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Crash-Tested: Rebuilding Momentum and Managing Crash Risk

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About the Author

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Executive Summary

Executive Summary

We study momentum crashes in Australian equities and evaluate an implementable volatility-managed overlay for momentum strategies. Momentum crashes cluster in states with elevated volatility and market rebounds, making them partly forecastable. We design a simple volatility-control mechanism that scales exposure to a momentum index and reallocates to cash when forecast volatility exceeds a target, thereby capping portfolio volatility while preserving exposure to the momentum premium. Using daily Australian data from July 2005 to March 2025, we show that the overlay mitigates the absolute severity of momentum crashes and lowers volatility, drawdowns, and tail losses, while maintaining comparable average returns and improving Sharpe ratios relative to a static momentum index. The approach reduces effective market exposure in turbulent states without eliminating momentum exposure. The results generalise out-of-sample using U.S. evidence, where the same overlay reduces drawdowns and raises risk-adjusted performance. Overall, volatility-aware scaling improves the investability of momentum by curbing crash risk without materially diluting exposure to the momentum premium.

Introduction

Introduction

The evidence for the momentum premium is both pervasive and robust, having been well-documented across decades of data and various markets. In Australia, studies such as Hurn and Pavlov (2003) and Chan and Docherty (2016) demonstrate the persistence of the premium, while international evidence provided by Rouwenhorst (1998), Fama and French (2012), and Jegadeesh and Titman (1993, 2023) highlight its global nature. The momentum premium, which refers to the tendency of assets with strong past returns ("winners") to outperform those with weak past returns ("losers"), has established itself as a common component in both single-factor and multi-factor portfolios. Investors seeking higher average returns frequently allocate capital to strategies targeting the momentum premium.

However, the strong positive average returns offered by momentum strategies are punctuated by periods of extreme negative performance, commonly referred to as *momentum crashes*. These crashes are characterized by infrequent yet sharp and persistent drawdowns, often coinciding with market recoveries following significant declines. Daniel and Moskowitz (2016) show that momentum crashes are not purely random but are, to some extent, forecastable based on elevated market volatility. This predictability presents an opportunity for investors to dynamically manage risk exposure and mitigate the severity of momentum crashes.

In this paper, we study the design and effectiveness of a risk-managed momentum strategy that employs volatility controls. The strategy scales momentum exposure dynamically in response to forecasted volatility, reallocating to cash when estimated volatility exceeds a target. The intent is to stabilise performance while retaining exposure to the momentum premium.

This paper makes three primary contributions to the literature on momentum investing and risk management, using Australia as a case study. First, we demonstrate that momentum crashes are to some extent forecastable in Australia, consistent with prior studies (Daniel and Moskowitz, 2016; Barroso and Santa-Clara, 2015). We show that heightened market volatility serves as a signal for increased crash risk, reinforcing the link between volatility and extreme negative returns for momentum strategies.

Second, we propose and assess a volatility-managed momentum strategy that reduces absolute risk (volatility, drawdowns, tail losses) and mitigates the magnitude of momentum crashes. By reallocating to cash during periods of elevated volatility, the volatility control mechanism improves the resilience of momentum strategies during turbulent market conditions.

Third, we assess the relative performance of the risk-managed momentum strategy compared to a standard momentum strategy. Our results show that the volatility control mechanism enhances the Sharpe ratio of momentum strategies by improving risk-adjusted returns. Specifically, we find that the volatility-managed momentum strategy delivers comparable or slightly higher returns while exhibiting lower downside volatility, maximum drawdowns, and extreme negative returns.

Introduction

These findings have important implications for investors seeking to maximise risk-adjusted returns. While the momentum factor has historically offered the highest Sharpe ratio among common equity factors (Barroso and Santa-Clara, 2015), its susceptibility to crash limits its appeal for risk-averse investors. By incorporating dynamic volatility control, investors can better harness the momentum premium while managing the risks associated with severe drawdowns.

The volatility control mechanism offers a systematic approach to risk management that reduces absolute risk while preserving strong exposure to the momentum premium. These results contribute to the broader literature on momentum investing by providing a practical framework for mitigating crash risk and improving the stability of momentum-based portfolios.

Momentum Strategies in Australia

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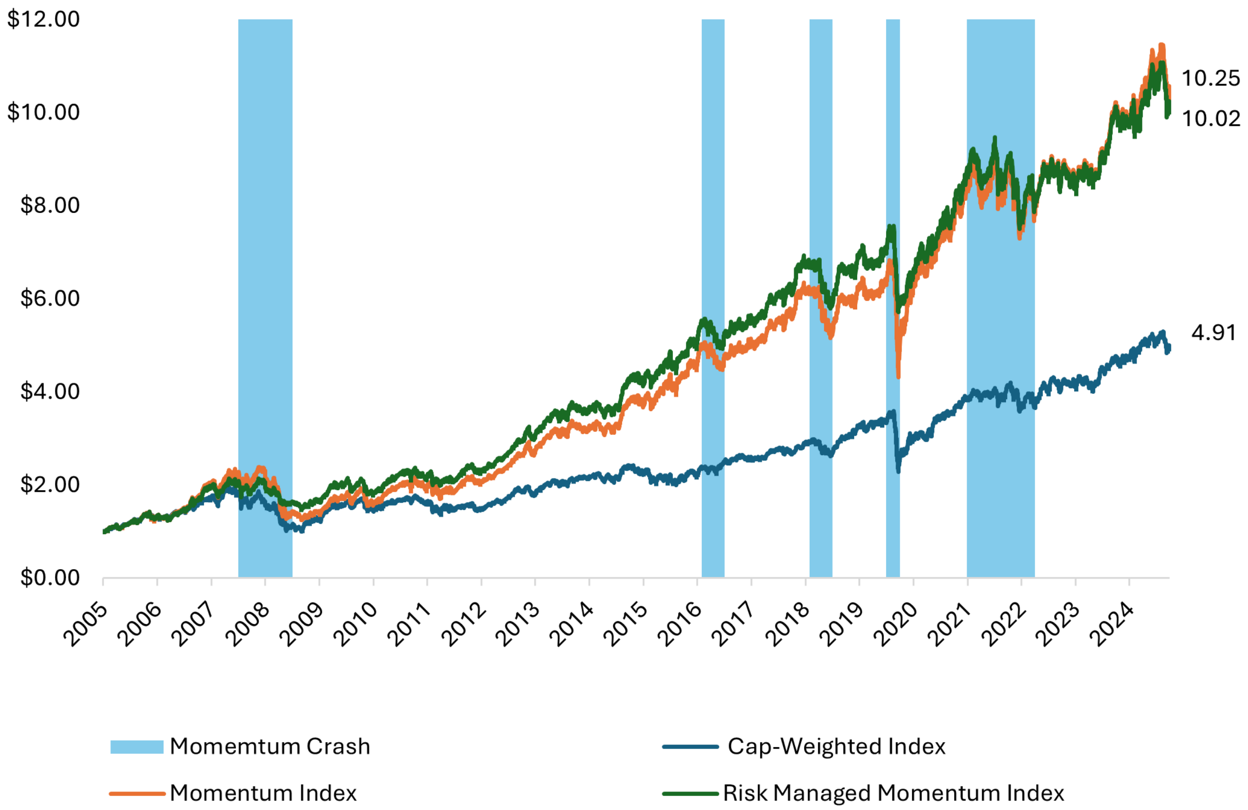
Momentum strategies, which involve buying assets with high past returns ("winners") and shorting those with low past returns ("losers"), have consistently generated significant positive returns across equities and other asset classes. The traditional momentum strategy is implemented as a long-short portfolio, balancing exposure to both winners and losers. Many investors, particularly those with specific constraints, pursue long-only momentum strategies, focusing exclusively on the long leg of the portfolio by investing in assets with strong past performance.

