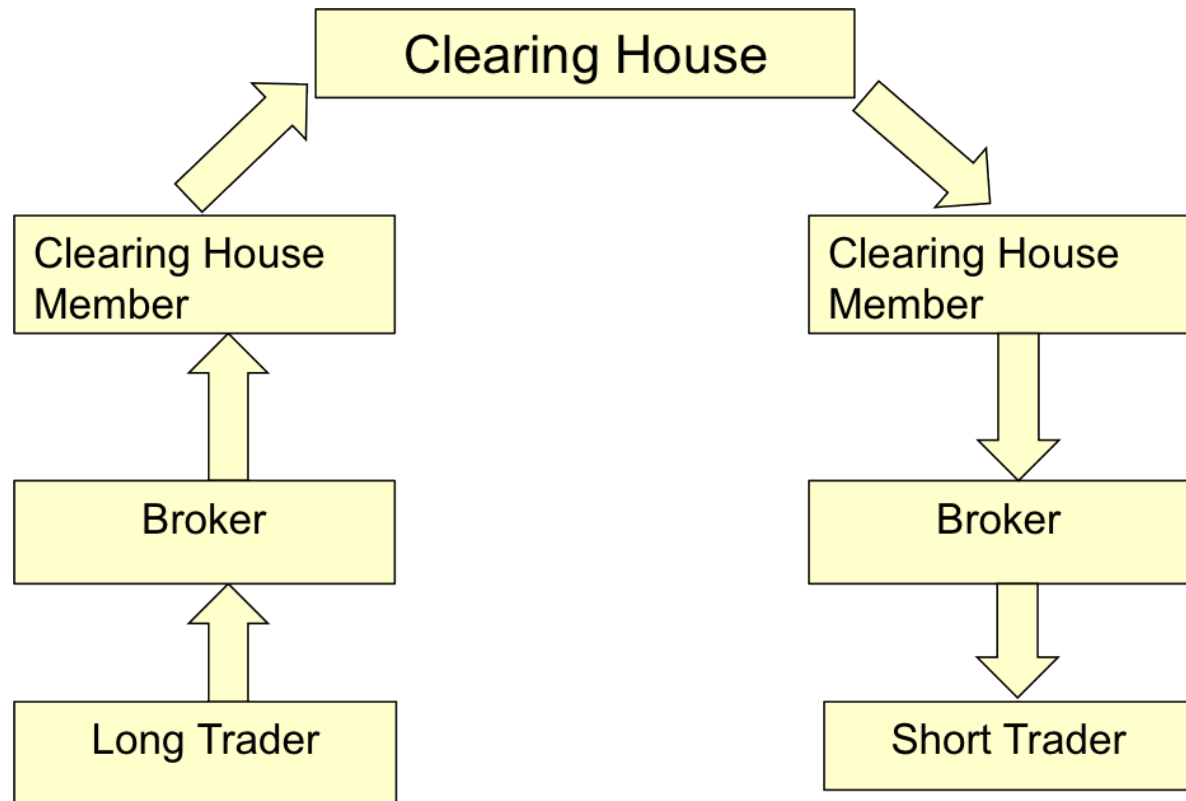
Clearing house should have sufficient fund to ensure payment to each party. This reduces credit risk.

On October 19, 1987, S&P 500 declined by over 20%. Some traders with long positions in S&P500 futures have negative margin. They defaulted and some brokers went bankrupt, because they were unable to meet margin calls on tracts they entered on behalf of their clients.

Margin cash flows when futures gain



Margin cash flows when futures lose



Credit risk

- The possibility that either the investor or the broker goes bankrupt is known as **credit risk**
- Futures have smaller credit risk exposure than forwards
 - Through the margin accounts, the investor is guaranteed to receive the profit she is entitled to
 - Also, the broker is assured to not be left with huge open positions if the investor goes bankrupt

Systemic risk

- The clearing house, in addition, provides additional security
 - A broker may fail if many of his investors go bankrupt
 - This may affect otherwise healthy investors and push them into bankruptcy as well
 - The possibility of a cascading sequence of failures is known as **systemic risk**
- Clearing makes future markets safer, but there are subtle issues in terms of how to set up the clearing house to ensure that it works well in scenarios in which systemic risk arises

<http://video.cnbc.com/gallery/?video=3000390999>

Goldman's Cohn wants to make clearing houses safer

OTC markets

Over-the-counter (OTC) markets are markets where companies agree to derivatives transactions without involving an exchange.

Credit risk has been a feature of OTC derivatives markets.

Central counterparties (CCP) are clearing houses for standard OTC transactions. They perform the same role as exchange clearing houses.

Once an OTC derivative transaction has been agreed between A and B, and accepted by a CCP, CCP will become counterparty to both A and B.

For example, A has agreed to buy an asset from B in one year for a certain price in a forward contract. Then CCP agrees to

- Buy the asset from B in a one year for the agreed price
- Sell the asset to A in one year for the agreed price.

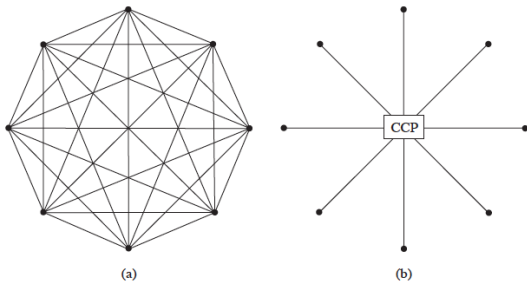
All members of the CCP are required to provide initial margin and variation margin.

Bilateral Clearing vs Central Clearing

Collateral agreement: If, from one day to the next, the transactions increase in value to A by X and therefore decrease in value to B by X, then B is required to provide collateral worth X to A.

From 2016, regulation requires standard transactions between financial institutions be cleared through CCPs.

Figure 2.2 (a) The traditional way in which OTC markets have operated: a series of bilateral agreements between market participants; (b) how OTC markets would operate with a single central counterparty (CCP) acting as a clearing house.



Regulation of futures

- In the US, the regulation of futures markets is primarily the responsibility of the Commodity Futures and Trading Commission (CFTC)
- The Securities and Exchange Commission (SEC), the Federal Reserve Bank (Fed), and the US Treasury have also claimed rights over the regulation of futures
- Regulators try to protect the public interest and prevent questionable trading practices
- Their main goal is to minimize costs for society that arise due to bad trading

<https://www.youtube.com/watch?v=dIq16lZBnDY>

Regulating the futures industry