RESEARCH INSIGHTS

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Factor Indexing Through the Decades

Lessons from 50 years, today's challenges and future directions

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Executive summary

Over the past five decades, factor investing has transformed from being a subject of hot academic research and the province of specialist quant managers into a core component of both institutional and wealth-management investment processes. Barr Rosenberg's pioneering multi-factor risk model, introduced in the mid-1970s, showed how a parsimonious set of systematic and economically-plausible characteristics could explain a substantial share of equity risk and return. By the late 1980s, pension plans, endowments and sovereign funds were already allocating capital explicitly to portfolios aligned with historically rewarded factors such as value, size and momentum while risk models began to underpin the analytics for decomposing portfolio exposures, risk and return. Today, more than USD 6 trillion are linked to factor-oriented mandates spanning active, indexed and ETF vehicles across institutional and wealth segments.

Analysis of the 50-year deep histories of the MSCI factor indexes confirms that most classic factors have delivered significant premia over that horizon. Since 1975, every MSCI World-based single-factor index except growth has out-performed the parent benchmark. Minimum volatility, momentum and quality indexes achieved the highest risk-adjusted returns.

A long-term view of the factor performance record, however, masks pronounced cyclicality. Factors go through clear cycles of outperformance and underperformance. Over the past decade, momentum and quality outperformed, while value, low volatility, equal weight (low size) and dividend yield lagged the broad market by 260-350 basis points (bps), annually. Performance attribution shows that old diversification rules failed to hold. Negative stock-specific contributions from underweights in mega-cap tech names accounted for much of the shortfalls and were enough to derail the track record.

These drawdowns, the resurgence of macro and geopolitical volatility and the rise of AI have prompted a reevaluation of factor definitions and associated index and portfolio construction. Have traditional signals become less effective in capturing reality? Are widely followed signals too crowded? How much does it matter that metrics like book-to-price ratios overlook intangible capital and research and development (R&D)? Can pure momentum strategies end up clustering in the same winners favored by indexed investors? Will future style tilts need to be built so they are more aware of macro variables and exposure to rate shocks? We conclude with a forward-looking factor agenda that expands the factor toolkit for today's investors. The paper offers four in-depth explorations of how factor definitions and portfolio construction may evolve to meet each of these contemporary investment challenges, from the "growth of growth" to the "return of macro." While the foundations of factor investing remain robust, investors today seek a new framework; one that is less dogmatic about the academic definition of a relevant factor and more attuned to the current drivers of return — however episodic or novel those characteristics might be.

An evolution in factor investing

We trace key developments in factor investing over the past 50 years, through the lens of the evolution in investor needs and, correspondingly, the development of MSCI risk models and factor indexes. These tools have helped shape the modern landscape for systematic factor investing.

Early foundations of factor investing

Bill Sharpe was awarded the 1990 Nobel Prize in Economics for his 1962 introduction of the Capital Asset Pricing Model (CAPM) that proposed that a single market factor —beta — could explain cross-sectional differences in expected stock returns.[1] In 1976, Stephen Ross extended this market model into a general framework for asset pricing — the Arbitrage Pricing Theorem — that could incorporate multiple factors or drivers of risk and return. Around the same time, Barr Rosenberg and co-workers at the University of California, Berkeley (1973) had developed one such theory and, as importantly, its practical implementation with common factors such as industry membership, financial structure, valuation multiples, trading metrics and growth orientation. These risk model innovations could decompose forecast and realized equity risk returns into granular style and industry exposures.

Client demand and risk model expansion

Institutional investors in the 1970s were grappling with practical problems such as attributing portfolio performance beyond the single-beta CAPM framework and isolating the specific drivers of risk and return. This need was met by Barr Rosenberg's first multi-factor risk Barra model, which supported the decomposition of equity returns into fundamental style and industry exposures.

As global investing accelerated through the 1980s and 1990s, client demand for more comprehensive models grew (as described in Gupta et al. 2025). This led Barra to expand both the breadth and depth of its factor model coverage. Country and then regional models gave way to global frameworks.

Concurrently, these decades also saw a huge body of academic and practitioner empirical research that revealed a richer tapestry of return drivers that characterized different investor approaches: first, with value and size and then subsequently with momentum, low volatility and finally quality. This journey is chronicled in detail in Melas (2018).

As investor needs for insights deepened in the following decades, risk models evolved further. Over successive generations, factor definitions were refined to provide investors with a more nuanced view of exposures; new systematic equity strategy (SES) factors were introduced to attribute risk to common components of alpha signals (Bayraktar et al. 2013) and specialized risk models were developed to help investors assess exposures to targeted equity mandates, such as technology funds or China allocations.

[1] Other key contributors in the early 1960s to this work include Jack Treynor, John Lintner and Jan Mossin.

The growth of factor indexing

In the 2000s, factor investing solutions spread beyond the active mandate space where it had started. Asset owners increasingly sought turnkey vehicles that could deliver the same exposures they had pursued actively, but with benchmark-like efficiency and the lower implementation costs that were typical with their cap-weighted allocations. This led to the development of rules-based, investable factor indexes, a trend also enabled by the increasing and effective standardization of factor definitions. As global equity allocations expanded, institutional investors often shifted to a core-satellite structure: anchoring equity portfolios in broad market indexes and then using select factor sleeves to better express strategic or tactical views. Asset owners often adopted indexed ETFs for implementation of factor views as well as through customized index designs and segregated mandates.

Starting in 2006, MSCI built a comprehensive range of seven single factor indexes for investors to achieve these exposures. The indexes represented value, low size, low volatility, dividend yield, quality, momentum and growth factors[2] (Bender et al. 2013).

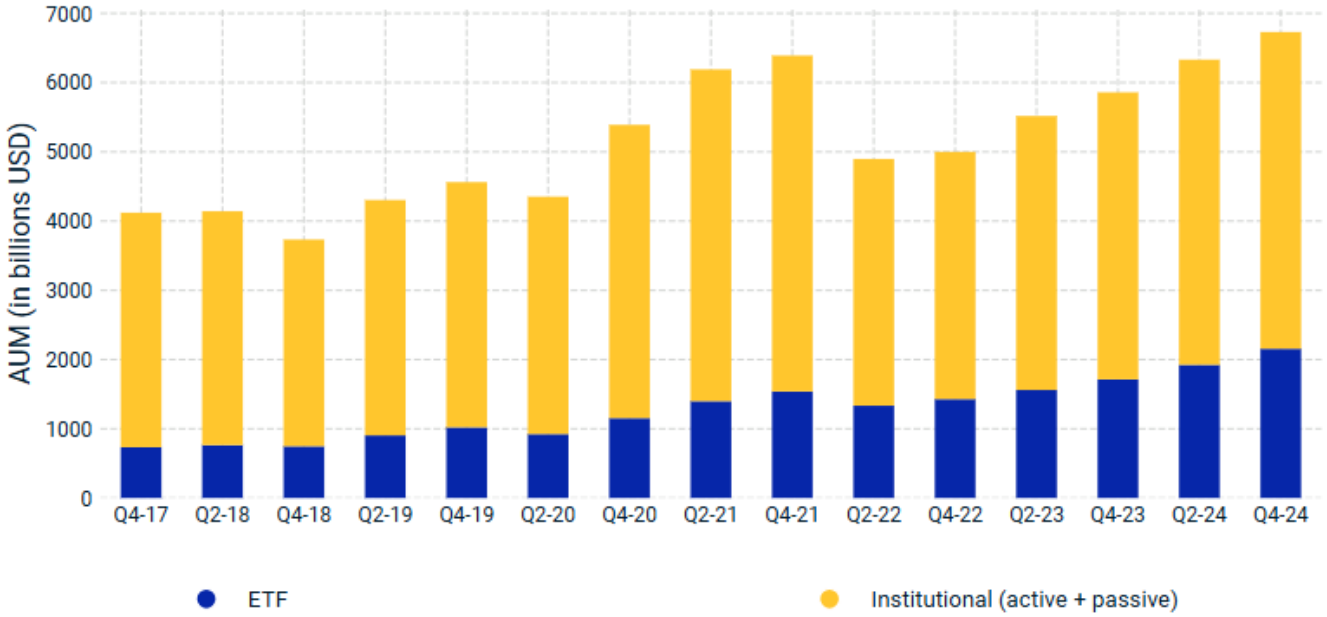
Evolution of MSCI Single factor indexes

Recognizing the cyclicality of individual factor performance, many investors turned to multi-factor strategies, which aimed to diversify across factors and hence reduce portfolio volatility. Initially, in the index space, this diversification was achieved by the top-down blending of individual factor indexes but the 2010s saw the development of integrated multi-factor index solutions, sometimes using optimization to manage index turnover explicitly and efficiently control exposures to targeted factors (Doole et al. 2015, Kulkarni et al. 2018).

Over the last 10 years, the integration of sustainability and climate risk constraints into factor strategies for institutional investors has become routine, even if the complexity of the targeted outcomes has increased. Multi-objective optimization can be used to achieve both financial factor exposure as well as sustainability improvement targets within the same index construction framework (Kulkarni et al. 2017). Equally, against the backdrop of greater macro and market volatility, factor indexing based on dynamic or timing-based approaches, with rotation among factors based on macroeconomic reports, alternative data signals, valuation spreads or volatility conditions has gained popularity. All these trends have broadened the assets under management (and the client segments) that can be linked to factor investing activity. Over the past decade, assets deployed in factor-based strategies across institutional and wealth segments have increased by 50%, from USD 4 trillion to over USD 6 trillion.

[2] In 2025, MSCI launched the MSCI Analyst Sentiment Index.

Assets under management linked to factor strategies has increased over the last eight years



Assets under management (AUM) as of Dec. 31, 2024, reported on or before March 31, 2025, using data from eVestment for active and passive institutional funds. Equity ETF values are based on data from Refinitiv and MSCI. Institutional AUM includes separate/segregated AUM, pooled/commingled AUM and mutual fund institutional AUM. AUM includes equity funds and excludes feeder funds and funds of funds. For funds where AUM was not reported as of March 31, 2025, the previous period AUM was utilized as an estimate. MSCI does not guarantee the accuracy of third-party data.

Insights from 50 years of factor index history

The longer the history we have, the better able we are to find context and perspective for contemporary investment questions. The combined simulated and live history of MSCI factor indexes now spans almost five decades. This extensive dataset is a strong foundation for analyzing factor performance over the long term, providing insights into how factors have behaved across a wide range of market regimes and macro environments. In this section, we present visuals and data to highlight key characteristics of long-only factor exposures, as shown by MSCI factor indexes,[3] as way to support better investor insights into future factor performance. Where a full 50-year history is unavailable, our analysis is based on the longest data series available.

Factor index performance and characteristics

We review the performance of long-only factor implementations using MSCI factor indexes. The chart below presents the risk-return profile of the MSCI World factor indexes over nearly 50 years, from

[3] The MSCI USDEEP risk model has a daily history back to January 1973 with coverage of U.S. companies down to small- and micro-cap securities. As a reference and to help validate factor index capture, the performance of pure factors from the MSCI USDEEP model is presented in Appendix I.

November 1975 to May 2025.[4] The data shows that, except for the MSCI World Growth Index, all other factor indexes have outperformed the parent MSCI World Index during this period. The MSCI World Quality Index and the MSCI World High Dividend Yield Index not only delivered higher returns but did so with significantly lower volatility. The MSCI World Minimum Volatility Index, consistent with its construction, exhibited the lowest risk, approximately 20% lower than the MSCI World Index.

50-year performance of MSCI World factor indexes

MSCI data from Nov. 28, 1975, to May 30, 2025. Annualized risk and return figures are calculated in USD, with risk measured using monthly return data.

Although factor strategies have generated positive active returns over the long-term, they are also characterized by cyclical periods of underperformance. For investors, the challenge often lies in managing this cyclicality. Our analysis shows that the correlations between different factor indexes — measured with excess returns relative to the MSCI World Index — are predominantly low to moderate. For instance, sector-relative value, as measured by the MSCI World Enhanced Value Index, often exhibited minimal or even negative correlations with momentum and quality. This means that, historically,

[4] The analysis uses both simulated and live history for the seven MSCI factor indexes. In 2014, the deep history was first constructed using the same methodology as the then live indexes (or a close proxy where data or tools became unavailable). Further details on the deep history construction methodology are provided in Appendix II.

combinations of these factor indexes were able to reduce overall index volatility without sacrificing excess returns.

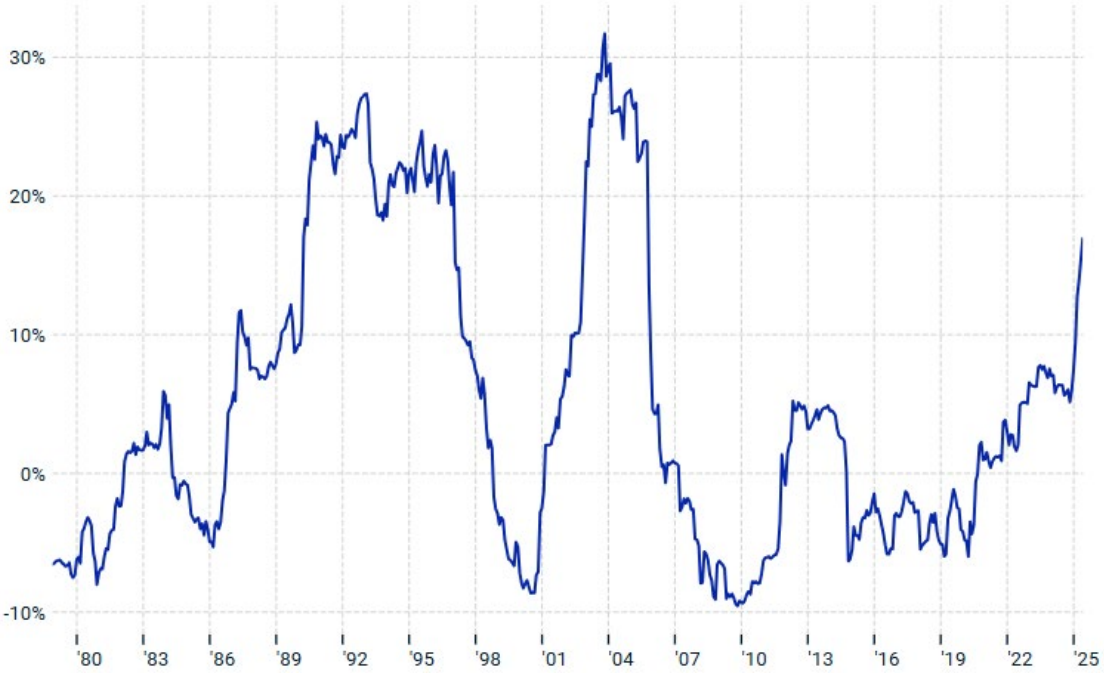
The table below displays this long-term correlation structure between single-factor indexes. The average pairwise correlations, calculated over rolling 36-month windows, have consistently remained below 30%. This relatively low level of correlation supports the rationale for a multi-factor approach.