Figure 1 shows the long-run cumulative performance of three long-only strategies from July 2005 to March 2025: a momentum index, a risk-managed momentum index and a broad market cap-weighted index for Australia. The results demonstrate the outperformance of momentum-based strategies compared to the market index over two decades.

As shown in figure 1, $1 investment in the SciBeta Australia Cap-Weighted Index (RI, AUD) grew to $4.91 by March 2025. By contrast, the long-only Momentum Index grew to $10.25, and the Risk-Managed Momentum Index had a similar cumulative return, reaching $10.02. Highlighting the long-term attractiveness of momentum strategies for enhancing portfolio returns.

Figure 1: Momentum Performance in Australia - Cumulative Returns to Long-Only Momentum Strategies



Momentum Strategies in Australia

The figure shows the cumulate returns and terminal value of the baseline static Momentum index, the dynamic Risk Managed Momentum Index and the broad Australian market. The broad Australian market is represented by the SciBeta Australia Cap-Weighted (RI) Index. All returns are in Australian Dollars. The sample period is July 2005 - March 2025. The shaded periods correspond to episodes of momentum crashes. Following the academic literature (e.g., Daniel & Moskowitz 2011, 2016; Barroso & Santa-Clara 2012), we use the term to describe infrequent but severe drawdowns in momentum strategies that typically occur in high-volatility states.

While the cumulative performance of momentum strategies is compelling, Figure 1 also reveals the challenges associated momentum strategies, particularly during periods of severe underperformance known as momentum crashes. Momentum crashes are periods when momentum strategies experience significant losses often in conjunction with sharp market reversals. These events typically occur during market rebounds following prolonged downturns, as previously underperforming stocks—those classified as "losers" in momentum portfolios—experience strong recoveries, while the previous winners lag or decline. As a result, momentum portfolios, which are heavily invested in prior winners, suffer disproportionate losses.

Notable crash occurred during the Global Financial Crisis (2008-2009), when momentum strategies experienced significant drawdowns. Other periods of significant absolute losses can be observed in subsequent years, including during the COVID-19 market rebound in 2020-2021. Despite these setbacks, the long-term performance of momentum strategies remains robust, as evidenced by their ability to recover and continue outperforming the market over time.

The Link Between Momentum Crashes and Volatility

The Link Between Momentum Crashes and Volatility

Momentum crashes are not random but systematically linked to periods of elevated market volatility. These episodes are characterised by heighted volatility and rapid reversals in market direction. Daniel and Moskowitz (2016) show that such crashes tend to occur in "panic states", where the market has declined, volatility is elevated, and prices subsequently rise. Crucially, the increase in volatility is a consequence of these turbulent reversals rather than their underlying cause.

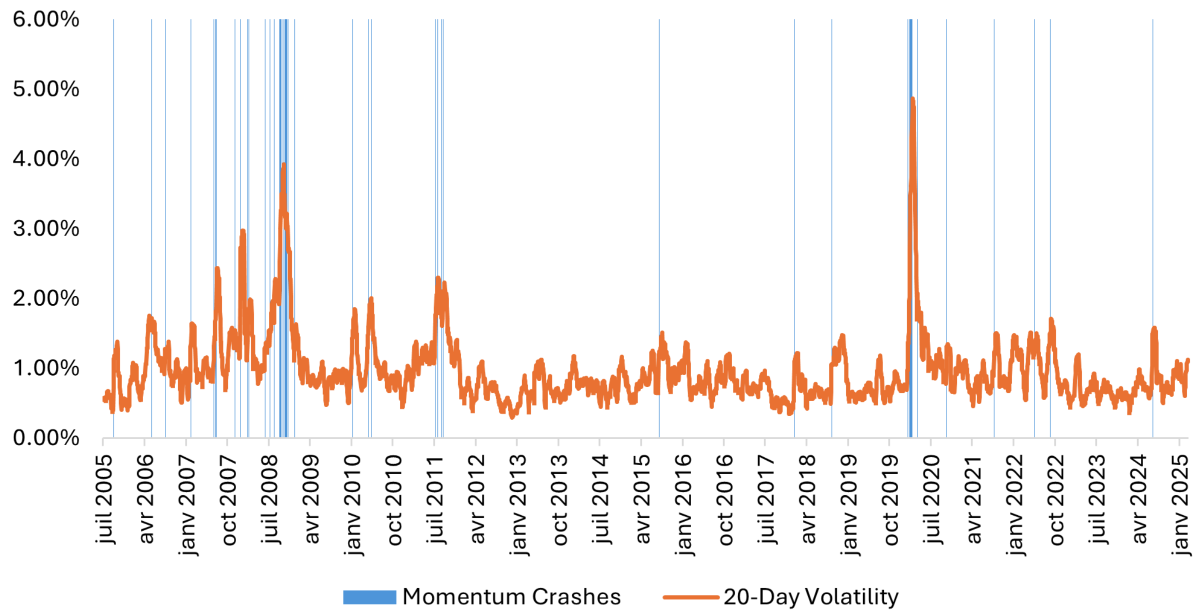
In these phases, past losers—typically high-beta stocks—experience disproportionate rebounds, while past winners—often low-beta stocks—exhibit muted performance. This beta asymmetry exacerbates the losses in momentum strategies as the short leg of the portfolio (losers) rebounds strongly, generating significant negative returns, particularly for long-short strategies.

These dynamics, while most extensively documented in the context of long-short portfolios, are also highly relevant for long-only momentum strategies. Although long-only investors are not exposed to sharp reversals in past losers, they remain vulnerable to the underperformance of past winners—typically low-beta stocks—during market recoveries. This asymmetry in beta, highlighted by Grundy and Martin (2001) and Daniel and Moskowitz (2016), can result in significant drawdowns and absolute losses in long-only portfolios. Barroso and Santa-Clara (2015) further demonstrate that the volatility clustering and negative skewness associated with momentum are not solely a product of the short leg, but also stem from the long side of the portfolio. As such, long-only strategies remain vulnerable to periods of sharp drawdowns.

