Factor Investing

Pure and simple

August 2018

For Institutional Investor and Financial Advisor Use Only

Introduction

Smart beta investing has become increasingly popular in recent years. Many index providers now offer a broad suite of smart beta strategies. The most common tend to be based on the well-established risk premia factors: value, small cap, momentum, low volatility and quality. However, our research shows that many of these indices exhibit unintended exposures to unrelated factors because of their simplistic construction method. A more sophisticated approach eliminates these unwanted risks, providing a 'pure' factor strategy for smart beta investors.

The aim of this paper is to illustrate how our approach emphasizes the importance of factors being:

- Precise
- Unbiased
- Robust
- Efficient

We investigate a method of measuring the purity of smart beta strategies based on the portion of active risk driven by the targeted factor. We find that pure beta strategies exhibit higher factor efficiency than most commercially available alternatives.

We also compare 'pure' strategies with conventional factor implementation to demonstrate the effectiveness of our construction method and the advantages of factor neutralisation.

Finally, we discuss practical applications to portfolio management and the value of 'pure' strategies as a tool to enhance investment performance.

HSBC Global Asset Management

Introducing the factors

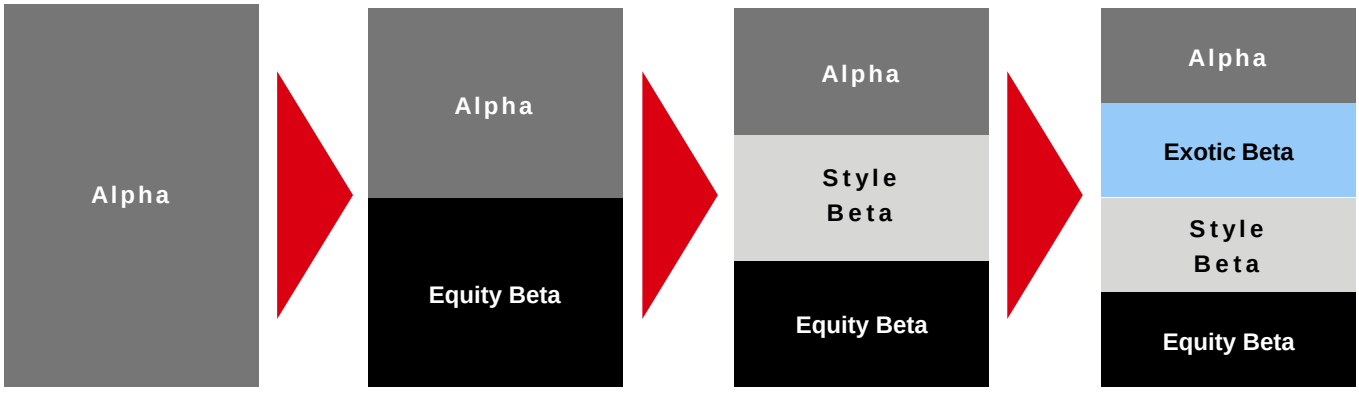
The appeal of smart beta strategies is that they are systematic and transparent, and thus easy to construct and rebalance. They can also be an inexpensive way for investors to obtain exposure to factors they might be lacking within their portfolios. Many smart beta strategies are constructed with an emphasis on simplicity, often using simple sorting and weighting techniques. These are usually based on either a single factor (e.g. book-to-price) or a composite score (e.g. value). Other smart beta strategies are put together to maximise investability, with factor tilts combined with market cap weighting. Although both these approaches result in higher exposures to the targeted factor, there is little restriction on exposures to other factors. This can lead to unintended factor exposure and taking on undesired risk.

Factor investing has become a topic of interest as it helps answer a fundamental question: is the concept of diversification still alive? The financial crisis saw the synchronised movement of traditionally uncorrelated assets.

Supposedly diversified strategies proved to be less diversified than thought, leading to dramatic underperformance.

Andrew Ang uses the following analogy to describe factors: 'factors are to assets what nutrients are to food'. According to Ang, assets earn risk premia because they are exposed to the underlying factor risks. Over time a growing proportion of investment performance has been explained in terms of factor exposures. Outperformance previously understood as 'alpha' is increasingly described as 'beta'. Beta can come from equity exposure, style, exotic factors, etc.

Historically, factor investing was considered an active strategy. Following the recent rise in investor demand for factor exposures, new cost efficient and highly accessible factor indices have been introduced. This new dimension in product design has opened up a set of opportunities designed to maximise convenience for investors.



Source: HSBC Global Asset Management

Theory behind factor based investing

1970

CAPM
Returns from a single systematic risk

The Capital Asset Pricing Model (CAPM) was first introduced in the 1960s by Treynor, Sharpe, Lintner and Mossin. It was the first formal model to capture the notion of factors being the driving force behind returns. This one-factor model implies that asset returns can be explained by just a single factor: the sensitivity of the asset's excess return to the excess return of the market. This sensitivity is referred to as the beta of the asset. The intuition behind CAPM is that the expected return of an asset, which is required to compensate for its undiversifiable risk, should be a function of its correlated volatility with the market (ß).

1976

APT
Returns from multiple sources

Arbitrage Pricing Theory (APT) was first introduced in 1976 as an alternative to CAPM and was one of the earliest multi-factor models. Its premise is that expected returns can be decomposed into a linear combination of factors. These can be chosen either through economic intuition or through factor analysis to identify the drivers of returns (a common method is principle components analysis). The appeal of APT is that it imposes fewer assumptions and requires less economic structure than CAPM.

1993

Fama-French
Value – Size

One of the best known multi-factor models was introduced by **Fama and French**. Using a 50-year dataset between 1941 and 1990, they found that the link between market beta and average return had been weak. They proposed adding two factors (size and book-to-market) to the single factor CAPM model to better explain the cross-section of security returns.

1997

Cahart
Value – Size - Momentum

Building on Fama-French legacy Cahart extended the three factor model to include a momentum factor. The addition of the MOM factor, as it is commonly known, improved the explanatory power of the model. Until recently it was considered to be the reference evaluation framework for active management and mutual funds.

2014

Frazzini et al.
Value – Size – Momentum – BAB – QMJ

Recently **Frazzini et al**. introduced a quality factor (QMJ) and a low beta factor (BAB). This followed the same methodology as Fama-French, extending further the range of potential valid factors. In addition Novy-Marx introduced a different quality factor, claiming that it captures alpha.

Source: Please see page 16 for full list of sources

Building Factor Strategies

A plethora of factor construction methods have been proposed in the academic literature, some of which have been implemented by industry practitioners. In this expanding ecosystem of factor based products, there is a common misconception that factor investing is very simple, providing superior results to traditional funds (e.g. cap-weighted indices, active management, strategic asset allocation). 'Raw' strategies approach factor construction by overweighting stocks that exhibit a particular characteristic (e.g. Price-to-Book). To respond to the challenge of transforming academic risk factors into investable portfolios we focus on four key qualities: our products must be Precise, Unbiased, Robust and Efficient.

Precise: The factors we seek exposure to are precisely defined, guided by empirical research.

Unbiased: Our indices are constructed to remove hidden bias towards untargeted factors.

Robust: Strong technological infrastructure, proprietary risk models and the conceptual clarity of our mathematical formulation ensure robust implementation.

Efficient: Our indices deliver strong factor purity ratios, exhibiting a high proportion of targeted risk per unit of active risk.

We refer to this product range as our "pure" factor strategy.

A transparent and intuitive construction process

Objective: We try to give investors maximum exposure to a factor, capturing as much of the premium as possible.

