Discussion Paper

Smart Beta Strategies into a Solvency II-Efficient Format

March 2016
A Solvency II Investment Solution from Morgan Stanley and ERI Scientific Beta

- ERI Scientific Beta is an EDHEC-Risk Institute venture fully dedicated to the design and production of smart beta benchmarks drawn from the research conducted by EDHEC-Risk Institute.

- Since 2013, ERI Scientific Beta has been working with Morgan Stanley to propose innovative solutions relying on their respective expertise.

- It is within this framework that Morgan Stanley, using ERI Scientific Beta indices, is today proposing an investment solution with respect to Solvency II.

- The goal is to use the overperformance of the smart beta index designed by ERI Scientific Beta to compensate the cost of the protection, delivered by Morgan Stanley, against the risk of significant loss related to equity investment.
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Section 1
The Knock-In Forward: a Solvency II-Efficient Overlay for Exposure to Equities
The Knock-In Forward: Concept & Mechanism

- The solution is designed to reduce the capital charge applied to an Equity investment under Solvency II, structured as **a zero-cost upfront** for the Insurer.

- The Insurer enters into a contract where he is selling a forward on the Equity Index at a certain Strike Level, knowing that this contract **will be activated only if the Equity Index closes below a pre-agreed Barrier Level** during the investment period.

**Example:**

- ✓ over a 1 year investment horizon, if the Equity Index **ever trades below 82%** of its initial level, then the Insurer is short SX5E **struck at 80% of its initial level**.

- ✓ Otherwise nothing happens

- ✓ Zero cost upfront
The Knock-In Forward

There are two major differences between a Knock-In Forward and a Vanilla Put as a hedging instrument:

- **The upfront cost**: the Vanilla Put will require a premium to be paid upfront by the Investor, whereas the levels of the Strike and the Barrier of a Knock-In Forward are calibrated so that upfront cost is zero.

- **The volatility of the Mark-to-Market**: the value of a struck Knock-In Forward tends to be more stable than the value of a struck Vanilla Put in a bullish scenario, whereas it stills mimic the behaviour of a struck Vanilla Put in a bearish scenario.

  i. *In the case of a bullish scenario*, we see that the amplitude of variations of the Vanilla Put are greater, as its value starts from 1%, goes to 1.5% after the first slight drop and then quickly erodes and converges to zero as soon as the market start to rally.

  ii. *In the case of a bearish scenario*, we see that the Knock-In Forward will rapidly match the profile of the Vanilla Put once the Barrier is hit.

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This information has been prepared solely for information purposes and is not an offer to buy or sell or a solicitation of an offer to buy or sell any security or instrument or to participate in any particular trading strategy. Please refer to important information at the end of this document.
The Knock-In Forward: Comparison vs. CPPI-like Management

- The payoff profile of Knock-In Forward combined with a direct long exposure reminds us of the nature of a stop-loss mechanism, and therefore one could draw a comparison with a CPPI-like type of risk management.

- However there is a fundamental difference between the two investments:
  - a CPPI-like mechanism will suffer by construction from a “Buy High, Sell Low” effect.
  - This penalising effect becomes very clear in volatile scenarios with no positive trend, as the CPPI-like approach will start to underperform the direct exposure to the Equity index.

- a Knock-In Forward combined with a long exposure avoids this pitfall, as the exposure to the Equity Index in such scenarios is kept constant at 100%.
The Knock-In Forward

The Knock-In Forward: Capital Saving under Solvency II

- Capital Requirement under Solvency II is immediately reduced to the difference “100% minus Strike Level”

  In our previous example, this means that Capital Requirement becomes 100%-80% = 20%, vs. a standard a charge at 39%

- From an economic standpoint, the Insurer benefits from:
  - Keeping a full upside exposure to his existing SX5E portfolio (during a rally the return of the Equity asset is not affected)
  - Getting full protection in case of a sharp market downturn (the Down & In Forward will act as a -20% stop loss on the overall portfolio).

