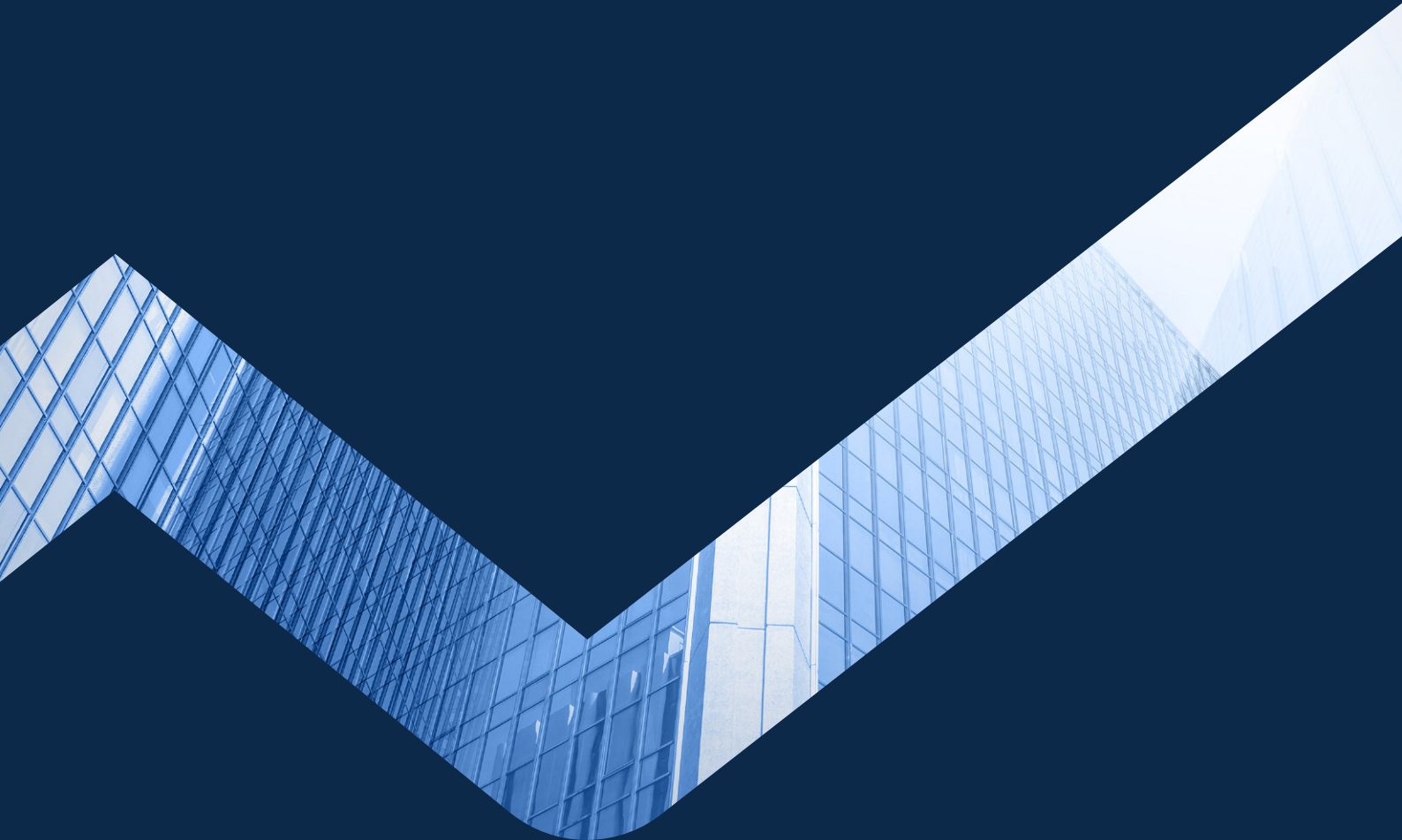# A Behind-the-scenes Look at the Design of the STOXX U.S. Equity Factor Index

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STOXX

Contents

1. Introduction

The STOXX Equity Factor indices, a range of Multifactor indices, offer exposure to fundamental drivers of performance such as Momentum, Quality, Value, Low Volatility and Size. The BlackRock-STOXX collaboration has led to the launch of 13 Multifactor indices:

- STOXX® U.S. Equity Factor
- STOXX® International Equity Factor[1]
- STOXX® Global Equity Factor[2]
- STOXX® Emerging Markets Equity Factor
- STOXX® U.S. Small-Cap Equity Factor
- STOXX® International Small-Cap Equity Factor[3]
- STOXX® Developed World Equity Factor
- STOXX® U.S. Equity Factor Base
- STOXX® Developed Europe Equity Factor Base
- STOXX® Developed World Equity Factor Base
- STOXX® U.S. Equity Factor Screened
- STOXX® Developed Europe Equity Factor Screened
- STOXX® Developed World Equity Factor Screened

across three index families:

- STOXX® STOXX Equity Factor indices
- STOXX® STOXX Equity Factor Base indices and
- STOXX® STOXX Equity Factor Screened indices

The collaboration between BlackRock and STOXX started in 2022 with the launch of the STOXX Equity Factor indices. The STOXX Equity Factor Base and Screened index families were launched in July 2024, with the Screened family comprising sustainable Multifactor indices with ESG exclusions and climate constraints. The first six indices in the list are the benchmark indices for six iShares ETFs listed in the United States, which aim to offer among the lowest management costs in the industry. These funds have amassed a combined USD 5.5 billion in assets.[4] The largest ETFs include:

- The iShares U.S. Equity Factor ETF (LRGF) tracking the STOXX U.S. Equity Factor index, with USD 2bn+ in AUM
- The iShares U.S. Small-Cap Equity Factor ETF (SMLF) tracking the STOXX U.S. Small-Cap Equity Factor index, with USD 1bn+ in AUM, and
- The iShares International Equity Factor ETF (INTF) tracking the STOXX International Equity Factor index, with USD 1bn+ in AUM

The STOXX Research Team has written about the STOXX Equity Factor indices previously in (Brown, 2021) and (Ang, et al., 2024). In this article, we take a "behind-the-scenes" look at the design of the STOXX U.S. Equity Factor index by focusing on the topics in the sections shown below:

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[1] This index covers developed markets.