Long-term correlation between MSCI World factor indexes

	Equal weighted	High div. yield	Minimum volatility	Momentum	Quality	Enhanced value	Growth
Equal weighted	1.00						
High div. yield	0.30	1.00					
Minimum volatility	0.09	0.52	1.00				
Momentum	-0.17	-0.06	0.12	1.00			
Quality	-0.24	0.29	0.18	0.23	1.00		
Enhanced value	0.61	0.53	0.01	-0.11	0.00	1.00	
Growth	-0.14	-0.24	-0.01	0.31	0.09	-0.11	1.00

MSCI data from Nov. 28, 1975, to May 30, 2025. Based on monthly returns in USD relative to the MSCI World Index.

Average pairwise correlation between MSCI World factor indexes

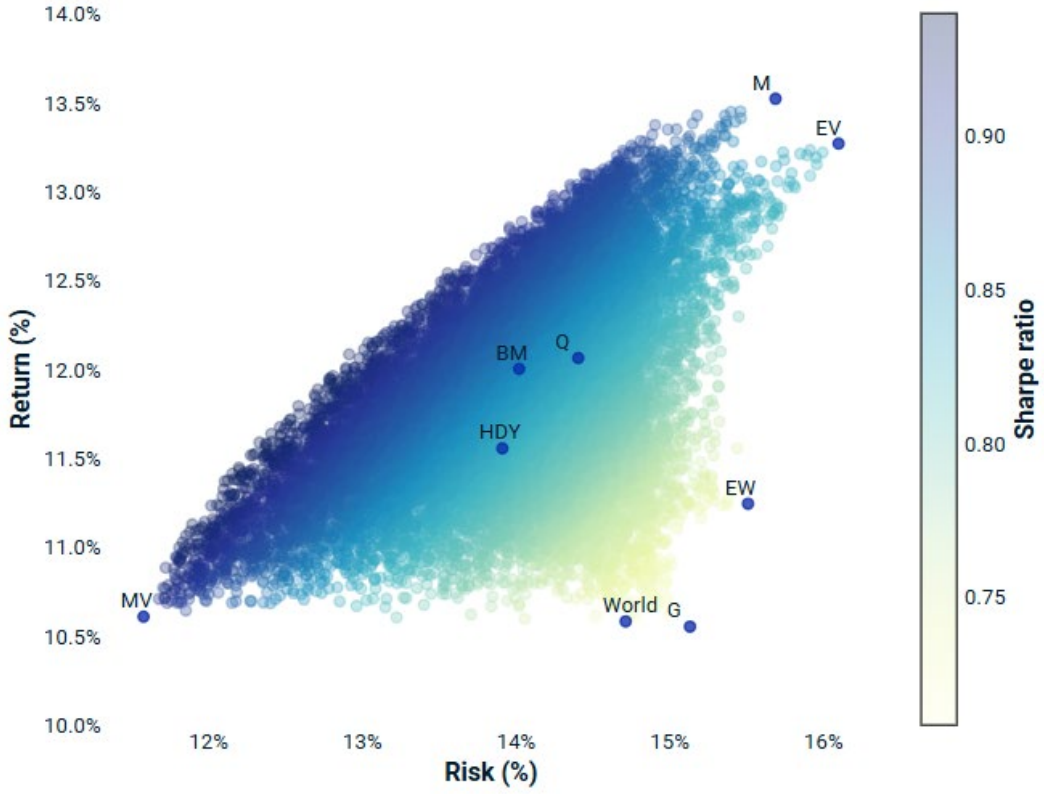


MSCI data from Nov 28, 1975, to May 30, 2025. Based on 3-year rolling correlations calculated using monthly returns in USD relative to MSCI World.

To investigate these potential benefits, we constructed a multi-factor index — an equal-weighted blend of the seven MSCI single-factor indexes — rebalanced semi-annually, which we refer to as the balanced mix (BM).

The chart below depicts an efficient frontier constructed using simulated portfolio allocations to single-factor indexes. It was generated by randomly allocating weights to each factor index and then calculating the resulting index risk and returns over the full study period. The visualization color-codes each combination based on its Sharpe ratio. Each dot is an index allocation; darker shades indicate higher Sharpe ratios. Historically, the equally-weighted BM index is close to the efficient frontier. This proximity illustrates the diversification benefits derived from combining weakly-correlated single-factor indexes. Alternative weighting methodologies — such as risk parity or volatility-based allocations — may yield more efficient portfolios than the BM but an equally-weighted approach benefits from its simplicity and transparency on construction and analysis.

Efficient frontier of single factor index allocations



MSCI data from Nov. 28, 1975, to May 30, 2025. Each circle represents a weighted combination of MSCI World single factor indexes rebalanced semi-annually. The acronyms represent the following: M-momentum, EV-enhanced value, EW-equal weight, G-growth, HDY-high dividend yield, Q-quality, MV-minimum volatility, and BM-balanced mix.

The next table summarizes key performance metrics for the MSCI World single-factor indexes and the BM over 50 years. Momentum and enhanced value delivered the highest total returns, at 13.5% and 13.3%, respectively. Meanwhile, minimum volatility achieved the highest risk-adjusted return, with a return-to-risk ratio of 0.92, reflecting its historical effectiveness in managing downside risk. The BM index has a strong information ratio (0.46) and while most individual factor indexes exhibited tracking errors above 5%, the BM had a reduced tracking error of 3.1%, benefiting from factor diversification. In

terms of beta, most factor indexes were close to or below one, indicating either market-level sensitivity or slightly defensive positioning.

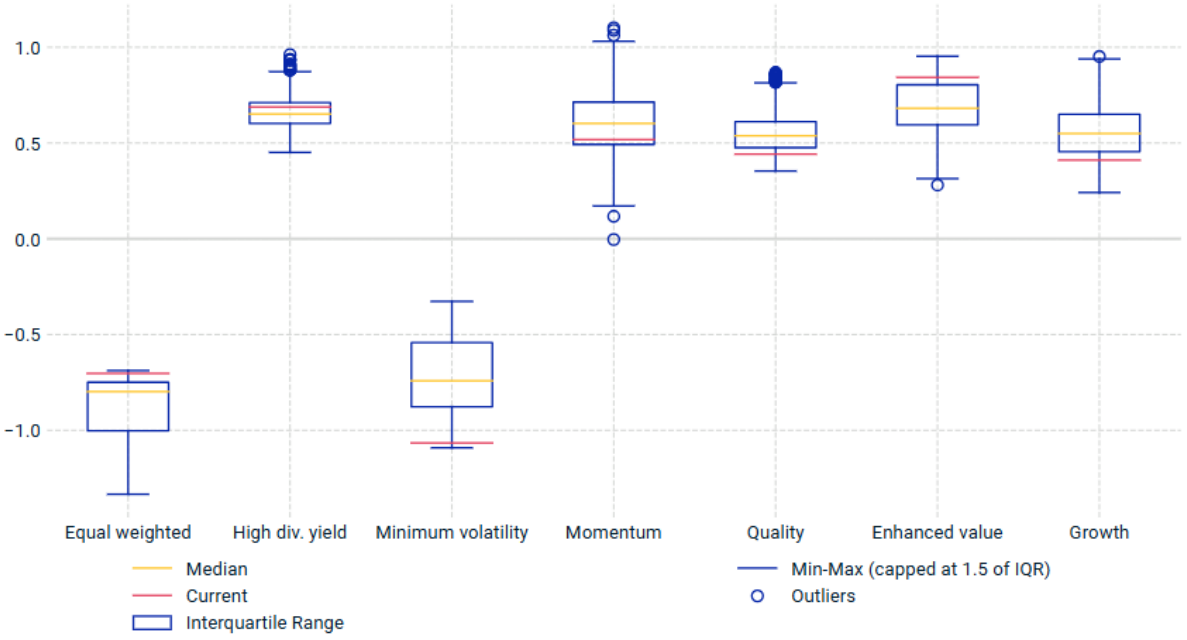
Key return metrics

	World	Equal weighted	High div. yield	Minimum volatility	Momentum	Quality	Enhanced value	Growth	Balanced mix
Total return* (%)	10.6	11.2	11.6	10.6	13.5	12.1	13.3	10.6	12.0
Total risk (%)	14.7	15.5	13.9	11.6	15.7	14.4	16.1	15.1	14.0
Return / risk	0.72	0.73	0.83	0.92	0.86	0.84	0.82	0.70	0.86
Active return (%)		0.7	1.0	0.0	2.9	1.5	2.7	-0.0	1.4
Tracking error (%)		4.9	6.1	6.3	7.8	5.5	6.6	3.0	3.1
Information ratio		0.14	0.16	0.00	0.38	0.27	0.40	-0.01	0.46
Historical beta		1.00	0.86	0.72	0.93	0.91	1.00	1.01	0.93

MSCI data from Nov 28, 1975 to May 30, 2025. *Returns annualized in USD.

The chart below displays the monthly distributions of target active factor exposures for each MSCI World single-factor index relative to the MSCI World Index (for instance, for the equal weighted index, the reported exposure is for the size factor). Over the period from June 30, 1999, to May 30, 2025, all single-factor indexes consistently maintained substantial active exposures to their respective targets, with the magnitude of active exposures for each index ranging between 0.5 and 0.8.

Target active factor exposures for single factor indexes

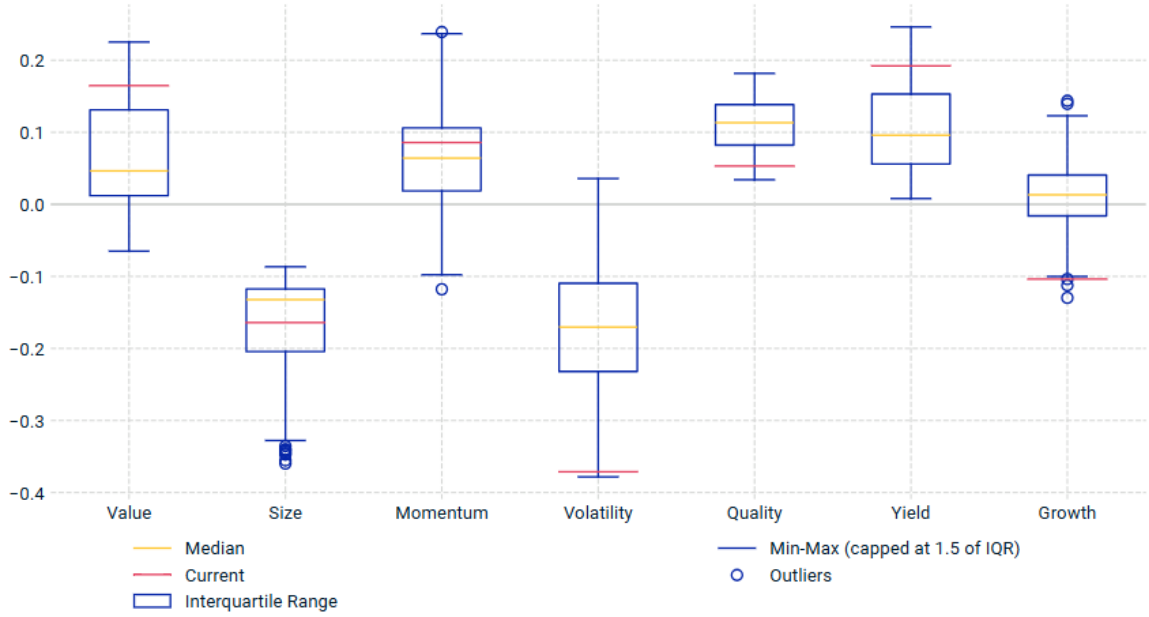


MSCI data based on monthly exposures from June 30, 1999, to May 30, 2025. Exposures were calculated based on MSCI's FaCS methodology.

As a comparison, the following figure shows the BM index active exposure to component factors. As expected, the BM exhibits lower exposure to target factors compared to the individual single-factor

indexes. This is due to offsetting effects, where opposing exposures to the same factor from different single-factor components can partially cancel each other out as well as the arithmetic of factor exposure dilution in an equal-weighted mix. Despite this moderation, the BM largely maintained the desired overall directional exposure to each target factor.

Target active factor exposures for balanced mix index

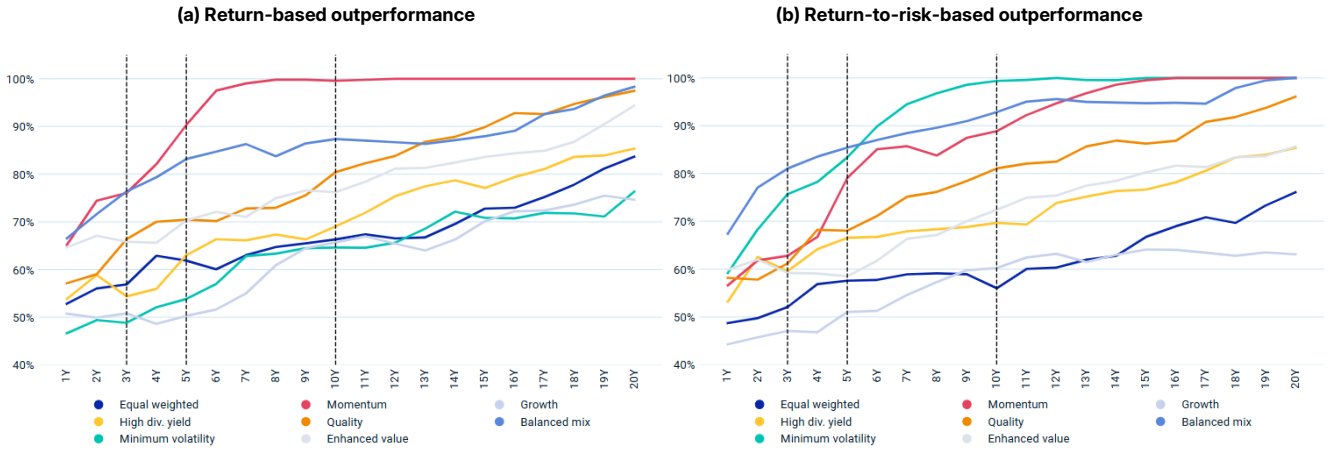


MSCI data based on monthly exposures from June 30, 1999, to May 30, 2025. Exposures were calculated based on MSCI's FaCS methodology.

The charts below analyze the frequency of outperformance, or hit ratio, for the factor indexes relative to the MSCI World Index, based on both absolute and risk-adjusted returns over rolling periods ranging from one to 20 years. The results highlight that the frequency of factors outperforming increased meaningfully with longer investment horizons.

Momentum outperformed the MSCI World Index in 90% of 5-year rolling periods based on absolute returns, but it took over 10 years to reach that same level of consistency in terms of risk-adjusted returns. In contrast, minimum volatility had one of the lowest hit ratios for absolute returns yet achieved one of the highest hit ratios for risk-adjusted performance. The BM approach demonstrated stronger hit ratios than most single-factor indexes across different time horizons — both for total return and risk-adjusted performance.