- The terms of the hedge (Strike Level & Barrier Level) are designed initially to keep the contract at zero-cost upfront.

The Knock-In Forward: Capital Charge/Release on an Equity Portfolio

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The Knock-In Forward: Key Points

- Simple, transparent and formulaic hedging overlay implemented \textit{at a zero cost upfront}

- \textit{Lower volatility of the Mark-to-Market} of the instrument versus Vanilla Puts

- \textit{No “Buy High, Sell Low” effect} as incurred with CPPI-type of mechanism

- \textit{Significant capital charge release} for an equity long position under Solvency II

- Simple mitigation of the worst case scenario (i.e. Barrier activation followed by a strong market rally): \textit{the hedge can be rolled down / re-structured} at tight bid-offers before the Barrier is breached
Section 2

Presentation of the Smart Beta Strategy: Multi-Beta Multi-Strategy (MBMS) designed by ERI Scientific Beta
Introduction

✓ The Smart Beta solution proposed by ERI Scientific Beta was designed to **address the two main shortcomings of cap-weighted indices**, namely their undesirable factor exposures and their heavy concentration, which penalise their risk-adjusted performances and do not make them good investment benchmarks.

✓ The objective of the SciBeta Multi-Beta Multi-Strategy indices is to **explicitly seek exposures to rewarded risk factors over a long period while diversifying away unrewarded risks**. This diversification leads to considerable improvements in risk-adjusted performance compared to traditional multi-factor indices.
Smart Beta: A Response to the Limitations of CW Indices

The Two Shortcomings of Cap-Weighted Indices

Concentration in few stocks leads to poor risk-adjusted reward for a given factor exposure

Dominance of large cap growth stocks leads to “wrong” exposures to (rewarded) systematic factors

Based on quarterly weights from June 2002 to December 2013. The geographical regions and total number of stocks are: Developed World (2000), USA (500). All index data is obtained from www.scientificbeta.com.
Better Factor Tilts and Better Diversification

The Smart Beta 2.0 1, 2 framework introduced by ERI Scientific Beta allows the two main shortcomings of cap-weighted indices to be addressed (in a clear and systematic manner):

- **Step 1**: Stock selection defines exposure to the desired (rewarded) risk factor
- **Step 2**: A smart weighting scheme (diversification strategy) reduces unrewarded risks:
  - Diversification strategies reduce stock-specific risk (management decisions, product success, etc.)
  - Combination of diversification strategies via the diversified Multi-Strategy weighting scheme reduces weighting scheme-specific risk 3

![Diagram showing Tilt to desired factor ("beta") + Diversify undesired risks ("smart" weighting) = "Smart Beta" ]

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Consensual and Rewarded Factors

- **Straightforward factor definitions** put investors in control of the risks they choose and avoid the risk of data-mining of complex and unproven factor definitions.
- ERI Scientific Beta has constructed long-only indices that tilt towards common factors. Among all available tilts, six are **rewarded** in the long term. Scientific Beta’s flagship Multi-Beta Multi-Strategy EW indices tilt towards four of these factors. Those factors are: **Value, Low Volatility, High Momentum and Mid Cap**.

Factor Tilt

Selection of Factors
Multi-Strategy Factor Indices Improve Risk-Adjusted Performance compared to Cap-Weighted Factor-Tilted Indices

