EDHEC-Risk Days 2016

Bringing Research Insights to Institutional Investment Professionals

From Smart Beta Products to Smart Beta Solutions

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Overview

• Managing the risk of smart beta
• Smart beta solution principles
• Smart beta 2.0
• Smart beta solutions
• Conclusion
• References
Managing the risk of smart beta: from indices to smart beta solutions (I)

- All index providers try to convince investors that the perfect index exists. Ultimately, all smart factor indices, even when they are well diversified and perform over the long term, present considerable short-term relative risks.

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Ann. Excess Returns</td>
<td>3.77%</td>
<td>2.95%</td>
<td>2.55%</td>
<td>3.84%</td>
<td>3.57%</td>
<td>2.54%</td>
<td>3.27%</td>
</tr>
<tr>
<td>Information Ratio</td>
<td>0.59</td>
<td>0.61</td>
<td>0.43</td>
<td>0.70</td>
<td>0.66</td>
<td>0.58</td>
<td>0.69</td>
</tr>
<tr>
<td>Outperf. Prob (1 Year)</td>
<td>66.6%</td>
<td>66.3%</td>
<td>63.5%</td>
<td>69.2%</td>
<td>70.3%</td>
<td>68.0%</td>
<td>72.1%</td>
</tr>
<tr>
<td>Outperf. Prob (3 Years)</td>
<td>75.7%</td>
<td>75.7%</td>
<td>75.7%</td>
<td>79.5%</td>
<td>82.0%</td>
<td>78.9%</td>
<td>80.9%</td>
</tr>
<tr>
<td>95% Tracking Error</td>
<td>11.54%</td>
<td>8.59%</td>
<td>11.38%</td>
<td>10.03%</td>
<td>9.88%</td>
<td>7.20%</td>
<td>8.41%</td>
</tr>
<tr>
<td>Bull Markets Rel. Returns</td>
<td>3.56%</td>
<td>2.75%</td>
<td>-0.91%</td>
<td>2.28%</td>
<td>2.02%</td>
<td>3.29%</td>
<td>2.22%</td>
</tr>
<tr>
<td>Bear Markets Rel. Returns</td>
<td>3.78%</td>
<td>2.99%</td>
<td>7.43%</td>
<td>5.78%</td>
<td>5.52%</td>
<td>1.30%</td>
<td>4.51%</td>
</tr>
<tr>
<td>Ext. Bull Markets Rel. Ret.</td>
<td>6.30%</td>
<td>2.49%</td>
<td>-6.18%</td>
<td>1.11%</td>
<td>0.17%</td>
<td>5.50%</td>
<td>1.61%</td>
</tr>
<tr>
<td>Ext. Bear Markets Rel. Ret.</td>
<td>2.97%</td>
<td>2.67%</td>
<td>7.24%</td>
<td>4.78%</td>
<td>5.05%</td>
<td>1.15%</td>
<td>4.02%</td>
</tr>
<tr>
<td>Maximum Relative DD</td>
<td>42.06%</td>
<td>17.28%</td>
<td>43.46%</td>
<td>32.68%</td>
<td>38.49%</td>
<td>25.21%</td>
<td>32.89%</td>
</tr>
<tr>
<td>Time Under Water (days)</td>
<td>1945</td>
<td>1948</td>
<td>2078</td>
<td>1813</td>
<td>1944</td>
<td>1837</td>
<td>1931</td>
</tr>
</tbody>
</table>

All statistics are annualized. Yield on Secondary US Treasury Bills (3M) is used as a proxy for the risk-free rate. The analysis is based on daily total return data in USD from 31 December 1970 to 31 December 2015 (45 years). Benchmark is the cap-weighted portfolio of all stocks in the USA universe. Scientific Beta LTTR USA universe consists of largest 500 USA stocks. Multi Beta MultiStrategy 6-Factor (EW) index is constructed by combining the six factor tilted (Mid Cap, Momentum, Low Vol, Value, High Profitability, Low Investment) MultiStrategy indices in equal proportion, rebalanced every quarter. 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 quarters with positive market returns are considered as bullish and the quarters with the negative returns are considered as bearish. Top 25% quarters with best benchmark index returns are extreme bull quarters and bottom 25% quarters with worst benchmark index returns are extreme bear quarters. Probability of outperformance the probability of obtaining positive excess returns over CW if one invests in the strategy at any point in time for a period of 3 years (1 year). It is computed as the frequency of positive values in the series of excess returns assessed over a rolling window of 3 years (1 year) and step size of one week covering the entire investment horizon.
Managing the risk of smart beta: from indices to smart beta solutions (II)

• Even though the vast majority of investors consider smart beta to be a means to outperform a cap-weighted benchmark that will remain the reference for the global asset allocation policy, explicit management of these relative risks is not really offered.

