

TAILORED RISK MANAGEMENT IN ACTION

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ABOUT PGIM QUANTITATIVE SOLUTIONS

PGIM Quantitative Solutions is a pioneer of quantitative investing. For 50 years, PGIM Quant has been helping investors around the world solve their unique needs by leveraging the power of technology, data, and advanced academic research. Since our founding in 1975, our time-tested process, based on academic, economic, and behavioral foundations, has been used to successfully navigate a wide variety of market environments.

Today, we manage systematic equity and multi-asset portfolios against a wide range of benchmarks. PGIM Quant's global client base includes corporate and public pension plans, endowments and foundations, sovereign wealth funds, multi-employer pension plans, and sub-advisory accounts for leading financial services companies. As of March 31, 2025, PGIM Quant managed approximately \$104 billion in client assets.

FOR MORE INFORMATION

To learn more about our capabilities, please visit www.pgimquantitativesolutions.com.

EXECUTIVE SUMMARY

Navigating risk in today's markets requires looking beyond generic frameworks. PGIM Quant's customized approach to risk management shifts away from off-the-shelf risk models to align risk control with client-specific objectives and investment strategies and address the inefficiencies associated with standard models. Our analysis highlights the value of tailoring risk models and presents data to support their effectiveness in improving outcomes for investors.

■ Customizing Risk Frameworks to Align with Strategies:

Unlike generic, off-the-shelf models, PGIM Quant's proprietary risk framework aligns risk control with the investment process. Our framework prioritizes diversification and ensures risk methodologies complement, rather than hinder, the pursuit of client-specific goals.

■ Refinement of Traditional Risk Factors:

Limitations in standard risk models, such as industry classification and factor misalignment, are addressed through PGIM Quant's refined methods, including broader and more balanced groupings, which improve the integration of risk factors into portfolio construction.

■ Empirical Validation of a Tailored Approach:

Through testing and simulations, including direct comparisons with a leading commercial risk model, the analysis demonstrates the advantages of PGIM Quant's tailored frameworks in enhancing risk-adjusted returns and improving the alignment between alpha and risk models.

CUSTOMIZING RISK, UNLOCKING POTENTIAL

For 50 years, PGIM Quant has sought to prioritize long-term client outcomes by challenging convention. Building on this foundation, since 1999 we've redefined risk management, rejecting one-size-fits-all risk models in favor of proprietary frameworks designed to deliver precision, control, and results. Today, our approach to risk offers valuable tools for navigating the complexities of an unpredictable world.

Our risk philosophy is rooted in achieving optimal diversification while carefully controlling allocations to known sources of risk, all while maximizing exposure to our proprietary investment insights. Unlike many of our peers who rely on off-the-shelf risk models to manage ex-ante risk, we take a more tailored approach, customizing risk frameworks to help clients reach their unique goals. Continuing our commitment to innovation and further extending our risk philosophy, we've developed a refined risk framework that enhances portfolio risk management and strengthens the alignment between our alpha and risk models, fostering a more symbiotic relationship.

PRECISION IN ACTION: MINOR ADJUSTMENTS, MAJOR EFFECTS

Quant managers have long focused on understanding the relationship between stocks. In the 1970s, Stephen Ross' arbitrage pricing theory¹ and Barr Rosenberg's founding of Barra, the first company to deliver a commercially available risk model², established the study of security co-movement as a cornerstone of modern asset management. By the 2000s, multi-factor models had become the standard for risk management, offering more than a hundred factors spanning country, currency, industry, market sensitivity, and style. While these factor models aim to forecast the uncertainty of individual securities and the portfolios they constitute, they do so by incorporating factors that are not tailored to the investment idea generation process. This misalignment can lead to inefficiencies between risk control and return forecasts.

Take the growth factor, for example—a classic risk factor in commercial fundamental risk models, which often treat growth as a risk to minimize. But in reality, it's a factor many investors actively seek out as a potential alpha source. By automatically penalizing exposure to growth, these models can unintentionally stifle investment insights and limit portfolio alpha. This fundamental misalignment was a key reason we moved away from off-the-shelf models and developed a customized approach that ensured risk control complemented, rather than conflicted with, our investment process.

