Factors

FRM Part II

1 A story: the cheap and the glamorous

- Dull, cheap shares versus exciting, expensive shares
- Over long periods the cheap group tended to win
- Not every year: that tendency is the value premium
- A factor premium rewards a type of exposure, not one stock

IN THE LESSON

- Larkfield's trustees ask a simple question.
- Some shares look dull and cheap, like a steel maker priced at less than the value of its plant.
- Others look exciting and expensive, like a fast growing software firm.
- Which group has done better over long periods?
- Historically, the cheap group has tended to win on average, though not every year.
- That tendency is the value premium.
- It is one of several factor premiums.
- Each is a reward that comes from holding a type of exposure, not from picking one lucky stock.
- The team wants to know how to capture it, and whether it will last.

2 How value investing is carried out

- Buy cheap relative to a fundamental anchor; sell expensive
- Ratios: book-to-market, earnings/price, cash flow/price
- Also dividend yield. A high ratio means cheap
- Rank every stock on the ratio
- Buy cheapest, sell dearest: long value, short growth

IN THE LESSON

- Value investing buys assets that look cheap relative to a fundamental anchor, and sells those that look expensive.
- The anchor is something real about the business.
- The first step is to pick a ratio of the anchor to the price.
- Common choices are book to market, earnings to price, cash flow to price and dividend yield.
- A high ratio means a lot of fundamental value per dollar of price.
- The second step is to rank every stock on that ratio.
- The third is to buy the cheapest group and sell the most expensive group, so the position is long value and short growth.
- Growth is the usual name for the expensive end.

3 Example 1: ranking on book-to-market

Book and market value of equity, $m. Book-to-market = book ÷ market

Arden Steel	600 ÷ 400	**1.50**
Bexley Retail	450 ÷ 500	**0.90**
Corran Foods	300 ÷ 375	**0.80**
Dunmore Tech	150 ÷ 750	**0.20**
Buy the top, sell the bottom	long Arden, short Dunmore	**1.50 vs 0.20**

IN THE LESSON

- Here are four shares on Larkfield's list, with book value and market value of equity in millions of dollars.
- Book to market is book divided by market.
- Arden Steel has book value of six hundred and market value of four hundred, a ratio of one point five.
- Bexley Retail has four hundred and fifty over five hundred, point nine.
- Corran Foods has three hundred over three hundred and seventy five, point eight.
- Dunmore Tech has one hundred and fifty over seven hundred and fifty, point two.
- Ranked from highest to lowest, Arden is the cheapest and Dunmore the dearest.
- With a real universe of thousands of stocks, the strategy buys the top group and sells the bottom group.
- Here that means long Arden and short Dunmore.

4 The Fama-French value factor, HML

HML = (SV + BV) ÷ 2 − (SG + BG) ÷ 2

Small value	Cheap, small companies
Big value	Cheap, large companies
Small growth	Expensive, small companies
Big growth	Expensive, large companies

IN THE LESSON

- Academics measure the value premium with a factor called H M L, high minus low, from the Fama-French model.
- The corner portfolios are small value, big value, small growth and big growth, each with its own monthly return.
- H M L takes the average of the two value portfolios and subtracts the average of the two growth portfolios.
- Why average across both sizes?
- Because small stocks behave differently from big ones.
- With small and big on both sides, H M L measures value and not size.
- Stocks are sorted by size and by book to market, and the middle group is left out.

5 Example 2: one month of HML

Last month: SV 2.4%, BV 1.6%, SG 0.8%, BG 1.2%

Value average	(2.4 + 1.6) ÷ 2	**2.0%**
Growth average	(0.8 + 1.2) ÷ 2	**1.0%**
HML for the month	2.0 − 1.0	**1.0%**

Small and big sit in both legs, so HML is size-neutral

IN THE LESSON

- Suppose that last month small value returned two point four per cent, big value one point six, small growth point eight and big growth one point two.
- The value average is two point four plus one point six, divided by two, which is two per cent.
- The growth average is point eight plus one point two, divided by two, which is one per cent.
- H M L for the month is two minus one, one per cent.
- So value beat growth by one percentage point.
- Notice that both legs hold small and big companies equally, which is why the factor is size neutral.