• The vast majority of investors replace active asset managers who are subject to ex-ante relative risk control with indices that are not subject to any risk control.

• Even when it involves reasoning on approaches in terms of absolute risks, the preoccupation with relative performance is not absent. For example, we observe that investments in minimum volatility-type defensive strategies are often appreciated conditionally on the return of the reference cap-weighted index.
Overview

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• Smart beta solution principles
• Smart beta 2.0
• Smart beta solutions
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• References
Involves proposing an investment solution based on systematic dynamic risk allocation and taking the investor’s risk objectives and constraints into account.

This solution, once it is approved by the investor, is the subject of a tailor-made benchmark support for a mandate replicated by the investor or their asset manager.

This smart beta solution relies on three ingredients:

1. A choice of investment support, which is the smart factor indices offered on the Scientific Beta platform.
2. Risk allocation techniques that are robust and adapted to the objectives defined by the investor and drawn from EDHEC-Risk Institute’s research.
3. Dynamic benchmark calculation capability based on the Scientific Beta platform.
Smart beta solutions: principles (II)

- Smart Beta Solutions forbid any approach based on an estimation of future factor returns: we promised zero alpha!

- Smart Beta Solutions do not introduce any discretionary decision that would be guided by managers’ opinions: we promised zero manager skill!
Overview

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Smart Beta Solutions are implemented using smart factor indices that are chosen on the basis of the following criteria:

- Represent factors that are well rewarded over the long term
- Are well diversified and as such benefit from excellent risk-adjusted performance because they are not only well exposed in factor terms but also well diversified; this combination of the two benefits constitutes the key element of the Smart Beta 2.0 approach, which differs from the Smart Beta 1.0 approaches, where the investor had to choose between selecting the factor exposure or selecting the diversification of the specific risk
- Are easily investable (liquidity and turnover controlled)
In the past two years, factor investing has eclipsed the concept of smart beta, and with it the original idea of responding to the two points of criticism of cap-weighted indices that render the creation of new investment benchmarks legitimate: their poor factor exposure and their concentration.

- 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.

**Smart beta 2.0: choice of factor exposure but also of diversification of specific risk**

**Concentration of CW Indices**

- Sci Beta Developed World CW: Effective Number of Stocks = 0, Nominal Number of Stocks = 2000
- Sci Beta USA CW: Effective Number of Stocks = 500, Nominal Number of Stocks = 500

**Value (B/M) Quintiles**

- Low: Sci Beta Developed World CW = 30%, Sci Beta USA CW = 25%
- 2: Sci Beta Developed World CW = 30%, Sci Beta USA CW = 25%
- 3: Sci Beta Developed World CW = 30%, Sci Beta USA CW = 25%
- 4: Sci Beta Developed World CW = 30%, Sci Beta USA CW = 25%
- High: Sci Beta Developed World CW = 30%, Sci Beta USA CW = 25%
Smart beta 2.0: avoiding the excessive concentration of traditional factor or multi-factor indices

- Even when there is factor diversification, there is not necessarily good diversification of specific risk.

- We observe for example that in September 2015, the J.P. Morgan Europe Multi-Factor index was very strongly exposed to the risk of the Volkswagen AG stock, as was the MSCI Europe Diversified Multi Factor index.

- As such, these indices respectively contained almost 1.5 and more than 2 times more Volkswagen AG stock than the Stoxx Europe 600, and almost 10 times and 16 times more Volkswagen AG stock than the Scientific Beta Extended Europe Multi-Beta Multi-Strategy EW index.
Smart Beta Solutions rely on a choice of indices constructed using an original approach termed Smart Beta 2.0, which enables each choice of factor to be associated with a choice of strategies so as to construct smart factors, i.e. indices that have the desired factor tilt, but are also well diversified.
Smart beta 2.0: benefitting from the choice of smart beta indices on the platform (II)

- United States
- Eurozone
- United Kingdom
- Developed Europe ex. UK
- Japan
- Dev. Asia Pacific ex. Japan
- Developed ex. UK
- Developed ex. US
- Developed
- Extended Developed Europe
- Extended USA
- Large / Mid Cap
- Value / Growth
- High / Low Volatility
- High / Low Momentum
- High / Low Profitability
- High / Low Investment
- High / Low Dividend
- Multi-Beta EW
- Multi-Beta ERC
- High / Mid Liquidity

- Stock selection (factor tilt)

- Weighting scheme (diversification method)
  - Max. Deconcentration
  - Max. Decorrelation
  - Efficient Min. Volatility
  - Efficient Max. Sharpe
  - Div. Risk Weighted
  - Div. Multi-Strategy

- Risk control options
  - 2% TE/CW
  - 3% TE/CW
  - 5% TE/CW
  - Country Neutral
  - Sector Neutral
This choice provides the benefit of two elements that are indispensable for the construction of a smart beta portfolio:

1. The decorrelation between factor returns
2. The decorrelation of returns between the diversification strategies
Overview

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Smart beta solutions: benefitting from the decorrelation between factors (I)

- The factors have variable risk premia that respond to varying economic logic.

