

WHITEPAPER

Real-world diversification in multifactor indices

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1. Introduction

In the past, factor ETFs have been dominated by single factor tilts (e.g., value, growth, momentum, etc.). Although these products are easy to describe to potential investors, they provide little or no diversification across factors. If value does poorly, then value ETFs do poorly as well.

As diversification has become a more central pillar of index design, products have been launched that tilt not just on one factor but on an array of factors. While these multifactor ETFs are more complicated to describe to potential investors, they allow the client discussion to evolve from debating which factors are currently working to examining which combinations of factors most effectively enhance overall performance. The steadier, more reliable performance of these products offers a compelling alternative to single factor alternatives. Multifactor ETFs have been able to outperform the market even during the recent US bull market. As is true of well diversified investments, when one factor does poorly, the other factors can make up for its performance drag.

In this paper, we describe the iSTOXX® Ang Research Enhanced US Large Cap index. This is a multifactor index that tilts on four factors: Momentum, Quality, Enhanced Value, and Cyclical Value. Both the single factor definitions and the composite multifactor score are diversified across different signals and factors. As a result, this index generated strong outperformance over a 22-year backtest. The index has a low 1% tracking error to the parent index, low turnover, and high liquidity.

The paper is organized as follows: First, the factor score definitions are presented. Second, the index construction approach is described. Next, a 22-year backtest is used to compare the performance of the single and multifactor scores. Next, we assess the impact of each single factor and the strength of the diversification by looking at a number of different backtest results, each of which omits one of the four single factors. Finally, the dynamic multifactor score is compared to a static score to show the advantages of the dynamic approach.

2. Factor score definitions

We define and use four factor scores: Momentum, Quality, and two variants of Value — Enhanced Value and Cyclical Value. All of these have an established academic literature. Each score and each component of the individual scores is z-scored and winsorized at plus or minus three standard deviations, so that signals can be meaningfully combined. Missing data is not included in any weighted combination.

Each factor score is a composite average, since this diversifies measurement error in the same way that averaging across assets diversifies idiosyncratic risk. The individual signals comprising each factor score are given in Appendix A.

A concerted effort has been made to broaden the number and types of signals used so as to maximize the diversification within each factor score. As a result, price momentum is just one of six different signals comprising our Momentum factor score. The other momentum inputs include idiosyncratic momentum (momentum of risk models' residual returns) and scores based on the positions taken by informed investors (i.e., short sellers, hedge funds, and analysts).

Quality is comprised of seven signals that are well known and common in commercial factor risk model exposures explaining profitability. These include return on equity, return on assets, cash flow to assets, sales to enterprise value, gross profits to assets, sales to assets, and operating accruals to assets.¹

We split Value into two sleeves, Enhanced Value and Cyclical Value. Cyclical Value comprises traditional value metrics: book-to-price and earnings yield. Enhanced Value is meant to address the shortcomings of traditional value metrics by measuring value that is not adequately captured in bookkeeping metrics. For example, it is well known that banks and technology companies often possess large volumes of non-traditional business assets such as software, patents, and research, which are not well measured by book value. Our Enhanced Value sleeve consists of economic profit yield, intangible asset ratio, and free cash flow yield. A company can be cheap relative to its book equity yet expensive relative to its intangible capital, or vice versa.

The multifactor score combines the four factor scores: Cyclical Value, Enhanced Value, Momentum, and Quality. Nominally, Momentum and Quality each receive one-third of the multifactor score while Value receives the remaining third, split evenly between its two sleeves. These nominal weights are modestly adjusted by the three timing models described below.

Timing model 1: Market similarity

This model applies machine learning to estimate the probability of benchmark-relative outperformance by each of the four single factors. The machine learning algorithm creates a reduced dimensional feature set and then uses this to compare the current market state to historical states.

The input data includes daily returns for the parent index, the sector indices, and the four factor sleeves, recent and medium-horizon past returns, volatilities, higher moments, market betas, cross-sectional dispersion, and measures of diversification derived from the covariance matrix.