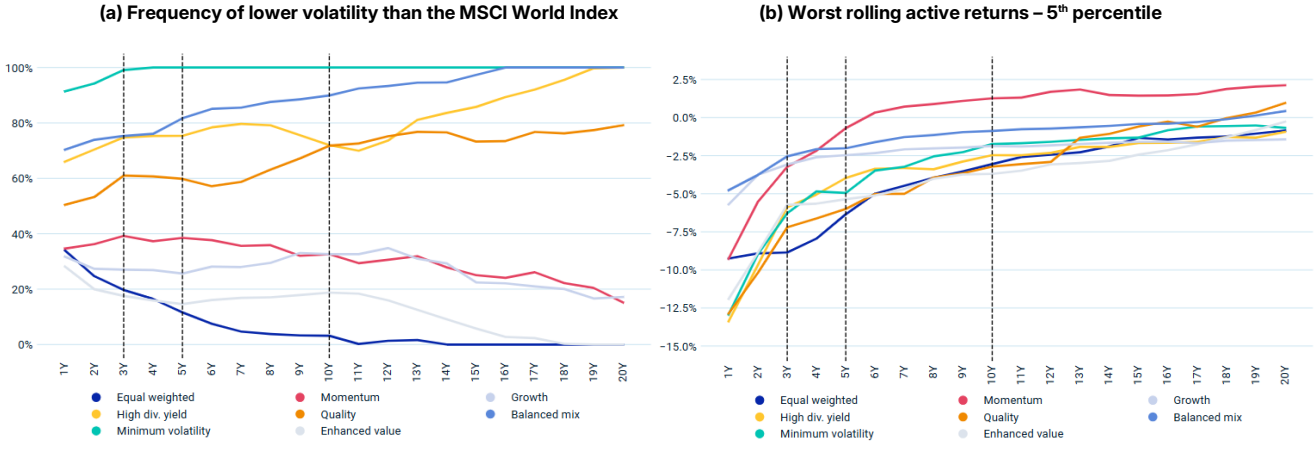
Frequency of MSCI World factor indexes outperforming parent index over rolling periods



MSCI data from Nov. 28, 1975, to May 30, 2025. Returns are in USD and observed monthly.

The figures below pivot to a more risk-focused assessment. On the left-hand side, we show the frequency with which each factor has historically exhibited lower volatility than the MSCI World Index. Strategies such as minimum volatility, by design, consistently maintained lower risk profiles across all horizons, and almost without fail beyond three years. Conversely, factors like momentum and enhanced value typically carry higher volatility relative to the benchmark. The right-hand side chart displays the worst active returns (5th percentile) for rolling periods from one to 20 years, as an indication of the downside risk or worst-case scenario investors have faced. Notably, extending the investment horizon substantially reduced the severity of these adverse outcomes for all factors. Further, combining factors resulted in improved risk mitigation compared to many single factor indexes.

Frequency of factor indexes having lower volatility than the MSCI World Index over rolling periods



MSCI data from Nov. 28, 1975, to May 30, 2025. Returns are in USD and observed monthly.

The next table shows maximum active return drawdowns and their historical durations. Single-factor indexes have historically experienced substantial periods of underperformance, as indicated by significant maximum active return drawdowns ranging from -23.8% (momentum) to -39.2% (enhanced value). More notably, these drawdowns have persisted for extended periods, often lasting multiple years,

such as the 263-month duration seen for the growth factor and 183 months for enhanced value. Such prolonged periods of underperformance that far exceed conventional manager appraisal intervals can be challenging for investors in terms of capital allocation. Adopting a diversified approach, such as the BM, has historically reduced the magnitude (-14.5%) and maximum duration (81 months) of such periods.

Key risk metrics

	World	Equal weighted	High div. yield	Minimum volatility	Momentum	Quality	Enhanced value	Growth	Balanced mix
Absolute risk metrics									
Total risk* (%)	14.7	15.5	13.9	11.6	15.7	14.4	16.1	15.1	14.0
Maximum drawdown (%)	-53.7	-55.8	-58.8	-43.0	-52.5	-44.5	-57.9	-50.7	-54.2
Maximum drawdown period (months)	15	15	15	15	15	15	15	15	15
Relative risk metrics									
Tracking error* (%)		4.9	6.1	6.3	7.8	5.5	6.6	3.0	3.1
Maximum active returns drawdown (%)	0.0	-36.2	-31.7	-33.0	-23.8	-37.1	-39.2	-30.9	-14.5
Maximum active returns drawdown period (months)	0	64	157	102	45	156	183	263	81

MSCI data from Nov. 28, 1975, to May 30, 2025. *Total risk annualized in USD.

The table below analyzes the performance of factor indexes in distinct market conditions, segmented into up and down markets relative to the MSCI World Index. Except for the equal-weighted and growth factors, all single-factor indexes, as well as the BM exhibited a pronounced disparity between their up- and down-market capture ratios. This spread in capture ratios expresses their historical effectiveness in preserving capital during market declines while still offering the upside potential during upswings.

Up- and down-market metrics

	World	Equal weighted	High div. yield	Minimum volatility	Momentum	Quality	Enhanced value	Growth	Balanced mix
Up markets* (372 out of 594 months)									
Average monthly return (%)	3.4	3.4	3.1	2.7	3.6	3.3	3.6	3.5	3.4
Average monthly active return (%)		-0.0	-0.4	-0.8	0.2	-0.1	0.1	0.0	-0.1
Capture ratio (%)		99.9	89.5	77.7	105.2	96.6	103.6	101.4	97.5
Down markets (222 out of 594 months)**									
Average monthly return (%)	-3.3	-3.1	-2.5	-2.1	-2.9	-2.8	-2.9	-3.3	-2.9
Average monthly active return (%)		0.2	0.8	1.2	0.3	0.5	0.4	-0.1	0.4
Capture ratio (%)		94.8	76.2	63.3	90.0	85.1	88.3	102.2	87.5

MSCI data from Nov. 28, 1975, to May 30, 2025. Returns in USD. *Months when MSCI World Index had positive returns. ** Months when MSCI World Index had negative returns.

To better understand factor index performance through prior macroeconomic cycles, we defined four regimes: heating up (rising growth, rising inflation), goldilocks (rising growth, falling inflation), slow growth (falling growth, falling inflation) and stagflation (falling growth, rising inflation). We calculated the average active returns of the factor indexes during each regime over the past 50 years.[5]

Historically, defensive factors such as minimum volatility, quality and high dividend yield have performed well in periods characterized by slowing growth (slow growth and stagflation) and lagged in periods of

[5] We classified each month from December 1975 through May 2025 into one of the four regimes based on the rise or fall of the OECD Composite Leading Indicator (CLI) (our proxy for growth) and the OECD Consumer Price Index (CPI) (our proxy for inflation). We used the month-on-month change for CLI and the recent 3mma less the 36mma for CPI. The regimes had the following number of monthly observations: stagflation (106), slow growth (190), goldilocks (213) and heating up (84). The approach taken here is consistent with Gupta et. al. "Index Performance in Changing Economic Environments," MSCI Research Insight, April 2014.

rising growth (heating up and goldilocks). Enhanced value and equal weighted indexes have in contrast performed particularly strongly during goldilocks. Both momentum and the BM consistently delivered returns across regimes over the long-run study period.

Factor indexes and their response to macro environment regimes

	Heating up	Goldilocks	Slow growth	Stagflation
Equal weighted	0.0%	0.4%	-0.2%	-0.2%
High div. yield	-0.1%	-0.0%	0.1%	0.2%
Minimum volatility	-0.5%	-0.4%	0.3%	0.4%
Momentum	-0.0%	0.3%	0.2%	0.4%
Quality	0.1%	-0.1%	0.3%	0.3%
Enhanced value	0.3%	0.7%	-0.1%	-0.1%
Growth	-0.0%	0.1%	-0.0%	-0.0%
Balanced mix	-0.0%	0.2%	0.0%	0.1%

MSCI data from Nov. 28, 1975, to May 30, 2025. Average monthly active returns in USD relative to MSCI World.

In the tables below, we present correlations between financial and economic indicators with forward excess returns of MSCI World factor indexes over 3-year and 5-year horizons. The high dividend yield and enhanced value indexes exhibited consistently positive correlations with short-term interest rates (3M T-Bill) and inflation (CPI), suggesting stronger relative performance in environments of rising interest rates and inflationary pressures. The growth index had negative correlations with yield spreads (10Y-3M) and CPI, suggesting potential vulnerability in periods of rising macro uncertainty or inflation.

The quality factor has had consistently negative correlations with nearly all economic indicators, particularly interest rate-related measure, i.e., its relative performance has tended to weaken in high-interest-rate or inflationary environments. Minimum Volatility has had generally low or mixed correlations. Finally, the BM approach demonstrated moderate and relatively balanced correlations with indicators across both horizons.

Correlation of macro indicators with forward 3-yr excess returns

	Equal weighted	High div. yield	Minimum volatility	Momentum	Quality	Enhanced value	Growth	Balanced mix
3M T bill	0.10	0.29	0.19	0.02	-0.08	0.25	-0.32	0.21
10Y rate	0.10	-0.16	-0.06	0.21	-0.22	-0.06	0.05	-0.04
10Y-3M	0.20	-0.08	0.02	0.07	-0.42	0.00	-0.26	-0.06
10Y-2Y	0.14	-0.18	0.00	0.05	-0.25	-0.06	0.04	-0.08
AAA-10Y	0.28	0.05	0.11	-0.33	-0.16	0.07	0.04	0.02
CPI	0.14	0.23	0.03	0.04	-0.18	0.20	-0.47	0.12
Money M1 growth	-0.02	-0.07	-0.11	-0.10	-0.04	-0.05	-0.04	-0.10

Correlation of macro indicators with forward 5-yr excess returns

	Equal weighted	High div. yield	Minimum volatility	Momentum	Quality	Enhanced value	Growth	Balanced mix
3M T bill	0.21	0.33	0.23	-0.04	-0.32	0.33	-0.42	0.22
10Y rate	-0.08	-0.15	-0.18	0.36	0.02	-0.13	0.12	-0.06
10Y-3M	-0.05	-0.03	0.00	0.27	-0.19	-0.07	-0.16	-0.04
10Y-2Y	-0.08	-0.20	-0.07	0.26	0.02	-0.18	0.15	-0.10
AAA-10Y	0.14	-0.06	0.03	-0.16	-0.14	-0.06	0.27	-0.04
CPI	0.19	0.32	0.12	0.03	-0.33	0.26	-0.57	0.16
Money M1 growth	-0.05	-0.10	-0.12	-0.07	-0.02	-0.07	0.01	-0.11

Macro data sourced from FRED and OECD. 10Y-3M data from Dec. 1981, 10Y2Y data from May 1976 and AAA-10Y data from Dec. 1982. Monthly excess returns from Nov. 28, 1975, to May 30, 2025.

Investability and replicability of factor indexes is a key consideration for investors. Next, we look at the capacity and concentration metrics for MSCI World factor indexes. All the single-factor indexes had higher concentration than the broad market, with factors like quality and momentum having the highest top-10 constituent weights (31.3% and 27.5%, respectively) and lower effective numbers of constituents. In contrast, the equal weighted and BM had much lower concentration. BM had lower active share (32%) than all the single-factor indexes. Overall, the analysis flags few concerns on capacity given the low float market cap ownership metrics across all factor indexes.

Capacity and concentration

	World	Equal weighted	High div. yield	Minimum volatility	Momentum	Quality	Enhanced value	Growth	Balanced mix
Concentration*									
Average number of constituents	1608	1608	367	289	347	298	397	246	1608
Effective number of constituents	284	1570	88	159	82	63	120	96	337
Parent index coverage (%)	100.0	100.0	27.1	36.3	26.2	31.4	18.4	21.1	100.0
Top 10 constituents weight (%)	13.0	1.0	25.1	13.5	27.5	31.3	20.1	23.0	10.8
Size family exposures**									
Large (%)	83.4	44.4	89.3	75.1	81.3	88.1	80.5	78.8	76.8
Mid (%)	16.6	55.6	10.7	24.9	18.7	11.9	19.5	21.2	23.2
Small (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Micro (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Index capacity - float market cap ownership***									
Average (%)	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.00
95th percentile (%)	0.00	0.02	0.01	0.03	0.01	0.01	0.02	0.01	0.01
Maximum (%)	0.00	0.03	0.01	0.03	0.01	0.01	0.04	0.02	0.01
Index capacity - full market cap ownership***									
Average (%)	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.00
95th percentile (%)	0.00	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.00
Maximum (%)	0.00	0.03	0.01	0.03	0.01	0.01	0.04	0.01	0.01
Degree of index tilt*									
Active share (%)	0.0	49.8	72.9	72.2	73.8	68.6	81.6	82.0	32.0
Average weight multiplier	1.0	4.3	3.8	8.3	4.5	3.4	7.4	8.8	1.6
Maximum weight multiplier	1.0	60.7	4.0	24.0	7.8	5.0	37.3	10.3	12.4
Maximum weight (%)	2.5	0.1	4.0	1.6	5.0	5.3	3.3	3.4	1.7

MSCI data from Nov. 30, 1999, to May 30, 2025. * Monthly averages. ** Monthly averages, size family data available from June 2008 *** Assuming a fund size of USD 1.0 billion as of the latest index review on Nov. 25, 2024.

In the table below, we highlight the liquidity characteristics and projected replication costs associated with MSCI World factor indexes. Momentum index, by design, exhibits highest one-way turnover of 92.8% leading to elevated projected replication costs. The minimum volatility and high dividend yield

factors have relatively moderate turnover and hence lower replication costs. The BM index had moderate turnover (28.4%), reflecting an effective compromise between factor exposure and liquidity. In terms of trading metrics, the number of "days to trade" remained consistently low across all single factor indexes.

