COMPUTATIONAL FINANCE & FINTECH

Managing Risk with Derivatives

Exposure, commitments, and one-sided protection

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LECTURE OUTLINE

Managing risk with derivatives

PART 1 Risk, uncertainty, and management

PART 2 Forward contracts and the locked fuel cost

PART 3 Futures, margin, and basis risk

PART 4 Options and one-sided protection

PART 5 Matching the instrument to the exposure

From uncertain operating cash flow to a deliberate position and instrument choice.

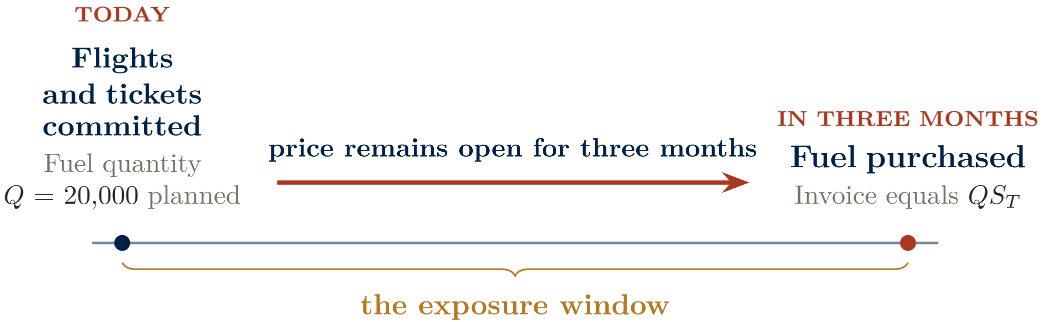
Risk, uncertainty, and management

How does an operating plan become a financial position?

Map the exposure, separate risk from uncertainty, and choose the outcome before the contract.

The operating plan creates a fuel-price exposure

A Shanghai-based airline schedules flights and sells tickets today. The fuel needed for those flights will be purchased in three months.



The business decision creates the exposure: the derivative, if used later, changes an exposure that already exists.

Running case: $Q = 20{,}000$ barrel-equivalent fuel units; T is the purchase date and S_T is the fuel price observed then. Prices are illustrative and quoted in USD per unit.

Identified price risk and unmodelled uncertainty

Risk has an identified exposure and modelled states; deeper uncertainty includes states or mechanisms the model may not contain.

A state is one possible future configuration of prices and operating conditions. An exposure is the cash-flow sensitivity of the business to that state.

KNOWN
KNOWN

The operating plan

quantity Q; purchase date T

plan and monitor

KNOWN
UNKNOWN

The market price

S_T is identified, but not observed yet

measure and position

UNKNOWN
UNKNOWN

The model boundary

closure, rule change, market failure

retain capacity to adapt

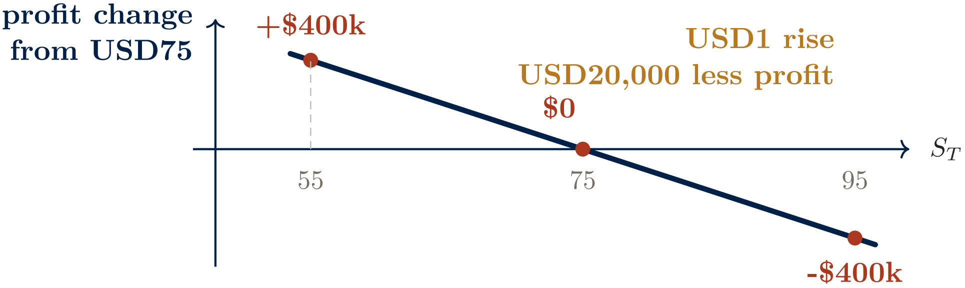
Use positions for modelled exposures; use liquidity, limits, diversification, and adaptable plans for what the model may have omitted.

Unhedged profit has slope $-Q$ in the fuel price

Let A denote committed revenue minus non-fuel costs. Once the flights are fixed, operating profit falls when the fuel price rises:

$$\Pi_T = A - QS_T \qquad \frac{\partial \Pi_T}{\partial S_T} = -Q = -20{,}000$$

Π_T is operating profit; A is revenue less non-fuel costs; $\partial\Pi_T/\partial S_T$ is price sensitivity.

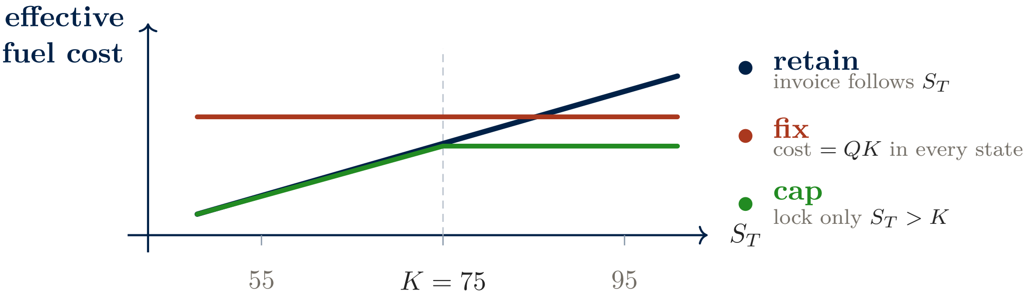


Not hedging is not neutral: it deliberately retains a negative fuel-price sensitivity. A hedge must gain in the high-price states that hurt the airline.

Three target cost shapes for one fuel price

Management does not need a price forecast to decide which exposure the firm is willing to bear.

A cash-flow shape maps each possible S_T into a final cost. Its slope measures retained price sensitivity; K marks the price boundary chosen in the contract.



At $S_T = 55$, retain and cap still pay the cheap invoice. At $S_T = 95$, fix and cap both pay $QK = \text{USD}1.50\text{m}$.

State the target cash-flow shape first. Only then ask which contract can deliver it, at what cost, and with which residual risks. [1] [2]

Opposite exposures transfer the fuel-price risk

The airline fears a high fuel price; a fuel producer fears a low selling price. Their operating exposures have opposite slopes.

Sensitivity $-Q$ means profit falls as price rises; sensitivity $+Q$ means profit rises as price rises. Opposite sensitivities create a natural basis for risk transfer.

FUTURE BUYER		FINANCIAL MARKET		FUTURE SELLER
AIRLINE	→	**Contract + price**	←	**PRODUCER**
sensitivity $-Q$		matches positions		sensitivity $+Q$
hurt when price rises		and maps states into cash		hurt when price falls

Market supplies: prices • matching • standard terms • risk-bearing capacity

The price risk does not disappear. The contract reallocates it to a party more willing or able to bear the opposite state exposure.

Hedged profit adds the derivative cash flow $D(S_T)$

A **derivative** is a contract whose payoff is written on an identified price. It does not replace the fuel purchase.

$$\Pi_T = A - QS_T + D(S_T)$$

$D(S_T)$ is the derivative cash flow received by the airline. The physical invoice remains QS_T; only the added settlement can change the slope.

