UBS

Global Research

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Practical issues in building risk premia portfolios

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Introduction

- Over the past twelve months, we have helped the UBS structuring team build a set of equity “alternative risk premia” indices.
- This has meant making a number of choices in terms of portfolio construction (never mind the factors themselves).
- Are our choices “correct”? Possibly not.
- In this presentation we highlight some of the research we have carried out to justify the choices we have helped the structuring team make.

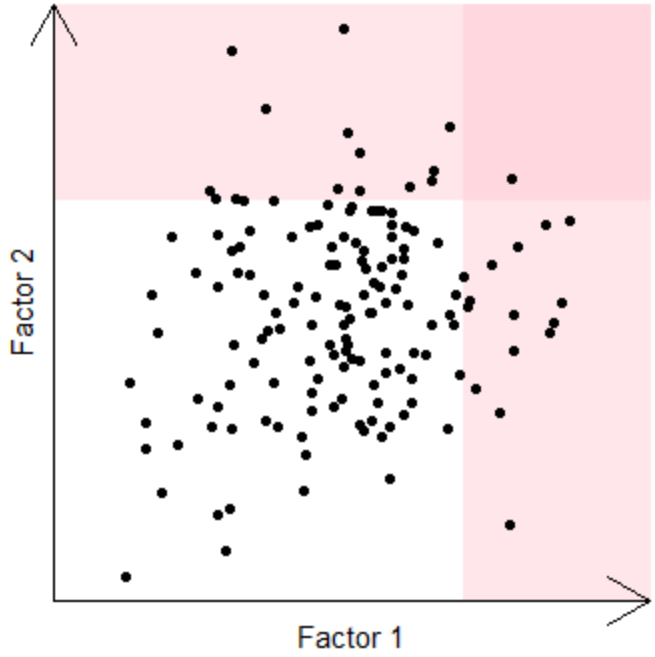
Section 1

Mix or integrate?

Mix or Integrate / Top-down or bottom-up

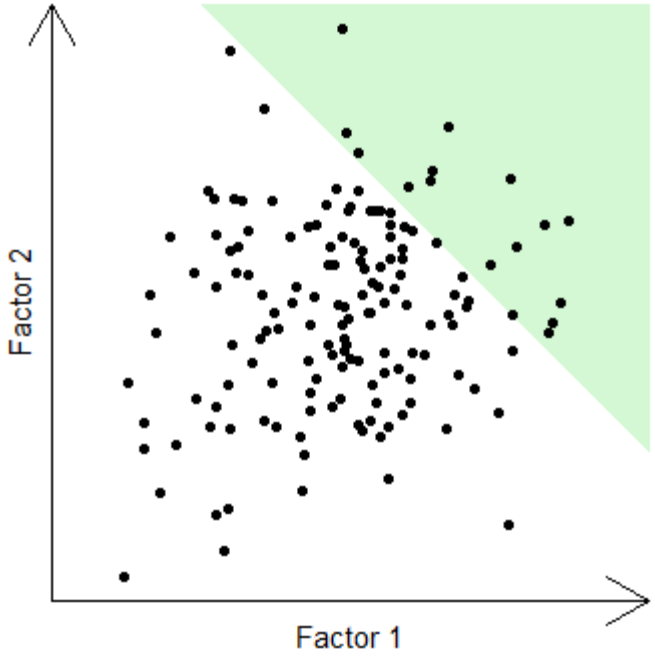
Mixed, aka top-down

- take weights in individual style portfolios
- buy stocks that are highly ranked by either factor, even if they look unattractive by the other
- stocks that rank highly by *both* factors get a higher weight



Integrated, aka bottom-up

- create a composite score with the different style factors and then construct a portfolio with that score
- buy stocks that are fairly highly ranked by both factors
- reject stocks that are very unattractive by either factor



Source: UBS Quantitative Research, illustrative example of long only mixed and integrated approaches

Which is better? (1)

- Academic literature favours the integrated approach (although the debate is not fully settled):
- Clarke et al found that a mixed approach captured less than half of the improvement of the Sharpe ratio vs the benchmark compared to an integrated approach, when trying to combine four long-only factors.

  Clarke, de Silva and Thorley, "Fundamentals of Efficient Factor Investing" (2016)

- Fitzgibbons et al found a return pick-up of c.1% p.a. using the integrated approach vs the mixed approach and a 40% increase in the information ratio for long-only portfolios.

  Fitzgibbons, Friedman, Pomorski & Serban, "Long-Only Style Investing: Don't Just Mix, Integrate" (2016)

- However, Leippold & Rüegg suggest these long-only results are due to data snooping and that, once you adjust for that there is no significant difference between the two approaches.

  Leippold and Rüegg, The Mixed vs the Integrated Approach to Style Investing: Much Ado About Nothing? (2017)

Which is better? (2)

- Factors which improve the performance of integrated relative to mixed:
  - Greater number of style factors
  - More negatively correlated styles
  - Long-only portfolios rather than long-short portfolios
- The majority of AUM in multi-factor smart beta ETFs and mutual funds use a mixed approach, suggesting the industry still prefers mixed over integrated.

Source: Chow, Li & Shim, "Smart Beta Multi-Factor Construction Methodology: Mixing vs Integrating" (2017)

Pros and cons of integrated approach

Advantages

- Typically better risk-adjusted returns in long-only portfolios.
- Can outperform the individual style factor portfolios.
- Will not buy stocks that look very unattractive by one or more of your style factors.

Disadvantages

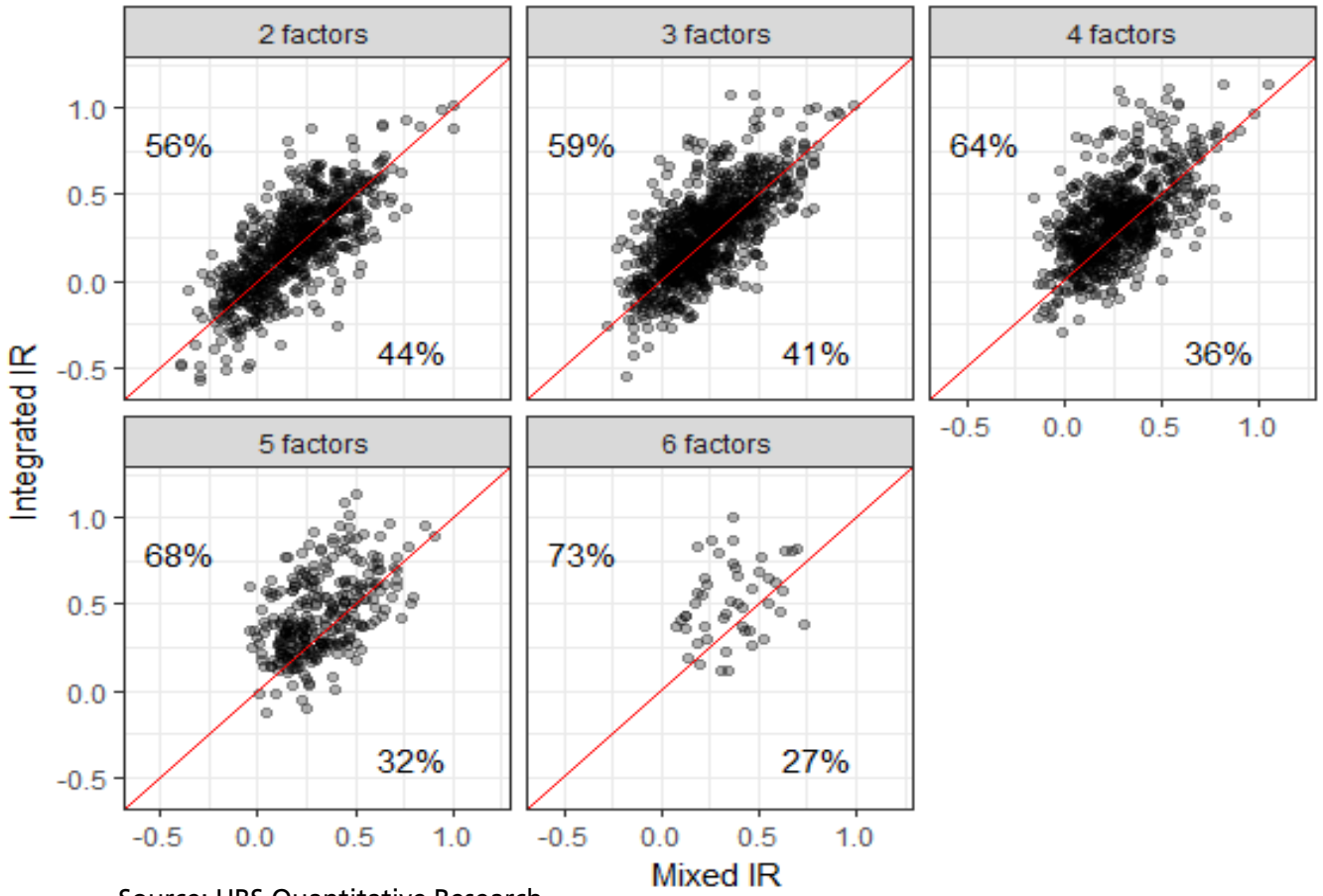
- Less transparency – it is much easier to do performance attribution with the mixed approach.
- More concentrated portfolios.
- Vulnerable to over-fitting when you create your composite score.
- Harder to change style allocation.
- Difficult to incorporate volatility targeting for momentum strategy or leverage for low-beta strategy

Our analysis

- We tried building portfolios using two or more style factors and running backtests.
- Our style factors were forecast earnings growth, 12-month price momentum, volatility, ROIC, earnings yield and market-cap
- For each combination of styles, we created two portfolios (one mixed and one integrated) using a variety of different portfolio construction specifications:
  - Four regions
  - long only or long short
  - Equal weighted or cap weighted
  - Top / bottom thirds or quintiles or deciles
- We then compared the performance of these pairs of portfolios (mixed vs integrated).

Naïve results: long only

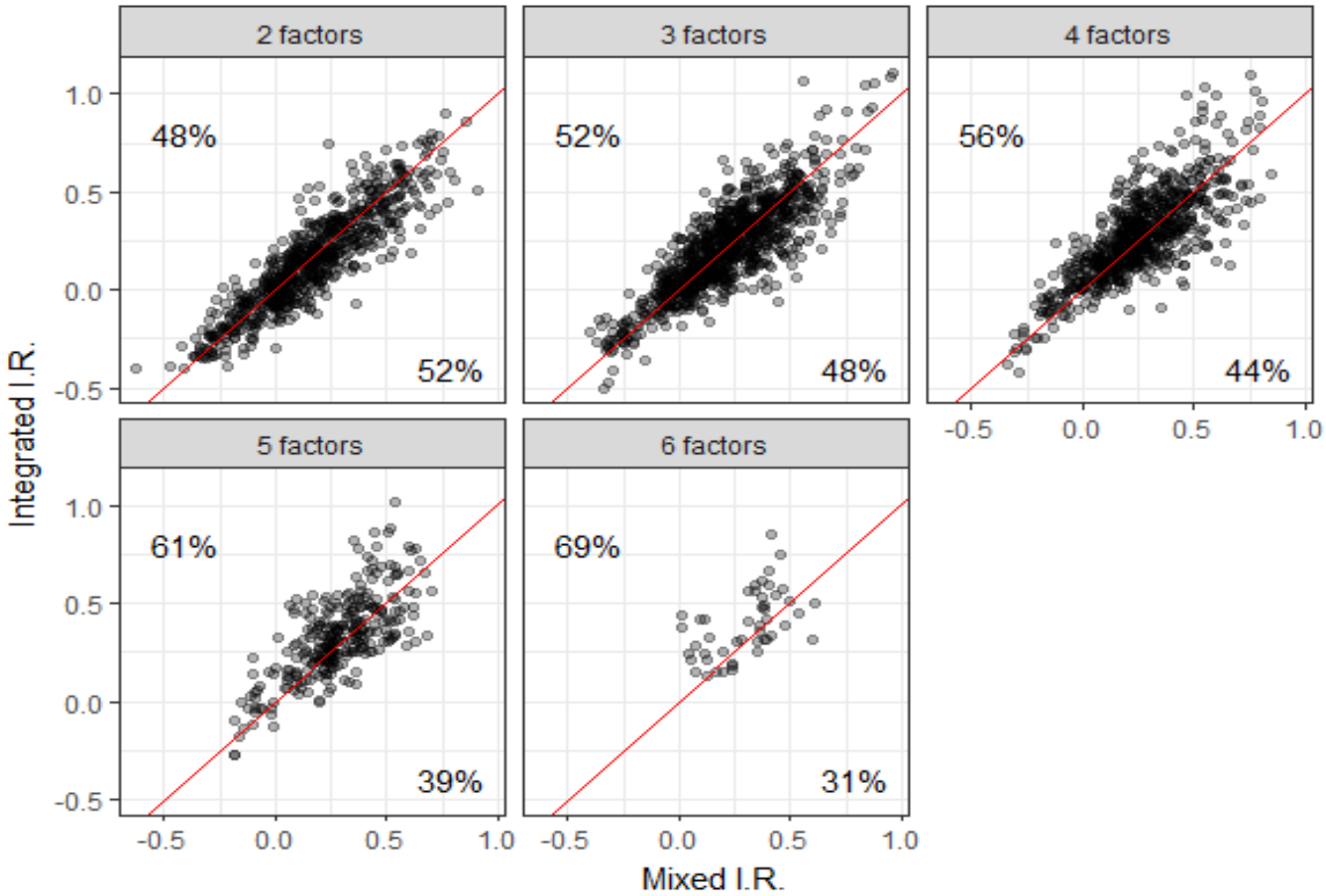
- As a first look at the long-only data we have plotted the information ratios of the mixed portfolio against the corresponding integrated portfolio.
- Integrated typically outperforms, particularly when combining many factors.



