Risk Management and Derivatives | Lecture 3

Hedging Strategies Using Futures

In Class Group Activity

· SJTU Summer School 2026 · Fatih Kansoy

How this block runs. You work in your home group of four or five, textbook open. Roles rotate today: **Scribe** (writes the answer), **Reporter** (speaks at the microphone), **Sceptic** (must raise one objection), **Timekeeper**. All money today is in US dollars ($) and pounds sterling (£).

- **Phase 1, Concept checks (~10 min).** For each question you vote on your own first. Then you talk for about 90 seconds with the people next to you, and vote again. Do not talk before the first vote.
- **Phase 2, Desk problem (~20 min).** One problem in parts. Your Reporter presents one part when the microphone reaches your group. Then we solve it together, part by part.
- **Phase 3, Case (~25 min).** You read one real story. The ending is hidden on purpose. You answer four questions and take a position. Then we reveal what happened.

A short word list for this block. A **hedge** is a trade you add to reduce the risk in your business. A **cross-hedge** hedges one product with the futures of a different but related product, because no exact futures contract exists. The **basis** is the gap between the spot price of the thing you hedge and the futures price you use, $b = S - F$. The **minimum-variance hedge ratio** h^* is the size of futures position, per unit of exposure, that removes the most variance. **Beta** is how much a share portfolio moves when the whole market moves by 1 per cent; beta is itself a hedge ratio. **Variation margin** is cash that flows in or out each day as a futures position settles its gain or loss.

Phase 1 – Concept checks

~10 MIN

ConcepTest 1. Two firms in the United States make gold jewellery: GoldHand and Sunmark. The retail price of jewellery moves up and down with the gold price. At the start of the year, GoldHand **hedges** its gold cost for the whole year at today's price. Sunmark does **not** hedge. Over the year the gold price falls sharply. Because jewellery prices follow gold, both firms' selling prices fall. A classmate says: "GoldHand was smart to hedge; it must be better off than its unhedged rival Sunmark now." Is the classmate right? Choose the best answer.

(a) Yes. The hedge made GoldHand's costs safer, so it must be ahead of Sunmark.

(b) No. The hedge fixed GoldHand's gold cost at the old high price, but the market price of jewellery fell with gold. GoldHand is now squeezed. Sunmark buys cheaper gold and can match the lower jewellery prices, so GoldHand is worse off than its unhedged rival.

(c) They end up exactly the same, because hedging only moves cash around.

(d) GoldHand is better off, but only if the gold price had risen.

ConcepTest 2. You hedge a fuel cost with a futures contract. The correlation between your fuel-price changes and the futures-price changes is $\rho = 0.7$. A colleague says: "So the hedge removes 70 per cent of the variance of your cost." Is the colleague right? Choose the best answer.

(a) Yes, 70 per cent, because the correlation is the share of variance removed.

(b) No. A hedge removes a fraction ρ^2 of the variance, not ρ. Here $\rho^2 = 0.7 \times 0.7 = 0.49$, so the best hedge removes about 49 per cent of the variance, not 70 per cent.

(c) It removes the square root of 0.7, about 84 per cent.

(d) It removes 30 per cent, because $1 - 0.7$ is the part that is left.

ConcepTest 3. A logistics firm must buy diesel in three months. There is no diesel futures contract that fits exactly, so it hedges with crude oil futures, carefully sized. A classmate says: "Good, now the firm's future fuel cost is completely certain." Is the classmate right? Choose the best answer.

(a) Yes, a correctly sized hedge removes all price risk.

(b) No. Diesel and crude do not move together perfectly. After the hedge, the firm still faces **basis risk**, the changing gap between the diesel price and the crude futures price. The hedge swapped a large price risk for a smaller basis risk; it did not remove all risk.

(c) No, because the firm will have to take delivery of crude oil.

(d) No, the firm now has more risk than before it hedged.

Phase 2 – The desk problem

~20 MIN

Two hedges, one idea

The setting. One problem in two parts. **Part One** is a fuel cross-hedge in the United States, money in US dollars ($). **Part Two** is a share-fund hedge in London, money in pounds sterling (£). They look different, but they teach the same idea.

Part One: a fuel cross-hedge (United States, money in $)

The setting. You run the fuel desk of a large trucking company. You must **buy 4,200,000 gallons of diesel** in three months. There is no diesel futures contract, so you cross-hedge with NYMEX heating-oil (ULSD) futures, a close but not identical product. Each futures contract is **42,000 gallons**. All prices are in dollars per gallon.

(a) Direction and the basis idea. You must *buy* diesel, so you are hurt if fuel rises. To see how basis works, follow one gallon hedged one-for-one. You buy futures today at $F_1 = \$2.50$. In three months you buy diesel at spot $S_2 = \$3.05$, and the futures has risen to $F_2 = \$2.90$.

(1) Should you go **long** or **short** the futures? Say why in one sentence.

(2) Work out the closing basis $b_2 = S_2 - F_2$.

(3) Work out your effective cost per gallon, $S_2 - (F_2 - F_1)$, and check it equals $F_1 + b_2$.

