Futures Markets and Central Counterparties

Lecture 2

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

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Outline

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

From a bilateral forward to an exchange

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

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

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 $Q\lvert\Delta F\rvert$	CCP pays $Q\lvert\Delta F\rvert$

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

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
variation margin	paid after each settlement price change	transfers that day's futures gain or loss: $Q(F_t - F_{t-1})$
initial margin	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

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

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
top-up_t	extra cash posted after a margin call; zero if none

Example for day 1:

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

A short futures position has the opposite daily price term.

Worked position: price sensitivity

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	$F_0 = ¥560$ per barrel
contract notional	$2{,}000 \times ¥560 = ¥1{,}120{,}000$
initial margin	assumed rule: $10\% \times ¥1{,}120{,}000 = ¥112{,}000$
maintenance margin	assumed floor: $75\% \times ¥112{,}000 = ¥84{,}000$

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

When does the margin call happen?

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

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

balance after settlement	decision	cash required
¥91,000	no call	¥0
¥84,000	no call	¥0
¥74,000	margin call	¥112,000 − ¥74,000 = ¥38,000

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

The margin account, day by day

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	ΔF	daily P&L	before 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

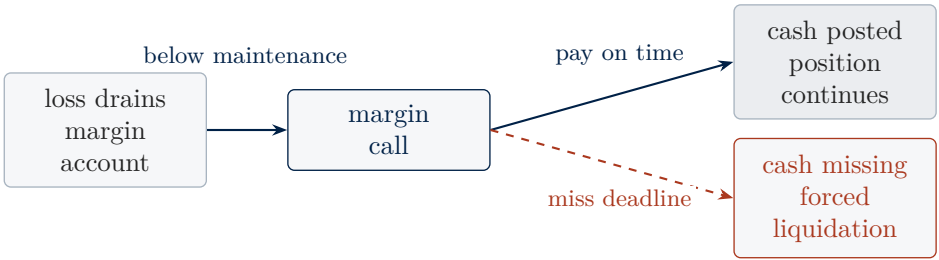
The daily account and the futures payoff must give the same total result.

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

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

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?

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

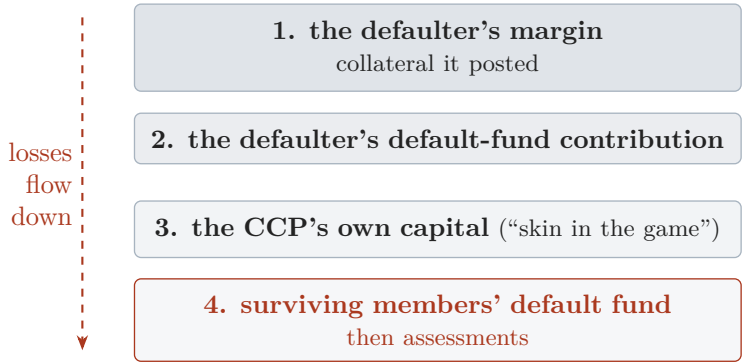
The arithmetic is the same; these rules determine when cash must be posted and whether a position can be kept open.

- **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

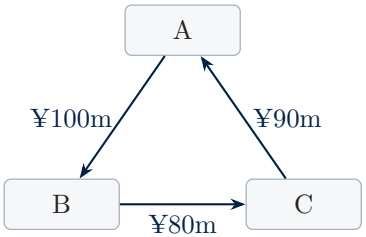
Margin can be exhausted by a move larger than it was sized for. Losses then fall through a fixed order of resources.



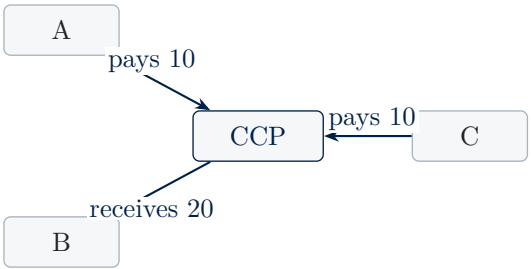
losses beyond the defaulter's own resources are mutualised across the surviving members.

Multilateral netting

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



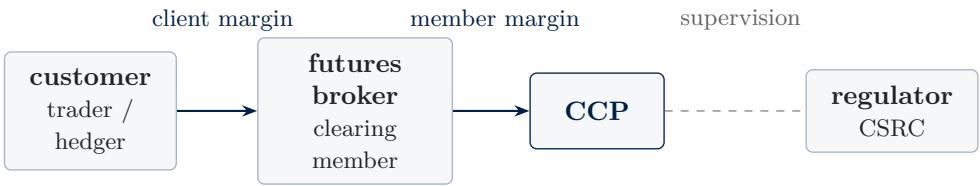
gross: ¥270m of obligations



net payers send ¥20m; B receives ¥20m

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

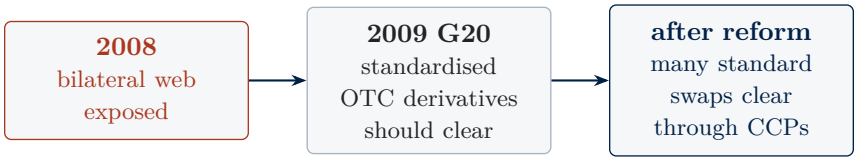
Who stands where



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.