Figure 2 illustrates this relationship, showing how spikes in 20-day rolling volatility frequently align with periods of momentum crashes. For example, the Global Financial Crisis (2008–2009) and the COVID-19 rebound (2020–2021) both witnessed substantial volatility spikes and corresponding momentum crashes.

The Link Between Momentum Crashes and Volatility

Figure 2: Momentum Crashes and Volatility



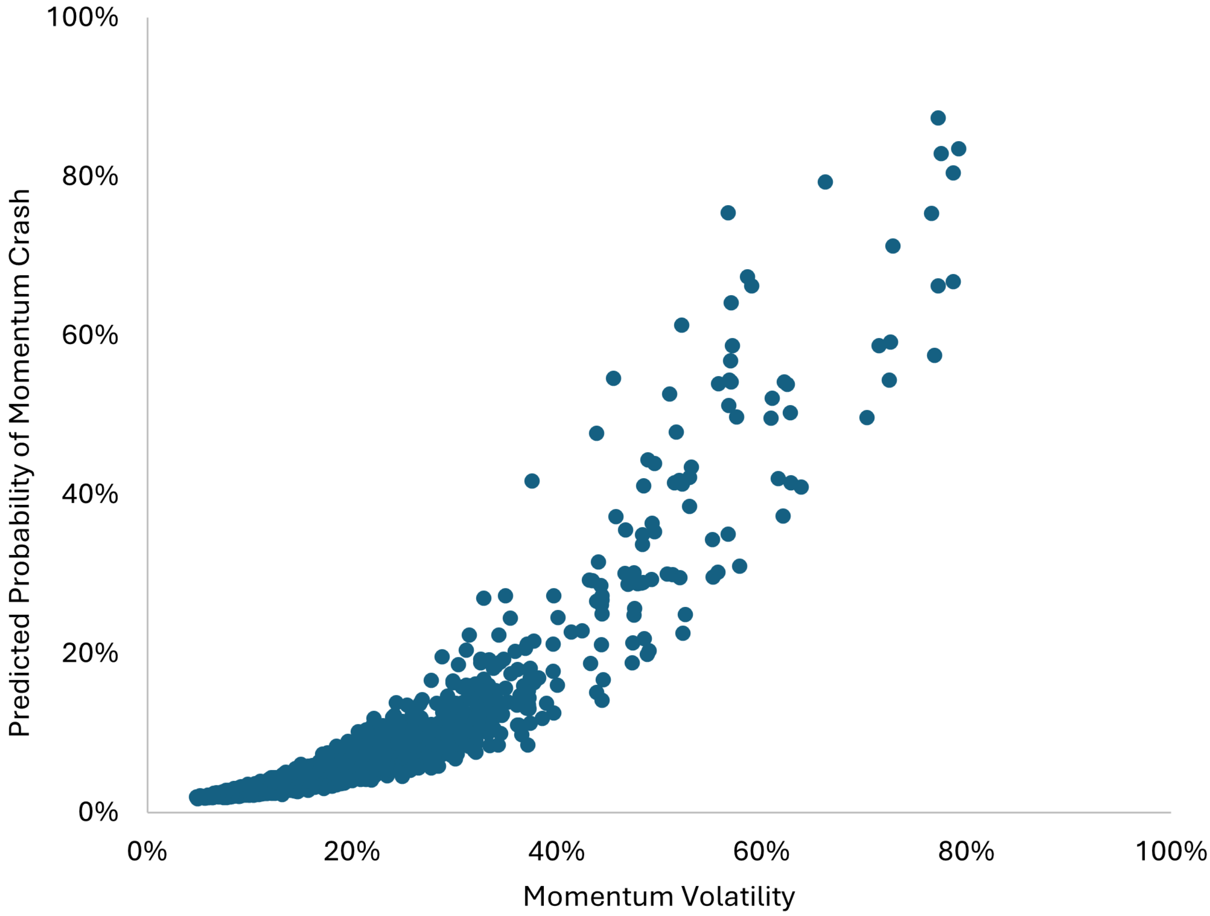
The figure shows the time-series relationship between momentum crashes and 20-day rolling volatility over time. The orange line represents the values of 20-day rolling volatility as a percentage. The blue line represents instances of momentum crashes, days where the returns fall in the bottom 1% of all observed returns. Momentum crashes are measured using the absolute daily returns of the Australian Momentum Index. The sample uses daily return observations between July 2005 and March 2025.

The time-varying beta behavior of momentum portfolios further magnifies the impact of volatility on momentum crashes. During market downturns, past losers often exhibit high market betas, while past winners show lower betas. As markets recover, this asymmetry reverses the relative performance of winners and losers, causing the momentum portfolio's overall beta exposure to become negative. This negative beta exposure amplifies losses during market rebounds, as momentum strategies effectively become short on market risk when it is most detrimental.

Grundy and Martin (2001) and Barroso and Santa-Clara (2015) show that time-varying risk is a characteristic of momentum portfolios. We quantify this link in **Figure 3** using a daily logistic regression that forecasts a momentum crash – defined as a return in the bottom 5% of the momentum index's daily return distribution - on the 20-day rolling volatility of the momentum index. Predicted crash risk rises steeply with volatility. The figure shows a strong conditional association between volatility and crash-risk.

The Link Between Momentum Crashes and Volatility

Figure 3: Predicted Probability of Momentum Crash vs. Momentum Volatility



This figure presents the relation between momentum return volatility and the predicted probability of momentum crashes. The horizontal axis measures momentum volatility as the 20-day rolling standard deviation of annualised daily momentum index returns. The vertical axis shows the predicted probability of a momentum crash, defined as daily returns falling in the bottom 5th percentile of the return distribution, as estimated from a logistic regression model. The model uses momentum volatility and lagged returns as explanatory variables. Each point represents a daily observation over the sample period July 2005 to March 2025. The positive relation indicates that periods of elevated momentum volatility are associated with higher probabilities of subsequent momentum crashes, consistent with volatility serving as a predictor of extreme negative momentum outcomes.

Understanding the link between momentum crashes and volatility is critical for managing the risks inherent in momentum investing. By incorporating volatility forecasts and dynamically adjusting portfolio exposure, investors can mitigate the impact of crashes and enhance the robustness of momentum strategies. The next section explores strategies for taming momentum crashes, focusing on practical methods to forecast volatility and implement dynamic risk management.

A Dynamic Volatility Control Mechanism

A Dynamic Volatility Control Mechanism

The volatility control is designed to prevent the volatility of an index from exceeding a predefined ceiling based on its long-term historical volatility level. This is achieved by dynamically adjusting portfolio allocations between the High Momentum index and cash, thereby maintaining the portfolio volatility within acceptable limits during periods of elevated forecasted volatility.