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Ann. Returns</td>
<td>11.38%</td>
<td>14.39%</td>
<td>15.36%</td>
<td>12.43%</td>
<td>14.54%</td>
</tr>
<tr>
<td>Ann. Volatility</td>
<td>17.08%</td>
<td>17.35%</td>
<td>16.08%</td>
<td>17.53%</td>
<td>16.33%</td>
</tr>
<tr>
<td>Sharpe Ratio</td>
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<td>0.54</td>
<td>0.65</td>
<td>0.43</td>
<td>0.59</td>
</tr>
<tr>
<td>Max. Drawdown</td>
<td>54.63%</td>
<td>57.09%</td>
<td>53.42%</td>
<td>50.81%</td>
<td>53.25%</td>
</tr>
<tr>
<td>Ann. Excess Returns</td>
<td>-</td>
<td>3.01%</td>
<td>3.98%</td>
<td>1.05%</td>
<td>3.16%</td>
</tr>
<tr>
<td>Ann. Tracking Error</td>
<td>-</td>
<td>5.62%</td>
<td>6.15%</td>
<td>3.58%</td>
<td>4.81%</td>
</tr>
<tr>
<td>95% Tracking Error</td>
<td>-</td>
<td>9.31%</td>
<td>11.42%</td>
<td>6.89%</td>
<td>8.69%</td>
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<tr>
<td>Information Ratio</td>
<td>-</td>
<td>0.54</td>
<td>0.65</td>
<td>0.29</td>
<td>0.66</td>
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<tr>
<td>Outperf. Prob. (1Y)</td>
<td>-</td>
<td>61.98%</td>
<td>66.99%</td>
<td>63.11%</td>
<td>66.65%</td>
</tr>
<tr>
<td>Outperf. Prob. (3Y)</td>
<td>-</td>
<td>70.50%</td>
<td>75.52%</td>
<td>70.96%</td>
<td>74.69%</td>
</tr>
</tbody>
</table>

The analysis is based on daily total return data from 31/12/1975 to 31/12/2015 (40 years). The benchmark used for the relative analytics is the SciBeta CW US 500 index. Mid Cap, High Momentum, Low Volatility, and Value selections all represent 50% of stocks with such characteristics in a US universe of 500 stocks. The risk-free rate is the return of the 3 month US Treasury Bill. Maximum relative drawdown is the maximum drawdown of the long-short index whose return is given by the fractional change in the ratio of the strategy index to the benchmark index. The probability of outperformance is the probability of obtaining positive excess returns from investing in the strategy for a period of 1 (or 3) years at any point during the history of the strategy. A rolling window of length 1 (or 3) years and a step size of 1 week is used. The full names of the US indices used are: SciBeta United States Mid-Cap Diversified Multi-Strategy, SciBeta United States High-Momentum Diversified Multi-Strategy, SciBeta United States Low-Volatility Diversified Multi-Strategy, SciBeta United States Value Diversified Multi-Strategy. Source: www.scientificbeta.com.
### Performance Benefits of the Scientific Beta MBMS EW Indices: Past 40 years for the US

- Choosing good factors tilts generates attractive risk-adjusted performance
- Combining them allows the relative risk-adjusted return to be improved

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<tbody>
<tr>
<td>Ann. Returns</td>
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<td>14.54%</td>
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<td>17.08%</td>
<td>16.08%</td>
<td>16.33%</td>
</tr>
<tr>
<td>Sharpe Ratio</td>
<td>0.38</td>
<td>0.65</td>
<td>0.59</td>
</tr>
<tr>
<td>Max. DrawDown</td>
<td>54.63%</td>
<td>53.42%</td>
<td>53.25%</td>
</tr>
<tr>
<td>Excess Returns</td>
<td>-</td>
<td>3.98%</td>
<td>3.16%</td>
</tr>
<tr>
<td>Tracking Error</td>
<td>-</td>
<td>6.15%</td>
<td>4.81%</td>
</tr>
<tr>
<td>95% Tracking Error</td>
<td>-</td>
<td>11.42%</td>
<td>8.69%</td>
</tr>
<tr>
<td>Information Ratio</td>
<td>-</td>
<td>0.65</td>
<td>0.66</td>
</tr>
<tr>
<td>Outperf. Prob. (3Y)</td>
<td>-</td>
<td>75.52%</td>
<td>74.69%</td>
</tr>
</tbody>
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Conditional Performance of the Scientific Beta MBMS EW Indices: Past 40 years for the US