ALREADY COMMITTED		ADDED CONTRACT		WHAT IS MANAGED
OPERATING PLAN	$+$	**DERIVATIVE**	$=$	**COMBINED PROFIT**
buy Q at date T invoice QS_T		payoff written on S_T cash, not the fuel		invoice plus $D(S_T)$ chosen slope

Risk management adds a settlement designed to change an exposure that already exists. The flights still need fuel.

[1]

The hedge must pay when the fuel price is high

The airline's adverse state is already known: a high fuel price. The contract is useful only if it delivers cash in that state.

From the operating plan: $Q = 20{,}000$. A USD20 rise from USD75 to USD95 raises the fuel invoice by $20{,}000 \times 20 = \text{USD}400{,}000$.

Fuel price S_T	Operating profit vs USD75	Test of a useful hedge
USD55	+USD400,000	pay only if the transfer is two-sided
USD75	USD0	no cash needed
USD95	−USD400,000	**must receive cash**

A USD400,000 receipt at USD95 would cancel this operating hit. Whether the airline also pays when fuel is cheap decides a two-sided transfer versus one-sided protection.

First test the contract against the adverse state. Only then ask whether the firm should transfer that state at all.

[2]

Hedging protects investment when financing is constrained

Diversified shareholders can bear volatility. The firm has a stronger reason to hedge when volatility damages financing or operations.

A financing friction is a cost or constraint that makes external funding harder precisely when an adverse price shock reduces internal cash.

fuel-price shock invoice rises → **cash shortfall** internal funds fall → **financing friction** borrowing is costly → **real consequence** investment is cut

Strong case: material exposure • costly funding • valuable investment at risk

Weak case: natural offset • immaterial exposure • no real decision threatened

The objective is not the lowest possible volatility. It is to protect valuable operating and investment decisions from avoidable financial disruption.

[2]

Each target shape corresponds to a contract type

Return to the airline's negative fuel-price sensitivity. What does management want the final cost to do?

A commitment binds both sides in every state; a purchased choice lets the holder walk away when exercise is unfavourable.

FIX	Lock price for a known quantity and date	→	**FORWARD** customised commitment
TRADE	Standard, cleared con-tract in a liquid market	→	**FUTURES** tradable commitment
PROTECT	Cap the price rise; keep the benefit of a price fall	→	**OPTION** purchased choice

Exposure → adverse state → target shape → instrument

The product follows the problem. We begin with the simplest linear solution: a flexible forward commitment.

Forward contracts and the locked fuel cost

How can a customised obligation turn an open fuel price into a fixed effective cost?

Read the agreement, combine the cash flows, test the match, and price the commitment.

A forward locks quantity, delivery price, and date

A **forward contract** is a private, binding agreement to buy or sell a stated quantity at date T for a delivery price K agreed today.

TODAY

Agree Q, K, T

no fuel
changes hands

S_T remains open; K is fixed

AT DATE T

**Deliver
or settle**

both parties
must perform

binding commitment over the exposure window

The airline becomes the committed buyer—the long side. A fairly negotiated forward normally begins near zero value, but it creates a future obligation.

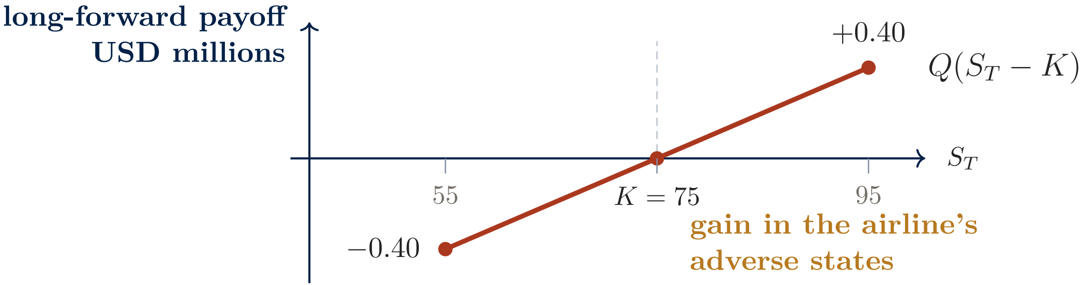
Running case: $Q = 20{,}000$ fuel units, delivery price $K = \text{USD}75$, maturity $T =$ three months, and market price at maturity S_T.

[1]

The long-forward payoff is $Q(S_T - K)$

Part 1 identified the adverse state: a high fuel price. The forward must therefore pay the airline when $S_T > K$.

Long means the committed buyer's side; short means the committed seller's side. Payoff is the derivative cash flow at maturity before considering the physical transaction.

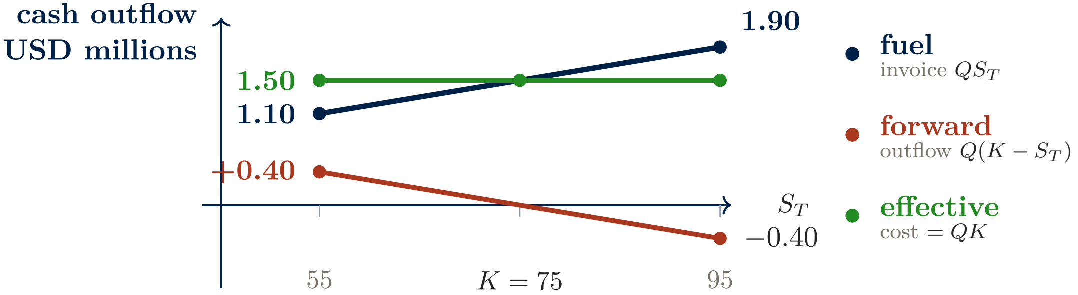


Future buyer → long forward; future seller → short forward. The short payoff is the exact opposite: $Q(K - S_T)$.

Physical fuel plus a long forward fixes cost at QK

$$QS_T + Q(K - S_T) = \boxed{QK}$$

Effective cost combines the physical fuel payment with the derivative cash flow. Here a positive number is a cash outflow by the airline.



A USD0.40m payment at 55 and a USD0.40m receipt at 95 cancel the physical slope.

The physical cost has slope $+Q$; the long-forward cash outflow has slope $-Q$. Their sum has slope zero.

Effective cost is USD1.50m in all three price states

Airline: $Q = 20{,}000$, $K = \text{USD75}$. Positive forward cash outflow means the airline pays; negative means it receives.

Fuel price S_T	Fuel purchase QS_T	Forward cash outflow $Q(K - S_T)$	**Effective cost**
USD55	USD1.10m	+USD0.40m payment	**USD1.50m**
USD75	USD1.50m	USD0.00m	**USD1.50m**
USD95	USD1.90m	−USD0.40m receipt	**USD1.50m**

At USD55, cheap physical fuel is offset by a forward payment. At USD95, expensive physical fuel is offset by a forward receipt.

