



The Power of Completion: How Completion Portfolios Enhance Alignment, Efficiency, and Flexibility

June 2025

Table of Contents

Executive Summary	4
Introduction	7
Restoring Factor Balance: Addressing an Excessive Growth Bias	10
Closing the Gap – Geographic Completion for Emerging Markets Exposure	21
Sustainability-Aligned Completion – Enhancing Efficiency Without Compromising Transparency ..	27
Conclusion: The Strategic Importance of Completion Portfolios	32
References	34
Appendix	36
About Scientific Beta	41
Scientific Beta Publications	44

About the Authors



Daniel Aguet serves as Index Director and Deputy CEO at Scientific Beta, where he plays a central role in the development and design of factor, climate and enhanced equity strategies. With extensive experience in quantitative finance and index design, he has been instrumental in advancing Scientific Beta's mission of providing research-backed systematic equity strategies to institutional investors. His expertise spans both the theoretical foundations of factor and climate investing and their practical implementation in institutional portfolios. Prior to his current role, Daniel worked as a Quantitative Investment Manager in the asset management industry for more than 10 years. Daniel has authored several papers published in practitioner journals on the design of systematic strategies. Daniel is a Chartered Alternative Investment Analyst (CAIA) and holds a master's degree in finance with a specialisation in Financial Engineering and Risk Management from HEC Lausanne.



Warwick Schneller is Head of Investment Solutions - Australia and New Zealand at Scientific Beta, Warwick works with asset owners, asset managers, and consultants to develop customised investment solutions. Prior to joining Scientific Beta, Warwick was a senior member of the Research Group and Investment Solutions Group at Dimensional Fund Advisors, a factor-based investment manager. In this role, he led research initiatives, provided thought leadership, and client education on investment-related topics. Warwick holds a Ph.D. in Finance from The University of New South Wales and is a CFA Charter holder. He also earned a master's degree in finance from Bond University and a Bachelor of Agricultural Economics (Hons) from Sydney University.



Saba Sinaee is a Senior Quantitative Analyst at Scientific Beta, focusing on index design and providing expertise on conceptual frameworks, methodology, and calculations related to factor-based and ESG/Climate indices. Prior to joining Scientific Beta, Saba spent over a decade at CPP Investments, primarily on the Quantitative Equity Investment team, where she focused on implementing factor models and developing advanced portfolio analytics tools. She holds an MBA from INSEAD, a Bachelor of Mathematics from the University of Waterloo and is a CFA charterholder.

We also thank Erik Christiansen and Vera Cady for providing empirical analysis and helpful comments.

Executive Summary

Executive Summary

Market movements and changing investment conditions can pose challenges for institutional investors, gradually shifting even carefully constructed portfolios away from their strategic objectives.

This risk has been particularly highlighted in recent years, a period when US growth stocks have significantly driven the performance of market cap benchmarks, resulting in many active and passive equity portfolios to develop significant unintended growth tilts.

In other instances of inadvertent shifts, regional imbalances can arise in multi-manager global equity portfolios as by-products of manager specialisation. Challenges also can arise in integrating and achieving sustainability objectives.

Completion portfolios can be used to correct these misalignments that can develop between investors' desired positioning and actual portfolio exposures. In this, they serve several important functions:

- **Correcting** unintended factor exposures like excessive growth imbalances;
- **Filling** geographic or sector allocation gaps within the broader portfolio;
- **Supporting** sustainability goals without disrupting existing mandates;
- **Improving** risk-adjusted performance by enhancing exposure to factors;
- **Enabling** tactical adjustments in response to changing market conditions.

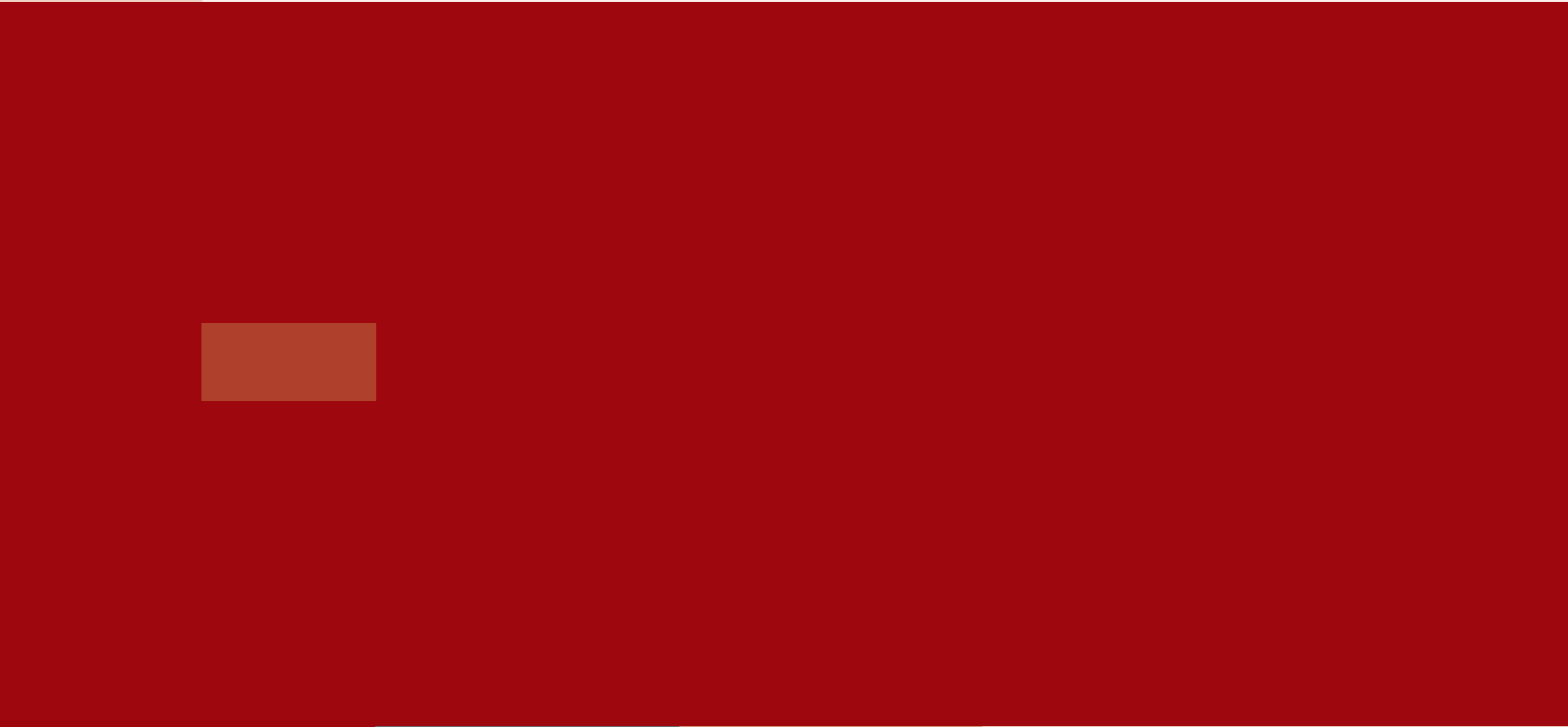
The paper details three case studies to highlight how investors can use completion strategies to correct biases, either to re-align their portfolio with its long-term strategic objectives, or to implement short-term tactical views to address unexpected change in market conditions.

1. The first case study examines how to address the challenge of when market-capitalisation weighting leads to investors' portfolios developing unintended concentration in growth-oriented exposures and specific sectors, such as technology. We show how a value factor completion portfolio, using Scientific Beta's United States Value Index, can systematically rebalance style exposures—specifically mitigating excessive growth bias—without dismantling existing core allocations.
 2. The second case study explains how completion portfolios can be used to address regional imbalances that often arise as the unintended by-products of manager specialisation and generate tracking error relative to the benchmark. We show how a completion strategy using Scientific Beta Market-Focused Multi-Factor index can efficiently address this geographic imbalance to reduce tracking error and improve information ratio while preserving the integrity of the underlying managers' investment processes.
 3. The third case study examines institutional investors' challenge in aligning portfolios with sustainability goals in a way that is effective, transparent, and consistent with long-term return expectations and benchmark constraints. This is in the context of research showing that many sustainability
-

Executive Summary

strategies rely on proprietary frameworks or opaque scoring systems, making it difficult for asset owners to assess exposure, explain outcomes, or ensure accountability. This case study explores an alternative approach for institutional investors that deploys a benchmark-sensitive completion portfolio embedding sustainability considerations using transparent, fact-based metrics.

Through the different case studies, we show that completion strategies provide a targeted, flexible mechanism for fine-tuning portfolio characteristics and offer a powerful tool for maintaining strategic intent and improving overall portfolio performance. Hence, they represent a solution to the persistent challenge of portfolio management: ensuring that investment allocations consistently reflect an investor's core objective.



Introduction

Introduction

Investment portfolios naturally develop unintended exposures, allocation gaps, and factor biases over time. Even carefully constructed portfolios can drift away from their strategic objectives due to market movements and changing investment conditions. For instance, in 2023, U.S. growth stocks significantly outperformed value stocks, with the Russell 1000 Growth Index surpassing the Russell 1000 Value Index by 23 percentage points, driven by the strong outperformance of large cap tech stocks. As a result, many market-cap weighted portfolios experienced an unexpected increase of growth tilt and technology sector concentration. Similarly, geographic allocations can skew over time: from 2015 to early 2025, the U.S. share of the MSCI World Index increased from approximately 63% to over 70%, driven by the strong performance of the US market relative to ex-US countries. Over time, shifts in a portfolio's exposures can add up. If these are not addressed, the portfolio can end up taking on more risk or behaving differently than originally intended.

Completion strategies address this challenge by using targeted instruments that help realign overall portfolio exposures with strategic investment goals. Rather than replacing existing investments, they complement core holdings to achieve more precise positioning.

The core purpose of completion strategies is to correct misalignments between actual portfolio exposures and desired positioning. They serve several important functions:

1. **Correcting unintended factor exposures** such as excessive growth imbalances
2. **Filling geographic or sector allocation gaps** that emerge within the broader portfolio
3. **Supporting sustainability goals**—for example, reducing portfolio carbon intensity or aligning with net-zero targets—without disrupting existing mandates
4. **Improving risk-adjusted performance** by enhancing exposure to rewarded risk factors
5. **Enabling tactical adjustments** in response to changing market conditions

There are two important aspects to ensure the success of completion strategies:

- i. The first one is the choice of the right instrument. Indeed, a well-designed equity portfolio will enable investors to better correct their existing portfolio misalignment with the strategic goal without creating additional unintended risks. For instance, factor-based strategies have proven particularly effective within completion portfolios. By targeting rewarded factors such as size, value, investment, profitability, momentum, or low volatility - investors can systematically address exposure gaps and biases. A factor approach provides a systematic and transparent approach for achieving the desired risk characteristics while targeting higher expected returns;
-

Introduction

ii. The second one is the measurement of factor exposures. Indeed, many commercial factor analytic services are based on proprietary factor definitions that are complex and not transparent leading to the risk of data-mining and the use of false factors. This can lead investors to take unintended exposures because of the mismeasurement of factor exposures. To avoid these pitfalls, Scientific Beta relies on a menu of academic factors that explain the cross-section of stock returns as well as univariate factor definition. Moreover, we use a return-based approach, instead of the use of characteristics, which enables to properly measure the sensitivity of equity portfolios to the rewarded risk factors by accounting for correlation between factors as well as their distribution. Our approach enables minimising data-mining risks as well as ensuring a proper factor measurement¹.

Completion strategies provide investors with several advantages. First, they enable precise factor allocation, allowing investors to fine-tune their exposures to specific return drivers without disrupting core holdings. Second, they offer risk management enhancement by addressing unintended biases such as country, sector or market beta bets and providing tools to adjust portfolio characteristics in response to changing market conditions. Third, completion portfolios deliver strategic flexibility, empowering investors to implement tactical shifts while maintaining alignment with long-term objectives. Finally, they ensure efficient and cost-effective implementation through targeted overlays that minimize turnover and transaction costs. Together, these benefits create a robust framework that enhances portfolio construction and management capabilities, allowing investors to achieve their specific objectives.

Key Benefits of Completion Strategies



This paper examines practical applications of completion strategies through case studies, demonstrating their implementation across different investment challenges. We explore how these factor portfolios can be structured to address factor biases, geographic imbalances, and sustainability objectives, illustrating their versatility as instruments for portfolio enhancement.

