Index Research and Design | Index Ideas

Robust index design

The case for sensitivity-aware methodologies

June 2025

AUTHORS

Andreas Schroeder
Head of Index Research and Design, EMEA
andreas.schroeder@lseg.com

Tom Chan
Senior Research Analyst, Research and Analytics
tsun.chan@lseg.com

Ely Klepfish
Manager, Research, FTSE Russell Index Research and Design – EMEA
ely.klepfish@lseg.com

FTSE RUSSELL
An LSEG Business

Contents

All data comes with noise

Let's start by exploring this simple statement: all data comes with estimation noise[1]. Sometimes the noise level is low, and the estimate is crisp; sometimes the estimate is very crude with large error bounds around it. In our data driven world, understanding how estimation noise propagates through investment models and impacts results is essential.

In this paper we outline how to measure and visualise the sensitivity of portfolio construction to the noise in the data inputs. We show that how data noise is managed can positively or negatively impact the robustness of a portfolio. We introduce a framework for stress-testing the sensitivity of different signals and methodologies and how it can help investors to navigate the uncertainty in data inputs with greater clarity and confidence.

Often data is assumed to be clean and precise, it's fed it into models with the expectation that it reflects objective reality. But in truth, data comes with layers of estimation and uncertainty — some negligible, others significant. Market prices, for example, are recorded with high precision, but may be distorted if thinly traded, or change fast. Is this measurement noise? Fundamental metrics, such as earnings or inventory levels, can vary depending on accounting standards and are also out of sync due to report timing. When we shift to sustainable investment datasets — such as ESG scores or carbon emissions — measurements are more subjective or modelled, or both, and estimation errors can skyrocket.

So, when we construct an index that leans heavily on these inputs it's critical to ask: how sensitive is our portfolio to variations in these noisy inputs?

Measuring sensitivity

A well-designed portfolio should strike a balance: it should (a) capture the core of the investment signal and (b) at the same time be robust to the noise in that signal. We cater for (a) by constructing portfolios that achieve a defined uplift in the signal, e.g. an uplift of 0.5 in a Value signal in standard deviation terms. This ensures that when we measure and compare the sensitivity (b) we compare like for like.

Here's how it works. Take carbon emissions intensity, a critical input to Paris-Aligned Benchmark indices, as an example. Based on discussions with data providers, a realistic error margin for carbon emissions intensity is ±10%. That means, if a stock has a carbon emissions intensity value of 100, the real figure can be between 90 and 110. If, in our model construction we use 90 (or 110) instead of 100 and our construction methodology delivers a completely different portfolio compared to the one constructed on the original data, one could argue the methodology is too sensitive.

Applying this idea across all stocks, we get the following recipe:

1. Construct the portfolio based on the original data
2. Perturb the emissions data (e.g. add 10% random noise)

[1] If you don't agree with this statement, we refer you to the Simpson's episode when Lisa visited a newspaper printing press

PR lady: "Each copy contains a certain percentage of recycled paper."

Lisa Simpson: "And what percentage is that?"

PR lady: "Zero… zero's a percent…"

3. Construct the portfolio using the noisy data
4. Measure the difference between the original and the "noisy" portfolios as the sum of absolute weight differences
5. Repeat this process 1,000 times to get a distribution of differences

Table 1: Visualisation of sensitivity calculation steps 1 to 4

Stock	Emissions Intensity	Index Weight	"Noisy" Emissions Intensity	"Noisy" Index Weight	Index Weight Difference
Stock A	171.58	0.047%	178.68	0.049%	0.002%
Stock B	6.3	0.000%	6.07	0.000%	0.000%
Stock C	0.78	0.068%	0.74	0.065%	-0.003%
Stock D	3.94	0.017%	3.88	0.017%	0.000%
Stock E	42.01	0.061%	44.09	0.064%	0.003%
				Difference	**2.101%**

Source: Index Research and Design, FTSE Russell, June 2025.

This gives us a powerful way to visualise and quantify the robustness of a given methodology or input signal. The bigger the difference in the results, the more sensitive the construction methodology is to the noise.

Now, let's see the framework in action.

Case 1: Comparing signals

First, we fix the methodology — in this case, FTSE Russell Fixed Tilt methodology — and test its sensitivity to style signals, such as Value, Momentum, Size, Quality, and Low Volatility. Given that these signals are based on market prices and fundamental metrics, the level of noise in the signal is relatively low. Therefore, we apply 5% noise[2] to these signals. We then measure the differences of noisy portfolios to portfolios built on the original signal. We measure the difference between the portfolios as the sum of absolute deviations in individual stock weights. This distance metric has the advantage of being directly interpretable. It is the hypothetical turnover incurred by transitioning to the noisy portfolio had the signal been measured in a reasonably different way. The bigger the distance the more sensitive the portfolio is to the noise in the signal.

