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Volatility Targeting: Why Your Index Isn't as Stable as You Think

Nomura's pioneering paper reveals that the risk of volatility targeting indices is systematically higher than the target level they are designed to maintain

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- Our research shows that volatility targeting indices have consistently higher volatility, usually more than 10% on a relative basis, than the indicated target level. As the rebalancing frequency increases, the actual volatility of these indices does not converge to the target, but to a level scaled up by a multiplier.
 - There is an intrinsic conversion between the rate/drift sensitivity and the volatility sensitivity for options written on these indices.
 - The research reveals a subtle competing effect between the window size for historical variance estimation and the rebalancing frequency.
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Volatility targeting has become one of the most popular strategies in institutional investing. Insurance companies, pension funds, and asset managers rely on volatility target indices to balance risk and return, offering investors a smoother ride through market turbulence. Yet our groundbreaking paper reveals a counterintuitive truth: the volatility of these indices is systematically higher than the target level they are designed to maintain.

This finding, [published in *Mathematical Finance*](#), has profound implications for how derivatives are priced, how portfolios are hedged, and how risk should be communicated to clients.

The promise and the problem

Volatility target indices work by dynamically adjusting leverage on a risky asset and allocating the remainder to cash. When markets become volatile, the strategy reduces exposure; when volatility falls, it increases leverage. Intuitively, this should keep portfolio volatility constant at a preset level, say 10% annually.

Investors get smoother returns, higher Sharpe ratios, and more manageable risk profiles. Major index providers like S&P and MSCI have launched many of these products and trillions of dollars now flow through volatility-targeting strategies.

But as the rebalancing frequency increases, a trend accelerated by high frequency and intraday trading, the actual volatility of these indices converges to a level biased from the target. Our research quantifies this bias precisely for the first time.

The mathematics behind the mirage

We examine what happens as rebalancing intervals shrink toward zero. Using advanced probability theory, specifically, a novel central limit theorem for dependent

random variables, we derive the *exact limiting distribution* of volatility target indices.

The key finding: two multiplier functions, denoted by $U(\lambda)$ and $V(\lambda)$, determine how far actual volatility strays from the target. Both are consistently greater than 1, meaning realized volatility always exceeds the target. For typical parameter values used in practice, this excess can be substantial.

For example, with a decay parameter $\lambda = 0.9$ (common in industry), the volatility multiplier $V(\lambda)$ is approximately 1.1 or higher. This means at least a 10% underestimation of the true volatility.

Why this matters

For risk managers: The research exposes a blind spot in risk reporting. Firms using volatility target indices as a "low-risk" sleeve, are likely underestimating risks.

For derivatives traders: The paper introduces a critical innovation: a *vega conversion formula* that translates volatility sensitivity on the underlying asset into interest rate sensitivity on the limiting diffusion. This solves a long-standing problem in options pricing on volatility target indices. Traders have typically assumed vega exposure is negligible, but we show this assumption is not always justified and provide the exact correction.

For index providers, asset managers, and institutional investors: The findings support empirical observations that volatility target indices outperform buy-and-hold strategies in most cases. They also suggest taking care of the competing effect between the moving average window and the rebalancing frequency in implementing volatility target strategies.

Looking forward

The research opens several doors. The vega conversion formula enables more accurate pricing of exotic derivatives on volatility target indices. The bounds on $U(\lambda)$ and $V(\lambda)$ allow practitioners to quickly estimate true volatility without running simulations. The framework extends to variants with leverage caps and fee structures, covering most real-world implementations.

Perhaps most importantly, the paper shifts the conversation. Volatility targeting isn't just a way to eliminate the uncertainty of volatility but rather to manage and trade volatility. The indices are not volatility-risk-free instruments; they are sophisticated, leveraged strategies that deserve in-depth analysis.

For two decades, the financial industry has treated volatility target indices as a solved problem. Our research suggests otherwise. By deriving the exact limiting distribution and providing practical tools for risk adjustment, we have shown that we have been underestimating the risk of these products while overestimating our understanding of how they work.

For more information on this topic please email [Michel Gauthier](#) or [Xuan Liu](#)

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