1 - For further details on Scientific Beta approach for the measurement of factor exposures, see *Measuring Factor Exposure Better to Manage Factor Allocation Better*, Scientific Beta (available at: <https://www.scientificbeta.com/factor/download/file/measuring-factor-exposure-better>).

Restoring Factor Balance: Addressing an Excessive Growth Bias

Restoring Factor Balance: Addressing an Excessive Growth Bias

A challenge for investors is the unintended concentration in growth-oriented exposures—a structural consequence of market-capitalisation weighting. Widely used U.S. equity benchmarks, such as the S&P 500 and Russell 1000, assign disproportionate weight to the largest constituents, many of which are fast-growing, technology-driven firms (Aguet, Goltz, and Schneller, 2025). As these firms outperform, their index weights increase, reinforcing growth and sector tilts within portfolios (see Arnott et al., 2005; Blitz and Swinkels, 2008).

Recent evidence illustrates the extent of this imbalance. By early 2025, the so-called “Magnificent Seven” mega-cap technology firms—Apple, Microsoft, Nvidia, Amazon, Alphabet, Meta, and Tesla—collectively accounted for nearly one-third of the S&P 500’s total market capitalisation. This concentration reflects a broader trend of index crowding in large-cap growth names. The Russell 1000 Growth Index, in particular, exhibits even more pronounced skewness, with the technology sector comprising nearly 65% of total weight—compared to 40% in representative broad-market benchmarks as of March of 2025. This recent concentration dynamic underscores the importance of monitoring portfolio composition, as cap-weighted benchmarks have increasingly amplified exposures to specific sectors and styles through performance-based reweighting.

Interestingly, even dedicated growth indices such as the Russell 1000 Growth Index exhibit meaningful variation in their style exposures over time. As shown in **Figure 1**, the index’s 1-year rolling value (HML) exposure has fluctuated between approximately -0.44 and $+0.07$ over the past two decades—demonstrating that growth exposure is not static, even in style-labelled benchmarks. Two key insights emerge from this pattern. First, there has been a notable deepening of the growth tilt in recent years, with the value exposure becoming increasingly negative—highlighting the extent to which large-cap growth indices have become more concentrated in high-growth names. Second, the long-run variability in exposures underscores that style biases can shift materially over time, influenced by market dynamics, sector performance, and benchmark reconstitutions. This variability reinforces the importance of monitoring implicit factor exposures, even within seemingly well-defined style benchmarks.

Restoring Factor Balance: Addressing an Excessive Growth Bias

Figure 1: 1-Year Rolling Value (HML) Factor Exposure of the Russell 1000 Growth Index from June 2005 to March 2025



The value (HML) factor is measured using a 1-year rolling regression using daily data and weekly steps. The HML factor is defined as the return series of an equal-weighted portfolio that is long the top 30% of stocks (value stocks) and short the bottom 30% of stocks (growth stocks), based on book-to-market ratios sorted in descending order and the performance is market beta neutralised ex-post to remove any market factor effect.

This embedded growth and technology bias is particularly acute in portfolios with significant allocations to style-specific indices such as the Russell 1000 Growth. The resulting factor and sector imbalances can expose investors to elevated drawdown risk, increased sector concentration, and style rotation underperformance.

While a growth index is expected to exhibit a tilt toward firms with strong profitability growth and high valuation ratios, it is not inherently designed to maintain a persistent overweight to any single sector—such as technology. The concern arises when performance-driven rebalancing mechanisms lead to unintended sector crowding, amplifying risks beyond the intended style exposure. This benchmark drift can result in concentration dynamics that are misaligned with the original diversification goals of style-based allocation.

These biases are not unique to passive indices—actively managed U.S. equity funds have also tended to display persistent overweights in mega-cap growth and technology stocks. For example, Cremers et al. (2016) find that many active U.S. equity managers exhibit low active share and often cluster around popular benchmark names, particularly large-cap growth stocks. Similarly, Morningstar (2023) reports that a significant proportion of actively managed funds maintain structural tilts toward high-growth, high-visibility companies, especially in the technology sector—mirroring the concentration seen in indices like the Russell 1000 Growth.

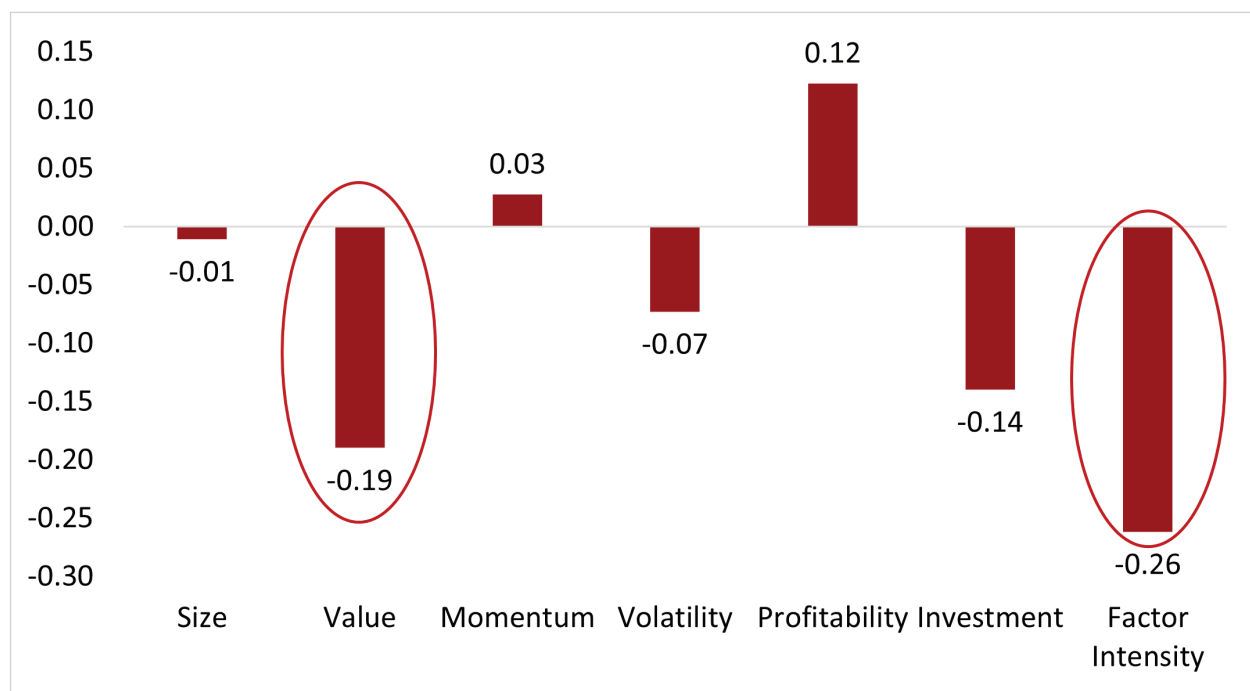
Restoring Factor Balance: Addressing an Excessive Growth Bias

The following case study examines how a value factor completion portfolio, constructed using Scientific Beta's United States Value Index, can systematically rebalance exposures and mitigate these risks. The objective is not to eliminate growth or technology exposure, but to reduce excessive sector concentration and obtain more balanced factor exposures to realign portfolio characteristics with long-term strategic objectives.

Identifying the Exposure Gap

The core U.S. equity holding is a passively managed fund tracking the Russell 1000 Growth Index, representing approximately 25% of an investor's total portfolio. As shown in **Figure 2**, the Russell 1000 Growth Index exhibits a material underweight to the value factor (-0.19) and negative exposures to the volatility (-0.07) and investment (-0.14) factors. The index shows only positive tilts to profitability (+0.12) and momentum (+0.03), with near-zero exposure to size (-0.01). The overall factor intensity of -0.26 highlights that the index has mostly negative exposures to rewarded factors, which are a source of long-term additional risk-adjusted returns.

Figure 2: Factor Exposure Analysis of the Russell 1000 Growth Index



This analysis evaluates the factor exposure profile of the Russell 1000 Growth Index from 18 June 2004 to 31 March 2025, with exposures estimated relative to the Scientific Beta United States Cap-Weighted Index as the reference universe. Factor intensity refers to the sum of the values of a portfolio's factor exposures (excluding the market beta) derived from a multi-factor regression. It reflects the overall magnitude of a portfolio's tilts across style factors. A low or negative factor intensity indicates limited or offsetting exposures.

Factor exposures are not static—they evolve as market conditions, index compositions, and company fundamentals change. Academic research, including the seminal work of Fama and French

Restoring Factor Balance: Addressing an Excessive Growth Bias

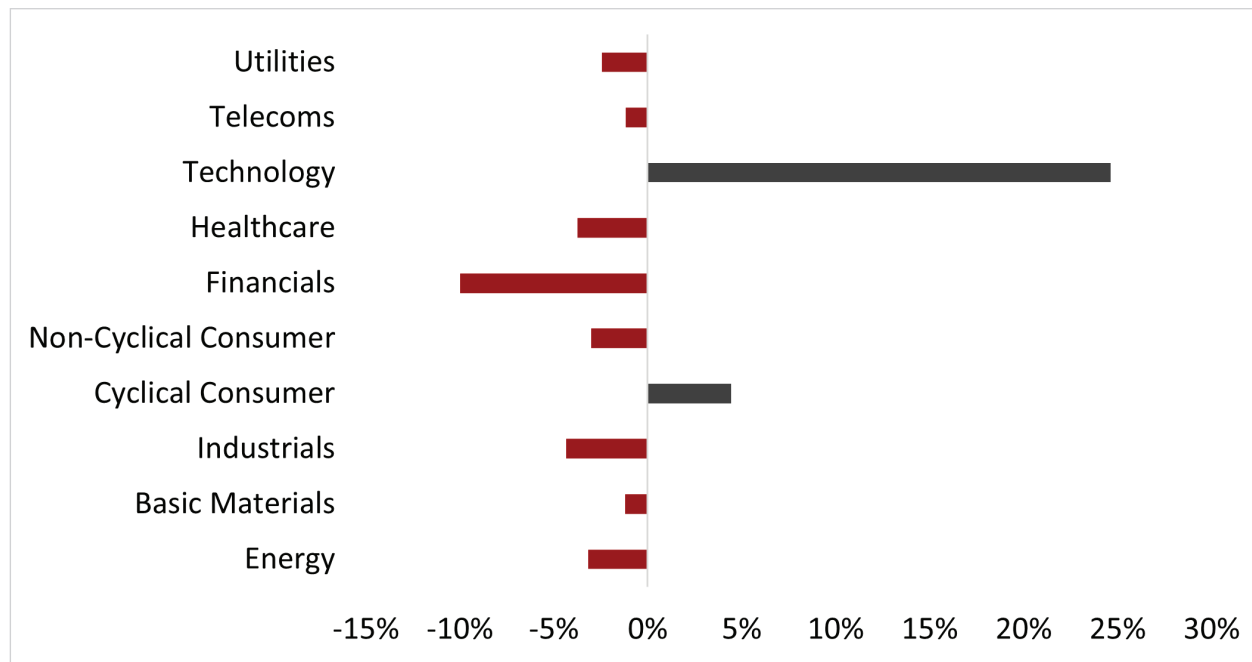
(1993, 2015), has shown that exposures to style factors such as value, growth, and momentum can vary significantly over time, even within passive strategies. These shifts may arise unintentionally, yet they can materially alter a portfolio’s risk profile and return drivers.

This underscores the importance of investors actively monitoring portfolio exposures. While the completion solution presented here uses a static allocation to correct a persistent bias, the broader framework allows for dynamic application. Scientific Beta does not implement timing or tactical adjustments, but it does provide the tools and transparency for investors to respond to evolving factor exposures based on their own diagnostics and governance processes.

The Russell 1000 Growth Index’s factor imbalances are mirrored at the sector level. As shown in **Figure 3**, the index allocates 64.76% to the technology sector—over 24 percentage points more than the Scientific Beta US Cap-Weighted Index. This overweight contributes to elevated sector concentration risk as it reduces sector diversification.

The Russell 1000 Growth Index is underweighted in eight of the nine remaining sectors, with relative underweights ranging from –10.00% to –1.17%. This skewed allocation reflects a redistribution of market cap weight predominantly toward the technology sector, underscoring the index’s narrow sector profile and increased sensitivity to the performance of large-cap technology companies.

Figure 3: Relative Sector Weight of Russell 1000 Growth minus US Market-Cap Index (as of 31st March 2025)



Sector weights for the US Cap-Weighted Index are based on the Scientific Beta US Cap-Weighted Index. Russell 1000 Growth Index sector weights are derived from the iShares Russell 1000 Growth ETF (IWF) as at 31st March, 2025. Positive values indicate sector overweights in the Russell 1000 Growth Index relative to the US Cap-Weighted Index, while negative values reflect relative underweights.