The allocation to the High Momentum index w_{index} is determined by the ratio of the target volatility to the forecasted volatility:

$$W_{Index} = \frac{\sigma_{Index\ target}}{\sigma_{Index\ forecast}}$$

Where $\sigma_{Index\ forecast}$ is the forecasted volatility of the index for the next rebalancing period[1], and $\sigma_{Index\ target}$ represents the target volatility, based on the historical volatility of the index. To enforce the no-borrowing constraint, the allocation to the index is capped at 100%:

$$W_{Index} = \min\left(\frac{\sigma_{Index\ target}}{\sigma_{Index\ forecast}}, 1\right)$$

The residual allocation is directed to cash, calculated as:

$$W_{Cash} = 1 - W_{Index}$$

The overall portfolio volatility $(\sigma_{Portfolio})$ can then be expressed as a weighted combination of the index volatility and cash volatility:

$$\sigma_{Portfolio} = W_{Index} \cdot \sigma_{Index} + W_{Cash} \cdot \sigma_{Cash}$$

Since cash is assumed to have negligible volatility ($\sigma_{Cash} \approx 0$), the portfolio volatility is effectively:

$$\sigma_{Portfolio} = W_{Index} \cdot \sigma_{Index}$$

This ensures that the portfolio volatility remains below the target, provided the allocation rule is followed.

Adjustments to the allocation are reviewed weekly, with changes implemented only if the new allocation implies a deviation exceeding 20% relative to the previous allocation:

$$\left|W_{Index}^{New} - W_{Index}^{Previous}\right| > 0.20$$

If the change is within this buffer, the allocation remains unchanged, reducing transaction frequency and reducing index turnover. A complete reset of the portfolio allocation occurs on the third Friday of each month, when the buffer is deactivated, and the allocation is recalibrated based on the most recent forecasted volatility.

1 - See appendix for further details on the approach to forecasting volatility.

A Dynamic Volatility Control Mechanism

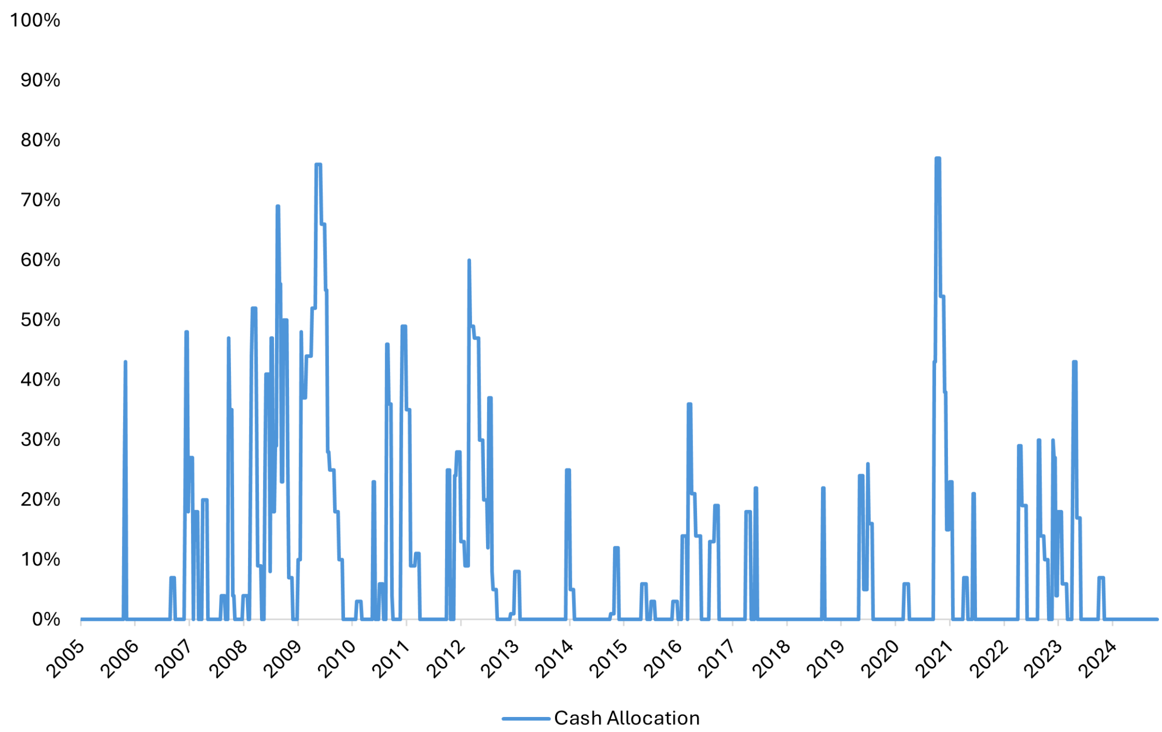
To ensure that the framework remains aligned with its volatility ceiling, the following condition must hold at all times:

$$\sigma_{Portfolio} \leq \sigma_{Index\,target}$$

Figure 4 further illustrates the dynamic asset allocation behaviour of the risk-managed momentum strategy, focusing on the time-varying allocation between the Momentum Index and cash. The cash allocation effectively captures the degree of risk reduction at each point in time.

Periods of elevated market volatility—such as the 2008–2009 Global Financial Crisis and the 2020 COVID-19 shock—trigger substantial increases in the allocation to cash, at times approaching 100%. This reflects the framework's design: to systematically scale down risk exposure as volatility forecasts rise. By reallocating away from risky assets during these stress periods, the strategy is able to mitigate large drawdowns. This reallocation behaviour effectively shields the portfolio from extreme downside risk. Conversely, during periods of market calm, the allocation to cash remains minimal, and the portfolio maintains near-full exposure to the Momentum Index. Throughout much of the sample, the strategy operates at or near full investment: in approximately 65% of months, the allocation to the Momentum Index is 100%, while in roughly 80% of months, the allocation exceeds 85%. This ensures that the strategy captures the momentum premium when risk conditions are favourable and volatility is subdued.

Figure 4: Time Series of Momentum Index and Cash Allocations



A Dynamic Volatility Control Mechanism

The figure reports the time-varying allocation between the Momentum Index and Cash as part of a risk management mechanism over the period July 2005 to March 2025. The allocations are determined dynamically based on forecasted volatility. See appendix for details on the estimation of forecasting volatility.

The exhibit also highlights the volatility control mechanism's responsiveness to changes in forecasted volatility. As volatility rises, the mechanism systematically reduces exposure to the Momentum Index and reallocates to cash, dynamically scaling back risk. Once volatility subsides, the allocation is restored, allowing the strategy to resume full exposure and remain aligned with its long-term return objective.

Notably, because these reallocations are relatively infrequent and typically occur in clusters around periods of market stress, the resulting turnover is moderate and concentrated—facilitating efficient implementation in institutional portfolios. This characteristic makes the risk-managed momentum approach more attractive from a cost, tracking error, and operational perspective.

Overall, this volatility control framework offers a robust solution for managing portfolio volatility dynamically while adhering to predefined risk constraints. By adjusting allocations in response to forecasted volatility changes and enforcing these conditions mathematically, the framework effectively mitigates risk during periods of market turbulence, maintaining alignment with the long-term target volatility.

