Factor Investing
Pure and simple

Quantitative Equity Research

For professional clients
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Quantitative Equity Research
HSBC Pure Factor Indices

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, HSBC’s 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 index for smart beta investors.

The aim of this paper is to illustrate how HSBC’s approach embeds an emphasis on:

- Precision
- Unbiasedness
- Robustness
- Efficiency

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

We also compare HSBC’s indices with conventional factor implementation to demonstrate the effectiveness of HSBC’s construction method and the advantages of factor neutralisation.

Finally, we discuss practical applications to portfolio management and the value of HSBC’s indices as a tool to enhance investment performance.
Introduction to Factors

The appeal of smart beta indices 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 indices 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 indices 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 by index providers. This new dimension in product design has opened up a set of opportunities designed to maximise convenience for investors.
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 (β).

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 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.
Building Factor Indices

A plethora of factor index construction methods have been proposed in the academic literature. Some have been implemented by index providers. 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’ indices 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 Precision, Unbiasedness, Robustness and Efficiency.

**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 efficiency ratios, exhibiting a high proportion of targeted risk per unit of active risk. We refer to this family of indices as our “pure” indices.

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.

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\(^1\)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.

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.
Why are turnover constraints important?

**Control Turnover**: 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.

Raw Momentum Monthly Turnover  Pure Momentum Monthly Turnover

**Style Neutral**: A focus on premia purity and approximate independence from other sources of risk/return is essential to building factor efficient indices. 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:

**Why do we want pure factor beta?**

Raw Momentum

![Active Factor Exposures](chart)

Pure Momentum Index

![Active Factor Exposures](chart)

Active exposures against MSCI World Index (MXWO). "Raw" style indices refer to the equally weighted first quintile of the desirable style.

**Sources**: Factset, Thomson Reuters, MSCI, IBES, Worldscope.
Raw momentum exhibits significant bias to small caps and high volatility stocks. This unintended exposure could prove problematic for performance and risk. HSBC’s pure momentum index is by construction immunised from such exposure. Furthermore, style neutrality translates into lower correlations among factor excess returns:

Raw Factors

<table>
<thead>
<tr>
<th></th>
<th>Size</th>
<th>Volatility</th>
<th>Quality</th>
<th>Value</th>
<th>Momentum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>100%</td>
<td>-13%</td>
<td>62%</td>
<td>67%</td>
<td>21%</td>
</tr>
<tr>
<td>Volatility</td>
<td>-13%</td>
<td>100%</td>
<td>9%</td>
<td>-30%</td>
<td>41%</td>
</tr>
<tr>
<td>Quality</td>
<td>62%</td>
<td>9%</td>
<td>100%</td>
<td>40%</td>
<td>34%</td>
</tr>
<tr>
<td>Value</td>
<td>67%</td>
<td>-30%</td>
<td>40%</td>
<td>100%</td>
<td>-11%</td>
</tr>
<tr>
<td>Momentum</td>
<td>21%</td>
<td>41%</td>
<td>34%</td>
<td>-11%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Average raw pairwise correlation: 22%

Pure Factor Indices

<table>
<thead>
<tr>
<th></th>
<th>Size</th>
<th>Volatility</th>
<th>Quality</th>
<th>Value</th>
<th>Momentum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>100%</td>
<td>29%</td>
<td>12%</td>
<td>41%</td>
<td>10%</td>
</tr>
<tr>
<td>Volatility</td>
<td>29%</td>
<td>100%</td>
<td>7%</td>
<td>-24%</td>
<td>26%</td>
</tr>
<tr>
<td>Quality</td>
<td>12%</td>
<td>7%</td>
<td>100%</td>
<td>18%</td>
<td>-3%</td>
</tr>
<tr>
<td>Value</td>
<td>41%</td>
<td>-24%</td>
<td>18%</td>
<td>100%</td>
<td>-2%</td>
</tr>
<tr>
<td>Momentum</td>
<td>10%</td>
<td>26%</td>
<td>-3%</td>
<td>-2%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Average pure pairwise correlation: 11%.