[2] This index covers developed and emerging markets.

[3] The STOXX International Small-Cap Equity Factor and STOXX U.S. Small-Cap Equity Factor indices do not include Small Size as a target factor.

[4] Data as of June 28, 2024.

Section 2: Signal analysis presents the customized factor scoring methodology developed by STOXX in conjunction with BlackRock. Factor selection and definitions have a strong grounding in academic research, including a behavioral and economic rationale for the existence of a risk premium. In addition, we demonstrate the risk premium of a signal formed by combining the aforementioned factors by comparing the realized performance of quartile portfolios constructed from this composite signal.

Section 3: Investable Multifactor strategy presents the customized factor strategy, which again was developed by STOXX in conjunction with BlackRock. We demonstrate that we continue to harvest the factor premium in an investable and repeatable framework even after adding typical practitioner risk management, diversification, and liquidity constraints.

Section 4: Performance attribution adds transparency to the sophisticated quantitative portfolio construction process by showing, using factor-based performance attribution, that the realized performance of the STOXX U.S. Equity Factor index is due primarily to the components of the Multifactor signal.

Section 5: Conclusions includes a brief summary of the key contributions.

2. Signal analysis

The academic and practitioner community has documented Value, Momentum, Quality. Low Volatility and Small Size as systematic sources of long-term risk premia – see (Aghassi, Asness, Fattouche, & Moskowitz, 2023) and (Ang, Asset Management: A Systematic Approach To Factor Investing, 2014) for good surveys of these factors.

Approaches to defining and measuring factors can vary from investor to investor. The STOXX Equity Factor indices utilize 16 types of data (signals) which are combined to create the Momentum, Quality, Value, Low Volatility and Small Size factors. These five factors are, in turn, aggregated to create the Multifactor alpha signal that is maximized in the portfolio construction process.

2.1. Factor definitions

Momentum. The Momentum factor captures the inertial risk premium at which outperforming (underperforming) stocks will continue to outperform (underperform) in the near future. A recent survey of Momentum as a smart beta factor can be found in (Asness C., Frazzini, Israel, & Moskowitz, 2014). Our Momentum factor combines three signals:

1) Price Momentum (25%): the cumulative performance of the asset (stock) over the past year excluding the last month to control reversal effects as discussed in (Jegadeesh.N. & Titman, 1993).

2) Earnings Momentum Drift (50%): the sum of the idiosyncratic returns from the Axioma US4 Medium-Horizon model on the most recent earnings announcement date and the next business day measuring earnings announcement returns. Each stock's idiosyncratic return is return not attributed to the systematic factors in the Axioma risk model. Earnings Momentum Drift as a source of risk premium is discussed in (Jegadeesh & Livnat, 2006).

3) Earnings Momentum (25%): changes (up versus down) in analysts' 12-month earnings forecasts, given by the sum of the number of Earnings Per Share (EPS) upgrades for the current (FY1) and following (FY2) fiscal years minus the sum of the FY1 and FY2 EPS downgrades, divided by the number of FY1 AND FY2 EPS estimates. Earnings Momentum as a source of risk premium is discussed in (Chan & Jegadeesh, 1996).

Quality. The Quality factor emphasizes stocks that are profitable and demonstrate consistent earnings over time. Our Quality signal combines five traditional measures:

1) Gross Profitability (20%): the revenues minus the cost of goods sold divided by total assets as discussed in (Novy-Marx, 2013),

2) Accruals (Earnings Quality, 20%): the negative of the monthly change in operating assets minus the monthly change in total liabilities divided by the 36-month rolling average of total assets as discussed in (Sloan, 1996),

3) Changes in Net Operating Assets (20%): the negative of the monthly change in net operating assets divided by the 36-month rolling average of total assets as discussed in (Fairfield, Whisenant, & Yoh, 2003). Net operating assets are calculated as the monthly delta in operating assets (total liabilities minus cash) minus the monthly delta in liabilities (total liabilities minus debt).

4) Dilution (shares outstanding, 20%): the negative of the relative monthly change in total shares outstanding (adjusted for any corporate actions) as discussed in (Asquith & Mullins, 1986).

5) Sustainability metrics (carbon intensity and science-based targets, 20%), which are strongly correlated with Quality as shown in (Kazdin, Schwaiger, Wendt, & Ang, 2021).

Value. The Value factor emphasizes stocks that are underpriced relative to their fundamentals (such as their book-to-price or earnings-to-price ratios), with the expectation being that the stock price will revert to the higher price implied by the fundamentals in the near future. Value was the first smart beta factor to be discovered and a recent survey can be found in (Asness C., Frazzini, Isreal, & Moskowitz, 2015). Our Value factor combines five signals:

1) Book-to-Price (20%): the latest book value divided by the total market capitalization.

2) Earnings Yield (earnings-to-price, 20%): the latest 12-month net income divided by the total market capitalization.

3) Dividend Yield (dividends-to-price, 20%): the latest 12-month trailing dividend divided by the total market capitalization.

4) Cash Flow Yield (cash flow from operations-to-price, 20%): the latest 12-month cash flow divided by the total market capitalization.

5) Time Series Normalized Cash Flow Yield (20%): the time series valuations of the cash flow from operations relative to price.

The first four metrics examine whether a company is cheap compared to its peers, while the last metric compares the current valuation of the company to its own historical valuation to see whether it is cheaper than it was in the past.

Low Volatility. The Low Volatility factor emphasizes stocks that have lower volatility than the broader market, since such stocks have been shown to outperform their riskier counterparts over the long term. A recent survey of Low Volatility as a smart beta factor appears in (Van Vliet & de Koning, 2017) and (Alquist, Frazzini, Ilmanen, & Pedersen, 2020). Our Low Volatility factor is the negative of the standard deviation of the monthly total returns in local currency over the past year.

Small Size. The Small Size factor emphasizes smaller companies, which have been shown to outperform their larger counterparts over time. A recent survey of Small Size as a smart beta factor appears in (Alquist, Israel, & Moskowitz, 2018). Our Small Size factor is the negative of the natural logarithm of the total market capitalization in USD.