- Combining factor tilts leads to smoother outperformance across market regimes compared to the average component index

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</thead>
<tbody>
<tr>
<td></td>
<td>Mid Cap</td>
<td>Momentum</td>
<td>Low Vol</td>
<td>Value</td>
<td>Multi-Beta Multi-Strategy EW</td>
</tr>
<tr>
<td>Bull Markets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ann. Rel. Returns</td>
<td>3.58%</td>
<td>2.94%</td>
<td>-1.04%</td>
<td>2.58%</td>
<td>2.06%</td>
</tr>
<tr>
<td>Ann. Tracking Error</td>
<td>5.31%</td>
<td>3.95%</td>
<td>5.03%</td>
<td>4.58%</td>
<td>4.13%</td>
</tr>
<tr>
<td>Information Ratio</td>
<td>0.67</td>
<td>0.74</td>
<td>-0.21</td>
<td>0.56</td>
<td>0.50</td>
</tr>
<tr>
<td>Bear Markets</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ann. Rel. Returns</td>
<td>4.30%</td>
<td>3.27%</td>
<td>8.52%</td>
<td>5.93%</td>
<td>5.56%</td>
</tr>
<tr>
<td>Ann. Tracking Error</td>
<td>7.91%</td>
<td>6.51%</td>
<td>8.12%</td>
<td>6.89%</td>
<td>6.51%</td>
</tr>
<tr>
<td>Information Ratio</td>
<td>0.54</td>
<td>0.50</td>
<td>1.05</td>
<td>0.86</td>
<td>0.85</td>
</tr>
</tbody>
</table>

Multi-Beta Multi-Strategy: Key Points

✓ Scientific Beta Multi-Beta Multi-Strategy (MBMS) indices address the two limitations of cap-weighted indices (ill-suited exposures to systematic risk factors, excessive concentration in a small number of stocks).

✓ Within each factor tilt, ERI Scientific Beta applies smart weighting methodologies to the selected stocks that correspond to the desired factor exposure. As a consequence, the indices are not only exposed to the relevant factor, but also well diversified.

✓ Scientific Beta Multi-Beta Multi-Strategy indices provide allocations to several well-documented risk premia in equity markets (Value, Momentum, Size, Low Volatility) which follow different economic cycles. This allows outperformance to be smoothed across market regimes.

✓ Each smart factor index is designed for investability. Multi-factor allocations reduce turnover through internal crossing of trades across different factors.

✓ ERI Scientific Beta offers full transparency on the methodology and the historical index composition. Investors can assess the robustness of strategies’ performances based on long-term track records (40 years of data) and advanced analytics.
Scientific Beta and Morgan Stanley: an Historical Partnership

- **June-14:** **Launch of our first ETF**
  Called the “Morgan Stanley Scientific Beta Global Equity Factors” (GEF LN in Bloomberg), the ETF tracks the performance of the SciBeta Developed Multi-Beta Multi-Strategy Equal-Weight Index, with the aim of outperforming developed market-cap benchmark indices through systematic and consistent factor exposure together with a diversified portfolio weighting process.
  
  Current AUM: $117mio

- **October-14:** **Launch of a protected UCITS fund using Scientific Beta indices as underlying**
  With the “MS Fideuram Equity Smart Beta Dynamic Protection 80” (MSFESAE ID in Bloomberg), Morgan Stanley’s partnership with the EDHEC-Risk Institute’s Scientific Beta range of factor-based equity indices gave Fideuram Asset Management the strength and breadth of alternative beta passive strategies with which they could fully implement their macro asset allocation model. As CPPI-based solutions were ruled out by Fideuram, Morgan Stanley was able to apply the innovative option-based open-ended protection mechanism (DMPI) to the managed portfolio of traditional and alternative beta indices.
  