If the resulting probability of outperformance by one of the four factors is at least 10% greater than any of the other three factors, the nominal weight of that factor is doubled. If the probability of one of the factors is at least 10% less than the other three, the nominal weight of the factor concerned is halved.

Timing model 2: Factor momentum

This model computes the information ratio for each individual factor over the preceding 18 months. If the largest information ratio exceeds the other three by at least 0.15, the nominal weight of that factor is doubled. If the smallest information ratio is at least 0.15 less than the other three, the nominal weight of that factor is halved.

Timing model 3: Factor of factors

This model computes the monthly change in the exponentially weighted moving average (EWMA) of the active exposures for the multifactor index. The EWMA gives the current month's active exposure (10%). Only the weights of two factors — Momentum and Cyclical Value — are potentially changed.

¹ It is worth noting that several of the momentum signals are also found in commercial risk models, e.g., short interest.

If the most recent EWMA of the active exposure for Momentum is at least 0.3% higher than the previous month, the nominal weight for Momentum is doubled. If the most recent EWMA of the active exposure for Cyclical Value is at least 0.3% less than the previous month, the weight for Cyclical Value is halved.

Combining timing weights

The three individual models all produce their own modifications to the nominal weights. Each of these modified weights is renormalized to sum to 100%, and the set of three modified, renormalized weights is then averaged using a 50% weight for the market similarity model and 25% for each of the other two models.

This final weighted combination of weights across each of the four factors represents the final dynamic multifactor score. Note that no score is ever eliminated, so that the final multifactor score always comprises all four signals.

3. Index construction

We used an index construction methodology that maximizes the index's exposure to a score. We analyzed five different scores: the four single factor scores and the multifactor score. The Axioma portfolio construction (optimization) software plus the Axioma US5.1 Medium-Horizon Factor Risk Model was used. The parent benchmark is the STOXX® US Universal index, a market cap-weighted index of large and mid-cap US stocks. Currently, this index holds a little over 500 names.

The optimized index was subject to the following constraints:

- Only names in the parent index could be held.
- ICB Level 1 active exposures had to lie within 2% of the parent index.
- Maximum one-way, quarterly turnover = 5% (20% annual).
- Maximum predicted tracking error = 1%.
- The predicted beta is between 0.98 and 1.20.
- Liquidity: The maximum weight of each asset was limited to twenty times its 60-day median daily trading volume multiplied by the ratio of the benchmark weight and the 60-day median daily trading volume of a representative asset. The representative asset was the 10th percentile of all assets in the parent index when sorted by the ratio of the 60-day median trading volume divided by the parent index weight.
- The minimum active exposures to the Momentum, Quality, and Enhanced Value factors used in multifactor optimization were 20%. The minimum active exposure to the Cyclical Value factor was 0%. The single factor optimizations did not impose any minimum active exposure constraint.

The index was optimized quarterly on the close of the last trading day in March, June, September, and December.

4. Backtest results

We performed the backtest from the end of May 2004 to the end of May 2026, with returns recorded monthly, gross of transaction costs and with dividends reinvested.

Table 1 reports the overall performance results. The multifactor index has an information ratio of 1.00 relative to the market benchmark. The Sharpe ratio is 0.83 (vs. 0.75 for the benchmark). Three of the four sleeves were positive contributors over the full sample – with information ratios of 0.65 for Momentum, 0.73 for Quality and 0.94 for Enhanced Value – while Cyclical Value was weak. However, the multifactor index beat every sleeve, including its best performer. The bottom panel shows the active exposures. The multifactor index exhibits the exposures designed: These were positive on every factor except Cyclical Value, where the exposure was small but positive (6.8%).

Table 1: Summary backtest results, May 2004 – May 2026.