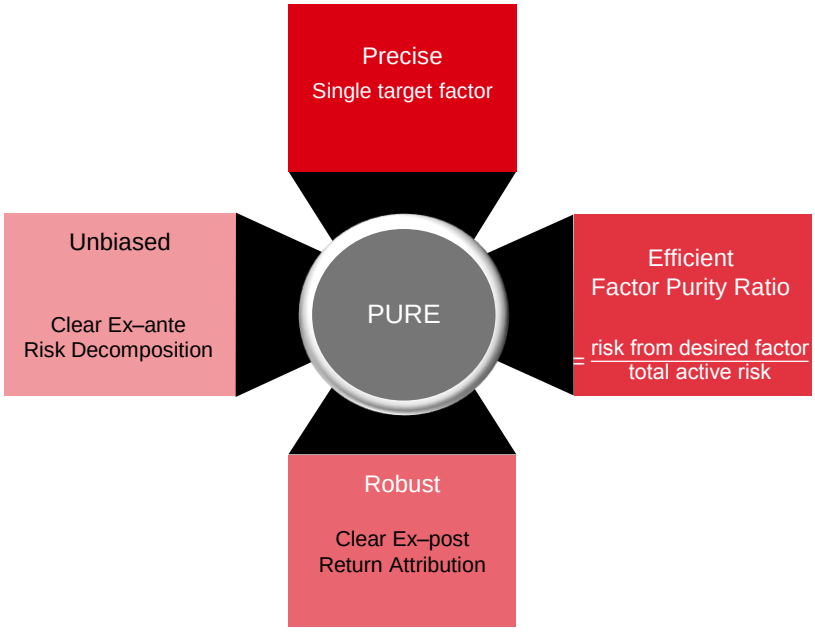
The Challenge: Unfortunately this isn't enough if we want to focus on multiple 'independent' sources of risk/return. Moving from the theoretical and impractical long-short portfolios of Fama-French to long only investable solutions requires an understanding of the correlations and exposures between factors.

There are three ways to tackle this:

- We could impose risk contribution constraints.
- We could apply a transformation algorithm such as 'minimum-torsion'[1] to approximate the closest orthogonal (uncorrelated) factors.
- We could apply neutralisation constraints to unwanted factor exposures.

The first two approaches require parameterisation of the factor model. This limits transparency when interpreting individual stock factor exposures.

The Solution: We take the third approach, following our emphasis on transparency. We also incorporate an active weight constraint to improve diversification, a capacity constraint to avoid illiquid names and a turnover constraint to control costs.



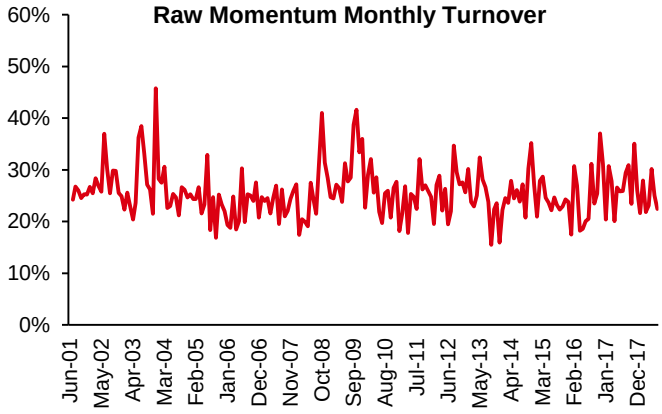
One of the challenges of factor investing is determining which factors really drive returns. Cochrane (2011) referred to a 'zoo of new factors' and Harvey et al. (2014) counted over 300 factors, showing a dramatic increase in recent years. In this 'zoo' it is essential to focus only on factors that are strongly supported by empirical evidence with solid economic justifications. From this perspective the value, size, momentum, low volatility and quality factors seem a natural choice.

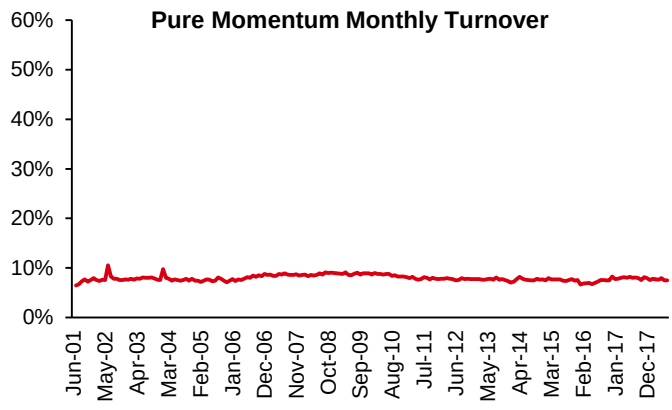
[1]*Minimum-torsion refers to a mathematical technique which applies a linear transformation to the original factors in order to find the closest orthogonal (uncorrelated) ones. For more information, see Meucci, Santangelo and Deguest (2013) – Risk Budgeting and Diversification Based on Optimized Uncorrelated Factors.*

What makes a robust smart beta product?

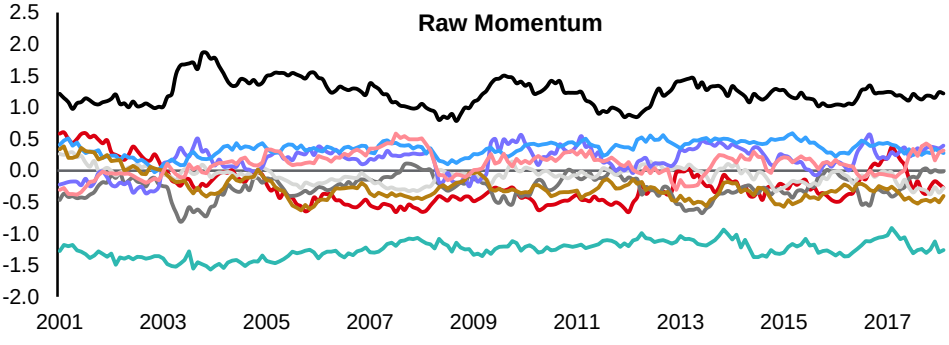
Amenc et al. argue for the importance of robustness in smart beta portfolio construction. 'Factor Fishing', 'Model-Mining', 'Non-Robust Weighting Scheme' and 'Dependency on Individual Factor Exposures' are common pitfalls to avoid. Of the precautionary steps taken in our pure strategy, two stand out as being particularly effective in the creation of resilient factor portfolios:

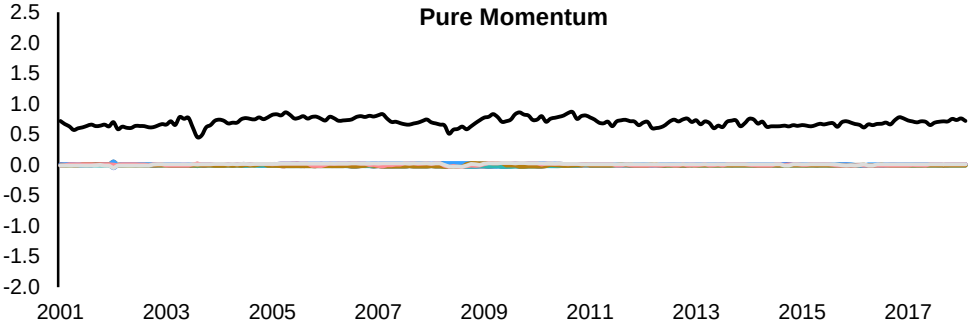
Turnover Control: A turnover constraint helps control costs and enhances portfolio stability. For example, momentum strategies naturally exhibit high turnover. With no turnover constraint, momentum has ~300% average annual turnover, imposing significant transaction costs on the portfolio.





Style Neutrality: A focus on premia purity and approximate independence from other sources of risk/return is essential to building efficient strategies. Factor neutralisation relative to the benchmark ensures low correlation with other styles and better risk adjusted excess returns (IR). Consider the active factor exposure of our pure momentum index against a simple raw momentum index:





Active exposures against MSCI World Index (MXWO). "Raw" style indices refer to the equally weighted first quintile of the desirable style. Source: HSBC Global Asset Management, raw data from Thompson Reuters, Factset, IBES, Worldscope and MSCI.

Source: HSBC Global Asset Management, raw data from Thompson Reuters, Factset, IBES, Worldscope and MSCI, July 2018.
***Simulated data is shown for illustrative purposes only, and should not be relied on as indication for future returns**.*
Simulations are based on Back Testing assuming that the optimisation models and rules in place today are applied to historical data. As with any mathematical model that calculates results from inputs, results may vary significantly according to the values inputted. Prospective investors should understand the assumptions and evaluate whether they are appropriate for their purposes. Some relevant events or conditions may not have been considered in the assumptions. Actual events or conditions may differ materially from assumptions.

Raw momentum exhibits significant bias to high volatility stocks. This unintended exposure could prove problematic for performance and risk. Our Pure Momentum strategy is by construction immunised from such exposure.