  Current AUM: €420mio

- **February-15:** **Launch of a UCITS fund offering a Long/Short framework with Scientific Beta indices as underlying**
  Called the “Global Equity Risk Premia Long/Short”(FAGERLA ID in Bloomberg), the fund implements long/short type of strategies, using the wide range of factor-based equity indices of the Scientific Beta platform.
  
  Current AUM: €328mio

- **August-15:** **Launch of the second ETF tracking Scientific Beta indices**
  Called the “Morgan Stanley Scientific Beta US Equity Factors” (USEF LN in Bloomberg), the ETF tracks the performance of the SciBeta United States Multi-Beta Multi-Strategy Equal-Weight Index, with the aim of outperforming US market-cap benchmark indices through systematic and consistent factor exposure together with a diversified portfolio weighting process.
  
  Current AUM: $60mio
Section 3

The Knock-In Forward (KIF) applied to the SciBeta Extended Developed Europe Multi-Beta Multi-Strategy EW - Eur Hedged (MBMS)
The Multi-Beta Multi-Strategy approach improves the risk metrics significantly vs. a traditional capitalisation-weighted index:

- Average excess return of ~3.78%
- Volatility reduction of ~3.45%

Note: risk metrics above reflects a calculation on a 250-bd rolling window over the whole period (June 2002 - February 2016) for the SciBeta Extended Developed Europe MBMS EW Eur Hedged and its CW benchmark.
The following KIF contract can be offered at a zero cost upfront: **1-year Maturity, 83.4% Barrier, 80% Strike**

- We compare over the whole period a 1-year investment via both:
  - MBMS alone
  - MBMS overlaid with the KIF contract

- We observe that:
  - The overlaid version logically avoids the large drawdowns (-20% vs. -45.13% worst annual perf.)
  - In few instances it lags however behind the standard investment: this happens typically when the Barrier has been hit but the Index finally closes above the Strike (worst case scenario)
  - That creates a lag of -0.49% on average vs. the MBMS alone

- If we focus only on the worst case scenario (Barrier hit and then Index bounces back above Strike), we calculate what we call the “Opportunity Cost” i.e. “**Historical Probability to hit the Barrier x Positive Difference Final Index Value vs. Strike**”. This **Opportunity Cost is at -1.48%**.

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**MBMS overlaid with a KIF : Impact on the Performance**

<table>
<thead>
<tr>
<th></th>
<th>MBMS - Net TR</th>
<th>MBMS - Net TR + KIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ann. Return</td>
<td>12.16%</td>
<td>11.67%</td>
</tr>
<tr>
<td>Average Cost of Protection</td>
<td>-</td>
<td>-0.49%</td>
</tr>
<tr>
<td>&quot;Opportunity Cost&quot;</td>
<td>-</td>
<td>-1.48%</td>
</tr>
<tr>
<td>Worst Ann. Return</td>
<td>-45.13%</td>
<td>-20.00%</td>
</tr>
</tbody>
</table>

Note: risk metrics above reflects a calculation on a 250-bd rolling window over the whole period (June 2002- February 2016) for the SciBeta Extended Developed Europe MBMS EW –Eur Hedged (MBMS) with and without the KIF.
We compare over the whole period a 1-year investment via both:

- MBMS overlaid with a KIF contract
- Its CW Benchmark

Main conclusions:

- The overlaid MBMS strategy outperforms the CW Benchmark by ~+3.3% on average.
- Under Solvency II capital requirements, the overlaid MBMS will trigger only +20% vs. +39% for standard investment into the CW Benchmark.
- In a nutshell, the proposed solution allows the investor to gain a European Equity exposure that generates on average +3.3% p.a. excess return, and that roughly halves the capital requirements under Solvency II.

Note: risk metrics above reflects a calculation on a 250-bd rolling window over the whole period (June 2002-Feb 2016) for the SciBeta Extended Developed Europe MBMS EW Eur Hedged (MBMS) with the KIF and its CW benchmark.
We want to focus here on the worst case scenario which is “the Barrier Level is hit during the investment, and then afterwards the Index finishes above the Strike Level”.