Liquidity metrics and cost of replication

	World	Equal weighted	High div. yield	Minimum volatility	Momentum	Quality	Enhanced value	Growth	Balanced mix
ATVR* (%)	143.9	145.7	96.7	113.4	157.4	121.8	128.9	161.0	132.4
Days to trade - periodic index review**									
Average	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0
95th percentile	0.0	0.0	0.2	0.3	0.2	0.1	0.1	0.4	0.0
95% of all trading volume	0.0	0.1	0.2	0.3	0.1	0.1	0.1	0.3	0.0
Maximum	0.1	0.8	0.5	1.2	0.5	0.3	0.7	0.8	0.2
Days to trade - relative to benchmark***									
Average	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0
95th percentile	0.0	0.3	0.1	0.3	0.1	0.1	0.2	0.2	0.1
95% of all trading volume	0.0	0.2	0.1	0.3	0.1	0.1	0.2	0.2	0.1
Maximum	0.0	1.7	0.4	1.8	0.4	0.3	0.8	0.6	0.3
Days to trade - relative to cash***									
Average	0.0	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.0
95th percentile	0.1	0.3	0.2	0.7	0.2	0.2	0.4	0.5	0.1
95% of all trading volume	0.0	0.2	0.2	0.4	0.1	0.1	0.3	0.3	0.1
Maximum	0.2	1.8	0.6	1.9	0.6	0.4	0.9	0.6	0.3
Cost of replication									
Turnover** (%)**	2.6	15.9	19.3	23.7	93.4	22.4	29.6	41.6	28.4
Performance drag at 25 bps*** (bps)**	1.3	8.0	9.7	11.8	46.7	11.2	14.8	20.8	14.2
Performance drag at 50 bps*** (bps)**	2.6	15.9	19.3	23.7	93.4	22.4	29.6	41.6	28.4
Performance drag at 75 bps*** (bps)**	3.8	23.9	29.0	35.5	140.0	33.6	44.4	62.4	42.7

* As of May 30, 2025 ** Average of last four index reviews ending May 30, 2025, and assuming a fund size of USD 1.0 billion and a maximum daily trading limit of 20% *** As of the latest index review on Nov. 25, 2024 **** Annualized one-way index turnover over index reviews ***** Performance drag aims to represent the total two-way annualized index level transaction cost assuming various levels of security level transaction cost.

Performance challenges in factor investing over the past decade

While factor performance has historically shown cyclicality, the past decade was particularly challenging. Four out of seven MSCI single-factor indexes underperformed the MSCI World Index by 2.6% to 3.5% annually over the last 10 years, with enhanced value lagging the most. Momentum, quality and growth were the outperforming factor indexes during this period.

Performance by decade

	Nov-75 to Oct-85		Nov-85 to Oct-95		Nov-95 to Oct-05		Nov-05 to Oct-15		Nov-15 to May-25	
	Return/risk	Active return (%)	Return/risk	Active return (%)	Return/risk	Active return (%)	Return/risk	Active return (%)	Return/risk	Active return (%)
World	1.1	-	0.9	-	0.5	-	0.4	-	0.8	-
Equal weighted	1.3	3.1%	1.0	1.6%	0.6	1.3%	0.4	0.4%	0.5	-3.0%
High div. yield	1.4	3.4%	1.0	0.8%	0.9	4.0%	0.3	-0.2%	0.7	-2.8%
Minimum volatility	1.3	0.6%	1.0	-0.7%	0.9	1.6%	0.6	1.4%	0.8	-2.6%
Momentum	1.1	2.8%	1.0	3.1%	0.7	4.7%	0.5	1.9%	0.9	2.3%
Quality	0.9	-2.0%	1.0	1.4%	0.7	3.0%	0.6	3.0%	0.9	2.0%
Enhanced value	1.4	4.8%	1.1	3.7%	1.0	8.1%	0.3	0.5%	0.5	-3.5%
Growth	0.8	-2.9%	0.8	-1.1%	0.6	2.0%	0.4	0.8%	0.8	1.0%
Balanced mix	1.3	1.7%	1.1	1.6%	0.8	4.1%	0.4	0.8%	0.8	-0.8%

Gross performance in USD relative to MSCI World.

Performance attribution unpacks the drivers behind this. For most factor strategies, target factors contributed positively to performance (equal weighted and minimum volatility were the exception with a small drag). The primary source of underperformance were stock-specific effects with some of the largest negative contributors being mega-cap tech companies. Many factor indexes systematically underweight these due to their expensive valuations, high beta or other historically unfavorable style exposures. Even in the BM index — where most factor exposures contributed positively — stock-specific effects were the largest drag, ultimately driving its underperformance.

Stock-specific effects drove largest underperformance over past 10 years

	Equal weighted	High div. yield	Minimum volatility	Momentum	Quality	Enhanced value	Growth	Balanced mix
				Returns (%)				
Total	8.51	8.70	8.93	13.85	13.55	8.05	12.50	10.74
Benchmark	11.53	11.53	11.53	11.53	11.53	11.53	11.53	11.53
Active	-3.03	-2.83	-2.60	2.32	2.02	-3.48	0.96	-0.79
Specific	-1.72	-1.62	-1.25	1.29	0.34	-3.58	0.47	-0.83
Currencies	-0.52	-0.28	-0.07	0.01	0.13	-0.66	-0.18	-0.23
Common factor	-0.78	-0.93	-1.28	1.02	1.55	0.75	0.67	0.26
Countries	0.10	0.01	0.22	-0.01	0.20	-0.02	0.19	0.11
Industries	-0.17	-0.82	-0.59	0.13	1.41	-0.05	-0.39	-0.04
Market	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Styles	-0.71	-0.12	-0.91	0.89	-0.06	0.82	0.87	0.19
Target style factors	-0.57	0.16	-0.69	2.00	0.80	1.35	0.49	0.22
Non-target style factors	-0.14	-0.28	-0.22	-1.08	-0.83	-0.53	0.39	-0.02

Period: Nov. 30, 2015, to May 30, 2025. Monthly returns in USD. Return decomposition using the MSCI Global Equity Risk Model (EFMGEMLT).

A modern playbook for factor portfolio construction

For both institutional and wealth investors, factor investing has moved beyond the traditional catalogue of value, size, momentum and quality. The increasing weight of intangible assets in corporate balance sheets, the proliferation of alternative data sets and shifts in market micro-structure have highlighted limitations in legacy signals. Classic book-to-price ratios systematically undervalue firms with substantial R&D and brand capital. Momentum exposures can unwind sharply when indexed portfolios become crowded. Style tilts that omit explicit macro considerations will likely leave portfolios exposed to geopolitical uncertainty or inflation shocks. Investors have become more interested in novel, emergent or episodic drivers of return even if they can't be validated by the usual factor model econometrics. In response, practitioners are refining the usual factor toolkit — integrating intangible-adjusted valuation metrics, macro-sensitive style definitions, crowding scores, low-carbon proxies and machine-learning-derived patterns into risk models and factor allocations.

The explorations that follow look at four applications of this modern factor playbook. More specifically, we dive into the following areas:

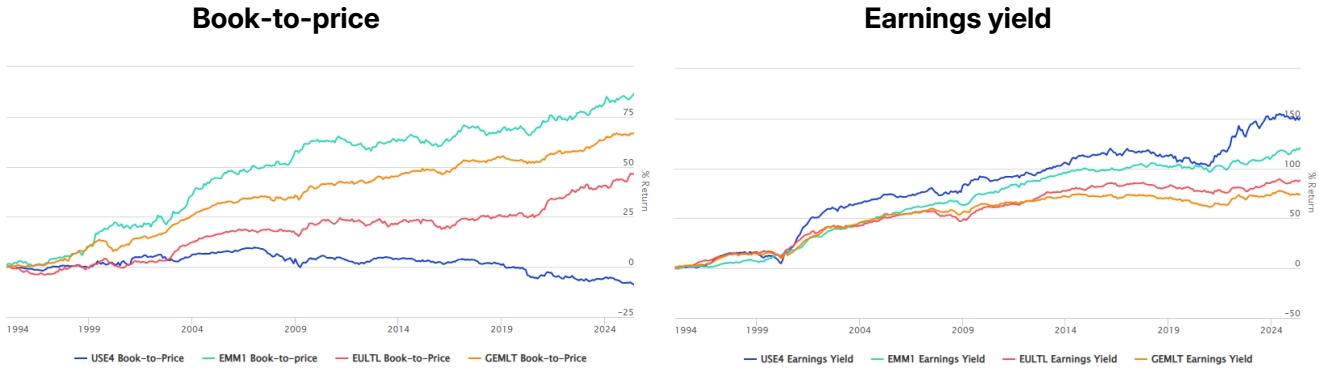
- Evaluation of how re-engineering valuation ratios to capitalize R&D and other intangibles can potentially revitalize the traditional value factor.
- Discussion of how growth exposures are increasingly expressed through thematic baskets linked to robotics and artificial intelligence, digital health and comparable secular trends.
- Demonstration of how crowding analytics can identify and mitigate concentrations within momentum-oriented and sentiment-driven portfolios.
- Assessment of how portfolios might be hedged against changes in interest rates.

Collectively, these case studies underscore that the evolution of factor investing need not be a total departure from foundational principles, but more a systematic enhancement of signals and construction techniques aimed at delivering more resilient outcomes.

Re-engineering value for an intangible economy

Value investing, rooted in Benjamin Graham's discipline of buying companies priced below intrinsic worth first described in the 1930s and 1940s, generated strong excess returns through the 2000s — especially in the wake of the dot-com bust. The subsequent decade, however, marked one of the most protracted drawdowns in the factor's history. From 2010 onward, MSCI's global and regional risk models show that traditional value descriptors such as book-to-price and earnings-yield generated muted or even negative excess returns in developed markets, with the shortfall most acute in the book-to-price metric for the U.S.

Value performance



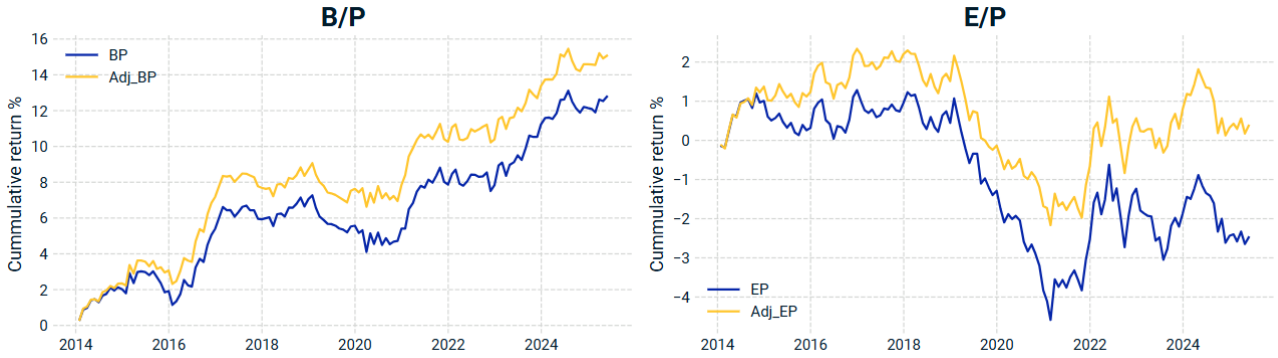
MSCI data from Dec. 29, 1994, to May 30, 2025. Pure factor returns from the MSCI global and regional equity risk models.

This extended value drawdown has prompted a broad re-examination of value's construction, its relevance in a changing market and capital structure, and the adjustments needed prospectively to restore its full effectiveness. A structural headwind has been the economy's pivot toward intangible-rich, asset-light business models. Between 1990 and 2020, the share of intangibles in corporate balance sheets rose from 18 % to 39 % and R&D spending climbed from 4.6 % to 10.2 % of cost of goods sold (J.P. Morgan 2020). Standard accounting treats plant and equipment as capital to be amortized, yet often expenses R&D immediately, thus understating the book equity of firms whose value is embedded in intellectual property, software and brand equity. Traditional value ratios will therefore tend to penalize

many of today's more innovative and service-based companies, systematically excluding them from classic value portfolios.

One way to address this mismatch is to capitalize R&D, adding it to the balance sheet as an intangible asset and amortizing the expense over its useful life. Value descriptors — book-to-price and earnings-to-price — when recalculated with this adjustment have seen superior outcomes. Since 2014, the R&D-adjusted book-to-price and earnings-to-price factors have outperformed their unadjusted counterparts, both in absolute terms and on a risk-adjusted basis.

Capitalization of R&D improved performance of value metrics



MSCI data from Jan. 31, 2014, to May 30, 2025. R&D adjustments to value factors — specifically book-to-price and earnings-to-price — are analyzed by incorporating the adjusted factors into the MSCI Global Equity Risk Model (GEMLT), replacing the model's corresponding unadjusted factors. Using multivariate regression, we calculate the factor returns. We then compare the adjusted and unadjusted factor returns to assess the impact of the R&D adjustment. Factor returns represent the performance of pure factor portfolios, which have exposure of one to the target factor and no exposure to country, industry, or other style factors.

There are other factors that were also responsible for value's disappointing performance. A decade of low interest rates and modest inflation favored growth over value, as that combination disproportionately benefits companies with long-duration cash flows. This resulted in widening of valuation spreads between cheap and expensive stocks and the dislocation failed to quickly trigger any mean reversion.

Beyond macro and accounting-related limitations, the construction of value strategies has also come under scrutiny. Value indexes can unintentionally carry exposure to low-quality or high-volatility stocks, obscuring the intended signal. Purifying value — removing overlapping exposures to other factors — has also been proposed as a key enhancement (Alighanbari et al. 2022). Furthermore, comparisons to a stock's own historical valuation, rather than a sole reliance on cross-sectional multiples, can offer additional insight into mispricing (Virgaonkar et al. 2021, Sze et al. 2025).

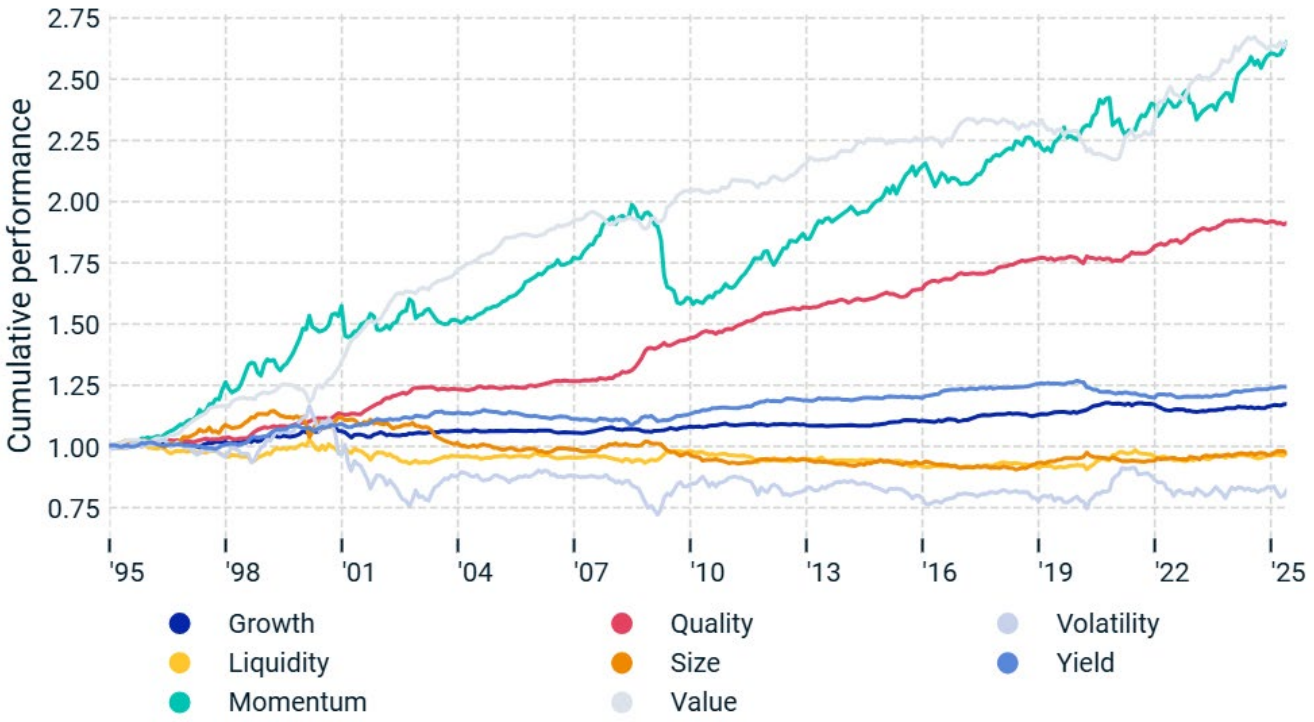
Despite these headwinds, value investing continues to offer long-term potential. Its cyclicality is well-documented. Value drawdowns, while painful, have historically been followed by periods of recovery and outperformance. Instead of abandoning the style, investors may wish to consider modernizing their approach — incorporating intangible adjustments, diversifying value definitions, applying sector controls and using more refined index construction techniques that control for specific risk.

