

# Futures Markets and Central Counterparties

## LECTURE 2

<https://fatih.ai/sjtu/derivatives/>



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# Outline

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- 1 Central clearing, novation, and margin
- 2 Contract specifications and the life of a position
- 3 Margining and liquidity risk: three episodes

# Central clearing, novation, and margin

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## From a bilateral forward to an exchange

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Lecture 1 ended with a problem. A forward transfers price risk, but it leaves **counterparty credit risk**: if the price moves so that the contract is valuable to one side, that side depends on the other side performing.

- In a bilateral OTC forward, each party must assess and bear the other's credit risk directly.
- On a futures exchange, counterparties are anonymous and may never have transacted before.

**QUESTION** — How can anonymous trading be credible, when neither side has chosen or assessed the other?

## Novation: the clearing house becomes the counterparty

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When a trade is matched on the exchange, the contract between the two traders is replaced by two contracts, each with the **clearing house**, acting as **central counterparty** (CCP).



This legal substitution is called **novation**. After it, each trader's credit exposure is to the CCP, not to an unknown counterparty.

*Novation replaces credit exposure to a stranger with credit exposure to the clearing house.*

## The CCP runs a matched book

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After novation, the CCP is between every long and every short. It has offsetting price exposures, but it must still collect cash from the losing side.

| price move                            | cash flow with longs       | cash flow with shorts    |
|---------------------------------------|----------------------------|--------------------------|
| futures price rises by $\Delta F > 0$ | CCP pays $Q\Delta F$       | CCP collects $Q\Delta F$ |
| futures price falls by $\Delta F < 0$ | CCP collects $Q \Delta F $ | CCP pays $Q \Delta F $   |

If everyone pays, the CCP's net cash flow from price moves is zero:

$$\text{payments out} - \text{payments in} \approx 0.$$

The remaining risk is different: the losing side may fail to pay before its position can be closed.

*The CCP is not mainly exposed to price direction. It is exposed to member default: the risk that the losing side cannot pay.*

## Two kinds of margin

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The CCP faces one practical question: if the losing side stops paying today, is there enough cash to close the position before losses spill to others?

| margin type             | timing                                                   | purpose                                                         |
|-------------------------|----------------------------------------------------------|-----------------------------------------------------------------|
| <b>variation margin</b> | paid after each settlement price change                  | transfers that day's futures gain or loss: $Q(F_t - F_{t-1})$   |
| <b>initial margin</b>   | posted before trading and maintained during the position | collateral for the adverse move that may occur during close-out |

Daily settlement prevents old losses from accumulating. Initial margin is the buffer for the new loss that can occur after the last settlement but before the CCP closes a defaulting position.

# What the margin account is doing

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Do not read margin as the price of the contract. It is a collateral account through which futures gains and losses are settled.

| cash item        | interpretation                                                                   |
|------------------|----------------------------------------------------------------------------------|
| initial margin   | collateral posted first; normally returned after final settlement, net of losses |
| variation margin | daily futures gain or loss credited to, or debited from, the account             |
| margin call      | extra collateral required because the account balance has fallen too low         |

Margin changes the timing of cash. The total futures P&L still comes from position size times the price change from entry to exit.

## The margin-account equation

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For a **long** futures position, the account update is

$$M_t = M_{t-1} + Q(F_t - F_{t-1}) + \text{top-up}_t.$$

| symbol            | meaning in this lecture's crude-oil example                       |
|-------------------|-------------------------------------------------------------------|
| $M_t$             | margin-account balance after today's settlement and any cash call |
| $M_{t-1}$         | yesterday's balance after all yesterday's actions                 |
| $Q$               | position size: 2 lots $\times$ 1,000 barrels = 2,000 barrels      |
| $F_t - F_{t-1}$   | today's change in the official settlement price per barrel        |
| $\text{top-up}_t$ | extra cash posted after a margin call; zero if none               |

Example for day 1:

$$M_1 = 112,000 + 2,000(555 - 560) + 0 = \text{¥}102,000.$$

A short futures position has the opposite daily price term.

