A Scientific Beta Publication

Scientific Beta
An EDHEC-Risk Institute Venture

A More Robust Defensive Offering

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Abstract

Defensive strategies have been popularised for many decades. In addition to providing protection in bear markets, they deliver higher risk-adjusted performance than cap-weighted indices over the long-term. This oddity has been documented in the academic literature as the "Low Volatility" anomaly. There are two main approaches that benefit from this anomaly. Modern Portfolio Theory uses optimisation techniques to obtain the portfolio with the lowest volatility. This approach is not robust, since it is known to produce concentrated portfolios and to be sensitive to parameter estimations and outliers. At Scientific Beta, we favour the Smart Beta 2.0 framework, which is the cornerstone of all indices we provide to clients, to harvest the Low Volatility factor. We first select low volatility stocks, then we apply a High Factor Intensity (HFI) filter to remove the stocks with the lowest multi-factor scores, and finally diversify away idiosyncratic risks with a diversified weighting scheme. This approach delivers high factor intensity and good long-term risk-adjusted performance, because it harvests the Low Volatility factor while maintaining positive exposures to other rewarded risk factors, thanks to the use of the HFI filter.

We strongly believe that investors are unique and have different investment objectives and constraints. This is why we offer them three different defensive indices that address the needs of various investments. In this paper, we review the construction of our defensive offering and show that it is more robust than the popular MSCI Minimum Volatility index and that it delivers high risk-adjusted performance while providing good protection in bear markets. As they are part of the Scientific Beta smart factor indices, our defensive indices are underpinned by the same principles that form the basis of all our other indices, namely good diversification of unrewarded risks and the capacity to limit undesired risks in a very transparent manner. For investors, this is a guarantee that their decision to use our indices is the best choice.

About the Authors

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Noël Amenc is CEO of Scientific Beta and Professor of Finance at EDHEC-Risk Institute. He has conducted active research in the fields of quantitative equity management, portfolio performance analysis, and active asset allocation, resulting in numerous academic and practitioner articles and books. He is on the editorial board of the *Journal of Portfolio Management* and serves as associate editor of the *Journal of Alternative Investments* and the *Journal of Index Investing*. He is a member of the Monetary Authority of Singapore Finance Research Council. He holds graduate degrees in economics, finance and management and a PhD in finance from the University of Nice Sophia-Antipolis.

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Introduction

Introduction

Investors looking for defensive equity strategies want to participate in bullish markets while protecting their capital in bear periods by limiting their losses relative to the cap-weighted index. This concern for capital protection leads to equity investors usually investing in Low Volatility or Low Beta strategies, the main objectives of which are to offer defensive payoff profiles and to benefit from a superior risk-adjusted performance relative to cap-weighted indices. The fact that a portfolio that is less risky than a cap-weighted index can generate outperformance on a risk-adjusted basis runs counter to the main financial theories, and it has been popularised under the name of Low Volatility anomaly.

The Low Volatility anomaly has its roots in the failure of the Capital Asset Pricing Model (CAPM) to explain the cross-section of expected returns. Indeed, according to the central prediction of the CAPM developed by Sharpe (1964) and Lintner (1965), there is a linear relationship between systematic risk or market beta and expected returns. However, this prediction has been very soon contradicted by many academic works, Friend and Blume (1970), Black, Jensen and Scholes (1972), Miller and Scholes (1972) and Haugen and Heins (1972, 1975), highlighting a negative or flat relationship between systematic risks and expected returns in the cross-section of stock returns. Following the work of Black (1972), Frazzini and Pedersen (2014) derive an equilibrium model that provides a risk-based justification of the Low Volatility anomaly. One major prediction of their model is that a "betting against beta" (BAB) strategy, that goes long low-beta assets and short high-beta assets, adjusting both legs with leverage to have a market neutral portfolio, produces significant positive risk-adjusted returns that are not explained by the size, value and momentum effects of Fama and French (1992, 1993) and of Jegadeesh and Titman (1993). They show that the poor returns of the BAB strategy occur when funding constraints become tight, which is consistent with liquidity-constrained investors having to sell leveraged positions in low-risk assets in bad times.

Several other academic works provide the same finding on persistence and existence of the Low Volatility anomaly on US and international universes. Ang et al. (2006, 2009) show that stocks with high recent idiosyncratic volatility have low average returns that are not explained by standard risk factors (size, value, momentum). Finally, Blitz and van Vliet (2007) show that low volatility stocks have higher risk-adjusted returns than high volatility stocks and that standard risk factor cannot explain the alpha resulting from a long/short portfolio. Overall, the Low Volatility anomaly is one of the strongest risk factors found in the academic literature (along with size, value, momentum, low investment and high profitability), with a strong annual premium of 8.7% over the period 1926 to 2012 (Frazzini and Pedersen, 2014).

There are two main approaches to benefit from the "Low Volatility" factor reward and obtain a defensive portfolio based on i) Modern Portfolio Theory and ii) factor investing. The former approach tries to build the portfolio with the lowest risk on the efficient frontier (Markowitz, 1952) by combining stocks with low volatilities and low pairwise correlations. This minimum volatility portfolio, achieved through an optimisation, is known to produce very concentrated portfolios. This is why most commercial solutions use very tight constraints (like min-max weights) to force the

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optimiser to generate less concentrated allocations. Moreover, optimisers, used to solve minimum volatility allocations, are very sensitive to outliers and to parameter estimation errors that can lead to dramatic changes to the optimal weights leading to high turnover and sub-optimal allocations that does not reach minimum volatility ex-post.

The second approach is the one we pursue at Scientific Beta for harvesting rewarded risk factors. The Smart Beta 2.0 framework is the cornerstone of the construction of our smart factor indices. It favours a clear separation of the stock selection and weighting phases. The stock selection objective is to expose the portfolio towards a desired and rewarded factor tilt, like the Low Volatility factor, and the weighting objective is to diversify away idiosyncratic risks in order to obtain a well-diversified portfolio. The latter is key to achieving the highest possible risk-adjusted performance over the long-term. Amenc et al. (2012) shows that this approach is more robust for achieving well-diversified defensive portfolios that produce a similar level of outperformance with higher risk reduction than portfolios based solely on Modern Portfolio Theory.

Scientific Beta's defensive offering relies on three types of indices to address the various objectives of investors:
i. The High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) index;
ii. The High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral) index;
iii. The Narrow High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) index.

The objective of the first (standard HFI) index is to be exposed to the Low Volatility factor in order to provide a reduction of volatility compared to the cap-weighted index and to also provide protection in bear markets. Moreover, it aims to maintain a high factor intensity by using a High Factor Intensity (HFI) filter and deliver the best risk-adjusted performance through the diversification of idiosyncratic risks. This index is clearly defensive, since it offers a good reduction of risk and protection of capital while benefiting from a high risk-adjusted performance over the long-term, due to its strong factor intensity.

The second (sector neutral HFI) index has two main objectives. The first one is to provide exposure to the Low Volatility factor. The second one is to deliver low relative risks compared to the cap-weighted index through a sector-neutral objective. The latter implies that the index will have less exposure to the Low Volatility factor than the standard HFI index and consequently a lower reduction of volatility and less protection in bear markets. Nonetheless, we will show that the index delivers better relative performance and lower exposure to interest rate risks, because of its reduced sector deviations relative to the cap-weighted index. The latter can be suitable for investors seeking to benefit from both defensive characteristics and rewards of the Low Volatility factor but who are worried by the unexpected consequences of minimum volatility strategies' exposures to fixed income risks.