Furthermore, style neutrality translates into lower correlations among factor excess returns:

Raw Factors

	VALUE	MOMENTUM	VOLATILITY	SIZE
VALUE	100%	-8%	-35%	33%
MOMENTUM	-8%	100%	44%	-2%
VOLATILITY	-35%	44%	100%	4%
SIZE	33%	-2%	4%	100%

Raw average pairwise correlation: 26%

Raw average absolute pairwise correlation: 31%

Pure Factors

	VALUE	MOMENTUM	VOLATILITY	SIZE
VALUE	100%	-15%	25%	63%
MOMENTUM	-15%	100%	25%	20%
VOLATILITY	25%	25%	100%	40%
SIZE	63%	20%	40%	100%

Pure average pairwise correlation: 6%
Pure average absolute pairwise correlation: 21%
Correlations of factor excess total returns over MSCI World (USD), monthly returns 07-2001 to 07-2018.
Source: HSBC Global Asset Management, raw data from Thompson Reuters, Factset, IBES, Worldscope and MSCI.

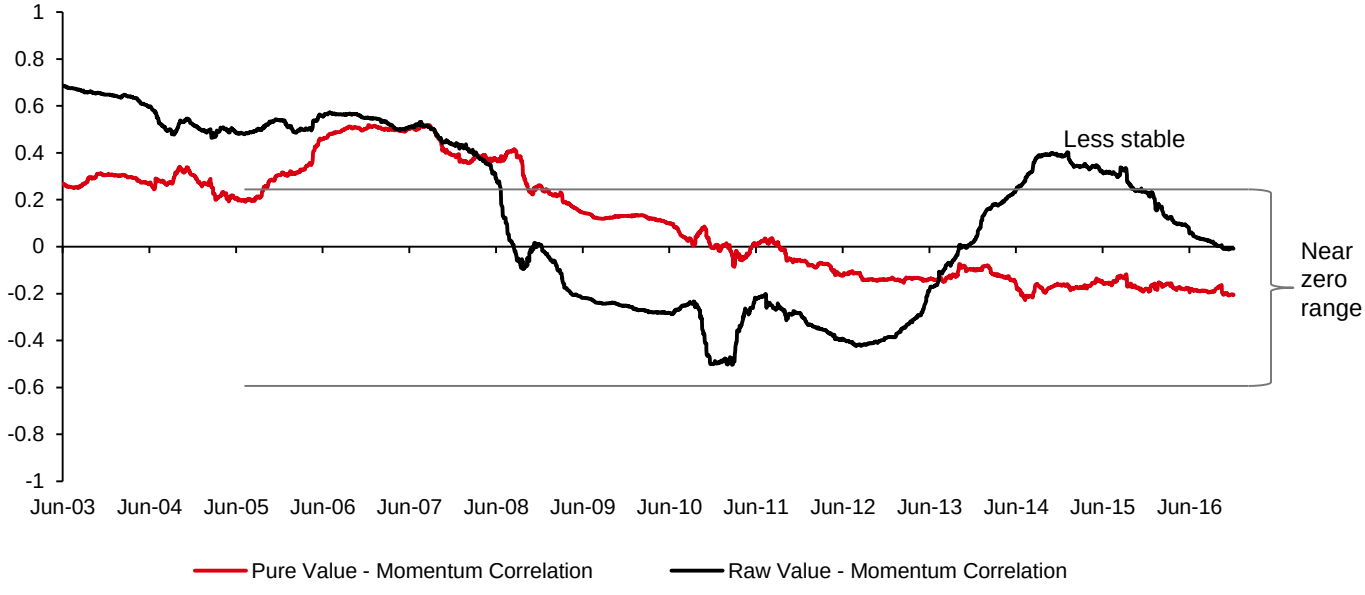
Compared to raw factor implementation, only volatility seems to demonstrate stronger correlation with other factors, but this is still within acceptable levels. As we will discuss later, correlations follow time varying patterns so a static calculation reveals little about their structure.

Source: HSBC Global Asset Management, raw data from Thompson Reuters, Factset, IBES, Worldscope and MSCI, July 2018.
***Simulated data is shown for illustrative purposes only, and should not be relied on as indication for future returns**.*
Simulations are based on Back Testing assuming that the optimisation models and rules in place today are applied to historical data. As with any mathematical model that calculates results from inputs, results may vary significantly according to the values inputted. Prospective investors should understand the assumptions and evaluate whether they are appropriate for their purposes. Some relevant events or conditions may not have been considered in the assumptions. Actual events or conditions may differ materially from assumptions.

The risk of time-varying correlations

A popular factor blending approach is to combine value and momentum. This is primarily because these factors exhibit low return correlations. However, in extreme circumstances, these correlations can break down.

A raw factor implementation of value and momentum depends on their correlation remaining small and stable. This is often assumed to be constant and negative. The graph below demonstrates that this is not the case - the correlation varies over time, depending on the economic environment:



Correlations calculated using daily excess (against MSCI World Index) total returns (2 years rolling) in USD from 30/06/2003 – 31/07/2018. Source: HSBC Global Asset Management, raw data from Thompson Reuters, Factset, IBES, Worldscope and MSCI.
***Simulated data is shown for illustrative purposes only, and should not be relied on as indication for future returns**.*
Simulations are based on Back Testing assuming that the optimisation models and rules in place today are applied to historical data. As with any mathematical model that calculates results from inputs, results may vary significantly according to the values inputted. Prospective investors should understand the assumptions and evaluate whether they are appropriate for their purposes. Some relevant events or conditions may not have been considered in the assumptions. Actual events or conditions may differ materially from assumptions.

The historic correlation between raw value and momentum has been unstable, repeatedly oscillating between large positive and negative values. In contrast, the pure correlations have shown a greater tendency to remain close to zero. A major exception is the period around the 'quant crisis' in 2007 when factor payoffs became unstable, and even then the correlations were close.

The long only nature of the portfolio construction process also impacts the combination of value and momentum. Academic studies that refer to a consistent negative correlation usually point to Fama-French factors based on long-short portfolios incorporating illiquid securities.

How can we measure the purity of a factor strategy?

As we discussed earlier, most smart beta indices have unintended exposures to non-targeted factors. This usually stems from the requirements of transparency, simplicity or investability. There is evidence that simple minimum variance optimisation, a common smart beta strategy, results in time-varying factor exposures. Goldberg et al. suggest that it is important to be aware of these exposures and highlight the benefits of targeting pure exposures when building such strategies.

For this reason, we need to assess how well a given strategy allocates its risk budget to its target factor. Our factor purity ratio (FPR) is defined as the ratio of tracking error from the desired factor(s) to the total tracking error. This quantitative metric facilitates rapid comparison between different providers' factor products to assess their relative purity.

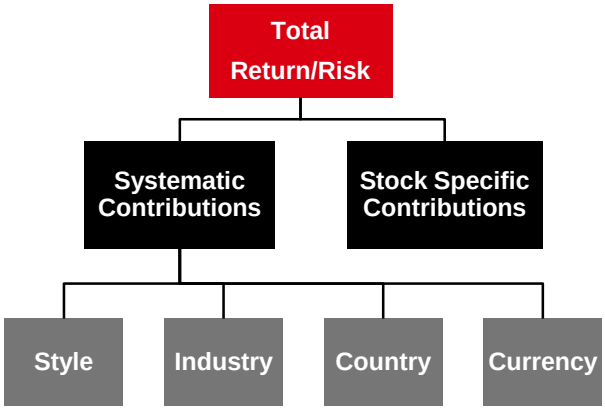
A strategy with high exposure to a particular factor will not necessarily have high FPR. For example, it is well known that a strategy based simply on the ranking of value stocks often has significant small-cap exposure. If we were to buy the top quintile of value names, we would anticipate a high exposure to both value and small cap factors. We would prefer a pure beta to have a large proportion of active risk driven by the style factor of interest and minimal active risk contributions from other factors.

$$\textit{Factor Purity Ratio} = \frac{\sum AR_D}{TAR}$$

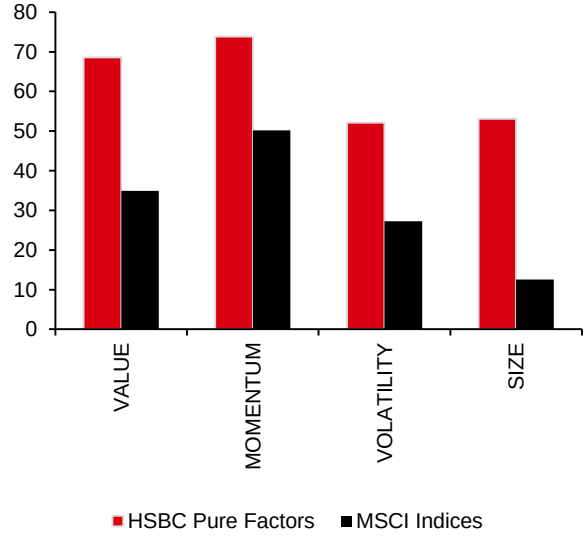
$\sum$

AR_D is the sum of active risk contributions of the desired factors while TAR is the total active risk of the portfolio.

