



The Investment Risk Manager's Toolkit



CLARE LINDEQUE
HEAD OF QUANTITATIVE ANALYSIS



KEY TAKE-AWAYS

- *Strong investment risk management is vital in delivering the portfolio returns expected from a fund.*
- *The many tools involved in risk management include not only different types of computer data analysis, but also continuous personal interaction and independent interrogation.*
- *Prudential's risk management approach is to "spend" a fund's total risk budget on investment ideas in which they have the highest conviction.*

In addition to the catastrophic changes it effected on almost every aspect of our lives in community as humans, the Covid-19 pandemic caused massive disruption in the world's financial markets. As the economic effects of the pandemic, both immediate and projected, began to be processed by market participants and the actual numbers to reflect in economic and higher frequency data, remarkable volatility in the price of almost every asset class characterised the months of March and April 2020 in particular. For many people, the risk – rather than just the return – of their investments was, perhaps for the first time, front of mind. The risk I refer to here is the risk that is broadly associated with prices moving up and down. There are associated effects (such as ratings downgrades, liquidity changes, and the likelihood of reaching performance targets) that flow from price volatility and changes in the economic climate. It is an investment risk manager's job to think about these sorts of risk.

A question of independence

The risk manager role differs across firms; at Prudential, investment (or market) risk measurement and reporting is a function that sits inside

the investment team, while most other risks (e.g. operational, business and strategic risk) are monitored by the compliance team. There are advantages of positioning investment risk within the team of investment professionals (traders, portfolio managers and analysts) who make and execute investment decisions.

“For many people, the risk – rather than just the return – of their investments was front of mind”

Information about portfolio risk can be both quickly gathered, and quickly fed back into the investment process, enabling careful calibration of active positions, and nimble adjustments to portfolios whose risk characteristics become a concern. Regular conversations within the investment team about market risk facilitate improved literacy around market risk measures and empower portfolio managers to discuss and act upon market risk information. They also cultivate trust between the risk management function and the rest of the investment team, which

is particularly useful during times of market stress, when the risk manager may have to ask difficult questions.

An objection to positioning the investment risk function inside the investment team rather than as a middle-office function, perhaps alongside the performance reporting team, is that independence – which is vital to ethical and accurate risk monitoring – is potentially compromised. A risk manager who sits alongside the investment team cannot help but hear, and even buy into, the narratives that are associated with trades or strategies deployed by the team. It is the risk manager's job to dispassionately evaluate risks, and even the appearance of bias or a lack of objectivity can be damaging to the integrity of the role and should be a source of concern to senior management.

To address this shortcoming while still enjoying the previously mentioned benefits of the market risk function being close to the investment team, it is vital that there is independent oversight of portfolios' investment risk characteristics and trends. Keep reading – I'll shortly tell you more about how we handle this at Prudential.

An investment risk manager needs strong numerical capabilities and a sound grounding in the fundamentals of mathematical finance, but also the ability to communicate complex information clearly, and as simply as possible without misleading. While many introverts may raise their hands after reading the first part of this description, it is important that a risk manager not be such an introvert that they fail to speak to the humans taking the very risks that they are trying to monitor and manage. In addition to giving feedback both to portfolio managers and senior management on what risks are evident in the portfolios, this communication also entails extracting and synthesising information from members of the investment team and other parts of the business (more on that in a moment).

What tools should an investment risk manager have available to do all this?

Ex-ante risk measures

Let's get this one out of the way first. It is tempting to imagine that, with the aid of incredibly sophisticated mathematical tools embedded in shiny software systems, investment risk managers are able to push a button, print out a report that covers all

possible forecast risks, send an email and clock off for the day with an air of smug satisfaction.

While we do have extremely complex systems available to estimate the risk contribution of every single instrument in a portfolio, using these systems is only one component of investment risk management. But first – what do these systems do?

Early practitioners of mathematical finance and econometrics realised that equity returns could be explained in terms of exposures to underlying factors – such as to the market itself (the classical “beta” you might be familiar with), to large or small market capitalisation stocks, to value stocks, and so on. If returns can be described in this way, so too, with a little bit of matrix algebra, can risk, in the fairly narrow sense of volatility or standard deviation. This insight has extended across multiple asset classes and factors, and has allowed the construction of “risk models”, which are essentially giant matrices that describe how assets move in relation to one another (called covariance).

This covariance matrix is the heart of every risk model. It is possible to build one's own risk model, but typically firms such as Prudential, with large and relatively complex asset class investments, choose a provider and purchase their tools. The interface to the risk engine may be Cloud-based (this is increasingly common), or via a standalone piece of software. The only inputs required are the portfolio and benchmark holdings on the day for which you want to estimate risk.

The outputs of most risk engines include the contribution of each instrument in the portfolio to the portfolio's active (i.e. benchmark-relative) and total risk. It is common to aggregate these risk contributions up to sector level for equities, for example, or into duration or credit ratings buckets for fixed income instruments, or by region or currency for funds that cover multiple geographies. Active risk is commonly known as tracking error (this is the standard deviation or variability of the portfolio's active returns), and in contrast to the tracking error numbers reported after the fact (such as on fund fact sheets), risk models give an estimate of forward-looking, or

ex-ante, tracking error. But how is this possible?

A fundamental assumption of the risk models I am describing - one that is both necessitated by there not being much in the way of alternatives, and that makes forward-looking risk estimation possible - is that the way assets have recently co-moved, is a "good enough" guide to how they will move in the immediate (3-12 month) future. The covariance matrix is constructed using asset class return data looking back over a few years (3-5 years is common) but weighted in such a way that recent returns carry more significance than returns from a few years ago. Some matrix algebra – a more complex cousin of linear regression – combined with just the current portfolio and benchmark holdings, gives ex-ante risk contributions that depend only on those inputs. Usefully, these forward-looking risk numbers are actionable; if the portfolio manager changes his portfolio holdings, the ex-ante tracking error and total risk of the portfolio will change immediately.

