Risk Management and Derivatives | Lecture 1

Introduction to Derivatives

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, google/baidu is fine but not AI generated answers. Roles rotate today: **Scribe** (writes the answer), **Reporter** (speaks at the microphone), **Sceptic** (must raise one objection), **Time-keeper**. We use one year and simple annual interest throughout.

- **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: the **spot price** is the price to buy something now. A **forward** is a deal made today to buy or sell at a fixed price on a fixed future date. To go **long** a forward is to agree to buy; to go **short** is to agree to sell.

Phase 1 – Concept checks

~10 MIN

ConcepTest 1. A US factory uses copper. Today the spot price of copper is \$9,000 per tonne. The safe interest rate for one year is 4%. We ignore storage costs. A bank works out the one-year forward price by cash-and-carry: it takes today's price and grows it by the interest cost, $9{,}000 \times 1.04 = \$9{,}360$ per tonne. A junior analyst says: "So the market is predicting that copper will be \$9,360 in a year." Is the analyst right? Choose the best answer.

(a) Yes. The bank looked at copper supply and demand and decided \$9,360 is where copper is most likely to be in a year.

(b) No. The \$9,360 is the cost today of locking in copper for one year, that is, today's price plus the interest cost. It is not a prediction of next year's price. Nobody looked at copper supply or demand to get it.

(c) No. The forward is a forecast, but it is shaded down a little to be safe, so the real expected price is a bit higher than \$9,360.

(d) No. The \$9,360 is just an accounting number from a formula. It has no real meaning for buying copper.

ConcepTest 2. Two London banks sign a one-year interest-rate swap. In a swap, two sides agree to exchange interest payments for a set time. The notional is £500 million. The notional is the size number used only to work out the interest payments. The two banks never exchange this £500 million itself. A newspaper writes: "The two banks have £500 million on the line." Is the newspaper right? Choose the best answer.

(a) Yes. The £500 million is the money each bank can lose on this swap.

(b) No. At fair terms on day one the swap is worth about zero to both sides. The £500 million is only the size used to work out the interest payments. The principal is never exchanged, so it is not the money at risk.

(c) No. The risk is split evenly, so each side has £250 million on the line.

(d) No. The full £500 million is at risk, but only for the one side that the market later hurts.

ConcepTest 3. A French wheat farmer and a bakery sign a forward at €200 per tonne for wheat, for delivery after the harvest. They fix this price today. After the harvest the spot price turns out to be €170 per tonne. Under the forward the bakery still pays the farmer €200. Against the spot price of €170, the bakery pays €30 more per tonne than in the open market. That €30 per tonne goes from the bakery to the farmer. So €30 moves from one side to the other. Nothing is created or destroyed. A classmate says: "So the bakery made a mistake. One side always loses. It is zero-sum, so nobody is better off." Is the classmate right? Choose the best answer.

(a) Yes. The classmate is right. One side always loses, so no one is better off from signing the forward.

(b) No. The payoff at the end is indeed a zero-sum transfer of €30. But both sides can still be better off when they sign, because each one locked a price it could plan around. Certainty has value to both.

(c) No. The farmer's gain is bigger than the bakery's loss, so the forward creates extra value overall.

(d) No. It is not zero-sum at all; the €30 is not really a transfer between the two sides.

Phase 2 – The desk problem

~20 MIN

Alpine Chocolate: a chocolate maker buys cocoa forward

The setting. You work on the risk desk of Alpine Chocolate, a Belgian chocolate company. All money is in euros (€). Alpine has already signed contracts to sell chocolate at fixed prices. To make that chocolate, Alpine must buy **10,000 tonnes** of cocoa beans in one year ($T = 1$). So Alpine has a problem. If cocoa beans get more expensive over the year, Alpine still has to sell the chocolate at the old fixed price. Its profit would shrink, or it could even lose money.

Today's numbers:

- Today's spot price of cocoa: $S_0 = €3{,}000$ per tonne.
- A trading desk offers Alpine a one-year forward with delivery price $K = €3{,}200$ per tonne.
- The amount Alpine needs: $Q = 10{,}000$ tonnes.