Correlations of factor excess total returns over MSCI World (USD), monthly returns 07-2001 to 10-2015.

Sources: Factset, Thomson Reuters, MSCI, IBES, Worldscope.

Compared to raw factor implementation only size and volatility seem to have a higher correlation, 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.

A recent paper from EDHEC (Amenc et al.) argues for the importance of robustness in smart beta index construction. ‘Factor Fishing’, ‘Model-Mining’, ‘Non-Robust Weighting Scheme’ and ‘Dependency on Individual Factor Exposures’ are common pitfalls to avoid.
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 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:

![2 Years Rolling Correlation](image)

Correlations calculated using daily excess (against MSCI World Index) total returns (2 years rolling) in USD from 04/06/2003 – 30/10/2015.

Sources: Factset, Thomson Reuters, MSCI, IBES, Worldscope.

In fact the 2 year historic correlation between value and momentum is generally closer to zero, and more stable, for pure factor indices. The only 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.

To illustrate the importance of this effect, we now look at the impact of this correlation instability in the period just after the financial crisis – a period when equity markets rose rapidly. This was a strong value driven rally, sustained for a number of months - a good time to be exposed to the value factor.
A comment on manager diversification

A study from RVK showed that manager diversification (i.e. increasing the number of funds in a multi-manager portfolio basket) could potentially lead to negative effects. As more managers are added to a portfolio:

- Portfolio active share declines
- Cost increases
- There is minimal diversification benefit

Ultimately returns suffer:

Median Seven-Year Return by Number of Managers in Portfolio

How can we measure the purity of a factor index?

The inspiration for this section comes from a recently published paper by Hunstad and Dekhayser, where they introduce a new measure called the factor efficiency ratio. As discussed above, most smart beta indices have unintended exposures to untargeted 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 indices.

The factor efficiency ratio is defined as the ratio of tracking error from the desired factor(s) to the total tracking error. It follows that this can be used to measure the efficiency of an index, i.e. the ratio of desired to undesired active risk. Formally, it is calculated as:

\[
\text{Factor Efficiency Ratio} = \frac{\sum \text{AR}_D}{\text{AR} \cdot \sum \text{AR}_D}
\]

\(\sum \text{AR}_D\) is the sum of active risk contributions of the desired factors while \(\text{AR}\) is the total active risk of the portfolio.

Avoiding this problem requires a parsimonious approach of building thematic blocks and identifying the point of diminishing returns.

Typically additional managers are added to the roster to bring complementary, uncorrelated exposures to the overall portfolio. Our pure factor indices provide a useful set of tools to achieve this. They are designed to represent independent sources of risk and return at low cost. This provides the opportunity to control overall factor exposure without affecting true ‘active’ share or introducing new unwanted risk exposures.
The contributions to total active risk can be estimated using a factor risk model.

Hunstad and Dekhayser highlight the interesting disparity between active exposure and factor efficiency. An index with high exposure to a particular factor will not necessarily have high factor efficiency. For example, it is well known that a pure 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 index to have a large proportion of active risk driven by the style factor of interest and minimal active risk contributions from other factors.

In the chart below we show the factor efficiency ratios for HSBC’s developed world pure beta indices against those for MSCI’s developed world style indices. (i.e MSCI Enhanced Value, MSCI Momentum Tilt, MSCI Quality Tilt, MSCI Volatility Tilt).

**Factor efficiency ratios**

![Factor efficiency ratios chart](image)

**MSCI indices used:** MSCI World Enhanced Value, MSCI World Momentum Tilt, MSCI World Quality Tilt, MSCI World Volatility Tilt (as of 31/10/2015)