The STOXX Equity Factor indices maximize their exposure to a Multifactor signal that is, in turn, constructed from the individual Value, Momentum, Quality, Low Volatility and Small Size signals. This integrated approach that evaluates and selects stocks based on their combined factor exposures, as opposed to combining individually-constructed factor sleeves has been documented in several studies as being a superior approach to constructing Multifactor portfolios - see (Fitzgibbons, Friedman, Pomorski, & Serban, 2017). Table 1 shows the breakdown of the Multifactor signal. It comprises 36% Quality, 27% Momentum, 27% Value, 5% Size and 5% Low Volatility. The Multifactor alpha signal is smoothened using an exponentially weighted moving average with a half-life of 12 months, with each asset's smoothed score then being multiplied by the asset's idiosyncratic volatility from the Axioma US4 Medium Horizon Risk Model to arrive at the final score.[5]

The STOXX U.S. Equity Factor index seeks to limit differentiation from the parent STOXX USA 900 by targeting an ex ante tracking error (TE) of 1%. This is one reason why the Small Size and Low Volatility factors receive a lower weight in the Multifactor signal, since Low Volatility (with a low beta to the parent index) and Small Size (with a large beta to the parent index) give rise to factor portfolios with a high tracking error to the parent index.

Table 1: Components of the Multifactor signal

Momentum (27%)	Earnings announcement drift: 25% Earnings momentum: 50% Price momentum: 25%
Quality (36%)[6]	Accruals: 20% Dilution: 20% Gross profitability: 20% Change in net operating assets 20% Carbon intensity: 13%[7] Science-based targets: 7%[8]
Value (27%)	Book-to-price: 20% Cash flow yield: 20% Time-series normalized cash flow yield: 20% Dividend yield: 20% Earnings yield 20%
Low Volatility (5%)	Standard deviation of monthly total returns in local currency over past 12 months multiplied by −1
Small Size (5%)	Negative of the natural logarithm of the total market capitalization in USD

Source: STOXX.

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[5] Please refer to the "STOXX Equity Factor Index" chapter of the STOXX Index Guide for more details.

[6] Before January 2014: Quality = 25% Accruals + 25% Dilution + 25% Gross Profitability + 25% Change in Net Operating Assets.

[7] Carbon intensity (provided by ISS) has been used in the Quality score as from January 2014. It is calculated as (Scope 1 + Scope 2 emissions/revenue).

[8] Science-based targets (provided by ISS) have been used in the Quality score as from January 2021.

2.2. Cross-sectional factor correlation

Combining factors with low correlations to each other can offer diversification benefits and a potentially smoother investment profile over time. Table 2 compares the cross-sectional correlation between the five single factor signals as of June 2024. Some of the factors (such as Momentum and Quality, for example) are uncorrelated, while others (such as Value and Momentum, for example) are slightly negatively correlated. This shows that the factors capture diverse sources of risk premiums.

The individual factors provide long-term risk premiums but can suffer from severe shorter-term under-performance, which is often cited as an explanation for why the long-term factor risk premiums exist. By diversifying across multiple uncorrelated factors, the Multifactor indices seek to reduce the risks associated with any single factor, including increased volatility and economic downturns. Section 3 shows that the Multifactor portfolio constructed from the five factor signals enjoys reduced portfolio risk, improved portfolio returns and diversification benefits.

Table 2: Cross-sectional factor correlation in June 2024

	Momentum	Quality	Value	Low Volatility	Small Size
Momentum	1.00	-	-	-	-
Quality	0.06	1.00	-	-	-
Value	−0.29	−0.12	1.00	-	-
Low Volatility	−0.14	0.04	0.17	1.00	-
Small Size	−0.10	−0.12	0.20	−0.25	1.00

Source: STOXX.

## 2.3. Estimating the risk premium in the Multifactor signal

We ran a quarterly rebalanced backtest for the period from December 2002 to June 2024 by constructing free-float market capitalization-weighted quartile portfolios (Q1, Q2, Q3 and Q4) on the stocks in the STOXX USA 900 index, with:

• Q1 containing the assets in the top 25th percentile
• Q2 containing assets in the 25th – 50th percentile
• Q3 containing assets in the 50th – 75th percentile and
• Q4 containing the assets in the bottom 25th percentile

of the Multifactor scores, respectively. The performance of the quartile portfolios is given in Figures 1 and 2.

Figure 1 shows that the Q1 portfolio outperforms the STOXX USA 900 parent index by 2% (annualized), while Q4 underperforms the parent by 3.35% (annualized) over the entire backtest. In addition, Figure 2 shows that the Q1 (Q4) portfolio consistently outperforms (underperforms) the parent index over the entire backtest.

Figure 1: Multifactor quartile active performance
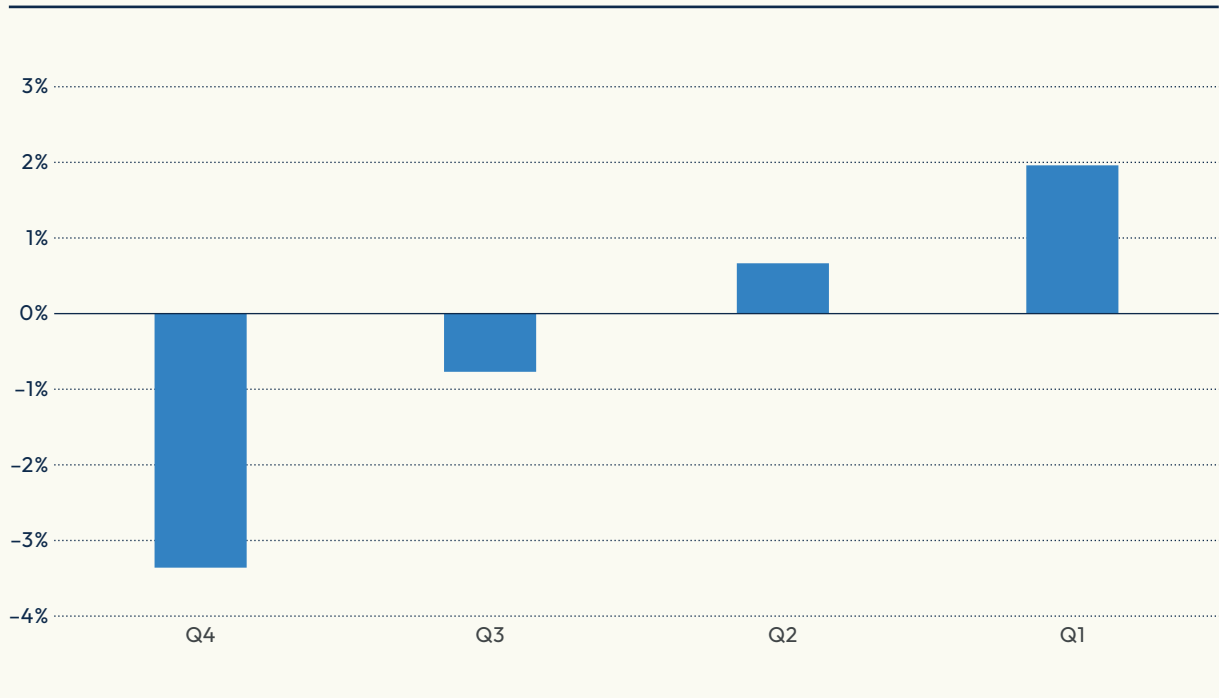
Source: STOXX.