A way to measure it would be to calculate a quantity (called “the Opportunity Cost”), that would be the product of:

- the probability of hitting the Barrier
- the positive difference between the Final Index Value and the Strike Level

We want to calculate and compare this quantity both from an historical point of view and from a forward-looking point of view:

- Historical-based approach: we simply run the historical performance of the MBMS overlaid by the KIF. That quantity equates to -1.48%
- Forward-looking-based approach: we run Monte Carlo simulations (*) and calculate the expected value of this quantity. These simulations show that the expected value of the Opportunity cost is -1.86%
- As a conclusion, this shows that both measurements are quite consistent

(*): Monte Carlo simulations have been run under a standard Local Volatility model, using the implied market parameters that are used to price the KIF. A total of 16,384 paths have been computed for these simulations.
The protection solution against the risk of significant loss proposed by Morgan Stanley entails two major advantages:

- Contrary to a Constant Proportion Portfolio Insurance (CPPI), it allows to be fully invested in the underlying equity. The protection is activated only when necessary. This strongly reduces both its cost and the average cost, defined as the average value of the excess return difference with an investment in the MBMS index alone. For a protection against a 20% loss of capital, the average cost is 0.49% for the Extended Developed Europe Universe.

- Contrary to protections provided by options, the KFI protection can be proposed with a zero cost upfront and at a more stable mark-to-market price, which minimises the impact on the volatility of the insurer results.

- To conclude, the smart beta offer with the Solvency II protection proposed by Morgan Stanley on the basis of ERI Scientific Beta indices provides access to the performance of equities with limited opportunity cost, which is lower than the additional return delivered by the smart beta index compared to the cap-weighted benchmark.
Appendices

Appendix 1 – Smart Factor Indices - SciBeta Extended Developed Europe Data: Performance Benefits

Appendix 2 – Smart Factor Indices - SciBeta Extended Developed Europe Data: Outperformance over time

Appendix 3 – Smart Factor Indices - SciBeta Extended Developed Europe Data: Implementation Benefits

Appendix 4 – MBMS Europe overlaid with a KIF at +89%
## Appendix 1

### Smart Factor Indices – SciBeta Extended Developed Europe Data – Past 10 years

#### Performance Benefits

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mid Cap</td>
<td>Momentum</td>
<td>Low Vol</td>
</tr>
<tr>
<td>Ann. Returns</td>
<td>4.95%</td>
<td>8.28%</td>
<td>9.60%</td>
</tr>
<tr>
<td>Ann. Volatility</td>
<td>19.88%</td>
<td>17.41%</td>
<td>17.68%</td>
</tr>
<tr>
<td>Sharpe Ratio</td>
<td>0.19</td>
<td>0.41</td>
<td>0.48</td>
</tr>
<tr>
<td>Max. DrawDown</td>
<td>53.58%</td>
<td>57.12%</td>
<td>51.46%</td>
</tr>
<tr>
<td>Excess Returns</td>
<td>-</td>
<td>3.33%</td>
<td>4.64%</td>
</tr>
<tr>
<td>Tracking Error</td>
<td>-</td>
<td>6.35%</td>
<td>5.89%</td>
</tr>
<tr>
<td>95% Tracking Error</td>
<td>-</td>
<td>12.70%</td>
<td>11.51%</td>
</tr>
<tr>
<td>Information Ratio</td>
<td>-</td>
<td>0.52</td>
<td>0.79</td>
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<tr>
<td>Outperf. Prob. (3Y)</td>
<td>-</td>
<td>77.32%</td>
<td>84.15%</td>
</tr>
</tbody>
</table>