Restoring Factor Balance: Addressing an Excessive Growth Bias

Completion Portfolio Design

To address this imbalance, a completion strategy is implemented using Scientific Beta's United States Value Index². The objective is twofold: to rebalance the style exposure—specifically, to mitigate the negative value tilt—and to moderate the portfolio's technology concentration. The design does not displace the existing core holding, but rather overlays a calibrated exposure to restore factor and sector balance.

A common assumption is that value investing inherently leads to a structural underweight to the technology sector. However, this does not hold for value strategies built on a modern understanding of capital formation and carefully designed portfolio construction. Scientific Beta's Value index employs an intangible-adjusted book-to-price ratio (iB/P) (Amenc, Goltz, and Luyten, 2020), which incorporates estimates of unrecorded intangible assets—such as R&D-driven knowledge capital and investment in brand and organisational capital. These are particularly relevant for technology firms, which tend to be undervalued under traditional accounting measures that ignore such assets. By capturing intangible capital, the iB/P metric provides a more accurate and economically grounded measure of valuation. It also aligns more closely with the risk-based explanation for the value premium: firms with high capital intensity—whether physical or intangible—tend to be riskier in downturns and command a return premium.

The ability of the index to maintain exposure to the technology sector, despite its value orientation, is the result of thoughtful portfolio construction. In addition to the valuation metric, the index incorporates a market beta adjustment and sector rescaling, which help manage market risk and avoid unintended structural biases. These design elements allow the value exposure to be expressed more evenly across sectors—supporting both factor purity and sector neutrality. This approach ensures that undervalued technology firms are not excluded and explains why the Scientific Beta Value index can maintain an allocation to technology that is in line with the benchmark despite its value orientation.

To evaluate the impact of different allocation levels, we examine a series of completion portfolios that combine the Russell 1000 Growth Index with incremental allocations—ranging from 10% to 30%—to the Scientific Beta United States Value Index. Each scenario reflects a partial reallocation, enabling a controlled adjustment of portfolio exposures. This framework allows us to assess how increasing value allocations influence the overall portfolio's factor loadings and technology sector weight relative to the broad U.S. market. **Figures 4 to 6** illustrate these relationships and highlight the evolution of style, factor intensity and sector characteristics across the allocation range.

Figure 4 shows how progressively allocating to the Value index improves the portfolio's value factor exposure. These figures represent factor loadings—a measure of the portfolio's sensitivity to the value factor. A negative loading implies that the portfolio behaves like a growth portfolio,

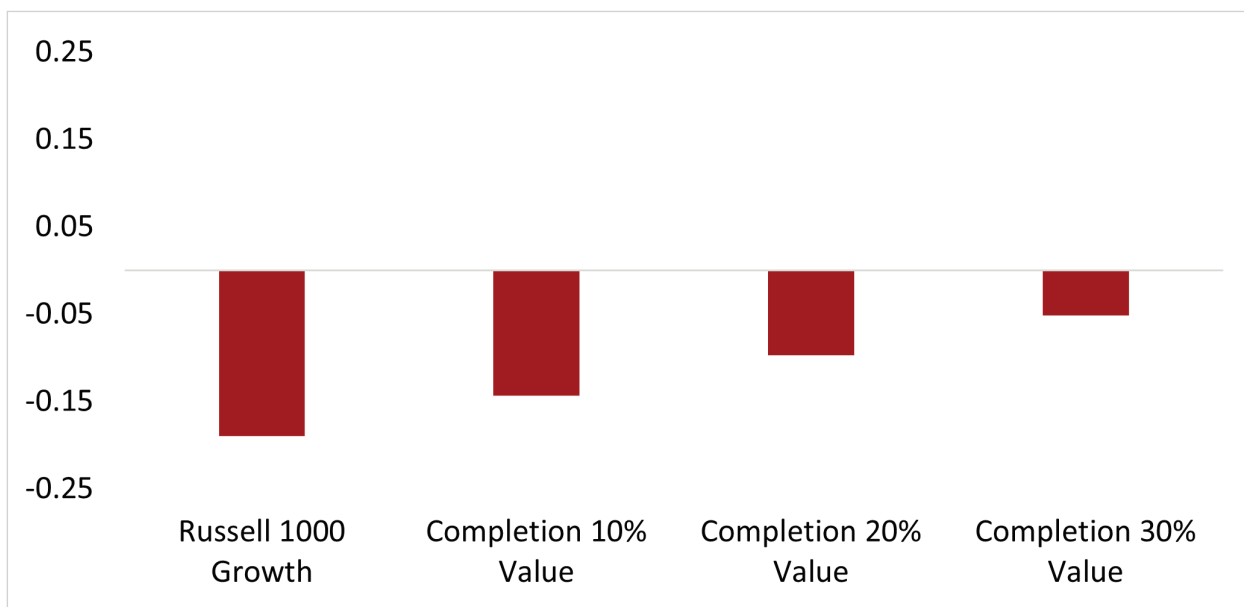
² - For further details on the construction and refinement of Scientific Beta's value factor methodology, see *Refining Value Investing*, Scientific Beta (available at: <https://www.scientificbeta.com/factor/download/file/refining-value-investing>).

Restoring Factor Balance: Addressing an Excessive Growth Bias

while a positive loading indicates value-tilted behaviour. A loading close to zero suggests a neutral stance, balancing exposures between value and growth. The smooth transition in factor loadings across allocation levels demonstrates how even modest shifts in portfolio design can systematically rebalance style exposures without requiring wholesale changes.

The standalone growth portfolio begins with a deeply negative exposure of -0.21, indicating a strong tilt toward growth characteristics. A modest 10% allocation to the Value index reduces this to -0.16. As allocations increase, the exposure steadily moves toward neutrality: -0.10 at 20%, -0.05 at 30%, reflecting a more balanced profile.

Figure 4: Value Factor Exposures Across Completion Portfolio Allocations



This exhibit shows the value factor loadings or betas for a series of completion portfolios that combine the Russell 1000 Growth Index with increasing allocations to the Scientific Beta United States Value Index. The sample period spans from June 2004 to March 2025.

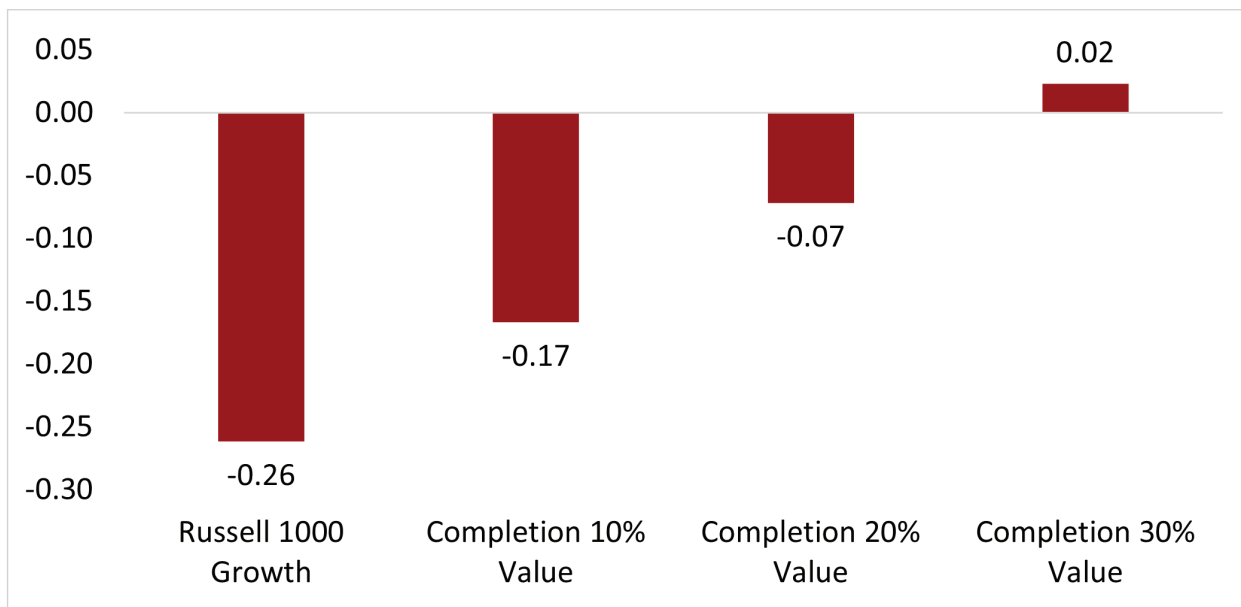
Figure 5 further illustrates how these value-based allocations affect the portfolio's Factor Intensity—a broader measure of exposure to rewarded risk premia. Factor Intensity is defined as the sum of a strategy's beta exposures to six rewarded risk factors (excluding market beta): value, size, momentum, low volatility, profitability, and investment. A higher intensity suggests that the portfolio will capture a larger portion of the premia of risk factors to outperform the benchmark over the long-term, while more negative values imply that the long-term performance will be dragged down.

The Russell 1000 Growth portfolio starts with a negative Factor intensity, consistent with its concentrated exposure to growth-oriented firms that lack representation across multiple rewarded factors. As value allocations increase, factor intensity improves: becoming less negative at 10% and

Restoring Factor Balance: Addressing an Excessive Growth Bias

20%, and eventually turning slightly positive at 30%. This shift reflects a deliberate rebalancing—not a rejection of growth exposure, but a restoration of diversification across multiple factors. The ability to reduce negative Factor intensity without materially disrupting the core portfolio highlights a key strength of the completion approach: improved structural balance achieved through incremental, calibrated changes.

Figure 5: Factor Intensity Across Completion Portfolio Allocations



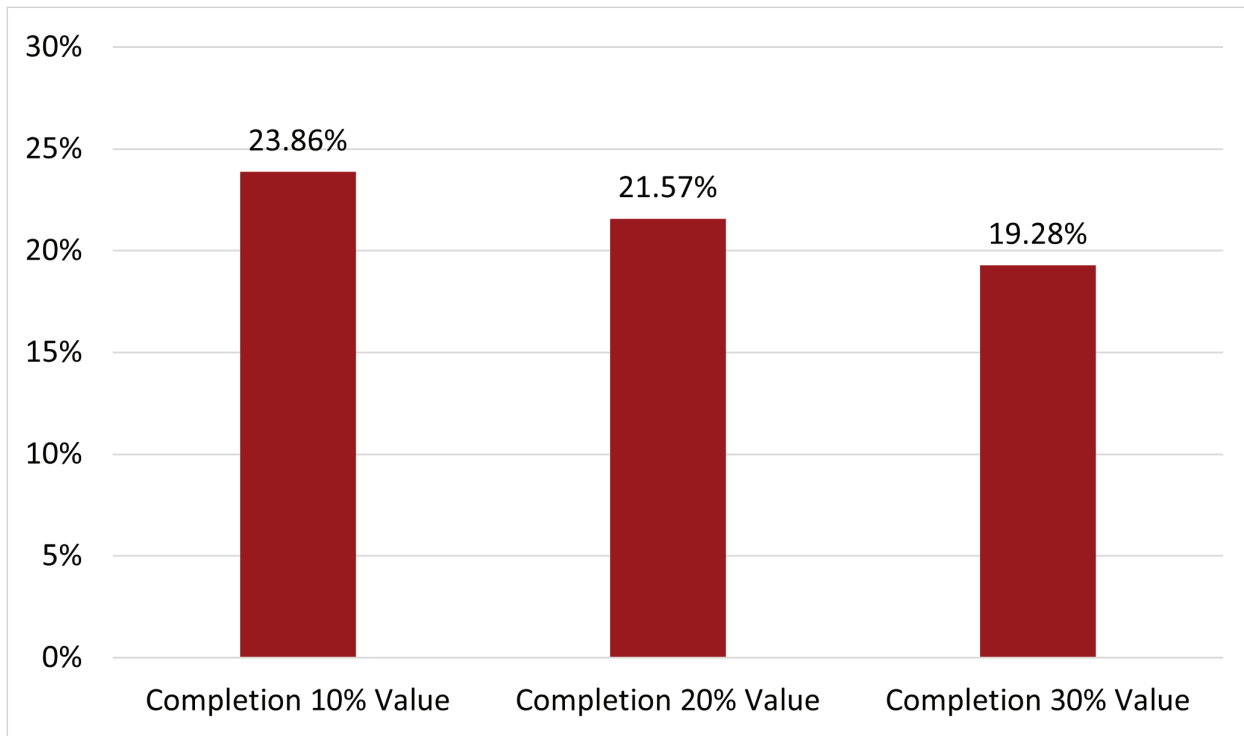
This exhibit shows the aggregate factor intensity of completion portfolios that blend the Russell 1000 Growth Index with increasing allocations to the Scientific Beta United States Value Index. Factor intensity is defined as the sum of the portfolio's beta exposures to six rewarded risk factors, excluding market beta. The sample period spans from June 2004 to March 2025.

