Smart Beta Performance Report

Scientific Beta

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Introduction

Recent years have seen the development of numerous smart beta indices whose weighting schemes depart from those of cap-weighted indices. Smart beta indices may be obtained by tilting economic factors, such as book-to-market, size or volatility, or by introducing greater diversification into the index, as illustrated in deconcentration indices. The positive performance of smart beta indices over the long term has been largely documented in the literature. However, these indices are exposed to risk factors that differ from those of cap-weighted indices and that may cause variations in performance over short periods. As a result, the presentation of long-term performance is not enough for investors, who are also demanding performance figures over recent and shorter periods. The present report gives a complete picture of smart beta index performance with both long-term and short-term figures that illustrate the variations in performance over the different time periods, as well as the variations in performance between the various strategies. As a result, combining the various smart beta strategies makes it possible to obtain more robust performance.

From this report, it appears that the Value strategy is dominant in terms of performance over the long-term (see the performance of smart factor indices as well as the list of best-performing indices). Over shorter periods, the strategies are exposed to fluctuations according to the variations in market conditions. Year-to-date, the High Volatility strategy appears to be dominant by posting the best relative return compared to cap-weighted indices among all the smart factor strategies. The High Volatility strategy also provides the three best performing indices year-to-date, while this strategy provided the three worst performing indices over the long term, which shows that this strategy may be quite volatile in terms of performance.

1. Performance Overview for Smart Factor Indices for the Scientific Beta Developed Equity Universe and Long-Term US Indices

Table 1 displays the performance of diversified multistrategies. The five tilts selected – book-to-market, dividend yield, size, liquidity and volatility – are the common tilts documented in the literature as liable to produce outperformance compared to cap-weighted indices. The table presents performance statistics for both high and low stock selections by factor tilt. In addition, the table displays the performance of the index including all stocks. All these indices serve to create a diversified portfolio of the relevant stocks. In particular, they draw on different smart beta weighting schemes[1], which we refer to as a diversified multistrategy index. In addition, these indices offer investable proxies for smart beta factor indices. These indices allow investors to be both

[1] Maximum Deconcentration, Diversified Risk Parity, Maximum Decorrelation, Efficient Max Sharpe, Efficient Minimum Volatility.

exposed to a specific risk factor (beta) and to have good diversification of other risk factors, leading to quite a good Sharpe ratio associated with the factor tilt. This table also displays the performance of long-term US indices based on the same factor selection and weighting scheme, the initial reference universe of these long-term US indices being the S&P 500 universe.

Table1. Performance Overview for Smart Factor Indices for the Scientific Beta Developed Equity Universe and Long-Term US Indices.

Diversified Multistrategy Index for	Past month (as of 30/11/2013)		Year-to-date (as of 30/11/2013)		Since Inception: from 21/06/2002 to 30/11/2013																Long Term US Track Records since 1970 (as of 31/12/2012)			
	Relative Return compared to cap-weighted		Relative Return compared to cap-weighted		Relative Return compared to cap-weighted		Volatility		Sharpe Ratio		Tracking Error		Information Ratio		Maximum Relative Drawdown		Outperformance Probability (1Y)		Outperformance Probability (3Y)		Relative Return compared to cap-weighted		Outperformance Probability (3Y)	
All Stocks	-0.76%		0.62%		2.13%		15.98%		0.56		2.34%		0.91		4.07%		85.0%		100.0%		2.31%		75.63%	
High/low stock selections by	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
Book-to-market	-1.09%	-0.41%	0.03%	0.72%	2.73%	1.41%	16.95%	15.24%	0.56	0.54	2.73%	3.28%	1.00	0.43	5.79%	6.08%	77.8%	69.0%	86.4%	86.7%	2.17%	3.01%	77.37%	68.02%
Dividend Yield	-1.24%	-0.14%	-1.90%	3.03%	2.32%	1.68%	15.42%	16.57%	0.59	0.61	3.14%	3.35%	0.74	0.50	5.22%	8.32%	79.3%	73.1%	99.8%	94.8%	3.50%	1.08%	78.83%	59.01%
Size	-0.47%	-1.19%	0.29%	-0.22%	1.55%	2.75%	16.12%	15.98%	0.52	0.60	1.89%	3.61%	0.82	0.76	3.58%	6.77%	86.4%	81.5%	99.3%	89.8%	1.36%	4.14%	75.67%	71.75%
Liquidity	-0.21%	-1.24%	1.72%	-1.01%	1.72%	2.55%	17.04%	15.13%	0.50	0.62	1.85%	3.88%	0.93	0.66	4.37%	6.67%	77.8%	79.3%	98.6%	94.3%	1.31%	3.94%	74.71%	72.67%
Volatility	-0.46%	-1.06%	5.28%	-2.03%	1.59%	2.42%	19.38%	13.68%	0.43	0.67	4.17%	4.71%	0.38	0.51	16.94%	9.20%	67.4%	65.8%	57.5%	94.3%	2.13%	2.69%	63.61%	74.61%