A loss on the derivative is not evidence of a failed hedge. Judge the physical and derivative cash flows together.

Forward terms must match the operating exposure

Customisation is useful only when the contract fields are chosen to match the operating exposure.

The underlying is the reference price used for settlement. Cash settlement pays the price difference; physical settlement exchanges the asset itself.

FORWARD CONFIRMATION

Underlying	Jet-fuel index	**basis risk**
Quantity	20,000 units	**volume risk**
Maturity	Three months	**timing risk**
Price	USD 75 per unit	**fixed term**
Settlement	Physical or cash	**cash-flow rule**

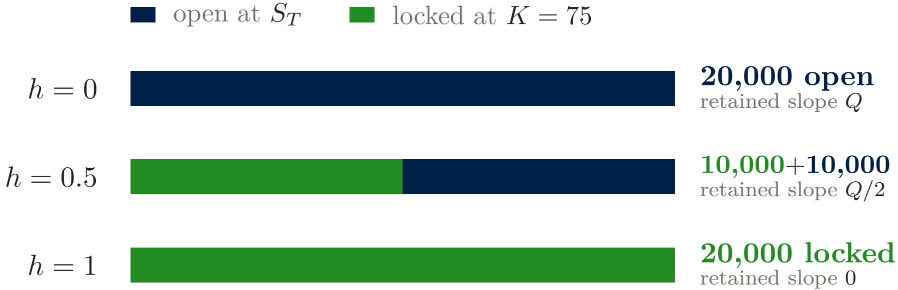
A correct long/short direction is not enough. Mismatch in the asset, quantity, or date leaves residual exposure.

The hedge ratio h is the fraction of quantity locked

With $Q = 20{,}000$, $h = 0.5$ locks 10,000 units at $K = 75$ and leaves 10,000 at S_T.

The hedge ratio h is the fraction of quantity Q covered; $C_T(h)$ is the combined fuel cash outflow.

$$C_T(h) = (1-h)QS_T + hQK \qquad \frac{\partial C_T(h)}{\partial S_T} = (1-h)Q$$



The hedge ratio is a management decision about retained sensitivity. Full locking is one possible target, not an automatic objective.

The no-arbitrage forward price is $F_0 = S_0(1+r)^T$

For an asset that can be bought and carried without income or storage costs, compare the cash flows at two dates.

$+S_0$ borrow	$+F_0$ deliver asset
$-S_0$ buy asset	$-S_0(1+r)^T$ repay loan
net today $= 0$	**no-arbitrage net** $= 0$

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

commodity extension: $F_0 = S_0 e^{(r+u-y)T}$

No-arbitrage prices the delivery commitment by replication. It does not imply $F_0 = \mathbb{E}[S_T]$.

S_0 is today's spot price and F_0 is today's no-arbitrage delivery price. The annual effective financing rate is r, with T in years; in the continuous extension, u is carrying cost and y is convenience yield.

[1]

Forwards are customised, bilateral, and hard to transfer

A forward fits a well-specified corporate transaction because it is bespoke. That same feature makes the position bilateral and difficult to transfer.

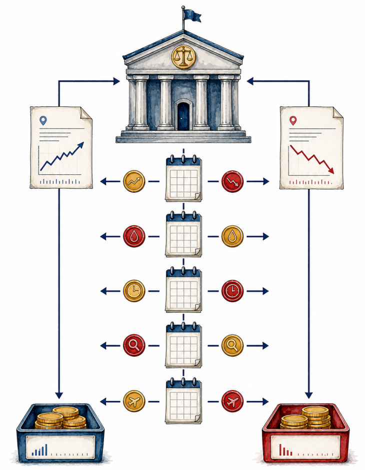
Bespoke means privately tailored; bilateral credit means each original party depends directly on the other's performance.

The forward solves price uncertainty by accepting commitment and counterparty exposure. Futures ask whether that commitment can become standardised, tradable, and cleared.

Futures, margin, and basis risk

How does the same linear hedge become standardised, cleared, and tradeable?

Keep the hedge direction; add contract units, daily cash, basis risk, and liquidity discipline.



Futures are standardised, cleared, and settled daily

A **futures contract** is a standardised agreement traded on an exchange, centrally cleared, and settled through daily gains and losses.

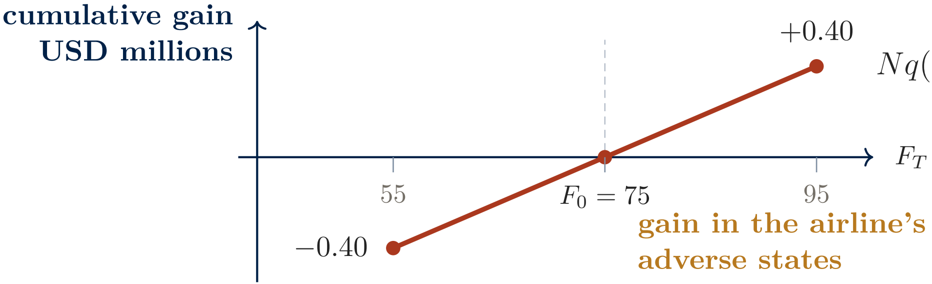
1	**Standard terms**	The exchange fixes unit, month, and delivery terms
2	**Central clearing**	A clearing house becomes the counterparty on both sides
3	**Daily cash**	Gains and losses are posted in cash every day

The airline still needs a long position. What changes is the contract's flexibility, counterparty structure, and timing of cash.

The long-futures payoff is $Nq(F_T - F_0)$

When the locked quantity equals the fuel need, $Nq = Q$, and the entry price equals the forward delivery price, the two lines coincide.

N: contract count; q: units per contract; F_0: entry price; F_T: terminal futures price. Running case: $Nq = 20{,}000$ and $F_0 = 75$.



At $F_T = 95$, $20{,}000 \times (95 - 75) = +\text{USD}400{,}000$. Daily settlement changes when that cash arrives, not the terminal slope.

The exchange specification fixes unit, month, and notional

The exchange creates one transferable contract for many participants rather than a bespoke agreement for one airline.

Contract notional qF_0 measures the reference exposure controlled by one contract. It is not the cash paid when the futures position opens.

ILLUSTRATIVE FUTURES CONTRACT

Underlying	Fuel benchmark	
Contract unit	$q = 1{,}000$ units	scale
Delivery month	3 months	timing
Quotation	USD per unit	
Settlement	Cash or physical	
Margin	Set by exchange	

$$\text{notional} = qF_0 = 1{,}000 \times 75 = \text{USD}75{,}000$$

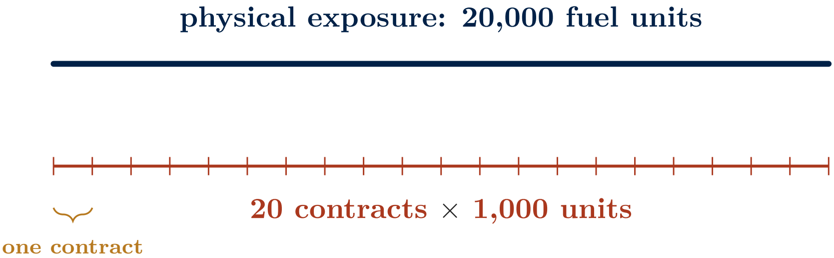
Standardisation sacrifices exact matching but creates transparent pricing, liquidity, and easier exit. All contract inputs here are illustrative.