The growth of growth investing

Growth investing, while long practiced by active managers, has historically played second fiddle to value in the academic literature and quantitative investing frameworks.[6] (That is less than surprising when we recall the hugely extended historical active drawdown presented earlier).The roots of growth investing can be traced back to early 20th-century investors who focused on companies with strong earnings potential and reinvestment prospects. However, it was value investing — popularized by Benjamin Graham and formalized by Fama and French — that gained early academic validation and a more defined role in systematic investing and public funds.

Decades of cross-sectional studies had established that a pure growth factor — typically defined by high historical or expected earnings and sales growth — had not delivered a persistent positive risk premium the way value, momentum or quality had done so. Projected company earnings growth and high investment in assets was typically followed by disappointment by corporate performance. MSCI's pure factor returns reflect the same long-run story: over the past 30 years growth has lagged all the classic rewarded factors.

Pure growth has historically lagged other traditional style factors



MSCI data from Dec. 31, 1999, to May 30, 2025. Pure factor performance based on MSCI Global Equity Risk Model (GEMFaCS).

[6] The growth factor has been investigated in several empirical studies, for example, Ofer (1975), Bauman and Dowen (1988), Harris (1999), Fama and French (2002, 2006) and Arnott and Asness (2003).

Practitioners, however, rarely implement growth as a single, clean factor. Instead, they tend to build style portfolios of companies with rapidly expanding revenues, cash-flows or addressable markets — attributes often accompanied by richer valuations, higher volatility and lower dividend payout. This broader definition has enjoyed periodic leadership. After the 2008 global financial crisis, an extended period of low interest rates and accommodative monetary policy created a supportive backdrop for growth stocks. Between 2015-2020, innovation and disruption drove capital into growth companies leading the digital transformation; and more recently and since late 2022 in particular, the rapid advancement of artificial intelligence (AI) has triggered a new wave of enthusiasm for growth-oriented firms, especially in the U.S.

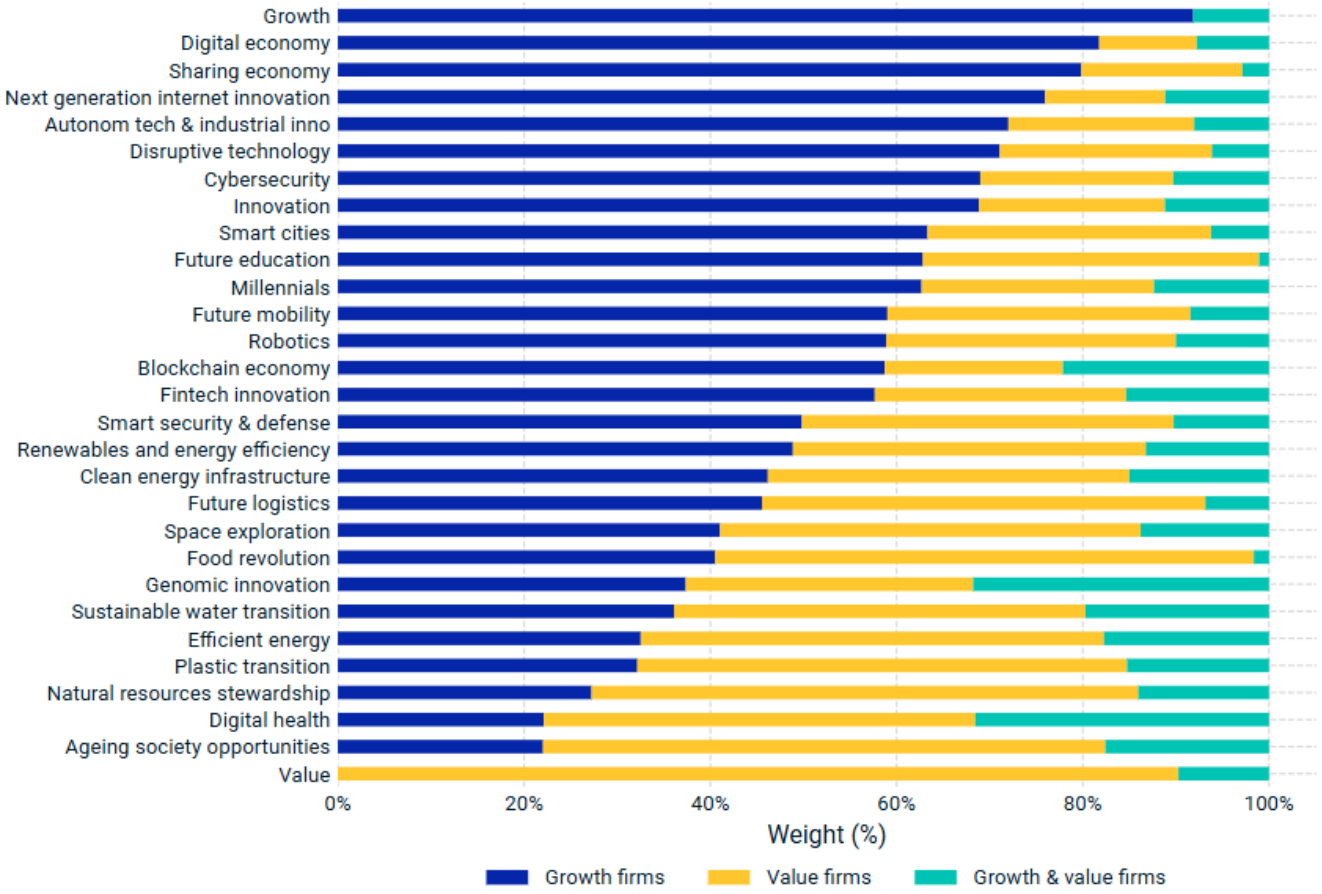
From 2008 to mid-2020, the MSCI Growth indexes beat their parent benchmarks in the U.S., developed ex-U.S. and emerging markets (EM) universes. However, since late 2022, performance has splintered: U.S. growth, dominated by AI champions, has kept outperforming, while growth in the rest of the world has lagged.

Performance of growth style relative to market capitalization

MSCI data from Dec. 31, 1999, to May 30, 2025. Performance of MSCI Growth style indexes relative to corresponding MSCI parent indexes.

Firms leading in innovation and disruption, especially those aligned with long-term secular themes, have consistently attracted investor attention. The growth theme and its performance is now closely intertwined with such trends — for example, the digital economy, future mobility and autonomous technology. As shown below, growth companies dominate MSCI thematic indexes associated with technology and innovation, highlighting the concentration of high-growth potential in a relatively small group of firms. The thematic lens has provided investors with new and alternative means to express their confidence in growth-oriented firms (Doole et al 2020, Doole and Rao 2021).

Growth firms dominate technology and innovation themes

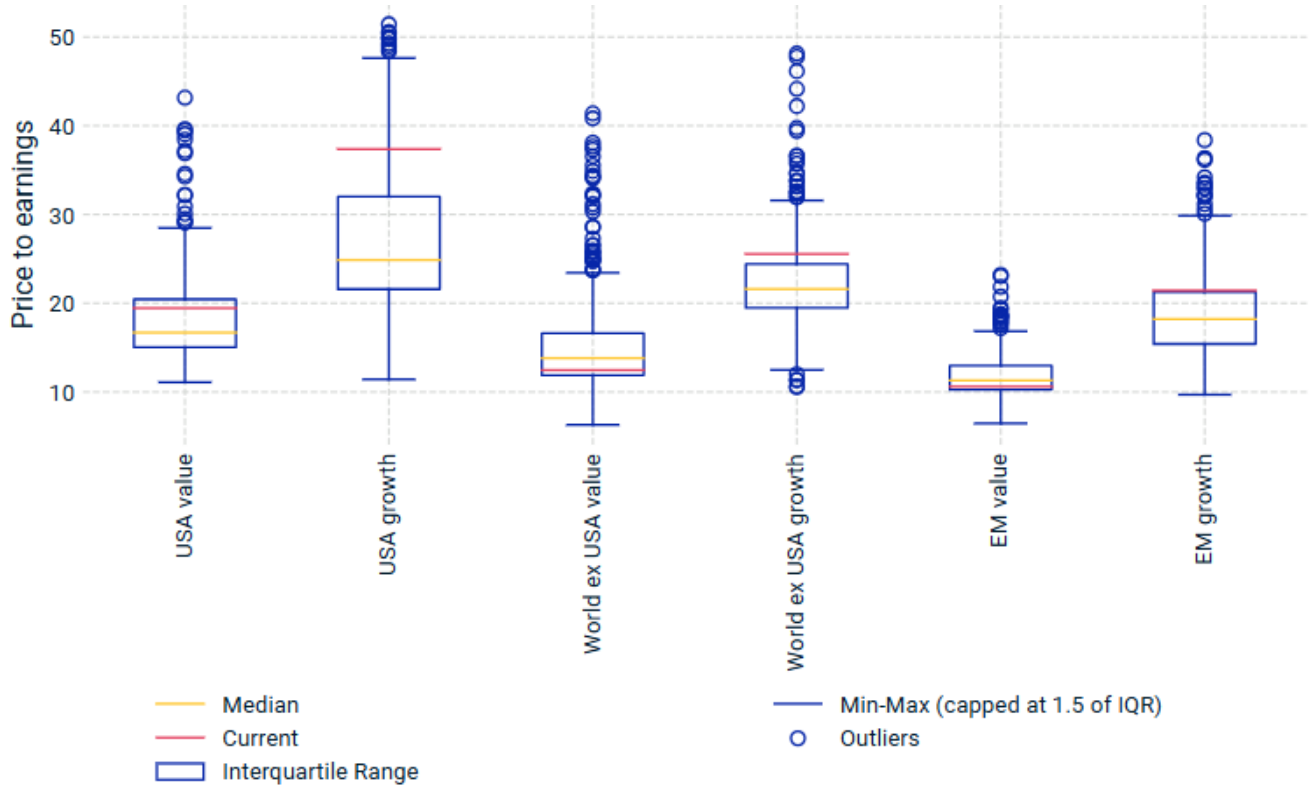


MSCI data as of May 30, 2025. The chart shows overlap between MSCI Thematic Indexes and MSCI Value & Growth style indexes — we calculate the weight in MSCI Thematic Indexes that are constituents of the MSCI Value or MSCI Growth style indexes.

Despite this recent success, growth investing faces challenges that warrant close investor scrutiny. Elevated valuations, often driven by ambitious expectations for future earnings and new category growth, can leave growth stocks vulnerable to downside risk — particularly if those expectations were to be disappointed, as macro conditions deteriorate.

Growth stocks consistently trade at higher valuation multiples than value stocks across all major regions, as shown below. Moreover, the current growth premium has risen above historical averages, especially in the U.S.

Growth associated with higher valuations

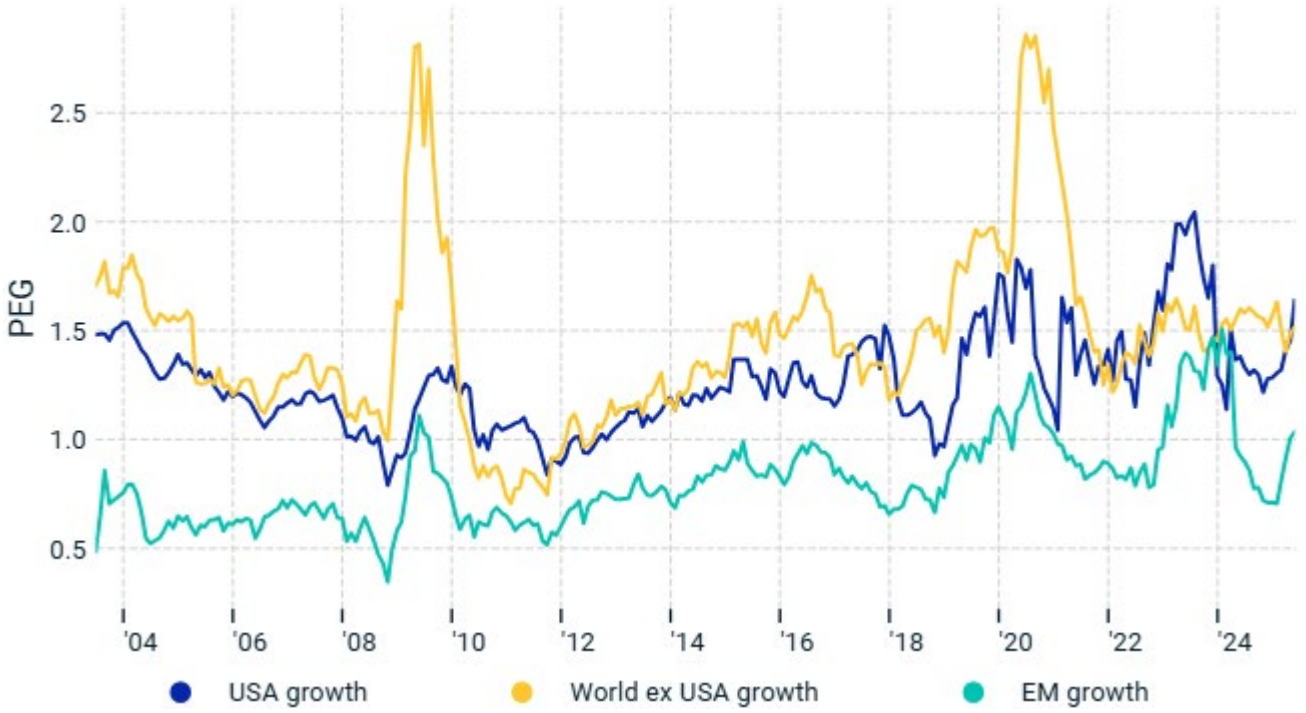


MSCI data based on monthly snapshots from Dec. 31, 1999, to May 30, 2025.