	STOXX US Universal	Momentum	Quality	Enhanced Value	Cyclical Value	Multi- factor
Realized return (% ann.)	11.13%	11.97%	11.99%	12.21%	10.83%	12.38%
Realized risk (% ann.)	14.85%	14.94%	14.86%	14.84%	15.11%	14.86%
Sharpe ratio	0.75	0.80	0.81	0.82	0.72	0.83
Realized active return (% ann.)	-	0.84%	0.86%	1.08%	-0.30%	1.24%
Realized active risk (% ann.)	-	1.29%	1.18%	1.15%	1.52%	1.25%
Information ratio	-	0.65	0.73	0.94	-0.20	1.00
Avg. names held	588.5	272.6	301.3	261.3	275.3	276.0
Avg. ann. one way turnover	5.0%	20.6%	20.5%	20.8%	20.7%	22.5%
Realized beta	1.00	1.00	1.00	1.00	1.01	1.00
Avg. predicted risk (% ann.)	14.14%	14.21%	14.15%	14.13%	14.20%	14.18%
Avg. predicted tracking error (% ann.)	-	1.03%	1.04%	1.06%	1.04%	1.04%
Avg. active exp. to Momentum	-	40.5%	-0.7%	1.4%	-1.0%	25.6%
Avg. active exp. to Quality	-	0.7%	64.4%	8.9%	-10.7%	41.4%
Avg. active exp. to Enhanced Value	-	5.6%	10.7%	64.1%	-1.9%	29.2%
Avg. active exp. to Cyclical Value	-	-1.2%	-11.9%	0.2%	55.8%	4.8%
Avg. active exp. to multifactor	-	28.5%	39.1%	25.3%	6.8%	53.3%

Source: STOXX, USD gross monthly returns. The summary backtest results show that the multifactor signal has an information ratio larger than any of the individual factor signals. The average active factor exposures are given at the bottom and show good diversification across the factors.

The combination of the factors has a higher Sharpe ratio and information ratio than the individual components due to diversification. Table 2 shows the correlations of the monthly active returns across the five factor indices. Since the correlations among the single factor indices are low, the multifactor index combines four positive but lowly correlated active return streams. The composite keeps most of the factors' active return while diversifying away much of their active risk. The index does not require every factor to work at the same time, only that the factors should not all fail together. The multifactor index's correlations with Momentum, Quality, and Enhanced Value mirror the active exposures in Table 1.