The futures count is $N = Q/q = 20$ long contracts

The airline is a future buyer and is harmed by a price rise, so it takes the long side.

Q is the physical quantity exposed, q is the standard contract unit, and N is the required whole-contract count.

$$N = \frac{Q}{q} = \frac{20{,}000}{1{,}000} = \boxed{20 \textbf{ long contracts}}$$



The simple count assumes an exact benchmark and timing match. Whole-contract rounding and forecast revisions leave residual exposure.

Novation replaces the trade with two CCP obligations

The original buyer–seller exposure is replaced by two cleared obligations.

Novation replaces the original trade with two trades against a central counterparty (CCP), which becomes buyer to every seller and seller to every buyer.

LONG MEMBER
AIRLINE
posts collateral

↔

CENTRAL COUNTERPARTY
CCP
buyer to sellers; seller to buyers

↔

SHORT MEMBER
SELLER
posts collateral

Margin, default resources, and member controls support performance around the two obligations.

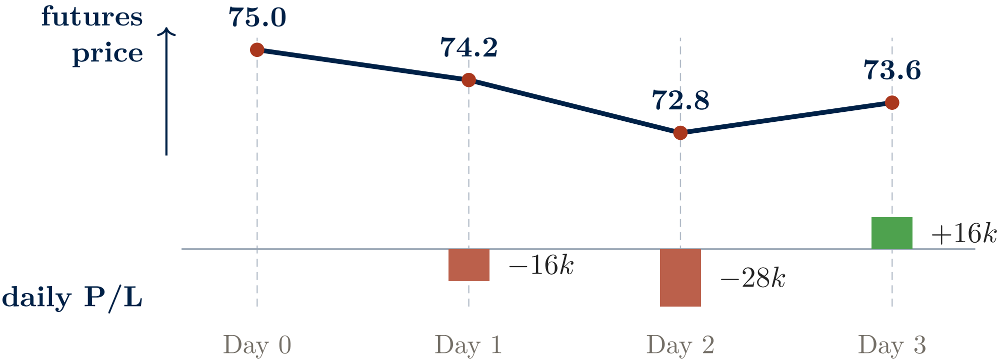
Clearing reduces bilateral counterparty exposure; it does not eliminate market, liquidity, operational, or extreme default risk.

Daily variation margin equals $Nq(F_t - F_{t-1})$

For a long position, each day's variation-margin cash flow is

$$\Delta VM_t = Nq(F_t - F_{t-1}).$$

F_t is the official settlement price. Variation margin (VM) transfers P/L; positive ΔVM_t is cash received by the long.



The cumulative futures result is 20(1,000)(73.6 – 75.0) = –USD28,000, but the cash arrives one day at a time.

The CCP takes daily P/L from a posted cash buffer

Variation margin is due the same day. The clearing house therefore requires a cash balance it can debit before the next settlement.

Collateral is cash posted to the futures account. It is not the USD1.50m notional and not the physical fuel invoice.

EXPOSURE SIZE		TODAY'S RESULT		WHAT THE CCP HOLDS
NOTIONAL	$\neq$	**DAILY P/L**	$\neq$	**BUFFER**
$20 \times$ USD75,000 $=$ USD1.50m		$Nq(F_t - F_{t-1})$ -16k, -28k, $+16$k		cash in the account absorbs daily P/L
not paid to open		already computed		must stay large enough

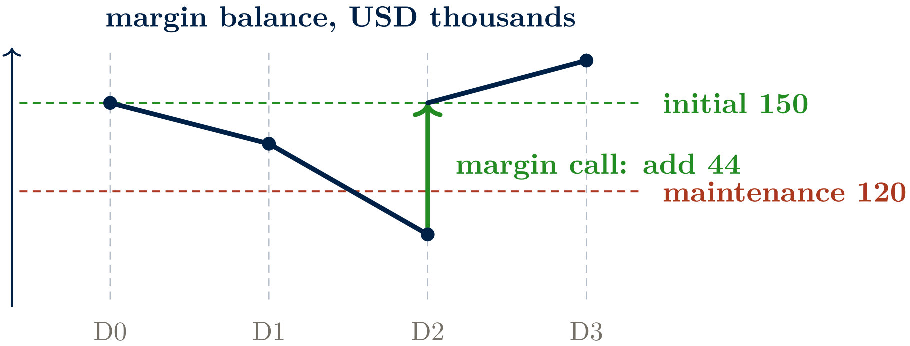
The buffer exists because someone might not pay tomorrow. Daily P/L is taken from this balance, not from the fuel invoice.

Separate the exposure size from the cash sitting in the account. The next slide states the two rules that govern that buffer.

Initial and maintenance margin are posted collateral

Once the buffer is posted, two account rules govern it: an opening deposit and a floor.

Initial margin opens the position; maintenance margin is the minimum allowed balance; a margin call requests cash to restore collateral.



Variation margin moves the balance each day.

Margin changes the timing and funding of the hedge, not the direction of its terminal price protection.

Recommended movies on market stress

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?**

Daily P/L and margin top-ups are separate cash items

Twenty long contracts; $q = 1{,}000$; entry $F_0 = 75$; initial margin USD150,000; maintenance USD120,000. Daily P/L changes collateral; cash added restores collateral but is not a second trading loss.

Date	Settlement F_t	Daily P/L	Cash added	End balance
Day 0	75.0	—	150,000	150,000
Day 1	74.2	−16,000	0	134,000
Day 2 before call	72.8	−28,000	0	106,000
Day 2 after call	72.8	—	44,000	150,000
Day 3	73.6	+16,000	0	166,000

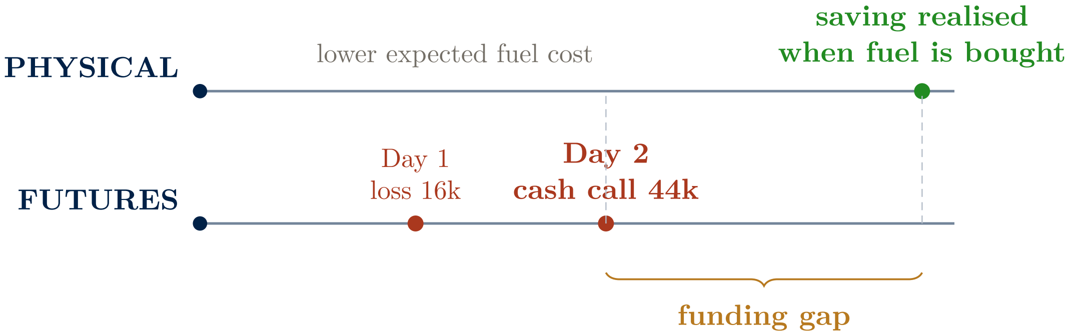
$$\textbf{cumulative P/L} = -16 - 28 + 16 = \boxed{-\text{USD}28k}$$

The USD44k top-up is not another loss. It restores collateral after the daily P/L pushed the account below maintenance.