Figure 2: Multifactor quartile cumulative active performance
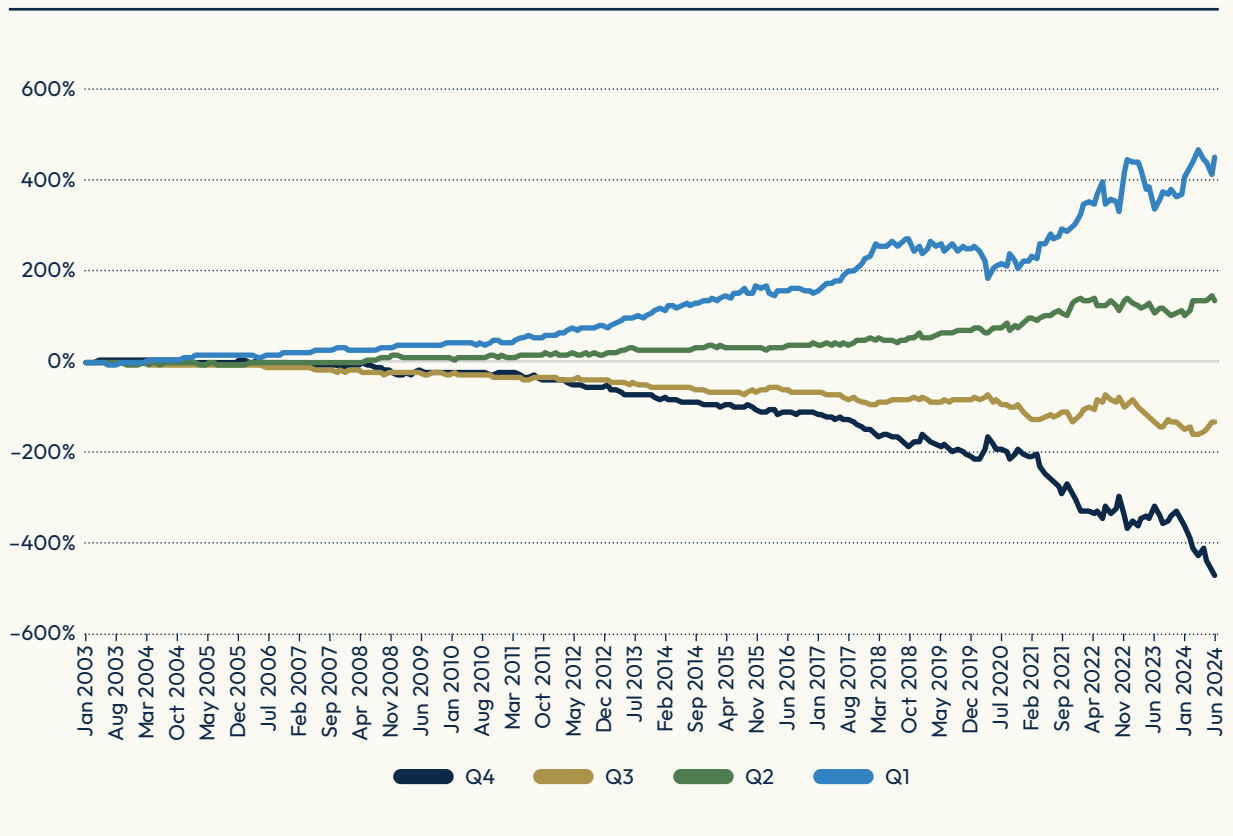
Source: STOXX.

3. Investable Multifactor strategy

We then tested the Multifactor signal in a practical setting to generate the STOXX U.S. Equity Factor index. The objective was to construct a portfolio that maximizes its exposure to the Multifactor signal subject to the following risk management, diversification, and liquidity constraints:

1. Only names in the STOXX USA 900 parent index can be held
2. Long-only and fully invested
3. Active ICB (Level 1) active exposures lie within +/-2% of the parent index
4. Active asset weight of +/2%
5. Target predicted beta of between 0.98 and 1.02
6. UCITS 4.5/8/22.5% rule
7. Do not trade assets with zero/missing trading volumes
8. Minimum threshold asset weight of 1 basis point (bp) and maximum asset weight ≤ 20 x the weight of the asset in the parent index
9. Quarterly one-way turnover (TO) of 5%
10. Ex ante TE of 1% with respect to the Axioma US4 Medium Horizon Risk Model (US4MH)
11. Targeted active exposures to the individual factors defined in Section 2, including:
    a. 20% ≤ Quality ≤ 50%
    b. 20% ≤ Momentum ≤ 40%
    c. 0% ≤ Value ≤ 40%
    d. 0% ≤ Low Volatility ≤ 40%
    e. 0% ≤ Small Size ≤ 40%

A detailed description of the STOXX U.S. Equity Factor index strategy can be found in Table 3.