Whether today's premium is warranted can be tested with a price-to-earnings-growth (PEG) lens, which gauges how much investors are paying for each unit of forward EPS growth.[7] Recent PEG readings indicate that both U.S. and developed-ex-U.S. growth segments are trading above levels justified by current consensus growth forecasts. The U.S. divergence is especially notable: Year-to-date downgrades to 2025–26 earnings have left valuations richer than at the start of the year.

[7] The PEG ratio is considered fairly priced at one by convention, as popularized by Peter Lynch (One Up on Wall Street, 1989). Unity reflects a balance where the current P/E ratio aligns with the expected growth rate.

Developed market valuations not fully supported by growth expectations



MSCI data from June 30, 2003, to May 30, 2025. Earnings multiple and long-term forward earnings growth based on MSCI Fundamental Data Methodology.

With interest rates seeming to be normalizing and capital costs rising, the favorable conditions that supported growth's dominance since 2008 may no longer hold. As a result, long-duration, high-growth assets could come under pressure if markets begin to reprice based on more disciplined or cautious valuation assumptions. Investors who wish to keep a growth allocation, yet temper the risk, might adopt a growth-at-reasonable-price (GARP) approach. One practical implementation is to scale active weights to growth benchmarks (or thematic sleeves) in proportion to a valuation signal.

Mitigating crowding risks in portfolios

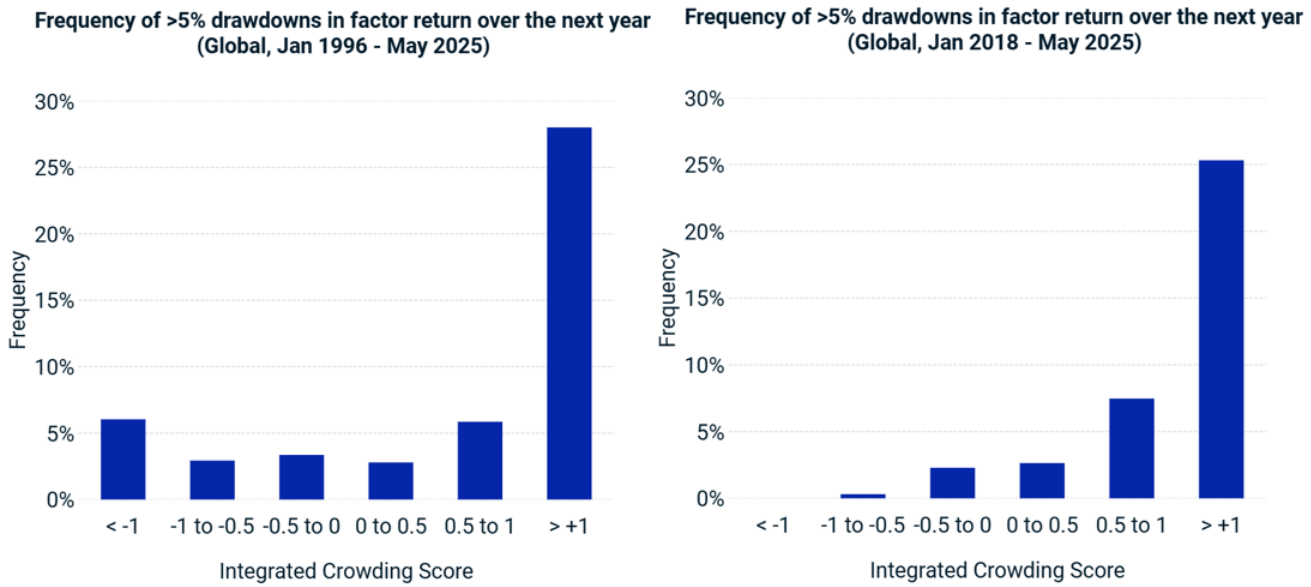
By the late 1990s quant portfolios pursuing factor strategies collectively managed hundreds of billions of dollars. Many of those quants pursued similar signals and — often unknowingly — loaded into exactly the same names, increasing the risk that a one-sided unwind could trigger sharp price dislocations.

Several market episodes have underscored this crowding risk, including the quant crunch of August 2007. These events reminded investors that a stock's crowding profile can matter as much as its book-to-price or prior return.

Empirical evidence shows that elevated levels of crowding has often foreshadowed sharp reversals at the factor level. The chart below shows the frequency of a factor experiencing a 5% or larger drawdown

over the next year based on the MSCI integrated factor crowding score.[8] For a crowding score above one, this frequency exceeded 25%, significantly higher than factors with lower crowding score. Since 2018, a period characterized by historic levels of market concentration and the dominance of technology stocks, the crowding–drawdown curve has become almost monotonic: The more crowded the factor, the higher the tail-risk.

Higher frequency of drawdown when factor crowding score was above one



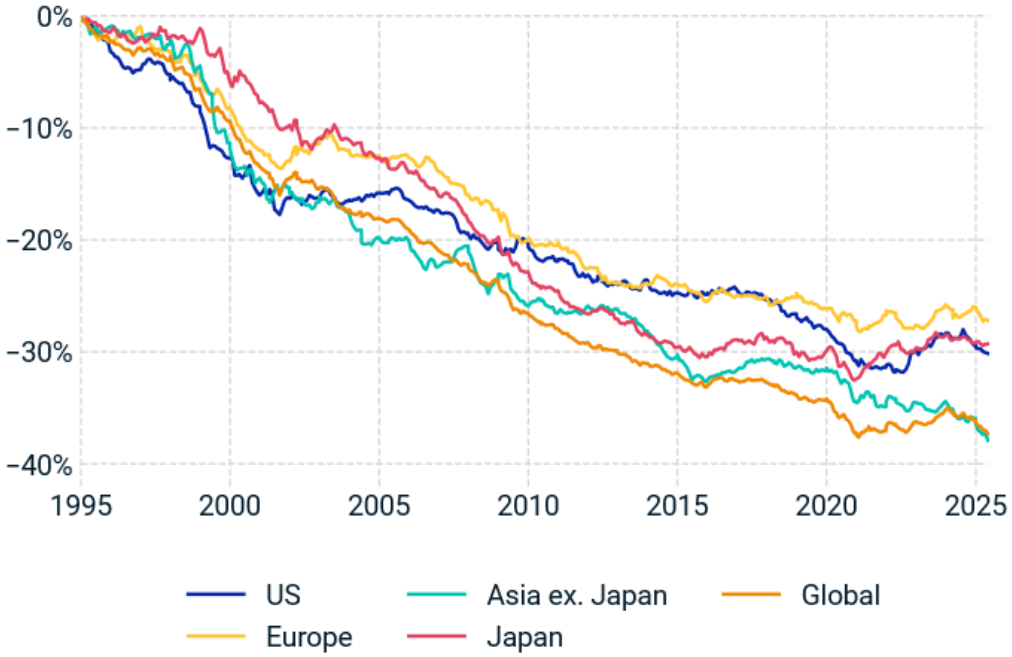
The analysis includes all factors in the Barra Global Total Market Equity Model (GEMLT). Drawdown is defined as the lowest value of cumulative factor return in next 12 months relative to the value on the evaluation date. Source: MSCI.

A similar relationship appears at the security level. Historically, crowded stocks have tended to underperform their less-crowded peers. MSCI's stock crowding factor, included in its global and regional equity trading models, captures this effect.[9]

[8] The MSCI Integrated Factor Crowding Model examines crowding in factors based on a range of metrics – valuation spreads, short interest spreads, pairwise correlations, relative volatility and factor momentum.

[9] The MSCI Stock Crowding Model seeks to highlight stocks at greater risk of being crowded by comparing the stock valuation, short interest, momentum, volatility and turnover relative to its own-history (time-series) as well as the stocks in the universe (cross-sectional). The stock crowding factor in the MSCI Equity Factor Model is based on the time-series crowding model.

Cumulative monthly return to the crowding factor



MSCI data from Jan. 31, 1995, to May 30, 2025. Returns based on MSCI Equity Factor Trading Model.

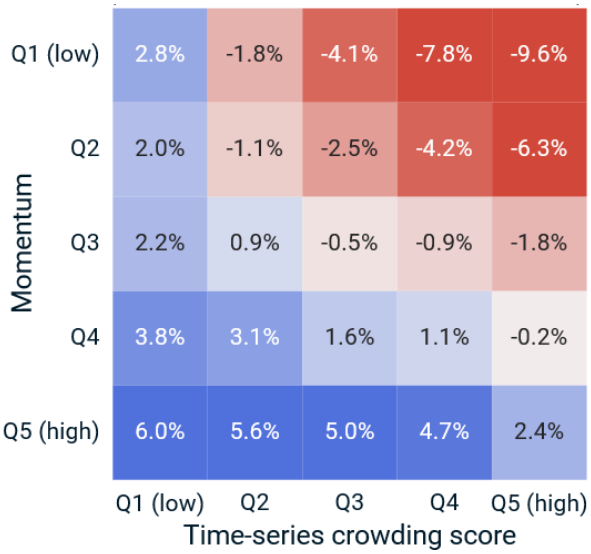
Accounting for crowding is essential for any investment strategy, especially during periods of market stress, when liquidity is scarce and risk sentiment turns rapidly. This is particularly relevant for sentiment-based or momentum strategies, which are inherently more susceptible to crowding.

Momentum — buying recent winners and selling recent losers — often leads investors toward the same narrow subset of stocks already favored by discretionary and indexed capital. While these trades may work in trending markets, they can unwind quickly when market regimes shift.

A crowding overlay allows investors to better distinguish between broadly supported price trends and over-owned names vulnerable to reversal. This concept is illustrated below, where we group global stocks into quintiles by momentum (y-axis) and plot next-month average excess return (x-axis) based on five buckets of the time-series crowding scores.

The result is that for a given level of momentum, excess returns fell consistently as crowding increases. In other words, uncrowded, high-momentum stocks historically delivered the strongest performance, while crowded, low-momentum stocks underperformed the most.

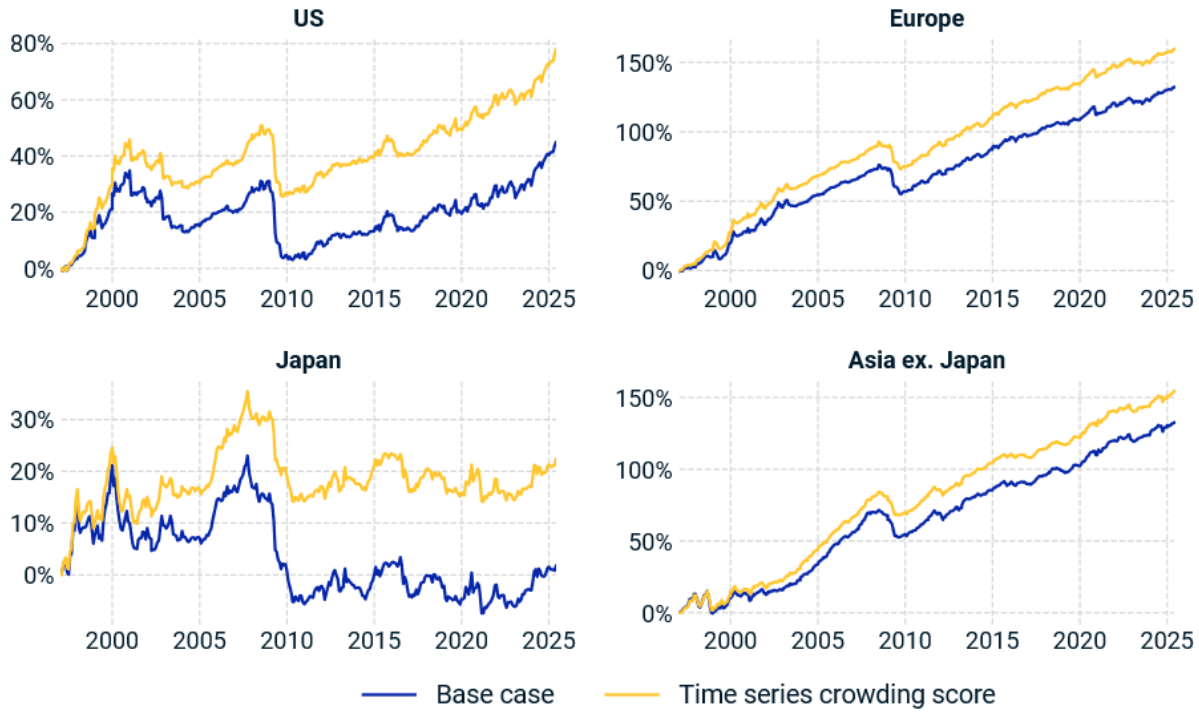
Crowding discriminated momentum returns



MSCI data from Jan. 31, 1997, to May 30, 2025. The stock universe is the MSCI ACWI IMI Index constituents. Each month, stocks are first ordered by exposure to the momentum factor, followed by the crowding score (dependent sort). This results in (roughly) equal number of stocks in each bin. Returns for each month are calculated using square-root of market cap-weighting. Monthly returns for each bin are averaged over time and adjusted for market returns. Exposures to momentum are sourced from the MSCI Global Equity Factor Model (EFMGEMLT) while the time-series crowding score is sourced from the MSCI Security Crowding Model.

Recognizing crowding as a hard-to-observe headwind to long-term wealth accumulation, we added the MSCI time-series crowding score as an additional factor to our long-term risk models and re-estimated pure-momentum returns. Neutralizing the factor's exposure to the most crowded names improved momentum's performance in every major region — U.S., Europe, Japan and Asia ex-Japan.

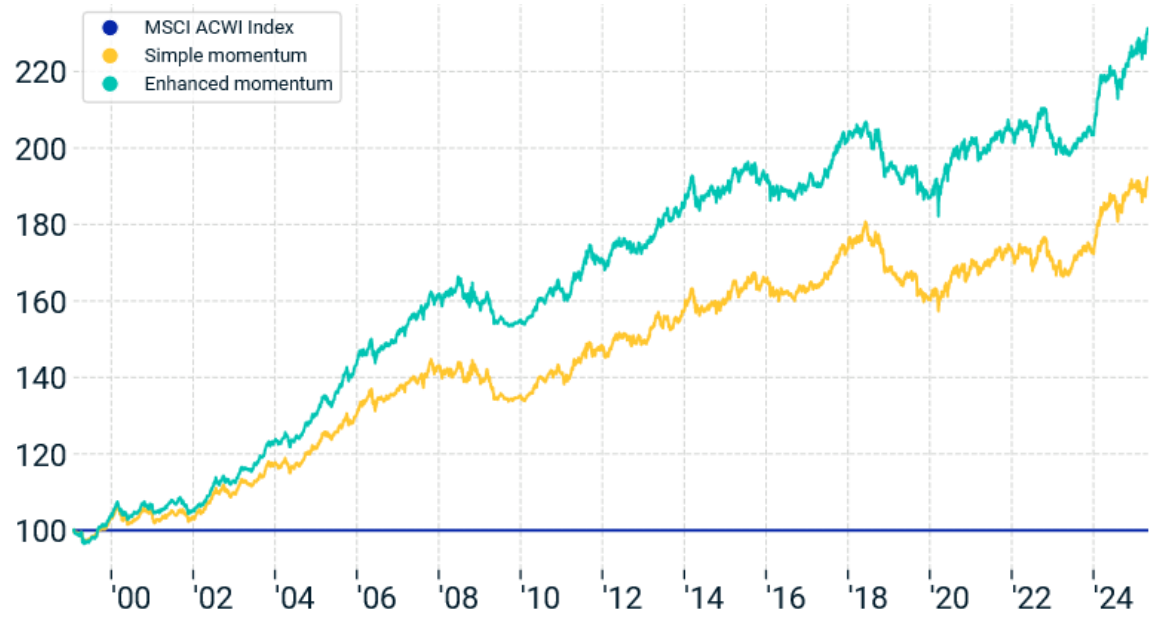
Crowding overlay improved pure momentum factor returns



MSCI data from Jan. 31, 1997, to May 30, 2025. The blue line shows the performance of the momentum factor from the MSCI equity risk models as the base case. The yellow line shows the performance of the momentum factor after the time-series crowding score was added as an additional factor. The stock universe is the relevant MSCI IMI Index.