Taming Momentum Crashes: The Australian Evidence

Taming Momentum Crashes: The Australian Evidence

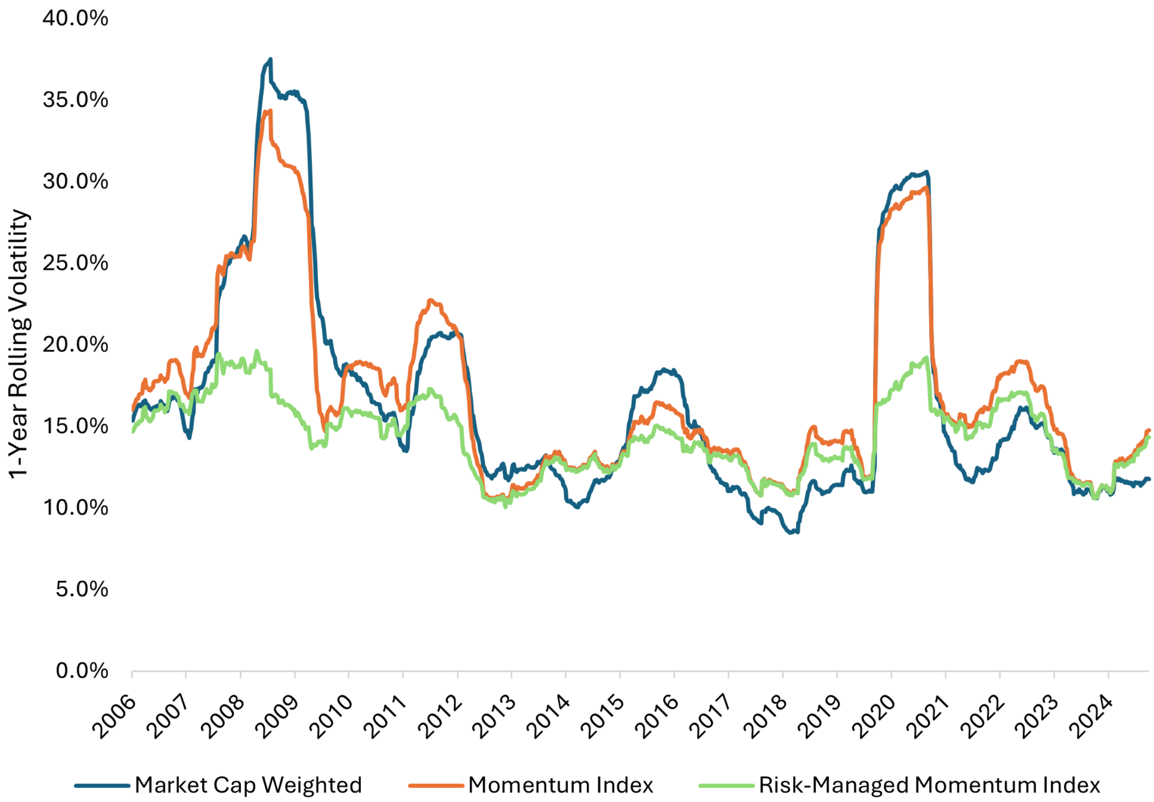
The sample period is July 2005 to March 2025. This period features the global financial crisis, COVID-19, heightened volatility in 2022, as well as several relatively low volatility periods such as the 2010s. Therefore, our set-up is informative about the forecasting accuracy and volatility control mechanism to reduce volatility spikes in an Australian momentum strategy.

Figure 5 compares the rolling 1-year volatility of three strategies—Market Cap Weighted Index, a standard Momentum Index without any volatility controls, and a Risk-Managed Momentum Index, which incorporates the volatility control overlay. The y-axis represents annualised volatility in percentage terms, calculations are based on a trailing 1-year window. The standard Momentum Index exhibits significant volatility spikes, particularly during periods of market stress such as the 2008-2009 Global Financial Crisis and the 2020 COVID-19 Pandemic, where volatility briefly exceeds 35%. In contrast, the Risk-Managed Momentum Index successfully reduces these volatility spikes by dynamically adjusting exposure to the Momentum strategy and reallocating to cash when forecasted volatility surpasses a target threshold.

Compared to the Market Cap Weighted Index, which remains relatively stable between 10% and 20%, the Risk-Managed Momentum Index demonstrates significantly reduced volatility relative to the Standard Momentum Index, particularly in crisis periods, and aligns more closely with the benchmark during calmer market conditions. The result highlight the effectiveness of the volatility control framework in mitigating volatility spikes and enhancing the stability of the Momentum strategy over the long term.

Taming Momentum Crashes: The Australian Evidence

Figure 5: One-Year Rolling Volatility

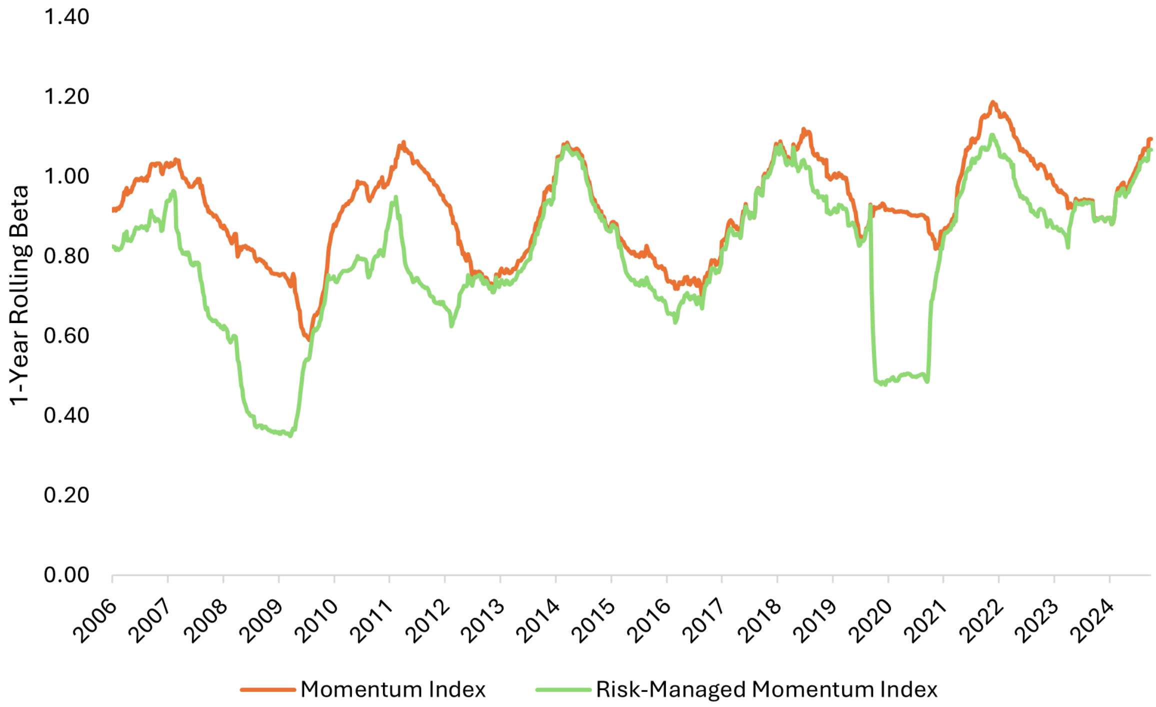


The one-year rolling volatility measures the variability of a portfolio's returns over time. Volatility is estimated using a trailing window of 252 trading days (approximately one year), which captures daily return fluctuations within the period. Each week, the trailing window is rolled forward by one week to update the volatility estimate. This rolling approach captures the time-varying nature of volatility. The sample period is July 2006 to March 2025.