This ability to modulate factor exposures with precision is a hallmark benefit of completion design. Importantly, exposures are not static. As market leadership rotates and index constituents evolve, even passive strategies can accumulate unintentional biases. Completion portfolios must therefore be dynamic—monitored regularly and recalibrated as needed to preserve alignment with long-term strategic goals.

Figure 6 highlights how these allocations affect the portfolio's relative technology sector weight. At a 10% allocation to the Value index, the technology overweight relative to the broad market benchmark is 23.9%. This reduces progressively with increased allocation: 21.6% at 20%, and 19.3% at 30%. This indicates that rebalancing does not eliminate exposure to growth-oriented sectors but tempers its dominance in a controlled, measured way.

Restoring Factor Balance: Addressing an Excessive Growth Bias

Figure 6: Relative Technology Sector Weights Across Completion Portfolio Allocations



The exhibit shows the technology sector weights of completion portfolios that combine the Russell 1000 Growth Index with increasing allocations (10% to 30%) to the Scientific Beta United States Value Index. The weights are expressed relative to the technology sector weight of the broad U.S. market, as represented by the Scientific Beta United States Cap-Weighted Index, using data as at March 2025.

One of the key advantages of the completion portfolio approach lies in its inherent flexibility. Allocations can be dynamically adjusted to align with evolving investment objectives, market conditions, or risk tolerance. For example, an investor with a higher conviction in technology and growth and willing to accept more tracking error may choose a 10% or 20% allocation to the Value index, preserving stronger growth characteristics while modestly improving sector diversity. A 30% allocation may suit investors more focused on correcting factor imbalances, further reducing sector concentration and reducing tracking error to limit the risk of potential underperformance.

This calibration flexibility allows the portfolio to be tailored precisely to specific client mandates—without requiring wholesale rebalancing, abandoning existing core positions, or triggering significant capital gains. It is a pragmatic, low-friction mechanism for maintaining a balanced and intentional factor profile in dynamic market environments.

Evaluating Completion Performance

To assess the effectiveness of the value completion strategy, we analyse long-term performance and

Restoring Factor Balance: Addressing an Excessive Growth Bias

risk metrics across a series of allocation scenarios. The sample spans over two decades, capturing a wide range of market environments—including periods of heightened volatility, macroeconomic conditions as well as extended periods of underperformance for the US Value premium. This provides a robust basis for understanding how a blended portfolio would have performed across different market environments.

Table 1 presents key performance and risk statistics for the Scientific Beta US Market Cap Index, the Russell 1000 Growth Index, completion portfolios with 10% to 30% allocations to the Scientific Beta United States Value Index.

Table 1: Performance and Risk Metrics

	US Market Cap Index	Russell 1000 Growth	Completion Portfolio Allocation (Value Allocation)		
			10%	20%	30%
Ann. Returns	10.22%	11.66%	11.74%	11.83%	11.90%
Ann. Volatility	18.87%	19.80%	19.60%	19.43%	19.29%
Sharpe Ratio	0.45	0.51	0.51	0.52	0.53
Ann. Rel. Returns	-	1.44%	1.53%	1.61%	1.68%
Ann. Tracking Error	-	4.60%	4.03%	3.52%	3.12%
Information Ratio	-	0.31	0.38	0.46	0.54
Max Rel. Drawdown	-	15.7%	14.0%	12.3%	10.6%

Performance and risk statistics are shown for the Scientific Beta US Market Cap Index, the Russell 1000 Growth Index, and completion portfolios with increasing allocations (10% to 30%) to the Scientific Beta United States Value Economic Risk Index. Data are based on total return indices in USD over the period 18th June 2004 to 31st March 2025.

The completion portfolios exhibit a consistent improvement in performance and Sharpe ratio compared to the standalone Russell 1000 Growth Index. As allocations to the Value Index increase, both absolute returns and risk-adjusted returns improve. A 30% allocation results in an annualised return of 11.90%, up from 11.66% for the standalone Russell 1000 Growth Index. Importantly, this return enhancement is achieved with progressively lower volatility, resulting in steady gains in Sharpe ratio from 0.51 to 0.53.

Moreover, the completion portfolios deliver this improvement with increasing benchmark-relative efficiency. The information ratio—which measures the amount of excess return per unit of tracking error relative to the Growth Index—rises from 0.38 at a 10% allocation to 0.54 at a 30% allocation. This trend demonstrates that the portfolio not only delivers higher returns but does so with increasing efficiency per unit of benchmark relative risk. Notably, tracking error declines from 4.60% to 3.12%, a reduction of approximately 32%, reinforcing that excess return is achieved with progressively tighter alignment to the return path of the broad US market. Similarly, the extreme relative risk, as measured by the maximum relative drawdown, declines from 15.7% to 10.6%, highlighting lower risk of underperformance. Together, these improvements illustrate how the completion strategy enhances the initial portfolio: generating more return per unit of risk while achieving closer alignment to the

Restoring Factor Balance: Addressing an Excessive Growth Bias

overall U.S. equity market. These improvements underscore the value of a completion portfolio in enhancing both performance and risk efficiency, while maintaining benchmark awareness³.

Restoring Factor Balance Without Disruption

This case demonstrates how completion portfolios can systematically rebalance style exposures—specifically mitigating excessive growth bias—without dismantling existing core allocations. A targeted value overlay can correct excessive growth and sector imbalances while preserving exposure to high-growth companies. The consequence is an enhancement of information ratio via two channels: first, the outperformance is improved through better factor diversification, second, tracking error is reduced by better alignment with the market cap benchmark. Finally, this can be integrated seamlessly with existing mandates, avoiding high turnover or governance disruption.

Completion is not a replacement mechanism—it's a precision tool. In this case, incrementally allocating to a value factor sleeve provided meaningful improvements in both performance and factor and sector exposures validating the role of completion as a strategic enhancer of long-term investment intent.

3 - For a detailed analysis of market beta stability in completion portfolios, including empirical comparisons with the Russell 1000 Growth Index, see Appendix 1.



Closing the Gap – Geographic Completion for Emerging Markets Exposure

Closing the Gap – Geographic Completion for Emerging Markets Exposure

In multi-manager global equity portfolios, regional imbalances often arise as unintended by-products of manager specialisation. This case examines a global equity portfolio that has developed a significant unintended underweight to Emerging Markets.

The portfolio employs multiple specialised managers who, through their security selection and investment approaches, naturally gravitate toward developed markets across North America, Europe, Japan, and Asia Pacific. While each manager implements their distinct investment process effectively, the collective positioning may create a substantial exposure gap in Emerging Markets. This type of geographic imbalance is not uncommon—studies have shown that multi-manager equity structures frequently lead to regional skews and underexposures when not actively monitored or corrected (Mercer, 2021). While individually sound, the collective result is a significant and unintended geographic tilt.

This case demonstrates how a targeted completion portfolio using Scientific Beta Emerging Markets Market Focused Multi-Factor indices can efficiently address this geographic imbalance while preserving the integrity of the underlying managers' investment processes.

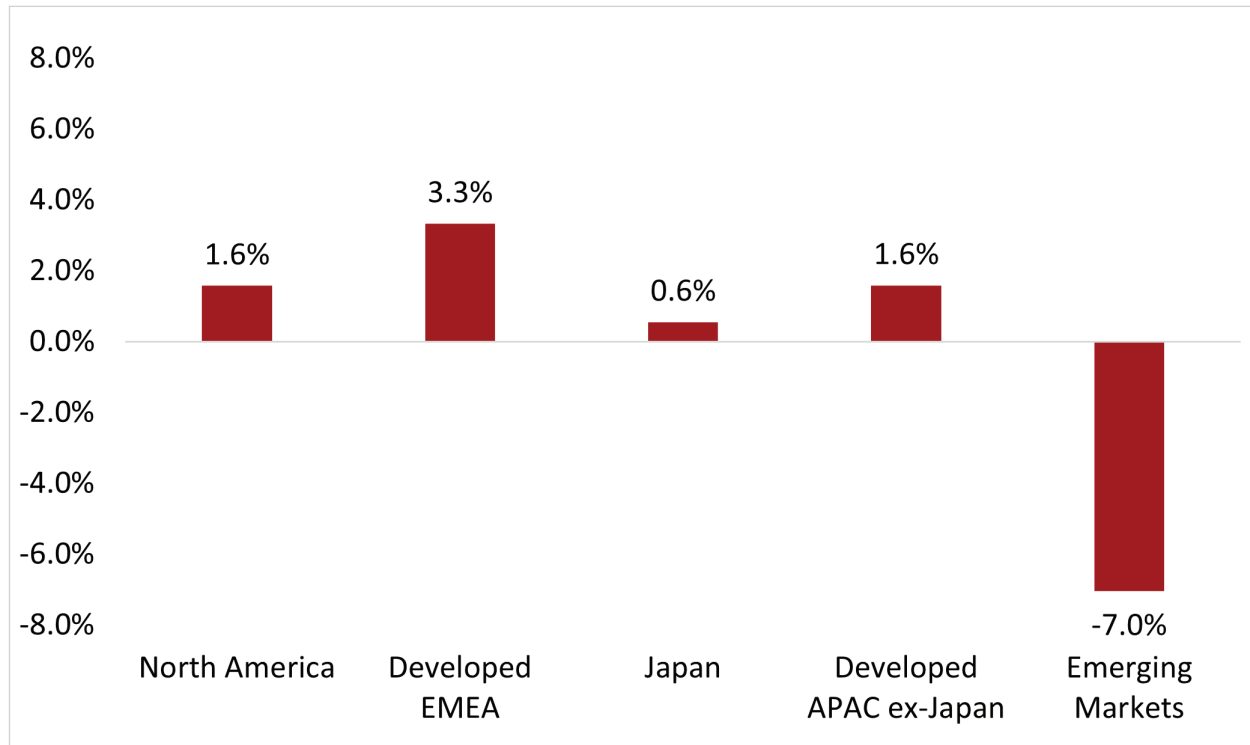
The Challenge: Current vs. Benchmark Regional Allocations

Figure 7 illustrates the regional weight differences between the current (pre-completion) portfolio and the MSCI ACWI as of March 2025. While the portfolio is composed of carefully selected mandates, the aggregate regional allocation reflects the underlying decisions made by individual asset managers—most of whom favour developed markets.

This collective positioning has led to modest overweights in regions such as Developed EMEA and North America. However, the most pronounced deviation is in Emerging Markets, where the portfolio holds just 3.1% exposure—well below the MSCI ACWI benchmark weight of 10.2%. The resulting 7.0 percentage point gap was not driven by a top-down underweighting decision, but rather emerged organically from the structure of the underlying allocations. Addressing this exposure gap requires a solution that rebalances regional exposures without disrupting the integrity of the existing manager line-up.

Closing the Gap – Geographic Completion for Emerging Markets Exposure

Figure 7: Bridging the Emerging Markets Gap: Regional Allocation Difference Pre-Completion Portfolio vs. MSCI ACWI (March 2025)



This figure illustrates the relative regional weight differences between the pre-completion portfolio and the iShares MSCI ACWI ETF as of 31st March 2025. The values represent the weight of each region in the pre-completion portfolio minus the corresponding weight in the MSCI ACWI benchmark. Positive bars indicate regional overweight positions, while negative bars reflect underweights. Data as of 31st March 2025. Allocations reflect total portfolio weights across major geographic regions.