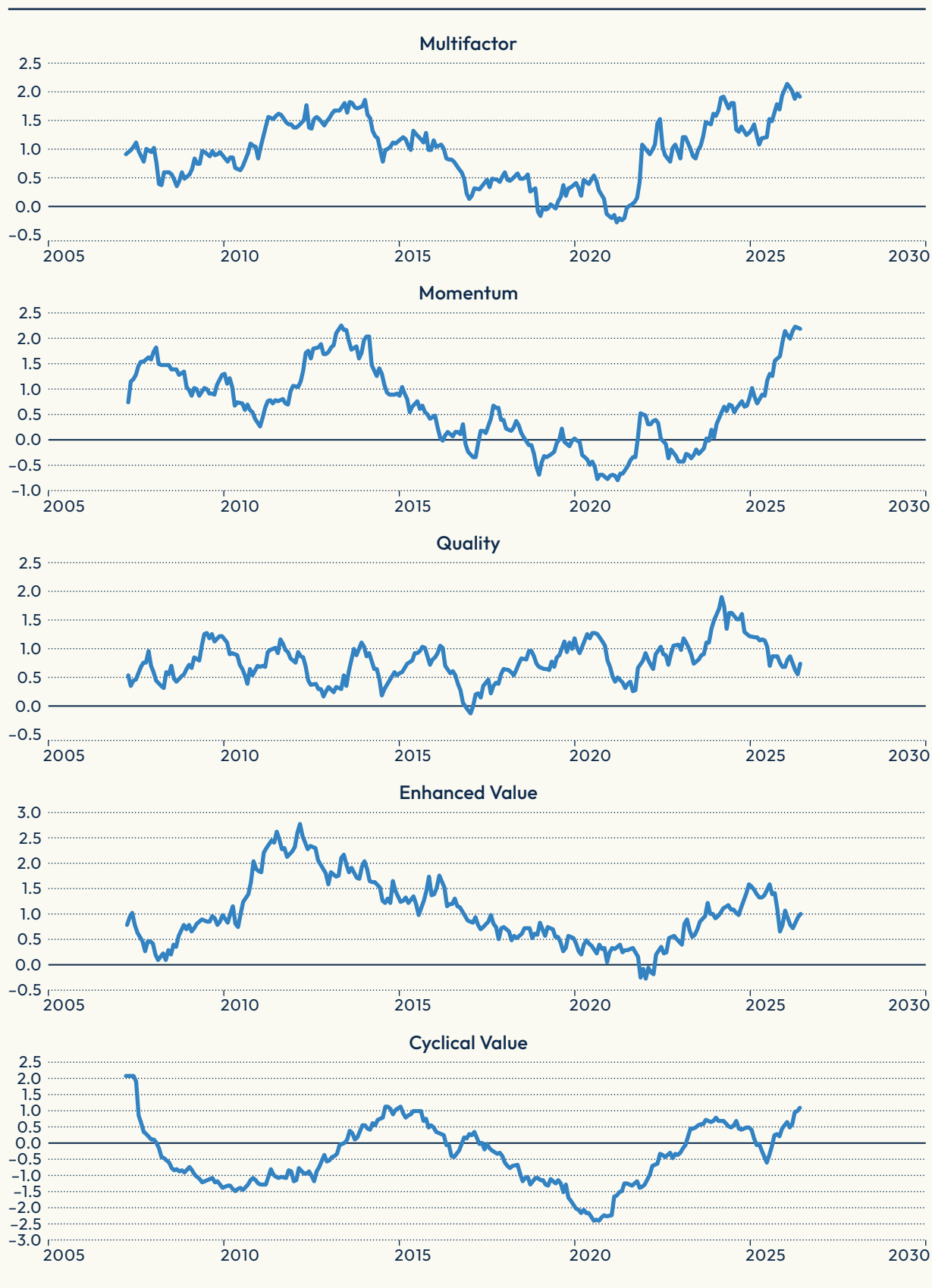
Table 2: Correlation of monthly active returns.

	Momentum	Quality	Enhanced Value	Cyclical Value	Multifactor
Momentum	1.00	0.06	-0.05	0.00	0.55
Quality	0.06	1.00	0.17	-0.21	0.64
Enhanced Value	-0.05	0.17	1.00	0.13	0.35
Cyclical Value	0.00	-0.21	0.13	1.00	0.05
Multifactor	0.55	0.64	0.35	0.05	1.00

Source: STOXX, USD gross monthly returns. The active returns of the individual factors are substantially uncorrelated, allowing the multifactor case to take advantage of diversification within the factors.

Figure 1 plots rolling 36-month information ratios for each index. In 2020, only Quality remained substantially positive, whereas Momentum and Enhanced Value were roughly flat and Cyclical Value was clearly negative. Since 2024, the roles have reversed: Quality has underperformed while Momentum and Cyclical Value have carried the index. Cyclical Value shows long weak stretches (2008–2014 and 2017–2023) punctuated by sharp recoveries (before 2008, around 2015, and since 2023). The multifactor index in the top panel is above zero for nearly the entire backtest, dropping into negative territory only during two short windows (November 2018–May 2019 and November 2020–June 2021). This is because the composite does not depend on any single sleeve's cycle.

Figure 1: Rolling 36-month information ratios (IRs) for each factor.



Source: STOXX, USD gross monthly returns. The figure shows the rolling trailing 36-month information ratios for each factor. The multifactor information ratio only drops below zero briefly twice.