Decomposition of total active risk in a cross-sectional factor risk model



FPR ratios across Pure Factors and MSCI Factor Indices



MSCI indices used: MSCI World Enhanced Value, MSCI World Momentum Tilt, MSCI World Quality Tilt, MSCI Wold Volatility Tilt. Data source for MSCI Weights: MSCI. Other data: HSBC Global Asset Management, raw data from Thompson Reuters, Factset, IBES, Worldscope and MSCI. Data as of 31/12/2016.

Pure Factor Strategies

	Total Active Risk (%)	FPR (%)	Active Exposure
VALUE	3.18	68.6	1.1
MOMENTUM	2.42	73.9	0.7
VOLATILITY	3.18	52.1	0.6
SIZE	2.61	53.1	1.5

MSCI Factor Strategies

	Total Active Risk (%)	FPR (%)	Active Exposure
VALUE	5.36	34.91	1.1
MOMENTUM	3.98	50.20	0.8
VOLATILITY	5.41	27.23	0.6
SIZE	3.09	12.55	1.1

Source: HSBC Global Asset Management, raw data from MSCI, Thompson Reuters, Factset, IBES and Worldscope. Data as at 31/12/2016.
***Simulated data is shown for illustrative purposes only, and should not be relied on as indication for future returns**.*
Simulations are based on Back Testing assuming that the optimisation models and rules in place today are applied to historical data. As with any mathematical model that calculates results from inputs, results may vary significantly according to the values inputted. Prospective investors should understand the assumptions and evaluate whether they are appropriate for their purposes. Some relevant events or conditions may not have been considered in the assumptions. Actual events or conditions may differ materially from assumptions.

As can be seen, factor exposure does not directly correlate with factor purity. For example, HSBC's Pure Momentum strategy has a low factor exposure at 0.67 but a high factor purity of 73.9%. This makes sense as momentum is a more volatile factor with a higher active risk contribution. Looking at the desired factor's exposures alone might be misleading. Factor exposures fail to take into account the risks contributed by other potentially undesirable factors.

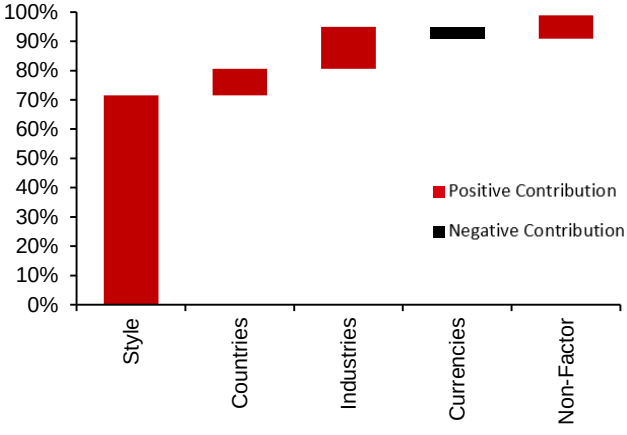
Concentrating on active risk contribution also connects back to the general debate on risk premia factors. There is a degree of risk in investing in factors and their returns are time-varying. Note that strategies with the same factor exposures may have different active risks based on the nature of the factor. A strategy that is pure has less contribution from undesired risks. The key point is that we are only taking a risk on the factors that we choose to invest in.

Comparing this to the MSCI World Enhanced Value Index, we can see how different HSBC's Pure Value strategy is in terms of factor purity. The FPR ratio of the MSCI index at the same point in time is 34.9%, compared to HSBC's of 68.6%. This implies that HSBC's index allocates twice as much of its active risk budget to the desired factor than MSCI.

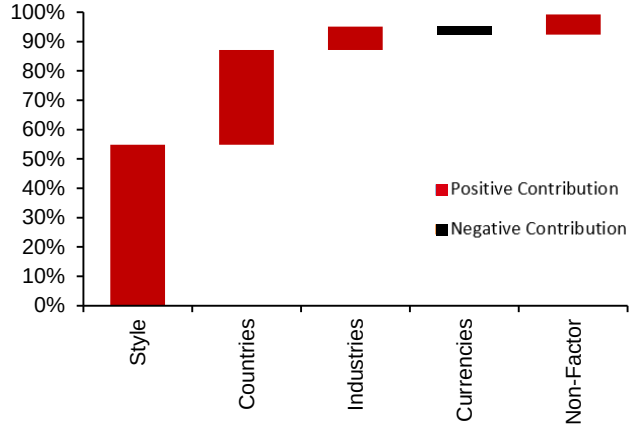
The charts below are decompositions of active risk for the HSBC Pure Value Strategy and MSCI Enhanced Value Index as at end of 12/2016. This is a common risk attribution output from portfolio attribution packages.

Decomposition of style active risk

Pure Value

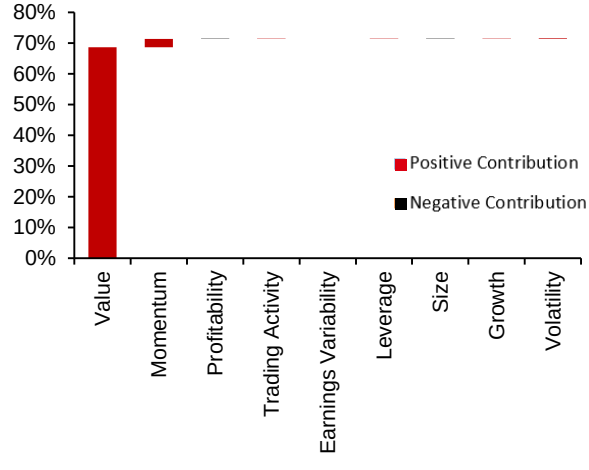


MSCI Enhanced Value

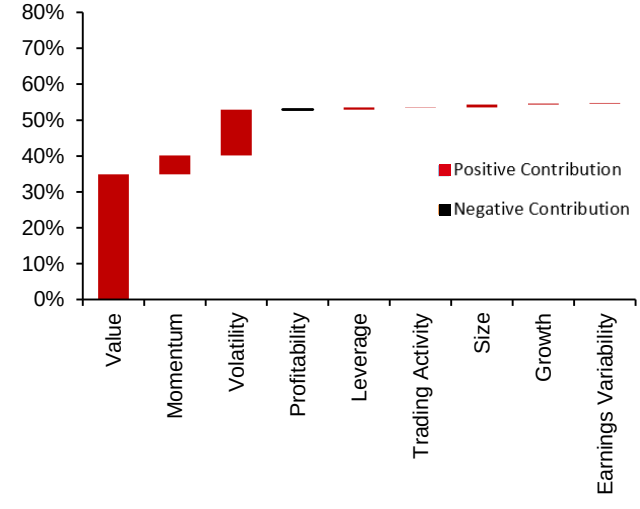


Decomposition of style active risk

Pure Value



MSCI Enhanced Value



Source: HSBC Global Asset Management, raw data from MSCI, Thompson Reuters, IBES and Worldscope. Data as at 31/12/2016. ***Simulated data is shown for illustrative purposes only, and should not be relied on as indication for future returns****. Simulations are based on Back Testing assuming that the optimisation models and rules in place today are applied to historical data. As with any mathematical model that calculates results from inputs, results may vary significantly according to the values inputted. Prospective investors should understand the assumptions and evaluate whether they are appropriate for their purposes. Some relevant events or conditions may not have been considered in the assumptions. Actual events or conditions may differ materially from assumptions.*

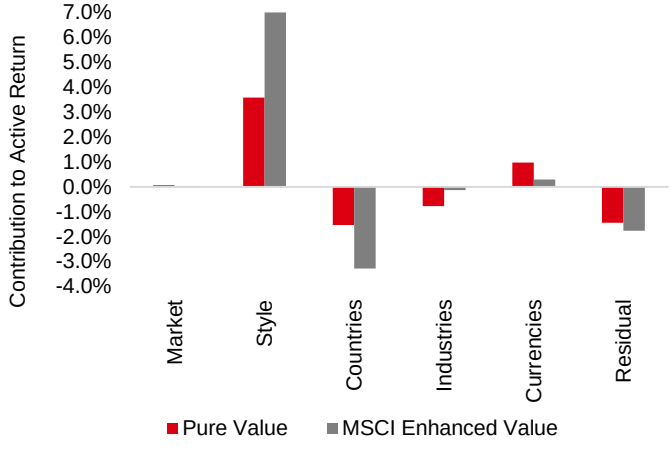
Looking at the decomposition of active risk for the MSCI index above, we see that a significant portion comes from country active risk. A closer look at the breakdown shows that the majority of this comes from active exposure to Japan. Furthermore we can see that even though the biggest component of style active risk is indeed value, there are still significant contributions from volatility and momentum. This does not appear to be consistent with a simple 'index' strategy – the ex-ante performance becomes too dependent on a single risk which is not immediately associated with the strategy.

