Blind spots in current risk management practices: Measurement error

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Abstract While significant progress has been made in the field of risk management over recent decades, much work remains. One area requiring further attention and rigour is 'measurement error'. In contrast to the physical sciences, financial measures of risk, especially credit risk, are rarely reported with error bars. The implication of this deficiency is that decision makers fail to recognise imprecision in reported numbers, leading to suboptimal decisions.

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The field of risk management has grown in sophistication and attracted many eager practitioners and academicians in recent decades. Recognised as a formal profession, those with appropriate expertise have prospered as demand for their skills has steadily increased. While progress has been significant, certain aspects of risk management modelling and reporting call out for more attention and rigour — measurement error is one such aspect.

Measurement error may be thought of as the imprecision of a model's output due to uncertainty around the measurement of its inputs. This is distinguished from model risk, which refers to the possibility that a model may be used inappropriately, or implemented incorrectly. Thus, the issue in question is not the model's inapplicability, but rather the precision of its inputs and outputs. Measurement error may arise in random or systematic fashion. The former refers to randomly introduced errors, leading to overestimation or underestimation of the 'true' result in a balanced, or symmetrical, fashion. The latter refers to bias of measurements in one particular direction. While systematic error may in general pose the greater danger, both may lead an uninformed decision maker to flawed conclusions and in turn to suboptimal decisions.

Unlike precise sciences such as physics and chemistry, outputs in the field of financial risk management, and in particular credit risk management, often do not include tolerance or precision qualifications. A probability of default (PD) calculation may be described in words such as 'the PD over a one-year horizon for the corporate borrower is 5 per cent'. Rarely, however, is an effort made to report imprecision in inputs as 'the PD over a one-year horizon for the corporate borrower is 5.0 per cent *plus or minus 0.4 per cent*'. Even more misleading is the habit of reporting the output of typical PD models to several decimal points. This is typical of vendor-supplied models. For example, a borrower's estimated PD may appear on a computer screen as 5.231 per cent. In practice, given the measurement challenges, it is not credible to state or even merely imply the precision is meaningful to three decimal points. Still, many such reports are delivered to management, implicitly sending the message that such precision exists. In this example, inclusion of the qualifier 'plus or minus 0.4 per cent' makes the result more useful and immediately makes it clear that second and third decimal points are meaningless.

To be fair, quantification of a model's precision (or imprecision) is far from trivial in financial risk management. There is much uncertainty at every stage of the process, from data quality to variable selection, to model fitting and subsequently calibration, making it difficult to make concrete assessments. Techniques to cut through measurement error exist, and in cases where bias is not present, statistical methodologies can be relied upon to provide reasonable point estimates of desired outputs. The issue even in these cases is that there is often a lack of explicit recognition of the measurement error around these point estimates. Thus, 5 per cent may well be a very reasonable estimate of an entity's PD, but the single number does not tell the whole story. That is, due to measurement error, the 'true' answer may be as low as 4 per cent or as high as 6 per cent. In cases where bias is present, the true measures may be significantly different, and asymmetrically distributed, from the reported estimate of 5 per cent.

While quotes of PD measures generally ignore error bars, measures of recovery or loss given default (LGD) explicitly include them, as in, 'the LGD is 50 per cent plus or minus 45 per cent'. Unfortunately, this is not a sign of greater rigour. It is a sign of relative helplessness. This becomes clear on closer examination of the quotation, which unhappily reflects the state of the LGD science for a variety of asset classes. The statement effectively says that the LGD is somewhere between 5 per cent and 95 per cent. As LGDs are for the most part bounded by 0 per cent and 100 per cent, the statement does not reflect precision, but rather lack thereof. This level of imprecision or unreliability may be equivalent to having to admit that the PD for a company is 10 per cent plus or minus 9.5 per cent, effectively stating that the firm in question may be anywhere between very safe to on the verge of bankruptcy. Such broad ranges of potential outcomes are unhelpful.