The Momentum strategy's vulnerability to crashes is further linked to the dynamic behaviour of its market beta, particularly during volatile market environments. **Figure 6** presents the 1-year rolling market beta for the Standard Momentum Index, and the Risk-Managed Momentum Index with the volatility control mechanism. The y-axis measures beta, while the x-axis spans the period from July2006 to March 2025.

Taming Momentum Crashes: The Australian Evidence

Figure 6: One-Year Rolling Market Beta



The market beta (β) measures the sensitivity of a portfolio's returns to market returns. The beta is estimated using a trailing window of 252 trading days (approximately one year). Each week, the window is rolled forward by one week to update the beta estimate. This rolling approach captures the time-varying nature of the beta, which reflects changes in portfolio risk and market dynamics over time. The sample period is July 2006 to March 2025.

The results highlight two critical dynamics. First, the standard Momentum Index displays a market beta that typically hovers around 1.0 during normal conditions but becomes unstable during periods of market stress and recovery. Specifically, beta tends to rise sharply when the market experiences recoveries following significant downturns. For example, following the 2008-2009 Global Financial Crisis (GFC) and during the 2020 COVID-19 Pandemic rebound, the beta of the standard momentum index increased significantly. Reflecting greater sensitivity to systematic risk at precisely the wrong time – when market reversals penalise prior winners. This patterns aligns with prior literature (Daniel and Moskowitz, 2011), which attribute momentum crashes to the asymmetric beta exposures of winners and losers, with past losers (excluded in long-only implementations) rebounding sharply in recoveries and dragging down relative momentum performance.

Second, the Risk-Managed Momentum Index displays a more an adaptive beta profile. During turbulent periods such as the GFC and the COVID-19 pandemic, its beta dropped substantially—often falling below 0.5. This reflects the effect of dynamic volatility management, where exposure to the momentum portfolio is scaled down in high-risk environments. While not eliminating risk

Taming Momentum Crashes: The Australian Evidence

entirely, this adjustment reduces the strategy's sensitivity to adverse market dynamics, thereby mitigating a key driver of momentum crashes.

Overall, the evidence reinforces that momentum drawdowns are linked not only to rising volatility but also to pro-cyclical increases in market beta. In long-only portfolios, managing this beta dynamic can improve resilience. By actively lowering beta in periods of heightened volatility, the Risk-Managed Momentum Index demonstrates how incorporating volatility-aware exposure adjustments can reduce crash risk while preserving exposure to the momentum premium.

The results further demonstrate the effectiveness of the Risk-Managed Momentum Index in addressing extreme losses and improving risk-adjusted returns compared to both the standard Momentum Index and the Market Cap Weighted Index. **Table 1** presents key metrics for drawdowns and extreme absolute losses.

Table 1: Extreme Absolute Losses are Reduced, July 2005 – March 2025

	Market Cap Weighed Index	Momentum Index	Risk-Managed Momentum Index
Max. Drawdown	48.8%	47.8%	31.0%
Max. Drawdown 1-year	40.2%	47.2%	29.7%
1-Year Rolling Extreme Abs. Return	-14.4%	-19.3%	-10.3%
3-Year Rolling Extreme Abs. Return	-3.3%	-3.2%	2.5%

Extreme absolute return corresponds to the worst 5% of the 1- or 3-year rolling absolute return, computed using weekly steps. This is a robust metric of extreme loss an investor can expect over a defined horizon. The Max. Drawdown 1-year is the worst calendar year maximum drawdown observed over the sample.

The maximum drawdown for the Risk-Managed Momentum Index is 31.0%, significantly lower than both the Momentum Index (47.8%) and the Market Cap Weighted Index (48.8%). This reduction highlights the effectiveness of the volatility control to mitigate severe losses during market crises. Additionally, the 1-year maximum drawdown, a measure of the worst calendar year decline, is reduced to 29.7% for the Risk-Managed Momentum Index compared to 47.2% for the Momentum Index, reflecting improved downside resilience. Similarly, the 1-Year rolling extreme absolute return, which captures the worst 5% of rolling returns, is halved for the Risk-Managed Momentum Index (-10.3%) compared to the Momentum Index (-19.3%). Over a 3-year horizon, the Risk-Managed Momentum Index not only avoids significant negative extreme returns but achieves a positive outcome of 2.5%, outperforming both the broad Market Cap Weighted Index (-3.3%) and the Momentum Index (-3.2%).

Table 2 and **Figure 6** provides further evidence of the volatility control frameworks's ability to reduce volatility and improve risk-adjusted returns. Over the same sample period, the annualised volatility of the Risk-Managed Momentum Index is 14.55%, notably lower than the Momentum Index (17.84%) and Market Cap Weighted Index (17.60%). This reduction in volatility directly translates into an improved Sharpe ratio of 0.61 for the Risk-Managed Momentum Index, compared

Taming Momentum Crashes: The Australian Evidence

to 0.51 for the Momentum Index and 0.28 for the Market Cap Weighted Index. Importantly, the Risk-Managed Momentum Index achieves this improvement without sacrificing returns, delivering an annualised return of 12.25%, which is comparable to the Momentum Index's return of 12.40% but with significantly lower volatility.