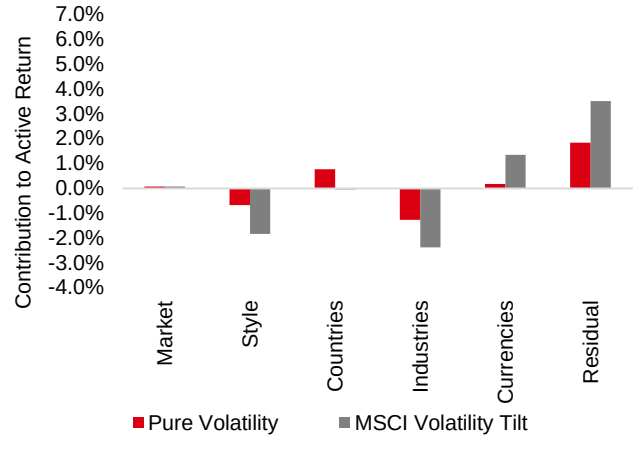
The Importance of a Pure Strategy

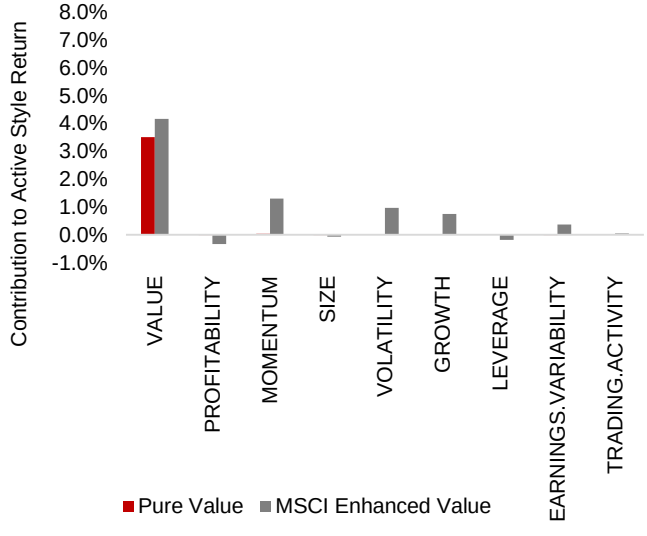
Non-target exposures can have a positive contribution to return. The style-only return attribution of the raw value strategy below shows that momentum exposure has enhanced performance significantly. However, it is hard to justify its classification as a value strategy when almost as great a share of return originates from momentum exposure.

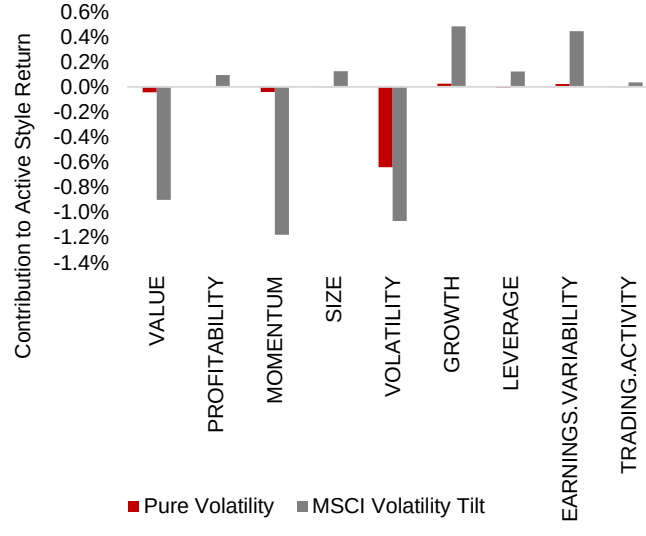
2016 saw a fundamental shift in factor performance as defensive styles retreated (e.g. quality and low volatility) and cyclical factors (e.g. value and size) outperformed. Unintentional systematic exposures are most likely to attract attention when the target style itself delivers a weak or negative return. In the example of raw low volatility below, the targeted style underperforms the benchmark by around 1%. Significant uncontrolled negative contributions from value and momentum accentuate this negative return, producing an overall style performance of -1.8%. The net result is that the client receives a worse return than his target style ought to deliver.

In both cases of value and volatility, the pure strategies demonstrate the benefit of a factor construction process that purposely constrains non-target exposures, leaving the advertised style as a dominant driver of return even when its return is weak.









Total active return and total active style return attributions versus MSCI World for HSBC Pure strategies and corresponding MSCI factor indices. The attributions consider returns for the period 30/11/2015 to 31/12/2016.
Source: HSBC Global Asset Management, raw data from MSCI, Thompson Reuters, IBES and Worldscope. ***Simulated data is shown for illustrative purposes only, and should not be relied on as indication for future returns****. Simulations are based on Back Testing assuming that the optimisation models and rules in place today are applied to historical data. As with any mathematical model that calculates results from inputs, results may vary significantly according to the values inputted. Prospective investors should understand the assumptions and evaluate whether they are appropriate for their purposes. Some relevant events or conditions may not have been considered in the assumptions. Actual events or conditions may differ materially from assumptions.*

Analysis: Value + Momentum Investing

We have already illustrated the time varying relationship between value and momentum. The combination of value and momentum as an investment strategy has been well studied in academic literature and is popular among investment practitioners.

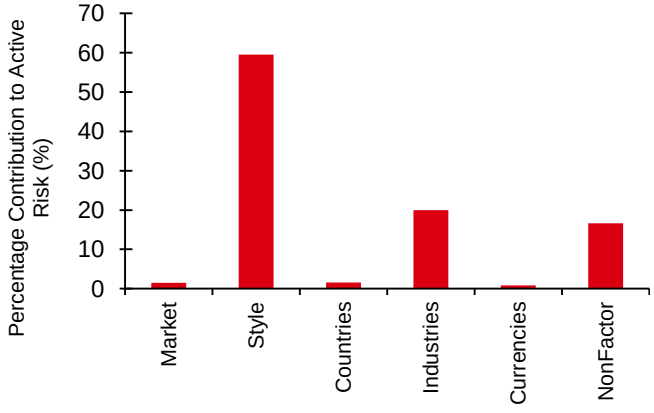
Consider the following two portfolios:

- Portfolio 1: 50% Pure Value strategy + 50% Pure momentum strategy
- Portfolio 2: 50% raw value strategy + 50% raw momentum strategy

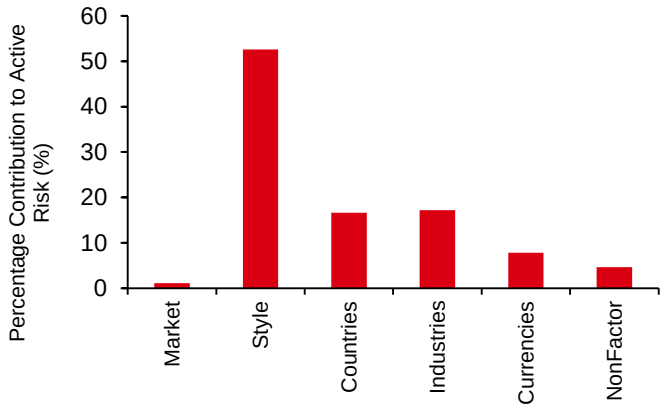
If combined factors are not purified beforehand, Portfolio 2 shows that the volatility factor contributes significantly to tracking error. This is to be expected: as discussed before, raw momentum exhibits high exposure to volatility. In contrast, Portfolio 1 appears to have a more balanced risk profile and 59.3% of the tracking error for Portfolio 1 is attributable to the targeted styles (value-momentum).