## Worked position: price sensitivity

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The quote is per barrel; the margin account is for the whole position.

| object              | number used in the example                                      |
|---------------------|-----------------------------------------------------------------|
| position            | 2 lots INE crude oil, long futures                              |
| contract size       | 1,000 barrels per lot                                           |
| position size       | $Q = 2 \times 1,000 = 2,000$ barrels                            |
| entry futures price | $F_0 = \text{¥}560$ per barrel                                  |
| contract notional   | $2,000 \times \text{¥}560 = \text{¥}1,120,000$                  |
| initial margin      | assumed rule: $10\% \times \text{¥}1,120,000 = \text{¥}112,000$ |
| maintenance margin  | assumed floor: $75\% \times \text{¥}112,000 = \text{¥}84,000$   |

A ¥1 settlement-price move changes the account by  $Q \times \text{¥}1 = 2,000 \times \text{¥}1 = \text{¥}2,000$ .

## When does the margin call happen?

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The maintenance margin is the *trigger*. The initial margin is the *destination* after the call is met.

$$\begin{aligned} M_t &\geq \text{¥}84,000 && \text{no margin call,} \\ M_t &< \text{¥}84,000 && \text{add } \text{¥}112,000 - M_t. \end{aligned}$$

| balance after<br>settlement | decision    | cash required                                       |
|-----------------------------|-------------|-----------------------------------------------------|
| ¥91,000                     | no call     | ¥0                                                  |
| ¥84,000                     | no call     | ¥0                                                  |
| ¥74,000                     | margin call | $\text{¥}112,000 - \text{¥}74,000 = \text{¥}38,000$ |

Equal to maintenance is still acceptable; below maintenance triggers the call.

## The margin account, day by day

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Daily cash flow is  $2,000(F_t - F_{t-1})$ . The important accounting point is the difference between the balance *before* and *after* a top-up.

| day | settle | $\Delta F$ | daily P&L | before<br>action | action           | after action |
|-----|--------|------------|-----------|------------------|------------------|--------------|
| 0   | ¥560.0 | —          | —         | —                | initial +112,000 | 112,000      |
| 1   | ¥555.0 | −5.0       | −10,000   | 102,000          | no call          | 102,000      |
| 2   | ¥549.5 | −5.5       | −11,000   | 91,000           | no call          | 91,000       |
| 3   | ¥546.0 | −3.5       | −7,000    | 84,000           | no call          | 84,000       |
| 4   | ¥541.0 | −5.0       | −10,000   | 74,000           | top-up +38,000   | 112,000      |
| 5   | ¥545.5 | +4.5       | +9,000    | 121,000          | no call          | 121,000      |
| 6   | ¥551.0 | +5.5       | +11,000   | 132,000          | no call          | 132,000      |

Day 4 is the only call: the account falls to ¥74,000 and is restored to ¥112,000.

## Reconciling the account

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The daily account and the futures payoff must give the same total result.

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| account cash view                                    | price-change view                                     |
|------------------------------------------------------|-------------------------------------------------------|
| deposits: $112,000 + 38,000 = \text{¥}150,000$       | final price minus entry price: $551.0 - 560.0 = -9.0$ |
| final account balance returned:<br>$\text{¥}132,000$ | position size: 2,000 barrels                          |
| net result: $132,000 - 150,000 = -\text{¥}18,000$    | futures P&L: $(-9.0) \times 2,000 = -\text{¥}18,000$  |

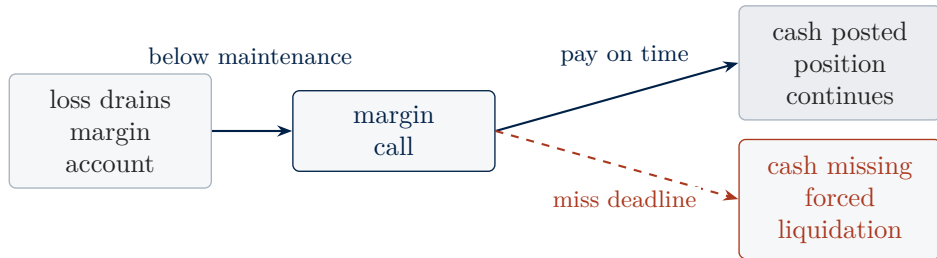
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The ¥38,000 margin call does not create an extra loss. It moves cash into the account earlier so the clearing system is protected.

# Margin calls and forced liquidation

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A margin call is a funding test, not a forecast about tomorrow's price.