Source: UBS Quantitative Research

Naïve results: long short

- For the long-short results the picture is more ambiguous.
- When combining two or three factors, neither the mixed nor the integrated approach was consistently more successful. When combining more factors though, integrated appears better.



Source: UBS Quantitative Research

Is this conclusive?

No:

- The data-points on the charts are not independent – if integrated outperforms mixed for one portfolio, then it most likely will for the other portfolio construction specifications. This can cause statistical issues.
- Very few of the pairs of portfolios have significantly different information ratios under a Ledoit & Wolf test.
- Given the very large number of backtests here, we would need to correct for multiple hypothesis testing to decide if / how many of these results are significant.

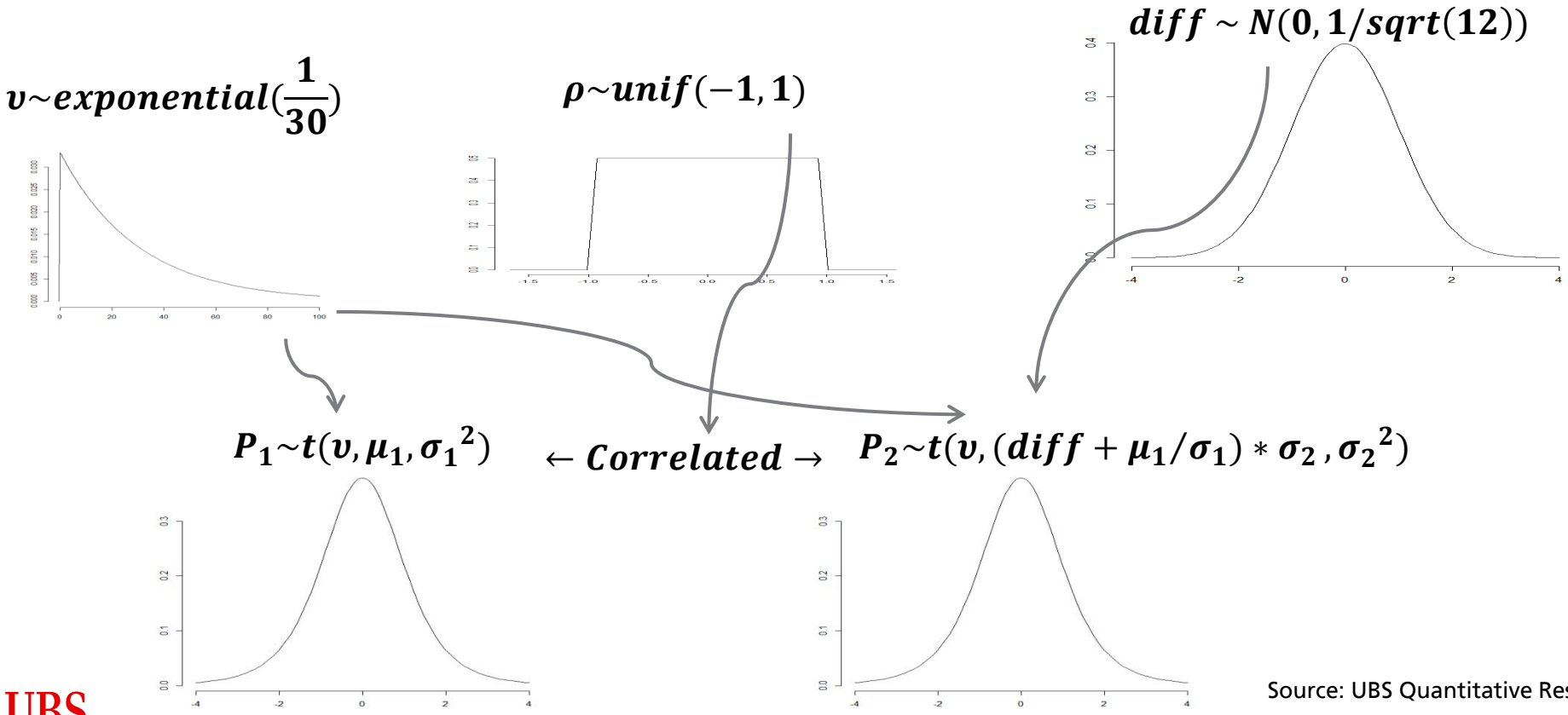
- We turn to Bayesian statistics for a more robust approach to distinguishing between the performance of each pair of portfolios.

Bayesian approach

- To quote Andrew Gelman, “Bayesian statistics uses the mathematical rules of probability to combine data with prior information to yield inferences which (if the model being used is correct) are more precise than would be obtained by either source of information alone.”
- In this case the data we have is the (simulated) returns to a set of pairs of portfolios. The parameters of each pair are identical except one has been created using a mixed approach, the other an integrated one.
- What we wish to model is the difference in the Sharpe ratios. To do this we need to model a correlated pair of returns.
- The approach we took was inspired by the article “Bayesian estimation supersedes the t test” by Kruschke (2012). This also has a good introduction to Bayesian statistics.

A sketch of the model

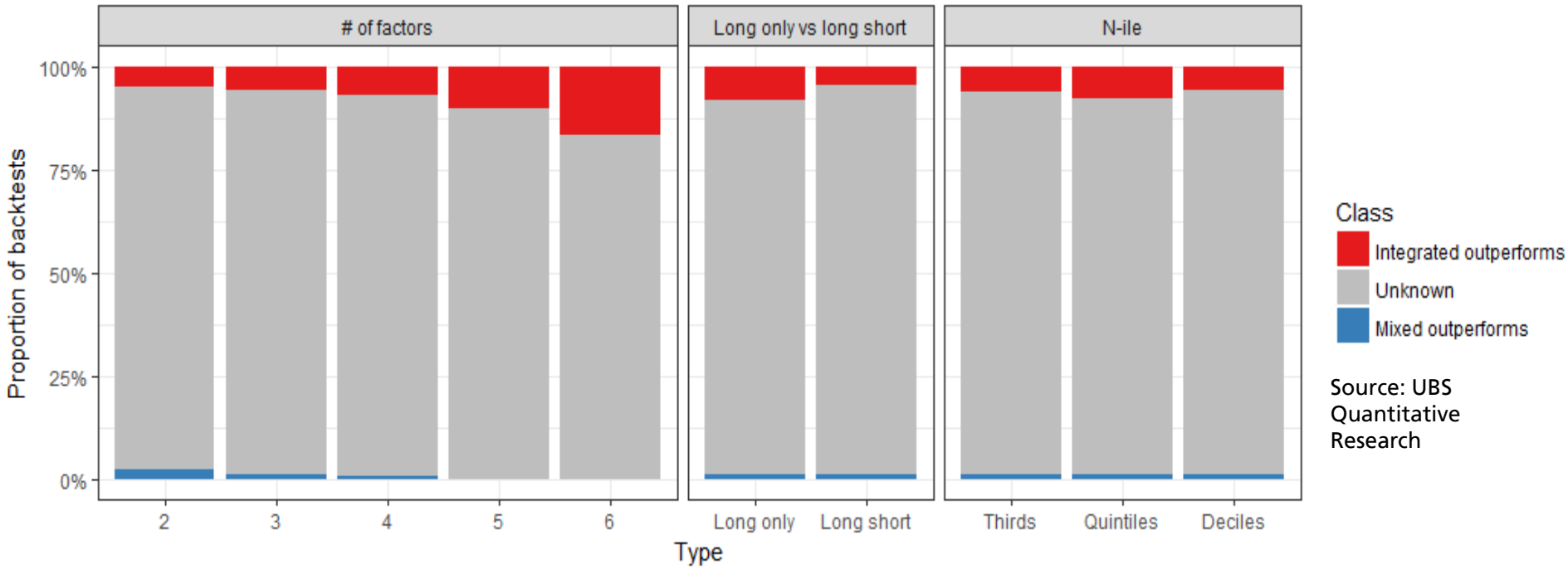
- For much of the modelling we assumed very little about the data (i.e. we used uninformative priors), except for the distribution of the difference itself. We use a correlated t-distribution for the portfolio returns.



Source: UBS Quantitative Research

Bayesian results

- What proportion of the backtests can our Bayesian analysis suggest a significant difference between the mixed and integrated risk-adjusted returns?



Source: UBS Quantitative Research

- For the great majority of cases, there does not appear to be any real difference between mixed and integrated performances.
- However, the integrated approach was much more likely to be significantly better than the mixed approach. This probability is higher for long only portfolios and for portfolios combining a large number of factors.

Conclusions

- The evidence does suggest a weak performance advantage to the integrated approach, but it is weak and inconsistent.
- Investors should weigh up the possible performance gains vs the disadvantages of lower transparency and more concentrated portfolios.
- The case for integrated over mixed appears stronger with long only portfolios and when combining large numbers of factors.

Section 2

Equal or cap weights?

Should we use equal or cap weighting?

- Once we have chosen the stocks to go into a portfolio, what portfolio construction methodology should we use? Two obvious options are cap (or free float) weighting or equal weighting. Both have benefits.
- Free float weighting (probably) gives you better liquidity and lower transaction costs amongst other things.
- Equal weighting gives you an automatic small cap tilt. It also has a "rebalancing premium" (effectively an exposure to short term price reversals).

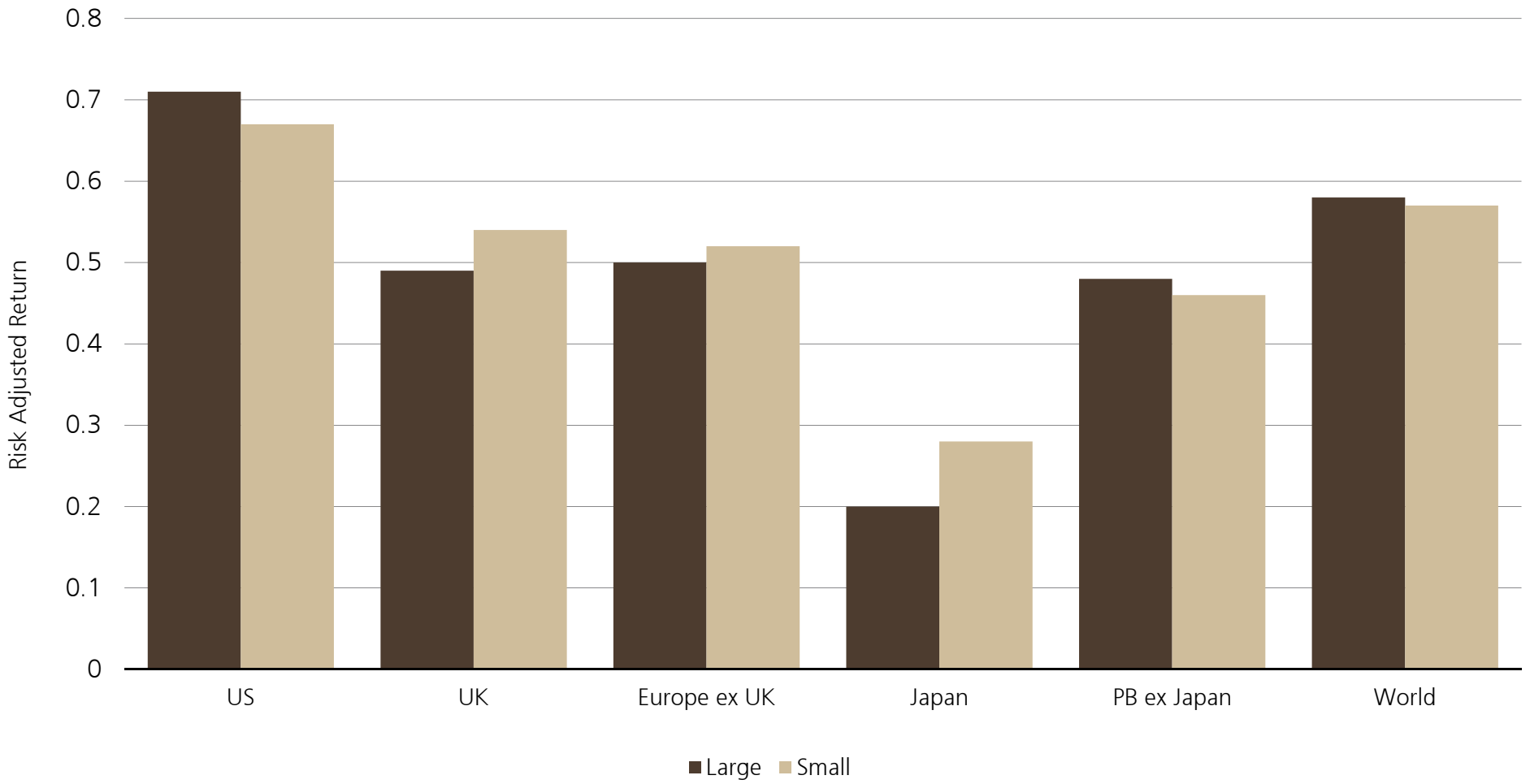
Is there a small cap effect?

- At least from 1992 the evidence of a small cap effect is limited. Smaller caps tend to have a higher return, but with higher risk.
- Given the costs of trading in smaller companies are higher, why would we want to equal weight and have a smaller cap bias?