6 Why a value premium? The risk story

- Explanation 1: risk-based
- Value firms hold assets that are costly to scale back
- In a downturn they suffer most
- Losing in bad times is disliked, so investors demand more
- The premium is fair pay for risk

IN THE LESSON

- Why should cheap stocks earn more?
- There are two explanations.
- The first is risk based.
- Value firms often hold assets that are costly to scale back, such as plant and machinery that cannot easily be sold or shrunk.
- When the economy weakens, they are stuck with too much capacity, and their profits and share prices suffer most.
- So value stocks do worst in bad economic times.
- Investors dislike losing money exactly when times are hard, so they demand an extra return for holding these stocks.
- On this view the premium is fair pay for risk.

7 The behavioural story, and why it matters

- Explanation 2: behavioural
- Investors extrapolate past growth and overpay for glamour
- Limits to arbitrage keep the mispricing alive
- Risk-based premium: should persist
- Mispricing premium: should shrink as capital arbitrages it

IN THE LESSON

- The second explanation is behavioural.
- Investors extrapolate past growth.
- They assume that a firm that grew fast will keep growing fast, so they overpay for glamour stocks and dump unloved ones too cheaply.
- When growth disappoints, glamour prices fall and value prices recover.
- Why does nobody trade this away?
- Limits to arbitrage: betting against a mispricing is costly and risky, and it can get worse before it gets better.
- The two stories predict different futures.
- A risk based premium should persist, because the risk does not go away.
- A mispricing premium should shrink as more capital arbitrages it away.

8 Example 3: a value trap

Arden Steel: market value $400m. Sector earnings/price is 8%

Last year's earnings	reported	**$60m**
Trailing earnings/price	60 ÷ 400, vs sector 8%	**15%**
Next year's forecast	demand is collapsing	**$20m**
Forward earnings/price	20 ÷ 400	**5%**

A cheap-looking ratio is a signal to investigate, not proof of a bargain

IN THE LESSON

- Go back to Arden Steel, which has a market value of four hundred million dollars, in a sector whose earnings to price ratio is eight per cent.
- Arden looked cheapest on book to market.
- Here is the usual mistake: treating a low price relative to fundamentals as proof of a bargain.
- Some cheap stocks are value traps, cheap because their fundamentals are about to fall.
- Last year it earned sixty million, so its earnings to price ratio is fifteen per cent, far above its sector's eight per cent.
- It looks cheap.
- But demand for its steel is collapsing, and next year's earnings are forecast at only twenty million.
- On that forecast, earnings to price is just five per cent, below the sector.
- On forward numbers Arden is expensive.
- A cheap looking ratio is a signal to investigate, not a verdict.

9 Three economy-wide drivers

- Three drivers: growth, inflation, volatility
- Growth: bad times are weak growth, a recession
- Inflation: bad times are high or unexpected inflation
- Volatility: bad times are high volatility
- Ask how each asset behaves in each bad time

IN THE LESSON

- Factors are not only about stock characteristics.
- Behind every asset sit a few economy wide drivers that explain much of what it returns.
- There are three.
- Economic growth, inflation, and volatility.
- Each one defines a kind of bad time.
- For growth, bad times mean weak growth, such as a recession.
- For inflation, bad times mean high or unexpected inflation, which erodes the real value of money.
- For volatility, bad times mean high volatility, when markets swing wildly and usually fall.
- The key question for any asset is how it behaves in each of these bad times.

10 Assets are priced by bad times

- An extra unit of wealth is most valuable in bad times
- Loses in bad times: must offer a risk premium
- Pays off in bad times: a hedge, low or negative premium
- Hedges: government bonds in a disinflationary recession
- and put options in a volatility spike

IN THE LESSON

- Why do bad times matter so much?
- Because an extra unit of wealth is most valuable then.
- A thousand dollars matters far more to you when you have just lost your job than in a boom.
- So an asset that loses in bad times is unattractive, and it must offer a higher expected return to be held.
- That extra return is a risk premium.
- An asset that pays off in bad times is a hedge.
- Investors will hold it for a low or even a negative premium, as they would buy insurance.
- Two hedges: nominal government bonds in a recession with falling inflation, and put options in a volatility spike.