Completion Portfolio Design

To address the structural underweight to Emerging Markets, we evaluate two distinct approaches for introducing targeted exposure through a completion sleeve:

- **Cap-Weighted Completion:** A benchmark-replicating strategy that introduces Emerging Markets exposure in line with their representation in the MSCI ACWI. This approach provides clean, index-consistent exposure and serves as a neutral baseline for comparison.
- **Market-Focused Multi-Factor Completion:** A strategy that allocates to the Scientific Beta Emerging Market-Focused Multi-Factor Index⁴. This option maintains the transparency and cost-efficiency of a passive approach, while seeking enhanced returns by systematically tilting toward rewarded risk premia—such as size, value, momentum, low investment and profitability. Unlike diversified factor strategies that prioritise Sharpe ratio and may deviate from the benchmark to diversify unrewarded risks such as stock-specific or economic risks, the Market-Focused approach aims to maximise the information ratio by aligning closely with the market-cap benchmark. It does this

4 - For further detail on the rationale and construction of the Market-Focused Multi-Factor strategy, see *Understanding and Managing the Impact of Market Concentration on Factor Strategies* (Aguet, Goltz, and Schneller, 2025).

Closing the Gap – Geographic Completion for Emerging Markets Exposure

through a three-step weighting process:

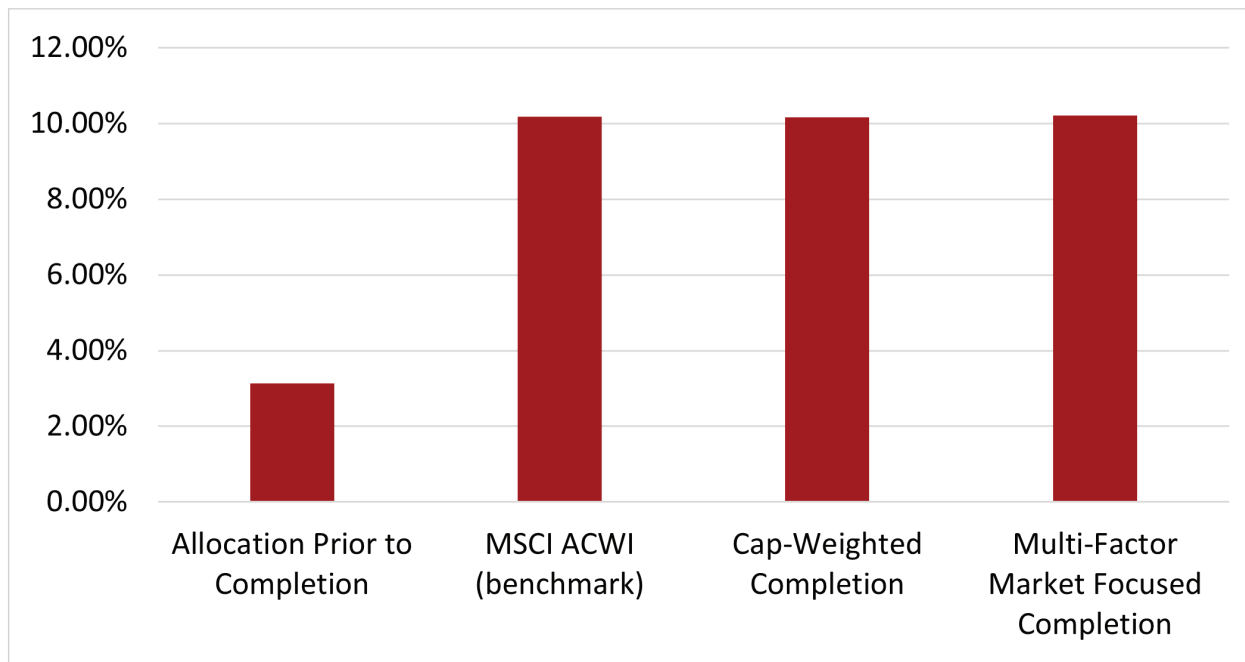
- i. assigning stock weights based on free-float market capitalisation;
- ii. rescaling weights to match sector allocations of the benchmark;
- iii. ensuring market beta neutrality. This design enables the strategy to get strong factor exposures while minimising tracking error and sector deviations, making it suitable for investors with benchmark-relative objectives who still wish to benefit from long-term factor premia.

Both approaches are designed to correct the geographic imbalance without disrupting the existing manager structure. Rather than imposing abrupt reallocations or carving out a fixed allocation (e.g., 10%), the completion sleeve is implemented through a proportional overlay methodology that adjusts weights based on actual regional deviations⁵.

Evaluating the Impact: Cap-Weighted vs. Market Focused Multi-Factor Completion

Both strategies successfully correct the Emerging Markets underweight. As shown in **Figure 8**, both approaches deliver the intended regional allocation, increasing the Emerging Markets allocation from 3.1% to around 10%, effectively closing the 7.0% exposure gap relative to the MSCI All Country World Index.

Figure 8: Emerging Markets Allocation Before and After Completion



Allocation comparison between the pre-completion portfolio, MSCI ACWI benchmark, and two completion strategies as of 31st March 2025.

⁵ - Please see appendix for further details on the methodology.

Closing the Gap – Geographic Completion for Emerging Markets Exposure

Table 2 compares the performance of four portfolios: the MSCI ACWI benchmark, a pre-completion portfolio with an Emerging Markets underweight, and two completion solutions—one incorporating a cap-weighted completion sleeve and the other using a market-focused multi-factor sleeve. Both approaches address the structural underweight to Emerging Markets by dynamically allocating additional exposure, with the completion sleeve averaging approximately 6.7% of the total portfolio over time. However, they differ meaningfully in how they contribute to overall portfolio outcomes.

The pre-completion portfolio delivers the highest annualised return (9.26%) among all configurations, outperforming both completion approaches and the MSCI ACWI benchmark (8.56%). However, this return advantage comes at the cost of materially higher risk: annualised volatility is elevated at 16.28% (compared to 15.57% for the benchmark), and the tracking error relative to the benchmark is significantly higher at 3.41%, notably due to country deviations such as the Emerging Markets under-allocation. This results in an Information Ratio of 0.20.

Both completion strategies serve to reduce this tracking error and improve benchmark-relative alignment. The cap-weighted completion portfolio achieves an annualised return of 8.89% with a reduced tracking error of 2.44% and an Information Ratio of 0.13. Meanwhile, the multi-factor completion portfolio delivers stronger performance at 9.12% and matches the volatility of the cap-weighted approach (15.87%) while achieving a slightly lower maximum drawdown (56.12% vs. 56.28%). Crucially, it offers the highest Information Ratio among the completion options at 0.23—demonstrating that it generates more excess return per unit of tracking error. This reflects the key objective of the market-focused multi-factor completion design: delivering performance gains in a benchmark-aware manner.

This reflects the strategy's core objective: to generate excess returns efficiently while maintaining tight alignment with the benchmark. Although the Sharpe Ratio is also marginally higher (0.47 versus 0.45), it is the improvement in the Information Ratio that best captures the value of the market-focused multi-factor approach—highlighting its effectiveness in delivering performance within a defined relative risk budget.

Both completion portfolios preserve the integrity of the overall portfolio structure, but it is the multi-factor strategy that delivers the most efficient use of the completion sleeve—enhancing returns while maintaining risk and benchmark discipline. This highlights the core value proposition of a multi-factor strategy: not just correcting a regional exposure gap, but doing so in a way that strengthens the overall portfolio's risk-return trade-off.

Closing the Gap – Geographic Completion for Emerging Markets Exposure

Table 2: Performance of the Portfolio with Emerging Market Completion – Cap-Weighted vs. Multi-Factor Completion Portfolio

	MSCI ACWI	Pre-Completion Portfolio	Completion Cap-Weighted Index	Completion Multi-Factor Index
Ann. Returns	8.56%	9.26%	8.89%	9.12%
Ann. Volatility	15.57%	16.28%	15.91%	15.87%
Sharpe Ratio	0.44	0.47	0.45	0.47
Max Drawdown	57.59%	55.7%	56.28%	56.12%
Ann. Rel. Returns	-	0.70%	0.33%	0.56%
Ann. Tracking Error	-	3.41%	2.44%	2.46%
Information Ratio	-	0.20	0.13	0.23

Performance metrics from 18 June 2004 to 31 March 2025. Returns are in USD. The table compares the MSCI All Country World Index with two Emerging Markets completion strategies: a cap-weighted approach and a market-focused multi-factor solution. Both completion portfolios average size are 6.7% of the total allocation and are designed to correct the Emerging Markets underweight while maintaining benchmark compatibility.

Why It Matters: Strategic Precision Without Disruption

This case illustrates how completion portfolios can be used not only to close geographic exposure gaps but also to improve portfolio efficiency without restructuring existing mandates. A factor-based overlay offers:

- Targeted geographic realignment without disrupting manager selection
- Improved diversification and factor capture in underrepresented regions
- Efficient implementation with high transparency and policy alignment



**Sustainability-Aligned Completion
– Enhancing Efficiency Without
Compromising Transparency**

Sustainability-Aligned Completion – Enhancing Efficiency Without Compromising Transparency

Institutional investors are increasingly seeking to align their portfolios with sustainability goals—whether reducing carbon intensity, excluding controversial business activities, or improving ESG profiles. The challenge lies in integrating these objectives in a way that is effective, transparent, and consistent with long-term return expectations and benchmark constraints.

The Portfolio Design: A Climate Enhanced Cap-Weighted Completion Overlay

We consider a global equity portfolio benchmarked to the MSCI World Index. Completion portfolios are constructed by reallocating between 10% and 30% of the core exposure to a sustainability-aligned enhanced cap-weight index. The objective is to integrate climate risk goals without compromising portfolio characteristics or meaningfully increasing tracking error.

The Scientific Beta Climate Enhanced Cap-Weight index is a transparent, rules-based strategy designed to improve on traditional cap-weighted benchmarks by integrating performance-enhancing factors and sustainability objectives—all within a disciplined tracking error framework.

Scientific Beta's Climate Enhanced Cap-Weight strategy incorporates three key pillars:

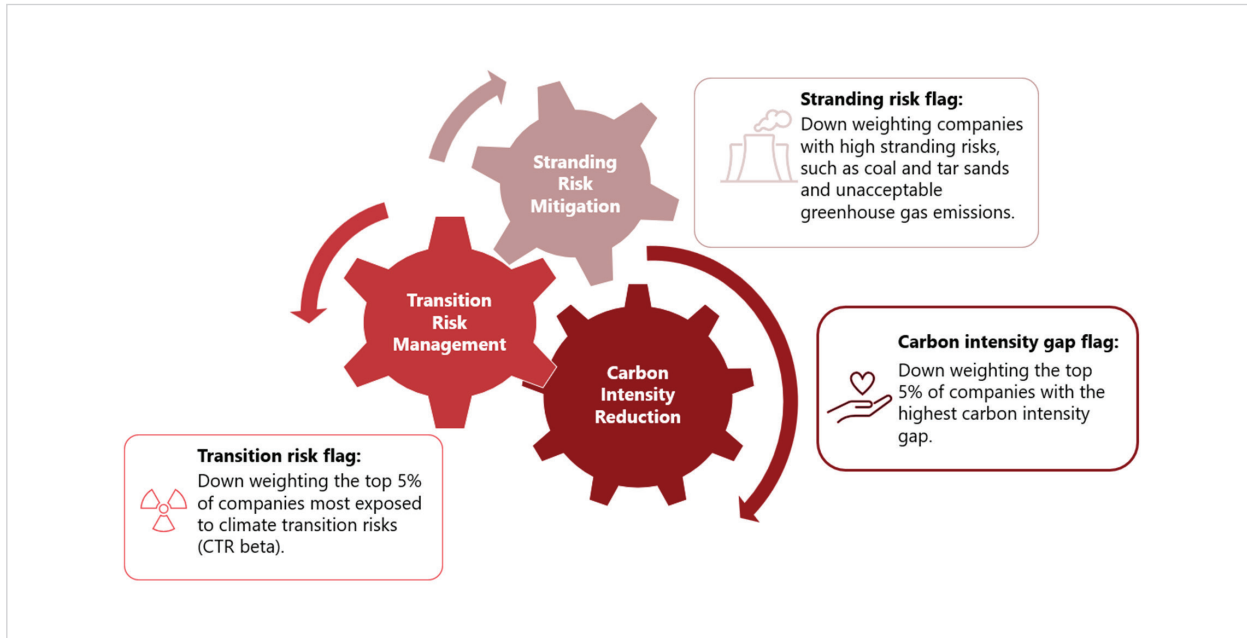
- **Disciplined Risk Control:** Tracking error is managed top-down at the portfolio level, rather than through bottom-up optimisation, allowing predictable and stable deviations from the benchmark—even during periods of market stress.
- **Systematic Quality Tilt:** The index includes a tilt toward companies with high profitability and low investment, constructed to maintain sector and market beta neutrality.
- **Transparent Climate Integration:** Climate tilts are applied based on observable, verifiable data—not subjective ESG scores, that are merely opinions. The Climate Enhanced Cap-Weight Index uses three distinct climate flags to penalise companies facing elevated transition risk by underweighting them relative to the benchmark. Each flag uses transparent data and quantitative thresholds such as share of revenues associated to some activities, like coal mining or tar sands extractions, or carbon intensity metrics. In addition, we use a forward-looking climate risk metric, the CTR beta, which enables to capture the wisdom of the crowds. This metric relies on market prices, which integrate investors' views on climate risks associated to each company, to measure how much a company is reacting to climate risk shocks⁶.