In Chinese market practice, forced liquidation is *qiang ping* (compulsory closing). After the position is closed, a later price recovery no longer helps the original holder.

# Mainland market: who enforces the margin?

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Margining is not only an equation; it is an enforcement chain.

| institution               | role in the margin system                                                                         |
|---------------------------|---------------------------------------------------------------------------------------------------|
| exchange / clearing house | sets contract rules, settlement price, minimum margin, price limits, and clearing obligations     |
| futures company / broker  | collects client margin, may require extra house margin, issues calls, and can liquidate positions |
| trader / hedger           | must keep the account funded; the hedge can fail operationally if cash is unavailable             |

The theory says “post margin.” The institution decides when, how much, and what happens if it is not posted.

## Mainland market: rules that affect liquidity

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The arithmetic is the same; these rules determine when cash must be posted and whether a position can be kept open.

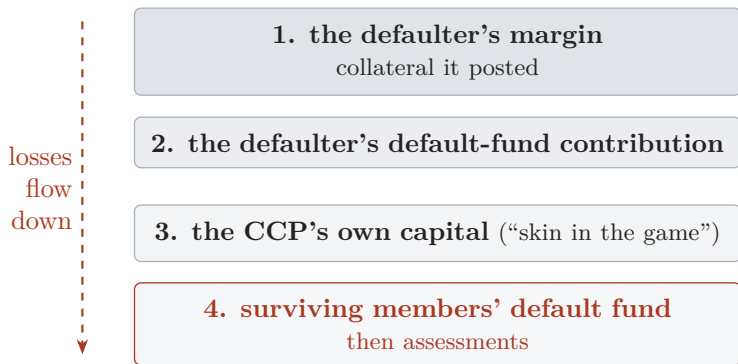
- **Margin rates:** usually a percentage of contract value; exchange minimums and broker add-ons can rise when risk rises.
- **Daily settlement:** gains and losses are credited or debited every trading day using the settlement price.
- **Price limits:** daily move limits can slow losses, but can also make exit difficult when many traders want the same exit.
- **Forced liquidation:** unpaid margin calls can lead to compulsory closing to protect the clearing system.
- **Intraday offset:** positions can often be opened and closed in the same trading day, so margin is monitored continuously.

These rules convert the margin equation into an operational funding test.

## If a member still defaults: the default waterfall

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Margin can be exhausted by a move larger than it was sized for. Losses then fall through a fixed order of resources.

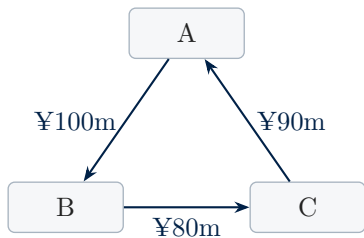


*losses beyond the defaulter's own resources are mutualised across the surviving members.*

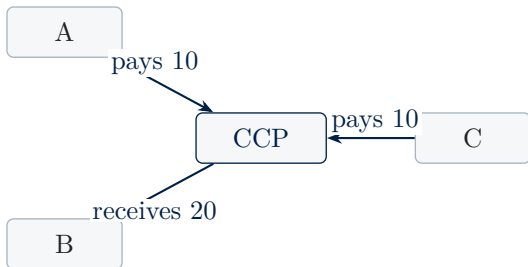
# Multilateral netting

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Three participants with offsetting bilateral obligations, settled gross versus settled through a CCP:



gross: ¥270m of obligations

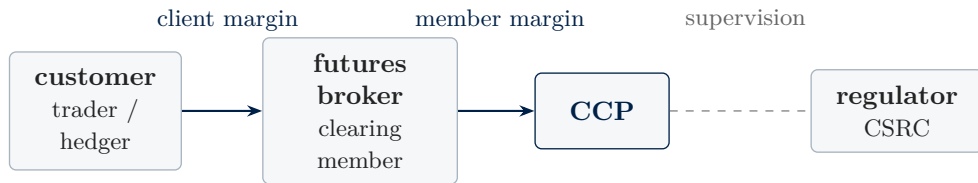


net payers send ¥20m; B receives ¥20m

*netting leaves net positions unchanged but reduces the collateral and cash that must actually move.*

# Who stands where

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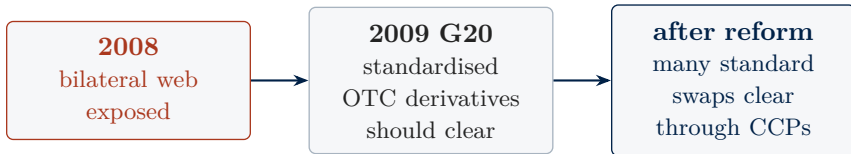


Customers face brokers; brokers (as clearing members) face the CCP; the regulator supervises the chain. A customer typically does not face the CCP directly, and margin requirements can be set higher at each link than the exchange minimum.