Table 3 shows the annual active returns for the four individual factors. The largest active return for any year is highlighted in yellow, while the smallest active return is highlighted in grey. Each factor has been — in different years — the best and worst annual performer. Enhanced Value was the best performer from 2008 to 2011, while Quality was the best performer from 2020 to 2023. Momentum outperformed in 2024 and 2025 but got off to a rocky start in 2026. Conversely, Cyclical Value produced the worst results in 2023 and 2024 but the best in 2025 and in 2026 to date. The unpredictability of the best and worst factor in any given year is a strong motivation for diversifying across different factors.

Table 3: Active annual returns for the four factors.

Year	Momentum	Quality	Enhanced Value	Cyclical Value
2004	0.83%	-0.49%	0.61%	1.70%
2005	4.10%	0.69%	0.17%	2.23%
2006	-1.54%	-0.83%	1.38%	2.04%
2007	3.10%	0.99%	-0.86%	-4.21%
2008	0.71%	1.45%	1.56%	-1.10%
2009	-0.36%	0.91%	2.83%	-0.18%
2010	0.39%	-0.22%	1.93%	-2.54%
2011	2.43%	1.93%	3.69%	-0.53%
2012	2.06%	-1.32%	-0.01%	1.02%
2013	1.03%	2.46%	2.17%	1.23%
2014	-0.58%	1.09%	1.39%	1.64%
2015	0.11%	-0.27%	1.45%	-0.73%
2016	-0.93%	-1.74%	-0.06%	1.07%
2017	2.26%	3.83%	1.07%	-1.89%
2018	-2.93%	0.12%	1.77%	-2.44%
2019	1.20%	0.02%	-1.06%	-3.14%
2020	-1.00%	3.13%	1.00%	-5.83%
2021	0.97%	1.46%	-0.14%	0.01%
2022	-1.01%	0.84%	0.62%	0.84%
2023	0.72%	1.95%	1.60%	-0.39%
2024	3.71%	0.14%	2.07%	-1.18%
2025	2.80%	-0.24%	-0.86%	3.30%
2026	-0.73%	-0.03%	0.67%	1.08%

Source: STOXX, USD gross monthly returns. The annual active returns of the four individual factors. The largest active return for each year is highlighted in yellow while the smallest active return is highlighted in grey.

Finally, to test each factor's marginal contribution, backtests were performed by removing one factor at a time from the multifactor score, renormalizing the remaining weights, and then rerunning the backtest. Panel A of Table 4 reports the four omission backtests over the full sample alongside the original. Panel B repeats the exercise for the last three years, from May 2023 to May 2026.

Table 4: Backtests omitting one factor at a time.

Panel A: Full sample May 2004 – May 2026.

	STOXX US Universal	Original multifactor	Omit Momentum	Omit Quality	Omit Enhanced Value	Omit Cyclical Value
Realized return (% ann.)	11.13%	12.38%	12.00%	12.10%	12.23%	12.44%
Realized risk (% ann.)	14.85%	14.86%	14.88%	14.85%	14.90%	14.84%
Sharpe ratio	0.75	0.83	0.81	0.82	0.82	0.84
Realized active return (% ann.)	-	1.24%	0.87%	0.97%	1.09%	1.31%
Realized active risk (% ann.)	-	1.25%	1.25%	1.22%	1.29%	1.24%
Information ratio	-	1.00	0.70	0.80	0.85	1.05
Avg. names held	588.5	276.0	279.9	258.6	284.5	278.3
Avg. ann. one way turnover	5.0%	22.54%	20.88%	21.43%	21.42%	22.28%
Realized beta	1.00	1.00	1.00	1.00	1.00	1.00
Avg. predicted risk (% ann.)	14.14%	14.18%	14.14%	14.19%	14.18%	14.17%
Avg. predicted tracking error (% ann.)	-	1.04%	1.04%	1.04%	1.03%	1.04%
Avg. active exp. to Momentum	-	25.6%	-0.5%	32.1%	27.4%	26.2%
Avg. active exp. to Quality	-	41.4%	52.6%	-0.1%	44.7%	44.9%
Avg. active exp. to Enhanced Value	-	29.2%	35.3%	31.4%	9.7%	29.5%
Avg. active exp. to Cyclical Value	-	4.8%	6.5%	16.9%	5.9%	-8.9%
Avg. active exp. to multifactor	-	53.3%	44.9%	36.0%	50.5%	52.2%

Source: STOXX, USD gross monthly returns.

