CHARTA LEARNING · LESSON NOTES

Liquidity Risk

FRM Part II

1 A story: the price you cannot get

- Kestrel's desk holds $50m of corporate bonds
- VaR: 1-day 99% = $1.5m, valued at the mid-price
- Buyers pay only the bid; size can push it lower
- Selling costs money that VaR never counted

IN THE LESSON

- Imagine Kestrel Bank's trading desk.
- It holds fifty million dollars of corporate bonds.
- Its value at risk, V a R, is the loss that should not be exceeded on ninety nine days in one hundred.
- The one day, ninety nine per cent V a R is one point five million dollars, and it values the bonds at the mid-price, halfway between the price buyers bid and the price sellers ask.
- Now the market turns, and the desk must sell.
- Buyers pay only the bid, which sits below the mid, and the sheer size of a big block can push the price lower still.
- So selling costs money that V a R never counted.
- That gap is trading liquidity risk.

2 Trading liquidity risk, and why VaR misses it

- Trading liquidity risk: no fast exit without a concession
- Bid: what buyers pay. Ask: what sellers want
- Mid-price: halfway between bid and ask
- VaR values at mid, as if selling were free
- So VaR understates the loss of a real exit

IN THE LESSON

- Trading liquidity risk is the risk that a position cannot be closed quickly without a price concession, meaning a worse price than the one the books show.
- Two prices are quoted in a dealer market.
- The bid is the price at which buyers will buy from you.
- The ask is the price at which sellers will sell to you, and it is above the bid.
- The mid-price sits halfway between them.
- Conventional V a R values each position at the mid-price, as if it could be sold at no cost.
- But a real exit happens at the bid.
- So conventional V a R understates the loss a bank would suffer if it actually had to get out.

3 The cost of liquidating a position

Spread = (Ask − Bid) ÷ Mid
Cost = 0.5 × Spread × Position

Mid-price	(Ask + Bid) ÷ 2
Relative spread	Relative: a percentage of mid
Position	Value of the position at mid
Cost of liquidating	Only mid to bid is given up

IN THE LESSON

- The relative spread is the ask minus the bid, divided by the mid-price.
- The cost of liquidating is one half, times the relative spread, times the position.
- Now the pieces.
- The mid is the ask plus the bid, divided by two.
- The spread is relative, a percentage, because dividing by the mid turns a gap in dollars into a share that fits a position of any size.
- The position is its value at the mid-price.
- And the cost uses only half the spread.
- You start at the mid, and you give up only the distance from the mid down to the bid, which is half the spread.
- The other half, from the mid up to the ask, is what a buyer gives up, not you.

4 Example 1: the cost of selling Kestrel's bonds

Kestrel holds $50m of bonds at mid. Quotes: bid 99.20, ask 100.80

Mid-price	(99.20 + 100.80) ÷ 2	**100.00**
Relative spread	1.60 ÷ 100.00	**1.6%**
Cost of liquidating	0.5 × 1.6% × $50m	**$400,000**
Wrong: full spread	1.6% × $50m	**$800,000**

IN THE LESSON

- Kestrel holds fifty million dollars of bonds, valued at the mid.
- Dealers quote a bid of ninety nine point two zero and an ask of one hundred point eight zero.
- First the mid-price: ninety nine point two zero plus one hundred point eight zero, divided by two, is one hundred.
- The ask minus the bid is one point six zero, so the relative spread is one point six zero divided by one hundred, which is one point six per cent.
- The cost of liquidating is one half, times one point six per cent, times fifty million dollars, which is four hundred thousand dollars.
- The classic mistake is to use the full spread, which doubles the answer to eight hundred thousand dollars.

5 Liquidity-adjusted VaR

LVaR = VaR + 0.5 × Spread × Position
Variable spread: use mean + k × st. dev. in place of Spread
Sale over T days: VaR × √T

VaR	Conventional VaR, valued at mid
Cost of liquidating	Half spread × position
k	Standard deviations of spread
T	Days needed to sell

IN THE LESSON

- In this simplified spread based adjustment, liquidity adjusted V a R, written L V a R, is V a R plus the cost of liquidating: V a R plus one half times the spread times the position.
- Spreads widen in a crisis, exactly when you need to sell.
- So with a variable spread, use the mean spread plus k standard deviations of the spread in place of the average.
- And if the sale takes T days rather than one, scale the V a R by the square root of T.
- Reading the pieces: V a R is the conventional figure at the mid, and the cost is half the spread times the position.
- k is the number of standard deviations, chosen by the bank.
- And T is the number of days needed to sell.