	US		UK		Europe ex UK		Japan		PB ex Japan		World	
	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small
Geometric Ret	9.3%	11.1%	6.6%	9.0%	7.8%	8.6%	2.1%	3.7%	8.4%	8.3%	7.6%	8.4%
Arithmetic Ret	9.9%	12.2%	7.7%	10.7%	9.2%	10.3%	3.9%	5.8%	10.8%	11.0%	8.4%	9.6%
Std Dev	14.1%	18.2%	15.6%	19.7%	18.5%	19.9%	19.1%	20.9%	22.5%	24.1%	14.6%	16.9%
Risk Adj Ret	0.71	0.67	0.49	0.54	0.50	0.52	0.20	0.28	0.48	0.46	0.58	0.57

Source: UBS Quantitative Research. Table shows annualised returns and standard deviations for the Dow Jones Large and Small Cap Indices. The returns are total returns in USD from 1/1/1992.

Is there a small cap effect?



Source: UBS Quantitative Research. Chart shows the risk adjusted returns for the Dow Jones Large and Small Cap Indices. The returns are total returns in USD from 1/1/1992.

What affects the performance of quant strategies?

- The fundamental law of active management:

  Information Ratio = Information Coefficient x √ (# of bets)

  would suggest:

  i. IC of quant signals

  ii. Breadth of the universe (how many possible bets are there)

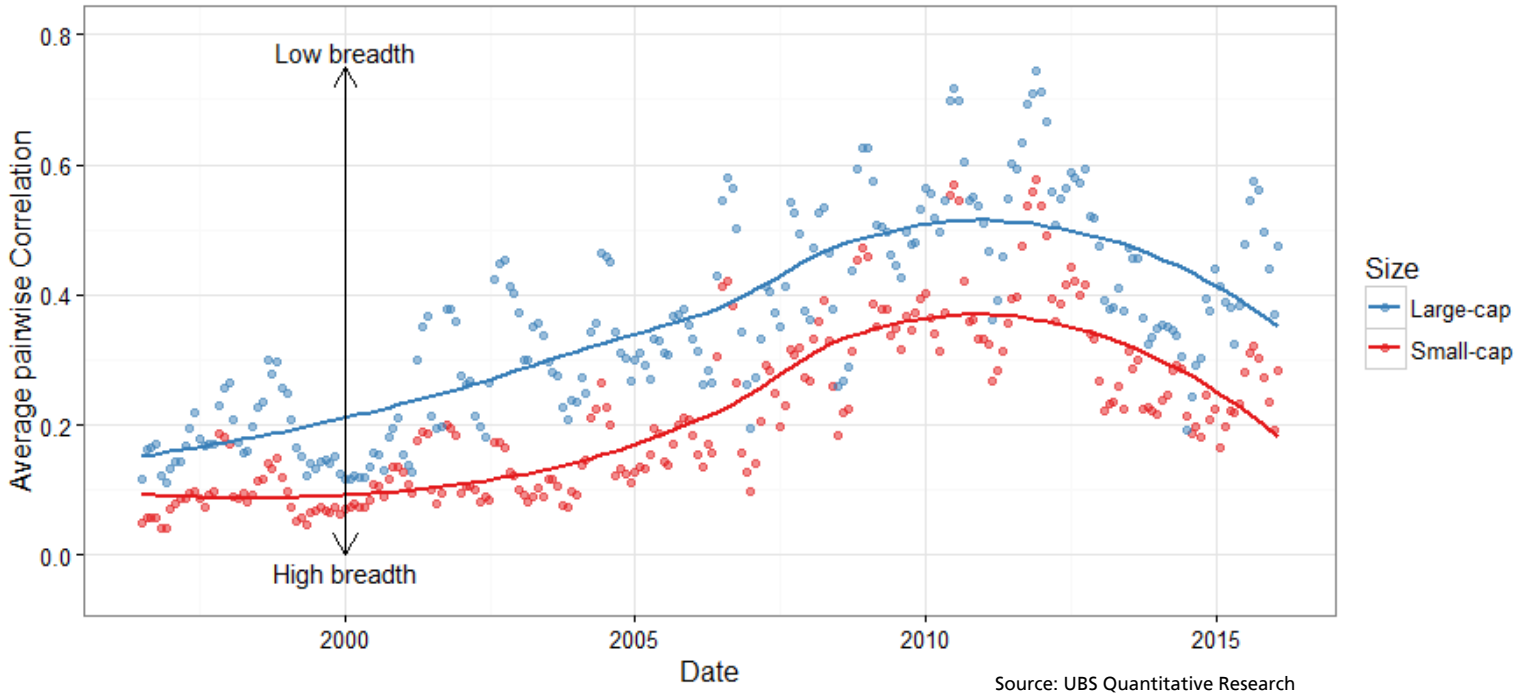
- And we would further add:

  iii. Trading costs

Breadth

- Small-cap stocks consistently move together less than large-cap stocks stocks.

Average pairwise correlation: Are the stocks moving together?

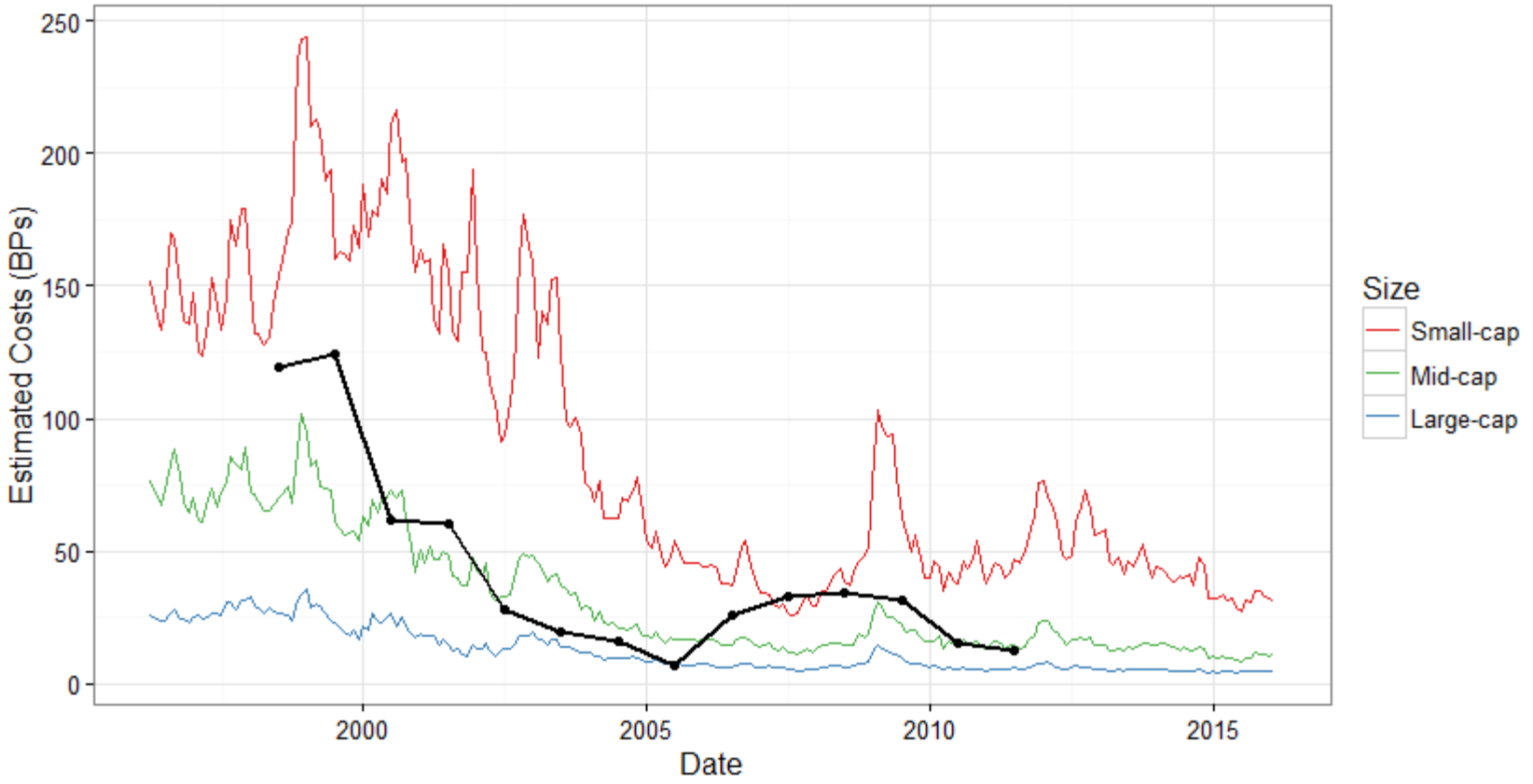


Source: UBS Quantitative Research

Costs

- Small-caps are considerably more expensive to trade than large-caps, although costs to trade have fallen enormously over recent years.
- Costs have stabilised since 2005.

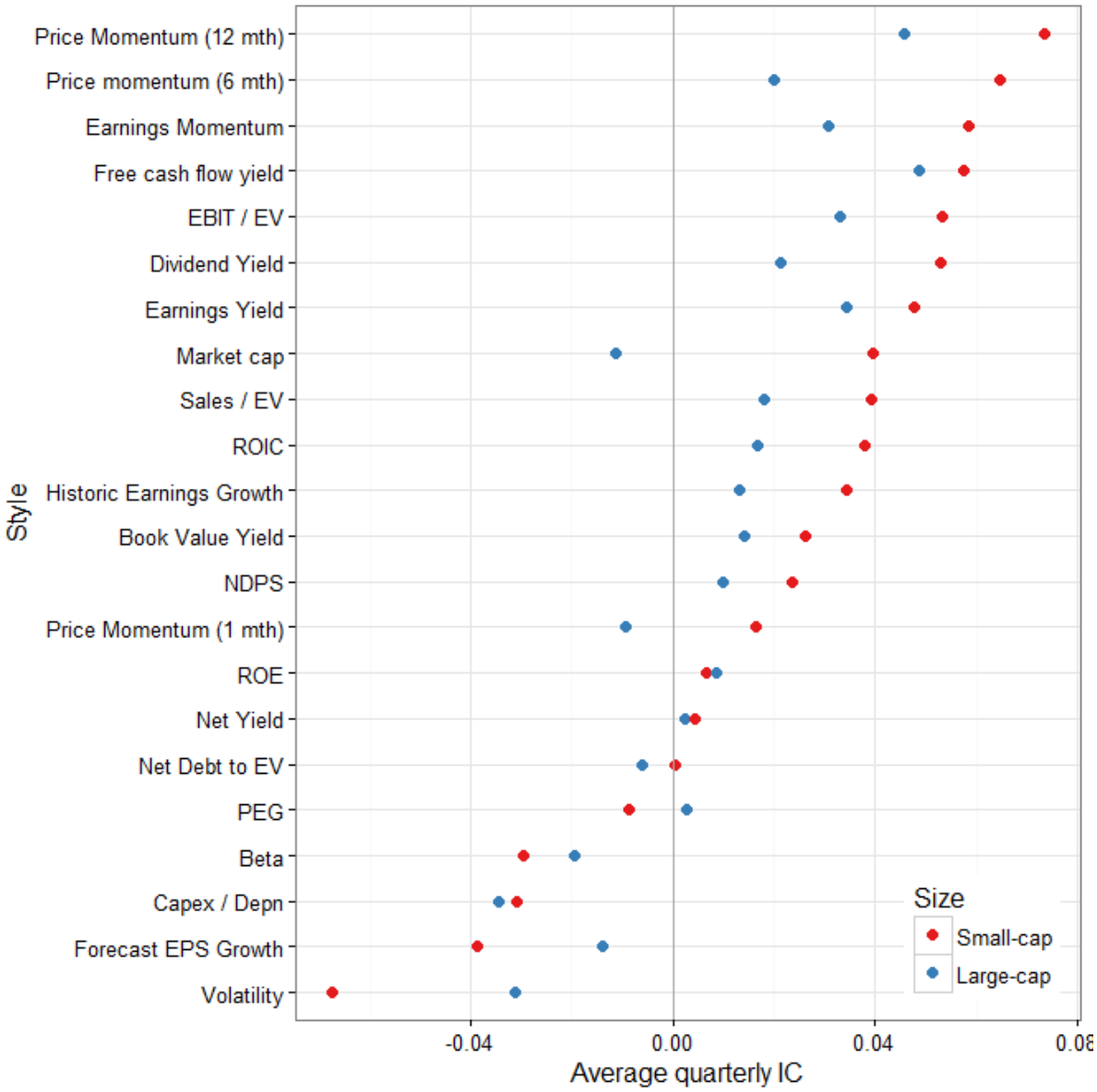
Costs estimates: How much does it cost to buy $250,000 of a stock in a day?



Source: UBS Quantitative Research & "Trading Costs of Asset Pricing Anomalies" by Frazzini A., Israel R. and Moskowitz, T, 2012. Used with permission.

The coloured lines shows the median estimated cost to buy $0.25m in each stock in the index in one day, based on our costs model. The black line shows the value weighted average cost of trades in the International markets over the course of the year, taken from Moskowitz et al.