# Central clearing of OTC derivatives

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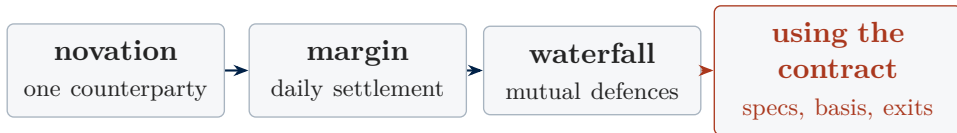
In 2008, the failure of Lehman Brothers left a web of *uncleared* bilateral derivatives that took weeks to value and unwind.



Clearing houses have thus become systemically important financial infrastructure, not only exchange plumbing.

## Where we are

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We have seen how the market makes anonymous trading credible.  
Next: how a futures position is specified, priced relative to spot, and closed.

# Contract specifications and the life of a position

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## Reading a contract specification

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A futures contract specification fixes everything needed to turn a quoted price into a cash exposure. The INE crude oil futures contract (SC), abridged:

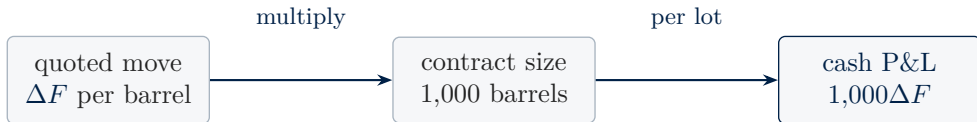
| term          | value                             | why it matters                  |
|---------------|-----------------------------------|---------------------------------|
| underlying    | medium sour crude oil             | what price risk is traded       |
| contract size | 1,000 barrels / lot               | turns a quote into cash P&L     |
| quotation     | yuan (¥) per barrel               | unit of the traded price        |
| tick size     | ¥0.1 / barrel                     | smallest price move             |
| settlement    | physical delivery, bonded storage | how positions end if not offset |

Because every term except the price is fixed, one contract is a perfect substitute for another, which is what supports a liquid market.

## From quote to cash exposure

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The exchange quotes SC in ¥per barrel, but a trader's account changes by the price move times the contract size.



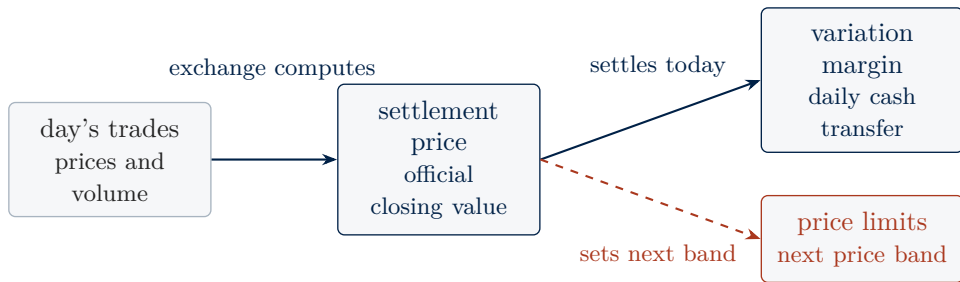
$$\text{tick value} = 0.1 \times 1,000 = \text{¥}100 \quad \text{per lot.}$$

A ten-tick move is ¥1 per barrel, or ¥1,000 per lot.

# The settlement price and price limits

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Daily settlement depends on one official price per contract per day.



A price limit is a stabiliser, but it has a cost: if a market needs to move further than the limit allows, trading can halt at the limit for one or more days, during which holders on the wrong side cannot exit.