Futures can require cash before the fuel is purchased

Falling prices reduce the airline's eventual fuel bill, but the long futures position requires cash before the fuel is purchased.

Liquidity risk is the possibility that cash is unavailable when required, even when the hedge improves the eventual combined operating outcome.

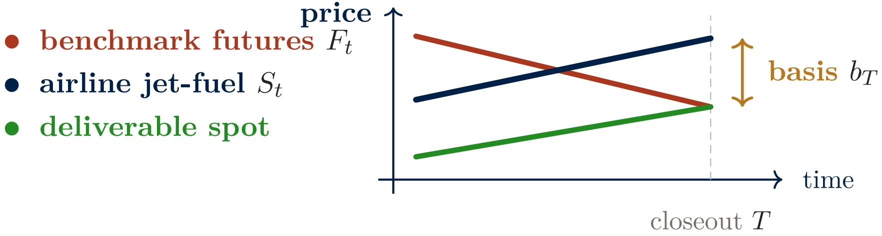


Hedge effectiveness and cash timing are different. Futures risk management therefore requires a liquidity plan.

A jet-fuel cross-hedge retains the basis $S_T - F_T$

The airline may hedge jet fuel with a liquid exchange benchmark that is similar, but not identical, to its commercial price.

Basis is the spot–futures gap, $b_t = S_t - F_t$. A cross-hedge uses a related benchmark when no exact futures contract exists.



$$\frac{C_T^{\text{eff}}}{Q} = S_T - (F_T - F_0) = F_0 + \underbrace{(S_T - F_T)}_{b_T}$$

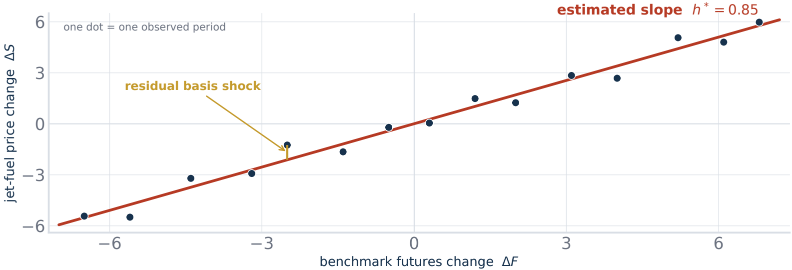
Convergence removes basis only for the same deliverable at expiry. A proxy hedge remains exposed to the jet-fuel–benchmark gap.

The minimum-variance hedge ratio is $h^* = \rho\sigma_S/\sigma_F$

For a cross-hedge, choose h to make the remaining change $\Delta S - h\Delta F$ as stable as possible.

Δ: observed change; ρ: correlation; σ_S, σ_F: volatilities; h^*: variance-minimising ratio.

$$\min_h \mathrm{Var}(\Delta S - h\Delta F) \quad \Longrightarrow \quad h^* = \frac{\mathrm{Cov}(\Delta S, \Delta F)}{\mathrm{Var}(\Delta F)} = \rho\frac{\sigma_S}{\sigma_F}$$



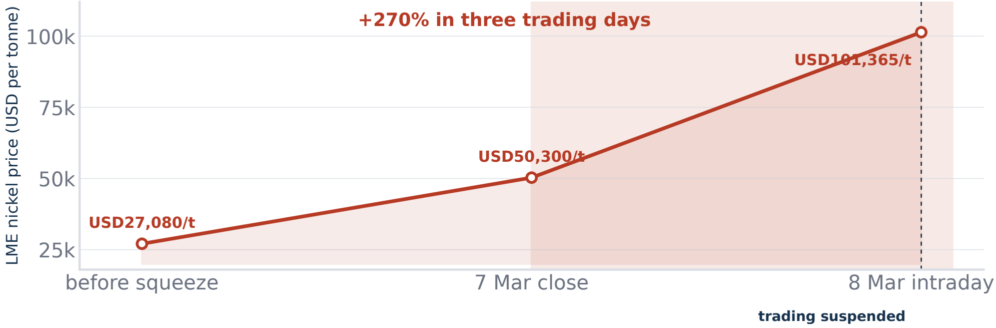
Here $h^* = 0.85$. With $Q = 20{,}000$ and $q = 1{,}000$, use $N^* = 0.85(20{,}000)/1{,}000 = \boxed{17}$ contracts; the vertical deviations remain as basis risk.

[1]

Tsingshan's nickel short required nearly USD16bn of margin

Tsingshan, a Chinese stainless-steel and nickel producer, held a large short nickel position intended to offset exposure to falling output prices. Nickel instead rose sharply.

short position $>$ 150,000 **tonnes** **variation margin met: nearly USD16bn**



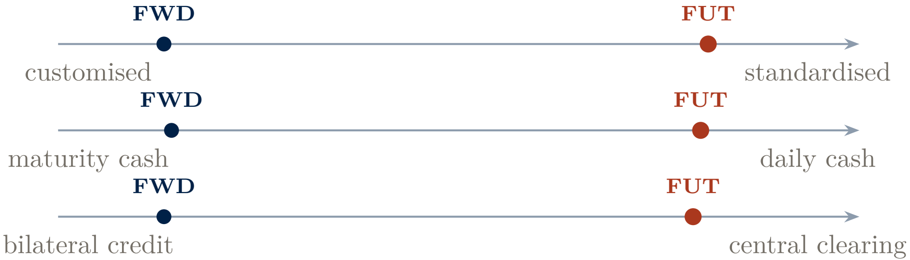
The hedge direction was natural, but size, thin liquidity, short covering, and daily collateral converted price risk into an immediate funding crisis.

LME Independent Review of Events in the Nickel Market in March 2022; Reuters, 14 March 2022.

Futures remain a two-sided linear obligation

The linear hedge is now tradeable and cleared, but it still fixes both adverse and favourable price movements.

FWD abbreviates forward; FUT abbreviates futures. A two-sided obligation gains in one price direction and loses symmetrically in the other.



What futures add: liquidity • price transparency • clearing • daily cash

What remains: obligation • basis • margin funding • lost favourable states

Next question: can the airline cap a price rise without surrendering the benefit of a price fall? That requires an option.