11 How assets line up with the drivers

Sign of the premium follows bad-times behaviour

Asset	Bad-times behaviour
Equities	Load on growth: fall in a slump
Nominal bonds	Hurt by inflation; gain in disinflation
Inflation-linked, commodities	Hedge inflation
Short volatility	Premium, but crashes when vol jumps
Index puts	Pay off in a spike: negative premium

IN THE LESSON

- The sign of each premium follows how the asset behaves in bad times.
- This table lists each asset class and how it behaves in bad times, row by row.
- Equities load on growth: they fall when growth weakens, so they earn a premium.
- Nominal bonds suffer when inflation rises, because fixed payments lose real value, but they gain in a disinflationary recession.
- Inflation linked bonds and commodities hedge inflation, because their value rises with prices.
- A short volatility position, meaning selling insurance against market swings, earns a premium most of the time but crashes when volatility jumps.
- Index put options are the other side of that trade.
- They pay off in a volatility spike, so they earn a negative premium.

12 Expected return from factor exposures

ER = rf + Σ β_k × λ_k

Expected return, ER	What the asset should earn
Risk-free rate, rf	Return with no risk
Exposure, beta k	Positive: loses in bad times
Premium, lambda k	Reward per unit of exposure

IN THE LESSON

- We can turn this into a formula.
- The expected return, E R, is roughly the risk-free rate plus a sum over all the drivers.
- Each term is an exposure times a premium.
- Beta k is the asset's exposure to driver k, signed so that a positive exposure means it loses in that driver's bad times.
- Lambda k is the premium for bearing driver k, the reward per unit of exposure.
- A hedge has a negative exposure, so it subtracts from the expected return.
- The key point: the premium depends on exposure to bad times, not on how volatile the asset is in total.

13 Example 4: equities and index puts

rf 2%. Premiums: growth 3%, inflation 1%, volatility 2%

Equities: exposures	growth 1.2, infl. 0.5, vol 0.8	**1.2, 0.5, 0.8**
Equities: ER	2 + 3.6 + 0.5 + 1.6	**7.7%**
Index puts: exposures	growth −0.5, infl. 0, vol −1.5	**−0.5, 0, −1.5**
Index puts: ER	2 − 1.5 − 3.0	**−2.5%**

IN THE LESSON

- Larkfield's team assumes a risk-free rate of two per cent and premiums of three per cent for growth, one per cent for inflation and two per cent for volatility.
- Its equity holdings have exposures of one point two to growth, point five to inflation and point eight to volatility.
- Expected return is two, plus one point two times three, three point six, plus point five times one, point five, plus point eight times two, one point six.
- That is seven point seven per cent.
- Now a position in index puts, with exposures of minus point five to growth, zero to inflation and minus one point five to volatility.
- Expected return is two minus one point five minus three, which is minus two point five per cent.
- The hedge costs money on average.

14 Example 5: volatility is not the premium

Same premiums: rf 2%, growth 3%, inflation 1%, volatility 2%

Asset X: volatility 30%	exposures all zero	**0, 0, 0**
Asset X: ER	2 + 0	**2.0%**
Asset Y: volatility 15%	growth 1, vol 1	**1, 0, 1**
Asset Y: ER	2 + 3 + 2	**7.0%**

The calmer asset earns more: premium follows bad-times exposure

IN THE LESSON

- Keep the same risk-free rate and premiums as before.
- Now the usual mistake: equating the premium with total volatility.
- Take two assets.
- Asset X is very volatile, at thirty per cent a year, but its ups and downs have nothing to do with growth, inflation or market volatility.
- Its exposures are all zero, so its expected return is just the risk-free rate, two per cent.
- Asset Y is calmer, at fifteen per cent, but it has an exposure of one to growth and one to volatility, so it loses in bad times.
- Its expected return is two plus three plus two, seven per cent.
- The calmer asset earns more, because the premium follows bad times exposure.