6 Example 2: Kestrel's LVaR

1-day 99% VaR $1.5m. Cost of liquidating from Example 1: $400,000

VaR at mid	1-day, 99%	**$1.5m**
Cost of liquidating	0.5 × 1.6% × $50m	**$0.4m**
LVaR	1.5 + 0.4	**$1.9m**
Rise over VaR	0.4 ÷ 1.5	**26.7%**
Wrong: full spread	1.5 + 0.8	**$2.3m**

IN THE LESSON

- The one day, ninety nine per cent V a R of Kestrel's bonds, valued at the mid, is one point five million dollars.
- The cost of liquidating, from the first example, is one half times one point six per cent times fifty million, point four million.
- Liquidity adjusted V a R is one point five plus point four, which is one point nine million dollars.
- Liquidity has raised the risk figure by point four divided by one point five, about twenty six point seven per cent.
- And the wrong answer again comes from the full spread: one point five plus point eight, two point three million.
- Exam questions are built to catch exactly that.

7 Example 3: a spread that widens

Spread: mean 1.6%, standard deviation 0.5%. Kestrel uses k = 2.33

Spread used	1.6% + 2.33 × 0.5%	**2.765%**
Cost of liquidating	0.5 × 2.765% × $50m	**$691,250**
LVaR	$1.5m + $691,250	**$2,191,250**
Constant-spread LVaR	from Example 2	**$1,900,000**

IN THE LESSON

- The mean relative spread of Kestrel's bonds is one point six per cent, its standard deviation is point five per cent, and the bank uses k equal to two point three three, roughly the ninety nine per cent point of a normal distribution.
- The spread used is one point six per cent plus two point three three times point five per cent, which is two point seven six five per cent.
- The cost of liquidating is one half, times two point seven six five per cent, times fifty million dollars, which is six hundred and ninety one thousand two hundred and fifty dollars.
- L V a R is one point five million plus that cost, two million one hundred and ninety one thousand two hundred and fifty dollars.
- With a constant spread, in the second example, it was one million nine hundred thousand.

8 Example 4: a sale that takes four days

The block is too big to sell in a day: Kestrel needs T = 4 days

One-day VaR	at mid	**$1.5m**
Four-day VaR	1.5 × √4 = 1.5 × 2	**$3.0m**
Cost of liquidating	0.5 × 1.6% × $50m	**$0.4m**
LVaR over four days	3.0 + 0.4	**$3.4m**

IN THE LESSON

- Now the block is too big to sell in one day, and Kestrel needs four days, while the price keeps moving.
- The one day V a R at the mid is one point five million dollars.
- Scale it by the square root of T: the square root of four is two, so the four day V a R is three million dollars.
- The cost of liquidating, with the average spread of one point six per cent, is still four hundred thousand dollars.
- So the L V a R over four days is three plus point four, which is three point four million dollars.
- Notice what is scaled.
- The square root of T applies to the V a R, the price risk while you wait.
- The spread cost is paid once, on the whole position.

9 What the simple formula leaves out

- Exam rule: LVaR = VaR + 0.5 × spread × position
- Quoted spread fits a normal size, not a large block
- Price impact: your own sale moves the price
- A sale can take longer than assumed
- These need further modelling beyond the formula

IN THE LESSON

- The exam rule is V a R plus one half times the spread times the position.
- But the quoted spread is for a normal sized trade, not for a block large enough to worry the market.
- Price impact is the move in the price caused by your own selling.
- The more you sell, and the faster, the further the price falls, so the true cost grows faster than the position.
- And a sale can take longer than assumed, especially when everyone else is selling too, which adds price risk.
- Market impact, position size and a longer sale all need further modelling, beyond this simple formula.
- Ignoring the price impact of a large position is a typical mistake.