**Performance and Risk** – The table compares the performance and risk of the SciBeta Multi-Strategy Index. The Multi-Beta Multi-Strategy Index is the equal combination of the four Multi-Strategy indices with stock selection based on Mid Cap, Momentum, Low Volatility, and Value respectively. The SciBeta CW Extended Developed Europe -600 index is used as the cap-weighted benchmark. The risk-free rate is the return of the Euribor (3M). The full names of the Extended Developed Europe indices used are: SciBeta Extended Developed Europe Mid-Cap Diversified Multi-Strategy Index, SciBeta Extended Developed Europe High-Momentum Diversified Multi-Strategy Index, SciBeta Extended Developed Europe Low-Volatility Diversified Multi-Strategy Index, SciBeta Extended Developed Europe Value Diversified Multi-Strategy Index, SciBeta Extended Developed Europe Multi-Beta Multi-Strategy EW. Source: www.scientificbeta.com. Analysis is based on daily total returns of the currency hedged indices hedged in EUR. for the period 31/12/2005 to 31/12/2015.
### Smart Factor Indices - SciBeta Extended Developed Europe Data – Past 10 years

#### Outperformance over time

- Combining factor tilts avoids ending up with the worst performing factor tilt in a given year

<table>
<thead>
<tr>
<th>Year</th>
<th>Mid Cap</th>
<th>Momentum</th>
<th>Low Vol</th>
<th>Value</th>
<th>Multi-Beta Multi-Strategy EW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 2015</td>
<td>10.89%</td>
<td>11.69%</td>
<td>7.64%</td>
<td>2.50%</td>
<td>8.17%</td>
</tr>
<tr>
<td>Year 2014</td>
<td>1.65%</td>
<td>4.41%</td>
<td>5.55%</td>
<td>0.78%</td>
<td>3.10%</td>
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<tr>
<td>Year 2013</td>
<td>6.44%</td>
<td>9.18%</td>
<td>-0.12%</td>
<td>9.53%</td>
<td>6.22%</td>
</tr>
<tr>
<td>Year 2012</td>
<td>8.57%</td>
<td>7.07%</td>
<td>2.26%</td>
<td>5.91%</td>
<td>6.03%</td>
</tr>
<tr>
<td>Year 2011</td>
<td>-2.37%</td>
<td>-0.55%</td>
<td>5.91%</td>
<td>-6.32%</td>
<td>-0.86%</td>
</tr>
<tr>
<td>Year 2010</td>
<td>14.81%</td>
<td>18.61%</td>
<td>4.04%</td>
<td>7.96%</td>
<td>11.25%</td>
</tr>
<tr>
<td>Year 2009</td>
<td>6.02%</td>
<td>-5.35%</td>
<td>-7.21%</td>
<td>7.10%</td>
<td>0.26%</td>
</tr>
<tr>
<td>Year 2008</td>
<td>-3.99%</td>
<td>0.16%</td>
<td>3.32%</td>
<td>-4.59%</td>
<td>-1.25%</td>
</tr>
<tr>
<td>Year 2007</td>
<td>-9.33%</td>
<td>-5.27%</td>
<td>-5.63%</td>
<td>-9.31%</td>
<td>-7.39%</td>
</tr>
<tr>
<td>Year 2006</td>
<td>11.42%</td>
<td>12.18%</td>
<td>6.78%</td>
<td>11.29%</td>
<td>10.42%</td>
</tr>
</tbody>
</table>

**Calendar Year Relative Returns** —The Multi-Beta Multi-Strategy EW index is the equal weighted combination of the four Multi-Strategy indices with stock selection based on Mid Cap, Momentum, Low Volatility, and Value respectively. The SciBeta CW Extended Developed Europe-600 index is used as the cap-weighted benchmark. The full names of the Extended Developed Europe indices used are: SciBeta Extended Developed Europe Mid-Cap Diversified Multi-Strategy Index, SciBeta Extended Developed Europe High-Momentum Diversified Multi-Strategy Index, SciBeta Extended Developed Europe Low-Volatility Diversified Multi-Strategy Index, SciBeta Extended Developed Europe Value Diversified Multi-Strategy Index, SciBeta Extended Developed Europe Multi-Beta Multi-Strategy EW. Source: www.scientificbeta.com. Analysis is based on calendar total returns of the currency hedged indices hedged in EUR for the period 31/12/2005 to 31/12/2015.
## Smart Factor Indices – SciBeta Extended Developed Europe Data – Past 10 years