15 Four ways to reduce volatility risk

Volatility risk: volatility rises, usually as prices fall

Approach	Its price
Less equity, more bonds or cash	Gives up equity premium
Puts, variance swaps, vol futures	Negative expected premium
Tilt to low-volatility stocks	Reduces, does not remove
Rules, e.g. volatility targeting	React after losses; trade a lot

IN THE LESSON

- Volatility risk is the risk that market volatility rises.
- It usually arrives together with falling prices.
- Larkfield has four ways to reduce it, and each has a price.
- First, hold less equity and more bonds or cash.
- That gives up part of the equity premium.
- Second, buy protection, through index puts, variance swaps, which pay out when realised variance exceeds an agreed level, or volatility futures.
- Protection earns a negative expected premium.
- Third, tilt towards low volatility stocks.
- That reduces exposure but does not remove it.
- Fourth, follow rules that cut risk when volatility rises, such as volatility targeting.
- Rules react after losses and trade a lot.

16 Example 6: what protection costs

Implied volatility 20% vs realised 16% on average. Equity sleeve $6bn

Premiums paid	a year, on the sleeve	**2.5%**
Average payout	mostly in rare crashes	**1.5%**
Expected net cost	2.5 − 1.5	**1.0% a year**
In dollars	1.0% × $6bn	**$60m a year**

IN THE LESSON

- Larkfield sees implied volatility of twenty per cent, while realised volatility averages sixteen, and its equity sleeve is six billion dollars.
- Why is protection expensive?
- Because implied volatility, the volatility built into option prices, exceeds the volatility actually realised, on average.
- Puts priced off the higher number cost more than they pay back on average.
- Suppose, for illustration, a rolling put programme on the whole sleeve costs two point five per cent a year in premiums, and pays out one point five per cent a year on average, mostly in rare crashes.
- The expected net cost is one per cent a year, which is sixty million dollars.
- The two volatilities explain why the net cost is positive, not how large it is.
- That is the negative premium of insurance.
- It may be worth paying, but it is not free.

17 Volatility targeting

Weight = target ÷ forecast

Weight in the risky asset	Share in risky asset; rest is cash
Target volatility	Volatility the investor wants
Forecast volatility	Of the risky asset

IN THE LESSON

- The fourth approach deserves a formula.
- Under volatility targeting, the weight in the risky asset is the target divided by the forecast.
- The rest sits in cash, which we treat as riskless.
- The target is the volatility the investor wants for the portfolio.
- The forecast is the forecast volatility of the risky asset.
- When the forecast rises, the weight falls, so risk is cut as volatility rises.
- When the forecast falls, the weight rises.
- A weight above one hundred per cent means borrowing to hold more than the whole portfolio.

18 Example 7: weights under a 10% target

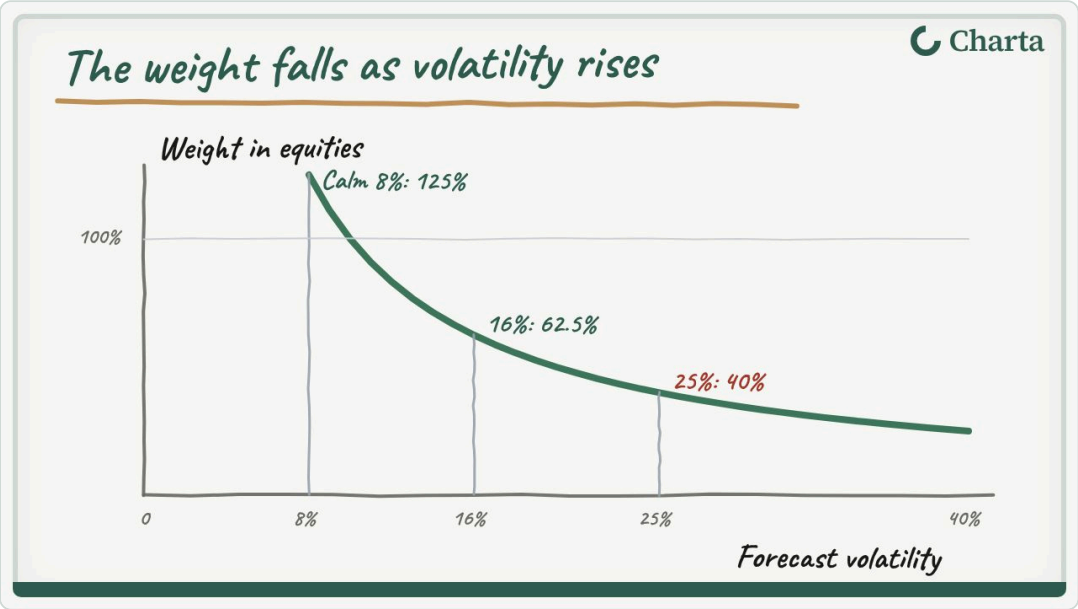
Target volatility 10%. Weight in equities = 10% ÷ forecast