Table 3: STOXX US Equity Factor strategy

	STOXX U.S. Equity Factor
Parent index	STOXX USA 900
Objective function	Maximize Multifactor exposure
Risk model	Axioma US4MH
Rebalance frequency	Quarterly

Risk, diversification and liquidity constraints:

Active ICB industry bounds	+/– 2%
Active style factor exposures	20% ≤ MOM ≤ 40%, 20% ≤ QUAL ≤ 50%, 0% ≤ VAL, LOWVOL, SMALL SIZE ≤ 40%.
Do not trade	Zero/missing ADV
TE (ex-ante)	1%
Turnover	Annual one-way TO of 20%
UCITS	4.5/8/22.5%
Minimum asset weight	1bp (threshold)
Maximum asset weight	20x parent weight
Predicted active beta	+/– 2%
Active asset weight	+/– 2%

Source: STOXX.

The STOXX U.S. Equity Factor index emphasizes the Quality, Momentum, Value, Low Volatility and Small Size factors in that order. This can be seen from the weights of these factors in the Multifactor signal, as well as from the targeted active exposures to these factors.

The backtest is run quarterly on the Monday after the third Friday in March, June, September, and December. It starts in December 2002, with the last rebalance to date being in June 2024.

The STOXX U.S. Equity Factor index has outperformed the STOXX USA 900 parent index over the entire backtest to date (December 2002 – July 2024). The realized performance is summarized in Table 4. The annualized active return over the backtest is 1.26% and the annualized active risk 1.27%, resulting in an impressive information ratio (IR) of 1. The STOXX U.S. Equity Factor index also had a lower maximum drawdown than the STOXX USA 900 over the current backtest period. This is due to the diversification benefit conferred by the uncorrelated factors in the Multifactor signal.

Table 4: Realized performance (December 2002 – July 2024)

	STOXX USA 900	STOXX U.S. Equity Factor
Annual active return (%)	0	1.26
Annual active risk (%)	-	1.27
Information ratio	-	1
Annual return (%)	10.59	11.86
Annual risk (%)	18.64	18.65
Sharpe ratio	0.57	0.64
Maximum drawdown (%)	−55.03	−54.57

Source: STOXX.

Figure 3 shows that USD 100 invested in the STOXX USA 900 parent and the STOXX U.S. Equity Factor indices in December 2002 would have been worth USD 945 and USD 1,218 respectively as of the end of July 2024.
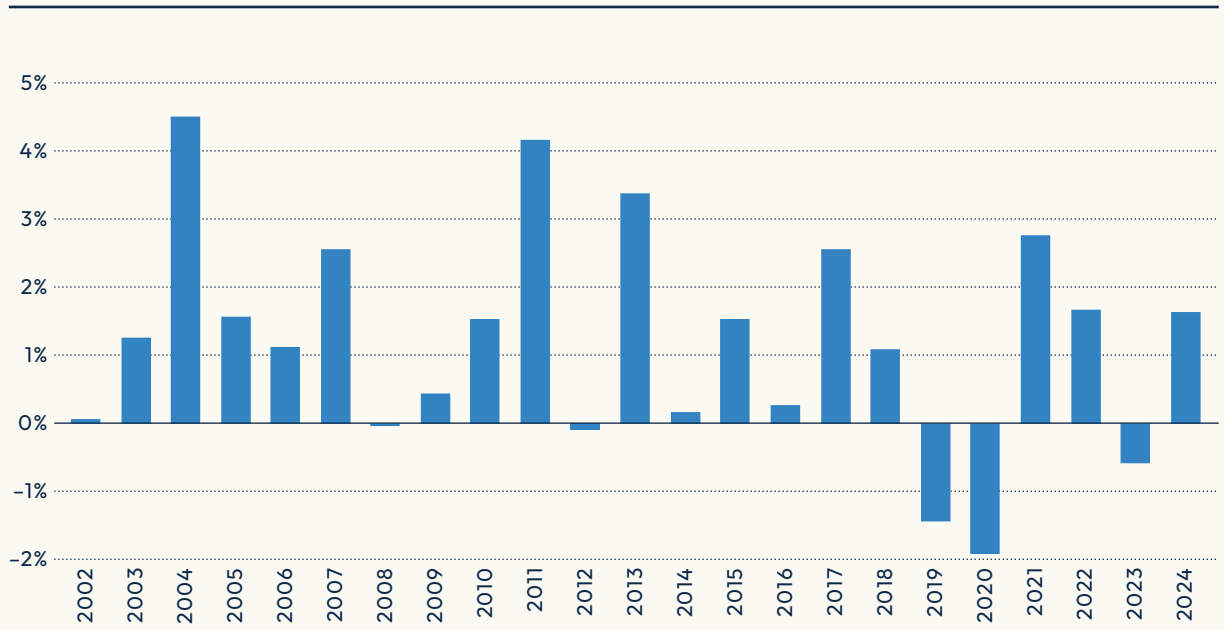
Figure 4 shows the annualized active returns for the STOXX U.S. Equity Factor index. The Multifactor index outperformed the benchmark for all years between 2003 and 2024, except for 2019 – 2020 and 2023.