### Implementation Benefits

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>1-Way Annualised Turnover</td>
<td>42.16%</td>
<td>36.84%</td>
<td>42.25%</td>
<td>37.32%</td>
</tr>
<tr>
<td>Weighted Avg. Market Cap ($m) on 18/12/2015</td>
<td>11,611</td>
<td>11,609</td>
<td>17,075</td>
<td>17,076</td>
</tr>
<tr>
<td>Information Ratio</td>
<td>0.51</td>
<td>0.63</td>
<td>0.32</td>
<td>0.48</td>
</tr>
<tr>
<td>Relative Returns</td>
<td>2.95%</td>
<td>3.02%</td>
<td>1.79%</td>
<td>1.88%</td>
</tr>
<tr>
<td>Relative Returns net of 20 bps transaction costs</td>
<td>2.86%</td>
<td>2.95%</td>
<td>1.70%</td>
<td>1.81%</td>
</tr>
<tr>
<td>Relative Returns net of 100 bps transaction costs</td>
<td>2.53%</td>
<td>2.65%</td>
<td>1.37%</td>
<td>1.51%</td>
</tr>
</tbody>
</table>

The analysis is based on weekly total return data from 31/12/2005 to 31/12/2015 (10 years). The SciBeta Extended Developed Europe CW index is used as the cap-weighted reference. Capacity is the weighted average market capitalisation of the index in $million as on last rebalancing date. The net returns are the relative returns over the cap-weighted benchmark net of transaction costs. Two levels of transaction costs are used - 20 bps per 100% 1-W turnover and 100 bps per 100% 1-W turnover. The first case corresponds to the worst case observed historically for the large and mid-cap universe of our indices while the second case assumes 80% reduction in market liquidity and a corresponding increase in transaction costs. The risk-free rate is the return of the Euribor (3M). The full names of the Extended Developed Europe indices used are: SciBeta Extended Developed Europe Mid-Cap Diversified Multi-Strategy Index, SciBeta Extended Developed Europe High-Momentum Diversified Multi-Strategy Index, SciBeta Extended Developed Europe Low-Volatility Diversified Multi-Strategy Index, SciBeta Extended Developed Europe Value Diversified Multi-Strategy Index, SciBeta Extended Developed Europe Multi-Beta Multi-Strategy EW. Source: www.scientificbeta.com. Analysis is based on daily total returns of the currency hedged indices hedged in EUR for the period 31/12/2005 to 31/12/2015.
The following KIF contract can be offered at a zero cost upfront: **1-year Maturity, 92.5% Barrier, 89% Strike**

We compare over the whole period a 1-year investment via both:

- MBMS overlaid with a KIF contract
- Its CW Benchmark

Main conclusions:

- The overlaid MBMS strategy outperforms the CW Benchmark by ~ **+0.63%** on average. The average lag of the overlaid MBMS is ~ **-3.16%** compared to the MBMS alone
- Under Solvency II capital requirements, the overlaid MBMS will trigger only **+11%** vs. **+39%** for standard investment into the CW Benchmark
- In a nutshell, the proposed solution allows the Investor to have a 100% European Equity exposure to the CW benchmark, and that roughly divides by 4 the capital requirements under Solvency II

**Note:** risk metrics above reflects a calculation on a 250-bd rolling window over the whole period (June 2002-Feb 2016) for the SciBeta Extended Developed Europe MBMS EW Eur Hedged (MBMS) with the KIF and its CW benchmark.
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