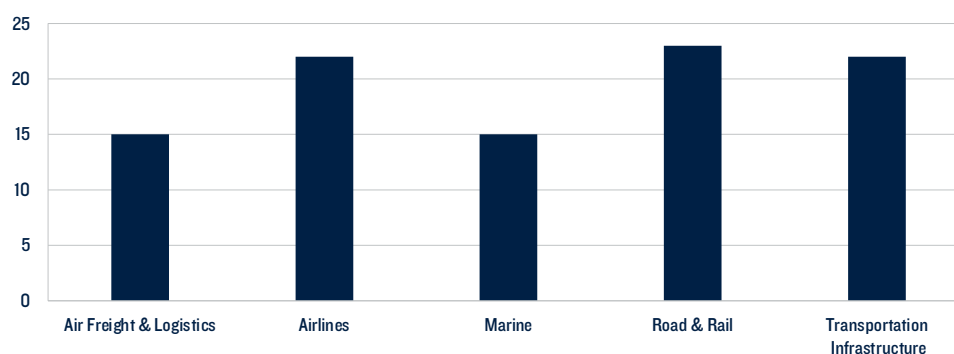
Now let's consider industry classifications. It's well understood that cohorts of stocks within an industry often move together simply because their business models are aligned. For instance, when oil prices drop, companies like ExxonMobil, Chevron, Shell, and Petrobras typically sell off—not because of idiosyncratic factors, but due to their shared exposure and correlation to oil price movement. This is where the art and science intersect. Use an industry grouping that's too narrow, and you're relying on only a few stocks to represent the entire cohort. Use a grouping that's too broad, and you sacrifice granularity and valuable information.

Commercial risk models often rely on standard industry classifications, essentially delegating a key aspect of risk management to an index calculation agent. This reliance can lead to misaligned classifications that fail to reflect the nuances of specific investment strategies. Figure 1 highlights the limitations of a leading commercial risk model vendor for categorizing global transportation companies, underscoring the need for a more balanced and practical classification system. The Y-axis represents the number of stocks in each segment of the transportation industry, illustrating how the off-the-shelf model divides the industry into very narrow groups. While this approach provides significant granularity, the small number of stocks in each grouping makes it difficult to draw statistically significant conclusions about how those companies may behave. To address these challenges, we developed a unique industry classification system that groups similar companies more effectively, while preserving the breadth of the classification. In this example, we classify all these companies simply as 'transportation,' striking the right balance between precision and practicality.

¹Ross, Stephen A (1976). "The Arbitrage Theory of Capital Asset Pricing." *Journal of Economic Theory*, 13(3), 341–360. [https://doi.org/10.1016/0022-0531\(76\)90046-6](https://doi.org/10.1016/0022-0531(76)90046-6)

²Rosenberg, Barr (1974). "Extra-Market Components of Covariance in Security Returns." *Journal of Financial and Quantitative Analysis* 9(2), 263–274. <https://doi.org/10.2307/2330104>

Figure 1: Commercial Risk Model's Industry Segments in PGIM Quant's Transportation Classification



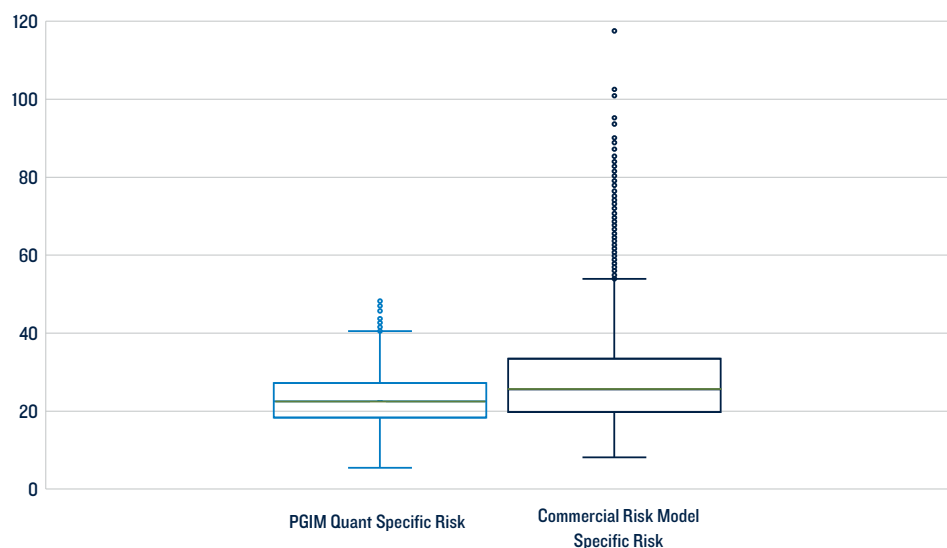
Source: PGIM Quantitative Solutions and Axioma. Data as of Feb 2025.