Finally, the last (Narrow HFI) index is for investors who seek the highest factor exposure to the Low Volatility factor through a narrow selection of low volatile stocks. Its objectives are similar to the

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standard HFI index, but the narrow selection increases the concentration to the Low Volatility factor thus increasing the defensiveness and hence the protection in bear markets. It comes at the cost of lower exposures to other rewarded risk factors and important losses in bull markets. This index can be used in overlay strategies that target the modification of the global exposure of a portfolio with only a limited investment in a smart factor index.

The rest of the article is organised as follows. In Section 1, we discuss our construction philosophy based on the Smart Beta 2.0 framework and the way we tackle negative factor interaction with the HFI filter. We also present our defensive offering in more detail. In the following sections, we compare our offering to the MSCI Minimum Volatility index on two universes: SciBeta USA and SciBeta Developed. More particularly, in Section 2, we show that our offering delivers a better risk-adjusted performance and a better volatility reduction compared to the cap-weighted index. In Section 3, we show that our offering has a high factor intensity and good factor deconcentration. In Section 4, we show that our offering improves relative performance, extreme relative risks and probabilities of outperformance. In Section 5, we show that our offering delivers good protection in bear markets. In Section 6, we analyse the macroeconomic sensitivity of our offering, such as interest rates or credit spreads and show that our offering has weaker sensitivities, in particular our sector neutral HFI index. Finally, Section 7 concludes.

1. A Robust Smart Factor Design

1. A Robust Smart Factor Design

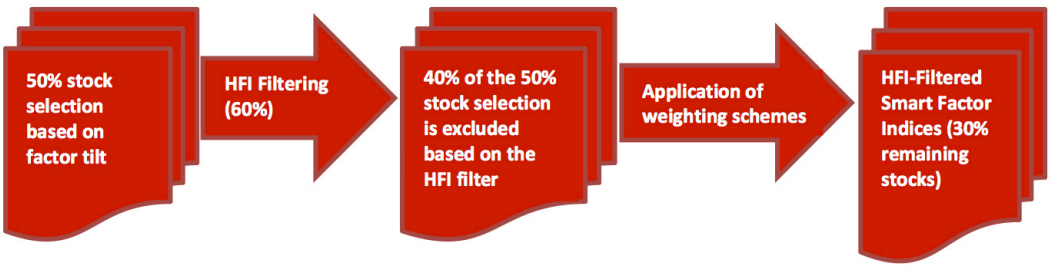
A key element in Scientific Beta smart factor index design is that each index not only tilts towards a desired factor, but also achieves a sound level of diversification of specific risk, in keeping with the Smart Beta 2.0 methodology introduced by Amenc and Goltz (2013) (see Exhibit 1).

Exhibit 1 – Smart Beta 2.0 framework

1.1. Stock selection

Focusing only on stocks with the highest factor scores ignores the potential negative interaction effects with other risk factors. For instance, a stock with a low volatility score might have a low value score. A smart factor index might therefore have a positive exposure to a desired factor tilt but low or even negative exposures to other rewarded risk factors. Thus, investors would benefit from additional controls in the stock selection mechanism to account for such interaction effects. To address the issue of factor interactions, we follow the approach proposed by Amenc et al. (2017), which differentiates from standard "bottom-up" approaches. The authors document that the "top-down" approach provides better performance per unit of factor exposure due to better diversification. They demonstrate a solution to increase factor intensity in the "top-down" approach by eliminating stocks with low multi-factor scores. They show that the absolute underperformance of a "factor losers" portfolio is substantially larger than the outperformance of a "factor champions" portfolio. Therefore, eliminating factor losers may be a more efficient way to increase factor intensity than focusing on factor champions, which is the milestone of "bottom-up" approaches.

Exhibit 2a – Stock selection with HFI filter



Scientific Beta uses a factor intensity (HFI) filter, which eliminates stocks with the lowest multi-factor scores. The score is based on the following factors: value, momentum, low volatility, high profitability and low investment. In Exhibit 2a, we show the standard selection process that we use for our smart factor indices. We select 50% of stocks based on the factor score and excludes stocks, within the

1. A Robust Smart Factor Design

factor-based selection, with the lowest multi-factor score, leaving 30% of stocks compared to the starting investment universe.

The HFI filter is available on our defensive indices and is essential to maintain a good factor intensity. Indeed, when investing in a Low Volatility smart factor, the objective is to increase the defensiveness of its portfolio and to benefit from the long-term reward of the factor, while preserving its current factor exposures that are the main driver of its portfolio long-term performance. In Exhibit 2b, we show the factor exposures of two Low Volatility indices on SciBeta US universe, with and without the HFI filter. We highlight that the index benefiting from the HFI filter has the same exposure to the Low Volatility factor but a positive exposure to the other risk factors. Therefore, when added to a portfolio, it will not deteriorate its existing factor exposures.

Note that the HFI filter is built with a dynamic adjustment, which takes into account the relative distance of the score of the whole of the universe compared to the score of the factor under consideration, which is not possible when using "bottom-up" approaches, which are based uniquely on scores or ranks. The ultimate objective is to preserve the factor intensity in its factor diversity.

Exhibit 2b – Factor exposures of two Low Volatility indices with and without the HFI filter

21-Jun-2002 to 31-Dec-2018 (RI/USD)	SciBeta US Low Volatility Diversified Multi-Strategy	SciBeta US HFI Low Volatility Diversified Multi-Strategy (4-Strategy)
Unexplained	0.01	0.01
Market Factor	**0.83**	**0.79**
Size (SMB) Factor	**0.11**	**0.07**
Value (HML) Factor	-0.02	**0.10**
Momentum (MOM) Factor	-0.01	**0.06**
Volatility Factor	**0.28**	**0.29**
Profitability Factor	-0.02	**0.08**
Investment Factor	0.02	**0.05**
Factor Intensity	0.37	0.65

The analysis is based on daily total returns in USD from 21-Jun-2002 (base date of SciBeta indices) to 31-Dec-2018. Yield on Secondary US Treasury Bills (3M) is used as a proxy for the risk-free rate. The regression is based on weekly total returns. The Market factor is the excess return series of the cap-weighted index over the risk-free rate. The cap-weighted index is the SciBeta USA Cap-Weighted. The other six factors are equal-weighted daily-rebalanced factors obtained from Scientific Beta and are beta-adjusted every quarter with their realised CAPM beta. Coefficients significant at 5% p-value are highlighted in bold. The smart factor indices used are the SciBeta USA Low Volatility Diversified Multi-Strategy and the SciBeta USA High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy).

To obtain more exposure to the desired factor tilt, we also have an alternative process, which starts with a narrower stock selection, which contains only 30% of stocks in the entire universe, and filters out a smaller number of stocks, leaving 20% of stocks compared to the starting investment universe at the end of the process (see Exhibit 2c). The Narrow HFI filter corresponds to investors favouring the highest factor exposure to a desired factor tilt.