Information Coefficient

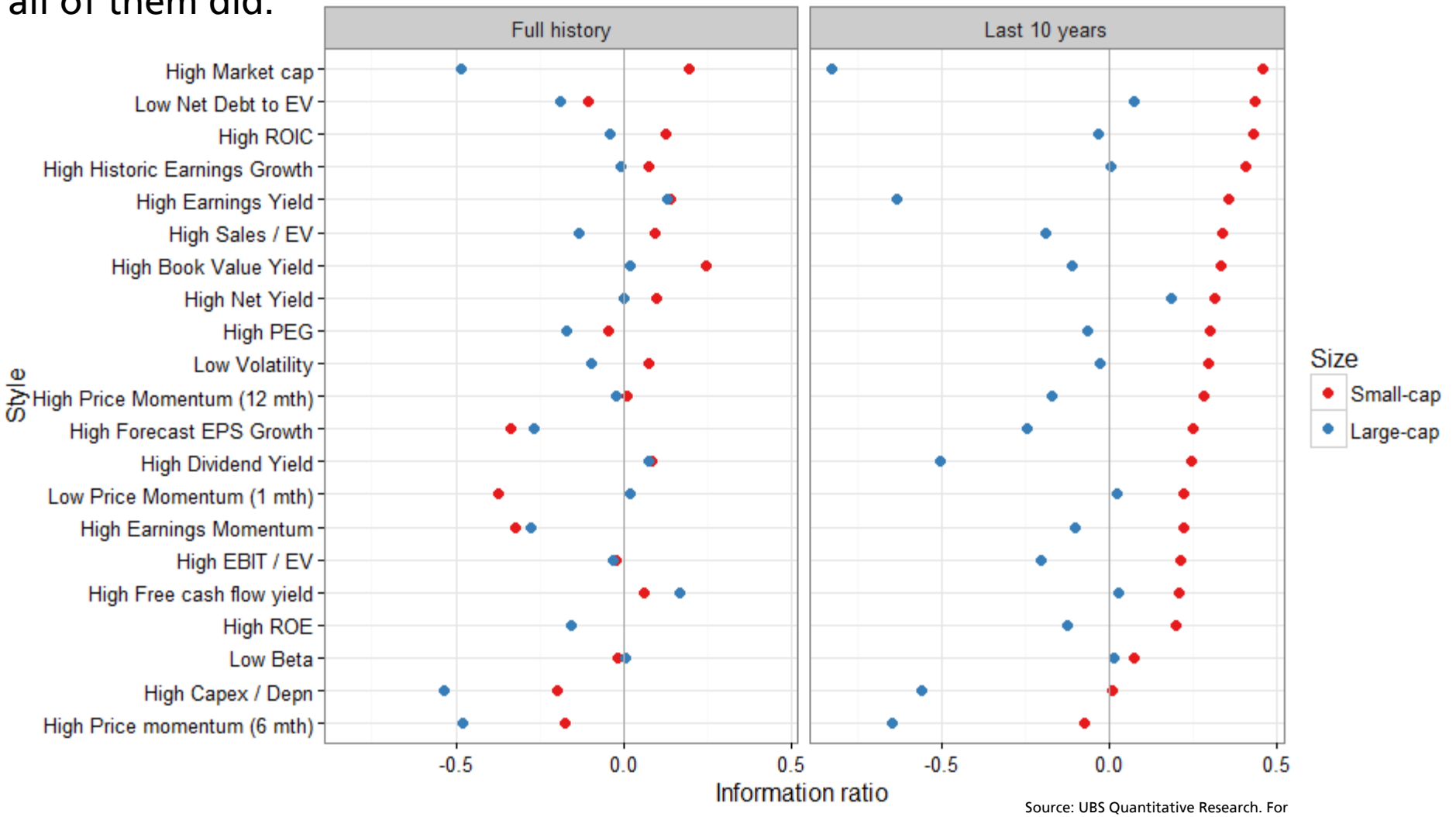


- Almost all traditional quant signals have bigger ICs in the small-cap universe.
- The momentum signals have the strongest ICs in small-caps.
- Note that we *want* a negative IC for volatility, capex/dep'n and beta, (and expect a negative IC for EPS growth) so there is a better IC in small-caps there too.

Source: UBS Quantitative Research.
For illustrative purposes only

Historical performances: Information Ratio

- Over the full history and after simulated costs, most of the small-cap styles performed better than the corresponding large-cap style and over the last 10 years, all of them did.



Source: UBS Quantitative Research. For illustrative purposes only

Equal weighting and the rebalancing premium

- In "Optimal Versus Naive Diversification: How Inefficient is the 1/N Portfolio Strategy?", DeMiguel et al (2009) show that "of the 14 [approaches to portfolio construction they] evaluate across seven empirical datasets, none is consistently better than the 1/N rule in terms of Sharpe ratio, certainty-equivalent return, or turnover, which indicates that, out of sample, the gain from optimal diversification is more than offset by estimation error."
- In "Equal of Value Weighting? Implications for Asset-Pricing Tests", Plyakha et al (2014) show that "with monthly rebalancing, an equal-weighted portfolio outperforms a value-weighted portfolio in terms of total mean return, four-factor alpha, and Sharpe ratio. [T]his outperformance is partly because the equal-weighted portfolio has higher exposure to systematic risk factors; but, a considerable part (42%) of the outperformance comes from the difference in alphas, which is a consequence of the rebalancing to maintain constant weights in the equal weighted portfolio."

Equal weighting – alternative views

- There are, unsurprisingly, a number of papers that argue against 1/N.
- Kirby and Ostdiek (2012) argue that other strategies can beat 1/N, for example a strategy where the asset weights are proportional to the inverse of the variance.
- Gou et al (2018) find that the 1/N portfolio beats a minimum variance portfolio when the former is “close” to the optimal portfolio, and the market is doing well.
- However, none of the ones we have found compare 1/N with cap weighting, nor do they discuss the rebalancing benefits.

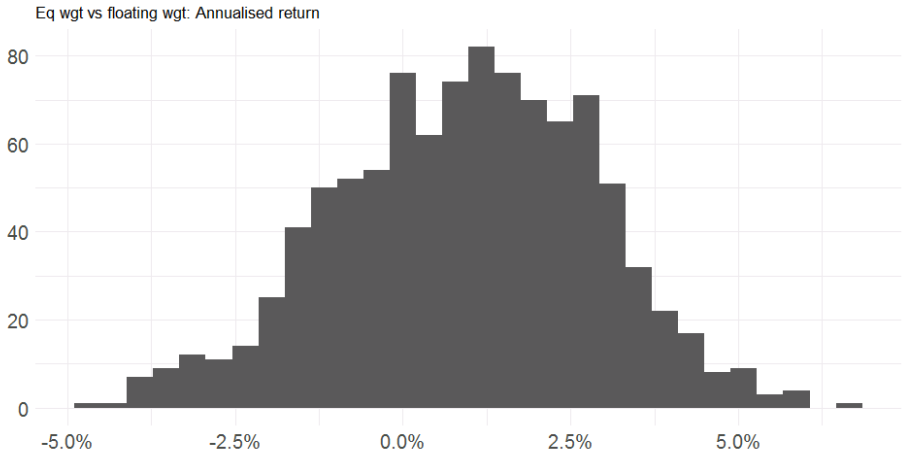
The "rebalancing effect"

- The rebalancing effect is simple to explain – assets that have done (relatively) well will have their weights reduced on the rebalancing day; assets that have done badly will be bought.
- If rebalancing is done weekly or monthly, this is implementing a short-term momentum strategy on the long side of the portfolio, which we know is successful.
- It is worth noting that on the short side you have the opposite effect – you have to buy the winners and sell the losers.

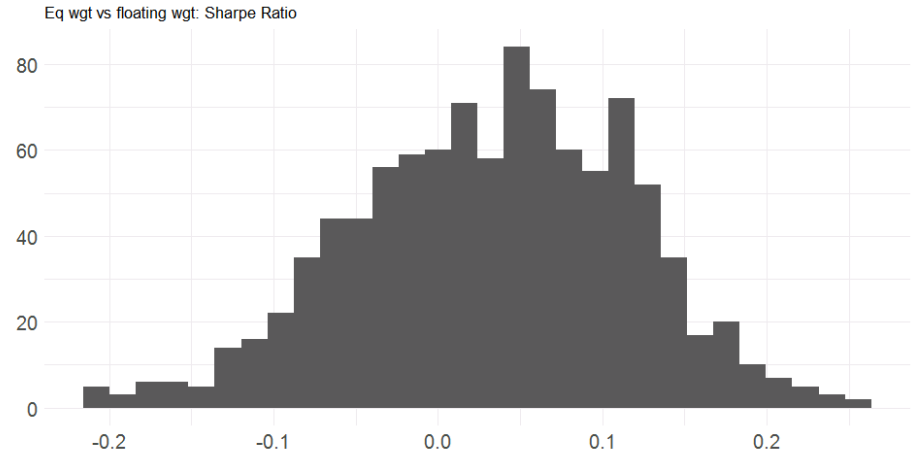
The "rebalancing effect": an example

- To illustrate this, we start with a universe of the stocks in the MSCI Europe index as at Dec 07 and restrict this to stocks that have a price history over the next ten years. This gives us a universe of 495 stocks.
- We randomly select 50 names from this universe and calculate the returns to three portfolios:
  - equal weighted, rebalanced monthly
  - random fixed weights, rebalanced monthly, and
  - floating weights.
- We repeat this 1,000 times.
- The charts show the difference in returns and Sharpe Ratios between the fixed weight portfolios and the floating weight portfolios.

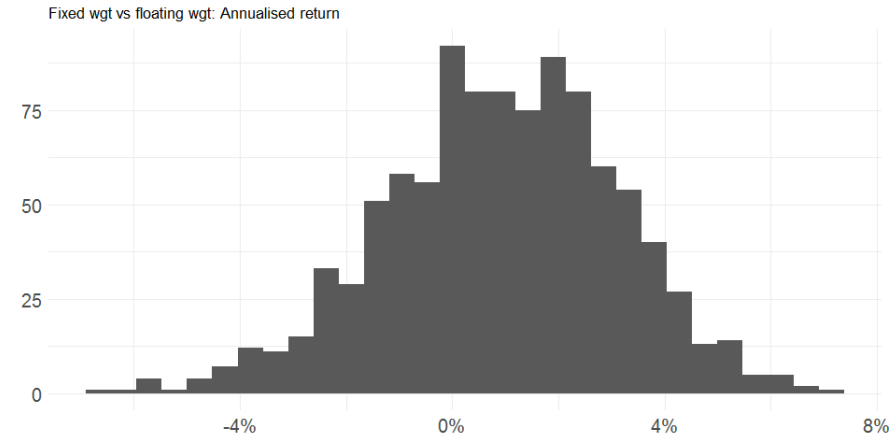
Results



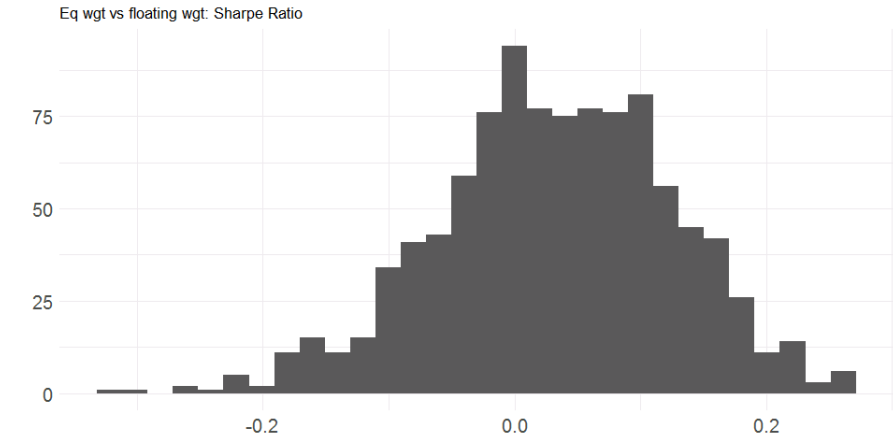
Source: UBS. 708 of the eq wgt portfolios beat the floating weight ones



Source: UBS. 683 of the eq wgt portfolios beat the floating weight ones



Source: UBS. 675 of the fixed wgt portfolios beat the floating weight ones



Source: UBS. 644 of the fixed wgt portfolios beat the floating weight ones

Conclusions

- There hasn't been a systematic small cap premium since 1992 globally
- However, quant factors tend to work better in smaller companies even after costs (or at least no worse)
- Being equal (or fixed) weights on the long side of a portfolio gives you an exposure to short-term reversals, which tends to help your returns.
- You might not want a fixed weight strategy on the short side of a portfolio.

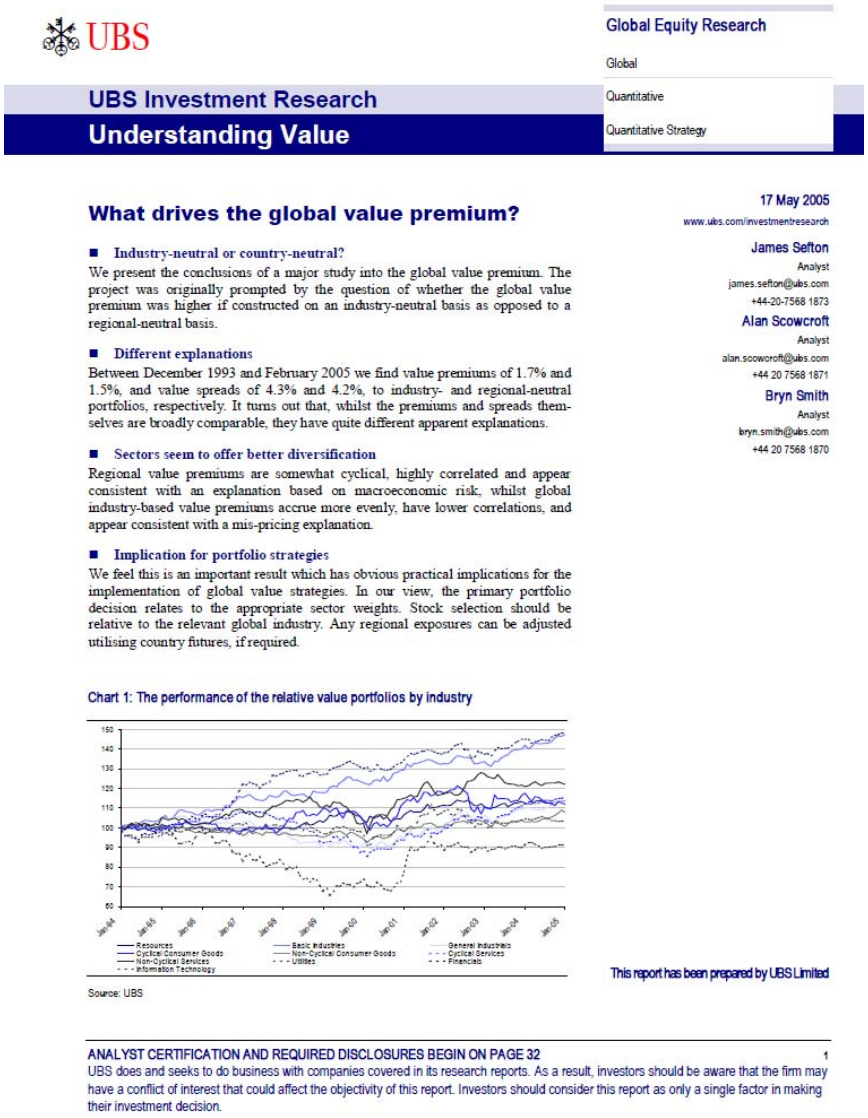
Section 3

Sector and region neutrality

UBS

Value & region or sector neutrality

- In *Understanding Value* (2005) we suggested that value was driven by two effects: a macroeconomic sensitivity and a behavioural mispricing.
- The "macroeconomic" value was acquired by creating a value portfolio relative to the market; the "mispricing" by using sector neutral value.
- We suggested then that one should create sector neutral value portfolios.
- We give a simple update of the analysis from the paper below.