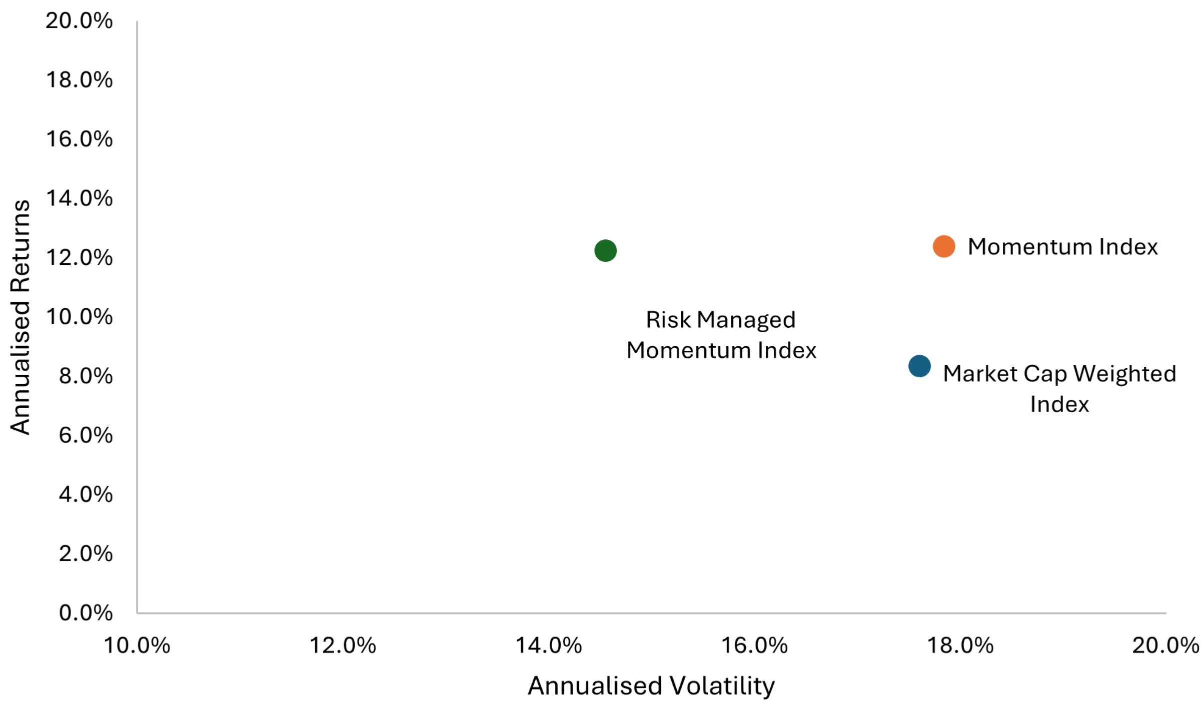
Table 2: Improvement of Sharpe Ratio and Reduction in Volatility, July 2005 – March 2025

	Market Cap Weighed Index	Momentum Index	Risk-Managed Momentum Index
Annualised Returns	8.35%	12.40%	12.25%
Annualised Volatility	17.60%	17.84%	14.55%
Sharpe Ratio	0.28	0.51	0.61

The table presents key performance and risk metrics, Annualised Returns measure the average annual performance of each strategy over the analysis period. Annualised Volatility represents the standard deviation of returns, providing a measure of total risk. The Sharpe Ratio evaluates risk-adjusted performance by comparing excess returns to annualized volatility.

Figure 7 visually underscores these results, showing the Risk-Managed Momentum Index achieves a similar level of returns as the standard Momentum Index but with considerably lower volatility.

Figure 7: Risk-Return Comparison: Momentum and Risk-Managed Strategies



The exhibit compares the performance of three indices — Risk Managed Momentum Index, Momentum Index, and Market Cap Weighted Index — in terms of their annualized returns and annualized volatility. Sample period July 2005 to March 2025.

Taming Momentum Crashes: The Australian Evidence

In summary, the results confirm that the volatility control provides substantial risk reduction benefits while preserving the momentum premium. By dynamically adjusting exposure to control volatility, the Risk-Managed Momentum Index achieves a material improvement in drawdown resilience, extreme loss mitigation, and Sharpe ratios, positioning it as a superior alternative to both the unadjusted Momentum Index and traditional cap-weighted benchmarks.

Momentum Factor Exposure and Dynamic Asset Allocation

Momentum Factor Exposure and Dynamic Asset Allocation

A key consideration in evaluating the Risk-Managed Momentum Index is whether the volatility control framework compromises its exposure to the momentum factor. Additionally, understanding how dynamic scaling of exposure to cash operates during periods of market stress provides critical insights into the strategy's ability to mitigate crashes while preserving long-term returns. The following results demonstrate that the volatility control framework effectively balances risk control and strong factor exposure while dynamically scaling asset allocation in response to volatility forecasts.

Table 3 presents the factor loadings and overall factor intensity of the Risk-Managed Momentum Index compared to the standard Momentum Index Factor exposures are measured across seven dimensions: size, value, momentum, volatility, profitability, investment, and factor intensity, providing a comprehensive view of the strategy's characteristics. The results indicate that the Risk-Managed Momentum Index retains a high momentum loading of 0.31, compared to 0.37 for the standard Momentum Index. While this represents a modest reduction, it is an expected outcome given the introduction of conditional cash allocations during periods of heightened volatility. Importantly, the retained momentum exposure ensures that the Risk-Managed Momentum Index continues to benefit meaningfully from the momentum premium.

Table 3: Strong Exposure to the Momentum Factor, July 2005 – March 2025

	Momentum Index	Risk-Managed Momentum Index
Size	**0.15**	**0.14**
Value	**0.05**	0.02
Momentum	**0.37**	**0.31**
Volatility	**-0.10**	**-0.08**
Profitability	**0.20**	**0.17**
Investment	**0.04**	**0.04**
Factor Intensity	0.71	0.60

The analysis is based on daily total returns in AUD. All statistics are annualised. The yield on the 90-day Australian Dealer Bill is used as a proxy for the risk-free rate. Regressions are performed using daily returns. Factor Intensity is defined as the sum of factor exposures. The Market factor is measured as the excess return of the Australian cap-weighted index over the risk-free rate. The other six factors are equal-weighted, daily-rebalanced factors obtained from the SciBeta Australia universe and are beta-adjusted quarterly using their realised CAPM beta. Coefficients significant at the 5% level are highlighted in bold.

Factor intensity, which aggregates the strength of exposures to systematic factors, declines slightly from 0.71 for the standard Momentum Index to 0.60 for the Risk-Managed Momentum Index. This reduction reflects the dilution of exposures caused by holding cash during volatile periods. Nevertheless, the retained factor intensity remains substantial, highlighting that the volatility control framework successfully stabilises volatility and drawdowns without significantly eroding exposure to systematic factors. Other factor loadings, such as size, value, and profitability, remain consistent between the two indices, with only marginal differences. Notably, the Risk-Managed Momentum Index achieves a slight improvement in its exposure to volatility risk, as its beta to market

Momentum Factor Exposure and Dynamic Asset Allocation

risk reduces from -0.09 to -0.08. This small reduction highlights the framework's role in enhancing defensiveness, particularly during periods of elevated market stress.

Overall, the Risk-Managed Momentum Index demonstrates an effective balance between dynamic risk management and strong exposure to the momentum factor.

Robustness and Consistency Across Markets

Robustness and Consistency Across Markets

To ensure the robustness of our findings, we examine the behaviour of momentum strategies in other markets, particularly in the U.S. equity market, where momentum has been extensively studied and well-documented. Similar to the results observed in Australia, momentum strategies in the U.S. exhibit strong positive average returns over the long term, punctuated by infrequent but severe momentum crashes during periods of heightened market volatility and sharp market recoveries.