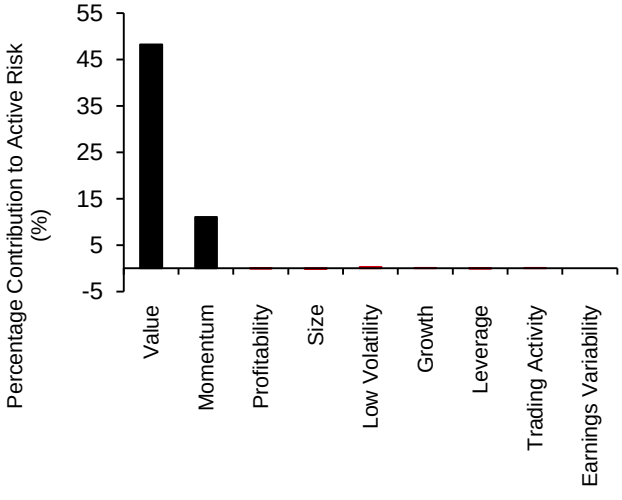
Tracking Error Percentage Decomposition

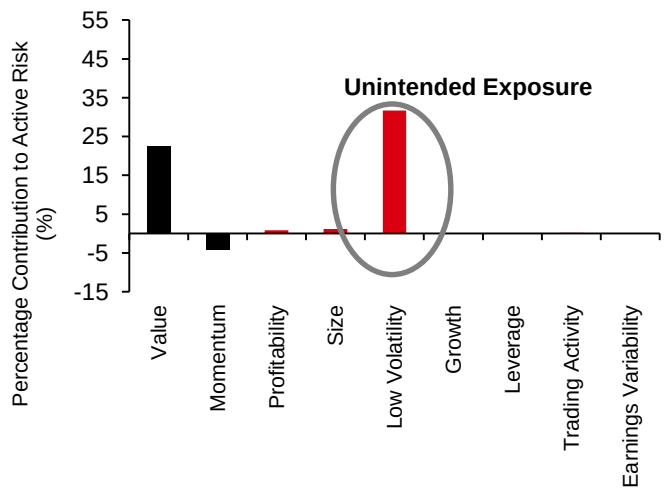
Portfolio 1: TE 1.58%



Portfolio 2: TE 4.88%







Percentage contribution (PCR) to tracking error (TE) for the cross-section of portfolio/benchmark weights on 31/12/2016.
Source: HSBC Global Asset Management, raw data from MSCI, Thompson Reuters, Factset, IBES and Worldscope.

Source: HSBC Global Asset Management, raw data from MSCI, Thompson Reuters, IBES and Worldscope. ***Simulated data is shown for illustrative purposes only, and should not be relied on as indication for future returns****. Simulations are based on Back Testing assuming that the optimisation models and rules in place today are applied to historical data. As with any mathematical model that calculates results from inputs, results may vary significantly according to the values inputted. Prospective investors should understand the assumptions and evaluate whether they are appropriate for their purposes. Some relevant events or conditions may not have been considered in the assumptions. Actual events or conditions may differ materially from assumptions.*

Applications to Portfolio Management

Diversifying a Passive Holding

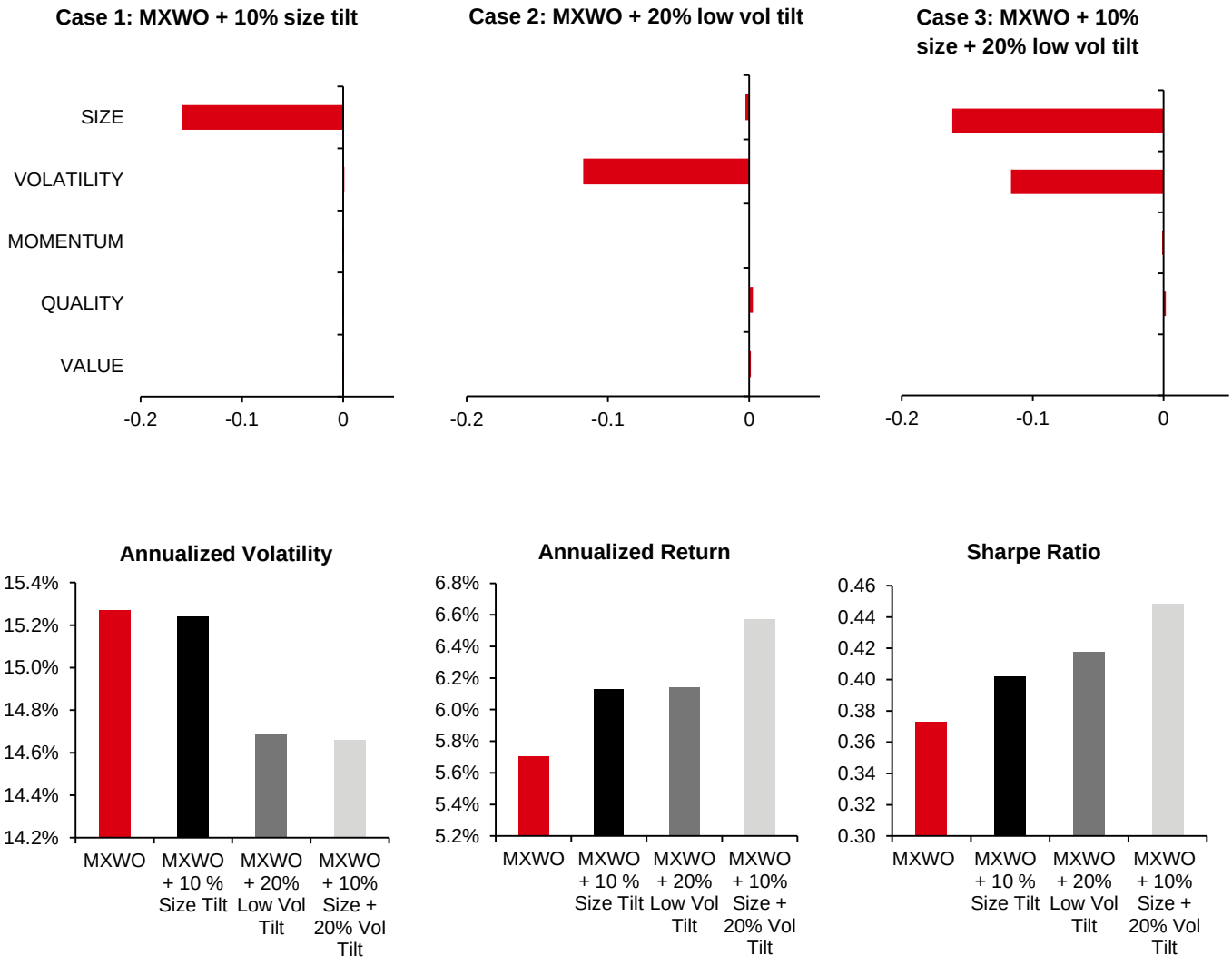
Factor tilts can be incorporated into portfolio management as an overlay to reduce risk, improve performance and enhance risk adjusted returns.