IT'S A MATTER OF FACT(ORS)!

At PGIM Quant, we also think differently about other traditional risk factors. Take beta and volatility, for example—most risk models estimate these metrics across the entire universe of securities. The problem? This broad-brush approach can lead to misestimation and portfolio construction that doesn't align with a strategy's goals.

Instead, we estimate exposures specifically within the investible universe for the strategy we're optimizing on. This targeted approach helps us reduce idiosyncratic risk and build portfolios that better align with client objectives. Figure 2 illustrates this point with a box-and-whisker interquartile chart of the MSCI ACWI IMI, comparing specific risk estimates of our proprietary system to those of the commercial risk model. The limited outliers in PGIM Quant's model suggest a more accurate fit for the investible universe, demonstrating that our model provides a more precise and strategy-aligned estimation of specific risk compared to the commercial risk model. This precision reduces noise and improves portfolio construction, aligning risk control with investment objectives.

Figure 2: Specific Risk Distribution for MSCI ACWI IMI: PGIM Quant vs. Commercial Risk Model



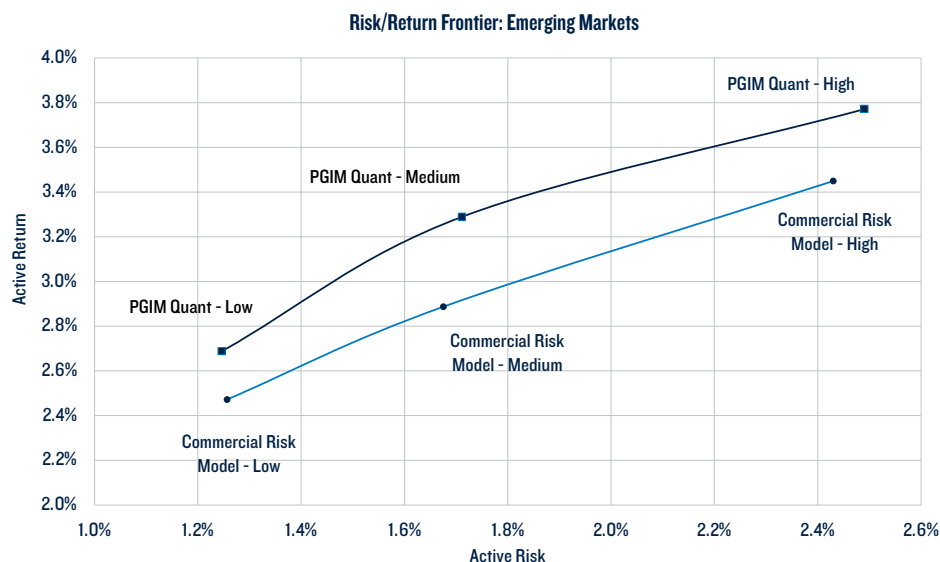
Source: PGIM Quantitative Solutions and Axioma. Data as of Feb 2025.
Shown for illustrative purposes only.

While the specific risk distribution demonstrates that the model fits the universe, it doesn't necessarily prove that it's fit for purpose. For that, we need to test performance within a strategy that allows for greater risk-taking.

TESTING THE MODEL: EMPIRICAL EVIDENCE

To determine if the model is truly fit for purpose, we created a simulation using the MSCI Emerging Markets Index, keeping all settings constant except for the risk model (comparing PGIM Quant’s model to the commercial risk model) and risk tolerances (low, medium, high). The results, spanning 2010 – 2023, are presented in Figure 3. The most striking takeaway? The consistent upward shift in performance of the PGIM Quant model for a similar level of risk.