**Sources:** Factset, Thomson Reuters, MSCI, IBES, Worldscope.
HSBC’s Pure Indices

<table>
<thead>
<tr>
<th>Factor</th>
<th>Total Active Risk (%)</th>
<th>Proportion of Active Risk Contributed by relevant Factor (%)</th>
<th>Factor Efficiency Ratio</th>
<th>Active Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Momentum</td>
<td>3.43</td>
<td>64.32</td>
<td>1.80</td>
<td>0.71</td>
</tr>
<tr>
<td>Quality</td>
<td>1.50</td>
<td>23.67</td>
<td>0.31</td>
<td>0.89</td>
</tr>
<tr>
<td>Value</td>
<td>2.72</td>
<td>39.21</td>
<td>0.65</td>
<td>1.10</td>
</tr>
<tr>
<td>Low Volatility</td>
<td>3.39</td>
<td>61.70</td>
<td>1.61</td>
<td>-0.63</td>
</tr>
</tbody>
</table>

MSCI’s Style Indices

<table>
<thead>
<tr>
<th>Factor</th>
<th>Total Active Risk (%)</th>
<th>Proportion of Active Risk Contributed by relevant Factor (%)</th>
<th>Factor Efficiency Ratio</th>
<th>Active Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSCI Momentum Tilt</td>
<td>1.88</td>
<td>47.43</td>
<td>0.90</td>
<td>0.29</td>
</tr>
<tr>
<td>MSCI Quality Tilt</td>
<td>0.84</td>
<td>9.25</td>
<td>0.10</td>
<td>0.27</td>
</tr>
<tr>
<td>MSCI Enhanced Value</td>
<td>3.99</td>
<td>18.91</td>
<td>0.23</td>
<td>0.92</td>
</tr>
<tr>
<td>MSCI Volatility Tilt</td>
<td>1.52</td>
<td>54.55</td>
<td>0.60</td>
<td>-0.26</td>
</tr>
</tbody>
</table>

Sources: Factset, Thomson Reuters, MSCI, IBES, Worldscope (as of 31/10/2015).

As can be seen, factor exposure does not directly correlate with factor efficiency. For example, HSBC’s momentum index has a low factor exposure at 0.71 but a high factor efficiency of 1.80. 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 indices with the same factor exposures may have different active risks based on the nature of the factor. An index that is factor efficient 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 value index is in terms of factor efficiency. The factor efficiency ratio of the MSCI index at the same point in time is 0.23, compared to HSBC’s of 0.65. This implies that HSBC’s index takes on approximately 3 times as much value-related active risk per 1% of non-value active risk.
The charts below are decompositions of active risk for the HSBC Pure Value Index and MSCI Enhanced Value Index as at end of 10/2015. This is a common risk attribution output from portfolio attribution packages.

**Decomposition of total active risk**

**HSBC Pure Value**

<table>
<thead>
<tr>
<th>Style</th>
<th>Countries</th>
<th>Industries</th>
<th>Currencies</th>
<th>Non-Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>10%</td>
<td>20%</td>
<td>30%</td>
<td>40%</td>
</tr>
</tbody>
</table>

**MSCI Enhanced Value**

<table>
<thead>
<tr>
<th>Style</th>
<th>Countries</th>
<th>Industries</th>
<th>Currencies</th>
<th>Non-Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>10%</td>
<td>20%</td>
<td>30%</td>
<td>40%</td>
</tr>
</tbody>
</table>

**Decomposition of style active risk**

**HSBC Pure Value**

<table>
<thead>
<tr>
<th>Volatility</th>
<th>Value</th>
<th>Trading Activity</th>
<th>Size</th>
<th>Profitability</th>
<th>Momentum</th>
<th>Growth</th>
<th>Earnings Variability</th>
<th>Dividend Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>10%</td>
<td>20%</td>
<td>30%</td>
<td>40%</td>
<td>50%</td>
<td>60%</td>
<td>70%</td>
<td>80%</td>
</tr>
</tbody>
</table>

**MSCI Enhanced Value**

<table>
<thead>
<tr>
<th>Volatility</th>
<th>Value</th>
<th>Trading Activity</th>
<th>Size</th>
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<td>40%</td>
<td>50%</td>
<td>60%</td>
<td>70%</td>
<td>80%</td>
</tr>
</tbody>
</table>

Sources: Factset, Thomson Reuters, MSCI, IBES, Worldscope (as of 31/10/2015).