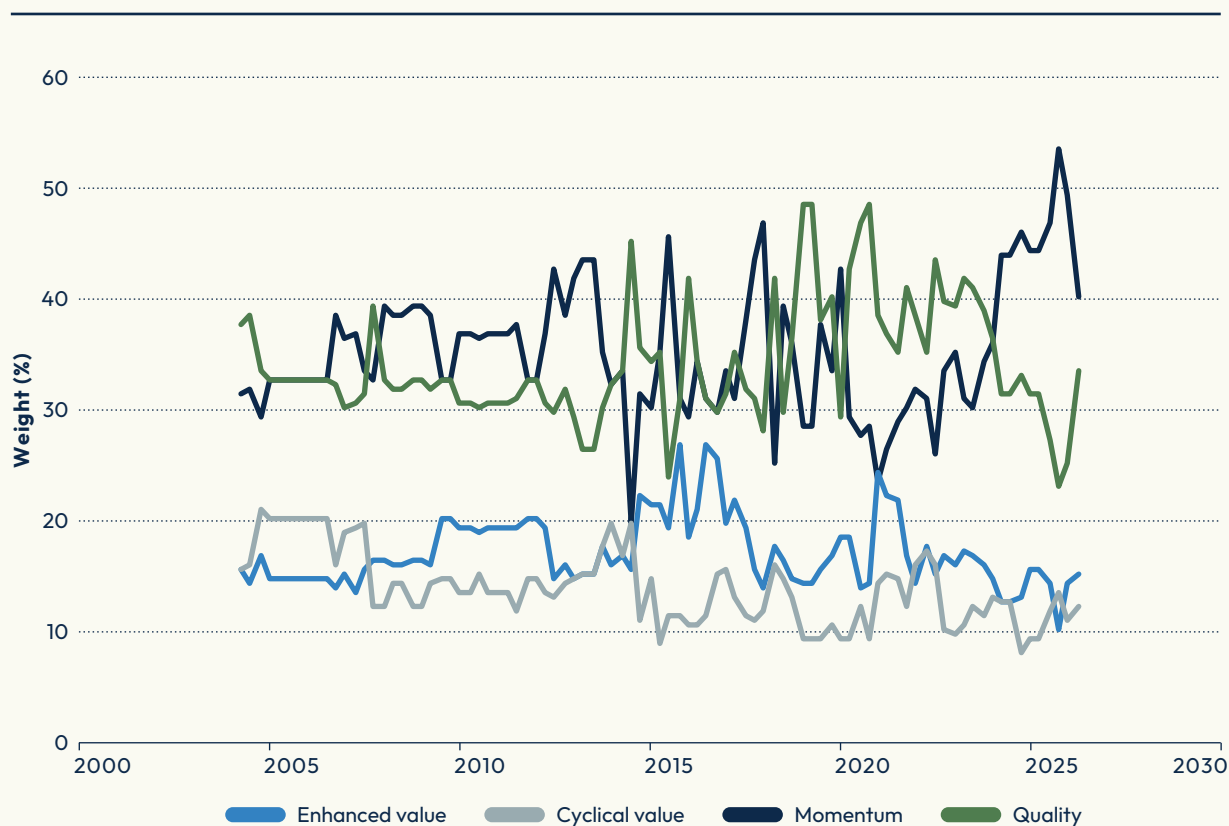
Panel B: Last three years, May 2023 – May 2026.

