TECHNIQUES FOR VERIFYING THE ACCURACY OF RISK MEASUREMENT MODELS

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Risk exposures are typically quantified in terms of a "value at risk" (VaR) estimate. A VaR estimate corresponds to a specific critical value of a portfolio's potential one-day profit and loss probability distribution. Given their function both as internal risk management tools and as potential regulatory measures of risk exposure, it is important to quantify the accuracy of an institution's VaR estimates.

This study shows that the formal statistical procedures that would typically be used in performance-based VaR verification tests require large samples to produce a reliable assessment of a model's accuracy in predicting the size and likelihood of very low probability events. Verification test statistics based on historical trading profits and losses have very poor power in small samples, so it does not appear possible for a bank or its supervisor to verify the accuracy of a VaR estimate unless many years of performance data are available. Historical simulation-based verification test statistics also require long samples to generate accurate results: Estimates of 0.01 critical values exhibit substantial errors even in samples as large as ten years of daily data.

This study considers alternative statistical techniques that could be used to verify the accuracy of estimates of the tail values of the distribution of potential gains and losses for a portfolio of securities, futures, and derivative positions. These so-called reality checks have been advanced as a tool for determining the accuracy of risk exposure estimates generated by risk measurement models.

Dealer banks and broker-dealers typically maintain internal risk measurement models that are used to estimate the daily global exposures generated by the institution's portfolio of financial assets and derivative obligations (see "Derivatives" [1993, Appendix III]). Risk exposures are typically quantified in terms of a "value at risk" (VaR) estimate.

A VaR estimate corresponds to a specific critical value of a portfolio's potential one-day profit and loss probability distribution. Typically, a VaR estimate is defined to be a loss large enough so that the probability that the portfolio could post a larger loss is at most some specified value, like 1% or perhaps 5%. A VaR measure thus corresponds to a specific left-hand critical value of the portfolio's potential profit and loss distribution.

The Basle Bank Supervisors Committee proposes that critical value estimates from a bank's internal risk measurement model become the basis for a bank's market risk regulatory capital requirement. Its proposal defines VaR in terms of a two-week holding period (see "An Internal Model-Based Approach" [1995]). Similarly, under a proposal by the Derivatives