![Annual Return Spread of Long-Short CW Factors](image)

**Calendar Year Returns of Risk Factors** – Factors are obtained from the Scientific Beta US Long-Term Track Records. The analysis is based on daily total returns in USD from 31/12/1970 to 31/12/2015 (45 years). Small Size/Value/Momentum factors are long short cap-weighted portfolios long in small cap stocks (in broad market) /30% highest book-to-market/30% past 12M-1M high returns stocks and short in 30% largest cap stocks/30% lowest book-to-market/30% past 12M-1M low returns stocks. Low Vol/High Profitability/Low Investment factors are long short cap-weighted portfolios long in 30% lowest past 2Y volatility/30% highest gross profit-to-total asset ratio/30% lowest 2Y total asset growth rate stocks and short in 30% highest past 2Y volatility/30% lowest gross profit-to-total asset ratio/30% highest 2Y total asset growth rate stocks. Average Across 6 factors are the mean annual returns in each year.
Smart beta solutions: benefitting from the decorrelation between factors (II)

• This decorrelation results in decorrelation between the relative returns of smart factor indices.

Correlation of Excess Returns across Factor Tilts

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mid Cap</td>
</tr>
<tr>
<td>Mid Cap</td>
<td>1.00</td>
</tr>
<tr>
<td>High Momentum</td>
<td></td>
</tr>
<tr>
<td>Low Volatility</td>
<td></td>
</tr>
<tr>
<td>Value</td>
<td></td>
</tr>
<tr>
<td>Low Investment</td>
<td></td>
</tr>
<tr>
<td>High Profitability</td>
<td></td>
</tr>
</tbody>
</table>

**Smart beta solutions: benefitting from the decorrelation between diversification strategies (I)**

- The strategies have different conditions and orders of optimality. This difference is a differentiating factor in the strategies’ exposures to the various rewarded or unrewarded risks.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Objective</th>
<th>Unconstrained closed-form solution</th>
<th>Required parameter(s)</th>
<th>Optimality conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Deconcentration</td>
<td>Maximise Effective Number of Stocks</td>
<td>$w^* = \frac{1}{N}\mathbf{1}$</td>
<td>None</td>
<td>$\mu_i = \mu \forall i \quad \sigma_i = \sigma \forall i \quad \rho_{ij} = \rho \forall i$</td>
</tr>
<tr>
<td>Diversified Risk Weighting</td>
<td>Equalise risk contributions under “Constant Correlation” assumption</td>
<td>$w^* = \frac{\text{diag}(\sigma^{-1})}{\mathbf{1}'\text{diag}(\sigma^{-1})}$</td>
<td>$\sigma_i$</td>
<td>$\lambda_i = \lambda \forall i \quad \rho_{ij} = \rho \forall i$</td>
</tr>
<tr>
<td>Maximum Decorrelation</td>
<td>Minimise the portfolio volatility under the assumption of identical volatility across all stocks.</td>
<td>$w^* = \frac{\Omega^{-1}\mathbf{1}}{\mathbf{1}'\Omega^{-1}}$</td>
<td>$\rho_{ij}$</td>
<td>$\mu_i = \mu \forall i \quad \sigma_i = \sigma \forall i$</td>
</tr>
<tr>
<td>Efficient Minimum Volatility</td>
<td>Minimise portfolio volatility</td>
<td>$w^* = \frac{\sum^{-1}\mathbf{1}}{\mathbf{1}'\sum^{-1}}$</td>
<td>$\sigma_i \rho_{ij}$</td>
<td>$\mu_i = \mu \forall i$</td>
</tr>
<tr>
<td>Efficient Maximum Sharpe Ratio</td>
<td>Maximise portfolio Sharpe ratio</td>
<td>$w^* = \frac{\sum^{-1}\mu}{\mathbf{1}'\sum^{-1}\mu}$</td>
<td>$\mu_i \quad \sigma_i \rho_{ij}$</td>
<td>Optimal by construction</td>
</tr>
</tbody>
</table>
This differentiation has consequences for the decorrelation between the relative returns of the strategies for a given choice of factor exposure.