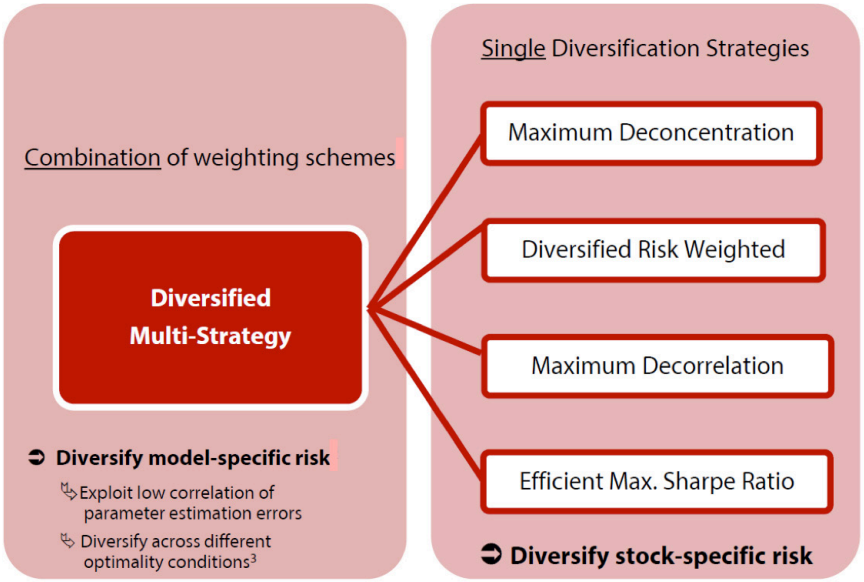
1. A Robust Smart Factor Design

Exhibit 2c – Stock selection with Narrow HFI filter

1.2. Diversification Weighting Scheme

Selecting stocks based on factor characteristics is only the first step of the Smart Beta 2.0 framework. The second step consists in diversifying away idiosyncratic risks to obtain a well-diversified portfolio and the highest possible risk-adjusted performance. To achieve this objective, we need to choose a diversifying weighting scheme.

Exhibit 3 – Multi-Strategy diversification scheme



Scientific Beta's approach is to combine four different weighting schemes, as explained in Exhibit 3, in order to diversify model risks. The diversified multi-strategy weighting scheme equally weights the following strategies: efficient maximum Sharpe ratio, maximum deconcentration, maximum decorrelation and diversified risk-weighted. Amenc et al. (2015) show that diversifying across different models improve the robustness of smart beta strategies, because the risk of choosing one specific weighting scheme is not rewarded.

Since each weighting scheme is different in terms of parameter estimation risk and optimality risk, investors can improve the diversification of model risks by combining several weighting schemes

1. A Robust Smart Factor Design

and avoid, for instance, the high sensitivity of minimum volatility approaches to the estimation of risk parameters.

1.3. Scientific Beta Defensive Offering Design

Scientific Beta's offering design is aimed at providing investors a defensive profile, i.e. a lower volatility compared to the cap-weighted index as well as a protection in bear markets. Moreover, we want to offer them different choices that will fit with their various investment objectives. Indeed, some investors might be interested to have the lowest volatility and the highest protection in bear markets without any regards for tracking error. Others might want to have the smallest volatility while keeping a low tracking error, whereas some investors might want to have a good volatility reduction and protection in bear markets but with the highest possible risk-adjusted returns.

Therefore, our defensive offering relies on three different indices that will give different level of exposure to the Low Volatility factor, and consequently different level of defensiveness, factor intensity, risk-adjusted performance and relative risks, to fit investors' preferences.

1.3.1. High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy)

This is the flagship index of the offering (hereafter the "standard HFI index"). Its design is similar to our flagship multi-beta multi-strategy offering. Its construction follows the one described in Exhibit 2a. It seeks an exposure to the Low Volatility factor through the selection of 50% of stocks of the universe with the lowest volatility. The use of the HFI filter, which allows to take into account the negative factor interaction between factors, removes 40% stocks with the lowest multi-factor scores (based on Value, Momentum, Low Volatility, High Profitability and Low investment scores), leading to a final selection of 30% of the size of the original universe. Finally, we apply the diversified multi-strategy weighting scheme described in Section 1.2 to diversify away idiosyncratic risks. This index is aimed at investors seeking the highest risk-adjusted performance with a high factor intensity and a good reduction of volatility and protection in bear markets compared to the cap-weighted index.

1.3.2. High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral)

It is well known that smart factors are exposed to implicit risks (see Shirbini, 2018) and in particular sector risks (see Aguet et al. 2018) that can have important consequences on short-term performances. Therefore, the design of this index (called sector neutral HFI index in the rest of the paper) is similar to our standard HFI index but with an additional sector neutral objective, to control sector risks and reduce relative risks like tracking error. The index seeks an exposure to the Low Volatility factor through the selection, within each sector, of 50% of stocks with the lowest volatility. The use of the HFI filter, which allows to take into account the negative factor interaction between factors, removes 40% stocks with the lowest multi-factor scores, leading to a final selection of 30% of the size of the original universe. Finally, we apply the diversified multi-strategy weighting scheme described in Section 1.2 to diversify away idiosyncratic risks. The index is aimed at investors that

1. A Robust Smart Factor Design

cares about tracking error or relative risks, while seeking a reduction of volatility and protection in bear markets relative to the cap-weighted index. Obviously, the sector neutrality objective, since it reduces the distance of the smart factor to the cap-weighted index, has a cost. Indeed, the exposure to the Low Volatility factor and the overall factor intensity of the index will be weaker than without sector neutrality, which is the case of the standard HFI index. Nevertheless, its benefits reside in a lower tracking error, higher information ratio and low exposures to macroeconomic factors and in particular to interest rate risks.

1.3.3. Narrow High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy)

The construction of this index (hereafter referred to as the "Narrow HFI index") seeks a strong exposure to the Low Volatility factor through the selection of 30% of stocks (narrow selection) of the universe with the lowest volatility (see Exhibit 2c). The use of the HFI filter, which allows to take into account the negative factor interaction between factors, removes one-third of stocks with the lowest multi-factor scores, leading to a final selection of 20% of the size of the original universe. Finally, we apply the diversified multi-strategy weighting scheme described in Section 1.2 to diversify away idiosyncratic risks. This index is aimed at investors seeking the highest exposure to the Low Volatility factor to obtain the highest reduction of volatility compared the cap-weighted index and obtain the highest protection in bear markets, while having a strong factor concentration, a high tracking error and strong losses in bull markets. Nonetheless, we highlight that the use of the HFI filter avoids a factor over concentration, which is the risk of traditional high concentrated minimum volatility portfolio, and maintains a relatively good factor intensity.

2. High Risk-Adjusted Performance and Strong Volatility Reduction

2. High Risk-Adjusted Performance and Strong Volatility Reduction

Due to the combination of the HFI filter and the stock selection based on low volatility, our defensive indices offer very good risk-adjusted performances and strong volatility reductions compared to the cap-weighted index, as seen in Exhibit 4. Indeed, we observe in Panel A (US universe) that our indices have Sharpe ratios ranging from 0.59 to 0.64, which corresponds to an improvement of 60% and 74% compared to the cap-weighted index and 20% and 31% compared to the MSCI Minimum Volatility index. The volatility reductions are ranging from 15% and 25% whereas the MSCI index offers a reduction of 17%, which is only slightly higher than our sector neutral HFI index. Due to the good overall factor intensity, that avoids factor concentration issues, and the diversification of specific risk, we observe a reduction in extreme risks, since maximum drawdown and extreme 3-Year rolling volatility statistics are strongly reduced in comparison to the cap-weighted index. We also highlight that extreme risk statistics of our three defensive indices are better than the MSCI index.

Exhibit 4 – Absolute performance of SciBeta Defensive offering and MSCI Minimum Volatility on SciBeta USA and SciBeta Developed universes.