*price limits reduce disorderly moves but can prevent holders from closing positions.*

## Three ways a position ends

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### **offset**

opposite trade;  
position closed

### **delivery**

receive or deliver  
the underlying

### **cash settlement**

pay the cash  
difference

Cash settlement allows futures on underlyings that cannot be delivered as a unit – a stock index, an interest rate, a volatility measure.

## Cash settlement: CSI 300 index futures

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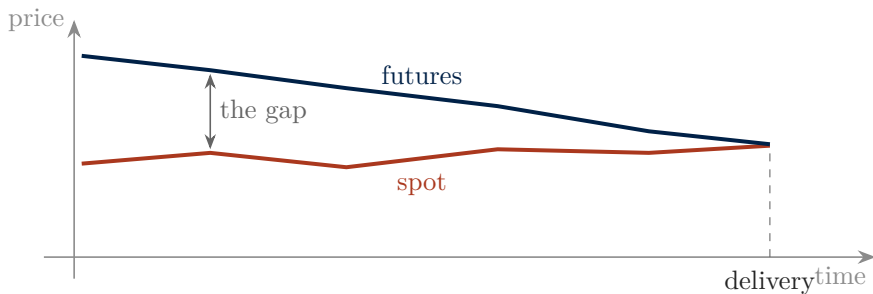
CFFEX lists futures on the CSI 300 index (code IF), with a multiplier of **¥300 per index point**; the contract is cash-settled.

|                                               |                    |
|-----------------------------------------------|--------------------|
| index level today                             | 4,000 points       |
| notional per contract ( $4,000 \times ¥300$ ) | ¥1.2 million       |
| margin (about 12%)                            | $\approx ¥144,000$ |
| <hr/>                                         |                    |
| final settlement level at expiry              | 4,050              |
| long receives $(4,050 - 4,000) \times ¥300$   | +¥15,000           |
| <hr/>                                         |                    |

No portfolio of 300 stocks is delivered; only the cash difference changes hands.

## Convergence of futures to spot

For a physically deliverable contract, delivery ties the futures price to the spot price as expiry approaches.



At delivery, holding the futures contract is equivalent to a spot purchase, so any remaining gap would create an arbitrage opportunity. The two prices therefore converge as delivery approaches.

$$\text{basis at delivery} = S_T - F_T \approx 0.$$

# The basis and basis risk

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$$\text{basis} = \text{spot price} - \text{futures price}$$

- The basis converges to zero at delivery, but varies before then.
- A hedge using a related but non-identical contract – for example, hedging jet fuel with crude oil futures – has a basis between two prices that move together but not identically.

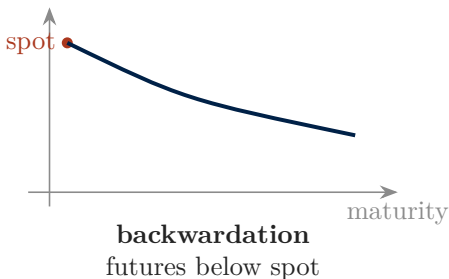
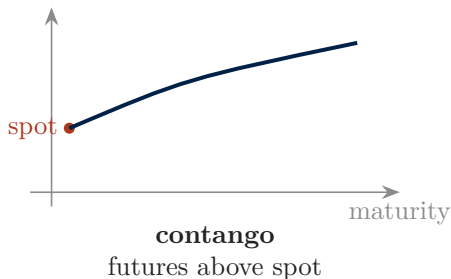
For a long hedge that will buy the physical commodity later:

$$\text{hedged cost} = S_T - (F_T - F_0) = F_0 + \underbrace{(S_T - F_T)}_{\text{basis at close}}.$$

**Basis risk** is the risk that this gap moves against the hedger. It is what remains after the futures hedge removes the main price risk.

# Contango and backwardation

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Storage costs and financing push the futures price above spot (contango); a benefit from holding the physical commodity now (convenience yield) pulls it below (backwardation). The quantitative cost-of-carry model is Lecture 5.

$$F_0 \approx \text{spot price} + \text{carry costs} - \text{benefit from holding physical inventory}.$$

# Forward prices and futures prices

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Lecture 1 priced the *forward*. Futures settle daily, so cash arrives or leaves before maturity.

| contract | cash timing                               |
|----------|-------------------------------------------|
| forward  | one settlement at maturity                |
| futures  | daily settlement through variation margin |

Daily settlement can make the fair futures price slightly different from the forward price when the underlying co-moves with interest rates. For the maturities in this course, we usually use

$$\text{futures price} \approx \text{forward price}.$$

The one market where this difference is large enough to matter – interest-rate futures – is treated in Topic 6.