10 Funding liquidity risk

- Can't meet obligations when due, or only at distress cost
- Source 1: maturity mismatch, long assets on short funding
- Source 2: reliance on short-term funding that can vanish
- Distress cost: forced sales, very expensive borrowing
- The link: a forced seller pays the spread, and more

IN THE LESSON

- Now the second face.
- Funding liquidity risk is the risk that a firm cannot meet its cash obligations when they fall due, or can meet them only at a distress cost.
- It arises from two sources.
- The first is maturity mismatch: lending long, for example through ten year mortgages, while borrowing short, for example overnight.
- The second is reliance on short term funding that can vanish, because a lender can simply decline to roll it over.
- A distress cost is the price of raising cash in a hurry: forced sales of assets at poor prices, or very expensive borrowing.
- That is where the two faces link.
- A bank short of funding must sell assets, and a forced seller pays the spread, and often much more.

11 Funding sources: flighty and sticky

Short-term sources leave first; stickier ones stay

Source	How it can fail
Wholesale deposits	Large lenders withdraw fast
Repo	Not rolled, or haircut raised
Commercial paper, interbank lines	Not renewed; lines cut
Margin and collateral calls	Cash demanded at short notice
Insured retail, long-term debt	Stickier: slow to leave

IN THE LESSON

- Short term sources leave first, and stickier ones stay.
- Wholesale deposits, from companies and other institutions, are large and well informed, so large lenders withdraw fast at the first doubt.
- Repo is borrowing against securities through a repurchase agreement.
- The lender may refuse to roll it, or may raise the haircut, the margin of extra collateral it demands.
- Commercial paper, short term notes sold to investors, may not be renewed, and interbank credit lines can be cut.
- Margin and collateral calls on derivatives demand cash at short notice when prices move against you.
- The last row is stickier.
- Insured retail deposits stay because the depositors are protected, and long term debt cannot leave before it matures, so both are slow to leave.

12 Example 5: a repo haircut rises

Kestrel funds its $50m of bonds with overnight repo at a 5% haircut

Bonds at market value		**$50.0m**
Borrowed at 5% haircut	95% × 50	**$47.5m**
Borrowed at 20% haircut	80% × 50	**$40.0m**
Cash to find tomorrow	47.5 − 40.0	**$7.5m**
If the repo is not rolled	whole loan due	**$47.5m**

IN THE LESSON

- Kestrel funds its fifty million dollars of bonds with overnight repo at a five per cent haircut.
- Their market value is fifty million.
- With a five per cent haircut, the lender advances ninety five per cent of fifty, which is forty seven and a half million dollars.
- Now the market grows nervous, and the lender raises the haircut to twenty per cent.
- It will lend only eighty per cent of fifty, forty million.
- Kestrel must find forty seven and a half minus forty, seven and a half million dollars of cash by tomorrow, though nothing has defaulted.
- Worse, if the lender refuses to roll the repo at all, the whole forty seven and a half million is due.
- The bonds have not changed.
- The funding has.

13 Northern Rock, 2007

- UK mortgage lender: long-term mortgage assets
- Funded by wholesale and securitisation markets
- Those markets closed in 2007
- A retail run followed
- Lesson: funding that worked yesterday can close at once

IN THE LESSON

- Now three episodes.
- First, Northern Rock, a mortgage lender in the United Kingdom.
- Its assets were long term mortgages.
- It financed them heavily with wholesale funding and with securitisation, meaning it packaged mortgages into securities and sold them to investors.
- When those markets closed in two thousand and seven, the bank could no longer refinance itself in the usual way.
- A run by retail depositors followed.
- The mismatch had been there all along, but became visible only when the sources stopped.
- The lesson is that funding that worked yesterday can close at once, and that a wholesale funding problem can turn into a run by ordinary savers.

14 Ashanti Goldfields, 1999

- Gold producer with a derivative hedge book
- Hedges gain if gold falls, lose if it rises
- Gold spiked in 1999: the hedge book lost value
- Counterparties demanded cash: collateral and margin
- Lesson: a hedge can drain cash before it pays off

IN THE LESSON

- Second, Ashanti Goldfields, a gold producer.
- It had a derivative hedge book, contracts that protected it against a fall in the gold price.
- Such contracts gain when gold falls and lose when gold rises.
- In nineteen ninety nine the gold price spiked.
- The hedge book lost value, and its counterparties made cash demands, for collateral and margin, on the losing positions.
- In principle the gold still in the ground was now worth more.
- But that gold could not be mined and sold in time to meet the demands.
- The lesson is that a hedge can drain cash long before it pays off, and that a hedger must plan for the cash its hedges may demand.