Calm: forecast 8%	10 ÷ 8, needs borrowing	**125%**
Normal: forecast 16%	10 ÷ 16	**62.5%**
Stressed: forecast 25%	10 ÷ 25	**40%**
Normal to stressed	62.5 − 40	**sell 22.5 pts**

IN THE LESSON

- Larkfield sets a target volatility of ten per cent for one of its portfolios.
- In calm markets, the forecast volatility of equities is eight per cent, so the weight is ten divided by eight, one hundred and twenty five per cent.
- That requires borrowing.
- In normal markets, the forecast is sixteen per cent, and the weight is ten divided by sixteen, sixty two point five per cent.
- In stressed markets, the forecast jumps to twenty five per cent, and the weight is ten divided by twenty five, forty per cent.
- Moving from normal to stressed, the rule sells twenty two point five per cent of the portfolio out of equities.

19 The weight falls as volatility rises



IN THE LESSON

- This chart draws the rule.
- Along the bottom is forecast volatility, from zero to forty per cent.
- Up the side is the weight in equities.
- The green curve is ten per cent divided by the forecast.
- It starts high at the left, at one hundred and twenty five per cent when the forecast is eight per cent.
- At sixteen per cent the weight is sixty two point five.
- At twenty five per cent it is forty.
- The level of one hundred per cent is marked on the side.
- The curve is steepest where volatility is low, so small changes in a calm forecast move the weight a lot.
- And the rule only moves after the forecast has risen.

20 Example 8: selling low, missing the rebound

$100 at 62.5% in equities. Market falls 20%, then rebounds 15%. Cash earns 0

After the 20% fall	62.5 × 0.8 = 50; cash 37.5	**87.5**
Rule cuts to 40%	40% × 87.5 = 35; sells 15	**35 in equities**
After 15% rebound: rule	35 × 1.15 + cash 52.5	**92.75**
After 15% rebound: hold	50 × 1.15 + cash 37.5	**95.00**
Cost of reacting late	95.00 − 92.75	**2.25**

IN THE LESSON

- Start with one hundred dollars at the normal weight, sixty two point five in equities and thirty seven point five in cash, which earns nothing.
- The market will fall twenty per cent and then rebound fifteen.
- Here is the main difficulty.
- The market falls twenty per cent, so equities are worth fifty and the total is eighty seven point five.
- Only now does the forecast jump to twenty five per cent.
- The rule cuts to forty per cent of eighty seven point five, which is thirty five, so it sells fifteen dollars of equities after the fall.
- Then the market rebounds fifteen per cent.
- The rule's equities grow to forty point two five, plus cash of fifty two point five, ninety two point seven five.
- Holding instead gives fifty times one point one five, plus thirty seven point five, ninety five.
- Reacting late cost two point two five dollars, before trading costs.

21 Why volatility risk is hard to manage

- Persistent, but mean-reverting, and it jumps
- Rules react after losses: sell low, miss the rebound
- Trading costs every time the weight changes
- Selling volatility adds crash risk in bad times
- Every hedge costs expected return: none is free

IN THE LESSON

- Let us collect the difficulties.
- Volatility is persistent, so a calm or a stormy period tends to last, which is why forecasting works at all.
- But it is also mean reverting, and it jumps.
- A jump arrives before any forecast can react, so rules respond after the losses, and can sell low and miss the rebound, as we just saw.
- Trading costs apply each time the weight changes.
- Some investors sell volatility to earn its premium, but that adds crash risk exactly in bad times.
- And every hedge costs expected return.
- No approach to volatility risk is free.