Looking at the decomposition of style active risk for the MSCI index above, we see that a significant portion of its active risk comes from country active risk. Furthermore we can see that even though the biggest component of active risk is indeed value, there are still significant contributions from size, growth and volatility. A closer look at the breakdown shows that the majority of this comes from active exposure to Japan. 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.
Analysis: Value Index

Typically investors are most concerned when an alternative weighting scheme underperforms the capitalisation weighted index. In the example below we show a 13m period where the value factor underperformed on a relative basis. One might expect that main source of return will be the targeted factor but this is not always the case. For example, consider the two portfolios shown below: the Pure Value Index and MSCI Enhanced Value Index. We conduct return attribution analysis which reveals a clear connection between factor efficiency and realised style exposure. In the case of MSCI’s index, unintended style exposures (especially volatility and size) drove the negative style contribution to overall performance. However, our pure factor index avoided contamination from other styles which could have led to further underperformance.

These graphs analyse illustrative portfolios using our internal risk model and monthly weights. The charts show contribution (CTR) to total active return (TR) against MSCI World, for portfolio/benchmark weights for 09/2014 to 10/2015.

**Sources:** Factset, Thomson Reuters, MSCI, IBES, Worldscope.
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 index + 50% pure momentum index
- **Portfolio 2**: 50% raw value index + 50% raw momentum index

**Tracking Error Decomposition**

**Portfolio 1: TE 2.08%**

These graphs analyse illustrative portfolios using our internal risk model. The charts show percentage contribution (PCR) to tracking error (TE) for the cross-section of portfolio/benchmark weights for 10/2015.

*Sources: Factset, Thomson Reuters, MSCI, IBES, Worldscope.*

From the charts above 37.25% of the tracking error for Portfolio 1 can be attributed to the targeted styles (value-momentum). However, Portfolio 2 shows that the volatility factor contributed significantly to tracking error, much more than the targeted styles. This is to be expected: as discussed before, raw momentum exhibits high exposure to volatility and size. Portfolio 1 appears to have a more balanced risk profile.
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.

With the MSCI World Index as a base portfolio:

**Case 1**: Add 10% size tilt to improve performance

**Case 2**: Add 20% low vol index tilt to reduce risk

**Case 3**: Combine 10% size index and 20% low vol index tilt for better risk adjusted returns

<table>
<thead>
<tr>
<th>Case 1: MXWO + 10% size tilt</th>
<th>Case 2: MXWO + 10% low vol tilt</th>
<th>Case 3: MXWO + 10% size + 20% low vol tilt</th>
</tr>
</thead>
</table>

Average active exposures (vs MXWO) for 07/2001 to 10/2015.

Annualised performance numbers from internal backtests covering 07/2001 to 10/2015.

**Sources**: Factset, Thomson Reuters, MSCI, IBES, Worldscope.
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 factor index 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 improves performance after the financial crisis.

**Portfolio 1** with unwanted Momentum tilt - Active factor exposures (vs MXF

**Portfolio 2** with tilt correction – adding 10%

Momentum tilt - Active factor exposures (vs MXF)

The charts above show active average exposures and the cumulative wealth curve of hypothetical strategies for illustrative purposes only.

**Data period:** 31/07/2007 – 30/04/2015.

**Source:** Factset, Thomson Reuters, MSCI, IBES, Worldscope, cumulative total returns net of trading cost.
Fulfilling an Equity Exposure

Each factor has its own characteristics, responding differently to economic cycles and environments. Time varying volatility and performance can cause discrepancies from expectations over short term horizons. According to Andrew Ang (2014) factors are collections of ‘bad times’. By combining factor indices to create a multi-equity factor product it is possible to overcome the cyclical behaviour of individual factors and improve risk adjusted returns. As explained before this approach is potentially more robust using pure factor indices.

**Defensive Scenario:** 33% value, 33% quality and 33% low vol

- Size
- Profitability
- Momentum
- Volatility
- Value

**Balanced Scenario:** 20% value, 20% momentum, 20% quality, 20% size and 20% low vol

- Size
- Profitability
- Momentum
- Volatility
- Value

**Dynamic Scenario:** 33% value, 33% momentum and 33% size

- Size
- Profitability
- Momentum
- Volatility
- Value

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**Data period:** 31/07/2001 – 31/10/2015. Graphs to the left show average factor exposures and graphs above show annualised performance information for developed world strategies against MSCI World (MXWO).