15 Metallgesellschaft, 1993

- US oil unit sold long-dated fixed-price contracts
- Hedged with short-dated futures, rolled forward
- Oil prices fell in 1993
- Futures losses: large variation margin calls now
- Lesson: a profitable hedge can still exhaust cash

IN THE LESSON

- Third, Metallgesellschaft.
- Its oil unit in the United States sold long dated contracts to customers, promising to supply oil at fixed prices for years ahead.
- To hedge, it bought short dated futures and rolled them forward.
- Futures are settled daily: gains and losses are paid in cash every day, through variation margin.
- In nineteen ninety three oil prices fell.
- The fixed price contracts gained value, because the unit had locked in high selling prices, but that gain would arrive only over years of deliveries.
- The futures lost money at once, and the variation margin calls were large and immediate.
- The lesson in one line: a profitable hedge can still exhaust cash.

16 Example 6: the cash gap in a rolled hedge

Fenwick sold 10m barrels at fixed prices over 10 years; long 10m barrels of futures

Long futures hedge	rolled each month	**10m barrels**
Oil price falls	per barrel	**$5**
Variation margin paid now	10m × $5	**$50m**
Gain on fixed-price sales	in value, not cash	**+$50m**
Cash from that gain, year 1	50 ÷ 10 years	**$5m**

Year-one cash gap: 50 − 5 = $45m, though the hedge works

IN THE LESSON

- Fenwick Fuels, a client of Kestrel, has sold ten million barrels at fixed prices, delivered evenly over ten years.
- Its long futures hedge covers ten million barrels, rolled each month.
- Now the oil price falls by five dollars a barrel.
- The futures lose ten million times five dollars, so Fenwick pays fifty million dollars of variation margin now.
- The fixed price sales gain fifty million dollars in value, so Fenwick's net worth is unchanged.
- But that gain is not cash.
- It arrives as deliveries are made, fifty divided by ten years, five million in the first year.
- The cash gap in year one is fifty minus five, forty five million dollars, even though the hedge works.

17 The Liquidity Coverage Ratio

LCR = HQLA ÷ Net outflows (30 days) ≥ 100%
Net outflows = Outflows − min(Inflows, 75% × Outflows)

HQLA	Unencumbered high-quality assets
Outflows	Stressed outflows over 30 days
Inflows	Inflows, capped at 75% of outflows

IN THE LESSON

- Basel three added two liquidity standards.
- The first is the liquidity coverage ratio, L C R.
- It asks whether a bank could survive a thirty day stress on its own.
- The L C R is the stock of high quality liquid assets, H Q L A, divided by net cash outflows over a thirty day stress period, and it must be at least one hundred per cent.
- Net outflows are outflows minus inflows, but inflows count only up to seventy five per cent of outflows.
- H Q L A must be unencumbered, meaning not pledged to anyone, so the bank can sell it freely.
- Outflows are the cash expected to leave over thirty stressed days.
- Inflows are the cash expected to come in over the same thirty days.

18 Inside the ratio

- Level 1: cash, central bank reserves, top government bonds
- Level 2: other liquid securities, with haircuts and caps
- Outflows: each balance × a run-off rate
- Inflows: cash due in, at regulatory rates, then capped
- Rates, haircuts and caps: set by the regulator

IN THE LESSON

- H Q L A comes in levels.
- Level one assets are cash, reserves held at the central bank, and the highest quality government bonds, and they count in full.
- Level two assets are other liquid securities, such as high grade corporate and covered bonds.
- They take haircuts, so only part of their value counts, and caps, which limit how much of the stock they can make up.
- Outflows are built by multiplying each funding balance by a run-off rate, the share assumed to leave in the stress.
- Inflows are the cash contractually due in, at regulatory rates, and then capped.
- All the run-off rates, haircuts and caps are set by the regulator, and an exam question will give you the ones it wants.