As shown in **Table 4**, Over the period June 1970 to December 2023, the Risk-Managed Momentum Index achieved a notable reduction in risk while preserving the returns of the momentum premium. Specifically, the annualized volatility of the Risk-Managed Momentum strategy declined to 12.65%, compared to 16.31% for the standard Momentum Index and 17.16% for the Market Cap Weighted Index. This reduction in volatility highlights the effectiveness of the volatility control mechanisms in mitigating risk during turbulent market conditions. Importantly, the Sharpe ratio for the Risk-Managed Momentum Index improved to 0.63, representing a 17% increase over the Sharpe ratio of 0.54 observed for the standard Momentum Index. This improvement demonstrates the enhanced risk-adjusted performance achieved through dynamic risk control.

Table 4: Evidence in the US, June 1970 to December 2023

	Market Cap Weighed Index	Momentum Index	Risk-Managed Momentum Index
Annualised Returns	11.06%	13.29%	12.51%
Annualised Volatility	17.16%	16.31%	12.65%
Sharpe Ratio	0.38	0.54	0.63
Max Drawdown	55.5%	52.0%	34.0%
Annualised Relative Returns	-	2.23%	1.45%
Information Ratio	-	0.50	0.19

The Risk-Managed Momentum Index also delivers superior downside protection, as evidenced by a significant reduction in maximum drawdown to 34.0%, compared to 52.0% for the standard Momentum Index and 55.5% for the broad Market Cap Weighted Index. By dynamically scaling exposure during periods of heightened volatility, the volatility control reduces the severity of momentum crashes, providing greater resilience against extreme losses. Despite the risk reduction, the Risk-Managed Momentum Index maintains competitive long-term returns, with annualized returns of 12.51%, closely aligning with the 13.29% observed for the standard Momentum Index.

These results are consistent with those documented in the Australian market, reinforcing the generalizability of our findings across different market environments. The challenges posed by volatility spikes, beta asymmetry, and momentum crashes appear to be global phenomena, inherent to the dynamics of momentum strategies. The consistent performance of the volatility control framework in mitigating these challenges highlights its effectiveness as a robust risk management framework for momentum investing. By reducing volatility, improving the Sharpe ratio, and enhancing downside protection, the Risk-Managed Momentum strategy offers investors a practical solution for capturing the momentum premium while managing the associated risks in diverse market conditions.

Implications for Practitioners

Implications for Practitioners

Momentum investing in Australia and many other markets around the world, has historically delivered attractive risk-adjusted returns, making it a widely studied and applied strategy. However, its inherent vulnerability to sharp and infrequent crashes remains a significant challenge, particularly during market recoveries following downturns. The evidence presented highlights that momentum crashes are not entirely random but can be partially anticipated through elevated volatility and time-varying beta dynamics.

Advancements in risk management techniques, such as dynamic volatility control, provide practitioners with a robust framework for mitigating these risks. By dynamically scaling exposure based on forecasted volatility, investors can reduce drawdowns and stabilize performance without fully sacrificing exposure to the momentum premium. This approach offers a meaningful trade-off: maintaining long-term momentum exposure while improving resilience during turbulent market conditions.

For practitioners, the key implication lies in balancing the preservation of the momentum premium with the need to manage downside risks effectively. Implementing risk-managed strategies not only enhances risk-adjusted returns, as demonstrated by improvements in Sharpe ratios and reductions in drawdowns, but also provides a practical solution for navigating the volatility and asymmetry that characterize momentum investing.

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Appendix A: Forecasted Volatility

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The forecasting model employed by Scientific Beta to predict volatility is an asymmetric GARCH (Generalized Autoregressive Conditional Heteroskedasticity) model with Student-t innovations. This model is particularly well-suited for capturing the well-documented stylized facts of financial returns, including volatility clustering, the leverage effect, and fat tails.

1. *Volatility Clustering*: Financial time series often exhibit periods of high volatility followed by periods of low volatility, implying that volatility is not constant but clusters over time. The GARCH model effectively models this feature by allowing conditional volatility to evolve as a function of past squared returns and past volatility.

2. *Leverage Effect*: Negative shocks tend to increase volatility more than positive shocks of the same magnitude, a phenomenon known as the leverage effect. The asymmetric GARCH model incorporates this asymmetry by allowing negative returns to have a stronger impact on future volatility than positive returns. This is particularly important for risk control mechanisms, as momentum strategies tend to be highly sensitive to market downturns.

3. *Fat Tails*: Financial returns often exhibit excess kurtosis, meaning the tails of the return distribution are thicker than those of a normal distribution. By incorporating Student-t innovations, the model accounts for these extreme events, improving its ability to capture the observed return dynamics and provide more accurate volatility forecasts.

The asymmetric GARCH (1,1) model with Student-t innovations can be expressed as follows:

$$r_t = \mu + \epsilon_t, \epsilon_t = \sigma_t z_t, \qquad z_t \sim t(v)$$

$$\sigma_t^2 = \omega + \alpha \epsilon_{t-1}^2 + \beta \sigma_{t-1}^2 + \gamma \epsilon_{t-1}^2 I_{\epsilon_{t-1<0}}$$

Where:

r_t is the return at time t

μ is the mean return

ϵ_t is the innovation (shock) with volatility $\sigma_t{}^2$

z_t follows the standard Student-t distribution with degrees of freedom v

ω,α,β, and γ are estimated parameters

$I_{\epsilon_{t-1<0}}$ is an indicator function that equal 1 if $\epsilon_{t-1} < 0$ and 0 otherwise

The conditional variance $\sigma_t{}^2$ evolves as a function of past squared innovations (ϵ_{t-1}^2), lagged variance (σ_{t-1}^2), and an asymmetric term ($\gamma \epsilon_{t-1}^2 I_{\epsilon_{t-1<0}}$) that amplifies volatility following negative shocks.

Appendix B: Addressing Structural Breaks

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To address potential structural breaks in volatility dynamics, Scientific Beta incorporates two parallel forecasts based on:

1. *An Expanding Window*: This approach uses all available historical data up to the current time to estimate the model parameters, providing a long-term perspective on volatility.

2. *A Rolling 5-Year Window*: This method uses only the most recent five years of daily returns to estimate the model, ensuring the forecast is more responsive to recent market conditions.

The combination of these two forecasts aligns with the recommendations of Rapach et al. (2007), who emphasize the importance of balancing long-term and short-term volatility information to improve forecast robustness in the presence of structural breaks. By combining forecasts from both windows, the model can adapt to evolving market dynamics while preserving stability in the volatility estimates.

The model uses daily return observations, which provide a high-frequency view of volatility changes. This granularity enhances the model's ability to quickly detect shifts in market conditions and update forecasts accordingly. The use of daily data also ensures that the volatility forecasts remain highly relevant for dynamic risk management frameworks.

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.

PRI Principles for Responsible Investment

IIGCC The Institutional Investors Group on Climate Change

Investor Group on Climate Change

ESG Investing WINNER AWARDS 2022
Scientific Beta | Best Specialist ESG Index Provider

ESG Investing Awards 2024 RUNNER-UP

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