Figure 3: Portfolio levels (quarterly backtest: December 2002 – July 2024)
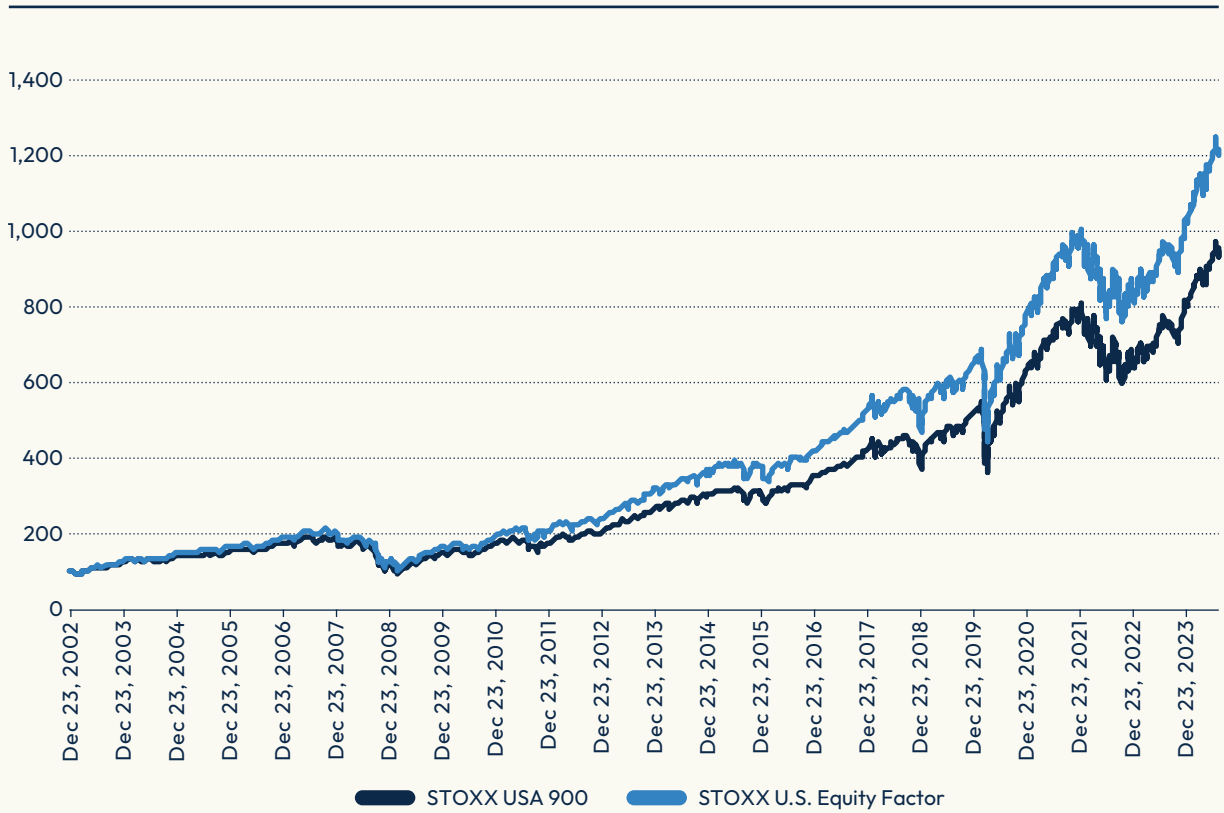
Source: STOXX.

Figure 4: Annualized active return for the STOXX U.S. Equity Factor index

Source: STOXX.

An attribution of the Multifactor portfolio performance in 2019-2020 indicates that the underperformance of the Multifactor portfolio was primarily due to the negative performance of the Value and Small Size factors during that period. Since the Multifactor portfolio seeks a managed level of differentiation from the parent index, the Multifactor underperformance was limited to 2%. Similarly, a large portion of the underperformance of the Multifactor portfolio in 2023 came from the underperformance of the Momentum factor. The underperformance of equity factor strategies during these periods is also documented in (Blitz, 2021), (Asness, The Long Run is Lying to You, 2021), and (Ang A., 2023)

Notably, the Multifactor portfolio quickly bounced back from these periods of underperformance: In 2021 and 2024, the Multifactor portfolio outperformed the parent index by 2.5% and 1.5%, respectively. To further emphasize this point, Figure 5 shows the rolling three-year IR for the STOXX U.S. Equity Factor index; this confirms that the IR was positive except for the brief drawdown in 2019–2020. One can also see how the IR quickly bounced back to a clearly positive value thereafter.

Figure 5: Rolling 3-yr IR for the STOXX U.S. Equity Factor index

Source: STOXX.

Figure 6: Rolling 3-yr active factor exposures
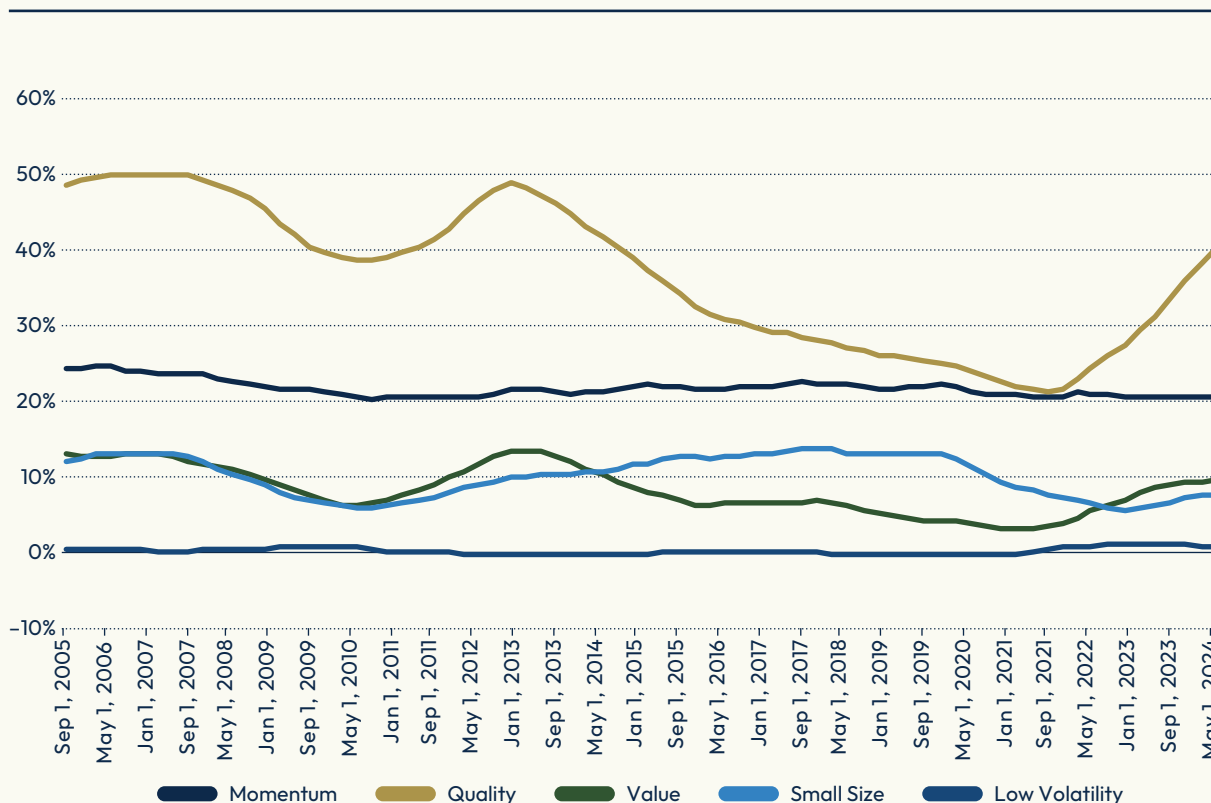
Source: STOXX.