19 Example 7: Kestrel's 30-day outflows

Run-off rates assumed here: retail 5%, corporate 40%, financial 100%

Retail deposits	$40bn × 5%	**$2.0bn**
Corporate deposits	$15bn × 40%	**$6.0bn**
Financial institution funding	$4bn × 100%	**$4.0bn**
Total outflows	2 + 6 + 4	**$12.0bn**
Inflows due in 30 days	below cap of 75% × 12 = 9	**$4.0bn**

IN THE LESSON

- Now Kestrel's own numbers, in billions of dollars, with run-off rates assumed for this example: five per cent for retail deposits, forty per cent for deposits from companies, and one hundred per cent for funding from other financial institutions.
- Kestrel has forty billion of retail deposits, and five per cent of that is two billion.
- It has fifteen billion of corporate deposits, and forty per cent is six billion.
- It has four billion of funding from financial institutions, all assumed to leave: four billion.
- Total outflows are two plus six plus four, twelve billion dollars.
- Loans repaying bring inflows of four billion, after the regulatory inflow rates.
- The cap is seventy five per cent of twelve, nine billion, so four billion is below the cap and counts in full.

20 Example 8: Kestrel's LCR

Level 1 $8bn; Level 2 $2bn, haircut 15% (assumed). Outflows $12bn, inflows $4bn

Level 1 assets	count in full	**$8.0bn**
Level 2 after haircut	$2bn × (1 − 15%)	**$1.7bn**
HQLA	8.0 + 1.7	**$9.7bn**
Net cash outflows	12 − 4	**$8.0bn**
LCR	9.7 ÷ 8.0	**121.25%**

At least 100%: Kestrel passes

IN THE LESSON

- Kestrel holds eight billion dollars of Level one assets, and two billion of Level two bonds, which we assume take a haircut of fifteen per cent.
- Outflows are twelve billion and inflows four billion.
- The Level one assets, cash and government bonds, count in full: eight billion.
- The Level two bonds count at two billion times one minus fifteen per cent, which is one point seven billion.
- The H Q L A stock is eight plus one point seven, nine point seven billion.
- Net cash outflows are twelve minus four, eight billion.
- The L C R is nine point seven divided by eight, which is one hundred and twenty one point two five per cent.
- That is at least one hundred per cent, so Kestrel passes.

21 Example 9: the 75% inflow cap

Suppose Kestrel expected inflows of $10bn instead of $4bn. Outflows still $12bn

Cap on inflows	75% × 12	**$9.0bn**
Inflows allowed	min(10, 9)	**$9.0bn**
Net cash outflows	12 − 9	**$3.0bn**
LCR	9.7 ÷ 3.0	**323.3%**
Wrong: no cap	9.7 ÷ (12 − 10)	**485.0%**

IN THE LESSON

- Suppose Kestrel expected inflows of ten billion dollars instead of four, with outflows still twelve billion.
- The cap on inflows is seventy five per cent of twelve, nine billion.
- Inflows allowed are the smaller of ten and nine, so nine billion.
- Net cash outflows are twelve minus nine, three billion.
- The L C R is nine point seven divided by three, three hundred and twenty three point three per cent.
- Forget the cap, and you would divide nine point seven by twelve minus ten, that is by two billion, giving four hundred and eighty five per cent.
- Without the cap, a bank could cover its outflows with promised inflows and hold almost no liquid assets.
- With it, at least a quarter of outflows must always be covered by H Q L A.

22 The Net Stable Funding Ratio

NSFR = ASF ÷ RSF ≥ 100% (one year)
ASF = Σ funding × factor
RSF = Σ assets × factor

ASF	Available stable funding
RSF	Required stable funding
Horizon	One year, not 30 days

IN THE LESSON

- The second standard is the net stable funding ratio, N S F R.
- Where the L C R asks about the next month, the N S F R looks at the structure of the balance sheet over one year.
- It is available stable funding divided by required stable funding, and it too must be at least one hundred per cent.
- Available stable funding adds up each source of funding times a factor for how stable it is.
- Required stable funding adds up each asset times a factor for how much stable funding it needs.
- So available stable funding is what the bank can rely on for the year, required stable funding is what its assets need, and the horizon is one year, not thirty days.
- By rewarding stable sources, the N S F R limits reliance on short term wholesale funding.