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Understanding Value

17 May 2005

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What drives the global value premium?

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Industry-neutral or country-neutral?

We present the conclusions of a major study into the global value premium. The project was originally prompted by the question of whether the global value premium was higher if constructed on an industry-neutral basis as opposed to a regional-neutral basis.

Different explanations

Between December 1993 and February 2005 we find value premiums of 1.7% and 1.5%, and value spreads of 4.3% and 4.2%, to industry- and regional-neutral portfolios, respectively. It turns out that, whilst the premiums and spreads themselves are broadly comparable, they have quite different apparent explanations.

Sectors seem to offer better diversification

Regional value premiums are somewhat cyclical, highly correlated and appear consistent with an explanation based on macroeconomic risk, whilst global industry-based value premiums accrue more evenly, have lower correlations, and appear consistent with a mis-pricing explanation.

Implication for portfolio strategies

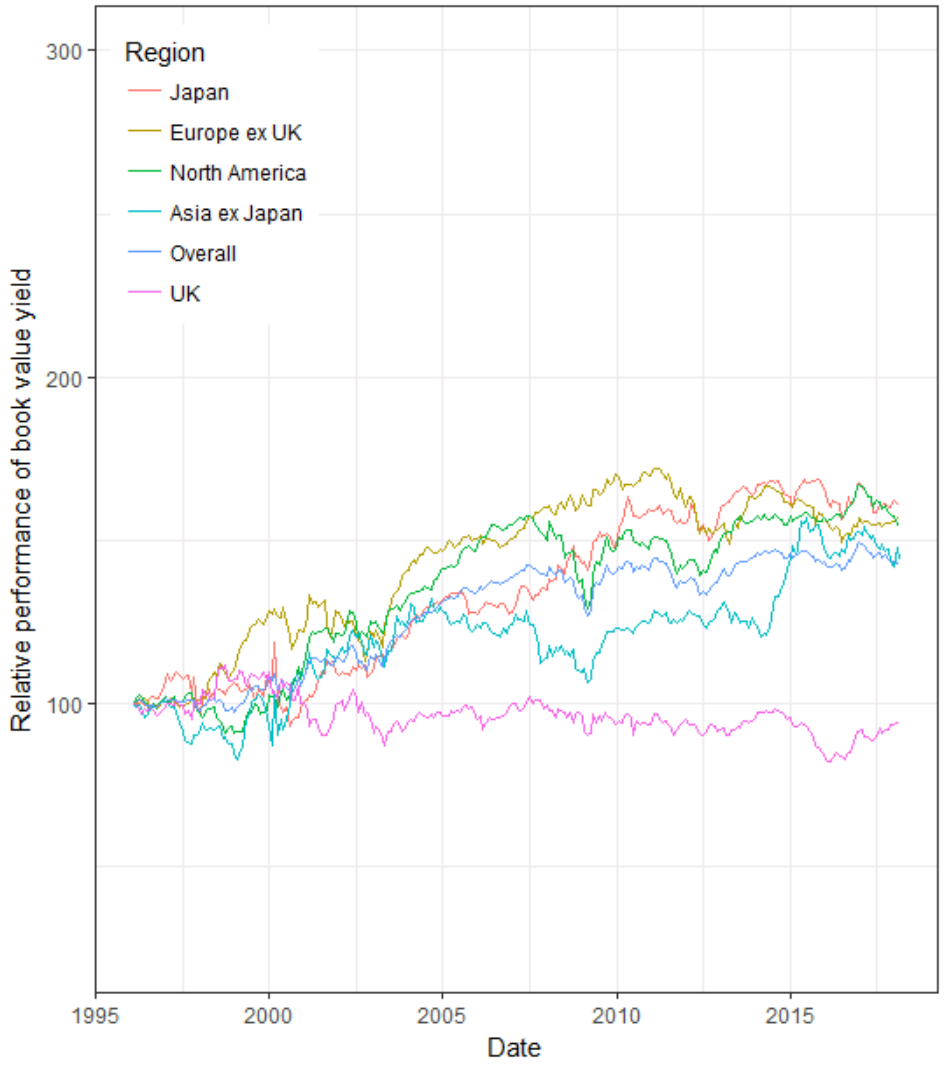
We feel this is an important result which has obvious practical implications for the implementation of global value strategies. In our view, the primary portfolio decision relates to the appropriate sector weights. Stock selection should be relative to the relevant global industry. Any regional exposures can be adjusted utilising country futures, if required.

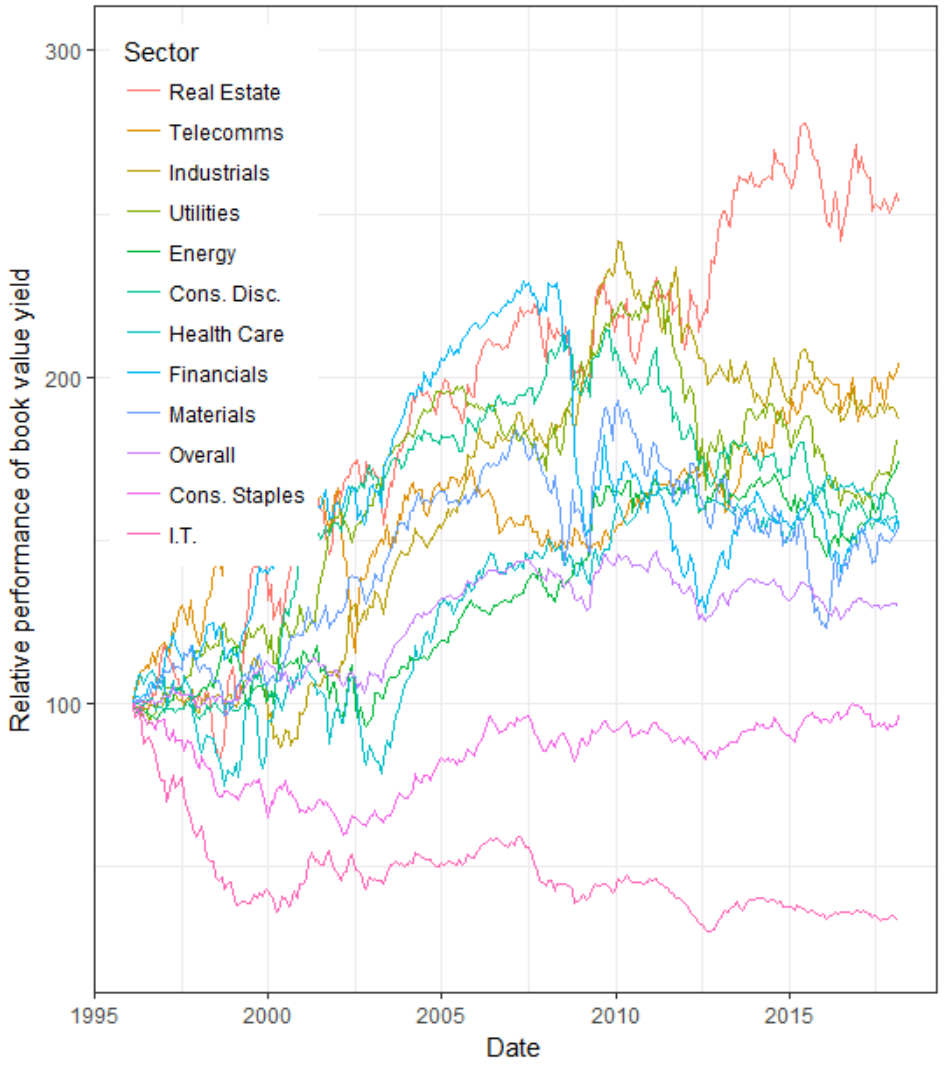
Chart 1: The performance of the relative value portfolios by industry

Source: UBS

This report has been prepared by UBS Limited

Regional and sector neutral Book Yield portfolios

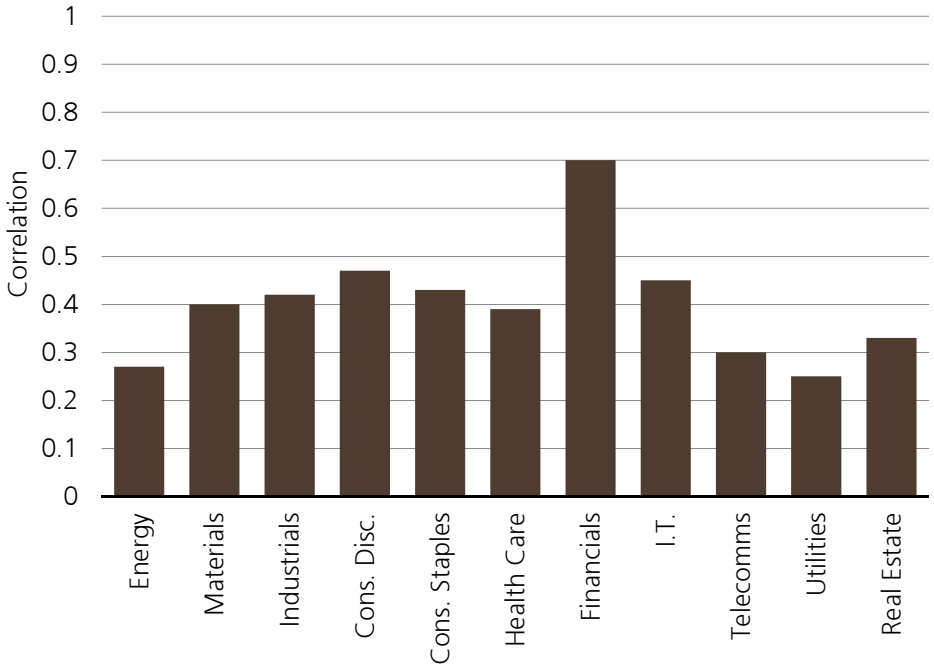


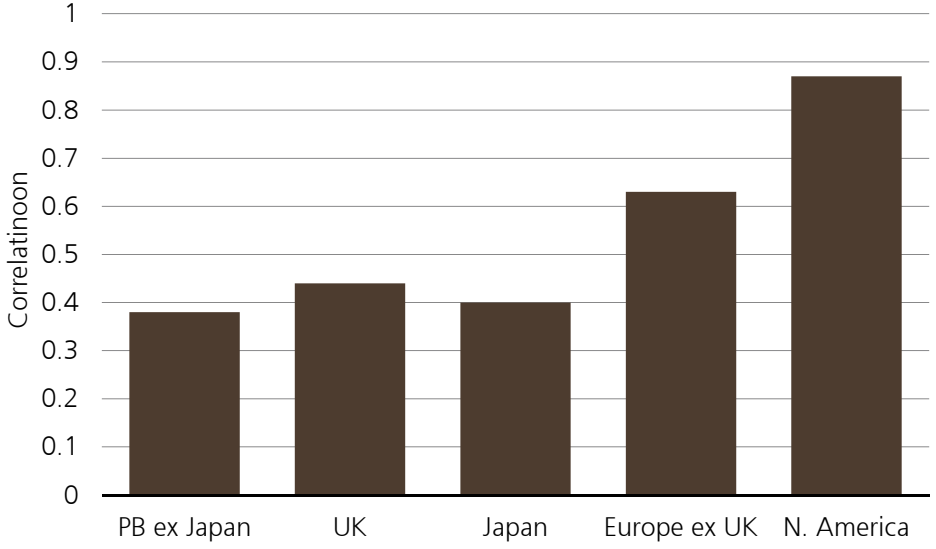


Source: UBS. The charts show the relative performance (to either the region or the sector) of the top third of stocks, free float weighted by book yield.

Correlations

- Average correlation lower between industry value. The charts show the correlations of each sector / region value performance with the overall strategy.





Source: UBS. The tables show the correlations relative performance (to either the region or the sector) of the top third of stocks, free float weighted by book yield.

Conclusions

- For value there is a much greater diversification benefit running a sector neutral strategy.
- We reported in Understanding Momentum that much of a momentum strategy comes from sector rotation, so for momentum one wants to allow the strategy to pick sectors.

Section 4

Should we orthogonalise or not?