Nobody knows the spot price one year from now. To study the problem, look at three possible spot prices in one year:

	spot at T, S_T
Price falls	€2,600/t
Price ends equal to K	€3,200/t
Price jumps up	€4,000/t

Part (a). Which side of the forward, and the payoff. Alpine must *buy* cocoa in one year. So Alpine is hurt when cocoa rises and helped when cocoa falls.

(1) Should Alpine be **long** the forward (agree to buy at K) or **short** the forward (agree to sell at K)? Explain in one sentence.

(2) Write the payoff of Alpine's forward position, per tonne, as a formula in S_T and K.

(3) Work out that payoff for each of the three spot prices: €2,600, €3,200, €4,000.

Part (b). The full hedge table. Alpine buys cocoa in the spot market in one year *and* holds the forward for the full 10,000 tonnes. Fill in this table for each of the three spot prices.

spot in 1 year	spot cost of 10,000 t	gain/loss on forward	net cost
€2,600	?	?	?
€3,200	?	?	?
€4,000	?	?	?

Use: spot cost = $S_T \times 10{,}000$; gain/loss on forward = $(S_T - K) \times 10{,}000$; net cost = spot cost minus the gain on the forward. Then answer: what is the net cost in each state, and what does this tell you about what a hedge does?

Part (c). Counterparty credit risk at the jump. Look only at the jump state, where the spot price in one year is €4,000.

(1) What is the forward worth to Alpine in that state? Use value to Alpine = $(S_T - K) \times Q$.

(2) Suppose the trading desk refuses to pay and walks away. Alpine still needs the cocoa. The fair forward price for new cocoa is now €4,000 per tonne, but Alpine's old contract said €3,200. To rebuild the same protection, how much extra must Alpine pay in total? This extra amount is called the *replacement cost*.

(3) In one or two sentences: in which state is the desk most tempted to break its promise, and why is that the worst possible moment for Alpine? This is counterparty credit risk: the risk that the other side does not pay.

Part (d). The no-arbitrage check. The fair forward price should follow one rule. Buying cocoa now and storing it for a year should cost the same as agreeing a forward now. If the two routes cost different amounts, there is free money. We call free money *arbitrage*. Use these facts: the bank interest rate is $r = 4\%$ per year, storage is free, and cocoa pays no income while you hold it.

(1) Work out the fair one-year forward price, $F_0 = S_0(1 + r)$.

(2) A second desk quotes a forward at €3,250 per tonne. Is that too high or too low compared with the fair price?

(3) Build the cash-and-carry trade that earns the free money. The steps are: borrow €3,000 today, buy 1 tonne of cocoa today, and sell the expensive forward (agree to deliver 1 tonne in one year at €3,250). Show the cash flow today and the cash flow in one year. What is the profit per tonne? On 10,000 tonnes?

(4) Prove the profit does not depend on the final spot price. Redo the one-year cash flow for two very different spot prices: $S_T =$ €2,000 and $S_T =$ €5,000. Do you still get the same profit?

Part (e). Option versus forward, and leverage. The desk also offers a call option instead of a forward. A call gives Alpine the *right* to buy cocoa at the strike price, but not the duty. Alpine pays a fee for this right, called the *premium*. Call strike: €3,200 per tonne. Premium: €100 per tonne, paid today.

(1) The breakeven is the spot price at which the call just covers its premium. Work out the breakeven (strike + premium).

(2) Fill in this effective-cost-per-tonne table for the three spot prices. "Effective cost" means the all-in cost of one tonne after the hedge, including any premium paid.

spot in 1 year	unhedged	forward	call (incl. premium)
€2,600	?	?	?
€3,200	?	?	?
€4,000	?	?	?

(3) In one or two sentences, say the difference between the forward and the call. When is each one better for Alpine?

(4) **Leverage.** A speculator (not Alpine) has €3,000,000 to bet that cocoa will jump.

- How many tonnes of cocoa can they buy at €3,000 per tonne?
- How many tonnes of cocoa exposure can they get by buying calls at €100 per tonne instead?
- If cocoa jumps to €4,000, work out the profit and the percentage return for each choice.
- What happens to the call buyer if cocoa ends at €3,200 or below?

Extension (for fast groups). A third desk quotes the one-year forward at €3,050 per tonne. Compare this with the fair price of €3,120.