23 Example 10: Kestrel's NSFR

Kestrel's balance sheet: $73bn. All factors are assumed for this example

ASF: equity and long-term debt	6 + 8 at 100%	**$14.0bn**
ASF: deposits	90%×40 + 50%×15 + 0%×4	**$43.5bn**
Total ASF	14.0 + 43.5	**$57.5bn**
RSF: L1, L2, mortgages, other	0.4 + 0.3 + 32.5 + 11.05	**$44.25bn**
NSFR	57.5 ÷ 44.25	**129.9%**

IN THE LESSON

- Kestrel's balance sheet totals seventy three billion dollars, and every factor is assumed for this example.
- Equity of six billion and long term debt of eight billion count at one hundred per cent: fourteen billion.
- Retail deposits of forty billion at ninety per cent give thirty six, corporate deposits of fifteen at fifty per cent give seven and a half, and the four billion from financial institutions at nought per cent gives nothing: forty three point five.
- Total available stable funding is fifty seven point five billion.
- Required stable funding takes Level one assets of eight at five per cent, point four, Level two bonds of two at fifteen per cent, point three, mortgages of fifty at sixty five per cent, thirty two point five, and other loans and assets of thirteen at eighty five per cent, eleven point zero five.
- In total, forty four point two five billion.
- The N S F R is fifty seven point five divided by forty four point two five, one hundred and twenty nine point nine per cent.

24 LCR and NSFR side by side

Do not confuse the horizons: 30 days against one year

Feature	LCR	NSFR
Horizon	30-day stress	One year
Numerator	HQLA	Available stable funding
Denominator	Net cash outflows	Required stable funding
Minimum	100%	100%
Guards against	A short, sharp run	Structural mismatch

IN THE LESSON

- Do not confuse the horizons: thirty days against one year.
- The horizon of the L C R is a thirty day stress, and of the N S F R, one year.
- The numerator of the L C R is H Q L A, and of the N S F R, available stable funding.
- The denominator is net cash outflows for the L C R, and required stable funding for the N S F R.
- Both have a minimum of one hundred per cent.
- Finally, what each guards against.
- The L C R guards against a short, sharp run, by making the bank hold a liquid buffer.
- The N S F R guards against structural mismatch, the habit of funding long assets with short money that we saw at Northern Rock.

25 The BIS principles for sound liquidity management

- The bank is responsible; it sets a liquidity risk tolerance
- Price liquidity costs into business decisions
- Stress test regularly
- A contingency funding plan and a cushion of liquid assets
- Disclosure, so the market can judge

IN THE LESSON

- The ratios sit alongside the B I S Principles for Sound Liquidity Risk Management.
- They place responsibility on the bank itself.
- First, the bank is responsible, and it sets a liquidity risk tolerance: how much liquidity risk it will accept.
- Second, it prices liquidity costs into business decisions, so a desk that ties up funding, or relies on flighty funding, pays for it.
- Third, it runs stress tests regularly.
- Fourth, it keeps a contingency funding plan, a written plan for raising cash in a crisis, and a cushion of unencumbered liquid assets to draw on.
- Fifth, it discloses enough information for the market to judge its liquidity position.

26 Weighing up ratios and principles

- Ratios: simple, comparable, a hard minimum
- But fixed factors may not match a bank's real stress
- Principles: the bank's own tolerance, tests and plans
- But judgement varies and is harder to check
- Together: a floor, plus the bank's own management

IN THE LESSON

- How should we weigh them up?
- The ratios are simple and comparable across banks, and they set a hard minimum that a supervisor can check.
- But their run-off rates and factors are fixed, and they may not match the stress a particular bank would really face.
- The principles fill that gap.
- They rest on the bank's own risk tolerance, its own stress tests and its own contingency plans, which can fit its actual business.
- But judgement varies between banks, and it is harder for outsiders to check.
- So the two work together.
- The ratios give a floor, and the principles require the bank to manage its own liquidity above that floor.