The history of Scientific Beta Index returns begins on 21/06/2002. The statistics are based on daily total returns (with dividend reinvested). All statistics are annualised and performance ratios that involve the average returns are based on the geometric average, which reliably reflects multiple holding period returns for investors. ERI Scientific Beta uses the yield on Secondary Market US Treasury Bills (3M) as a proxy for the risk-free rate in US Dollars. Long-Term US indices are based on the S&P 500 Universe (according to CRSP). All results are in USD.

Over the long term all diversified multistrategy indices exhibit a positive relative return compared to cap-weighted indices based on a similar universe. The highest performances are posted by the small-cap index and the high book-to-market (value) index (2.75% and 2.73%, respectively), which is not surprising as value stock and small-cap stock premiums are largely documented in the literature. The high book-to-market index is also the one exhibiting the highest information ratio.

Looking at year-to-date relative returns, we observe that performance results are more contrasted on the shortest periods, as some of the strategies post negative returns. Depending on variations in short-term market conditions, these strategies are expected to exhibit fluctuations according to the variations in the risk premium associated with the factor tilt. In addition, the spread in relative return between the two smart factor indices, respectively resulting from high and low stock selections, greatly differs between the strategies, with some of them presenting a moderate spread, such as the size strategy, which exhibits the lowest one, with a relative return of 0.29% for the large-cap index, compared to -0.22% for the small-cap index. The book-to-market strategy also exhibits a moderate spread year-to-date between high and low book-to-market selection stocks. Other indices exhibit large spreads in relative return

between high and low selection stocks, like volatility indices, with a relative return of 5.28% for the high volatility index, compared to -2.03% for the low volatility index since the start of 2013.

The outperformance of high volatility stocks may be explained by rising markets since the beginning of the year. Not surprisingly, among all the diversified multistrategies presented in table 1, the two volatility indices (high and low) exhibit the highest maximum relative drawdown with regards to cap-weighted indices over the long term (16.94% and 9.20%, respectively), which confirms that these strategies may encounter high performance variations over time due to strong dependence of their performance on market conditions.

The dividend yield indices also present quite a large spread between high and low stock selection (-1.90% and 3.03%, respectively) since the start of 2013. In both cases, this spread is much weaker in longer term performance. Looking at market beta for all these strategies, it appears that the indices presenting the lowest spread of performance between high and low are also the ones for which the two market betas are quite similar. For example, the value and growth indices both have a market beta of 0.93 and the large-cap and small-cap indices have market betas of 0.93 and 0.92, respectively. Conversely, as far as the high difference in performance between high and low volatility indices is concerned, these two indices exhibit the highest difference between their market beta, with a market beta of 1.11 for the high volatility index and 0.78 for the low volatility index. Dividend yield and liquidity strategies exhibit comparable differences in their respective market beta, with respective spreads of 0.13 and 0.12 between the two market betas[2].