**Pair-wise Correlations of Excess Returns across Five Weighting Schemes**

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Average Correlation across Five Weighting Schemes</td>
<td>0.89</td>
<td>0.87</td>
<td>0.96</td>
<td>0.88</td>
<td>0.90</td>
<td>0.85</td>
</tr>
<tr>
<td>Minimum Correlation across Five Weighting Schemes</td>
<td>0.76</td>
<td>0.68</td>
<td>0.91</td>
<td>0.75</td>
<td>0.78</td>
<td>0.64</td>
</tr>
</tbody>
</table>

*The analysis is based on daily total returns in USD of US Long-Term Track Records from 31/12/1970 to 31/12/2015 (45 years). The average and minimum pair-wise correlations across the five weighting schemes – Max Deconcentration, Max Decorrelation, Max Sharpe Ratio, Min Volatility and Diversified Risk Weighted for the six factors – Momentum, Low Volatility, Value, Size, Low Investment and Low Profitability are provided. Source: www.scientificbeta.com*
The integration of this decorrelation the weighting schemes has given rise to the creation of diversified multi-strategy indices for each of the factor tilts. These indices are good proxies for smart factors.


Multi-strategy smart factor indices ultimately present very good diversification of specific risks.
Smart beta solutions: diversified (smart) factor indices (II)

- Smart factor indices with well-diversified specific risks that outperform traditional cap-weighted factor indices.


<table>
<thead>
<tr>
<th>Metric</th>
<th>Mid Cap</th>
<th>Momentum</th>
<th>Low Volatility</th>
<th>Value</th>
<th>Low Investment</th>
<th>High Profitability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ann Returns</strong></td>
<td>10.45%</td>
<td>12.97%</td>
<td>14.22%</td>
<td>11.39%</td>
<td>13.39%</td>
<td>10.76%</td>
</tr>
<tr>
<td><strong>Ann Volatility</strong></td>
<td>16.88%</td>
<td>17.09%</td>
<td>15.80%</td>
<td>17.26%</td>
<td>16.01%</td>
<td>15.39%</td>
</tr>
<tr>
<td><strong>Sharpe Ratio</strong></td>
<td>0.32</td>
<td>0.46</td>
<td>0.58</td>
<td>0.37</td>
<td>0.52</td>
<td>0.37</td>
</tr>
<tr>
<td><strong>Max Drawdown</strong></td>
<td>54.63%</td>
<td>57.09%</td>
<td>53.42%</td>
<td>50.81%</td>
<td>53.25%</td>
<td>51.10%</td>
</tr>
<tr>
<td><strong>Ann Excess Returns</strong></td>
<td>2.52%</td>
<td>3.77%</td>
<td>0.94%</td>
<td>2.95%</td>
<td>0.32%</td>
<td>2.55%</td>
</tr>
<tr>
<td><strong>Ann Tracking Error</strong></td>
<td>5.72%</td>
<td>6.42%</td>
<td>3.49%</td>
<td>4.84%</td>
<td>4.27%</td>
<td>5.99%</td>
</tr>
<tr>
<td><strong>95% Tracking Error</strong></td>
<td>9.27%</td>
<td>11.54%</td>
<td>6.24%</td>
<td>8.59%</td>
<td>8.18%</td>
<td>11.38%</td>
</tr>
<tr>
<td><strong>Information Ratio</strong></td>
<td>0.44</td>
<td>0.59</td>
<td>0.27</td>
<td>0.61</td>
<td>0.07</td>
<td>0.43</td>
</tr>
<tr>
<td><strong>Max Rel. Drawdown</strong></td>
<td>35.94%</td>
<td>42.06%</td>
<td>14.44%</td>
<td>17.28%</td>
<td>33.82%</td>
<td>43.46%</td>
</tr>
<tr>
<td><strong>Outperf. Prob. (3Y)</strong></td>
<td>69.4%</td>
<td>75.7%</td>
<td>71.3%</td>
<td>75.7%</td>
<td>52.7%</td>
<td>75.7%</td>
</tr>
<tr>
<td><strong>Outperf. Prob. (5Y)</strong></td>
<td>75.9%</td>
<td>81.5%</td>
<td>81.1%</td>
<td>87.0%</td>
<td>58.4%</td>
<td>86.9%</td>
</tr>
</tbody>
</table>

The analysis is based on daily total return data in USD from 31/12/1970 to 31/12/2015 (45 years). Benchmark is the cap-weighted portfolio of all stocks in the USA universe. Scientific Beta LTTR USA universe consists of largest 500 USA stocks. Mid Cap, High Momentum, Low Volatility, Value, Low Investment and High Profitability 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 3 (or 5) years at any point during the history of the strategy. A rolling window of length 3 (or 5) years and a step size of 1 week is used. Source: [www.scientificbeta.com](http://www.scientificbeta.com).
The smart beta solutions proposed rely on EDHEC-Risk’s research in the area of smart beta risk allocation (Amenc et al. 2014), while the standard multi-strategy or multi-beta indices offered by Scientific Beta are EW assemblies of factors and/or weighting strategies. The risk allocation solutions offered aim to exploit the differences in risk and correlations between factors and between weighting strategies.