27 Liquidity black holes

- Almost everyone wants to trade the same way
- Sellers find no buyers
- Prices gap: they jump rather than move smoothly
- Liquidity disappears just when it is needed

IN THE LESSON

- Now the last idea.
- Picture a crowded theatre when someone shouts fire, and everyone heads for the same door at once.
- A liquidity black hole is the market version.
- It is a market state in which almost every participant wants to trade the same way.
- Sellers find no buyers, or only buyers at far lower prices.
- Prices gap, which means they jump from one level to another, with little or no trading in between.
- And liquidity disappears just when it is needed most.
- For Kestrel, this is the moment when the spread in its L V a R widens and its repo lenders raise haircuts, all at the same time.

28 Why black holes form

- Shared models, limits, regulation and information
- So reactions are correlated: all sell together
- Negative feedback traders supply liquidity
- Value investors and market makers lean against moves
- Black hole: when they are scarce or constrained

IN THE LESSON

- Why does everyone want to trade the same way?
- Because participants share similar models, similar risk limits, the same regulation and the same information.
- So their reactions are correlated, and they all sell together.
- What normally stops this?
- Negative feedback traders, who supply liquidity.
- They buy when prices fall and sell when they rise.
- Value investors buy what has become cheap, and market makers lean against moves, taking the other side for a price.
- A black hole appears when these traders are scarce or constrained, for example because they too have hit their limits or lost their funding.
- Then nothing stands between the sellers and a falling price.

29 Positive feedback traders

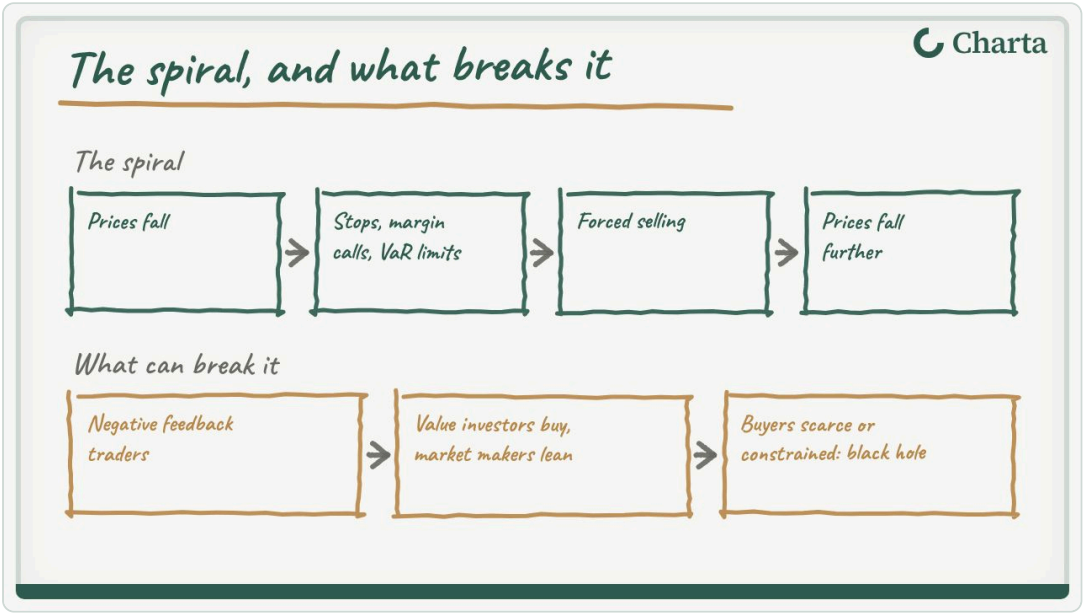
They sell as prices fall and buy as they rise, reinforcing the move

Trader or rule	Why it sells into a fall
Stop-loss rules	Sell once a loss limit is hit
Portfolio insurance	Cuts risky assets as prices fall
Short options, delta hedged	Negative gamma: sell as price falls
Leveraged investors	Margin calls, higher haircuts
VaR-based limits	Volatility up: cut positions

IN THE LESSON

- The opposite are positive feedback traders.
- They sell as prices fall and buy as they rise, reinforcing the move.
- Stop-loss rules sell a position once its loss reaches a limit, so a fall triggers more selling.
- Portfolio insurance is a strategy that protects a floor value by cutting risky assets as prices fall.
- A dealer that has sold options and delta hedges them has negative gamma: its hedge requires it to sell as the price falls.
- Leveraged investors face margin calls and higher haircuts as prices fall, and must sell to meet them.
- And V a R based limits force position cuts when volatility rises, because the same position now shows a higher V a R.
- Each one turns a fall into more selling.