Options and one-sided protection

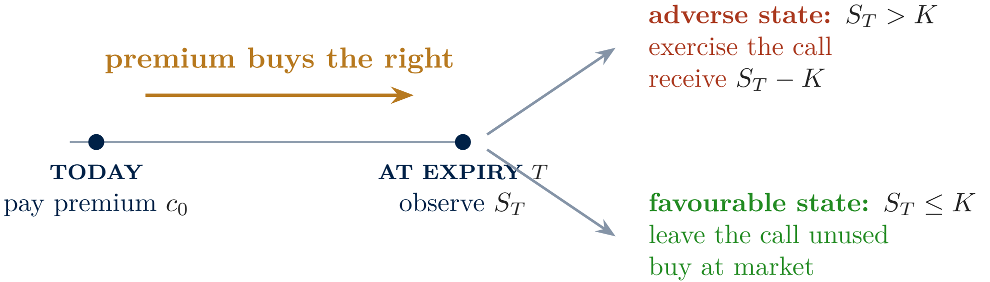
How can the airline cap a price rise without surrendering a price fall?

Replace a binding commitment with a purchased right, a payoff kink, and an explicit premium.

An option is a purchased right to transact at strike K

An **option** gives its holder a right, but not an obligation, to transact at strike K by expiry T. The holder pays a premium today.

The holder owns the exercise choice; the writer receives the premium and must perform if the holder exercises. Exercise means using the contractual right.



The premium purchases asymmetry: protection is activated only in the states management chooses to transfer.

[1] [2]

A future fuel buyer hedges with a long call

At $S_T = 95$, the airline's fuel invoice is USD400,000 above the USD75 case.
A call is a right to buy; a put is a right to sell. A long option is the holder's position; the corresponding short option is the writer's obligation.

FUTURE BUYER
Airline → $S_T = 95$ invoice +USD400k → **LONG CALL** right to buy at K

FUTURE SELLER
Producer → $S_T = 55$ selling price falls → **LONG PUT** right to sell at K

Start from the operating slope: buy the option that pays in the state that damages the business.

Six fields define one option series

Illustrative European fuel call for the running airline case. European means exercisable only at expiry; American means exercisable on permitted dates up to expiry.

The underlying identifies the reference asset; the strike is the contractual transaction price; the contract unit scales one per-unit payoff into cash.

underlying	type	strike	expiry	unit	premium
fuel benchmark	**call**	$K = 75$	**3 months**	$q = 1{,}000$	$c_0 = 4$

one complete option series

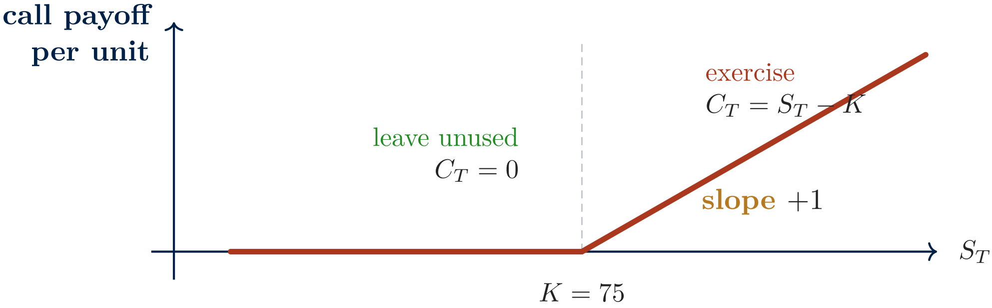
$$qc_0 = \text{USD}4{,}000 \qquad \bullet \qquad qK = \text{USD}75{,}000$$

Direction alone is not enough: underlying, strike, expiry, unit, and premium determine whether the right matches the exposure.

Call payoff is $\max(S_T - K, 0)$

C_T is the call's per-unit expiry payoff before premium. The maximum operator selects exercise only when $S_T - K > 0$.

$$C_T = \max(S_T - K, 0)$$



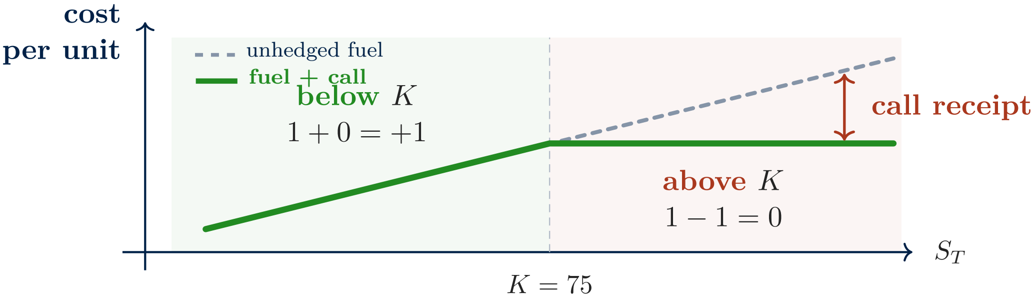
The maximum operator is the option: the holder selects the positive branch after the state is known.

[1] [2]

Fuel plus a long call has cost $\min(S_T, K)$

Effective cost equals the physical spot purchase minus the call receipt. This slide excludes the premium so that the hedge mechanism is visible first.

$$S_T - \max(S_T - K, 0) = \boxed{\min(S_T, K)}$$

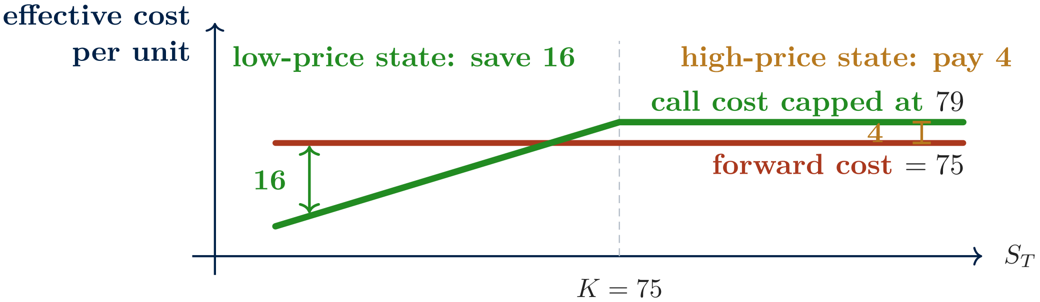


Below K, the airline retains the fuel-price slope. Above K, the call contributes slope -1 and cancels the adverse $+1$.

The purchased call caps all-in cost at $K + c_0$

Compare a forward fixed at 75 with a call struck at 75 costing $c_0 = 4$ per unit; financing is ignored. The premium is paid in every state.

The call's all-in cost cap is $K + c_0 = 79$; the forward fixes cost at $K = 75$ but removes the benefit of lower prices.



The premium buys state-contingent protection: the call is costlier than the forward in high-price states but preserves the benefit of low prices.

Three states cap effective cost at USD1.58m

Airline: $Q = 20{,}000$, $K = 75$, premium $Qc_0 = \text{USD}0.08m$. Cash outflows are positive; an exercised-call receipt is recorded as negative.