21-Jun-2002 to 31-Dec-2018 (RI/USD)	CW Index	Standard HFI	Sector Neutral HFI	Narrow HFI	MSCI Min Vol
Panel A - SciBeta USA					
Ann. Returns	8.14%	10.80%	10.60%	9.85%	8.87%
Ann. Volatility	18.61%	14.80%	15.81%	13.96%	15.51%
Volatility Reduction	-	-21%	-15%	-25%	-17%
Sharpe Ratio	0.37	0.64	0.59	0.62	0.49
Sortino Ratio	0.52	0.92	0.84	0.87	0.69
Max Drawdown	54.6%	43.5%	46.3%	43.1%	46.6%
Extreme 3Y Rolling Volatility	40.9%	31.9%	33.6%	30.2%	35.0%
Panel B - SciBeta Developed					
Ann. Returns	7.40%	10.65%	10.21%	10.17%	8.39%
Ann. Volatility	15.51%	12.10%	12.75%	11.44%	11.54%
Volatility Reduction	-	-35%	-31%	-39%	-38%
Sharpe Ratio	0.40	0.78	0.70	0.78	0.62
Sortino Ratio	0.55	1.08	0.98	1.08	0.86
Max Drawdown	57.1%	46.2%	47.4%	44.3%	47.7%
Extreme 3Y Rolling Volatility	32.3%	25.2%	26.5%	24.0%	25.6%

The analysis is based on daily total returns in USD from 21-Jun-2002 (base date of SciBeta indices) to 31-Dec-2018. All statistics are annualised. Yield on Secondary US Treasury Bills (3M) is used as a proxy for the risk-free rate. The smart factor indices used are the SciBeta USA High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta USA High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral), SciBeta USA Narrow High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta Developed High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta Developed High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral) and the SciBeta Developed Narrow High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy). The cap-weighted indices are the SciBeta USA Cap-Weighted and the SciBeta Developed Cap-Weighted.

We have similar conclusions on Panel B (Developed universe). Indeed, we observe that our indices have Sharpe ratios ranging from 0.70 to 0.78, which corresponds to an improvement of 77% and 97% compared to the cap-weighted index and 14% and 26% compared to the MSCI Minimum Volatility index. The volatility reductions are ranging from 31% and 39%, which are in the same range as the MSCI index (reduction of 38%). We also observe a reduction in extreme risks, since maximum

2. High Risk-Adjusted Performance and Strong Volatility Reduction

drawdown and extreme 3-Year rolling volatility statistics are strongly reduced in comparison to the cap-weighted index.

Overall, our three defensive indices have very clear behaviour. The standard HFI index offers a similar level of volatility reduction as the MSCI Minimum Volatility index, but with a much higher Sharpe ratio, which is the highest of our offering. The sector neutral HFI index offers the weakest volatility reduction and the smallest Sharpe ratio of our offering because its objective is to control sector risks and therefore improve relative risks (we will discuss this point in Section 4). Nonetheless, it offers only a slightly lower volatility reduction than the MSCI Minimum Volatility index (-15% vs -17% on US universe and -31% vs -38% on Developed universe) but with a higher Sharpe ratio (+20% on US and +14% on Developed universe). Finally, the Narrow HFI index offers the highest volatility reduction and the lowest level of extreme risks, which is its main objective. Moreover, it delivers slightly reduced Sharpe ratio as our standard HFI index.

2. High Risk-Adjusted Performance and Strong Volatility Reduction

3. High Factor Intensity and Good Factor Deconcentration

3. High Factor Intensity and Good Factor Deconcentration

The very good risk-adjusted performance of our defensive indices finds its roots in factor intensity. Indeed, we observe in Exhibit 5 that our indices have much higher factor intensities than the MSCI Minimum Volatility index while having a good exposure to the Low Volatility factor. This is the main benefit of the HFI filter that we use in our construction process.

Exhibit 5 – Factor exposures of SciBeta Defensive offering and MSCI Minimum Volatility on SciBeta USA and SciBeta Developed universes.

21-Jun-2002 to 31-Dec-2018 (RI/USD)	Standard HFI	Sector Neutral HFI	Narrow HFI	MSCI Min Vol
Panel A - SciBeta USA				
Ann. Unexplained	0.01	**0.02**	0.00	0.00
Market Beta	**0.79**	**0.86**	**0.72**	**0.81**
SMB* Beta	**0.07**	**0.05**	**0.06**	**0.05**
HML* Beta	**0.10**	**0.15**	**0.12**	-0.04
MOM* Beta	**0.06**	**0.07**	**0.04**	**-0.02**
Low Vol* Beta	**0.29**	**0.16**	**0.41**	**0.32**
High Prof* Beta	**0.08**	**0.08**	0.00	**-0.04**
Low Inv* Beta	**0.05**	0.01	0.01	**-0.06**
R Sqrd	95.9%	96.6%	94.6%	95.6%
Factor Intensity (Int)	0.65	0.52	0.65	0.19
Factor Deconc. (ENF)	3.81	4.36	2.28	0.34
Factor Exp. Quality (Int x ENF)	2.47	2.24	1.48	0.06
Panel B - SciBeta Developed				
Ann. Unexplained	0.01	0.01	0.00	-0.01
Market Beta	**0.77**	**0.82**	**0.72**	**0.71**
SMB* Beta	**0.09**	**0.08**	**0.08**	**0.10**
HML* Beta	**0.08**	**0.13**	**0.07**	**-0.12**
MOM* Beta	**0.05**	**0.07**	**0.04**	**-0.05**
Low Vol* Beta	**0.32**	**0.22**	**0.44**	**0.42**
High Prof* Beta	**0.08**	**0.08**	0.00	-0.05
Low Inv* Beta	0.03	-0.03	-0.02	-0.04
R Sqrd	97.5%	98.0%	96.8%	94.5%
Factor Intensity (Int)	0.65	0.56	0.60	0.26
Factor Deconc. (ENF)	3.33	3.69	1.78	0.33
Factor Exp. Quality (Int x ENF)	2.18	2.08	1.07	0.09

The analysis is based on daily total returns in USD from 21-Jun-2002 (base date of SciBeta indices) to 31-Dec-2018. All statistics are annualised. Yield on Secondary US Treasury Bills (3M) is used as a proxy for the risk-free rate. The regression is based on weekly total returns. The Market factor is the excess return series of the cap-weighted index over the risk-free rate. The cap-weighted indices are the SciBeta USA Cap-Weighted and the SciBeta Developed Cap-Weighted. The other six factors are equal-weighted daily-rebalanced factors obtained from Scientific Beta and are beta-adjusted every quarter with their realised CAPM beta. Coefficients significant at 5% p-value are highlighted in bold. The Factor Deconcentration (ENF) statistic is the inverse of the sum of squared of normalized factor betas, where the latter is the factor beta divided by the sum of factor betas. The Factor Exposure Quality is the multiplication of the Factor Intensity and the Factor Deconcentration. The smart factor indices used are the SciBeta USA High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta USA High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral), SciBeta USA Narrow High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta Developed High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta Developed High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral) and the SciBeta Developed Narrow High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy).