This research led to the use of robust allocation methods that enable systematic and transparent allocation between smart factor indices while conserving a maximum total of 50% annual one-way turnover.)
Smart beta solutions: robust risk allocation methods (II)

- We differentiate between two major categories of risk allocation methods:

1. Absolute risk methods, which aim to target an absolute risk profile (e.g. reduction in volatility) for the smart beta solution.
2. Relative risk methods, which aim to target a relative risk profile with respect to a market reference (e.g. cap-weighted index) or even with respect to liabilities (correlation with liabilities, cf. work by Martellini et al.).

- These allocations can also integrate factor exposure constraints (equal-weight or risk parity for example) or geographical constraints.
Smart beta solutions: example of an absolute risk solution (I)

• Defensive smart beta solution aiming to reduce the volatility of the benchmark while avoiding very poor periods of performance relating to the defensive nature of the index in a bull market situation (main problem posed by a minimum volatility or low volatility strategy).

• This objective led us to make the choice of a volatility target relative to market volatility. To do this, we implemented a simple risk allocation method: maximum deconcentration with volatility constraints, with the goal of taking into account the asymmetric nature of volatility, which is very often higher in bear markets than in bull markets (see Hentschel (1995) or Bekaert and Wu (2000) for a review); a relative rather than absolute volatility budget approach adapts the defensive nature of the allocation to market conditions and limits negative tracking error in bull markets, which can be substantial in absolute risk reduction strategies such as low volatility or minimum volatility allocation.
**Smart beta solutions: example of an absolute risk solution (II)**

- Such an approach allows a strong reduction in the volatility of the benchmark to be conserved, but when it is needed, i.e. when market volatility is high. This ultimately avoids excessive underperformance in bull markets because the solution avoids an overly defensive bias.
Smart beta solutions: example of an absolute risk solution (III)

- We use 30 [6 factors x 5 weightings] smart factor indices in the USA universe.
  - Mid Cap / Momentum / Low Vol. / Value / High Profitability / Low Investment

- The following optimisation, **maximising the effective number of constituents with a constraint on volatility**, is performed:

  \[
  ENC(w) = 1/(w^T \ast w) \\
  w^* = \text{argmax}\{1/(w^T \ast w)\} \\
  \begin{align*}
  \sum_{i=1}^{N} w_i &= 1 \\
  w_i &\geq 0 \ \forall \ i \\
  \sqrt{w^T \ast \Sigma \ast w} &\leq 90\% \ast Volatility_{CW} \\
  \Sigma &= \text{covariance matrix of returns}
  \end{align*}
  \]

  - The rebalancing frequency for allocations is systematic quarterly.
  - The calibration period is two years. The (sample) covariance matrix and the benchmark volatility are estimated using the past 104 weekly total returns of the component indices in USD.
**Smart beta solutions: example of an absolute risk solution (IV)**