$S_T = 55$	$S_T = 75$	$S_T = 95$
fuel + call + premium	fuel + call + premium	fuel + call + premium
$1.10 + 0.00 + 0.08$	$1.50 + 0.00 + 0.08$	$1.90 - 0.40 + 0.08$
EFFECTIVE COST	**EFFECTIVE COST**	**EFFECTIVE COST**
USD1.18m	**USD1.58m**	**USD1.58m**

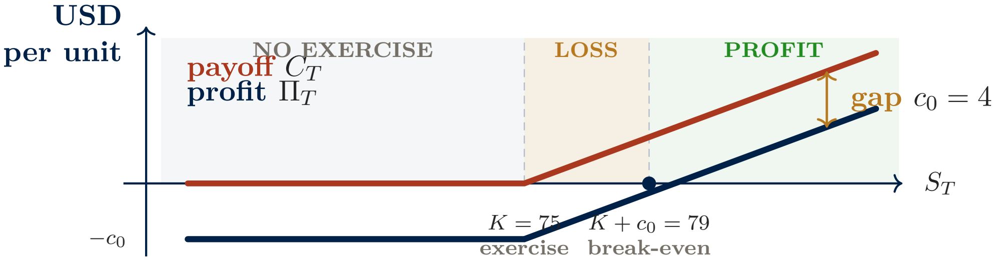
The call is more expensive than the forward in the high-price state, but it preserves USD0.32m of the low-price benefit at $S_T = 55$.

Exercise starts at K; profit starts at $K + c_0$

Same call: $K = 75$, premium $c_0 = 4$ per unit, and financing ignored.

$$C_T = \max(S_T - K, 0), \qquad \Pi_T = C_T - c_0$$

Sunk means already paid and unchanged by today's decision. At expiry the premium is sunk for exercise, but it still counts when measuring total profit.



Exercise is a marginal decision at expiry, so the sunk premium is ignored. Profit is the total trade result, so the premium moves break-even from K to $K + c_0$.

Moneyness compares the spot price with the strike

Moneyness compares the current spot price S with strike K. For expiry payoff, make the same comparison using S_T.

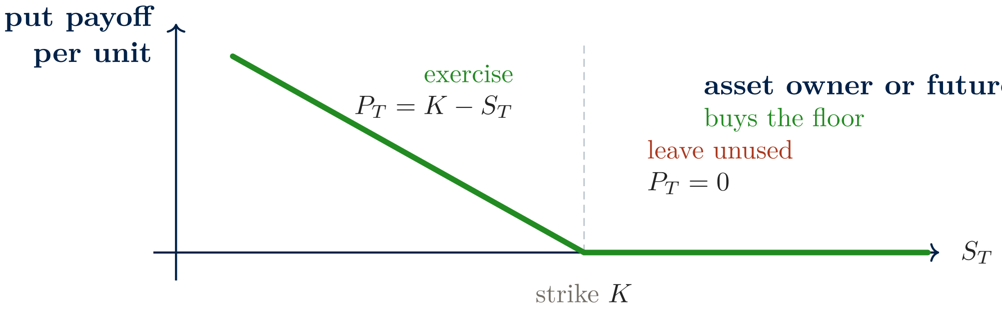
	$S < K$	$S \approx K$	$S > K$
CALL	**out of the money**	**at the money**	**in the money**
PUT	**in the money**	**at the money**	**out of the money**

Moneyness describes immediate exercise value. It does not measure profit after the premium or guarantee future exercise.

Put payoff is $\max(K - S_T, 0)$

P_T is the put's per-unit expiry payoff before premium. It is positive only when the contractual selling price K exceeds the market price S_T.

$$P_T = \max(K - S_T, 0)$$



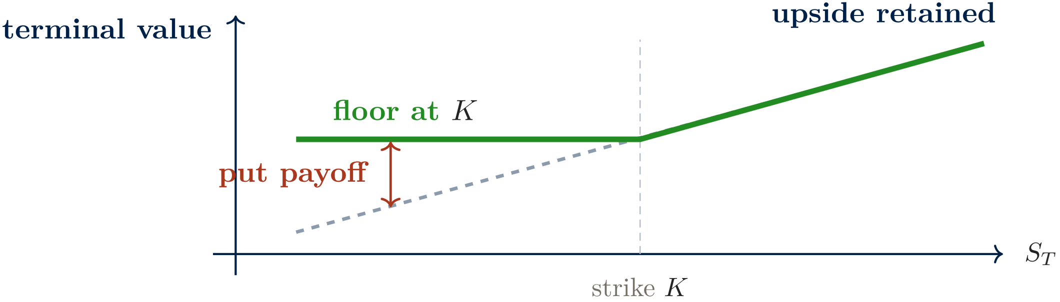
Calls insure future purchases against price rises; puts insure owned assets or future sales against price falls.

A protective put has terminal value $\max(S_T, K)$

Combine one owned asset with one put struck at K:

A protective put means long asset plus long put. The expression below is terminal value before subtracting the option premium.

$$S_T + \max(K - S_T, 0) = \boxed{\max(S_T, K)}$$

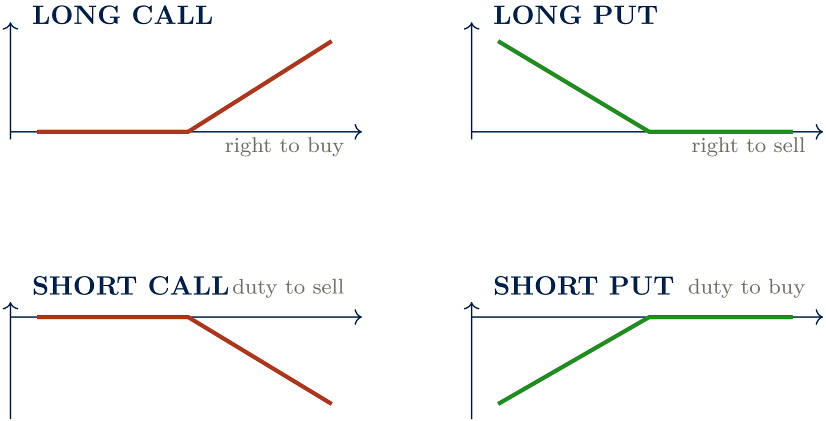


A protective put is financial insurance: the holder pays a known premium to replace an open downside with a floor.

[2]

Four basic positions: long and short calls and puts

The four diagrams show expiry payoff before premium. Long means holder; short means writer. Profit shifts a long position down by the premium and a short position up by the premium.



The buyer's maximum loss is the premium. The writer's gain is capped at that premium, while the adverse obligation can be much larger.

Premium CNY1,200 controls notional CNY40,000

Illustrative CSI 300 ETF call: $S_0 = K = \text{CNY}4.000$, premium 0.120 per unit, contract unit $10{,}000$.
Notional qS_0 is the reference exposure controlled; premium qc_0 is the cash paid. Notional is not the buyer's maximum loss.

$$0.120 \times 10{,}000 = \boxed{\text{CNY}1{,}200} \qquad \bullet \qquad 4.000 \times 10{,}000 = \text{CNY}40{,}000$$

The buyer's loss is pre-paid and bounded at CNY1,200, but percentage returns can be extreme because the premium is small relative to the controlled position.