3. High Factor Intensity and Good Factor Deconcentration

In Panel A (US universe), we observe that factor intensities of our indices are ranging between 0.52 to 0.65, which is an improvement of 166% and 236% compared to the MSCI Minimum Volatility index. Exposures to the Low Volatility factor are ranging between 0.16, for the sector neutral HFI index to 0.41 for the Narrow HFI index. In between, we find the standard HFI index with an exposure of 0.29. The sector neutrality objective explains the low exposure of the sector neutral index, which dilutes the Low Volatility exposure. Nevertheless, the index is still well exposed to other rewarded risk factors and therefore has a good factor intensity. We highlight that our indices have no negative exposures to any rewarded risk factors whereas the MSCI Minimum Volatility index has negative exposures that are statistically significant to Momentum, High Profitability and Low Investment, which translates into a poor factor intensity of only 0.19. Moreover, its Low Volatility exposure is similar to our standard HFI index but 20% lower than our Narrow HFI index. The factor deconcentration, which is the effective number of factor to which the index is exposed and the factor exposure quality are much higher for our indices than the MSCI index, which is the result of better exposures to rewarded risk factors. Finally, the level of market beta exposures reflect the defensiveness of our indices. The Narrow HFI index, which has the highest Low Volatility exposure has also the lowest market beta exposure (0.72), explaining why it has the highest level of volatility reduction (Exhibit 4). Our sector neutral index has the highest market beta exposure (0.86) and is therefore the least defensive index of our offering but its objective is to reduce relative risks compared to the cap-weighted index, so it was expected. Finally, our standard HFI index has a market beta exposure of 0.79, which is similar to the MSCI Minimum Volatility index.

We have similar conclusion on Panel B (Developed universe). Indeed, we observe that factor intensities of our indices are ranging from 0.56 to 0.65, which is an improvement of 115% to 150% compared to the MSCI Minimum Volatility index. Exposures to the Low Volatility factor are ranging between 0.22, for the sector neutral HFI index to 0.44 for the Narrow HFI index. In between, we find the standard HFI index with an exposure of 0.32. We highlight that our indices have almost no negative exposures to any rewarded risk factors whereas the MSCI Minimum Volatility index has negative exposures that are statistically significant to Value and Momentum, which translates into a poor factor intensity of only 0.26. The factor deconcentration and the factor exposure quality are much higher for our indices than the MSCI index, which is the result of better exposures to rewarded risk factors. In terms of market beta exposures, the Narrow HFI index has the lowest one (0.72), which is similar to the MSCI Minimum Volatility index. Our sector neutral index has the highest market beta (0.82) because of the sector neutrality objective. Finally, our standard HFI index has a market beta exposure of 0.77, which unlike to the US universe is higher than the MSCI index.

3. High Factor Intensity and Good Factor Deconcentration

4. High Information Ratio and Robustness of Outperformance

4. High Information Ratio and Robustness of Outperformance

Our defensive offering has very good relative performance compared to the cap-weighted index as well as strong probability of outperformance as seen in Exhibit 6. Indeed, we observe in Panel A (US universe) that our indices have information ratios ranging from 0.23, for our Narrow HFI index, to 0.54 for our sector neutral HFI index. These numbers are much higher than the MSCI Minimum Volatility index, which delivers an information ratio of only 0.14. The probabilities of outperformance for each horizon are also much better for our indices, which demonstrates the robustness of our construction process based on the Smart Beta 2.0 framework. The sector neutral HFI index clearly exhibits the best relative statistics, since it is one of its objective to reduce the distance to the cap-weighted index. It exhibits the strongest probabilities of outperformance for the 1-Year and 3-Year horizon and the lowest maximum relative drawdown. The standard HFI index has a good information ratio, which is more than 200% higher than the MSCI index with only a slightly higher tracking error. It also exhibits high probabilities of outperformance, especially at the 5-Y horizon and has weaker extreme risks than the MSCI index (11.9% vs 13.7%). Finally, the Narrow HFI index has logically the highest tracking error. Indeed, its objective is to achieve the strongest volatility reduction relative to the cap-weighted index, this is only possible with a high tracking error. Consequently, it also delivers the smallest information ratio (0.23) and the lowest probabilities of outperformance of our offering. Nevertheless, except for tracking error and maximum relative drawdown, it has better statistics than the MSCI index. This means that for a lower level of absolute risk, the Narrow HFI index delivers a better relative performance compared to the MSCI index.

Exhibit 6 – Relative performance of SciBeta Defensive offering and MSCI Minimum Volatility on SciBeta USA and SciBeta Developed universes.

21-Jun-2002 to 31-Dec-2018 (RI/USD)	Standard HFI	Sector Neutral HFI	Narrow HFI	MSCI Min Vol
Panel A - SciBeta USA				
Ann. Rel. Returns	2.66%	2.46%	1.71%	0.73%
Ann. Tracking Error	6.04%	4.56%	7.48%	5.25%
Information Ratio	0.44	0.54	0.23	0.14
Max Rel. DD	11.9%	9.5%	17.7%	13.7%
Outperf Prob (1Y)	65.10%	69.30%	52.65%	48.09%
Outperf Prob (3Y)	91.09%	92.08%	81.75%	67.47%
Outperf Prob (5Y)	96.02%	91.38%	82.42%	68.49%
Panel B - SciBeta Developed				
Ann. Rel. Returns	3.24%	2.81%	2.76%	0.99%
Ann. Tracking Error	4.89%	3.89%	5.93%	6.04%
Information Ratio	0.66	0.72	0.47	0.16
Max Rel. DD	10.8%	9.0%	15.0%	17.3%
Outperf Prob (1Y)	65.60%	72.38%	57.34%	46.61%
Outperf Prob (3Y)	97.88%	99.15%	88.40%	68.32%
Outperf Prob (5Y)	100.00%	100.00%	95.19%	71.97%

The analysis is based on daily total returns in USD from 21-Jun-2002 (base date of SciBeta indices) to 31-Dec-2018. All statistics are annualised. Yield on Secondary US Treasury Bills (3M) is used as a proxy for the risk-free rate. The smart factor indices used are the SciBeta USA High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta USA High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral), SciBeta USA Narrow High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta Developed High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta Developed High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral) and the SciBeta Developed Narrow High-Factor-Intensity Low Volatility Diversified Multi-Strategy (4-Strategy). The cap-weighted indices are the SciBeta USA Cap-Weighted and the SciBeta Developed Cap-Weighted.

4. High Information Ratio and Robustness of Outperformance

We have even stronger conclusions on Panel B (Developed universe). Indeed, we observe that our indices have information ratios ranging from 0.47, for our Narrow HFI index, to 0.72 for our sector neutral HFI index. These numbers are much higher than the MSCI Minimum Volatility index, which delivers an information ratio of only 0.16 (very similar to Panel A). The probabilities of outperformance for each horizon are also much higher for our indices. They reach 100% at the 5-Year horizon for our standard HFI and sector neutral HFI indices and are very close to 100% at the 3-Year horizon. These numbers again demonstrate the robustness of our construction process. The sector neutral HFI index clearly exhibits the best relative statistics, since it has the highest information ratio (+342% compared to the MSCI index), the strongest probabilities of outperformance at each horizon, the lowest maximum relative drawdown and the lowest tracking error (which is 36% lower than the MSCI index). The standard HFI index has a good information ratio, which is more than 305% higher than the MSCI index with even a smaller tracking error (-19%) and weaker maximum relative drawdown (10.8% versus 17.3%). Finally, the Narrow HFI index has the smallest information ratio and probabilities of outperformance and the highest relative risks of our offering, but its statistics are still better in comparison to the MSCI index.

4. High Information Ratio and Robustness of Outperformance

5. Good Protection in Distressed Markets

5. Good Protection in Distressed Markets

Conditional performance is an interesting tool to assess the robustness of smart beta strategies. Indeed, they are, by construction, more or less dependent to some market or macro regimes. Defensive solutions provide, by construction, protection in bear markets, therefore there relative returns should be highly sensitive to market regimes.

In this section, we analyse the conditional performance of our offering given three different types of regimes: bull/bear market return regimes, low/high volatility market regimes and bull/bear Low Volatility return regimes.