## Volatility-Constrained Maximum Deconcentration Allocation compared to Defensive Approaches

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Ann Returns</td>
<td>10.16%</td>
<td>12.53%</td>
<td>12.94%</td>
<td>13.67%</td>
</tr>
<tr>
<td>Ann Volatility</td>
<td>17.15%</td>
<td>14.36%</td>
<td>14.08%</td>
<td>14.64%</td>
</tr>
<tr>
<td>Sharpe Ratio</td>
<td>0.29</td>
<td>0.52</td>
<td>0.56</td>
<td>0.58</td>
</tr>
<tr>
<td>Maximum Drawdown</td>
<td>54.63%</td>
<td>47.33%</td>
<td>48.31%</td>
<td>48.70%</td>
</tr>
<tr>
<td>Ann Rel. Returns</td>
<td>-</td>
<td>2.37%</td>
<td>2.77%</td>
<td>3.51%</td>
</tr>
<tr>
<td>Tracking Error</td>
<td>-</td>
<td>5.21%</td>
<td>6.08%</td>
<td>5.13%</td>
</tr>
<tr>
<td><strong>Information Ratio</strong></td>
<td>-</td>
<td><strong>0.45</strong></td>
<td><strong>0.46</strong></td>
<td><strong>0.68</strong></td>
</tr>
<tr>
<td>Max Rel. Drawdown</td>
<td>-</td>
<td>40.10%</td>
<td>43.46%</td>
<td>33.18%</td>
</tr>
<tr>
<td>3-Y Rolling Vol Mean</td>
<td>16.40%</td>
<td>13.70%</td>
<td>13.43%</td>
<td>13.99%</td>
</tr>
<tr>
<td>3-Y Rolling Vol Std Dev</td>
<td>5.33%</td>
<td>4.53%</td>
<td>4.47%</td>
<td>4.61%</td>
</tr>
<tr>
<td>3-Y Rolling Vol 95%ile</td>
<td>29.29%</td>
<td>25.14%</td>
<td>24.63%</td>
<td>25.06%</td>
</tr>
<tr>
<td>Rel. Returns Bull Markets</td>
<td>-</td>
<td>-0.07%</td>
<td>-0.77%</td>
<td>1.84%</td>
</tr>
<tr>
<td>Rel. Returns Bear Markets</td>
<td>-</td>
<td>5.53%</td>
<td>7.52%</td>
<td>5.53%</td>
</tr>
<tr>
<td>Rel. Returns 25% Bull Markets</td>
<td>-</td>
<td>-4.77%</td>
<td>-6.39%</td>
<td>-0.69%</td>
</tr>
<tr>
<td>Rel. Returns 25% Bear Markets</td>
<td>-</td>
<td>5.08%</td>
<td>7.35%</td>
<td>5.14%</td>
</tr>
<tr>
<td><strong>CAPM Beta</strong></td>
<td><strong>1.00</strong></td>
<td><strong>0.84</strong></td>
<td><strong>0.80</strong></td>
<td><strong>0.86</strong></td>
</tr>
<tr>
<td>1-Way Ann Turnover</td>
<td>3.1%</td>
<td>31.9%</td>
<td>26.5%</td>
<td>39.4%</td>
</tr>
</tbody>
</table>

Max Deconcentration (90% BM Vol) allocation is performed using 30 [6 factors x 5 weightings] Standard Smart Factor Indices in the US LTTR universe. The factors are - Mid Cap / Momentum / Low Vol. / Value / High Profitability / Low Investment. The weightings are - Max Deconc. / Max Decorr. / Eff. Min Vol. / Eff. Max Sharpe / Div. Risk Weighted. The analysis is based on daily total returns in USD in the period 31-Dec-1972 to 31-Dec-2015 (43 years). *Regressions are performed using weekly total returns in USD. All statistics are annualised. Yield on Secondary US Treasury Bills (3M) is used as a proxy for the risk-free rate. Reported turnover is one-year annual and it is averaged across 172 rebalancings in the 43-year period. All allocations are systematically rebalanced quarterly. 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. Quarters with positive benchmark index returns are bull quarters and the remaining are bear quarters. Top 25% quarters with best benchmark index returns are extreme bull quarters and bottom 25% quarters with worst benchmark index returns are extreme bear quarters. The Scientific Beta USA LTTR universe contains 500 stocks. Source: scientificbeta.com/Scientific Beta USA Long-Term Track Records. Scientific Beta US Long-Term Smart Factor Indices have a 45-year track record, of which 2 years are used for calibration of parameters. Consequently US Long-Term Smart Beta Solutions have a 43-year track record.
Smart beta solutions: example of an absolute risk solution (V)

Volatility Constrained Maximum Deconcentration Allocation Weights – The figure shows the evolution of weights across the 30 [6 factors x 5 weightings] Standard Smart Factor Indices in the US LTTR universe. The factors are - Mid Cap / Momentum / Low Vol. / Value / High Profitability / Low Investment. The weightings are - Max Deconc. / Max Decorr. / Eff. Min Vol. / Eff. Max Sharpe / Div. Risk Weighted. The allocations are rebalanced quarterly over the period of 43 years (31-Dec-1972 to 31-Dec-2015). Source: scientificbeta.com/Scientific Beta USA Long-Term Track Records. Scientific Beta US Long-Term Smart Factor Indices have a 45-year track record, of which 2 years are used for calibration of parameters. Consequently US Long-Term Smart Beta Solutions have a 43-year track record.
In addition to their exposure to rewarded factors, the vast majority of solutions have a slightly defensive bias, either because the integration of low volatility factors weighs on the overall beta of the portfolio, or because the diversification schemes themselves are of a defensive nature (risk parity, minimum volatility, etc.). Ultimately, they are sold as enabling investment in rewarded factors but are not totally invested in equities and do not benefit totally from the market risk premium.