Looking at the performance of the all stocks diversified multistrategy index, it appears that investing in this index smoothes the variations in performance observed among the smart factor indices, which leads to more robust performance. With an information ratio of 0.91, the risk-adjusted return of this index is not far from the highest value (1.00) observed for the high book-to-market index. This performance is obtained with lower variations in short-term performance, compared to smart factor indices, as shown by its maximum relative drawdown and tracking-error, which are very low compared to the smart factor indices displayed in table 1.

[2] All beta values are from www.scientificbeta.com.

2. Performance Overview for Plain Vanilla Diversification Schemes for the Scientific Beta Developed Equity Universe and Long-Term US Indices

Table 2 displays the performance of indices using the various diversification schemes that have been identified as alternatives to the cap-weighted scheme known to generate indices concentrated in a limited number of stocks. In addition, the table displays the performance of the diversified multistrategy index including all stocks, as well as the performance of long-term US indices based on the same stock selection and weighting scheme.

Table2. Performance Overview for Plain Vanilla Diversification Schemes for the Scientific Beta Developed Equity Universe and US Long Term Indices.

	Past month (as of 30/11/2013)	Year-to-date (as of 30/11/2013)	Since Inception : from 21/06/2002 to 30/11/2013										Long Term US Track Records since 1970 (as of 31/12/2012)	
Weighting scheme	Relative Return	Relative Return	Relative Return	Volatility	Sharpe Ratio	Tracking Error	Information Ratio	Maximum Relative Drawdown	Outperformance Probability (1Y)	Outperformance Probability (3Y)	Turnover	Capacity	Relative Return	Outperformance Probability (3Y)
Maximum Deconcentration	-0.61%	1.33%	1.84%	17.52%	0.49	2.17%	0.85	9.49%	71.4%	88.2%	29.1%	16997	2.18%	69.38%
Diversified Risk Parity	-0.70%	0.47%	2.01%	16.62%	0.53	2.06%	0.97	6.48%	83.2%	94.6%	28.7%	17968	2.25%	73.35%
Maximum Decorrelation	-0.64%	1.64%	1.98%	16.22%	0.54	2.51%	0.79	4.03%	77.8%	99.5%	32.9%	17280	2.22%	75.63%
Efficient Max. Sharpe	-0.85%	0.74%	2.14%	15.60%	0.57	2.69%	0.79	4.04%	86.4%	100.0%	32.5%	18163	2.53%	76.60%
Efficient Minimum Volatility	-0.98%	-1.09%	2.59%	14.09%	0.66	4.00%	0.65	8.14%	74.7%	99.3%	30.5%	20457	2.28%	77.42%
Diversified Multistrategy	-0.76%	0.62%	2.13%	15.98%	0.56	2.34%	0.91	4.97%	85.0%	100.0%	26.1%	18173	2.31%	75.63%

The history of Scientific Beta index returns begins on 21/06/2002. The statistics are based on daily total returns (with dividend reinvested). All statistics are annualised and performance ratios that involve the average returns are based on the geometric average, which reliably reflects multiple holding period returns for investors. ERI Scientific Beta uses the yield on Secondary Market US Treasury Bills (3M) as a proxy for the risk-free rate in US Dollars. The table shows the turnover level of the index in % and the average capacity of the index as measured by the average market capitalization in M$, as of 20/09/2013. Long Term US indices are based on the S&P 500 Universe (according to CRSP). All results are in USD.

Since inception in 2002, all diversification schemes post positive relative returns. In terms of risk-adjusted performance, the best performance is delivered by the Efficient Minimum Volatility index, with a Sharpe ratio of 0.66. However, the Efficient Minimum Volatility strategy is also the one with the largest tracking error, leading it to have the lowest information ratio among all indices (0.65). When looking at the information ratio that measures the risk-adjusted relative performance, the best performing strategy appears to be Diversified Risk Parity with 0.97. In terms of probability of outperformance for a one-year holding period, the best strategy appears to be the Efficient Max Sharpe strategy with a probability of 86.4%. The performance of all strategy indices since inception in the Developed Markets universe is quite comparable to the long term US track record.