22 The Fama-French three-factor model

$r = \alpha + \beta_{mkt} \times MKT + \beta_{SMB} \times SMB + \beta_{HML} \times HML + \varepsilon$

Alpha	Return not explained by factors
MKT: market minus rf	Market return minus rf
SMB: small minus big	Small-cap minus large-cap
HML: value minus growth	Value minus growth
Residual, epsilon	Random residual

IN THE LESSON

- Now we use the Fama-French model to see how factors work inside a return model.
- It explains a portfolio's excess return, its return over the risk-free rate, with three factor returns, each with its own beta, the portfolio's loading on it.
- Alpha is the part not explained by the factors.
- M K T is the market return minus the risk-free rate.
- S M B, small minus big, is the return of small companies minus large ones.
- H M L is value minus growth, as we built it earlier.
- Epsilon is the random residual.
- On average, expected excess return is the sum of each beta times its factor premium, and alpha is whatever is left.

23 Example 9: how much is really alpha?

Manager: 8.0% excess return. Factors averaged MKT 5%, SMB 1%, HML 2%

Market	1.1 × 5	**5.5%**
Size	0.4 × 1	**0.4%**
Value	0.5 × 2	**1.0%**
Alpha after factors	8.0 − (5.5 + 0.4 + 1.0)	**1.1%**
Market-only 'alpha'	8.0 − 5.5	**2.5%**

IN THE LESSON

- Larkfield's equity manager earned an average excess return of eight per cent a year.
- Over the same years the market, size and value factors averaged five per cent, one per cent and two per cent.
- A regression gives betas of one point one on the market, point four on size and point five on value.
- The market explains one point one times five, five point five.
- Size explains point four times one, point four.
- Value explains point five times two, one point zero.
- Together that is six point nine, so alpha is eight minus six point nine, one point one per cent.
- Judged against the market alone, alpha would look like eight minus five point five, two point five.
- Ignoring size and value would more than double the apparent skill.

24 Factors that change over time

- Premia fluctuate and can be negative for years
- A short-sample average premium is noisy
- Betas drift: exposure is not fixed
- Constant-beta regression then misstates alpha
- Expect long dry spells, even for sound factors

IN THE LESSON

- The factors are time varying.
- Their premia fluctuate, and they can be negative for years.
- Value, for example, can lag growth for a long stretch.
- So an average premium estimated from a short sample is noisy, as we will measure next.
- Betas can drift too: a manager's exposure to a factor is not fixed.
- A regression that assumes constant betas then misstates alpha, when exposure moves together with the factor's returns.
- The practical lessons are to judge alpha only after controlling for factors, and to expect long dry spells, even for sound factors.

25 How noisy is an average premium?

SE = σ ÷ √n
Years needed: n = (t × σ ÷ premium)^2

Standard error, SE	Uncertainty in the average
Factor volatility, sigma	Annual volatility of the factor
Years of data, n	Number of annual returns
t-statistic wanted	Usually 2

IN THE LESSON

- How noisy is an average?
- The standard error of the average premium is sigma divided by the square root of n.
- Sigma is the factor's annual volatility, and n is the number of years of data.
- The error shrinks only slowly as data are added.
- We can turn this around.
- To be confident a premium is real, we usually want its average to be about two standard errors above zero.
- That ratio, the average premium divided by its standard error, is the t statistic.
- Solving for n, the years needed are the t statistic times sigma, divided by the premium, all squared.