As illustrated in **Figure 9**, these flags work in combination to reduce exposure to companies at risk of climate transition-related devaluation. This combination results in a scalable and benchmark-aware strategy that allows investors to meet sustainability targets without undermining risk control, return potential, or transparency.

⁶ - For further detail on the rationale and construction of the CTR betas, see Addressing Both Sides of the Transition Coin – The Scientific Beta Climate Change Screen and Sustainability Target Framework (Christiansen, 2024).

Sustainability-Aligned Completion – Enhancing Efficiency Without Compromising Transparency

Figure 9: Climate Transition List Framework



Portfolio Outcomes: Return, Risk, and Benchmark Alignment

The results of this case study demonstrate that sustainability-aligned completion portfolios can deliver meaningful climate benefits while preserving performance efficiency and maintaining alignment with the investor’s strategic benchmark.

Across all completion scenarios—ranging from 10% to 30% allocation to the sustainability-enhanced index—the portfolios exhibit return and risk characteristics comparable to the MSCI World Index. As shown in **Table 3**, annualised returns increase modestly with greater allocations, reaching 11.53% at a 30% allocation compared to 11.44% for the benchmark. Volatility remains stable across the completion range, with minimal deviation from the MSCI World. Sharpe ratios hold around 0.66 while the information ratio remains consistent at 0.33, indicating that the strategy achieves a stable level of benchmark-relative outperformance across all configurations.

Crucially, these improvements are achieved within a disciplined tracking error constraint. Even at the 30% allocation level, tracking error remains below 0.3%, confirming that sustainability integration can be accomplished without compromising benchmark sensitivity or exceeding institutional risk budgets.

Sustainability-Aligned Completion – Enhancing Efficiency Without Compromising Transparency

Table 3: Performance Metrics – MSCI World vs. Completion Portfolios

From Dec-2008 to Mar-2025 (RI/USD)	MSCI World	Climate Enhanced Index	Completion Portfolio		
			10%	20%	30%
Ann. Returns	11.44%	11.73%	11.47%	11.50%	11.53%
Ann. Volatility	15.66%	15.42%	15.63%	15.61%	15.58%
Sharpe Ratio	0.65	0.68	0.66	0.66	0.66
Ann. Tracking Error	-	0.91%	0.09%	0.18%	0.27%
Information Ratio	-	0.32	0.33	0.33	0.33

The table is based on daily USD returns from 31st December 2008 to 31st March 2025. Comparison of the MSCI World Index, full Enhanced Index replacement, and blended completion portfolios using a sustainability-aligned factor strategy.

Decarbonisation Results: Measurable Outcomes, Transparent Metrics

The strategy delivers measurable improvements in climate-related exposures. As shown in **Table 4**, Weighted Average Carbon Intensity (WACI) for Scope 1 and 2 emissions are reduced by nearly 12% at a 30% allocation, following a consistent pattern of improvement across allocation levels. While reductions in Scope 1+2+3 emissions are more modest, they still reach just over 2% at the highest allocation, reflecting gradual improvement in supply chain-related emissions exposure.

More notably, Climate Transition Risk (CTR) Beta—a forward-looking measure of a portfolio's sensitivity to repricing risk during a low-carbon transition—declines. From a baseline of 0.05 in the MSCI World Index, CTR Beta declines by 18.3% at a 10% allocation, 24.0% at 20%, and nearly 30% at 30%, reflecting a consistent reduction in the portfolio's sensitivity to climate transition risk. This highlights the value of a completion portfolio solution in enabling targeted improvements to sustainability characteristics—such as transition risk—without disrupting the core structure of the existing portfolio. By adjusting exposures at the margin, the strategy allows asset owners to enhance climate resilience in a deliberate and scalable way.

Table 4: Sustainability Metrics – Completion Portfolio vs. MSCI World Index

Mar 31, 2025	MSCI-World	Completion Portfolios		
		10%	20%	30%
WACI Scope 1+2	99.86	-4.00%	-7.98%	-11.95%
WACI Scope 1+2+3	1152.40	-0.69%	-1.37%	-2.05%
CTR Betas	0.05	-18.30%	-24.02%	-29.73%

This table compares the sustainability characteristics of the MSCI World Index with three completion portfolio configurations (10%, 20%, and 30% allocations to a climate-enhanced strategy), measured across three key climate-related metrics: WACI Scope 1+2, WACI Scope 1+2+3, and Carbon Transition Risk (CTR) Betas. WACI (Weighted Average Carbon Intensity) is calculated based on company-level greenhouse gas emissions (Scopes 1+2 and 1+2+3) divided by corporate revenues. Analytics are computed at the end of the latest calendar quarter using end-of-quarter constituent weights. Emissions data are updated annually in June based on company-reported figures from the prior year, and the corresponding corporate revenues are from the same reporting year. CTR Betas are calculated at the index level and represent the sensitivity of an index's return to a carbon transition risk factor. Stock-level CTR betas are estimated using time-series bivariate regressions of daily stock returns over a two-year period, controlling for market exposure and carbon risk (Brown-minus-Green factor).

Sustainability-Aligned Completion – Enhancing Efficiency Without Compromising Transparency

Why It Matters: Integrating Sustainability Without Sacrificing Structure

This case illustrates how completion portfolios can deliver sustainability outcomes in a controlled, benchmark-aware, and evidence-based manner. Rather than rely on opaque ESG scores, this approach embeds climate-aware principles into portfolio design without compromising performance or introducing excessive tracking error.

- **Objective and transparent Sustainability implementation** using fact-based climate metrics;
 - **Preserved portfolio performance and risk objectives** with consistent return-to-risk and benchmark-relative performance.
-

Conclusion: The Strategic Importance of Completion Portfolios

Conclusion: The Strategic Importance of Completion Portfolios

Completion portfolios are an important tool to address the inherent challenges of investment drift and exposure misalignment. By providing a targeted, flexible mechanism for fine-tuning portfolio characteristics, these strategies offer investors a powerful tool for maintaining strategic intent and improving overall portfolio performance.

The case studies presented demonstrate the versatility of completion portfolios across different investment contexts. From correcting geographic imbalances to addressing factor exposures and sustainability objectives, these strategies provide a nuanced approach to an optimal portfolio. Unlike wholesale portfolio reconstructions, completion portfolios allow for precise adjustments that preserve the core investment philosophy and existing allocations.

Key advantages of completion portfolios include:

- 1. Control of Factor Exposures:** Investors can fine-tune their exposure to rewarded risk factors—such as value, quality, momentum, or low volatility—while correcting unintended tilts that emerge over time.
- 2. Risk Management:** Completion strategies help mitigate unintended biases—whether geographic, sectoral, or style-based—thereby improving the portfolio's risk profile, such as tracking error, and alignment with long-term objectives.
- 3. Strategic Flexibility:** Completion portfolios allow investors to make targeted adjustments in response to evolving market conditions or shifting investment priorities—without requiring wholesale changes to the core portfolio. This flexibility supports tactical decision-making while preserving long-term strategic intent.
- 4. Efficient and Cost-Effective Implementation:** By working alongside existing holdings, completion portfolios minimize turnover and transaction costs, providing a scalable and efficient mechanism for portfolio improvement.

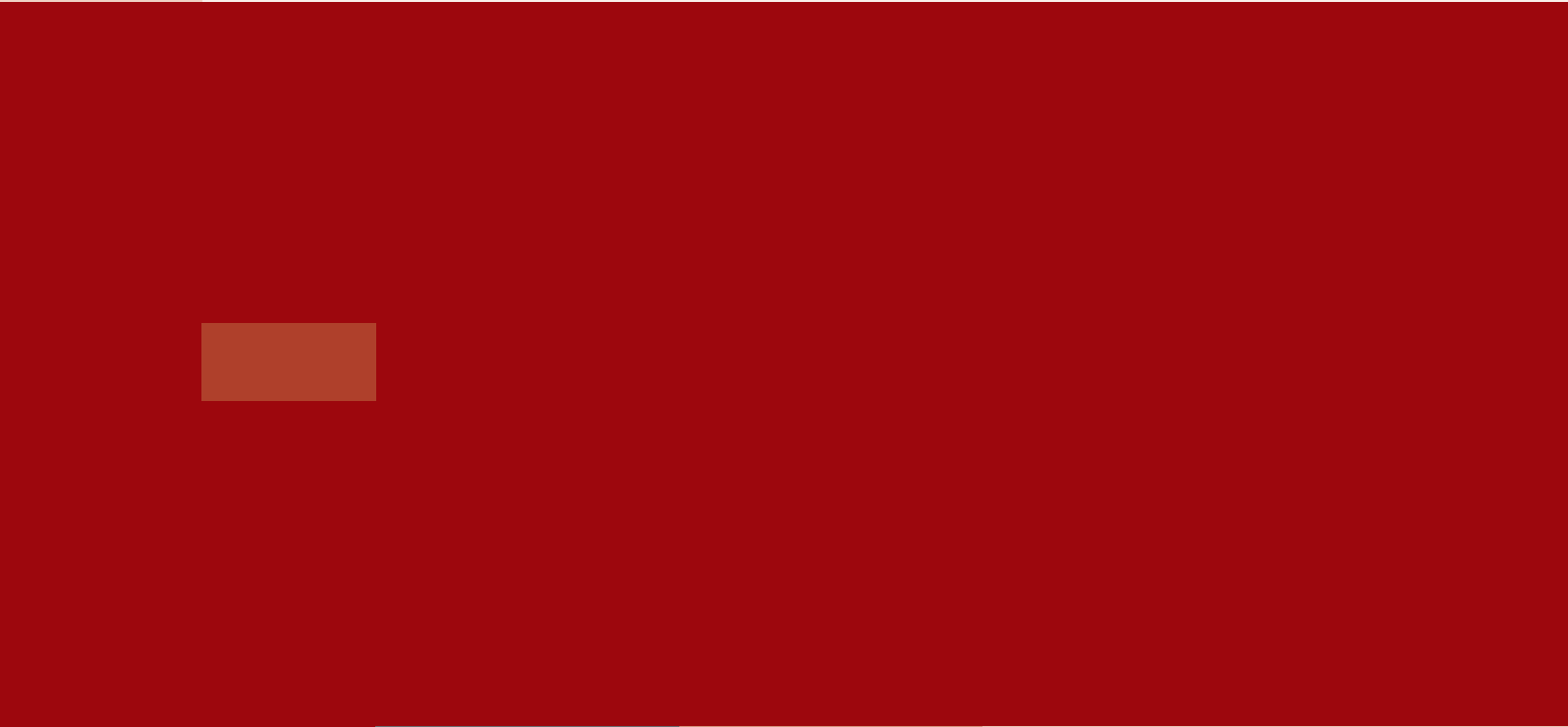
The effective implementation of completion portfolios depends on the index provider's ability to design portfolios that address specific deficiencies and customise exposures without creating new gaps or unintended risks. Hence, the value of a completion portfolio relies not only on identifying what exposures are needed, but on having access to well-design and targeted equity solutions rather than generic market benchmarks.

The fundamental value of completion portfolios lies in their ability to bridge the gap between strategic intent and actual portfolio composition. By providing a precise mechanism for addressing exposure misalignments, these strategies offer investors a powerful approach to maintaining the integrity of their investment philosophy. Completion portfolios represent a solution to the persistent challenge of portfolio management: ensuring that investment allocations consistently reflect an investor's core objectives.