Year-to-date, only the Efficient Minimum Volatility strategy delivered a negative performance (-1.09%), while all other strategies posted positive relative returns, the best performing strategy being the Maximum Decorrelation strategy (1.64%). The Diversified Multistrategy index allows these extremes to be

avoided by diversifying across the five weighting schemes and posts year-to-date return of 0.62%. Since inception in 2002, the Diversified Multistrategy index also has the lowest turnover. It appears that investing in the Diversified Multistrategy index cancels out some of the transactions occurring in the single strategies. The turnover is only 26.1% per year. The low tracking error and low max relative drawdown of the Diversified Multistrategy index shows that combining several strategies leads to more robust performance over the long term.

3. Best and Worst Performing Indices for All Regions

In this section, we focus on the performance of the best and worst performers among the 2,442 Scientific Beta indices. Tables 3a and 3b display the top three indices and the bottom three indices, since inception and over the latest one-year period respectively. In addition, we provide the median performance statistic values.

Table 3a Best and Worst Performing Indices since Inception (all regions – 2,442 indices)

Best performers since inception (top 3 indices by relative return as of 30/11/2013)	Relative return	Outperformance probability			Relative bull/bear market performance		Relative high/low volatility performance		Maximum relative drawdown
		1 year	3 year	5 year	Bull	Bear	High volatility	Low volatility	
SciBeta Developed Asia-Pacific ex-Japan Value Maximum Decorrelation (Sector Neutral)	8.42%	69.8%	90.3%	96.7%	13.17%	2.24%	2.90%	17.59%	16.74%
SciBeta Developed Asia-Pacific ex-Japan Value Efficient Maximum Sharpe Ratio (Sector Neutral)	8.10%	75.8%	98.0%	99.4%	9.71%	5.17%	4.36%	13.98%	10.42%
SciBeta Developed Asia-Pacific ex-Japan Value Maximum Decorrelation	7.74%	75.3%	91.9%	95.0%	9.78%	4.41%	2.97%	15.38%	10.66%
Worst performers since inception (bottom 3 indices by relative return as of 30/11/2013)	Relative return	Outperformance probability			Relative bull/bear market performance		Relative high/low volatility performance		Maximum relative drawdown
		1 year	3 year	5 year	Bull	Bear	High volatility	Low volatility	
SciBeta Developed Asia-Pacific ex-Japan High-Volatility Efficient Minimum Volatility (2% TE/CW)	-2.83%	45.2%	35.3%	32.8%	2.62%	-7.82%	-7.25%	4.67%	37.56%
SciBeta Developed Asia-Pacific ex-Japan High-Volatility Efficient Maximum Sharpe Ratio (2% TE/CW)	-2.42%	50.5%	39.1%	36.7%	3.47%	-7.80%	-7.82%	6.96%	41.15%
SciBeta Developed Europe ex UK High-Volatility Efficient Maximum Sharpe Ratio (2% TE/CW)	-2.27%	44.9%	24.9%	15.4%	4.79%	-9.08%	-5.80%	3.20%	34.80%
	Relative return	Outperformance probability			Relative bull/bear market performance		Relative high/low volatility performance		Maximum relative drawdown
		1 year	3 year	5 year	Bull	Bear	High volatility	Low volatility	
Median performance statistics since inception as of 30/11/2013	1.61%	65.9%	75.8%	90.5%	0.92%	2.30%	1.21%	2.08%	10.90%

The history of Scientific Beta index returns begins on 21/06/2002. The statistics are based on daily total returns (with dividend reinvested). All statistics are annualised, except bull and bear market performances and high and low volatility market performances, which are quarterly values. Performance ratios that involve the average returns are based on the geometric average, which reliably reflects multiple holding period returns for investors. ERI Scientific Beta uses the yield on Secondary Market US Treasury Bills (3M) as a proxy for the risk-free rate in US Dollars. All results are in USD.

The top three indices based on the relative returns since inception are all from the Developed Asia-Pacific ex-Japan region and are all Value indices, which is not surprising as the existence of a value premium over the long term has been largely documented in the literature. In addition, these indices use two weighting schemes – Efficient Max Sharpe Ratio and Maximum Decorrelation– that take into account the correlations between stock returns.