Figure 6 shows the rolling 3-year active exposures to the different factors in the Multifactor signal. Note how the active exposures, and especially Quality, fluctuate over time. Also note that correlation between the different factor signals changes with market conditions, and that the Multifactor active exposure to the Quality signal varies across all allowable bounds (20%–50%). The average active exposure to the Low Volatility signal is 0%, indicating that this factor is not a driver of performance. This is to be expected since the Multifactor portfolio closely tracks the parent index with an ex ante TE of 1% and also maintains the parent index's beta. Otherwise, the Multifactor portfolio takes increasing active exposures to the Quality, Momentum, Small Size and Value factor signals in that order, and these are the main drivers of active return.

4. Performance attribution – drivers of performance

We ran a performance attribution of the STOXX U.S. Equity Factor index against its parent, the STOXX USA 900, from December 31, 2002, to July 31 2024 using the Axioma US4MH Model. This factor-based performance attribution decomposed the realized active return of the STOXX U.S. Equity Factor portfolio into a portion that can be explained by the factors in the US4 Model (the "factor contribution" or "systematic contribution") and the remaining portion, known as the "specific contribution".

The Axioma US4 Model also includes Value, Momentum, Quality, Small Size and Low Volatility style factors, although they are defined differently than the factor signals discussed so far in the paper. Nevertheless, the two sets of factors are correlated, and we expect to see some of the portfolio return attributed to these Axioma style factors.

Table 5 shows that 0.64% out of the annualized active return of 1.33% is attributable to Profitability (Quality), Earnings Yield (Value), Size and the Medium-Term Momentum factors in the Axioma US4 Model, with a statistically significant t-Stat of 6.22.

In addition, the specific active return of 0.62% came from the improved definitions of the BlackRock factors. This portion is part of the specific active return in the attribution since it is not captured by the Axioma style factors.

Table 5: Factor performance attribution for the STOXX U.S. Equity Factor with the Axioma US4MH Model

|	Return	Risk	IR	t-Stat
STOXX U.S. Equity Factor	12.40%	14.92%	-	-
STOXX USA 900	11.07%	14.85%	-	-
Active return	1.33%	1.28%	1.04	4.85
Specific	0.62%	1.09%	0.57	2.65
Factor	0.71%	0.55%	1.29	6
Style	0.64%	0.48%	1.34	6.22
US4MH Profitability	0.40%	0.24%	1.65	-
US4MH Earnings Yield	0.19%	0.18%	1.03	-
US4MH Size	0.15%	0.30%	0.5	-
US4MH Medium-Term Momentum	0.15%	0.17%	0.9	-
Industry	0.08%	0.37%	0.22	1.02

Source: STOXX.

Figure 7 shows that the style factor and the specific active return are the major components of the cumulative active return over time. In addition, Figure 8 shows that the Profitability, Earnings Yield, Size and Medium-Term Momentum factors in the US4 Model are the major drivers of the cumulative style return.

Figure 7: Return attribution – Common factor contributions
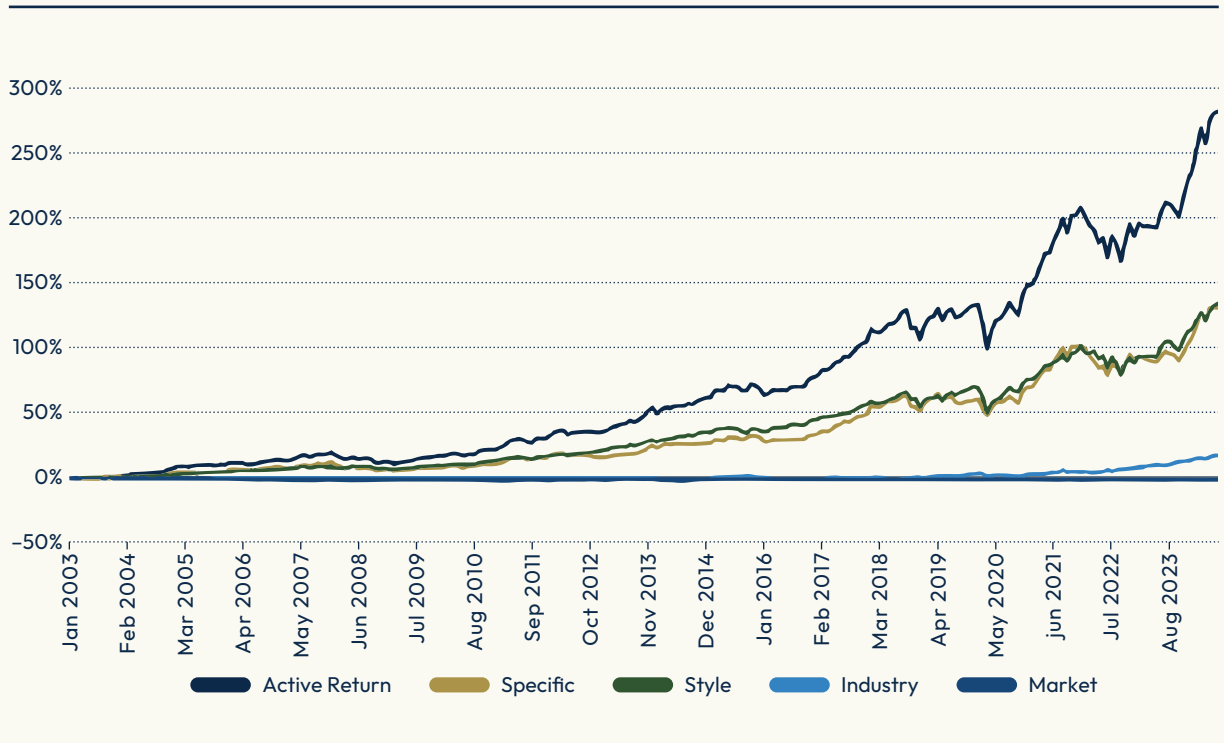
Source: STOXX.