26 Example 10: ten years of a value premium

Value factor: 10 years, average 3% a year, volatility 12%

Standard error	12 ÷ √10	**3.79%**
t-statistic	3 ÷ 3.79	**0.79**
Range of ± 2 SE	3 ± 7.59	**−4.6% to 10.6%**
Years needed for t = 2	(2 × 12 ÷ 3)^2 = 8^2	**64 years**

IN THE LESSON

- Larkfield's analyst has ten years of a value factor, with an average premium of three per cent a year and a volatility of twelve per cent.
- The standard error is twelve divided by the square root of ten, about three point seven nine per cent.
- The t statistic is three divided by three point seven nine, about point seven nine, well short of two.
- A range of two standard errors either side runs from minus four point six to plus ten point six per cent.
- So ten years cannot tell a real premium from luck.
- How long would it take?
- Two times twelve divided by three is eight, and eight squared is sixty four years.

27 Example 11: a drifting beta looks like alpha

Value holdings only. Year 1: HML 10%, beta 1. Year 2: HML −6%, beta 0

Year 1 return	1 × 10	**10%**
Year 2 return	0 × −6	**0%**
Constant-beta slope	(10 − 0) ÷ (10 − (−6))	**0.625**
Fitted 'alpha'	10 − 0.625 × 10	**3.75%**

All of it came from moving exposure, so the regression misstates alpha

IN THE LESSON

- Now a drifting beta.
- A manager holds only value stocks, but changes the value exposure from year to year.
- In effect the manager held value only when the value factor did well.
- In year one, H M L returned ten per cent, and the manager's value beta was one, so the value holdings earned ten.
- In year two, H M L returned minus six per cent, and the beta was zero, so they earned nothing.
- Fit one straight line through the two years, as a constant beta regression does.
- The slope is ten minus zero, over ten minus minus six, which is point six two five.
- The intercept, the alpha, is ten minus point six two five times ten, three point seven five per cent.
- The regression reports alpha, yet every dollar came from moving factor exposure.

28 Momentum, and how it differs from value

- Value: buys cheap assets, contrarian
- Momentum: buys winners, sells losers; follows trends
- Rank on the past 12 months, excluding the latest month
- Both earned positive premiums; momentum's often as large
- The differences: costs, crash risk, correlation

IN THE LESSON

- Value has a famous rival, momentum.
- Value buys cheap assets, which are often recent losers, so it is contrarian: it bets that prices will come back.
- Momentum buys recent winners and sells recent losers, so it follows trends.
- Winners are usually ranked on the past twelve months of return, excluding the latest month.
- Historically both strategies have earned positive average premiums, with momentum's often comparable to or larger than value's.
- But averages hide the real differences, which lie in costs, crash risk and correlation.

29 Value and momentum side by side

Each risk is different: compare more than the average return

Feature	Value	Momentum
Style	Contrarian	Trend-following
Turnover	Low	High: costs bite
Main risk	Long dry spells	Sudden crashes
Correlation	Negative with momentum	Negative with value

IN THE LESSON

- Compare more than the average return, because each strategy carries a different risk.
- This table sets the two side by side, row by row.
- On style, value is contrarian and momentum follows trends.
- On turnover, value trades slowly, because cheapness changes slowly, while momentum trades a lot, as last year's winners keep changing.
- So trading costs absorb more of momentum's premium.
- On the main risk, momentum suffers sudden crashes, while value can underperform for long periods.
- And the two tend to be negatively correlated, which makes them good partners.
- Let us put numbers on each of these.

30 Example 12: premiums after trading costs

Gross: value 4%, momentum 6%. Cost 0.6% per unit of turnover

Value turnover	half the portfolio a year	**0.5**
Momentum turnover	four times a year	**4.0**
Value, net of costs	4.0 − 0.5 × 0.6	**3.7%**
Momentum, net of costs	6.0 − 4.0 × 0.6	**3.6%**

Net premium = gross premium − turnover × cost

IN THE LESSON

- Larkfield's team expects gross premiums of four per cent a year for value and six per cent for momentum.
- On the face of it, momentum wins by two points.
- But value turns over half the portfolio each year, and momentum four times the portfolio.
- Trading costs are point six per cent for each unit of turnover.
- Value's net premium is four minus point five times point six, three point seven per cent.
- Momentum's is six minus four times point six, three point six per cent.
- After costs, the two point advantage has gone, and momentum now trails slightly.
- Net premium is gross premium minus turnover times cost.