The objective of the smart beta solution proposed here is to conserve exposure to factors that are rewarded over the long term while preserving a market beta of 1. This “beta 1” exposure provides full exposure to the risk premium of the equity markets.

It involves outperforming the cap-weighted index in long-only while guaranteeing a reduced level of tracking error that can then be adjusted as part of a core-satellite approach.

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<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>CAPM Market Beta</td>
<td>0.91</td>
<td>0.90</td>
<td>0.70</td>
<td>0.89</td>
<td>0.69</td>
<td>0.84</td>
</tr>
<tr>
<td>Carhart Market Beta</td>
<td>0.93</td>
<td>0.93</td>
<td>0.72</td>
<td>0.90</td>
<td>0.75</td>
<td>0.88</td>
</tr>
</tbody>
</table>

The analysis is based on weekly total return data in USD from 31/12/2005 to 31/12/2015 (10 years). The benchmark used is the Scientific Beta Developed CW index containing 2000 stocks. Market factor is the returns of benchmark index over risk free rate. SMB/HML/MOM factors are long short cap-weighted portfolios long in small cap stocks (in broad market)/30% highest book-to-market/30% past 12M-1M high returns stocks and short in 30% largest cap stocks/30% lowest book-to-market/30% past 12M-1M low returns stocks in Scientific Beta Developed universe. The risk-free rate is the return of the 3 month US Treasury Bill. Source: www.scientificbeta.com/Bloomberg.
Such an approach enables good relative outperformance to be preserved compared to the cap-weighted index while controlling the tracking error risk, notably the extreme tracking error risk, and therefore dramatically reducing the maximum relative drawdown, the source of which is underinvestment in the market, which penalises smart beta indices, because the market is very bullish.

Naturally, this index, which is a high-performance substitute for a cap-weighted index, is not representative of a defensive strategy. The objective is to have the same level of risk as the equity markets but with a higher premium derived from its diversification.
Smart beta solutions: example of a relative risk solution (III)

- We use 30 [6 factors x 5 weightings] High Liquidity smart factor indices in the USA universe.
  - Mid Cap / Momentum / Low Vol. / Value / High Profitability / Low Investment

- The following optimisation, **maximising the effective number of constituents with market beta = 1 constraint**, is performed:

  \[
  ENC(w) = 1/(w^T * w) \left\{ \begin{array}{l}
  \sum_{i=1}^{N} w_i = 1 \\
  w_i \geq 0 \ \forall \ i \\
  \beta = \frac{Cov[(R_s * w), R_{cw}]}{Var(R_{cw})} = 1
  \end{array} \right.
  \]

  - The rebalancing frequency for allocations is systematic quarterly.
  - The calibration period is two years. The (sample) covariance matrix and the benchmark volatility are estimated using the past 104 weekly total returns of the component indices in USD.
## Smart beta solutions: example of a relative risk solution (IV)

### High Liquidity Maximum Deconcentration (beta=1) Allocation Performance

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ann Returns</td>
<td>10.16%</td>
<td>13.72%</td>
<td>13.12%</td>
<td>12.76%</td>
</tr>
<tr>
<td>Ann Volatility</td>
<td>17.15%</td>
<td>15.34%</td>
<td>15.99%</td>
<td>16.87%</td>
</tr>
<tr>
<td>Sharpe Ratio</td>
<td>0.29</td>
<td>0.56</td>
<td>0.50</td>
<td>0.45</td>
</tr>
<tr>
<td>Maximum Drawdown</td>
<td>54.63%</td>
<td>50.93%</td>
<td>52.27%</td>
<td>54.10%</td>
</tr>
<tr>
<td>Ann Rel. Returns</td>
<td>-</td>
<td>3.55%</td>
<td>2.96%</td>
<td>2.60%</td>
</tr>
<tr>
<td>Tracking Error</td>
<td>-</td>
<td>4.83%</td>
<td>3.88%</td>
<td>3.30%</td>
</tr>
<tr>
<td>Information Ratio</td>
<td>-</td>
<td>0.74</td>
<td>0.76</td>
<td>0.79</td>
</tr>
<tr>
<td>Max Rel. Drawdown</td>
<td>-</td>
<td>32.89%</td>
<td>23.83%</td>
<td>7.29%</td>
</tr>
<tr>
<td>3-Y Rolling TE Mean</td>
<td>-</td>
<td>4.41%</td>
<td>3.56%</td>
<td>3.15%</td>
</tr>
<tr>
<td>3-Y Rolling TE Std Dev</td>
<td>-</td>
<td>1.91%</td>
<td>1.55%</td>
<td>0.93%</td>
</tr>
<tr>
<td>3-Y Rolling TE 95%ile</td>
<td>-</td>
<td>9.41%</td>
<td>7.92%</td>
<td>5.17%</td>
</tr>
<tr>
<td>Rel. Returns Bull Markets</td>
<td>-</td>
<td>2.62%</td>
<td>2.77%</td>
<td>4.12%</td>
</tr>
<tr>
<td>Rel. Returns Bear Markets</td>
<td>-</td>
<td>4.54%</td>
<td>2.98%</td>
<td>0.41%</td>
</tr>
<tr>
<td>Rel. Returns 25% Bull Mkts</td>
<td>-</td>
<td>1.35%</td>
<td>1.98%</td>
<td>6.35%</td>
</tr>
<tr>
<td>Rel. Returns 25% Bear Mkts</td>
<td>-</td>
<td>3.86%</td>
<td>2.47%</td>
<td>-0.11%</td>
</tr>
<tr>
<td>CAPM Beta*</td>
<td>1.00</td>
<td>0.90</td>
<td>0.94</td>
<td>0.99</td>
</tr>
<tr>
<td>Carhart Market Beta*</td>
<td>1.00</td>
<td>0.90</td>
<td>0.94</td>
<td>1.00</td>
</tr>
<tr>
<td>1-Way Ann Turnover</td>
<td>3.1%</td>
<td>27.2%</td>
<td>29.6%</td>
<td>41.2%</td>
</tr>
</tbody>
</table>