Exhibit 7 – Relative conditional performance based on bull/bear market return regimes of SciBeta Defensive offering and MSCI Minimum Volatility on SciBeta USA and SciBeta Developed universes.

21-Jun-2002 to 31-Dec-2018 (RI/USD)	Standard HFI	Sector Neutral HFI	Narrow HFI	MSCI Min Vol
Panel A - SciBeta USA				
Bull Rel. Ret	-5.26%	-2.43%	-9.59%	-8.33%
Bear Rel. Ret	10.79%	7.23%	13.97%	10.40%
Rel. Bull/Bear Spread	**-16.04%**	**-9.66%**	**-23.56%**	**-18.73%**
Panel B - SciBeta Developed				
Bull Rel. Ret	-5.81%	-3.90%	-9.45%	-12.80%
Bear Rel. Ret	11.24%	8.54%	14.06%	14.09%
Rel. Bull/Bear Spread	**-17.05%**	**-12.45%**	**-23.51%**	**-26.89%**

The analysis is based on daily total returns in USD from 21-Jun-2002 (base date of SciBeta indices) to 31-Dec-2018. All statistics are annualised. Yield on Secondary US Treasury Bills (3M) is used as a proxy for the risk-free rate. Bull regimes are defined as months with positive performance of the cap-weighted index. Bear regimes are defined as months with negative performance of the cap-weighted index. Coefficients significant at 5% p-value are highlighted in bold. The smart factor indices used are the SciBeta USA High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta USA High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral), SciBeta USA Narrow High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta Developed High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta Developed High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral) and the SciBeta Developed Narrow High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy). The cap-weighted indices are the SciBeta USA Cap-Weighted and the SciBeta Developed Cap-Weighted.

We start the analysis with bull/bear market regimes conditional analysis (see Exhibit 7). We first observe a clear asymmetry of relative returns compared to the cap-weighted index, since they are negative in bull markets and positive in bear markets while they are much higher in magnitude in bear markets. This is the typical characteristics of defensive strategies.

The Narrow HFI index provides, as expected, the strongest protection in bear markets, since its relative return stands at +13.97% on US and +14.06% on Developed, but it also provides the lowest relative return in bull markets (-9.59% and -9.45% on US and Developed universes respectively).

The standard HFI index offers also a good protection in bear markets, since its relative return stands at +10.79% on US, which is similar to the MSCI Minimum Volatility index (+10.4%) and +11.24% on Developed, which is slightly lower than the MSCI index (+14.09%). However, in bull markets, the index loses only -5.26% relative to the cap-weighted index on US and -5.81% on Developed, which is much better than the MSCI index (relative loss of -8.33% and -12.8% on US and Developed universes respectively).

5. Good Protection in Distressed Markets

Finally, the sector neutral HFI index provides the lowest level of protection in bear markets with a relative returns standing at +7.23% on US and +8.54% on Developed. Note that the protection is still interesting since it is only 33% and 24% lower than the standard HFI index, on both. In bull markets, the index loses only -2.43% compared to the cap-weighted index on US and -3.9% on Developed.

As expected, the sector neutral HFI index delivers the lowest protection in bear markets and is, as expected, less sensitive to market regimes, since it provides the smallest bull/bear spread relative return of all indices. At the opposite, the Narrow HFI index offers the highest protection in bear markets and suffers important relative losses in bull markets. The standard HFI index is a good compromise, since it provides good level of protection in bear markets, almost as high as the Narrow HFI index and has more controlled relative losses in bull markets. Moreover, for the same level of protection in bear markets if suffers smaller relative losses in bull markets than the MSCI index, due to its better factor intensity.

Exhibit 8 – Relative conditional performance based on bull/bear market volatility regimes of SciBeta Defensive offering and MSCI Minimum Volatility on SciBeta USA and SciBeta Developed universes.

21-Jun-2002 to 31-Dec-2018 (RI/USD)	Standard HFI	Sector Neutral HFI	Narrow HFI	MSCI Min Vol
Panel A - SciBeta USA				
LVol Rel. Ret	-2.35%	-0.87%	-6.16%	-7.08%
HVol Rel. Ret	6.55%	5.05%	7.96%	6.99%
Rel. LVol/HVol Spread	**-8.90%**	**-5.92%**	**-14.12%**	**-14.06%**
Panel B - SciBeta Developed				
LVol Rel. Ret	-1.84%	-0.77%	-4.24%	-7.63%
HVol Rel. Ret	7.26%	5.63%	8.36%	7.95%
Rel. LVol/HVol Spread	**-9.10%**	**-6.40%**	**-12.60%**	**-15.59%**

The analysis is based on daily total returns in USD from 21-Jun-2002 (base date of SciBeta indices) to 31-Dec-2018. All statistics are annualised. Yield on Secondary US Treasury Bills (3M) is used as a proxy for the risk-free rate. Months in which the volatility of the cap-weighted index is greater than the median volatility across all months are classified as high volatility regimes. Months in which the volatility of the cap-weighted index is lower than the median volatility across all months are classified as low volatility regimes. Coefficients significant at 5% p-value are highlighted in bold. The smart factor indices used are the SciBeta USA High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta USA High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral), SciBeta USA Narrow High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta Developed High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta Developed High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral) and the SciBeta Developed Narrow High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy). The cap-weighted indices are the SciBeta USA Cap-Weighted and the SciBeta Developed Cap-Weighted.

Next, we analyse the performance of our indices in low and high volatility market regimes (see Exhibit 8). As in Exhibit 7, we observe the same asymmetry of relative returns between low volatile and high volatile regimes, which is consistent with the defensive bias of the indices. The Narrow HFI index offers the highest protection in high volatile markets since its relative return stands at +7.96% on US and +8.36% on Developed, but delivers the lowest relative return of our offering in low volatile markets (-6.16% and -4.24% on US and Developed). Nevertheless, we highlight that the MSCI Minimum Volatility index does even worse with a relative loss of -7.08% in low volatile markets on the US universe and -7.63% on Developed.

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The standard HFI index provides a good level of protection in high volatile markets since its relative return stands at +6.55% on US and +7.26% on Developed, which is similar to the MSCI index (+6.99% and +7.95% on US and Developed). In low volatile markets, it loses -2.35% compared to the cap-weighted index on US and -1.84% on Developed, which is much better than the MSCI index (relative loss of -7.08% and -7.63% on US and Developed universes respectively).

The sector neutral HFI index has the lowest protection in high volatile markets with a relative return of +5.05% on US and +5.63% on Developed, which is only 23% lower than the standard HFI index on both universes and has the smallest relative loss in low volatile markets (-0.87% on US and -0.77% on Developed).

These results are similar with the bull/bear market return regimes analysis. The sector neutral HFI index delivers the lowest protection in low volatile markets but its relative performance is less conditional to market volatility regimes. At the opposite, the Narrow HFI index offers the strongest protection in high volatile markets and suffers important relative losses in low volatile markets. The standard HFI index is again a good compromise, since it provides good level of protection in high volatile market regimes, almost as high as the Narrow HFI index and suffers much smaller relative losses in low volatile markets. Moreover, for the same level of protection in high volatile markets if suffers lower relative losses in low volatile markets than the MSCI index, due to its better factor intensity.

Exhibit 9 – Absolute conditional performance based on bull/bear Low Volatility return regimes of SciBeta Defensive offering and MSCI Minimum Volatility on SciBeta USA and SciBeta Developed universes.