An important consideration of

measurement error is that it propagates through all subsequent calculations. PD and LGD reflect firm and security-specific risks. The product of these two measures yields the expected loss (EL) estimate for the security or firm, which is a significant factor in determining reserves for losses and in the pricing of credit-sensitive instruments. Measurement errors in PD and LGD thus carry over to EL, reserve calculations and pricing.

There is at least some comfort in knowing that PD measures have benefited in recent years from numerous data collection initiatives and improved modelling. The precision of these measures may at least now be more reasonable. Still, multiplication of a reasonably precise PD by an entirely imprecise LGD measure yields a relatively imprecise EL.

The EL measure is merely the first in a long line of increasingly complex calculations that depend on building blocks such as PD and LGD. Tracking measurement error becomes even more difficult and potentially more important when one seeks to calculate these more complex outputs, like a portfolio-based measure of economic capital. As with the EL, even if one knows the PD to a relatively high level of precision, once it is combined with LGD, the latter's imprecision swamps that of the former — and nothing has yet been said about the added complexity and imprecision of incorporating correlations. The combination of these underlying errors at least partly explains why portfolio level outputs such as economic capital may be far less precise than typical reports indicate. It may also partly explain some of the dramatic underestimation of risk in various securitisations, including subprime, which rely on similar portfolio analytics. This observation is even more meaningful if there is reason to believe that inputs are liberally biased, consciously or subconsciously, by various market players. For example, to generate transactions, LGDs and/or PDs may be uniformly underestimated, yielding overly optimistic estimates of risk. Proper understanding of how much error and how much bias are present in inputs will yield different reports and, in the best case, different managerial decisions.

The basic issue of model imprecision is known. Even if responsible risk managers continue to bring this issue to management's attention, as an abstraction it may blend into the background or be ignored. Part of the difficulty is that risk managers often conclude that repeating these qualifiers *ad nauseam* makes their models seem inadequate and annoys their seniors, neither of which contributes favourably to career advancement. Additionally, over time these important notes have sometimes become the 'small print' in management reports as rarely read footnotes.

Scenario analysis, a legitimate form of risk management, has occasionally been (erroneously) subverted to address measurement error. In these cases, the assumption is that, by undertaking worst and best-case scenarios, model imprecision is somehow accounted for, and therefore need not be addressed explicitly on its own. A typical scenario analysis may lead to the following summary:

> 'under best-case assumptions, the economic capital needed to cover this portfolio for 99.9 per cent of potential

> losses is \$2bn. Assuming the worst-case scenario of market turbulence, the economic capital at 99.9 per cent goes up to \$2.4bn.'

The problem is that model error calls for qualifiers such as:

> 'under best-case assumptions, the economic capital needed to cover this portfolio for 99.9 per cent of potential losses is \$2bn *plus or minus \$0.3bn*. Assuming the worst-case scenario of market turbulence, the economic capital at 99.9 per cent goes up to \$2.4bn *plus or minus \$0.3bn*.'

The point is that in *each* scenario the model suffers from imprecision. When this is taken into account it becomes clear that the possible ranges of outcomes are not \$2–2.4bn as originally stated, but rather \$1.7–2.7bn (\$2.0bn − \$0.3bn and \$2.4bn + \$0.3bn) — a significantly different set of figures.

Leaders are more likely to make poor decisions when they are provided with misleading or incomplete information regarding risks. In many institutions, as imprecise estimates of PDs, LGDs, EL and economic capital are reported up the managerial chain, they tend to lose all verbal qualifiers and explanations, leaving just the numbers on a page. Business managers with limited attention spans tend to react to just the numbers they see. In the example above, a business manager may well reach a different decision when confronted with the \$2.7bn number as opposed to the \$2.4bn, but that manager will never even realise an issue existed if reports lack appropriate qualification.

Not knowing the imprecision in model outputs is not an excuse for failing to communicate that imprecision exists. The responsibility for this rests within both the risk management and the general business management functions. Risk managers are obliged to quantify and report precision, or lack thereof. Business managers in turn must get more comfortable with, and more demanding about, looking at more than a single number summarising risk. Indeed, they must get in the habit of discussing risk implications in greater depth as a matter of course, rather than waiting until a crisis such as subprime looms.