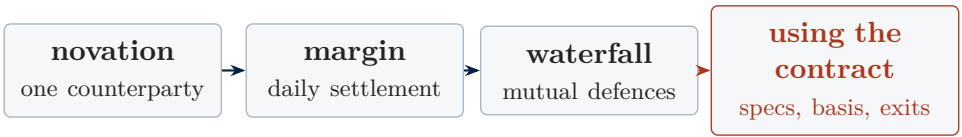
Central clearing of OTC derivatives

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



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

Reading a contract specification

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

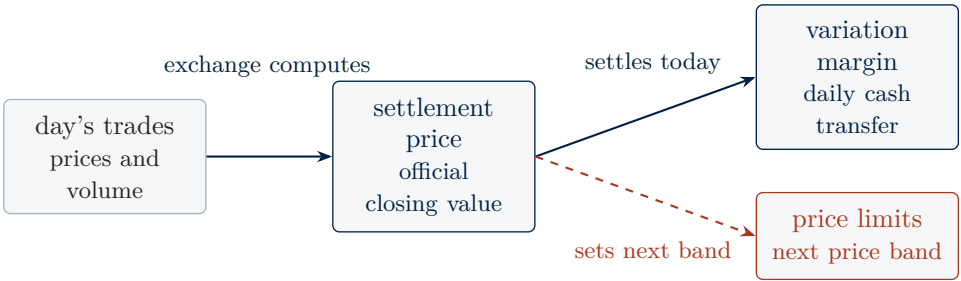
The exchange quotes SC in ¥per barrel, but a trader's account changes by the price move times the contract size.

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

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

The settlement price and price limits

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

offset	**delivery**	**cash settlement**
opposite trade; position closed	receive or deliver the underlying	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

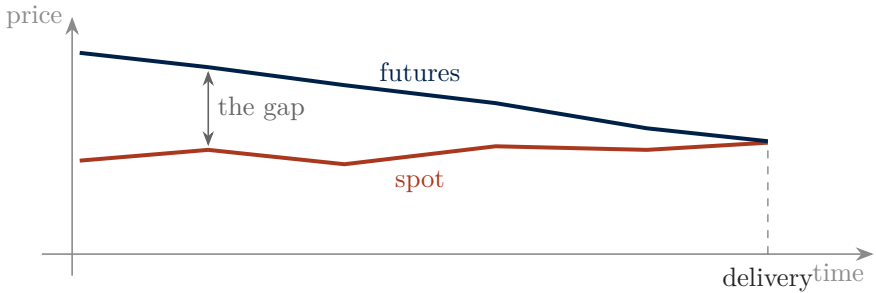
CFFEX lists futures on the CSI 300 index (code IF), with a multiplier of **¥300 per index point**; the contract is cash-settled.

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

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

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

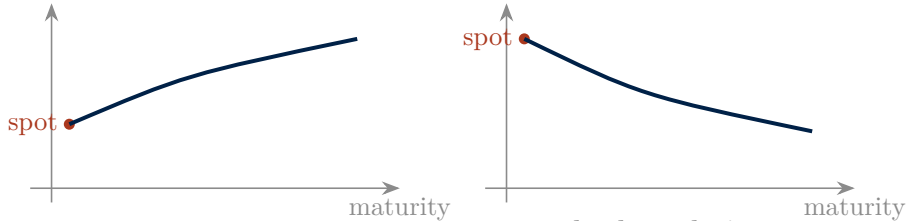
- The basis converges to zero at delivery, but varies before then.
- A hedge using a related but non-identical contract – for example, hedging jet fuel with crude oil futures – has a basis between two prices that move together but not identically.

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



contango
futures above spot

backwardation
futures below spot

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

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

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

margin posted (2 lots)	¥112,000
notional controlled (2,000 × ¥560)	¥1,120,000
leverage = notional/margin	about 10×

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

- 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

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

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

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

The proposition, tested three times

> 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

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

concept	test
solvent	asset value is greater than liabilities
liquid	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

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

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

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

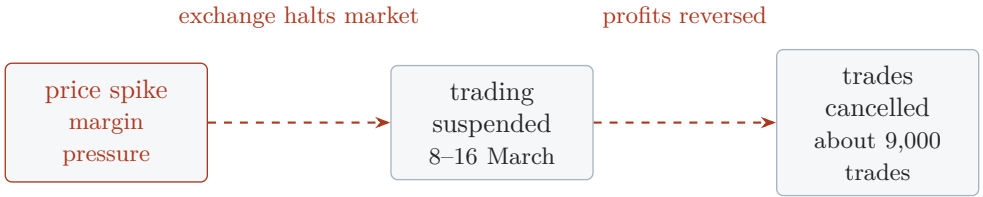
For a short, the daily cash loss is approximately

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

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

LME nickel, March 2022: the clearing house intervenes

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

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

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

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.

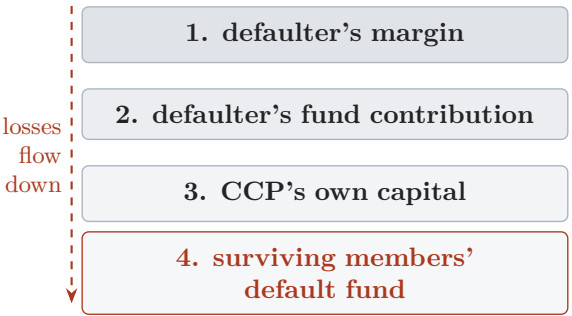
European energy, 2021–22: correct hedges, no cash

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



- **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?

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

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

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

- 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

- **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.