What is orthogonalisation?

- Smart beta factors are not independent, eg, if you increase your tilt towards high quality, you will probably increase your tilt to large-cap and low volatility at the same time.
- This makes risk budgeting and performance attribution complicated. It would be easier if the factors were independent (orthogonal).
- We can artificially create independent factors by a series of cross-sectional regressions:

Orthogonalisation Method:

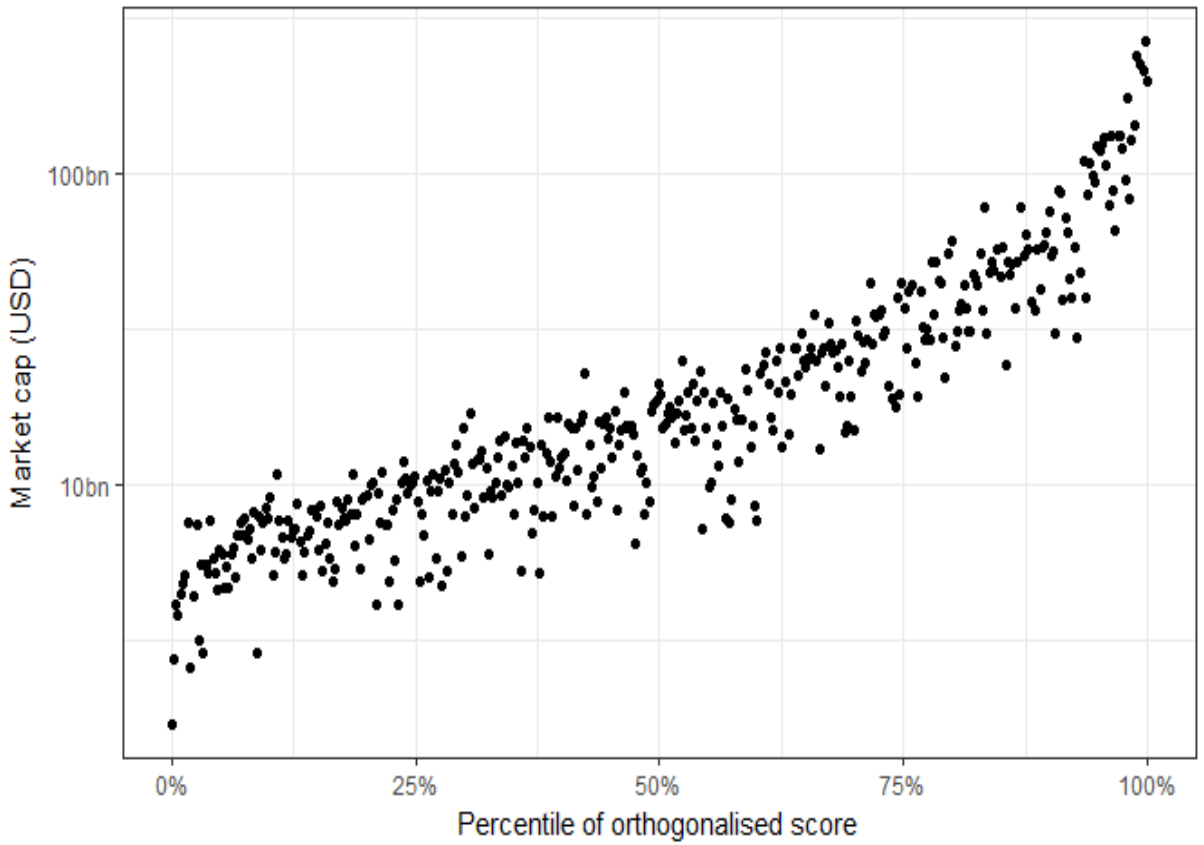
- Leave your 1st factor unchanged.
- For the 2nd factor, regress it onto the 1st factor and take the residuals. This is your new 2nd factor.
- For the 3rd factor, regress it onto both the 1st and 2nd factor and take the residuals. This is your new 3rd factor.
- Keep going until you have a list of orthogonal factors.

Why don't we like orthogonalisation?

- We do not generally recommend orthogonalisation:
  - You lose your intuition about the factors.
  - You increase the turnover of your smart beta factor portfolios.
  - There are statistical problems that investors mostly aren't thinking about.
  - It reduces the performance of price momentum.

You lose your intuition about the factors (2)

- This can also cause problems in portfolio implementation.
- For example, large-cap portfolios can usually be assumed to be very liquid, but a portfolio based on a size score orthogonalised to value, momentum, quality and risk may include some small-cap names.

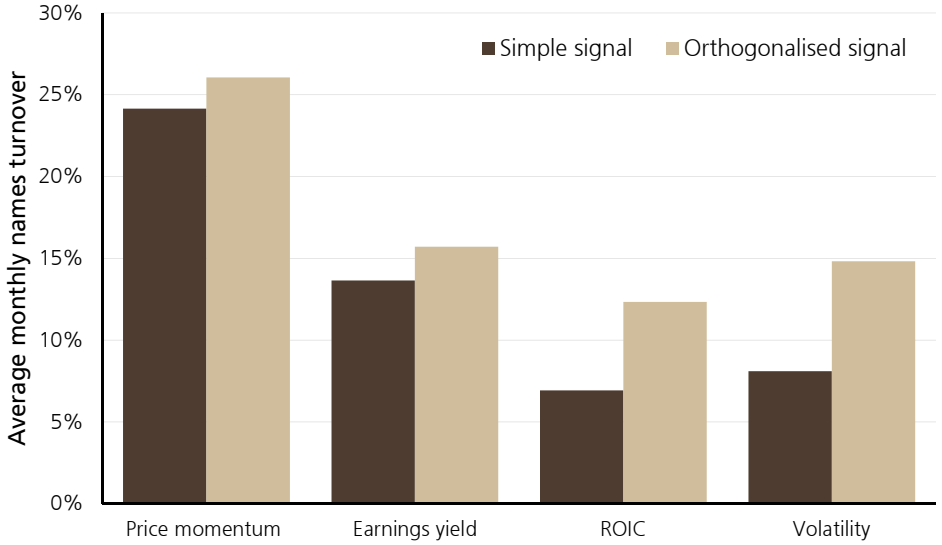


Source: UBS Quants

Increased turnover in smart beta factor portfolio

- Cross-sectional regressions are unstable. The coefficients can move a lot from month to month. That means that even very slow moving signals, eg, ROIC can have high turnover portfolios once they are orthogonalised.

- For example, suppose we run a simple backtest of either i) a simple smart beta factor or ii) a smart beta factor orthogonalised against three other smart beta factors.
- Turnover is a lot higher for the orthogonalised signal.



Source: UBS Quants

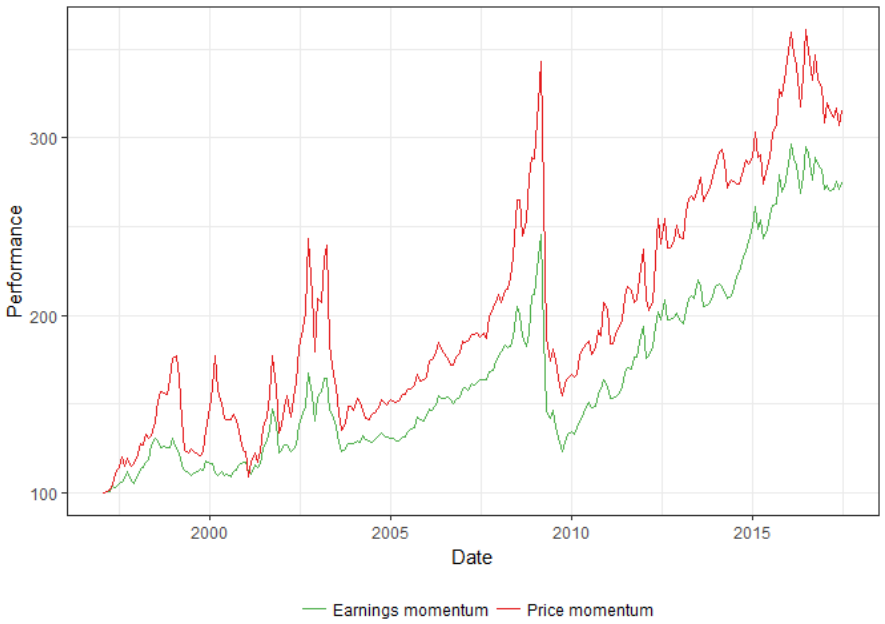
Please note that we do not adjust for the errors in variables problem in these orthogonalisations.

Statistical problems (1)

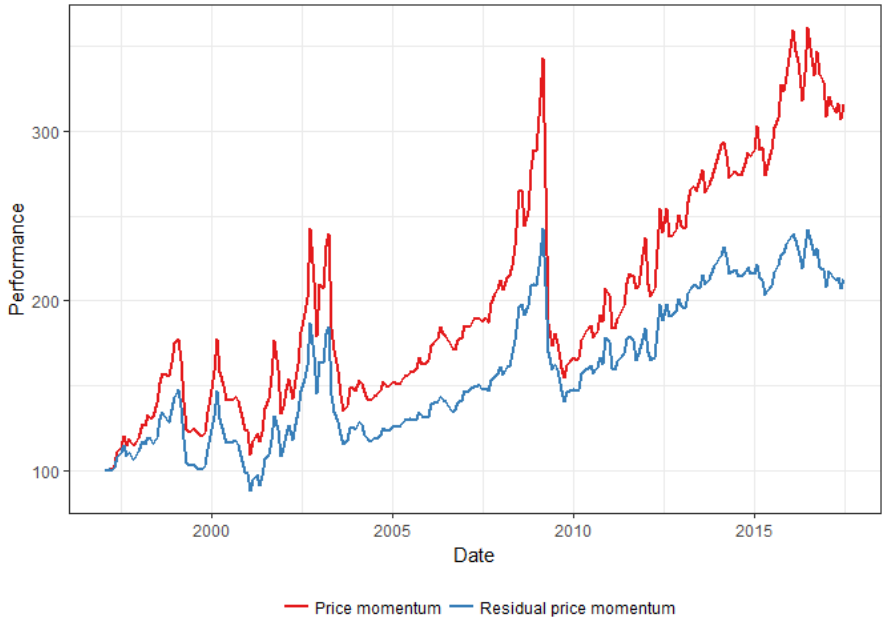
A puzzle:

- Price momentum and earnings momentum are extremely similar factors, so if you regress price momentum onto earnings momentum, the residual should be mostly random noise.
- Random noise should not outperform.
- But a backtest based on this residual *does* outperform.

Performance of price momentum & earnings momentum



Performance of price momentum residuals



Source: UBS Quants

Statistical problems (2)

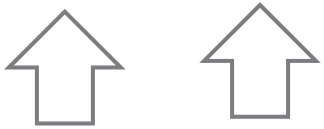
What's going on?

- Cross-sectional regressions with noisy data will typically underestimate the beta, due to an *errors in variables* problem, and all financial data is noisy.
- If your beta is underestimated then your residuals will not really be orthogonal to the earnings momentum signal. Some of the information from the earnings momentum signal has been "left in".
- That is what allows the outperformance of the residual signal.

What is an errors-in-variables problem? An example

- Suppose we are looking at the relationship of betas from one period to the next.
- We assume the true (but unobservable) beta is constant over time, but measured with error.

	A	B	C	D
1	Actual Beta	Beta Period 1	Beta Period 2	Beta Period 3
2	1.333	1.270	1.186	1.111
3	1.163	1.411	1.400	1.371
4	0.917	0.710	1.195	1.278
5	1.457	1.546	1.277	1.594
6	0.458	0.563	0.134	0.493
7	0.277	0.415	0.348	0.545
8	0.611	0.513	0.942	0.573
9	0.982	1.207	1.063	0.998
10	0.871	0.908	1.093	0.884