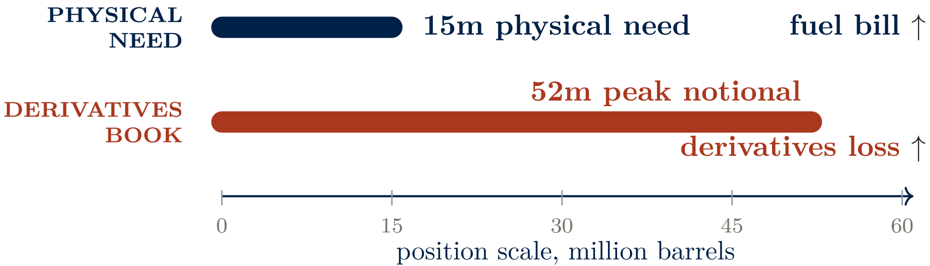
CAO's derivatives book was 3.47 times physical need

CAO bought fuel for Chinese airlines. As a future buyer it was harmed by oil rises, but its derivatives book also lost when oil rose.

$$\frac{\text{52m barrels}}{\text{15m barrels}} = \boxed{3.47\times}$$

disclosed loss ≈ USD550m

ADVERSE STATE: OIL PRICE ↑

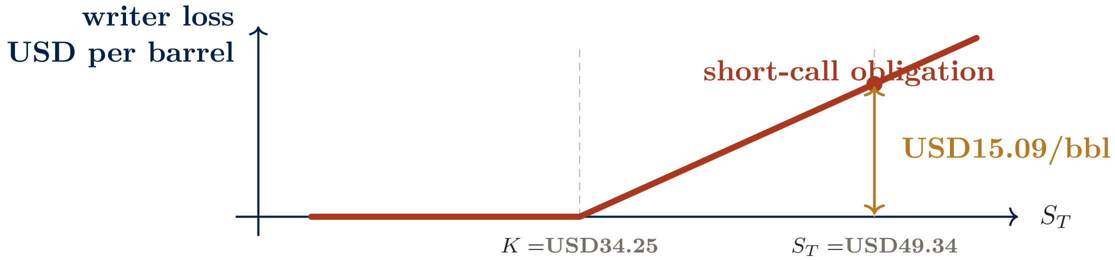


This was not a larger hedge: it was a larger same-direction exposure. The 3.47× figure compares notional scale with physical need; it is not an option delta.

[3]

One short call on 300,000 barrels lost USD4.53m

CAO sold one Brent call: $K = \text{USD}34.25$, $S_T = \text{USD}49.34$, $Q = 300{,}000$ barrels.
The short-call writer owes $Q\max(S_T - K, 0)$ if exercised; the graph shows loss before premium received.



$$(49.34 - 34.25) \times 300{,}000 = \boxed{\text{USD}4{,}527{,}000}$$

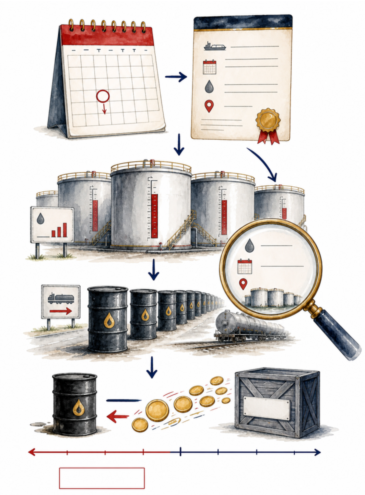
This one trade verifies the loss mechanism; the full book contained many strikes and structures. CAO later disclosed about USD550m of derivatives losses and faced roughly USD247.5m of margin and payment demands.

[3]

Matching the instrument to the exposure

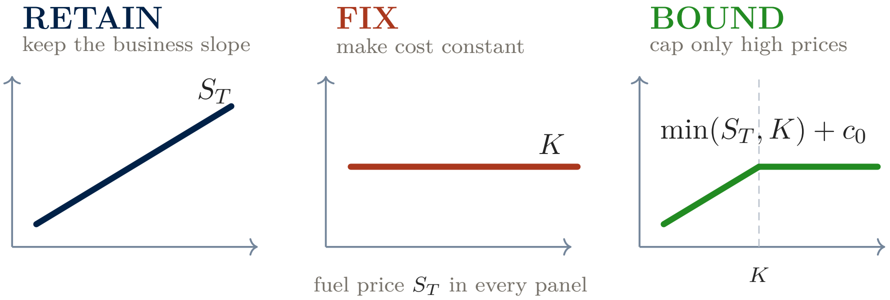
Which uncertainty should be retained, fixed, transferred, or bounded?

Compare payoff shape, market architecture, exposure match, and funding before taking the position.



Retain, fix, or cap the same fuel-price exposure

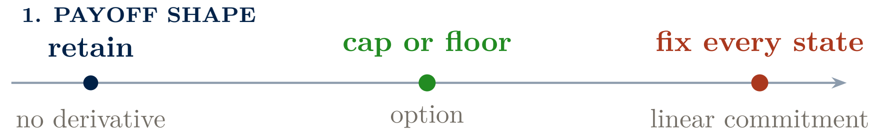
Every panel shows effective fuel cost per unit against the future fuel price. The option profile includes premium c_0; the forward profile is the fixed delivery price K.



Select the desired cash-flow shape first: retain the slope, fix every state, or bound only the adverse region.

Payoff shape and trading venue are separate choices

Market architecture describes where and how the contract trades. OTC means privately negotiated over the counter; listed means exchange-traded under standard rules.



A payoff can be economically correct yet operationally unsuitable. Shape and market architecture are separate decisions.

Residual risks: mismatch, credit, margin, and premium

Residual risk is the exposure left after hedging. Funding risk is the possibility that collateral, settlement cash, or premium cannot be paid when required.

chosen hedge

← →

MATCH THE EXPOSURE	**FUND THE CONTRACT**
asset • scale • timing	credit • cash • premium
underlying	**counterparty**
quantity	**margin liquidity**
date	**premium budget**

Hedge failure usually enters through mismatch or funding: basis, forecast error, timing, counterparty credit, margin calls, or an unaffordable premium.

Exposure, the derivative, and governance form one decision

Governance means limits, collateral and liquidity buffers, monitoring, and authority to resize or close a hedge when the exposure changes.

Exposure comes from the business. Derivatives reshape its cash flow. Governance makes the new obligation survivable.

Judge success by the combined operating outcome, not by whether the derivative alone reports a gain.

References

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2. Berk, J. and DeMarzo, P. *Corporate Finance*, 5th ed., Chapter 20. Derivatives as tools for reshaping corporate risk.
3. China Aviation Oil (Singapore), 2004: company loss disclosure; Risk.net trade reconstruction; Temasek restructuring release. Case synthesis and calculations by the author.

← **Return to the decision**