[2] i.e. random noise drawn from the normal distribution with 0 mean and 5% standard deviation.

Figure 1: Sensitivity of Fixed Tilt to various factor signals

Source: Index Research and Design, FTSE Russell, June 2025.

What do we see? Some signals are inherently more stable than others. Quality is consistently the least sensitive, while Size tends to be most sensitive to noise. These insights can shape how much confidence we place in signal-specific allocations — or how much safeguards might be required around them.

Case 2: Comparing methodologies

Next, we reverse the lens. We hold the signal fixed, namely Value and test multiple portfolio construction methodologies:

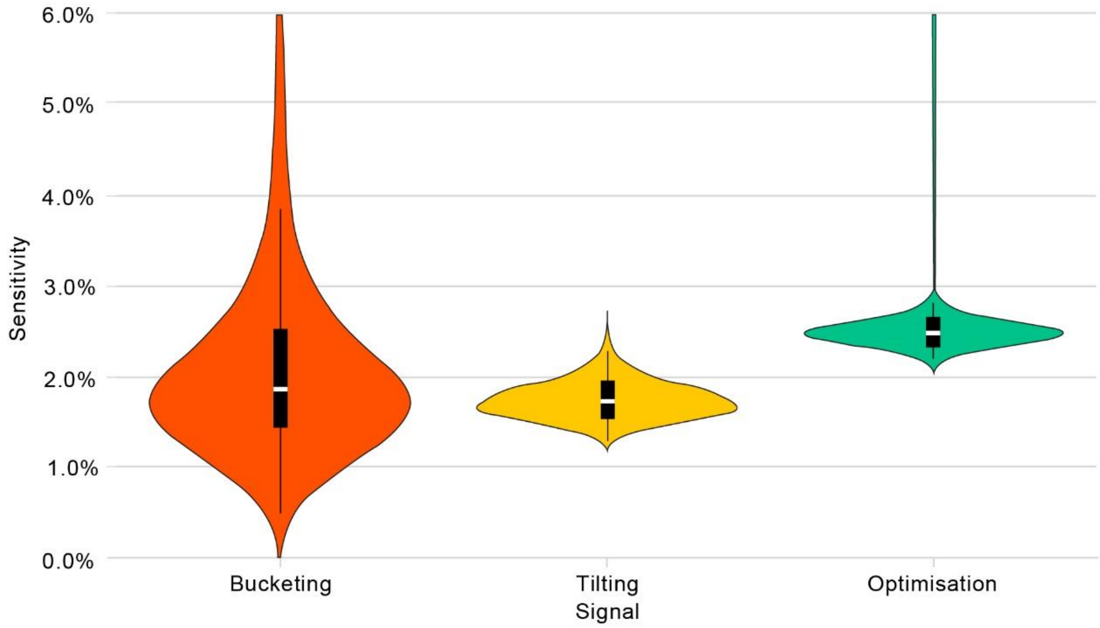
– Bucketing (sort by signal and select top n stocks)

– Tilting (Fixed Tilt and Target Exposure)

– Optimisation (Tracking Error Minimisation)

Each methodology uses the same signal but reacts differently when that signal is perturbed by noise.

Figure 2: Sensitivity of different methodologies to noise in value signal



Source: Index Research and Design, FTSE Russell, June 2025.

The results? Bucketing and Tilting methods are, on average, equally robust against noise; with Bucketing having a much broader distribution of outcomes compared to Tilting. Optimisation, on the other hand, shows significantly higher sensitivity — meaning small changes in input can produce large changes in output[3]. That might be acceptable in certain contexts, but it introduces fragility that investors need to be aware of.

Case 3: Rethinking design

We recently applied this framework with a client who asked us to design a climate aware portfolio based on projected 2050 emissions. While the concept is intuitive, the metric is a product of two components: (a) the current level of emissions and (b) the decarbonisation trajectory going forward. Both inputs with high levels of noise. Multiplying two noisy estimates is a recipe for amplified instability.

Our sensitivity analysis revealed that a reasonable 10% input noise produced a 7% average variation in index weights — an uncomfortable level of instability.