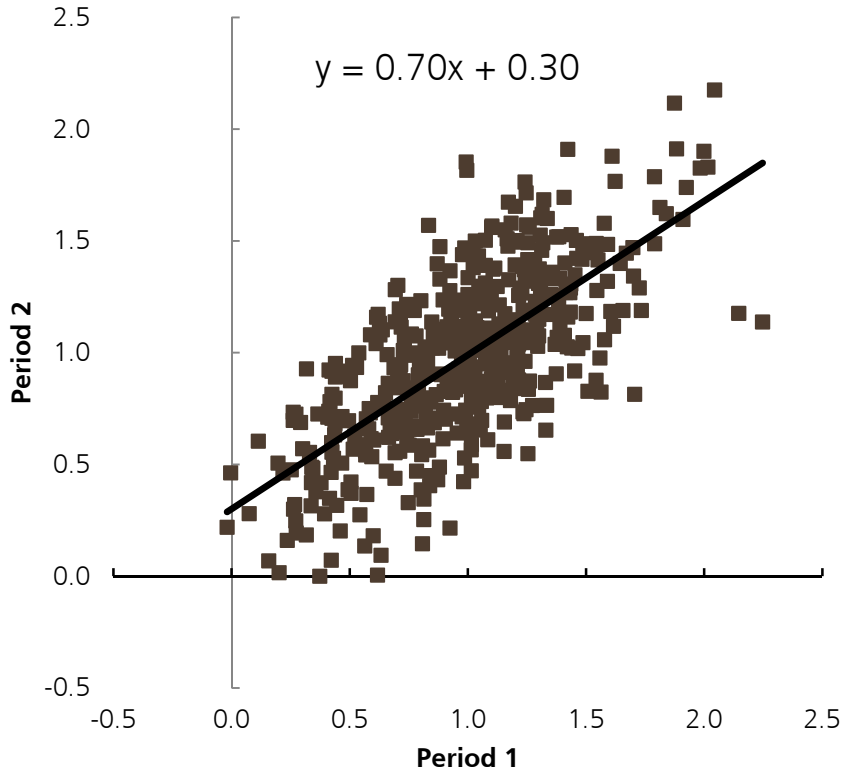
Source: UBS Quants

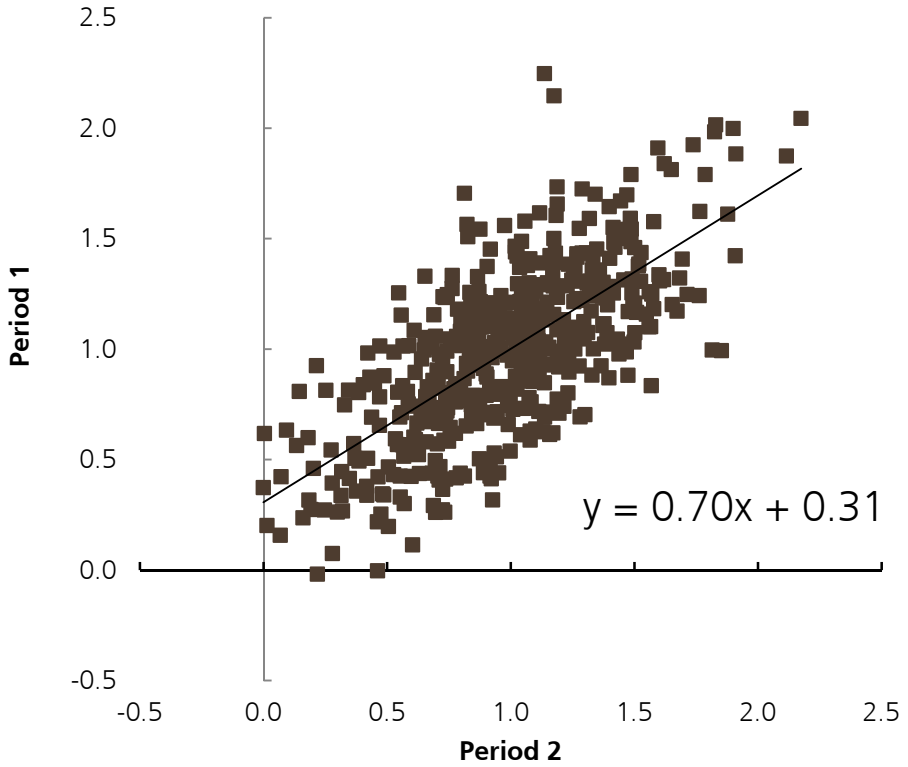
Actual Beta + $N(0,0.2^2)$ noise

Actual Beta + different $N(0,0.2^2)$ noise

What is an errors-in-variables problem? An example

- Regressing period two against period one gives us a slope of 0.7 …
- … but so does plotting period one against period two



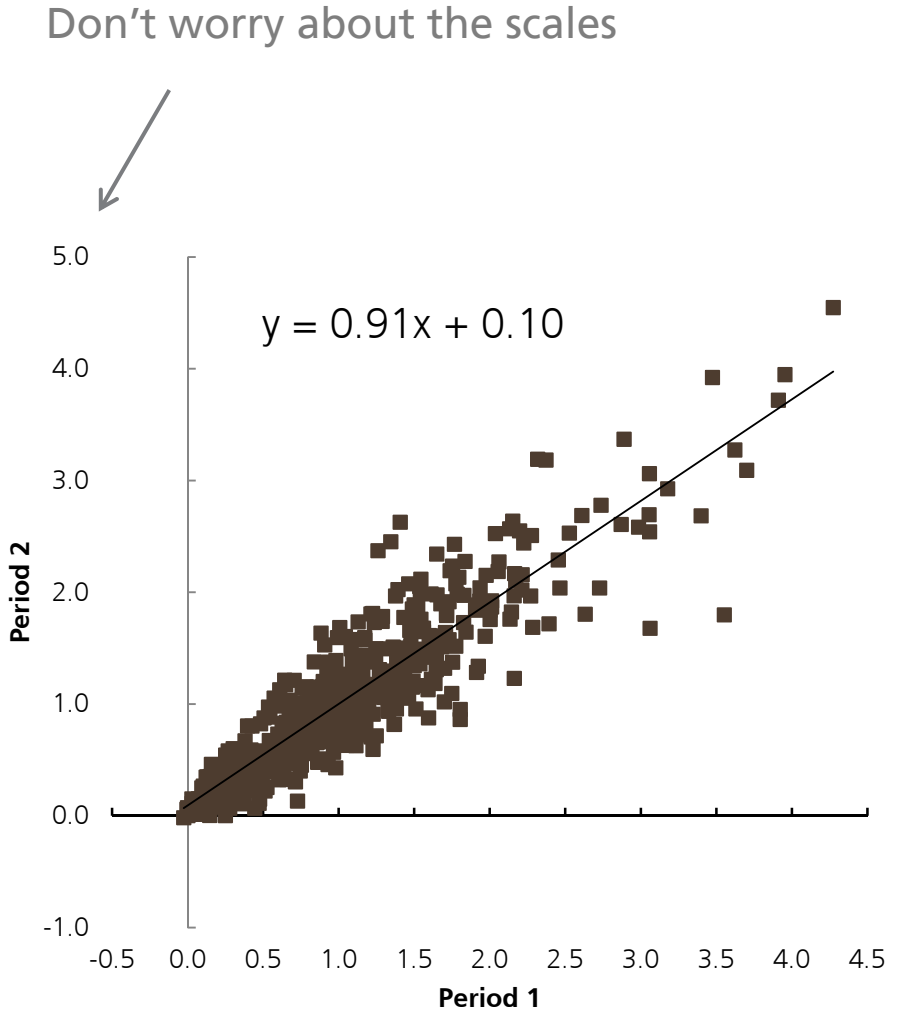


UBS

Source: UBS Quants. For illustrative purposes only

What is an errors-in-variables problem? The fix

- To try to fix this problem we need what is called an "instrumental variable", which is correlated with the signal (here the true beta) and not with the noise.
- In this example we can use the beta from a third period. Multiply both the period one and period two betas by this third column and repeat the regression.
- We obtain a new beta of 0.91. Still not perfect, but much closer to the truth.



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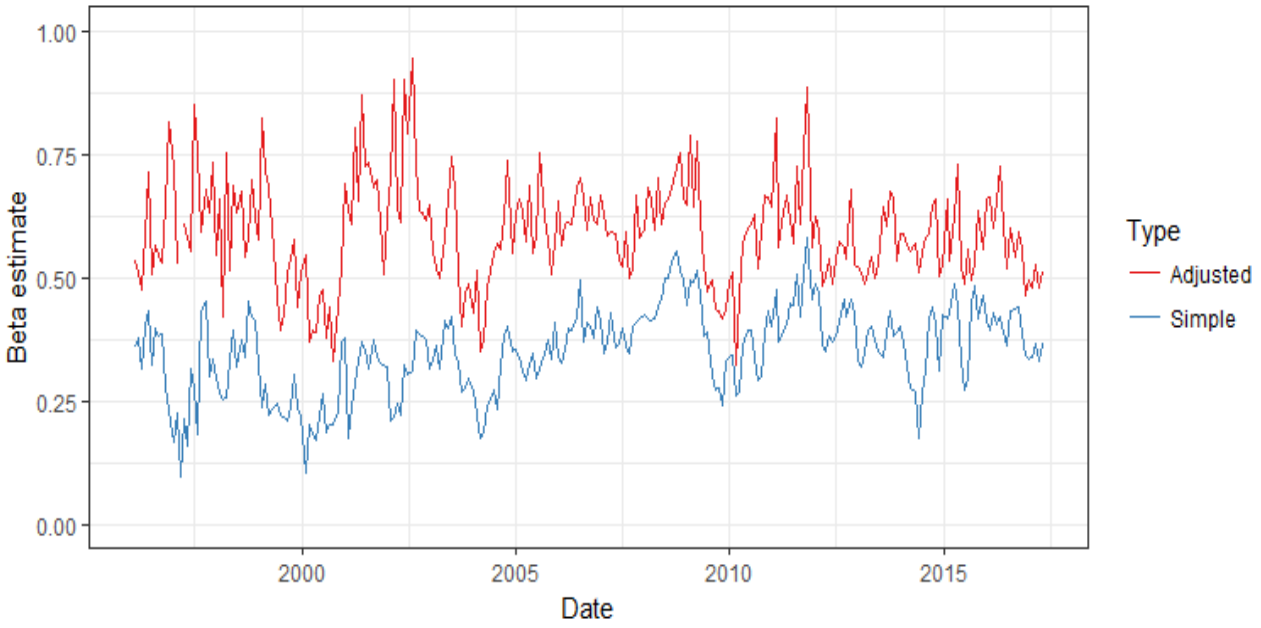
Statistical problems (3)

In our problem, what can we use as an instrumental variable?

- We use earnings revisions (number up vs number down) and re-estimate the beta in our regression:

$$New\ estimate\ of\ beta = \frac{cov(price\ momentum, earnings\ revisions)}{cov(earnings\ momentum, earnings\ revisions)}$$

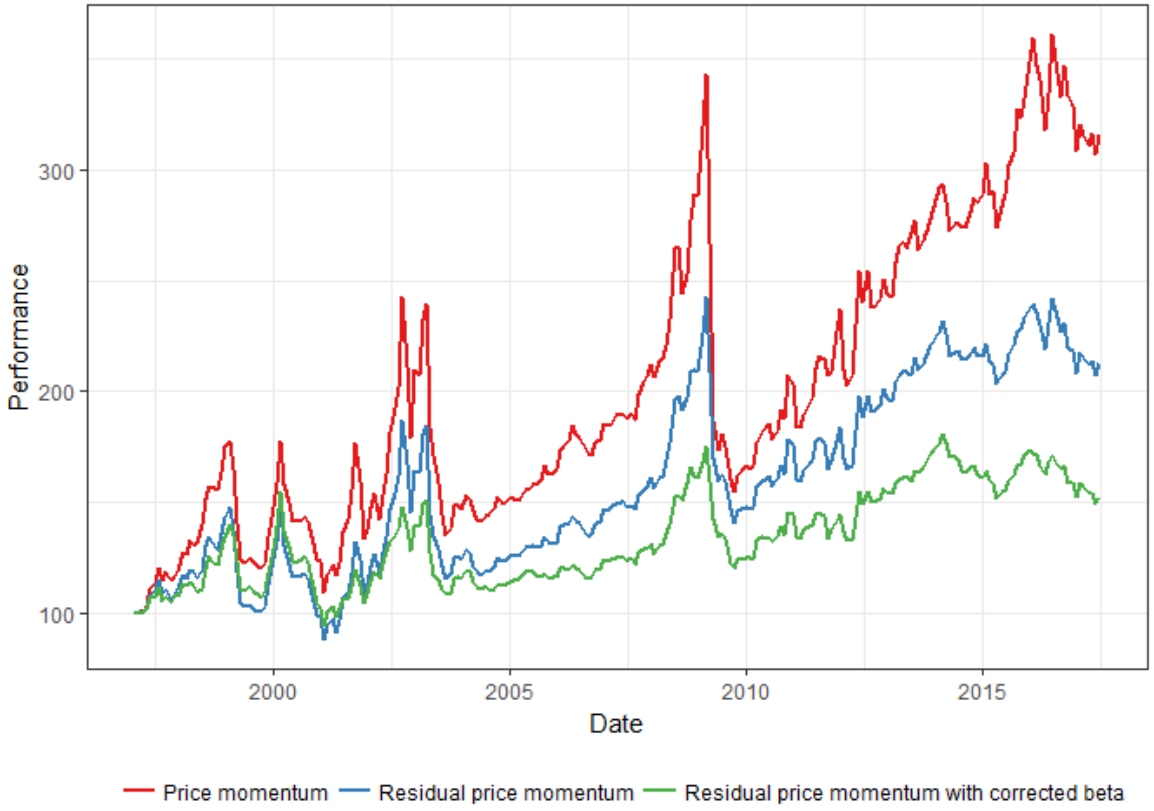


Source: UBS Quants. For illustrative purposes only

- Note that the new, adjusted estimate for the beta is consistently higher.
- That is evidence of an errors in variables problem.

Statistical problems (4)

- With the correct beta, price momentum orthogonalised to earnings momentum is close to flat.