In order to demonstrate this we consider three scenarios where different objectives require different factor tilts. Using the MSCI World Index as a base portfolio, we consider three test cases:

Case 1: Add 10% Pure Size tilt to improve performance

Case 2: Add 20% Pure Low Volatility tilt to reduce risk

Case 3: Combine 10% Pure Size and 20% Pure Low Volatility tilt for better risk adjusted returns



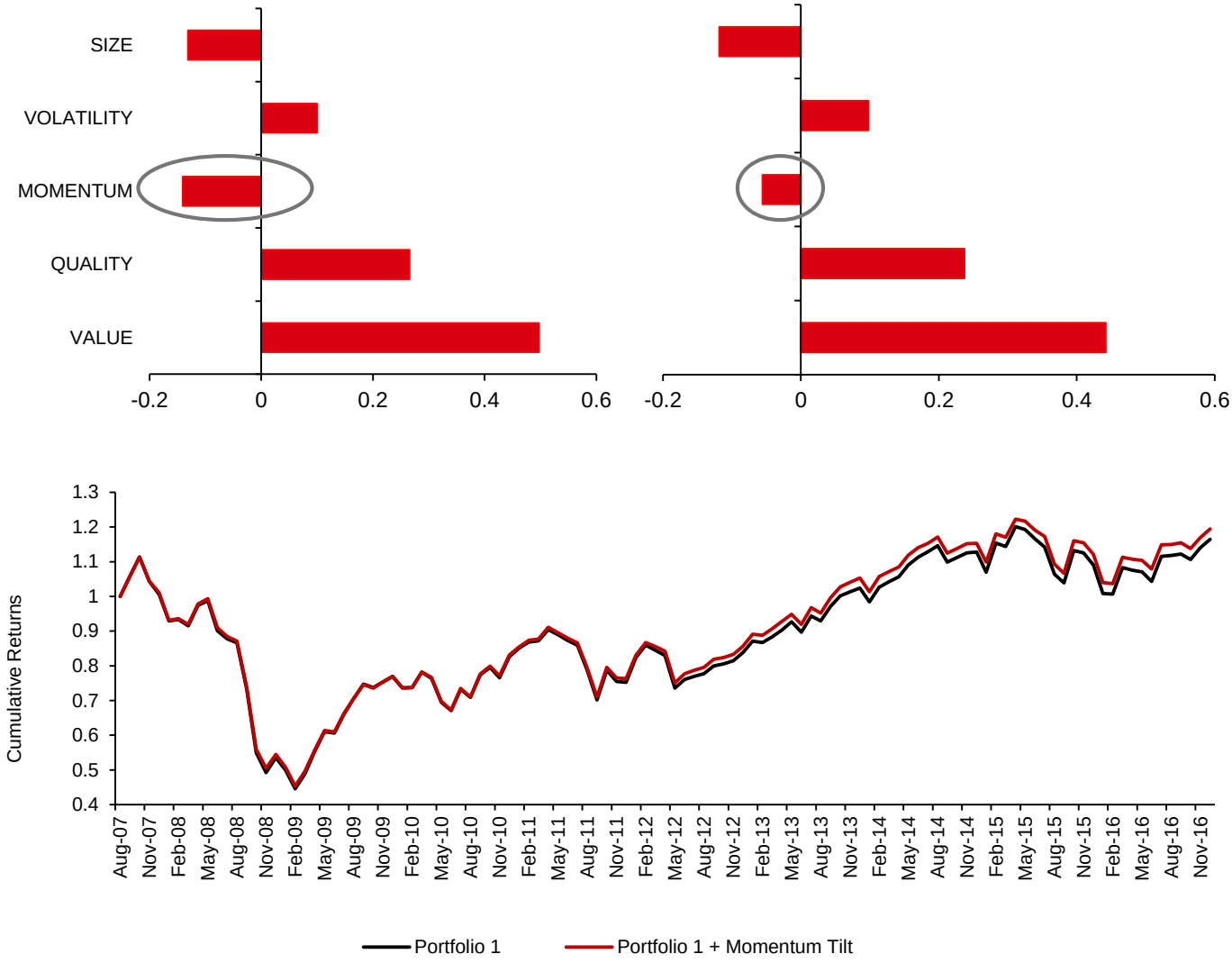
Annualised performance numbers from internal backtests covering 07/2001 to 12/2016.

Source: HSBC Global Asset Management, raw data from MSCI, Thompson Reuters, IBES and Worldscope. Simulated data is shown for illustrative purposes only, and should not be relied on as indication for future returns. Simulations are based on Back Testing assuming that the optimisation models and rules in place today are applied to historical data. As with any mathematical model that calculates results from inputs, results may vary significantly according to the values inputted. Prospective investors should understand the assumptions and evaluate whether they are appropriate for their purposes. Some relevant events or conditions may not have been considered in the assumptions. Actual events or conditions may differ materially from assumptions.

Completion of an Active Portfolio

Building portfolios with a bottom-up approach can sometimes result in a collection of securities that exhibit unwanted factor exposures. It is important to manage these biases in order to improve a portfolio's risk profile.

A value oriented portfolio is used as the base case in this section. Such a portfolio will exhibit a natural bias to the value factor. After performing factor analysis we can identify any significant unintended negative exposure to momentum. Using the relevant pure factor strategy we are able to mitigate the unwanted exposure to momentum and keep the factor profile of the portfolio close to benchmark. The wealth curve below demonstrates how the momentum bias correction provides a slight uplift to performance.



The charts above show active average exposures and the cumulative wealth curve of hypothetical strategies for illustrative purposes only. Data period: 31/07/2007 – 31/12/2016.
Source: HSBC Global Asset Management, raw data from MSCI, Thompson Reuters, IBES and Worldscope. Simulated data is shown for illustrative purposes only, and should not be relied on as indication for future returns. Simulations are based on Back Testing assuming that the optimisation models and rules in place today are applied to historical data. As with any mathematical model that calculates results from inputs, results may vary significantly according to the values inputted. Prospective investors should understand the assumptions and evaluate whether they are appropriate for their purposes. Some relevant events or conditions may not have been considered in the assumptions. Actual events or conditions may differ materially from assumptions.

Conclusion

Factor strategies represent a highly accessible and efficient way of investing in factor premia through passive vehicles. HSBC's approach to delivering factor exposure focuses on the integration of four distinct characteristics: Precision, Unbiasedness, Robustness and Efficiency. Our methodology incorporates factor neutralisation in order to improve premia purity and turnover control for stability and cost reduction. We compared the risk/return profile of HSBC's suggested methodology with the conventional (unconstrained) raw factor implementations. Not controlling for exposures to unwanted styles leads to the 'contamination' of a signal's purity and unintended risk exposure. Finally, we demonstrated some practical applications of using factors in portfolio management.

HSBC's approach achieves competitive performance characteristics avoiding, by design, unintended exposures.

References

Amenc, N., Goltz, F., Lodh, A. and Sivasubramanian, S. (October 2014): Robustness of Smart Beta Strategies, ERI Scientific Beta Publication.

Ang, A., 2014, Asset Management: A Systematic Approach to Factor Investing, Oxford University Press.

Fama, E.F. and French, K.R. (2013), A Four-Factor Model for the Size, Value and Profitability Patterns in Stock Returns, working paper.

Frazzini, A. and Pedersen, L.H. (2013) – Betting Against Beta, Journal of Financial Economics, 111, 1-25.

Goldberg, Leshem and Geddes (2013) – Restoring Value to Minimum Variance, forthcoming in Journal of Investment Management.

Harvey, Campbell R., Yan Liu, and Heqing Zhu (2013): ... and the Cross-Section of Expected Returns, unpublished working paper, Duke University.

Hunstad and Dekhayser (2014) – Evaluating the Efficiency of 'Smart Beta' Indexes, working paper.

Meucci, Santangelo and Deguest (2013) – Risk Budgeting and Diversification Based on Optimized Uncorrelated Factors, working paper.

John Cochrane of the University of Chicago coined the term 'zoo of factors' in his 2011 presidential address to the American Finance Association.

http://faculty.chicagobooth.edu/john.cochrane/research/ papers/discount_rates_jf.pdf

Appendix

Our factor strategies are constructed from the active universe for the relevant market cap weighted benchmark. They are rebalanced monthly with an 8% turnover allowance (~100% per year).

Factor Construction

Each single factor strategy is constructed from several individual factors, which we describe in detail below.

In order to combine these components into one factor we first need to normalise them by subtracting the global mean and dividing by the global standard deviation.

$$Zi = \frac{Xi - CapWeightedMean(X)}{Standard\ Deviation(X)}$$

This procedure ensures that all the individual components are in the same scale and their combination results in the formation of meaningful factors.

In addition, extreme normalised values that are outside the range [-3, 3] are set to -3 / 3.

The individual components of each factor are combined dynamically (ie the weights are not static) through a specialised algorithm

- At every point in time (cross-section) we calculate the Spearman rank correlation matrix of components and run a principal components analysis (PCA)
- We extract the first principal component and normalise to sum to 100%. Unlike the equal weight approach, this captures more of the information in individual components.