31 Example 13: a momentum crash

After a decline: winners' beta 0.6, losers' beta 1.6. Market rebounds 20%

Long winners	0.6 × 20	**+12%**
Short losers	1.6 × 20, lost on the short	**−32%**
Momentum, net	12 − 32	**−20%**

Crashes typically come in a sharp rebound after a decline

IN THE LESSON

- Now the crash risk.
- After a long market decline, momentum's winners tend to be defensive, low beta stocks, and its losers are the beaten down, high beta stocks.
- Suppose the winners have a beta of point six and the losers a beta of one point six.
- Then the market rebounds sharply, by twenty per cent.
- The long leg gains point six times twenty, twelve per cent.
- The short leg of losers snaps back by one point six times twenty, thirty two per cent, and the strategy loses that on its short.
- The net result is twelve minus thirty two, a loss of twenty per cent, in a month the market soared.
- Typical timing: a sharp rebound after a decline.

32 Example 14: combining value and momentum

Net: value 3.7%, vol 12%; momentum 3.6%, vol 14%; correlation −0.5

Value Sharpe ratio	3.7 ÷ 12	**0.31**
Momentum Sharpe ratio	3.6 ÷ 14	**0.26**
50/50 return	(3.7 + 3.6) ÷ 2	**3.65%**
50/50 volatility	√(36 + 49 − 42) = √43	**6.56%**
50/50 Sharpe ratio	3.65 ÷ 6.56	**0.56**

IN THE LESSON

- Finally, combine them.
- Using the net premiums, value earns three point seven per cent with volatility of twelve, a Sharpe ratio, return per unit of volatility, of point three one.
- Momentum earns three point six with volatility of fourteen, a Sharpe ratio of point two six.
- Their correlation is minus point five.
- Half in each earns three point six five per cent.
- The variance is a quarter of one hundred and forty four, thirty six, plus a quarter of one hundred and ninety six, forty nine.
- The correlation term is two times a half times a half times minus point five times twelve times fourteen, which is minus forty two.
- Thirty six plus forty nine minus forty two is forty three.
- Volatility is the square root, six point five six per cent.
- The Sharpe ratio is point five six, higher than either alone.
- Negative correlation is the reason to hold both.

33 Mistakes to avoid

- A cheap-looking ratio is not proof of a bargain
- Premium follows bad-times exposure, not total volatility
- No volatility hedge is free; rules react after losses
- Short samples are noisy; drifting betas fake alpha
- Value vs momentum: count costs, crashes, correlation

IN THE LESSON

- Before the questions, here are the traps from this lesson.
- First, a cheap looking ratio is not proof of a bargain, because some cheap stocks are value traps.
- Second, a premium is not the same as total volatility: it rewards exposure to bad times.
- Third, no volatility hedge is free, and rules that cut risk react after the losses.
- Fourth, a short sample cannot establish a factor premium, and a constant beta regression can turn moving exposure into apparent alpha.
- Fifth, never compare value and momentum on average returns alone.
- Count trading costs, crash risk and correlation.

34 Try three quick questions

1. SV 1.8%, BV 1.0%, SG 2.2%, BG 1.4%. What is HML?
   Answer: 1.4 − 1.8 = −0.4%. Value lost.
2. Target volatility 12%, forecast 20%. Weight in equities?
   Answer: 12 ÷ 20 = 60%.
3. Factor volatility 15%, 25 years of data. SE of the average?
   Answer: 15 ÷ √25 = 3%.

IN THE LESSON

- Now try three quick questions.
- Pause the video, think, then listen to the answers.
- Question one.
- In one month, small value returns one point eight per cent, big value one per cent, small growth two point two per cent and big growth one point four per cent.
- What is H M L?
- The value average is one point four, the growth average is one point eight, so H M L is minus point four per cent.
- Value lost that month.
- Question two.
- A fund targets twelve per cent volatility, and the forecast volatility of equities is twenty per cent.
- What weight goes in equities?
- Twelve divided by twenty, sixty per cent.
- Question three.
- A factor has a volatility of fifteen per cent a year and twenty five years of data.
- What is the standard error of its average premium?
- Fifteen divided by five, three per cent.