References

References

- Aguet, Daniel, Felix Goltz, and Warwick Schneller. 2025. "Understanding and Managing the Impact of Market Concentration on Factor Strategies", Scientific Beta Publication.
 - Amenc, Noël, Felix Goltz, Ashish Lodh and Ben Luyten. 2018. *Measuring Factor Exposure Better to Manage Factor Allocation Better*. Scientific Beta Research Paper.
 - Amenc, Noël, Felix Goltz, and Sivagaminathan Luyent. 2020. *Accounting for Intangibles in Value Investing: New Evidence on the Use of the Intangible-Adjusted Book-to-Market Ratio*. Scientific Beta Research Paper.
 - Arnott, Robert D., Jason Hsu, and Philip Moore. 2005. "Fundamental Indexation." *Financial Analysts Journal* 61 (2): 83–99. <https://doi.org/10.2469/faj.v61.n2.2718>.
 - Berg, Florian, Julian F. Koelbel, and Roberto Rigobon. 2022. *Aggregate Confusion: The Divergence of ESG Ratings*. *Review of Finance* 26 (6): 1315–1344.
 - Blitz, David, and Laurens Swinkels. 2008. "Fundamental Indexation: An Active Value Strategy in Disguise." *Journal of Asset Management* 9 (4): 264–69. <https://doi.org/10.1057/jam.2008.24>.
 - Cremers, Martijn, Miguel A. Ferreira, Pedro Matos, and Laura Starks. 2016. "Indexing and Active Fund Management: International Evidence." *Journal of Financial Economics* 120 (3): 539–60. <https://doi.org/10.1016/j.jfineco.2016.01.003>.
 - Christiansen, Erik. 2024. *Can We Make ESG Scores Great Again?* Scientific Beta Publication.
 - Christiansen, Erik. 2024. *Addressing Both Sides of the Transition Coin – The Scientific Beta Climate Change Screen and Sustainability Target Framework*. Scientific Beta Publication.
 - Mercer. (2021). *Building robust equity portfolios*. Retrieved from <https://www.mercer.com/insights/yield-point/building-robust-equity-portfolios/>
 - Morningstar. 2023. *Active U.S. Large-Cap Fund Trends and Sector Exposures*. Morningstar Research Report.
-



Appendix

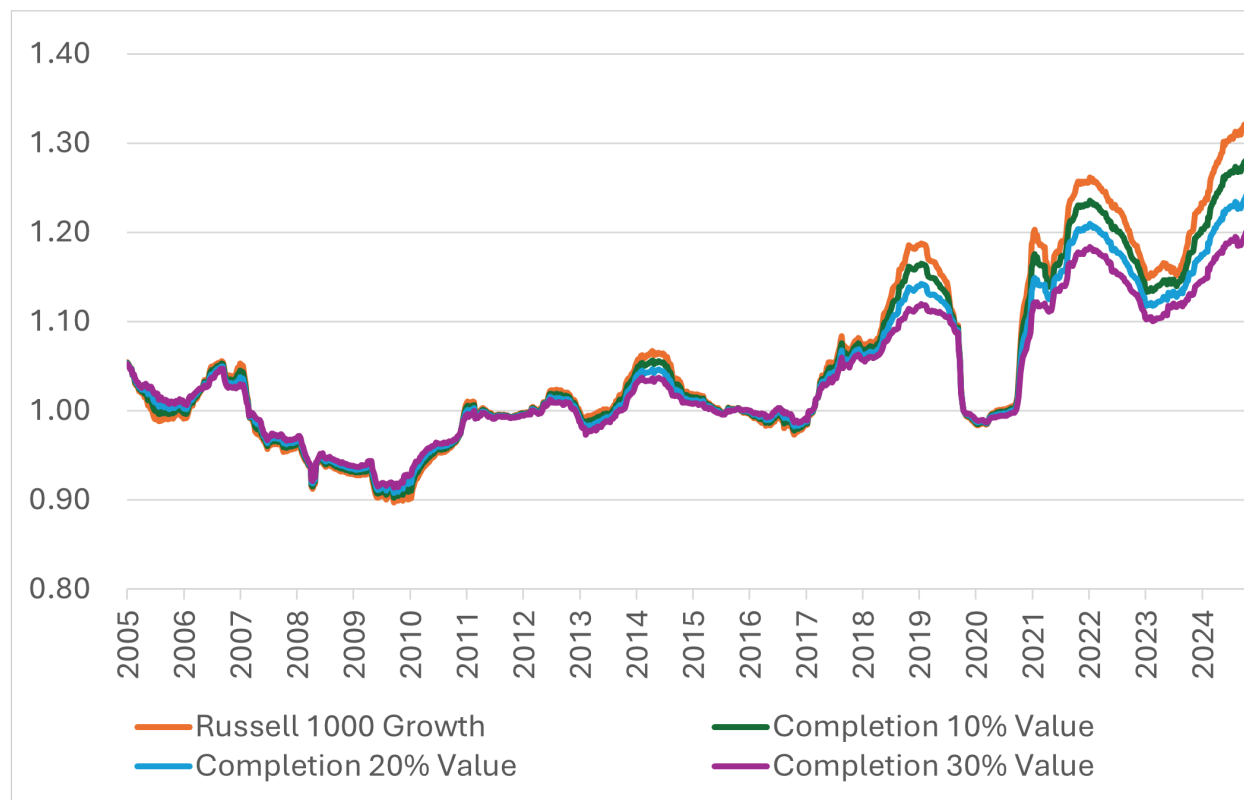
Appendix

Case Study 1: Improved Market Beta Stability in Completion Portfolios

Beyond return and volatility metrics, it is also critical to assess the market sensitivity of the completion portfolios, as measured by their 1-Year rolling beta to the US market. Maintaining a market beta profile close to one is important for many investors—particularly those with strategic asset allocation mandates or policy benchmarks—because it ensures the portfolio’s relative risk profile remains stable and broadly market-neutral over time.

Figure 10 plots the 1-year rolling market beta of the Russell 1000 Growth Index and the various completion portfolio configurations. The chart reveals that the Russell 1000 Growth Index exhibits greater market beta variability over time, reflecting its more concentrated exposures and sensitivity to cyclical shifts in market leadership. This is particularly evident during periods of heightened volatility, such as the COVID-19 shock in 2020 and subsequent recovery, where its market beta spiked sharply and then declined—resulting in higher peaks and lower troughs relative to the blended portfolios.

Figure 10: 1-Year Rolling Market Beta



The chart displays the 1-year rolling beta of the Russell 1000 Growth Index and the completion portfolios (10% to 30% allocation to the Scientific Beta US Value Index) relative to the Scientific Beta US Cap-Weighted Index.

Appendix

In contrast, the completion portfolios show a more stable and consistent market beta path. As allocations to the Value Index increase, market beta fluctuations are dampened, contributing to greater stability in the portfolio's overall market sensitivity.

This market beta stability offers two practical benefits for institutional investors:

- Improved predictability: A more stable market beta profile reduces unintended shifts in total portfolio risk.
- Benchmark alignment: Smoother market beta paths support policy consistency and adherence to tracking error budgets, especially in asset-liability or multi-manager frameworks.

Case Study 2: Geographic Completion Implementation Methodology

The completion overlay is constructed as follows:

Each quarter, we compare the regional weights of the current allocation against the MSCI ACWI across six regional cap-weighted blocks. The regional blocks are: United States, Developed America ex-USA, Japan, Developed Asia-Pacific ex-Japan, Developed Europe, and Emerging.

If an underweight to Emerging Markets is detected, we:

1. **Calculate the EM Gap:** Determine the size of the underweight by comparing the Emerging Markets weight in the pre-completion allocation to that in the MSCI ACWI.
2. **Identify Overweights:** Determine which regional blocks are overallocated relative to the benchmark.
3. **Proportional Reweighting:** Reduce weights in the overallocated regions on a proportional basis to fund the shortfall in Emerging Markets.

Stock-level weights are then adjusted using the following rule:

$$w_i^{completion} = w_i^{pre-completion} - \delta \cdot \frac{w_B}{\sum w_B} + \delta w_i^{EM}$$

Where:

- $w_i^{pre-completion}$ is the weight of stock i in the pre-completion portfolio
 - w_B is the aggregate weight of stock i in an overallocated region block β
-

Appendix

- w_i^{EM} is the weight of stock i in the Emerging markets completion index (either cap-weighted or multi-factor)
- δ is the total Emerging markets weight to be corrected

Finally, the adjusted weights are normalized to ensure the total portfolio sums to 100%. On average, the resulting completion sleeve represents approximately 6.7% of the total portfolio, though this varies depending on the size of the Emerging markets underweight in each period.

Case Study 3: Additional Sustainability and Decarbonisation Results

Table 5 presents fossil fuel involvement metrics for the MSCI World Index and the relative reductions achieved through allocations of 10%, 20%, and 30% to the Climate-Enhanced Completion Index. The first column shows baseline exposure levels in the MSCI World Index as of 31 March 2025. The subsequent columns display the percentage point reductions in those exposures resulting from incremental allocations to the completion strategy. The reductions follow a consistent monotonic pattern: as the allocation to the climate-enhanced sleeve increases, fossil fuel exposure declines steadily across all categories.

The impact is most pronounced at the 30% allocation level. Exposure to companies in the coal industry group is reduced by 30% relative to the MSCI World, while exposure to companies generating 10% or more of turnover from thermal coal mining is also reduced by 30%—effectively removing most of this segment from the portfolio. Exposure to companies with 25–50% of turnover from fossil fuels declines by over 7 percentage points, and companies in the broader fossil fuel sector show a 1.4 percentage point reduction.

These results illustrate how even partial completion allocations can produce substantial climate alignment. These changes reflect the application of fact-based, rules-driven tilts designed to target the most carbon-intensive and transition-risk-exposed assets.

Table 5: Fossil Fuel Involvement Metrics - MSCI World Index Relative to Completion Portfolio with Scientific Beta Climate Enhanced Index

Mar 31, 2025	MSCI-World	Completion Portfolio		
		10%	20%	30%
Companies classified in the Energy - Fossil Fuels Sector (TRBC5010)	4.24%	-0.47%	-0.93%	-1.40%
Companies with 25-50% of turnover from Fossil Fuels	1.77%	-2.34%	-4.67%	-7.01%
Companies with 50-100% of turnover from Fossil Fuels	5.08%	-1.62%	-3.25%	-4.87%
Companies with 10% or more of turnover from thermal coal mining	0.06%	-10.00%	-20.00%	-30.00%

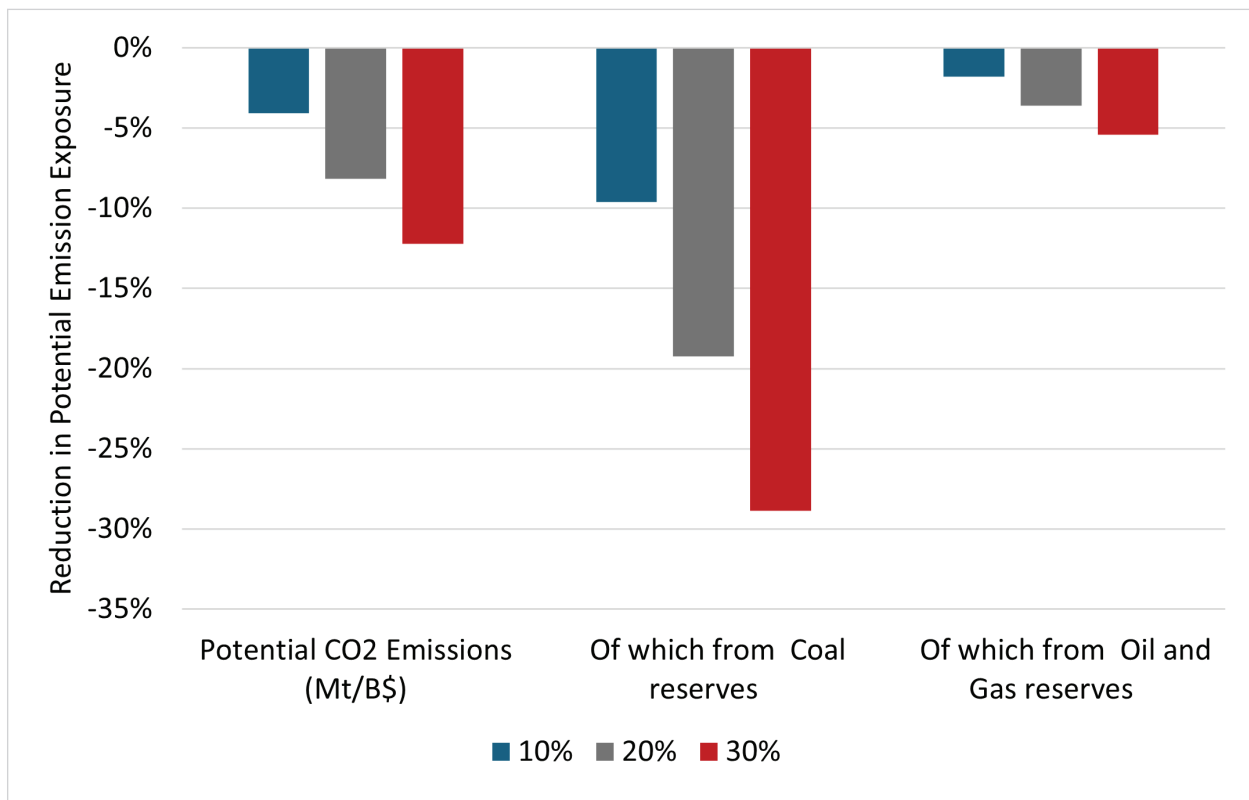
Appendix

Beyond reductions in fossil fuel involvement, the climate-enhanced strategy also lowers the portfolio’s embedded carbon risk—particularly exposure to potential emissions from reserves.