Single Factor Definitions

Value	Size	Momentum	Volatility	Quality
Book/Price	Log (Market Cap)	Total return over 12 months, while skipping the most recent two weeks to avoid the price reversal effects	Rolling volatility - Return volatility over the past 252 trading days	$ROE = \frac{Income}{Book\ Value}$
Earnings/Price	Log (Sales)	$Momentum(T) = \sum_{t=-54}^{-2} log(1+r_{n,T-t})$	Rolling CAPM beta - Rolling window regression of stock returns on home index returns	$ROCE = \frac{Income}{Capital\ Employed}$
((0.6*Earnings FY1) + (0.4*Earnings FY2))/Price	Log (Total Assets)	Where $r_{n,t}$ total weekly return of security n at the week t	Historical sigma - residual volatility from rolling window regression of stock returns on home index returns	$ROA = \frac{Income}{Total\ Assets}$
Cash Flows from Operation/Price			Cumulative range - the ratio of maximum and minimum stock price over the previous year (26%)	$EBITDA\ Margin = \frac{EBITDA}{Sales}$
Log (Sales/EV)				
EBITDA/EV				

Source: GLOBAL EQUITY FUNDAMENTAL FACTOR MODEL, Nick Baturin, Sandhya Persad and Ercument Cahan September 2012, Version 1.1, Bloomberg

Portfolio Optimisation

Target Function

The target function of the portfolio optimisation model drives the optimisation process.
Our target function is to maximise the Rank.

$$max\ w'Rank = max \sum_{i=1}^{N} w_i R_i\ , i \in U$$

Where Ri and wi is the Rank and weight of the stock i respectively and U the stocks universe.

Factor Exposure Constraints

$$-0.01 \leq \sum_{i \epsilon U} F_{i,z} w_i \leq 0.01$$

Where z represents each of the Risk factors (Value, Size, Volitility etc) and Fi,z is the value of Factor z for stock i.

Turnover Constraint

$$\frac{1}{2} \sum_{i \epsilon U} \left| w_i^t - w_i^{t-1} \right| \leq 8\%$$

Where w represents the weight of the stock i at time t and 8% is the value of the one way turnover.

Active Weight Constraint

$$Active\ Weight_i \leq 25bp$$

Source: GLOBAL EQUITY FUNDAMENTAL FACTOR MODEL, Nick Baturin, Sandhya Persad and Ercument Cahan September 2012, Version 1.1, Bloomberg

Authors

Vis Nayar

Deputy CIO, Equities
HSBC Global Asset Management

Vis Nayar is Deputy CIO, Equities and is responsible for investment research. He has been working in the industry since 1988, joining HSBC Markets in 1996, and has been with HSBC Global Asset Management since 1999. Over his career Vis has extensive research and portfolio management experience in the long only equity, alternative investments and structured products businesses.
Vis holds a BSc in Electrical Engineering from Imperial College, University of London and a Masters in Finance from London Business School. He is a CFA charterholder, holds a Certificate in Quantitative Finance (CQF) and also qualified as a Chartered Accountant in the UK. He is also a member of the advisory board for the Masters in Finance programmes at Imperial College.

Olivia Skilbeck

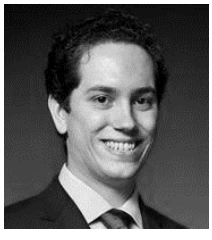
Quantitative Research Analyst
HSBC Global Asset Management

Olivia Skilbeck is a Quantitative Research Analyst in the Global Equity Research team and has been working in the industry since 2012, when she joined HSBC. Prior to joining Global Equity Research in 2015, Olivia trained as an Analyst in the Asian Equities team in Hong Kong. Olivia holds an MA in Natural Sciences from Trinity College Cambridge and has completed all three levels of the CFA examinations. She is also an FRM candidate.

Ioannis Kampouris

Quantitative Research Analyst
HSBC Global Asset Management

Ioannis Kampouris is a Quantitative Research Analyst in Global Equity Research and has been working in the industry since 2010. Prior to joining HSBC, Ioannis worked as a Quantitative Analyst at Gulf International Bank (GIB). He specializes in quantitative strategies research and development, statistical modelling and application of advanced optimization methods. Ioannis holds an MSc in Computational Statistics and Machine Learning from University College London (UCL) and MEng in Computer Engineering and Informatics from University of Patras (Greece).



Paul Denham

Lead Structured Equity Research Analyst
HSBC Global Asset Management

Paul Denham is the Lead Structured Equity Research Analyst in Global Equity Research and has been working in the industry since 2004. Prior to joining HSBC in 2015, Paul worked as an Associate at Credit Suisse and as an independent research analyst. He holds a MA in Physics & Philosophy from the University of Oxford and is a CFA Charterholder.

Key risks

The value of an investment in the portfolios and any income from them can go down as well as up and as with any investment you may not receive back the amount originally invested.

- Exchange rate risk: Investing in assets denominated in a currency other than that of the investor's own currency perspective exposes the value of the investment to exchange rate fluctuations.
- Derivative risk: The value of derivative contracts is dependent upon the performance of an underlying asset. A small movement in the value of the underlying can cause a large movement in the value of the derivative. Unlike exchange traded derivatives, over-the-counter (OTC) derivatives have credit risk associated with the counterparty or institution facilitating the trade.
- Emerging market risk: Emerging economies typically exhibit higher levels of investment risk. Markets are not always well regulated or efficient and investments can be affected by reduced liquidity.
- Operational risk: The main risks are related to systems and process failures. Investment processes are overseen by independent risk functions which are subject to independent audit and supervised by regulators.
- Real estate risk: Cost of acquisition and disposal, taxation, planning, legal, compliance and other factors can materially impact real estate valuation.
- Liquidity risk: Liquidity is a measure of how easily an investment can be converted to cash without a loss of capital and/or income in the process. The value of assets may be significantly impacted by liquidity risk during adverse market conditions.

Important information

HSBC Global Asset Management is a group of companies in many countries and territories throughout the world that are engaged in investment advisory and fund management activities, which are ultimately owned by HSBC Holdings plc. HSBC Global Asset Management is the brand name for the asset management business of HSBC Group. HSBC Global Asset Management (Canada) Limited is a wholly owned subsidiary of, but separate entity from, HSBC Bank Canada and provides services in all provinces of Canada except Prince Edward Island.

This information is intended for institutional / qualified investors only.

This material has been prepared by HSBC Global Asset Management (UK) Ltd and has been approved for use in Canada, it is distributed for informational purposes only and is not a solicitation or an offer to buy any security or instrument or to participate in any trading or investment strategy. All opinions and assumptions included in this presentation are based upon current market conditions as of the date of this presentation and are subject to change. All investments involve risk including the loss of principal. This presentation contains data compiled from third party sources believed to be reliable, but the accuracy of such data has not been verified. Any portfolio characteristics shown herein, including position sizes and sector allocations among others, are generally averages and are for illustrative purposes only and do not reflect the investments of an actual portfolio unless otherwise noted. The investment guidelines of an actual portfolio may permit or restrict investments that are materially different in size, nature and risk from those shown.

Any forecast, projection or target contained in this presentation is for information purposes only and is not guaranteed in any way. HSBC accepts no liability for any failure to meet such forecasts, projections or targets.

This material outlines potential investment vehicles and makes certain assumptions about their structure, strategies and market environment, including projections about their underlying assets, none of which have been purchased. All terms used herein are indicative and subject to change. Accordingly, there can be no assurance that the assumptions will prove to be correct, or that actual returns will be consistent with those described herein.

Source: MSCI, the MSCI information may only be used for your internal use, may not be reproduced or redisseminated in any form and may not be used as a basis for or a component of any financial instruments or products or indices. None of the MSCI information is intended to constitute investment advice or a recommendation to make (or refrain from making) any kind of investment decision and may not be relied on as such. Historical data and analysis should not be taken as an indication or guarantee of any future performance analysis, forecast or prediction. The MSCI information is provided on an “as is” basis and the user of this information assumes the entire risk of any use made of this information. MSCI, each of its affiliates and each other person involved in or related to compiling, computing or creating any MSCI information (collectively, the “MSCI Parties”) expressly disclaims all warranties (including, without limitation, any warranties of originality, accuracy, completeness, timeliness, non-infringement, merchantability and fitness for a particular purpose) with respect to this information. Without limiting any of the foregoing, in no event shall any MSCI Party have any liability for any direct, indirect, special, incidental, punitive, consequential (including, without limitation, lost profits) or any other damages. (www.msci.com)

Expiry: August 31, 2019

DK1800381A