21-Jun-2002 to 31-Dec-2018 (RI/USD)	Standard HFI	Sector Neutral HFI	Narrow HFI	MSCI Min Vol
Panel A - SciBeta USA				
Bull Ret	14.83%	10.48%	17.39%	14.13%
Bear Ret	5.16%	10.76%	-0.29%	1.63%
Bull/Bear Spread	9.67%	-0.27%	**17.68%**	12.50%
Panel B - SciBeta Developed				
Bull Ret	13.73%	10.78%	15.70%	13.58%
Bear Ret	5.33%	9.21%	0.91%	-0.32%
Bull/Bear Spread	8.41%	1.58%	**14.79%**	**13.90%**

The analysis is based on daily total returns in USD from 21-Jun-2002 (base date of SciBeta indices) to 31-Dec-2018. All statistics are annualised. Yield on Secondary US Treasury Bills (3M) is used as a proxy for the risk-free rate. Bull regimes are defined as months with positive performance of the Low Volatility index. Bear regimes are defined as months with negative performance of the Low Volatility index. Extreme Bull regimes are the top 50% of bull months. Extreme Bear regimes are the bottom 50% of bear months. Coefficients significant at 5% p-value are highlighted in bold. The smart factor indices used are the SciBeta USA High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta USA High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral), SciBeta USA Narrow High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta Developed High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta Developed High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral) and the SciBeta Developed Narrow High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy). The cap-weighted indices are the SciBeta USA Cap-Weighted and the SciBeta Developed Cap-Weighted.

Finally, in Exhibit 9, we show absolute performance of the different indices conditional on the returns of the Low Volatility factor. We observe that, as expected, the Narrow HFI index has the highest return in bull Low Volatility factor regimes (+17.39% and +15.7% on US and Developed) and very low

5. Good Protection in Distressed Markets

return compared to all other indices in bear Low Volatility factor regimes (-0.29% on US and +0.91% Developed). The bull/bear spread return is high, which means that the index is highly conditional on the Low Volatility factor regimes. The standard HFI index has a return of +14.83% in bull Low Volatility factor regimes on US and +13.73% on Developed, which is similar to the MSCI Minimum Volatility index. However, it delivers a return of +5.16% in bear Low Volatility factor regimes on US and +5.33% on Developed, which is much better compared to the MSCI index (+1.63% and -0.32% on US and Developed). The sector neutral HFI index has a very low conditionality to the factor return regimes, since it delivers almost the same returns in both bull and bear Low Volatility factor regimes and exhibits very low conditional spread returns (-0.27% on US and +1.58% on Developed).

As expected, the sector neutral HFI index has a low conditionality to the Low Volatility return regimes because of its sector neutrality objective that dilutes its exposures to the factor, unlike the Narrow HFI index, which exhibits the highest conditionality. The standard HFI index is again a good compromise, since it delivers a good performance in bull regimes (similar to the MSCI index) and a positive return in bear regimes, which is much higher relative to the MSCI index. The latter is possible because the standard HFI index has a high factor intensity since it has positive exposures to other rewarded risk factors.

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6. Low Sensitivity to Macroeconomic Factors

6. Low Sensitivity to Macroeconomic Factors

In this section, we analyse the sensitivity of our defensive indices to three different macroeconomic indicators:

- T-Bill or short-term rates – which reflects inflation expectations
- Term spread – which reflects monetary policy expectations
- Credit spread – which reflects risk aversion

Exhibit 10 – Macroeconomic sensitivity of SciBeta Defensive offering and MSCI Minimum Volatility on SciBeta USA and SciBeta Developed universes.

21-Jun-2002 to 31-Dec-2018 (RI/USD)	Standard HFI	Sector Neutral HFI	Narrow HFI	MSCI Min Vol
Panel A - SciBeta USA				
Unexplained	**0.00**	**0.00**	**0.00**	0.00
Market Beta	**0.78**	**0.85**	**0.71**	**0.80**
T-Bill	0.05	-0.01	-0.32	**-0.79**
Term Spread	**-1.48**	-0.46	**-1.80**	**-2.13**
Credit Spread	-0.23	-0.09	0.11	0.18
R Sqrd	91.0%	95.1%	84.5%	91.2%
Panel B - SciBeta Developed				
Unexplained	**0.00**	**0.00**	**0.00**	**0.00**
Market Beta	**0.76**	**0.82**	**0.71**	**0.70**
T-Bill	-0.11	-0.08	-0.32	**-0.65**
Term Spread	**-1.29**	**-0.73**	**-1.63**	**-2.39**
Credit Spread	-0.09	0.04	0.26	0.48
R Sqrd	93.5%	96.3%	89.3%	88.1%

The analysis is based on daily total returns in USD from 28-Jun-2002 (base date of SciBeta indices) to 28-Dec-2018. All statistics are annualised and regressions are based on weekly total returns in USD. The yield differential of Secondary US Treasury Bills (3M) is used as a proxy for the T-Bill Factor. Term Spread factor is the difference in yield differential of 10-year US Treasury Bonds and yield differential of 3-year US Treasury Bonds. The Market factor is the excess return series of the cap-weighted index over the risk-free rate. Credit Spread factor is the difference in yield differential of BAA Corporate bonds and AAA Corporate bonds. Coefficients significant at 5% p-value are highlighted in bold. The smart factor indices used are the SciBeta USA High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta USA High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral), SciBeta USA Narrow High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta Developed High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta Developed High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral) and the SciBeta Developed Narrow High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy).

Defensive strategies tend to overweight defensive sectors, like Utilities. This sector has an exposure to interest rate risks for two main reasons. First, the sector has lower risks than global equities, meaning that in a low interest rates period, as it was the case over the last years (and is still the case currently), bond investors can have interests to invest in Utilities companies, since they provide higher yields than bonds through their high dividend payouts. This is the so-called bond-like feature of the Utilities sector. If bond yields increase, Utilities stocks become less attractive and bond investors sell their investments. This negatively impacts stock prices and therefore returns. Second, utilities companies have high capital expenditures that cannot be solely financed by free cash flows and therefore require debt financing, which is cheaper than equity financing. In a rising rate environment, their interest payments will increase and have a negative impact on their earnings.

6. Low Sensitivity to Macroeconomic Factors

The latter will have a negative impact on their prices and returns. For these reasons, we can expect negative exposures of defensive solutions to T-Bill and Term spread factors.

Defensive strategies should be positively related to risk aversion and therefore to credit spread, which is a measure of financial distress. Indeed, we should expect spreads between BAA and AAA bonds to increase when market volatility increase. For this reason, we can expect positive exposures of defensive solutions to credit spreads.

We see in Exhibit 10 the different exposures of our defensive indices on the macroeconomic factors from which we can draw the following conclusions.

The sector neutral HFI index has the lowest exposures to the various macroeconomic factors and especially to interest risk factors because of its sector neutrality objective, which implies weak relative exposures to defensive sectors, like Utilities, that are negatively impacted by interest rate risks. We highlight that its exposure to the Term Spread factor is negative (-0.46 and -0.73 on US and Developed universes respectively), but is lower compared to the other indices of our offering and much reduced compared to the MSCI Minimum Volatility index. Defensive investors that are worried by a sudden increase in rates should favour this index.

The standard HFI index only significant exposure is to the Term Spread (-1.48 and -1.29 on US and Developed universes respectively). We highlight that while the index offers the same level of volatility reduction and protection in bear markets than the MSCI index, it offers much reduced exposure to macroeconomic factors and much better risk-adjusted performance. Indeed, the MSCI index has strong negative exposures to T-Bills and Term Spread factors. This is due its negative exposures to other rewarded risk factors, which results in a low factor intensity.