Figure 3: Enhanced Performance with PGIM Quant’s Risk Model



Source PGIM Quantitative Solutions, Axioma, MSCI. Data from Feb 2010 – Dec 2023.
Comparison of risk models for the MSCI Emerging Markets Index with consistent constraints and turnover levels.

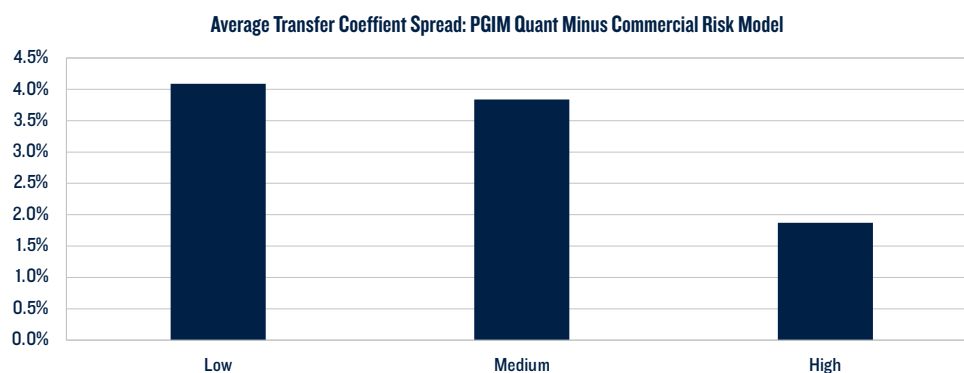
The upward shift observed in Figure 3 can be explained by the fundamental law of active management³, which states that a portfolio’s Information Ratio (active return / active risk) is proportional to three key factors: 1) the power of the alpha model 2) the breadth of the strategy, and 3) the transfer coefficient (the rate at which the model’s insights ‘transfer’ into the portfolio). These are illustrated in the equation below:

$$IR \sim IC \cdot \sqrt{Breadth} \cdot TC$$

Given that the alpha model and the strategy remain constant in the study, the only variable driving the difference is the transfer coefficient. As demonstrated in Figure 4, PGIM Quant’s risk model consistently achieves a higher transfer coefficient across all scenarios (low, medium, and high risk). The bar chart highlights the average gains in the transfer coefficient achieved by our customized risk framework relative to the commercial risk model. By leveraging the tailored risk model, we can effectively manage risk with minimal disruption to our alpha model, ultimately delivering higher risk-adjusted returns. To provide context, this improvement translates to roughly a 10% increase in alpha model exposure for a comparable level of risk. Notably, these gains are not limited to emerging markets; we observe similar increases in transfer coefficients across US and developed international markets.

³Grinold, Richard. “The Fundamental Law of Active Management.” *Journal of Portfolio Management*, vol. 15, no. 3, 1989, pp. 30-37. Clarke, Roger, Harindra de Silva, and Steven Thorley. “Portfolio Constraints and the Fundamental Law of Active Management.” *Financial Analysts Journal*, vol. 58, no. 5, 2002, pp. 48–66.

Figure 4: PGIM Quant's Transfer Coefficient Gains



Source: PGIM Quantitative Solutions, Axioma, LSEG Refinitiv. Data from Feb 2010 – Dec 2023. The PGIM Quantitative Solutions transfer coefficient minus Axioma Transfer coefficient at comparable levels of risk. Chart is shown for illustrative purposes only at a point in time. There is no guarantee that active returns will be achieved.

THE BOTTOM LINE

PGIM Quant has a proven history of thinking differently about risk and redefining traditional approaches to deliver effective solutions. Unlike many, we reject off-the-shelf models in favor of proprietary frameworks designed to meet the specific needs of our clients. Through a series of empirical analyses, we have demonstrated how our differentiated thinking has evolved, enabling us to refine and enhance our tailored risk framework to align with each client's unique objectives. Backed by advanced quantitative expertise and a commitment to customization, we aim to manage risk effectively while aligning with client objectives.

Looking ahead, PGIM Quant remains committed to redefining risk management by continually evolving our models, building on 50 years of innovation and differentiated thinking to stand apart in a crowded marketplace and deliver customized solutions that empower our clients to succeed in an ever-changing world.

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