The bottom three indices based on the relative returns since inception are all High-Volatility indices, known to achieve poor performance during bear markets. All three indices have a 2% tracking-error relative to the cap-weighted index based on the same universe, which shows that over the long term, strategies that closely follow cap-weighted indices are not the ones that overperform. It appears from conditional performance results that these indices posted especially negative relative returns during bear markets. They also posted negative relative returns during high volatility markets. Two of these indices are from the Developed Asia-Pacific ex-Japan region, like the top three indices, which shows that the best or worst performer status of these indices is first of all related to the strategy chosen (Value, rather than High Volatility) rather than to the geographic selection.

Table 3b Best and Worst Performing Indices over the Latest One-Year Period (all regions – 2,442 indices)

Best performers over one year (top 3 indices by relative return as of 30/11/2013)	Relative return	Outperformance probability			Relative bull/bear market performance		Relative high/low volatility performance		Maximum relative drawdown
		1 year	3 year	5 year	Bull	Bear	High volatility	Low volatility	
SciBeta Japan High-Volatility Maximum Deconcentration (5% TE/CW)	14.44%	53.1%	42.1%	24.3%	11.12%	-4.76%	-1.36%	3.91%	31.38%
SciBeta Eurozone High-Volatility Maximum Decorrelation (Geo Neutral)	12.49%	66.3%	70.6%	32.2%	7.35%	-4.33%	-0.76%	4.97%	22.92%
SciBeta Japan High-Volatility Maximum Decorrelation (5% TE/CW)	12.48%	49.5%	34.4%	21.0%	8.35%	-4.72%	-2.45%	3.15%	31.77%
Worst performers over one year (bottom 3 indices by relative return as of 30/11/2013)	Relative return	Outperformance probability			Relative bull/bear market performance		Relative high/low volatility performance		Maximum relative drawdown
		1 year	3 year	5 year	Bull	Bear	High volatility	Low volatility	
SciBeta Japan Mid-Liquidity Efficient Minimum Volatility	-22.18%	50.9%	64.3%	84.0%	-15.37%	14.92%	10.96%	-7.49%	20.84%
SciBeta Japan Mid-Liquidity Efficient Minimum Volatility (5% TE/CW)	-20.18%	52.7%	66.3%	89.6%	-14.59%	14.23%	10.20%	-6.71%	19.43%
SciBeta Japan Low-Volatility Efficient Minimum Volatility	-18.58%	58.8%	77.1%	90.8%	-15.58%	15.99%	11.08%	-6.50%	20.86%
Median relative return over one year (as of 30 Nov 2013)	-0.04%								

The history of Scientific Beta index returns begins on 21/06/2002. The statistics are based on daily total returns (with dividend reinvested). All statistics are annualised, except bull and bear market performances and high and low volatility market performances, which are quarterly values. Performance ratios that involve the average returns are based on the geometric average, which reliably reflects multiple holding period returns for investors. ERI Scientific Beta uses the yield on Secondary Market US Treasury Bills (3M) as a proxy for the risk-free rate in US Dollars. All results are in USD.

Over one year ending 30/11/2013, the top three indices are all High Volatility indices, which contrasts with the results obtained over the long term. This result may be explained by different market conditions compared to the ones experienced during the track record. Markets have been rising in the last year, a favourable situation for high volatility indices. Two of these are indices invested in Japan stocks. Looking at the Carhart performance attribution[3] for the three indices, it appears that the market factor explains more than 70% of the performance of the two Japan indices (72.62% and 71.60%, respectively), while it only explains 29% of the performance of the Eurozone index. Other factors have a weak contribution to the performance. For the two Japan indices, the size and value factors have a negative contribution, lower than 1% in absolute value, while the momentum factor has a positive value of around 1%. For the Eurozone index, we have opposite results as the size and value factors contribute positively (around 2% and 1.6%, respectively), and the momentum factor negatively (-0.09%) and insignificantly, while all other factors are statistically significant. In terms of sector contribution, the sector effect is negative for the two Japan indices (-2.12% and -1.11%, respectively) and positive for the Eurozone index (3.57%).