The Narrow HFI index has the highest macroeconomic factor exposures of our offering, especially to the Term Spread factor, because it has the strongest exposure to the Low Volatility factor. Nonetheless, while it provides a higher exposure to the Low Volatility factor than the MSCI index, it provides lower macroeconomic exposures, especially to interest rate risks than the latter. This is a confirmation that, when properly constructed, defensive strategies can limit exposures to interest rate risks, through positive exposures to other rewarded risk factors.

6. Low Sensitivity to Macroeconomic Factors

7. Conclusion

7. Conclusion

The design of Scientific Beta's defensive offering answers investors' needs for a reduction in volatility compared to the cap-weighted index and also offers capital protection in bear markets (see Exhibit 11). This is achieved through the Smart Beta 2.0 construction framework, which first selects stocks with low volatility, then applies an HFI filter to remove the stocks with the lowest multi-factor scores and finally diversifies away idiosyncratic risks with a diversified weighting scheme. This approach delivers high factor intensity and good long-term risk-adjusted performance, because it harvests the Low Volatility factor, which is known to provide an additional source of performance than the cap-weighted index over the long-term, while maintaining positive exposures to other rewarded risk factors, thanks to the use of the HFI filter. Moreover, Scientific Beta's top-down approach, gives investors the flexibility to select the solution that fits with their investment objectives by offering them three different versions of defensive indices.

Exhibit 11 – Recap of the key elements of our defensive offering

21-Jun-2002 to 31-Dec-2018 (RI/USD)	Standard HFI	Sector Neutral HFI	Narrow HFI	MSCI Min Vol
Panel A - SciBeta USA				
Volatility Reduction	-21%	-15%	-25%	-17%
Sharpe Ratio Improvement	74%	60%	67%	33%
Protection in Bear Markets	10.8%	7.2%	14.0%	10.4%
Factor Intensity	0.65	0.52	0.65	0.19
Tracking Error	6.0%	4.6%	7.5%	5.2%
Term Spread Exposure	**-1.48**	-0.46	**-1.80**	**-2.13**
Panel B - SciBeta Developed				
Volatility Reduction	-35%	-31%	-39%	-38%
Sharpe Ratio Improvement	96%	77%	96%	56%
Protection in Bear Markets	11.2%	8.5%	14.1%	14.1%
Factor Intensity	0.65	0.56	0.60	0.26
Tracking Error	4.9%	3.9%	5.9%	6.0%
Term Spread Exposure	**-1.29**	**-0.73**	**-1.63**	**-2.39**

The analysis is based on daily total returns in USD from 28-Jun-2002 (base date of SciBeta indices) to 28-Dec-2018. All statistics are annualised and regressions are based on weekly total returns in USD. The yield differential of Secondary US Treasury Bills (3M) is used as a proxy for the T-Bill Factor. Term Spread factor is the difference in yield differential of 10-year US Treasury Bonds and yield differential of 3-year US Treasury Bonds. Coefficients significant at 5% p-value are highlighted in bold. The smart factor indices used are the SciBeta USA High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta USA High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral), SciBeta USA Narrow High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta Developed High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy), SciBeta Developed High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral) and the SciBeta Developed Narrow High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy). The cap-weighted indices are the SciBeta USA Cap-Weighted and the SciBeta Developed Cap-Weighted.

The High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) index offers a good exposure to the Low Volatility factor and hence a good level of volatility reduction and protection in bear markets, similar to the popular benchmark like the MSCI Minimum Volatility index, while providing the highest factor intensity as well as the best risk-adjusted performance of our offering. This index is recommended for defensive investors with weak tracking error constraints that seek a solution, that is not only defensive, but that is also properly exposed to other rewarded risk factors to obtain the highest risk-adjusted return.

7. Conclusion

The High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) (Sector Neutral) index offers the lowest volatility reduction and protection in bear markets. Moreover, it delivers the smallest Sharpe ratio of our offering. Nonetheless, its additional objective is also to reduce tracking error through the sector neutrality objective. The objective is achieved, since the index delivers the lowest tracking error and the best information ratio of our offering. Moreover, it has low conditionality to market and macroeconomic factors in particular to T-Bills and Term-Spread factors. This index is recommended for defensive investors with tracking error constraints wanting to avoid negative relative performance in bull market regimes or in rallies of some sectors and that are worried by rising interest rates.

The Narrow High Factor Intensity Low Volatility Diversified Multi-Strategy (4-Strategy) index has the highest exposure to the Low Volatility factor and therefore delivers the strongest volatility reduction and offers the best protection in bear markets. The index is therefore designed for investors that seek the most defensive solution. Obviously, this high exposure to the Low Volatility factor comes with a cost, in the form of lower exposures to other rewarded risk factors, higher conditionality to various regimes, meaning important relative losses in bull markets for instance, and high tracking error. Moreover, it has the strongest sensitivity to macroeconomic factors of our offering and in particular to T-Bills and Term Spread factors. For Scientific Beta, this index should not be considered as a standalone solution, but rather as an overlay solution for investors willing to modify their portfolio's market beta or Low Volatility exposure, while simultaneously avoiding a reduction in the factor intensity of their existing portfolio thanks to the HFI filter.

To conclude, Scientific Beta's defensive offering is motivated by a strong belief that investors are not identical and that their investment objectives and constraints are different. This is why we believe that our top-down approach, which is simple and transparent, is the best approach for our clients. Finally, we offer risk control options (such as the sector neutrality objective) and concentrated selections (such as the narrow High Factor Intensity), which allows investors to explicitly define their preferences in terms of relative risks and level of defensiveness, which are often hidden by-products in defensives solutions offered by competitors. Whatever the defensive index chosen, the fact that they are part of the Scientific Beta smart factor indices ensures that they benefit from the same features as all the other indices we offer, namely the good diversification of unrewarded risks and the capacity to limit undesired risks. For investors, this is the guarantee that their choice will be the best possible.

7. Conclusion

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About Scientific Beta

About Scientific Beta

EDHEC-Risk Institute set up Scientific Beta in December 2012 as part of its policy of transferring know-how to the industry. Scientific Beta is an original initiative which aims to favour the adoption of the latest advances in "smart beta" design and implementation by the whole investment industry. Its academic origin provides the foundation for its strategy: offer, in the best economic conditions possible, the smart beta solutions that are most proven scientifically with full transparency of both the methods and the associated risks. Smart beta is an approach that deviates from the default solution for indexing or benchmarking of using market capitalisation as the sole criterion for weighting and constituent selection.

Scientific Beta considers that new forms of indices represent a major opportunity to put into practice the results of the considerable research efforts conducted over the last 30 years on portfolio construction. Although these new benchmarks may constitute better investment references than poorly-diversified cap-weighted indices, they nevertheless expose investors to new systematic and specific risk factors related to the portfolio construction model selected.

Consistent with a full control of the risks of investment in smart beta benchmarks, Scientific Beta not only provides exhaustive information on the construction methods of these new benchmarks but also enables investors to conduct the most advanced analyses of the risks of the indices in the best possible economic conditions.

Lastly, within the context of a Smart Beta 2.0 approach, Scientific Beta provides the opportunity for investors not only to measure the risks of smart beta indices, but also to choose and manage them. This new aspect in the construction of smart beta indices has led Scientific Beta to build the most extensive smart beta benchmarks platform available which currently provides access to a wide range of smart beta indices.

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