Figure 11 illustrates the percentage reduction in potential CO₂ emissions relative to the MSCI World Index, broken down into total emissions, those attributable to reserves, and emissions specifically linked to coal and oil & gas reserves. The decarbonisation benefits are progressive across allocation levels. At a 30% allocation, total potential CO₂ emissions fall by nearly 13%.

The most significant reductions are observed in coal-related reserves, with potential emissions dropping by nearly 30% at the highest allocation level. Oil and gas reserves also show steady declines, contributing further to the reduction in transition-related risk. These improvements reflect a meaningful reduction in exposure to embedded carbon intensity and stranded asset risk—highlighting the strategy’s role in aligning portfolios with long-term climate objectives.

Figure 11: Potential Emissions Associated with Reserves



About Scientific Beta

About Scientific Beta

Scientific Beta's aim is to encourage the entire investment industry to adopt the latest advances in smart factor and ESG/climate index design and implementation. Our institution was established in December 2012 by EDHEC-Risk Institute, one of the top academic institutions in the field of fundamental and applied research for the investment industry, as part of its mission to transfer academic know-how to the financial industry. Scientific Beta brings the same concern for scientific rigour and veracity to all the services that it provides to investors and asset managers. We offer the smart factor and ESG/Climate solutions that are most proven scientifically, with full transparency of both methods and associated risks.

On 31 January 2020, Singapore Exchange (SGX) acquired a majority stake in Scientific Beta. SGX continues to support our strong collaboration with EDHEC Business School, and the principles of independent, empirical-based academic research that have benefited our development to date.

Scientific Beta has developed two types of expertise over the years, responding to two of the major challenges that investors face:

- Smart Beta and, more particularly, factor investing.
- ESG, in particular climate investing.

To date, Scientific Beta has made offerings with two major types of climate objective available to investors:

Since 2015, we have offered products with financial objectives that respect ESG and carbon constraints. These correspond to the application of exclusion filters, the design of which allows the financial characteristics of the index to be conserved. This involves reconciling financial objectives and compliance with ESG norms and climate obligations. As such, our Core ESG, Extended ESG and Low Carbon filters can be integrated into smart beta or cap-weighted offerings in line with the financial objectives targeted by the investor.

Since 2021, Scientific Beta has also offered indices with pure climate objectives (Climate Impact Consistent Indices) that enable climate exclusions and weightings to be combined in order to translate companies' climate alignment engagement into portfolio decisions.

Since it was acquired by SGX in January 2020, Scientific Beta has accelerated its investments in the area of Climate Investing as part of the SGX Sustainable Exchange strategy, which is mobilising an investment of SGD20 million. In addition, EDHEC and Scientific Beta have set up a EUR1 million/year ESG Research Chair at EDHEC Business School.

With the aim of providing worldwide client servicing, Scientific Beta has a presence in Boston, London, Nice, Singapore and Tokyo. Scientific Beta has a dedicated team of 40 people who cover not only client support from Nice, Singapore and Boston, but also the development, production and promotion of our index offering. Scientific Beta signed the United Nations-supported Principles for Responsible Investment on 27 September 2016. We became an associate member of the Institutional Investor Group on Climate Change on 9 April 2021.

About Scientific Beta

Today, Scientific Beta devotes more than 40% of its R&D investment to climate investing and more than 45% of its assets under replication refer to indices with an ESG or climate focus. As a complement to its own research, Scientific Beta supports an important research initiative developed by EDHEC on ESG and climate investing and cooperates with Moody's ESG and ISS ESG for the construction of its ESG and climate indices.

On 27 November 2018, Scientific Beta was presented with the Risk Award for Indexing Firm of the Year 2019 by the prestigious professional publication Risk Magazine. On 31 October 2019, Scientific Beta received the Professional Pensions Investment Award for "Equity Factor Index Provider of the Year 2019." On 2 February 2022, Scientific Beta was named "Best Specialist ESG Index Provider" at the ESG Investing Awards 2022. On 6 March 2025, Scientific Beta was named "Best ESG Index Provider" at the ESG Investing Awards 2025.



Scientific Beta Publications

Scientific Beta Publications

2025 Publications

- Aguet, D., Goltz, F., Is now the time to diversify across stocks? (May).
- Aguet, D., V. Cady. Defensive Equity Investing Without the Implicit Bets (April).
- Aguet, D., Esakia, M., Goltz, F., Luyten, B. and Mirciov, I. Refining Value Investing: Benefits of Incorporating Intangible Capital and Stabilising Market Exposure (March).
- Aguet, D., Goltz, F. and Schneller, W. Understanding and Managing the Impact of Market Concentration on Factor Strategies (March).

2024 Publications

- Aguet, D., Goltz, F., and I. Mirciov. Improving Factor Exposure per Unit of Tracking Error: Managing Economic Risks to Improve Efficiency in Multi-Factor Equity Strategies (October).
- Aguet, D., Goltz, F., and B. Luyten. A New Approach to Quality Investing: Combining Risk Awareness and Robust Metrics (September).
- Christiansen, E. Can We Make ESG Scores Great Again? (April).
- Bruno, G., Goltz, F., and B. Luyten. Trade Policy Risk Exposure in Equity Portfolios (February).
- Bruno, G., Goltz, F. From ESG Confusion to Return Dispersion: Fund Selection Risk is a Material Issue for ESG Investors (February).

2023 Publications

- Christiansen, E., D. Aguet and N. Amenc. Climate Impact Consistent Indices (September).
- Aguet, D. Why Diversification Still Matters for Investors? (September).
- Amenc, N., F. Goltz and A. Naly. Green Dilution: How ESG Scores Conflict with Climate Investing. (June).
- Bruno, G., Goltz, F., and B. Luyten. Firm-Level Exposure to Trade Policy Shocks: A Multi-dimensional Measurement Approach. (June).
- Aked, M. The Three Principles of Climate Impact Investing. (May).
- Aked, M. Navigating the Factor Menu - The Role of Macroeconomic Factors. (February).

2022 Publications

- Christiansen, E. Scientific Beta welcomes the NZAOA's Principles for Net-Zero-Aligned Benchmarks (December).
- Christiansen, E. Financing the Energy Transition: What is the Role of Fossil Fuels Divestment? (November).
- Mauguin, R. Scientific Beta Global Universe. (July).
- Christiansen, E., D. Aguet and N. Amenc. Climate Impact Consistent Indices. (March).
- Esakia, M and F. Goltz. Targeting Macroeconomic Exposures in Equity Portfolios: A Firm-Level Measurement Approach for Out-of-Sample Robustness. (February).

2021 Publications

- Amenc, N., G. Bruno and F. Goltz. Should ESG alpha Really be Positive? Assessing the Five Forces that Drive ESG Investment Returns. (December).
- Mahtani, R. Scientific Beta Enhanced ESG Reporting – Supporting Incorporation of ESG Norms and

Scientific Beta Publications

Climate Change Issues in Investment Management. (August).

- Bruno, G., M. Esakia and F. Goltz. "Honey, I Shrunk the ESG Alpha": Reactions of Investment Professionals (November).
- Amenc, N., F. Goltz, and V. Liu. Doing Good or Feeling Good? Detecting Greenwashing in Climate Investing (August).
- Aguet, D. Protecting your Equity Portfolio Against Inflation. (July).
- Christiansen, E., D. Aguet and N. Amenc. Scientific Beta Core ESG Filter: A Consensus and Norms-Based ESG Investing Approach. (August).
- Christiansen, E. Scoring against ESG? What are Market Participants' Views on ESG Scores? (May).
- Amenc, N., M. Esaki and F. Goltz. When Greenness is Mistaken for Alpha: Pitfalls in Constructing Low Carbon Equity Portfolios. (May).
- Bruno, G., M. Esakia and F. Goltz. "Honey, I Shrunk the ESG Alpha": Risk-Adjusting ESG Portfolio Returns. (April).
- Aguet, D., N. Amenc and F. Goltz. Reconciling Financial and Non-Financial Performance. (February).

Disclaimer

The information contained on the Scientific Beta website (the "information") has been prepared by Scientific Beta Pte solely for informational purposes, is not a recommendation to participate in any particular trading strategy and should not be considered as an investment advice or an offer to sell or buy securities. All information provided by Scientific Beta Pte is impersonal and not tailored to the needs of any person, entity or group of persons. The information shall not be used for any unlawful or unauthorised purposes. The information is provided on an "as is" basis. Although Scientific Beta Pte shall obtain information from sources which Scientific Beta Pte considers to be reliable, neither Scientific Beta Pte nor its information providers involved in, or related to, compiling, computing or creating the information (collectively, the "Scientific Beta Pte Parties") guarantees the accuracy and/or the completeness of any of this information. None of the Scientific Beta Pte Parties makes any representation or warranty, express or implied, as to the results to be obtained by any person or entity from any use of this information, and the user of this information assumes the entire risk of any use made of this information. None of the Scientific Beta Pte Parties makes any express or implied warranties, and the Scientific Beta Pte Parties hereby expressly disclaim all implied warranties (including, without limitation, any implied warranties of accuracy, completeness, timeliness, sequence, currentness, merchantability, quality or fitness for a particular purpose) with respect to any of this information. Without limiting any of the foregoing, in no event shall any of the Scientific Beta Pte Parties have any liability for any direct, indirect, special, punitive, consequential or any other damages (including lost profits), even if notified of the possibility of such damages.

All Scientific Beta Indices and data are the exclusive property of Scientific Beta Pte.

Information containing any historical information, data or analysis should not be taken as an indication or guarantee of any future performance, analysis, forecast or prediction. Past performance does not guarantee future results. In many cases, hypothetical, back-tested results were achieved by means of the retroactive application of a simulation model and, as such, the corresponding results have inherent limitations. The Index returns shown do not represent the results of actual trading of investable assets/securities. Scientific Beta Pte maintains the Index and calculates the Index levels and performance shown or discussed, but does not manage actual assets. Index returns do not reflect payment of any sales charges or fees an investor may pay to purchase the securities underlying the Index or investment funds that are intended to track the performance of the Index. The imposition of these fees and charges would cause actual and back-tested performance of the securities/fund to be lower than the Index performance shown. Back-tested performance may not reflect the impact that any material market or economic factors might have had on the advisor's management of actual client assets.

The information may be used to create works such as charts and reports. Limited extracts of information and/or data derived from the information may be distributed or redistributed provided this is done infrequently in a non-systematic manner. The information may be used within the framework of investment activities provided that it is not done in connection with the marketing or promotion of any financial instrument or investment product that makes any explicit reference to the trademarks licensed to Scientific Beta Pte (SCIENTIFIC BETA, SCIBETA and any other trademarks licensed to Scientific Beta Pte) and that is based on, or seeks to match, the performance of the whole, or any part, of a Scientific Beta index. Such use requires that the Subscriber first enters into a separate license agreement with Scientific Beta Pte. The Information may not be used to verify or correct other data or information from other sources.

The terms contained in this Disclaimer are in addition to the Terms of Service for users without a subscription applicable to the Scientific Beta website, which are incorporated herein by reference.

For more information, please contact:
S verine Cibelly on: +33 493 187 863 or by e-mail to: severine.cibelly@scientificbeta.com

Scientific Beta HQ & Asia-Pacific

2 Shenton Way
#02-02
SGX Centre I
Singapore 068804
Tel: +65 6713 7578

Scientific Beta R&D

470 Promenade des Anglais
06200 Nice
France
Tel: +33 493 187 851

Scientific Beta—Europe

77 Leadenhall Street
London EC3A 3DE London
United Kingdom

Scientific Beta—North America

1450 Broadway
12th floor
New York, NY 10018
United States

Scientific Beta—Sydney

Level 35, 100 Barangaroo Avenue
Sydney NSW 2000
Australia
Tel: +61 2 8114 4588