30 The spiral, and what breaks it



IN THE LESSON

- Put together, these forces make a spiral.
- Look at the boxes.
- Prices fall.
- That triggers stops, margin calls and V a R limits.
- Those produce forced selling.
- And forced selling makes prices fall further, which starts the loop again.
- Notice that the funding problems from earlier, the margin calls and the haircut rises, sit inside this loop.
- The second row shows what can break the spiral.
- Negative feedback traders step in.
- Value investors buy what has become cheap, and market makers lean against the move, absorbing some of the selling.
- But if those buyers are scarce or constrained, there is nobody to break the loop, and that is a black hole.

31 Example 11: short gamma against long gamma

Kestrel's hedge shrinks by 15,000 shares per $1 fall. The price falls $4 to $50

Kestrel: short options	negative gamma	**must sell**
Shares to sell	15,000 × 4	**60,000**
Value sold into the fall	60,000 × about $50	**$3.0m**
Desk long the same options	positive gamma	**buys 60,000**
Verdict	long gamma does not	**short destabilises**

IN THE LESSON

- Kestrel's options desk has sold options and delta hedges them, so its hedge shrinks by fifteen thousand shares for each one dollar fall in the price.
- The price now falls four dollars, to fifty.
- Because Kestrel is short options, it has negative gamma, and it must sell.
- The shares to sell are fifteen thousand times four, sixty thousand.
- At roughly fifty dollars a share, that is about three million dollars sold into a falling market, adding to the fall.
- Now take a desk that is long the same options.
- It has positive gamma, and its hedge requires it to buy sixty thousand shares as the price falls, cushioning the move.
- The verdict to remember: short gamma hedging is destabilising, and long gamma hedging is not.

32 Mistakes to avoid

- Full spread in the cost: use half
- √T scales VaR, not the spread cost
- LCR is 30 days; NSFR is one year
- Inflows count only up to 75% of outflows
- Short gamma hedging destabilises; long gamma does not

IN THE LESSON

- The mistakes to avoid.
- First, using the full spread in the cost of liquidating.
- You give up only the distance from mid to bid, so use half.
- Second, the square root of T scales the V a R, the price risk while you sell, and not the spread cost, which is paid once.
- Third, mixing up the horizons: the L C R covers a thirty day stress, and the N S F R covers one year.
- Fourth, forgetting the inflow cap: inflows count only up to seventy five per cent of outflows.
- Fifth, treating all hedging as calming.
- Short gamma hedging sells into a fall and destabilises the market, while long gamma hedging does not.

33 Try three quick questions

1. $20m position: bid 49.50, ask 50.50, VaR $0.8m. LVaR?
   Answer: Spread 1 ÷ 50 = 2%. Cost 0.5 × 2% × 20m = $0.2m. LVaR = $1.0m.
2. HQLA $6bn; outflows $10bn; inflows $9bn. LCR?
   Answer: Inflows capped at 7.5. Net 2.5. LCR = 6 ÷ 2.5 = 240%.
3. A dealer is short options and delta hedges. Prices fall: buy or sell?
   Answer: Sell: short gamma, so it destabilises.

IN THE LESSON

- Try three quick questions, then listen.
- Question one.
- A twenty million dollar position has a bid of forty nine point five zero and an ask of fifty point five zero, and its V a R is point eight million dollars.
- What is L V a R?
- Ask minus bid is one and the mid is fifty, so the relative spread is one divided by fifty, two per cent.
- The cost is one half times two per cent times twenty million, two hundred thousand dollars, so L V a R is one million dollars.
- Question two.
- A bank holds six billion dollars of H Q L A, with outflows of ten billion and inflows of nine billion.
- What is the L C R?
- Inflows are capped at seven point five billion, so net outflows are two point five billion and the L C R two hundred and forty per cent.
- Question three.
- A dealer is short options and delta hedges.
- When prices fall, does it buy or sell?
- It sells: it is short gamma, which destabilises.