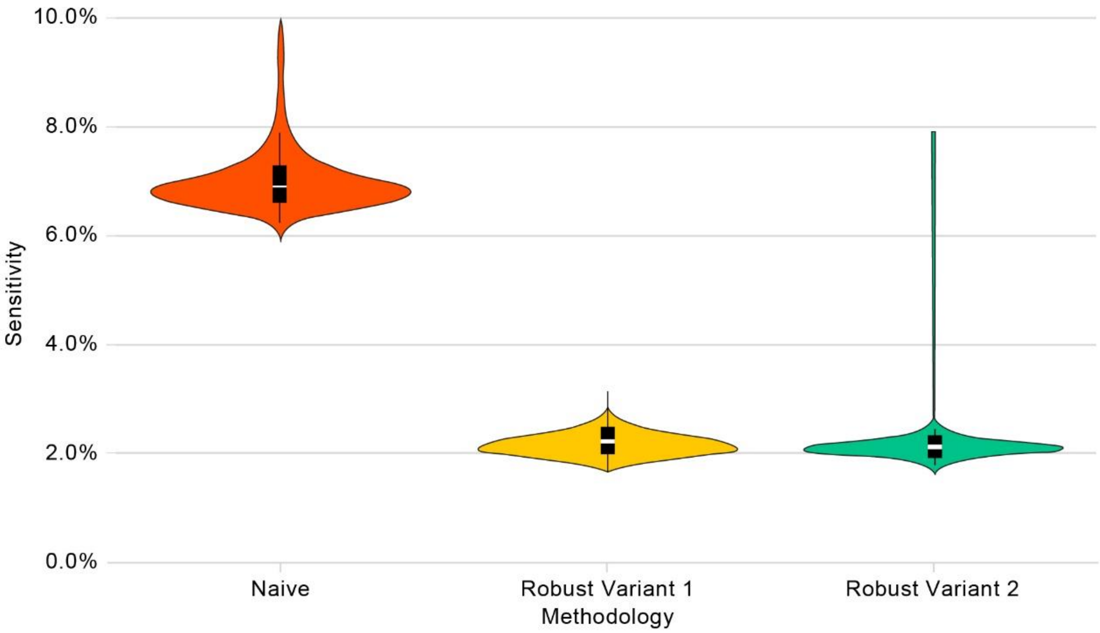
To improve robustness, we explored two alternative signals:

1. Cumulative emissions through 2050 (sum of emissions along the trajectory path instead of the product)
2. Current emissions and decarbonisation trajectory targeted separately

[3] Optimisation is highly sensitive to the choice of the risk model. It is a well-documented disadvantage of Optimisation. In this paper and in order to compare like-for-like, we assumed the risk model to be fixed, i.e. the sensitivity to the choice of the risk model is 0. In a follow-up study we show that resampled risk models introduce sensitivity into Optimisation which is magnitudes higher than when assuming that the risk model is fixed.

Both alternatives cut sensitivity substantially — to around 2% — while achieving the client's stated objective.

Figure 3: Comparison of sensitivities across original, naïve design and robust redesigned climate indices



Source: Index Research and Design, FTSE Russell, June 2025.

Why this matters

Our sensitivity framework provides a lens through which we can interrogate portfolio construction methodologies and how they respond to noisy inputs. It's not about choosing between precision and robustness — it's about recognising trade-offs and making informed design decisions.

If you're working with noisy data (and who isn't?), we'd love to discuss how sensitivity analysis can help you sharpen your portfolio design. Sometimes, the best insights come not from the signal itself — but from how it survives the noise.

Let's talk.

ABOUT FTSE RUSSELL

FTSE Russell is a leading global provider of index and benchmark solutions, spanning diverse asset classes and investment objectives. As a trusted investment partner we help investors make better-informed investment decisions, manage risk, and seize opportunities.

Market participants look to us for our expertise in developing and managing global index solutions across asset classes. Asset owners, asset managers, ETF providers and investment banks choose FTSE Russell solutions to benchmark their investment performance and create investment funds, ETFs, structured products, and index-based derivatives. Our clients use our solutions for asset allocation, investment strategy analysis and risk management, and value us for our robust governance process and operational integrity.

For over 40 years we have been at the forefront of driving change for the investor, always innovating to shape the next generation of benchmarks and investment solutions that open up new opportunities for the global investment community.

CONTACT US

To receive our research and insights email and Market Maps reports, directly to your inbox, subscribe here.

To learn more, visit lseg.com/ftse-russell; email info@ftserussell.com; or call your regional Client Service team office:

EMEA +44 (0) 20 7866 1810

North America +1 877 503 6437

Asia-Pacific

Hong Kong +852 2164 3333

Tokyo +81 3 6441 1430

Sydney +61 (0) 2 7228 5659

FTSE
RUSSELL
An LSEG Business