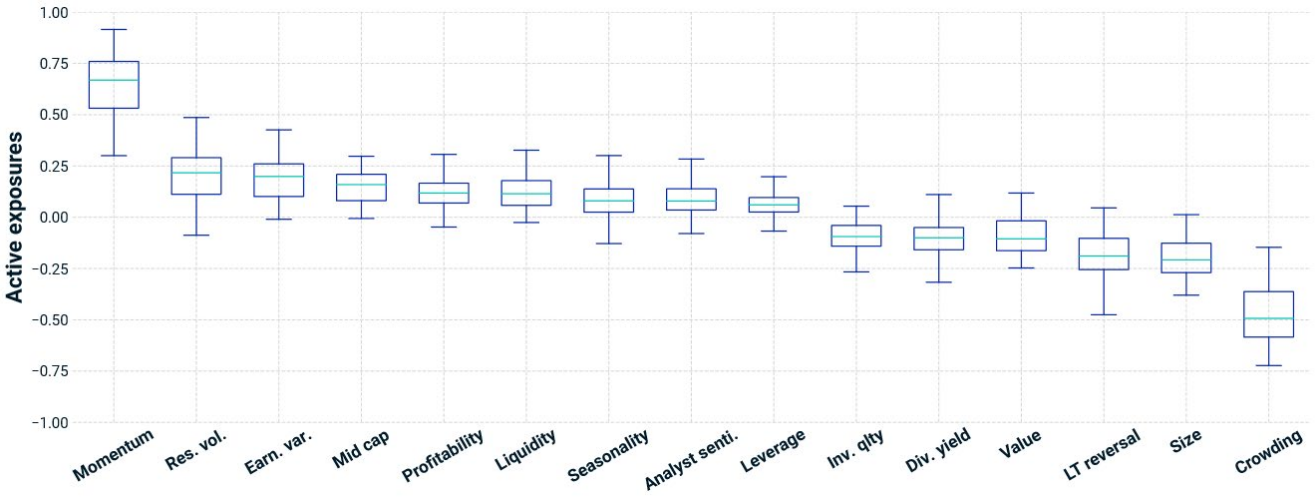
To understand how this effect may be leveraged in a long-only factor portfolio, we constructed a monthly rebalancing strategy designed to maximize momentum exposure at the portfolio level while maintaining a predicted tracking error below 3% and ensuring the time-series crowding score remains lower than the overall market. The charts below show that, over the long term, this straightforward crowding-score constraint has delivered favorable risk-return outcomes by helping avoid, for example, overbought stocks within the high-momentum quintiles, leading to more disciplined stock selection.

Simple crowding constraint improved long-only momentum strategy



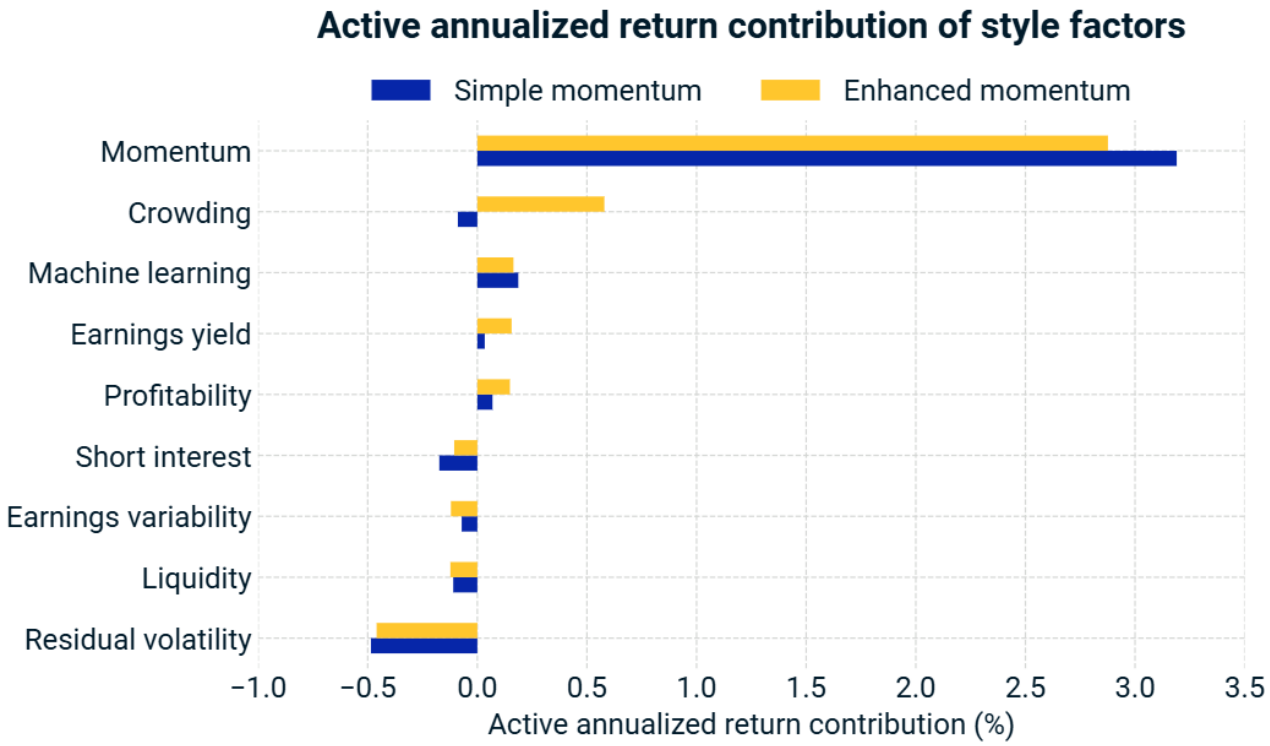
MSCI data from Jan. 29, 1999, to May 30, 2025.

Constraint on crowding score forced a strong underweight of the crowding factor



MSCI data from Jan. 29, 1999, to May 30, 2025. Active factor exposures are monthly averages using the EFMGEMTR model. We show factors with absolute median active exposure over one standard deviation.

Performance improvement was driven by the crowding factor



MSCI data from Jan. 29, 1999, to May 30, 2025. Active factor return contributions from simulation using the EFMGEMTR model. We show factors with absolute active annualized return contribution over 0.1%.

Crowding metrics offer several practical applications beyond just driving improvements in momentum — it can be a dimension for alpha generation, portfolio construction and risk management.

Shielding portfolios from macro risks

After a decade of near-zero policy rates, the rapid repricing of yields in 2022-24 reminded investors that equity returns react to the interest-rate and inflation cycle. Higher discount rates tend to compress valuation multiples while curve shifts could re-price balance-sheet leverage, funding costs and regulate returns across sectors. Investors therefore increasingly demand explicit macro lenses — rate, curve and inflation sensitivities — that capture risks conventional fundamental factor models may omit.

An interest-rate-sensitivity (IRS) factor

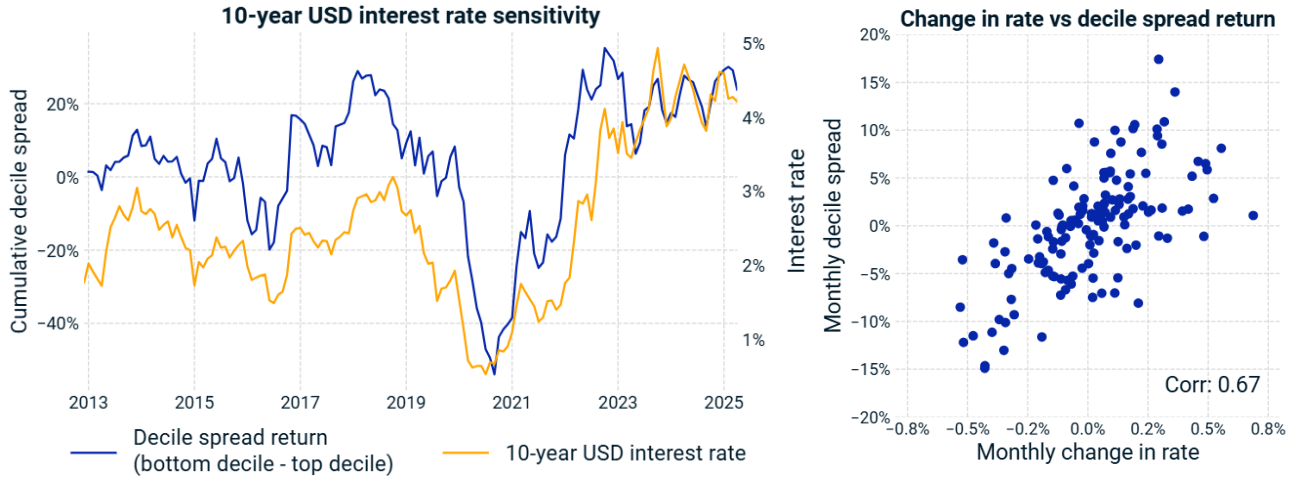
To quantify the impact of interest rate changes on equity returns, we take an interest rate sensitivity (IRS) factor from the MSCI Factor Lab.[10] This is calculated by regressing each stock's CAPM-residual return on the return of the USD 10-year key-rate-duration factor in the MSCI Multi-Asset Class (MAC) Factor

[10] MSCI Factor Lab provides access to new research-enhanced datasets for use cases ranging from alpha research to building custom risk factors. As of May 30, 2025, it included daily data of over 200 factor descriptors across 12 factor categories covering approximately 77,000 securities.

Model. A positive exposure indicates the stock has higher exposure to the risk of rising interest rate than the average stock in the estimation universe.

We sorted the MSCI USA IMI universe into IRS deciles and rebalanced monthly between December 2012 and May 2025. This showed that the long–short return spread between the most positive and most negative deciles produced a correlation of 0.67 with changes in the 10-year yield and visually tracked the rate series. Parallel exercises on euro- and yen-denominated universes yield similar slopes, suggesting the relationship is not limited to the U.S.

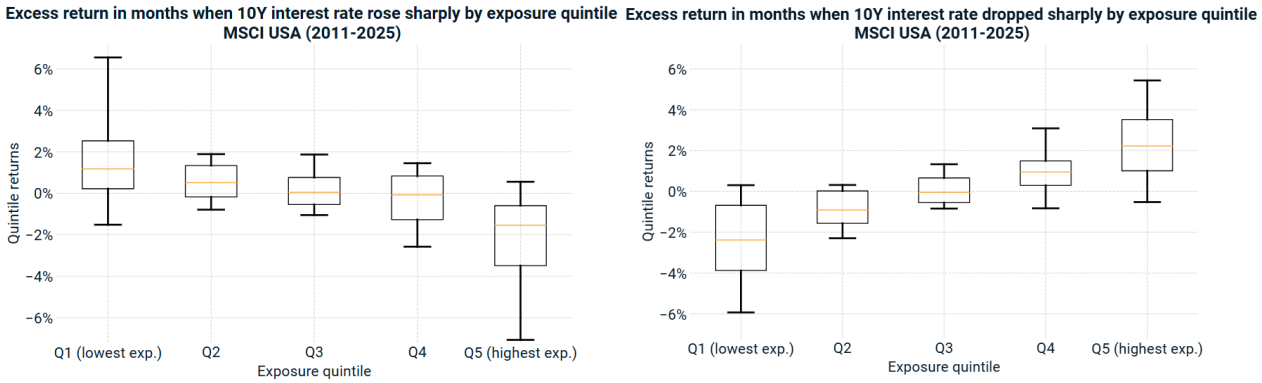
Interest-rate stock-level decile spreads track interest rates



MSCI data from Dec. 2012 to May 2025. Left: Cumulative decile spread returns based on monthly rebalancing and square root of market cap weighting, using local returns. The universe is MSCI USA IMI. Right: Scatter plot of monthly decile return spread and monthly change in 10-year interest rates.

To further explore the implications, we grouped the constituents of the MSCI USA Index into quintiles based on their interest rate exposure and analyzed their performance during periods of sharp rate movements (defined as top and bottom 20% of monthly rate changes). When interest rates rose sharply, the quintile with the highest interest rate exposure, on average, performed the worst. Similarly, when rates dropped sharply, that same quintile, on average, performed the best. These patterns highlight the importance of understanding macro exposures in portfolio construction.

Interest rate sensitivity and performance



Left chart: corresponds to months with the top 20% of interest rate movements. Right chart: corresponds to months with the bottom 20% of interest rate movements. Boxplots show the time series distribution of equal-weighted quintile portfolio returns, with monthly rebalancing. Whiskers show 5th and 95th percentiles. Yellow line is median. Source: MSCI.