**Sources:** Factset, Thomson Reuters, MSCI, IBES, Worldscope.
Multi-Factor Performance (Backtest)

In this section we provide evidence that HSBC’s indices exhibit attractive performance characteristics in comparison to well-known alternatives from a range of well-known providers.

In the following chart we compare HSBC’s multi-factor blend with FTSE Rafi and MSCI Min Vol.

<table>
<thead>
<tr>
<th>Developed World 31/07/2001 to 31/10/2015</th>
<th>HSBC Pure Factor Balanced Index</th>
<th>MSCI WORLD INDEX (MXWO)</th>
<th>FTSE RAFI</th>
<th>MSCI Min Vol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Returns</td>
<td>7.52%</td>
<td>5.76%</td>
<td>6.86%</td>
<td>7.69%</td>
</tr>
<tr>
<td>Annual Volatility</td>
<td>15.33%</td>
<td>15.71%</td>
<td>17.29%</td>
<td>11.23%</td>
</tr>
<tr>
<td>Sharpe Ratio</td>
<td>0.49</td>
<td>0.37</td>
<td>0.40</td>
<td>0.68</td>
</tr>
<tr>
<td>Maximum Drawdown</td>
<td>52%</td>
<td>54%</td>
<td>57%</td>
<td>43%</td>
</tr>
<tr>
<td>Annual Relative Returns</td>
<td>1.76%</td>
<td>1.10%</td>
<td>1.93%</td>
<td>0.93%</td>
</tr>
<tr>
<td>Tracking Error</td>
<td>1.70%</td>
<td>4.02%</td>
<td>7.08%</td>
<td>7.07%</td>
</tr>
<tr>
<td>Information Ratio</td>
<td>1.03</td>
<td>0.27</td>
<td>0.27</td>
<td>0.13</td>
</tr>
</tbody>
</table>

The above analysis uses total returns from monthly Bloomberg data for MSCI World Index, FTSE RAFI and MSCI Min Vol (Bloomberg tickers used: GDDUWI Index, TFRDU Index, M00IWO$T Index).

The HSBC Pure Factor Balanced Index data comes from our internal backtest, which uses monthly data to calculate total returns with a trading cost of 20 bps on average each way at every rebalance.

The following charts compare our individual developed world pure factor indices with the equivalent MSCI tilt products. Our approach achieves competitive performance characteristics but also avoids unintended exposures by design.

Performance characteristics

<table>
<thead>
<tr>
<th>31/07/2001 to 31/10/2015</th>
<th>HSBC Pure Value Index</th>
<th>MSCI Enhanced Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Returns</td>
<td>7.54%</td>
<td>8.49%</td>
</tr>
<tr>
<td>Annual Volatility</td>
<td>17.23%</td>
<td>18.50%</td>
</tr>
<tr>
<td>Sharpe Ratio</td>
<td>0.44</td>
<td>0.46</td>
</tr>
<tr>
<td>Maximum Drawdown</td>
<td>56.67%</td>
<td>58.24%</td>
</tr>
</tbody>
</table>

Source: Factset, Thomson Reuters, MSCI, IBES, Worldscope, Bloomberg Finance LP.
Performance characteristics