	STOXX US Universal	Original multifactor	Omit Momentum	Omit Quality	Omit Enhanced Value	Omit Cyclical Value
Realized return (% ann.)	23.83%	26.57%	25.16%	27.18%	26.73%	26.44%
Realized risk (% ann.)	13.53%	13.74%	13.51%	13.68%	13.81%	13.82%
Sharpe ratio	1.76	1.93	1.86	1.99	1.94	1.91
Realized active return (% ann.)	-	2.74%	1.33%	3.35%	2.90%	2.61%
Realized active risk (% ann.)	-	1.43%	1.15%	1.38%	1.37%	1.37%
Information ratio	-	1.92	1.16	2.42	2.12	1.90
Avg. names held	575.4	256.3	261.7	251.6	272.2	261.5
Avg. ann. one way turnover	2.80%	19.46%	19.46%	19.46%	19.46%	19.46%
Realized beta	1.00	1.01	0.99	1.01	1.02	1.02
Avg. predicted risk (% ann.)	14.14%	14.15%	14.14%	14.15%	14.16%	14.15%
Avg. predicted tracking error (% ann.)	-	1.05%	1.04%	1.06%	1.05%	1.05%
Avg. active exp. to Momentum	-	27.8%	2.8%	31.6%	30.1%	28.7%
Avg. active exp. to Quality	-	36.9%	48.5%	0.8%	38.3%	39.4%
Avg. active exp. to Enhanced Value	-	29.6%	37.3%	33.2%	11.4%	29.7%
Avg. active exp. to Cyclical Value	-	1.2%	2.2%	14.6%	1.0%	-8.8%
Avg. active exp. to multifactor	-	49.4%	38.8%	35.3%	47.4%	49.6%

Source: STOXX, USD gross monthly returns. Panel A reports the four omission backtests over the full sample alongside the original. Panel B repeats the exercise over the last three years, from May 2023 to May 2026.

Over the full sample, omitting Momentum, Quality, or Enhanced Value lowered the information ratio from 1.00 to 0.70, 0.80, and 0.85, respectively, while omitting Cyclical Value raised it to 1.05. The ranking flipped over the last three years. Omitting Cyclical Value had little effect and the largest improvement came from omitting Quality. Omitting Momentum – the strongest recent factor – reduced the information ratio from 1.92 to 1.16. In other words, Cyclical Value is the factor to drop over the full sample, while Quality is the factor to drop over the most recent three-year sample. This instability is exactly why the index was designed to be diversified.

Figure 2 shows the combined dynamic weights generated by all three timing models. In the past two years, the Quality weight dropped steadily from over 50% to under 30%, and the model reduced the weight to Quality in line with its recent underperformance.

Figure 2: Dynamic factor weights over time.

Source: STOXX. The dynamic weights generated by combining all three timing models.

Because the tilts are modest by design, the performance differences between static and dynamic weights should be modest as well. Table 5 compares the two first over the full backtest period and second for the last three years. Over the full sample, the dynamic weights improved the information ratio from 0.99 to 1.00, a negligible amount. Over the last three years, the improvement — from 1.83 to 1.92 — was more visible. This is due to the fact that the timing model overweighted Quality from 2020 to 2024, and to the overweighting of Momentum in 2025.

Table 5: Static versus dynamic multifactor scores.

Summary of backtest results	May 2004 – May 2026			May 2023 – May 2026		
	STOXX US Universal	Static multifactor	Dynamic multifactor	STOXX US Universal	Static multifactor	Dynamic multifactor
Realized return (% ann.)	11.13%	12.37%	12.38%	23.83%	26.41%	26.57%
Realized risk (% ann.)	14.85%	14.84%	14.86%	13.53%	13.68%	13.74%
Sharpe ratio	0.75	0.83	0.83	1.76	1.93	1.93
Realized active return (% ann.)	-	1.24%	1.24%	-	2.58%	2.74%
Realized active risk (% ann.)	-	1.24%	1.25%	-	1.41%	1.43%
Information ratio	-	0.99	1.00	-	1.83	1.92
Avg. names held	588.5	274.3	276.0	575.4	257.6	256.3
Avg. ann. one way turnover	5.00%	22.53%	22.54%	2.80%	19.46%	19.46%
Realized beta	1.00	1.00	1.00	1.00	1.01	1.01
Avg. predicted risk (% ann.)	14.14%	14.17%	14.18%	14.14%	14.14%	14.15%
Avg. predicted tracking error (% ann.)	-	1.04%	1.04%	-	1.05%	1.05%

Source STOXX. USD gross monthly returns. Backtest results comparing the static and dynamic multifactor signal over the full backtest period (left) and the last three years (right).