(4) Unhedged, you would have paid the spot $S_2 = \$3.05$. How much did the hedge save per gallon, and what is the only uncertainty that is left?

(b) The minimum-variance hedge ratio. From 24 months of monthly price changes you measure: standard deviation of diesel price changes $\sigma_S = \$0.04$ per gallon; standard deviation of futures price changes $\sigma_F = \$0.05$ per gallon; correlation $\rho = 0.9$. Work out

$$h^* = \rho \frac{\sigma_S}{\sigma_F}.$$

Then read the number out loud: why is h^* below 1 here?

(c) Number of contracts. Your exposure is $Q_A = 4{,}200{,}000$ gallons. One contract is $Q_F = 42{,}000$ gallons. Work out

$$N^* = h^* \frac{Q_A}{Q_F}.$$

State the answer as a whole number of contracts, and say whether you are long or short.

(d) Effectiveness. What fraction of the variance does this hedge remove? What is the leftover part, and what is it called?

Part Two: a London share fund (money in £)

The setting. A different firm. You manage a London share fund worth **£50,000,000**. Its beta to the FTSE 100 is **1.2**. You fear a market fall this quarter, but you do not want to sell the shares. You hedge with FTSE 100 index futures: £10 per index point, the index at 5,000, so one contract is worth $V_F = £10 \times 5{,}000 = £50{,}000$.

(e) The equity hedge.

(1) To remove the market risk, how many contracts do you trade, and long or short? Use $N = \beta\,(V_P/V_F)$.

(2) **Stress test.** Suppose the market falls 10 per cent (index 5,000 to 4,500). Work out the loss on the portfolio (about $\beta \times 10\% \times V_P$) and the gain on the short futures. Do they cancel?

(3) **Target beta.** Instead of removing all market risk, you want to keep a beta of 0.6. How many contracts do you trade now? Use $(\beta - \beta_{\text{target}})\,(V_P/V_F)$.

Extension (for fast groups): funding the hedge. Keep the full short of 1,200 contracts. Now the market *rises* 10 per cent (index 5,000 to 5,500) before you sell the shares.

(1) How much do the short futures lose, and how is that loss paid?

(2) Your shares are up about the same amount. Is that gain cash in your hand yet?

(3) In one sentence, link this to the Lecture 2 lesson about margin.

Phase 3 – The case

~25 MIN

Southwest Airlines and its fuel hedges, 2008 (United States)

How to run this. Read the story with your group. The ending is hidden on purpose. Your group must take a position on the four questions and hold your decision. Do not search the internet. Use only what you know from the lecture. I will reveal what happened only after every group has answered. All money is in US dollars ($).

The story. You run an airline in the United States. Your single biggest cost, after labour, is jet fuel. The fuel price moves with the price of crude oil, and crude oil is volatile. In a bad year a fuel spike can remove all your profit. You cannot pass the higher cost to passengers quickly, because ticket prices are set by competition.

For about ten years your airline has done something most rivals did not. You ran a steady fuel-hedging programme. Each year you locked in the price of a large share of your future fuel, well in advance, using futures and option contracts. This was not a reaction to the latest oil price. It was a written policy, approved at board level, repeated year after year in good times and bad.

For years this policy worked well, but few people noticed it. From about 1999 to 2008 the programme is widely reported to have saved your airline on the order of $3 billion to $3.5 billion, compared with simply paying the spot price for fuel. The savings built up slowly. They rarely made the news.

Then 2008 arrived. Crude oil climbed fast. It rose above about $147 per barrel in July 2008, a record. Your rivals, who had hedged little, were now paying very high prices for fuel. Some cut flights. Some grounded planes. Some lost money heavily.

You were in a different place. You had hedged a large share of your 2008 fuel. The hedged price was about $51 per barrel. That was far below the market price. While rivals struggled, your fuel cost was low and your hedges were worth a great deal. The years of discipline had paid off in the one year it mattered most.

Now it is the summer of 2008. Oil is near its peak. Some analysts ask a hard question. If oil keeps climbing, perhaps towards $200, should you hedge even more of your future fuel, right now, at these very high prices? Locking in more would protect you if oil keeps rising. But you would be locking in at a level far above anything seen before.

You must decide. Hold your answer.

The story stops here.

Four discussion questions (answer all four in your group; take a position):

1. **Good decision or good luck?** Was the multi-year hedging programme a sound decision when it was signed, or did your airline just get lucky that oil happened to spike in 2008? How would you tell the difference?
2. **The competitor trap, in reverse.** Right now you look far better than your unhedged rivals. Suppose instead that oil crashes over the next six months. What happens to your fuel cost compared with your rivals' cost? Who is better placed then?
3. **Hedge even more at the top?** Should you lock in more fuel now, at these very high prices, in case oil climbs to $200? What would make this a good idea, and what would make it a costly mistake? How should you decide, without forecasting the oil price?
4. **Judge the hedge by what?** Apply the lesson of the day: judge a hedge by the risk it removed when you signed it, not by the price that happened later. Using that rule, was the 2008 hedge a good hedge, whatever oil does next?

End of activity handout. Solutions are distributed after the block.