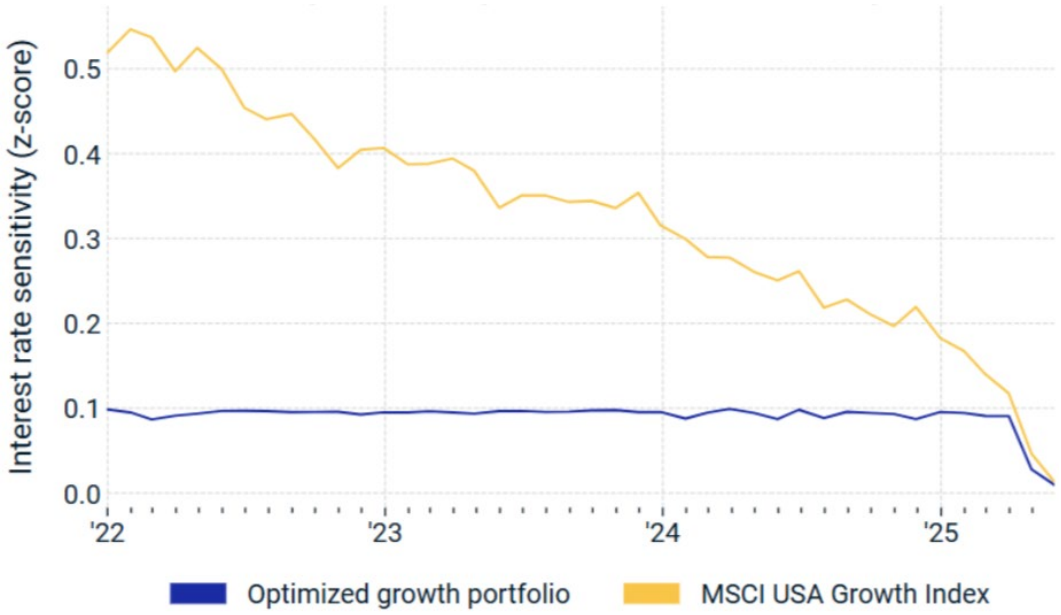
We applied this insight to a practical example: The MSCI USA Growth Index, which is often characterized by longer-duration cash flows and higher interest rate exposure. Between January 2022 to late 2023, U.S. 10-year yields rose from 1.5% to 5%, exerting pressure on rate-sensitive assets. During this period, the MSCI USA Growth index had positive IRS exposure, making it vulnerable to rising yields.[11]

To reduce this macro sensitivity, we constructed an optimized portfolio that closely tracks the MSCI USA Growth Index but constrains its interest rate exposure to within a narrow range (+/– 0.1 z-score).[12] This approach improved performance, preserved style purity while reducing macro vulnerability — a relevant application for investors seeking to hold growth allocations through volatile rate cycles.

[11] The IRS exposure of the MSCI USA Growth Index has declined over the past few years. This may be because advancements and enthusiasm around AI have made some of the largest mega-cap growth stocks less sensitive to interest rate changes.

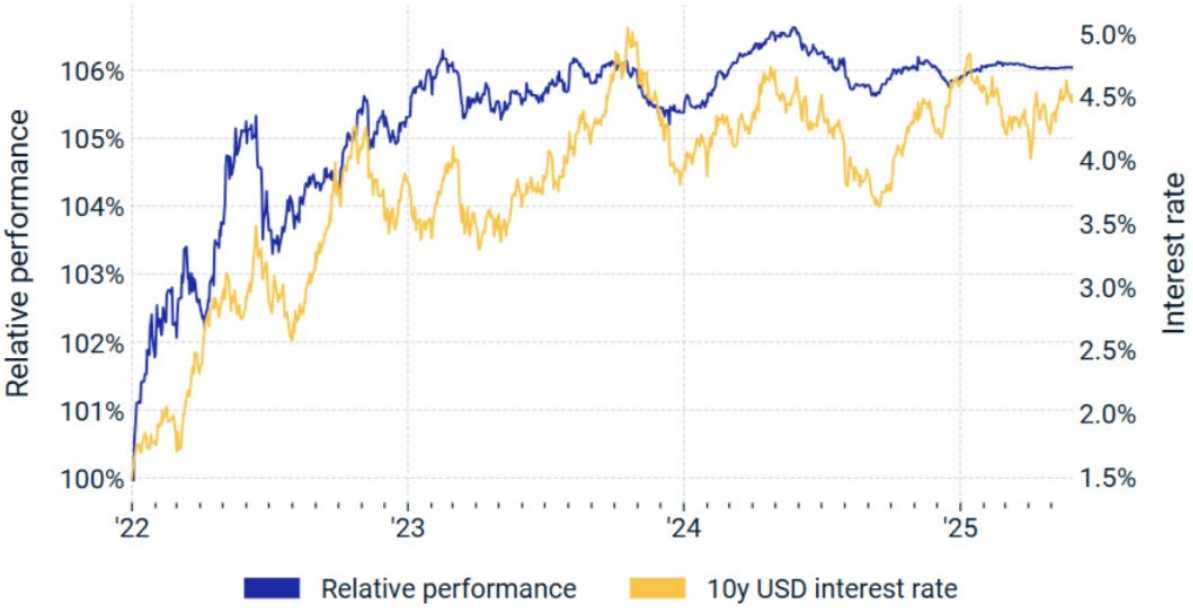
[12] The optimized growth portfolio was simulated to minimize tracking error relative to the MSCI USA Growth Index while constraining i. portfolio interest rate exposure to +/- 0.1 z-score, ii. active positions limited to +/- 1% or 10x benchmark weight, and iii. annual turnover limited to 25%.

Constraints on interest rate exposure reduced growth portfolio sensitivity to rate changes



MSCI data from Dec 2021 to May 2025.

Performance of optimized growth portfolio relative to MSCI USA Growth Index



MSCI data from Dec 2021 to May 2025.

Macro shocks have re-entered the equity narrative. By embedding IRS and related macro factors alongside conventional style and industry variables, investors could move from a purely micro view of

equity risk to a more holistic perspective and hopefully a more precise hedge against policy surprise and a clearer understanding of where returns are generated.

The future of factor investing

Factor investing has evolved significantly over the past five decades, from a topic for academic finance into a foundational element of modern investment practice. Today, it is embedded in how institutional investors and wealth managers alike manage risk, seek return and express investment views through indexed and active strategies. Foundational factors such as value, momentum, quality, size, low volatility and yield remain central, but the future of factor investing hinges on how these are refined and applied in an increasingly complex and fast-changing investment landscape.

Three key trends are reshaping the future of factor investing. First, is the ongoing evolution of traditional factor modelling. This includes ideas such as adjusting value metrics to account for intangibles like R&D and brand equity or enhancing quality factors by incorporating forward-looking indicators and text-based inputs from financial reporting.

Second, innovation in data and modeling techniques is expanding the factor toolkit. Alternative and unstructured data — ranging from analyst sentiment, insider trading, social media, news flows and sustainability disclosures — are being combined with machine learning and natural language processing to capture new and more dynamic exposures. As two simple examples, short interest as a factor has shown its utility in risk-off environments, while analyst sentiment has been found to provide forward-looking signals that complement momentum, which is backward-looking by definition. A shift to using text-based inputs for factors, for example, helps build factors that have a natural event-based narrative by design.

Finally, and moving beyond the listed equity focus of this paper, traditional asset allocation is being disrupted by explicit factor-based allocation. Rather than viewing asset classes as the starting point, investors may organize portfolios around macroeconomic, style and thematic factors. This shift is aligned with the Total Portfolio Approach (TPA) wherein an investor might reduce overall portfolio beta while maintaining return targets by increasing exposure to quality and low-volatility equities, long-duration bonds and defensive alternatives.

Looking ahead, the continued success of factor investing will depend on its ability to adapt. This means embracing new data, refining models, and integrating factor insights into total portfolio decisions. Thematic investing — focused on structural trends like new technologies, climate transition, geopolitics, or aging demographics — may increasingly draw from factor methodologies, blending fundamental signals with forward-looking narratives.

The authors thank Anurag Kumar, Donald Sze and Padmakar Kulkarni for their assistance in the preparation of this paper.

Appendix I: Deep history of pure factor performance

Summary statistics for the style factors of MSCI USDEEP model show a robust factor structure based on average t-statistics and the percentage of statistically significant months for each factor (absolute t > 2). Momentum has emerged as the strongest performing factor, followed by value measures such as earnings yield and book-to-price, while residual volatility has consistently detracted from returns.

50-year of pure factor performance in the U.S. equity market

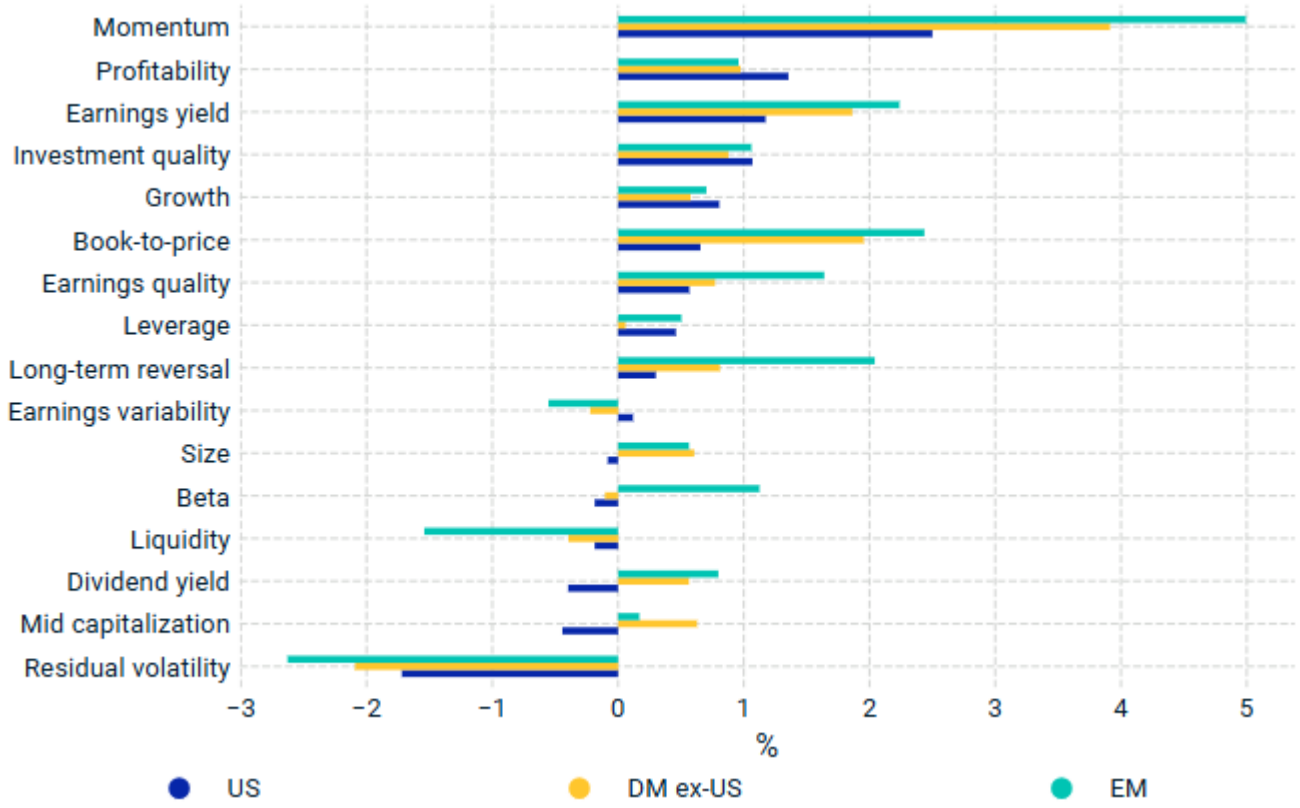
Factor	Avg |t|	%(|t|>2)	Annualized return (%)	Annualized volatility (%)	Information ratio	VIF	Corr. with market	Factor stability coeff.
Beta	3.85	68.3	-0.41	5.9	-0.07	3.0	0.71	0.96
Size	3.49	63.4	-0.45	3.5	-0.13	2.1	-0.25	1.00
Momentum	3.19	61.3	2.88	4.6	0.63	1.8	-0.13	0.88
Residual volatility	2.69	53.1	-2.55	3.8	-0.68	1.9	0.33	0.93
Earnings yield	1.86	39.7	1.90	2.5	0.75	2.3	-0.01	0.97
Mid capitalization	1.70	33.9	0.05	2.0	0.02	1.3	0.13	0.98
Leverage	1.64	30.4	0.09	2.1	0.04	2.1	0.36	0.99
Long-term reversal	1.60	31.5	0.73	1.8	0.40	1.6	-0.01	0.96
Value	1.60	30.8	1.83	2.3	0.80	2.5	0.06	0.98
Liquidity	1.53	28.9	-0.50	1.8	-0.27	1.6	0.29	0.98
Dividend yield	1.48	27.8	-0.54	2.0	-0.27	2.8	-0.26	0.99
Growth	1.45	25.6	0.39	2.0	0.20	2.2	0.24	0.98
Profitability	1.39	25.7	1.96	1.8	1.08	2.7	-0.15	0.99
Earnings quality	1.37	24.6	0.57	1.8	0.31	2.2	-0.25	0.95
Prospect	1.23	18.5	0.44	1.3	0.35	1.3	0.35	0.96
Management quality	1.17	16.5	0.92	1.2	0.74	1.6	0.01	0.97

MSCI data from Jan. 1973 to May 2025. Returns are annualized in USD. Style factors from the MSCI USDEEP risk model. The variance inflation factor (VIF) measures the degree of multicollinearity — a value greater than five represents high multicollinearity.

To examine regional differences, we use the MSCI DMEMUS risk model, which maintains the same factor structure across the U.S., developed markets ex-U.S., as well as emerging markets.[13] Data is available since November 1994. Over the past 30 years, risk factors have delivered strong performance across regions. The effects of value (captured through book-to-price, earnings yield, and long-term reversal) and momentum are most pronounced in emerging markets, followed by developed ex-U.S. markets, and then the U.S. Conversely, profitability has been rewarded more heavily in the U.S., while residual volatility remains a significant detractor in all three regions.

[13] The MSCI Global Investable Markets Equity Model (DMEMUS) is the first MSCI equity risk model that combines three equity markets. This model structure supports the prominent viewpoint that the three market segments of the model have distinct opportunities and challenges for investment.

Regional variation in pure factor performance



MSCI data from Nov. 30, 1994, to May 30, 2025. Returns are annualized in USD. Based on the MSCI Global Investable Markets Equity Model (DMEMUS), which combines three equity markets — U.S., DM excluding U.S. and EM into one integrated risk model.

Appendix II: MSCI World Factor Index history

Until 2014, MSCI's factor index history spanned 25 years. To enable deeper analysis encompassing a broader range of macroeconomic regimes, political events and market shocks, the history was extended in 2014 to cover 40 years. Alighanbari et al. (2014) leveraged this 40-year history to provide insights into the behavior and performance of factor indexes across four decades. Now, a decade later, MSCI factor indexes have a rich 50-year history.

Below, we highlight the start dates for MSCI World Factor Indexes.

Index name	Gross index start dates
MSCI World Equal Weighted Index	May 31, 1973
MSCI World High Dividend Yield Index	Nov. 28, 1975
MSCI World Minimum Volatility Index (USD)*	May 31, 1973
MSCI World Momentum Index	May 31, 1973

MSCI World Quality Index	Nov. 28, 1975
MSCI World Enhanced Value Index**	Nov. 28, 1975
MSCI World Growth Index***	Dec. 31, 1974

* Simulated using top 300 risk-weighted stocks prior to May 31, 1988

** MSCI World Enhanced Value index uses a composite score based on three value metrics: book-to-price, forward earnings-to-price and operating cash flow to enterprise value (CFO/EV). Prior to 1997, we used the cash-earnings-to-price ratio in place of CFO/EV

*** Based on MSCI Value and Growth Style Index methodology until 30 Apr., 1999 and MSCI Growth Target index methodology thereafter

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