# Leverage

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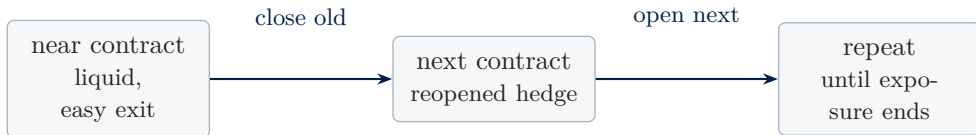
The crude-oil position from Block A, viewed as leverage:

|                                             |                  |
|---------------------------------------------|------------------|
| margin posted (2 lots)                      | ¥112,000         |
| notional controlled ( $2,000 \times ¥560$ ) | ¥1,120,000       |
| leverage = notional/margin                  | about $10\times$ |

A 5% move in crude (about ¥28 per barrel, or ¥56,000 on the position) is about half the posted margin. *margin lets a small deposit support a large exposure, which amplifies both gains and losses relative to the cash committed.*

## Contract month and rolling

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- A longer-dated exposure is often hedged in a liquid near contract.
- Rolling means closing the expiring contract and reopening the next.
- Each roll crosses the price gap between two contract months, creating roll and basis risk.

# An operational checklist

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Before opening a futures hedge, a treasurer needs:

- an account with a licensed futures broker, with trading and margin limits set;
- a funded cash reserve for margin calls, sized to a stressed period rather than an average one;
- a chosen contract month and a written roll schedule;
- a decision rule for who acts on a margin call and by when.

None of these requires a forecast of the price. They are about funding and governing the position.

# The scale of China's futures markets

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The same clearing and margin mechanics operate across mainland futures exchanges:

| exchange                                     | example market role                      |
|----------------------------------------------|------------------------------------------|
| Zhengzhou Commodity Exchange (ZCE)           | agricultural and industrial products     |
| Dalian Commodity Exchange (DCE)              | agricultural, chemical, ferrous products |
| Shanghai Futures Exchange (SHFE)             | metals, energy, industrial commodities   |
| Shanghai International Energy Exchange (INE) | renminbi energy contracts                |
| China Financial Futures Exchange (CFFEX)     | equity-index and bond futures            |

## Where we are

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The mechanism works on most days. Block C examines what happens when the funding obligation it creates becomes the binding constraint.

# Margining and liquidity risk: three episodes

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## The proposition, tested three times

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**CENTRAL PROPOSITION** — Central clearing converts counterparty credit risk into a daily liquidity obligation. A participant can be solvent and correct about prices, and still be forced out by a funding demand it cannot meet.

Three episodes, increasing in scope:

- a large producer forced to fund margin on a hedged position (2022);
- a single default that consumed a mutual default fund (2018);
- an industry of correct hedges that required state liquidity (2021–22).

## Solvency is not liquidity

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A margin call is due in cash on a deadline. Balance-sheet strength is not the same thing as cash available today.

| concept        | test                                                     |
|----------------|----------------------------------------------------------|
| <b>solvent</b> | asset value is greater than liabilities                  |
| <b>liquid</b>  | cash and credit lines are enough to meet today's payment |

The cases below are mostly liquidity cases: valuable assets existed, but margin cash was due before those assets could be turned into money.

# Optional viewing: market stress on screen

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## Margin Call (2011)

liquidity pressure, forced selling, and institutional survival



## The Big Short (2015)

opacity, crowded positions, and the patience needed to stay short

Watch for one question: **who needs cash before the trade is finally proved right or wrong?**

## LME nickel, March 2022: the position

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Tsingshan Holding Group, the world's largest nickel and stainless-steel producer, held a **short** position of more than **150,000 tonnes** of nickel.



The position was economically reasonable for a producer. The risk was in its size and its funding, not its direction.

## LME nickel, March 2022: the squeeze

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After Russia's invasion of Ukraine, buyers feared a supply shock, and short holders rushed to cover.



For a short, the daily cash loss is approximately

$$\text{tonnes short} \times \text{price increase}.$$

Physical assets can support solvency, but they do not automatically supply cash by the margin deadline.