[3] Carhart factor analysis and sector performance attribution results are available on www.scientificbeta.com.

The bottom three indices are all Efficient Minimum Volatility indices, which are indices that perform especially well during bear markets and that encounter negative performances relative to cap-weighted indices during bull markets. The three indices are all from the Japan region. As we saw with the long-term results, the same geographical region may provide the best performing indices, as well as the worst performing ones, showing that the choice of strategy prevails over the geographical selection in performance results. Looking at the Carhart performance attribution, it appears that the three indices have similar performance profiles, as the market factor explains around 50% of the performance for all three. All other factors (size, value and momentum), though statistically significant, have a marginal (lower than 1% in absolute value) and negative contribution. Differences are to be found in the sector effect, as the two Mid-Liquidity indices both have a positive sector effect (0.37% and 0.27% respectively), while the Low-Volatility index has a negative sector effect (-1.98%).

About ERI Scientific Beta

A "More for Less" Initiative for Smart Beta Investing
More Academic Rigour, More Transparency, More Choice, More Analytics, More Risk Control, Less Expensive

ERI Scientific Beta aims to be the first provider of a smart beta platform to help investors understand and invest in advanced beta equity strategies. It has three principles:

• **Choice:** A multitude of strategies are available allowing users to build their own benchmark, among the 2,442 indices available on the platform, choosing the risks to which they wish, or do not wish, to be exposed. This approach, which makes investors responsible for their own risk choices, referred to as Smart Beta 2.0, is the core component of the index offerings proposed by ERI Scientific Beta.

• **Transparency:** The rules for all of the Scientific Beta series are replicable and transparent.

• **Clarity:** Exhaustive explanations of construction methodologies are provided, as well as detailed performance and risk analytics.

Established by EDHEC-Risk Institute, one of the very top academic institutions in the field of fundamental and applied research for the investment industry, ERI Scientific Beta shares the same concern for scientific rigour and veracity, which it applies to all the services that it offers investors and asset managers. Part of EDHEC Business School, a not-for-profit organisation, EDHEC-Risk Institute has sought to provide the ERI Scientific Beta services in the best possible economic conditions.

The ERI Scientific Beta offering covers three major services:

• **Scientific Beta Indices**
Scientific Beta Indices are smart beta indices that aim to be the reference for the investment and analysis of alternative beta strategies. Scientific Beta Indices reflect the state-of-the-art in the construction of different alternative beta strategies and allow for a flexible choice among a wide range of options at each stage of their construction process. This choice enables users of the platform to construct their own benchmark, thus controlling the risks of investing in this new type of beta (Smart Beta 2.0). Since 22 April 2013, the Scientific Beta platform has been offering 2,442 smart beta indices.

From April 2014, ERI Scientific Beta, in line with the research conducted by EDHEC-Risk Institute on optimal allocation and the diversification of smart beta risks, will be offering a suite of multi-beta multi-strategy benchmarks.

- **Scientific Beta Analytics**

  Scientific Beta Analytics are detailed analytics and exhaustive information on smart beta indices to allow investors to evaluate the advanced beta strategies in terms of risk and performance. The analytics capabilities include risk and performance assessments, factor and sector attribution, and relative risk assessment. We believe that it is important for investors to be able to conduct their own analyses, select their preferred time period and choose among a wide range of analytics in order to produce their own picture of strategy performance and risk.

- **Scientific Beta Fully-Customised Benchmarks**

  The Scientific Beta Fully-Customised Benchmarks service enables investors and asset managers to benefit from its expertise and the ability to determine and implement their choice of stocks, weighting schemes, and absolute and relative risk constraints in keeping with their objectives.

With a concern to provide worldwide client servicing, ERI Scientific Beta is organising the presence of its teams in Boston, London, New York, Nice, Singapore and Tokyo.

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