There is no single way to build a risk model. Each one is the product of extensive and ongoing research and

development, and requires regular (usually daily or monthly) updates to reflect new market data. Different risk models from different providers give different risk numbers; while it may seem like a failure to have more than one tracking error estimate for your fund, it is extremely useful to draw comparisons and to look at multiple risk models to get a more complete picture of what is going on. At Prudential, we run two risk models in parallel for our equity investments, as the most volatile asset class.

"As a rule, one would like to 'spend' one's risk budget on the ideas in which one has the highest conviction"

What do we use the tracking error estimates and contributions for? Within the investment team, the most important use of the output from our risk models is risk budgeting. As a rule, one would like to "spend" one's risk budget on the ideas in which one has the highest conviction (i.e. we prefer our highest tracking error contributions to come from those assets from which we expect

the best future returns). Conversely, one doesn't want to embed a view – a risk – in a portfolio by accident, as a result of aggregating multiple active positions. As we are bottom-up investors at Prudential (e.g. selecting individual stocks rather than whole sectors), this is something that we monitor closely.

Outside the context of investing, mandates require that we monitor and control the tracking error of some of our portfolios (for example, the Prudential Enhanced Property Tracker Fund is required to have a tracking error of less than 2%). We also have internal risk limits, against which we monitor all our portfolios.

Other risk measures

Not all risk measures require an expensive risk engine to produce. Some of the simplest ones remain extremely useful both to risk and portfolio management. Examples are active share (a pure measure of activeness – or how different the portfolio is from its benchmark - calculated using the portfolio and benchmark weights) and the various duration measures that are the stalwarts of the fixed income world.

Stress testing

The risk models described above have other uses than simply producing tracking error and total risk estimates; they are also good for stress testing (or scenario analysis) of portfolios. Stress testing enables us to look at “what if” scenarios such as, what returns might have been generated if we had had our current portfolio positioning during the unravelling of the IT bubble in the early 2000's, or during the SA-specific turmoil of Nenegate, or if the rand were to weaken against the US dollar by 10%. We stress test our portfolios against both a standard set of historical and hypothetical market scenarios, as well as any events that the investment team feels they might be particularly vulnerable to. The results of stress tests enable the investment team to calibrate the amount of risk taken in particular positions or portfolios, and to weigh the portfolio's vulnerability to different types of market moves, against their investment ideas and convictions.

Trend analysis

In order to set and enforce risk limits, it's important to have a sense of what is “normal”. For this, analysis of long-

term trends in market risk-taking by the investment team is very useful. One of the two risk models we use for equities has been in use at Prudential since 2002 (with enhancements from the vendor). This gives us a long and detailed time series of risk numbers against which to contextualise current portfolio positioning. Because different risk models give different tracking error estimates, often the trend will deliver more insight than a spot estimate.

Monitoring of portfolio fundamentals such as yield, price-to-earnings and other accounting ratios adds a further layer of understanding when combined with tracking error and other holdings-based risk estimates. Deviation from longer-term trends with respect to these measures can signal several things (including, for example, a change in the opportunity set such as in the immediate aftermath of a crisis, where there are many buying opportunities). It is important to interrogate such changes from a risk management perspective.

Talking to people

A surprisingly large part of the risk management function involves talking to colleagues. As a rule, my team does not participate in portfolio

management or investment decision-making meetings, and it is therefore useful to have portfolio managers or analysts explain the investment rationale behind their decisions. This information can be compared to and tested against the quantitative information that I have from looking at the portfolio from the outside using a risk model and other tools. In each case, I am trying to understand, what is the reference narrative? What could go wrong? How can we test those outcomes? (Which brings us back to stress testing!)

The trading desk holds a wealth of useful information for risk management purposes. There are many limitations to numerical estimates, and, for example, a conversation with the traders along the lines of “how long do you think it would take to trade this much of this instrument?” is an essential adjunct to any quantitative estimate of liquidity. The average person probably doesn't know that it can take multiple days to complete a large trade of a smaller company's shares in the local equity market – think of the risk involved resulting from intervening news and share price changes during the trading time!

Independent eyes

I have mentioned how important it is for the risk management function to either report to, or be, an entity that is independent from the investment team. At Prudential, an independent risk oversight committee (with members who are not part of the investment team) regularly meets and reviews detailed investment risk data. The committee also consults with the heads of the departments within the investment team (equity, fixed income, multi-asset), and draws in information and feedback from multiple business areas to form as complete a picture as possible. The committee's deliberations and recommendations are ultimately reported to the board.

“Without strong risk management, it would be impossible to deliver the returns our clients expect from us over time”

If one had to boil down an investment risk manager's job to its essence, it is to be constantly asking “What is going on here?”. I spend a lot of my time pursuing this question down rabbit holes of quantitative data and asking questions of long-suffering colleagues on the trading desk, in the performance team, in compliance, in the data management team, and within the investment team itself. Then I synthesise and distil this information to feed back to investment team members, and to present to the oversight committee. It is a fulfilling role, and, more importantly, one that is vital to the disciplined functioning of the investment process. Without strong risk management, it would be impossible to deliver the returns our clients expect from us over time, through the ups and downs of financial markets. ■

Clare joined Prudential in 2007 and is the Head of Quantitative Analysis. With 17 years of industry experience, she has worked in a range of roles spanning quantitative analysis, marketing and web development. Clare holds a Master of Science degree in Financial Mathematics from the University of Cape Town, a Financial Risk Manager certification from the Global Association of Risk Professionals and is also a CFA charterholder.