<table>
<thead>
<tr>
<th>31/07/2001 to 31/10/2015</th>
<th>HSBC Pure Low Vol Index</th>
<th>MSCI Volatility Tilt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual Returns</strong></td>
<td>10.60%</td>
<td>5.91%</td>
</tr>
<tr>
<td><strong>Annual Volatility</strong></td>
<td>11.22%</td>
<td>13.48%</td>
</tr>
<tr>
<td><strong>Sharpe Ratio</strong></td>
<td>0.94</td>
<td>0.44</td>
</tr>
<tr>
<td><strong>Maximum Drawdown</strong></td>
<td>39.03%</td>
<td>49.75%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>31/07/2001 to 31/10/2015</th>
<th>HSBC Pure Momentum Index</th>
<th>MSCI Momentum Tilt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual Returns</strong></td>
<td>6.84%</td>
<td>6.02%</td>
</tr>
<tr>
<td><strong>Annual Volatility</strong></td>
<td>15.17%</td>
<td>14.83%</td>
</tr>
<tr>
<td><strong>Sharpe Ratio</strong></td>
<td>0.45</td>
<td>0.41</td>
</tr>
<tr>
<td><strong>Maximum Drawdown</strong></td>
<td>53.42%</td>
<td>52.48%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>31/07/2001 to 31/10/2015</th>
<th>HSBC Pure Quality Index</th>
<th>MSCI Quality Tilt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual Returns</strong></td>
<td>6.41%</td>
<td>5.99%</td>
</tr>
<tr>
<td><strong>Annual Volatility</strong></td>
<td>15.91%</td>
<td>14.84%</td>
</tr>
<tr>
<td><strong>Sharpe Ratio</strong></td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td><strong>Maximum Drawdown</strong></td>
<td>53.81%</td>
<td>50.52%</td>
</tr>
</tbody>
</table>

Source: Factset, Thomson Reuters, MSCI, IBES, Worldscope, Bloomberg Finance LP.

The analysis above and to the left is based on monthly net total returns in USD for the MSCI indices, using Bloomberg data for M1WOEV Index, M1WOWMT Index, M1WOWQT Index and M1WOWVT Index.

The HSBC Pure Indices data comes from our internal backtest, which uses monthly data to calculate total gross dividend returns with a trading cost of 20 bps on average each way at every rebalance. We have used net total returns for other providers instead of gross due to the unavailability of historical data before 2015 in most cases.
Conclusion

Factor indices represent a highly accessible and efficient way of investing in factor premia through passive vehicles. HSBC’s approach to building factor indices 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 factor indices in portfolio management.

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


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_if.pdf
Appendix

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

Factor Construction

Each factor composite 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.

\[ Z_i = \frac{X_i - \text{CapWeightedMean}(X)}{\text{StandardDeviation}(X)} \]

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.

Factor Definitions

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

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.

\[
\max_{i=1}^{N} w' \text{Rank} = \max \sum_{i \in U} w_i R_i
\]

Where \( R_i \) and \( w_i \) is the Rank and weight of the stock \( i \) respectively and \( U \) the stocks universe.

#### Relative Factor Exposure Constraints

\[-0.01 \leq \sum_{i \in U} F_{i,z} \text{Active Weight}_i \leq 0.01\]

Where \( z \) represents each of the Risk factors (Value, Size, Volatility etc), \( F_{i,z} \) is the value of Factor \( z \) for stock \( i \).

#### Relative Sector / Country Exposure Constraints

\[-5\% \leq \sum_{i \in J} \text{Active Weight}_i \leq 5\%\]

Where \( J \) is each of the 10 GICS sector classifications (Financials, IT, Industrials etc.), and:

\[-5\% \leq \sum_{i \in Q} \text{Active Weight}_i \leq 5\%\]

Where \( Q \) is each countries within the universe.

#### Turnover Constraint

\[
\frac{1}{2} \sum_{i \in U} |w^t_i - w^{t-1}_i| \leq 8\%
\]

Where \( w^t_i \) represents the weight of the stock \( i \) at time \( t \) and 8\% the one way turnover.

#### Active Weight Constraint

\( \text{Active Weight}_i \leq 25bp \)
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Stock market investments should be viewed as a medium to long term investment and should be held for at least five years. Any performance information shown refers to the past should not be seen as an indication of future returns. It is important to remember that these alternative indices do not outperform all the time. In particular in a momentum driven bubble (such as with technology stocks in the late 90s) share prices can diverge from fair value for an extended period. In such cases alternative index strategies will underperform capitalisation weighted indices as rebalancing does not improve returns. However when the bubble bursts and share prices drop back towards fair value then alternative index strategies are more likely to outperform.

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