Max Deconcentration (beta=1) allocation is performed using 30 [6 factors x 5 weightings] High Liquidity Smart Factor Indices in the US LTTR universe. The factors are - Mid Cap / Momentum / Low Vol. / Value / High Profitability / Low Investment. The weightings are - Max Deconc. / Max Decorr. / Eff. Min Vol. / Eff. Max Sharpe / Div. Risk Weighted. The Scientific Beta US LTTR High Liquidity MBMS 6-Factor (EW) index is an equal combination of the 6 factor tilted High Liquidity MultiStrategy indices. The analysis is based on daily total returns in USD in the period 31-Dec-1972 to 31-Dec-2015 (43 years). *Regressions are performed using weekly total returns in USD. All statistics are annualised. Yield on Secondary US Treasury Bills (3M) is used as a proxy for the risk-free rate. Reported turnover is one-way annual and it is averaged across 172 rebalancings in the 43-year period. All allocations are systematically rebalanced quarterly. 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. Quarters with positive benchmark index returns are bull quarters and the remaining are bear quarters. The top 25% quarters with the best benchmark index returns are extreme bull quarters and the bottom 25% quarters with the worst benchmark index returns are extreme bear quarters. The Scientific Beta USA LTTR universe contains 500 stocks. Source: scientificbeta.com/Scientific Beta USA Long-Term Track Records. Scientific Beta US Long-Term Smart Factor Indices have a 43-year track record, of which 2 years are used for calibration of parameters. Consequently US Long-Term Smart Beta Solutions have a 43-year track record.
Smart beta solutions: example of a relative risk solution (V)

**Maximum Deconcentration (beta=1) Allocation Weights** – The figure shows the evolution of weights across 30 [6 factors x 5 weightings] High Liquidity Smart Factor Indices in the US LTTR universe. The factors are - Mid Cap / Momentum / Low Vol. / Value / High Profitability / Low Investment. The weightings are - Max Deconc. / Max Decorr. / Eff. Min Vol. / Eff. Max Sharpe / Div. Risk Weighted. The allocations are rebalanced quarterly over the period of 43 years (31-Dec-1972 to 31-Dec-2015). Source: scientificbeta.com/Scientific Beta USA Long-Term Track Records. Scientific Beta US Long-Term Smart Factor Indices have a 45-year track record, of which 2 years are used for calibration of parameters. Consequently US Long-Term Smart Beta Solutions have a 43-year track record.
Overview

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- Smart beta 2.0
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- Conclusion
- References
Conclusion

**Smart beta solutions: sophisticated but transparent**

- EDHEC Risk Institute is a fervent promoter of transparency and considers that adding considerable value is not incompatible with transparency of the methods employed. That is why, once they have been validated by the investor, these solutions are the subject of a documented tailor-made benchmark that can be replicated by the client or their asset manager with complete transparency.

- These benchmarks are calculated by Scientific Beta in the form of customised indices.

- In addition, these Scientific Beta EDHEC Risk smart beta solution benchmarks respect investability constraints (turnover and liquidity) that are similar to those of the other Scientific Beta indices.
Overview

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References (II)