(1) Is €3,050 too high or too low?

(2) Build the trade that earns the free money. This time it is a *reverse cash-and-carry*. The steps are: short 1 tonne of cocoa now (sell borrowed cocoa) for +€3,000, invest that €3,000 at 4% to get €3,120 in one year, and agree the cheap long forward to buy 1 tonne back at €3,050 in one year. Show the cash flows and the profit per tonne.

(3) Show again that the profit does not depend on the final spot price by trying $S_T = €2{,}000$ and $S_T = €5{,}000$.

Phase 3 – The case

~25 MIN

Société Générale and the trader who broke the rules (Paris, January 2008)

How to run this. Read the story with your group. The ending is hidden on purpose. Answer the four questions and take a clear position. Do not search the internet. Use only what you know from the lecture. I will reveal what happened next. All money is in euros (€).

The story. You work at a large French bank called Société Générale. It is one of the biggest banks in Europe. Inside the bank there is a small trading desk. You are on that desk.

Your desk has a clear job. You trade stock-index futures. A stock-index future is a contract whose value follows a basket of shares, for example the main European share indices. Your job is **arbitrage**. You look for two prices that should be equal but are not. You buy the cheap one and sell the expensive one at the same time. The gap is small, so the profit on each trade is small. The risk is also meant to be small, because your two positions cancel out. You are not supposed to bet on the market going up or down. You are supposed to lock in tiny, low-risk gains.

One trader on your desk, named Jérôme, knows the bank's systems very well. Before he became a trader, he worked in the bank's back office. The back office is the part that checks, records and confirms trades after they are made. So he understands exactly how the controls work, and how they can be tricked.

Jérôme starts to change what he does. He stops cancelling out his positions. Instead, he places large **one-way bets**. He buys huge amounts of stock-index futures, betting the market will rise. This is no longer arbitrage. This is **speculation**, and on a giant scale.

To hide it, he enters **fake trades** into the system. Each fake trade looks like it offsets a real one. On the screen, the desk still looks balanced and low-risk. On paper, his risk looks tiny. In reality, his real bets are enormous and point one way.

For a while, the bets work. During 2007 his hidden positions make a large profit. He does not report the full amount. A trader who suddenly reports a giant profit would be asked one simple question: how did a low-risk arbitrage desk make this much money? So he keeps most of it hidden, to keep the secret safe.

These are **exchange-traded futures**. They clear through a central clearing house. Every day the position is **marked to market** and the bank must post **margin**, which is cash placed as security against losses. So you might think nothing can go badly wrong here. The exchange settles every day. The clearing house guarantees the trade. Margin is collected. This is the safe, regulated part of the market, not some private back-room deal.

Then, in January 2008, world markets start to fall. Jérôme's bets were that the market would rise. Now the market is dropping fast, and his position is huge. The daily losses grow.

In the third week of January 2008, the bank's controllers finally find the truth. The hidden position is far larger than anyone imagined. The total size is **about €50 billion in notional value**. That is larger than the whole bank. One trader, on a desk meant for tiny low-risk trades, is holding a bet bigger than the whole company.

The market is still falling. The position is still open. Senior managers gather in a room. They must now decide one thing, and decide it fast: **how do we close a €50 billion bet, in secret, into a market that is dropping every hour?**

The story stops here.

Four discussion questions (answer as a group; take a position):

1. **Mandate.** The desk's job was low-risk arbitrage. Was Jérôme doing his job? Name what he was actually doing. Use the words **hedger**, **speculator** and **arbitrageur** from the lecture. Remember: these are jobs, not personality types.
2. **What the futures did to risk.** A future does not create or destroy risk by itself. In this story, who carried the market risk of Jérôme's bets, and who was on the other side? When the market fell, where did the loss actually go?
3. **Two failures.** There were really two separate failures here: (a) the trading (placing huge one-way bets), and (b) the hiding (fake offsetting trades). For each one, name one simple control the bank should have had that would have caught it.
4. **Instrument or use?** Was the problem the futures themselves, or the way they were used? These were exchange-traded and margined every day. Would the clearing house and daily margin have saved the bank here? Why or why not?

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