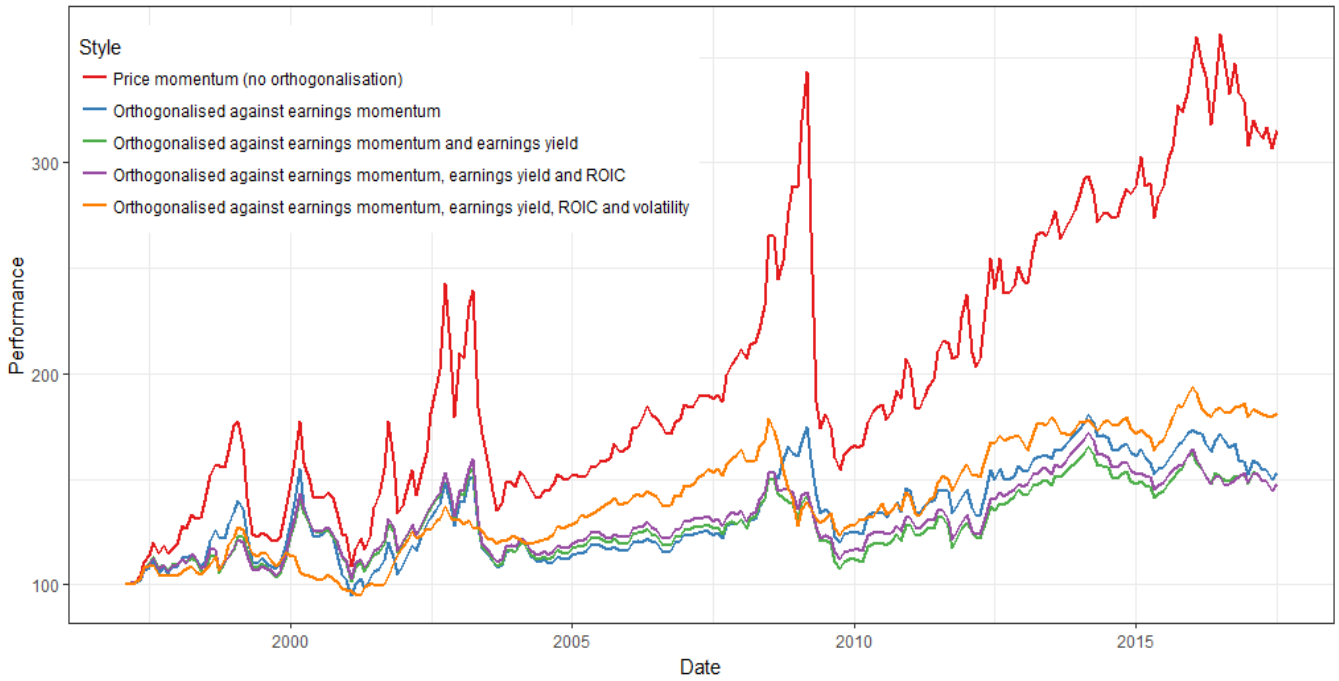


Source: UBS Quants. For illustrative purposes only

- We suspect that errors in variables problems are common with orthogonalisation and are not being corrected for.

Reduces the performance of price momentum (1)

- Price momentum has a time varying exposure to the other smart beta factors. When high quality has outperformed, price momentum will tilt towards high quality and when value has outperformed, price momentum will tilt towards value.
- This style rotation effect is driving a lot of the performance of price momentum. If you remove it, by orthogonalising the signal to the other smart beta styles, you will reduce the performance.



Source: UBS Quants, Europe, long-short factors

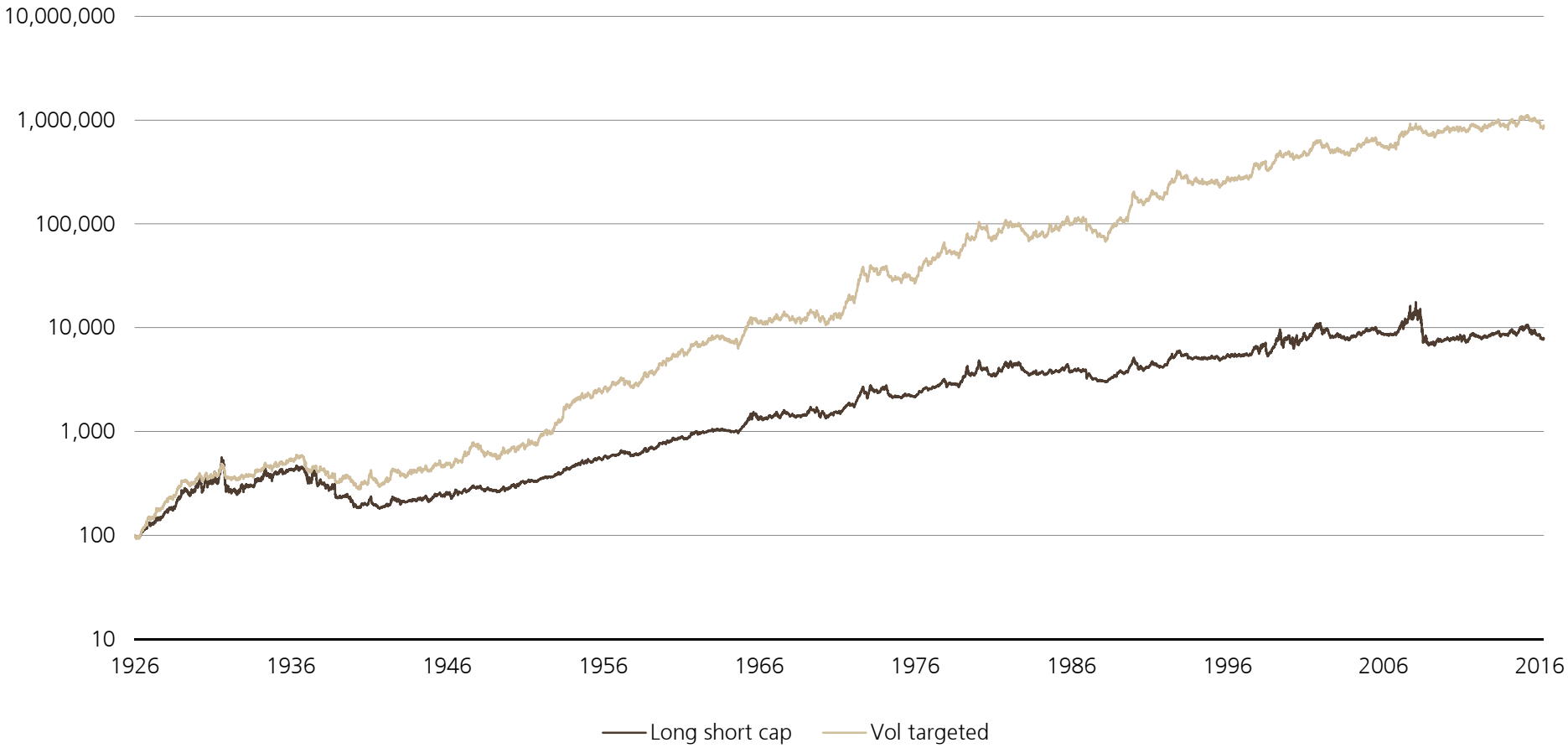
Orthogonalisations use instrumental factors for earnings momentum and for earnings yield.

Section 5

Volatility targeting

Volatility targeting momentum

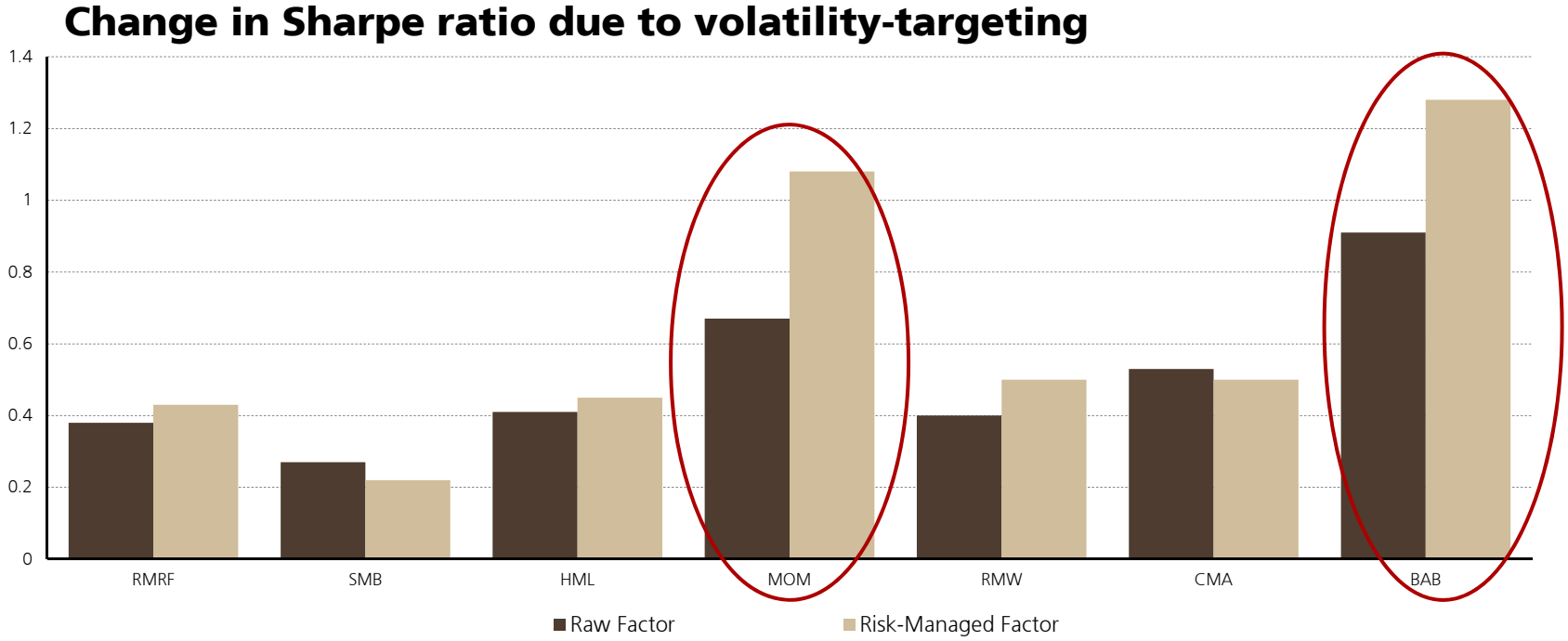
- Volatility targeting momentum is very effective – the return / risk goes from 0.40 to 0.75.



Source: UBS, Ken French Data Library (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). Used with permission. The momentum portfolio is a long / short portfolio based on the large cap "6 portfolios based on size and momentum". The volatility targeted portfolio has its gearing changed monthly to achieve a volatility equal to that of the base portfolio over the whole sample. The average gearing for the portfolio is 1.48.

Other factors

- What about other factors? We wrote on this in our January 2017 Academic Research Monitor where we summarised Barroso & Maio (2016) and Moreira & Muir (2016).
- Both papers look at a similar set of factors and report similar results. We note that the result for betting against beta extends to volatility as opposed to beta based portfolios.



Source: "Managing the Risk of the 'Betting-Against-Beta' Anomaly: Does It Pay to Bet Against Beta?" by P. Barroso & P. Maio; the figure is constructed using data reported in Tables 1 and 3; reproduced with permission. The figure presents the Sharpe ratio of raw (buy and hold) long-short factors and of their risk-managed form using volatility-targeting. Sample period: January 1964 to December 2015.

Appendix A

Errors in Variables

UBS

Errors in variables (1)

- Suppose there is a linear relationship between y and x:

$$y = \beta x + \varepsilon$$

- We want to estimate β, but, unfortunately, we don't have data on x, only on x*=x+η, because x is measured with error.
- We estimate β by regressing y onto x*:

$$Estimate = \frac{cov(x^*, y)}{var(x^*)}$$

$$= \frac{cov(x + \eta, \beta x + \varepsilon)}{var(x + \eta)}$$

$$= \frac{\beta {\sigma_x}^2}{{\sigma_x}^2 + {\sigma_\eta}^2}$$

$$= \frac{\beta}{1 + {\sigma_\eta}^2 / {\sigma_x}^2}$$

- Note that this estimate is always less than β and if x* is very noisy then it will be a lot less than β.

Errors in variables (2)

- Suppose we have found a variable z, which is correlated to x, but not to the noise term, η, or to the error term, ε.
- Then we can get a new estimate for the beta as the ratio of the covariance of y and z and the covariance of x* and z:

$$New\ estimate = \frac{cov(y,z)}{cov(x^*,z)}$$

$$= \frac{cov(\beta x + \varepsilon, z)}{cov(x+\eta, z)}$$

$$= \frac{\beta\sigma_{x,z} + \sigma_{\varepsilon,z}}{\sigma_{x,z} + \sigma_{\eta,z}}$$

$$\approx \beta$$

Appendix B

Value correlations

UBS

Correlations

- Average correlation lower between industry value, and dispersion higher

	Overall	Energy	Materials	Industrials	Cons. Disc.	Cons. Staples	Health Care	Financials	I.T.	Telecomms	Utilities	Real Estate
Overall	4.77%	0.27	0.40	0.42	0.47	0.43	0.39	0.70	0.45	0.30	0.25	0.33
Energy		8.15%	0.25	0.14	0.13	0.20	0.09	0.18	0.03	0.00	0.05	0.03
Materials			9.60%	0.21	0.24	0.15	0.21	0.30	0.11	-0.02	0.08	0.20
Industrials				7.87%	0.38	0.33	0.10	0.25	0.30	-0.07	0.15	0.31
Cons. Disc.					7.28%	0.28	0.13	0.43	0.28	-0.06	0.23	0.25
Cons. Staples						7.79%	0.27	0.27	0.30	0.01	0.08	0.28
Health Care							11.36%	0.26	0.11	0.08	-0.12	0.24
Financials								8.39%	0.22	0.13	0.31	0.28
I.T.									12.59%	-0.17	-0.02	0.15
Telecomms										9.63%	0.01	0.00
Utilities											7.99%	0.10
Real Estate												11.95%

	Overall	PB ex Japan	UK	Japan	Europe ex UK	N. America
Overall	4.13%	0.38	0.44	0.40	0.63	0.87
PB ex Japan		9.04%	0.15	0.35	0.12	0.29
UK			6.98%	0.12	0.20	0.18
Japan				7.01%	0.13	0.19
Europe ex UK					5.48%	0.37
N. America						5.46%

Source: UBS. The tables show the correlations relative performance (to either the region or the sector) of the top third of stocks, free float weighted by book yield. The diagonal of the matrix is the annualised standard deviation.

Appendix C

References

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Sell	FSR is > 6% below the MRA.	16%	13%
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Buy	Stock price expected to rise within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%
Sell	Stock price expected to fall within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%

Source: UBS. Rating allocations are as of 31 December 2017.
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