5. Discussion and conclusion

Academics and professionals have agreed for decades that diversification is the only free lunch in the market. Nevertheless, while there are many highly successful single factor ETFs in terms of both name recognition and assets under management, the number of well-known multifactor ETFs is, perhaps, surprisingly small. This paper shows that a well-constructed multifactor index that diversifies across several factors can sustain outperformance over decades with nominal trading costs (e.g., managed turnover). Such results suggest that it is possible to outperform the market over long periods of time.

The long-term outperformance that was observed occurs because the multifactor score has been explicitly diversified across four single factors, each well established in the literature. In addition, each single factor score has been constructed using multiple input signals so that the individual factors are also diversified.

The US stock market had a sustained bull market over the last decade, led by a handful of high-performing megacap stocks (the Magnificent Seven, FAANG, etc.). The low tracking error employed here ensures that none of the megacap stocks are strongly underweighted; consequently, if these continue to do well, the multifactor index will also do well. This should reassure investors who are focused on not missing out on strong market moves in the future (FOMO). Along with the observed outperformance, this makes the multifactor index an attractive investment.

Appendix: Signal definitions

This appendix defines the individual signals.

Value signals (the two sleeves together receive one-third of the multifactor score):

Signal	Description
Cyclical Value (one-sixth of the multifactor score)	
Book-to-price	The ratio of common equity to average 30-day total issuer market capitalization, using the common equity value reported on the most recent date within the last two years
Earnings yield	The three parts realized to one part forecasted earnings-to-price ratio. The realized component is the sum of the four most recently reported quarterly net income values divided by average 30-day market capitalization, while the forecasted component is the 12-month forward earnings estimate over the same denominator
Enhanced Value (one-sixth of the multifactor score)	
Economic profit yield	The ratio of Economic Value Added (net operating profit after tax minus a capital charge) to the enterprise value
Intangible asset ratio	Intangible capital (reported intangible assets plus cumulative capitalized R&D and advertising after tax) divided by total capital
Free cash flow yield	Free cash flow (net operating profit after tax less the change in capital, plus non-cash adjustments) divided by the enterprise value

Momentum signals (one-third of the multifactor score):

Signal	Description
Price medium-term momentum	The cumulative return over the last 260 trading days, with the last 21 days progressively downweighted
Idiosyncratic medium-term momentum	The cumulative idiosyncratic return over the last 250 trading days, excluding the last 20
Analyst revisions	Upgrades minus downgrades, divided by total analyst sentiments, over the past 30 days
Economic profit momentum	Growth in the annual change in Economic Value Added divided by prior-period sales
Low short interest	The average of assets on loan over market capitalization, over average daily volume, and over total lendable value; sign reversed
Hedge fund holdings	The average of the percentage of shares held by hedge funds, the holdings value over volume, and the number of holders over the square root of market capitalization

Quality signals (one-third of the multifactor score):

Signal	Description
Return on equity	The sum of the four most recent quarterly earnings over the average of the four most recent common equity values
Return on assets	The sum of the four most recent quarterly earnings over the average of the four most recent figures for total assets
Cash flow to assets	The most recent annual operating cash flow over average total assets
Sales to enterprise value	The sum of the four most recent quarterly sales over the enterprise value
Gross profits to assets	The sum of the four most recent quarterly net sales figures (sales minus the cost of goods sold) over average total assets
Sales to assets	The sum of the four most recent quarterly sales over average total assets
Operating accruals to assets	The sum of the four most recent accruals figures (income minus operating cash flow) over average total assets

7. Offices and contacts

Learn more about STOXX & DAX Indices on [STOXX.com](https://www.stoxx.com)

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