Figure 8: Return attribution – Style contributions
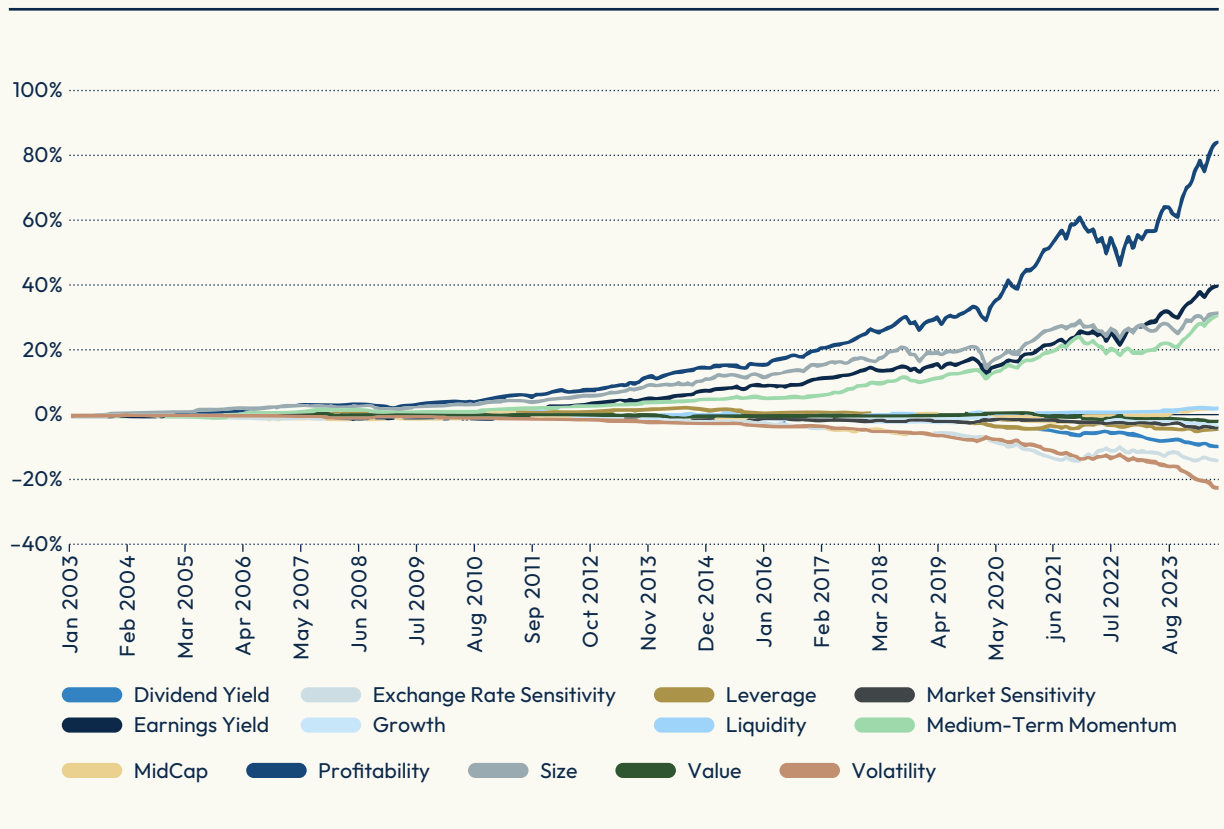
Source: STOXX.

5. Conclusions

The STOXX Equity Factor indices are designed as core equity solutions that deliver above-average exposure to five factors: Quality, Value, Momentum, Small Size and Low Volatility, with additional constraints to target diversification, removal of unintended systematic exposures, liquidity, and low ex ante tracking error.

The distinguishing features of these indices include:

• Use of the STOXX first-generation and STOXX World flagship indices as the investible universe
• Customized factor scores and strategy developed by STOXX in conjunction with BlackRock
• Use of Axioma's flagship portfolio optimizer and risk models to balance the trade-off between Multifactor exposure, ex ante TE, risk management, diversification, and liquidity

This paper took a behind-the-scenes look at the design of the STOXX U.S. Equity Factor index.

• We first showed that the customized Multifactor signal developed by STOXX in conjunction with BlackRock has a "standalone" risk premium. Our signal backtest demonstrated that the market capitalization-weighted portfolio in the top quartile of Multifactor scores of stocks outperformed the parent STOXX USA 900 index by 2.2%, while the market capitalization-weighted portfolio of stocks in the bottom quartile of Multifactor scores underperformed the parent index by 3.3%. This performance was consistent over time.

• We then presented the customized factor strategy that was developed by STOXX in conjunction with BlackRock in a practical setting with risk management, diversification, and turnover constraints. We ran a quarterly 20-plus year backtest for the period from December 2002 to June 2024 and showed that:

    a. The STOXX U.S. Equity Factor index outperformed the STOXX USA 900 index by 1.26% (annualized) with a realized TE of 1.27%, giving an impressive IR of 1 over this period.

    b. The STOXX U.S. Equity Factor outperformed the STOXX USA 900 for all years between 2003 and 2024, except for 2019–2020 and 2023.

    c. The STOXX U.S. Equity Factor quickly bounced back after its periods of underperformance. In 2021 and 2023, the Multifactor portfolio again outperformed the STOXX USA 900 by 2.5% and 1.5% respectively.

    d. The STOXX USA Equity Factor index took increasing (albeit varying) active exposures to the Quality, Momentum, Small Size and Value factor signals in that order, and these were the main drivers of its active return.

• We finally added transparency to the sophisticated quantitative portfolio construction process for the STOXX U.S. Equity Factor index. We did this by using factor-based performance attribution to show that:

    a. The STOXX U.S. Equity Factor index's outperformance primarily came from the Quality, Momentum, Value and Small Size components of the Multifactor signal. These factors accounted for 0.71% of the annualized active return of 1.33%.

    b. Another 0.62% of the active return came from the specific active return reflecting the improved definitions of the BlackRock factors.

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