# LME nickel, March 2022: the clearing house intervenes

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Facing potential cascading member defaults, the LME took extraordinary actions on 8 March 2022.



Members on the winning side had profits reversed; Tsingshan arranged bank credit and did not default.

*Under stress, an exchange may not only enforce its rules but change them; discretionary intervention is itself a risk.*

## What the nickel episode shows

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### **liquidity**

real assets did not meet an immediate cash deadline

### **rules**

suspension and cancellation became part of the risk

### **size**

a position large relative to the market is hard to exit

### **visibility**

uncleared OTC exposure weakened the CCP's view

## Nasdaq Clearing, September 2018: the position

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Einar Aas, a Norwegian trader and one of the most active members of Nasdaq's Nordic power clearing house, held a large **spread** position: long Nordic electricity futures, short German.



A spread is not “safe.” It is a position on the relationship between two prices. Aas defaulted on **11 September 2018** after the relationship moved sharply against him.

# Nasdaq Clearing, 2018: the waterfall consumed

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The default ran through the waterfall with real money.

| resource used after Aas's margin       | approximate amount |
|----------------------------------------|--------------------|
| Nasdaq's own capital                   | €7 million         |
| surviving members' mutual default fund | €107 million       |
| share of the ~€166m commodity fund     | about two-thirds   |

Members were required to replenish the fund within two business days.

*Mutualisation is a real cash obligation on members who never traded with the defaulter.*

## European energy, 2021–22: correct hedges, no cash

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As gas and power prices rose sharply, utilities that had **correctly** sold futures against future production faced very large variation-margin calls.

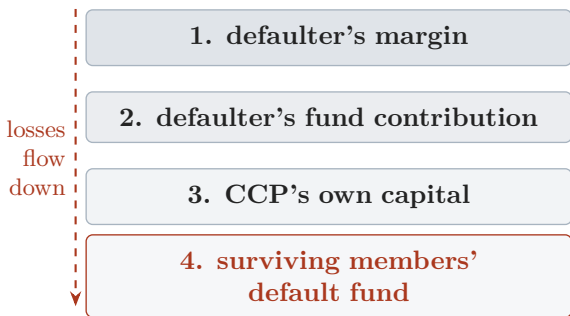


Initial margin on commodity portfolios roughly **doubled**; governments provided liquidity, including Germany's rescue of Uniper above **€50 billion** and Nordic backstops around **\$33 billion**.

*A correct hedge can still fail on the timing of cash.*

# The waterfall, annotated by the three episodes

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- **Nickel 2022:** margin pressure became so large that the exchange changed the rules.
- **Nasdaq 2018:** the default reached surviving members' money, about €107m.
- **Energy 2021–22:** stress hit before default, in hedgers' own margin cash.

# Does central clearing make markets safer?

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Clearing replaces a web of bilateral exposures with a single institution that holds them all. That concentration is the design.

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| what improves                         | what remains                           |
|---------------------------------------|----------------------------------------|
| fewer bilateral defaults              | liquidity pressure from daily margin   |
| lower cost of trust                   | mutualised losses after member default |
| more transparent prices and positions | systemic importance of the CCP itself  |

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Extreme conditions require CCP recovery and resolution planning, as with systemically important banks.

*Clearing reduces and reallocates counterparty risk; it does not remove risk, and it concentrates it in a systemically important institution.*

# Summary

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- Lecture 1: a derivative transfers risk; it does not remove it from the economy.
- Lecture 2: central clearing **concentrates** counterparty risk so that it can be measured, collateralised, and supervised.
- The cost is a continuous funding obligation: participants must meet margin in cash, every day, including in stressed markets.



## What carries into Lecture 3

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- **Basis** and **rolling**, located today in the crude-for-jet-fuel hedge, are developed in Lecture 3, with Metallgesellschaft as the case.
- **Convergence** and the carrying-cost picture become the quantitative cost-of-carry model in Lecture 5.
- **CSI 300 index futures** return in the equity material.
- The **margin–liquidity** relationship recurs wherever leverage appears in the course.

Central clearing makes the futures contract enforceable.

A hedge of jet fuel with crude futures still leaves a gap between the two prices.

**How large should the hedge be, and what risk remains?**

Lecture 3: hedging strategies, basis risk, and the hedge ratio.