MEANINGFUL RISK MEASURES

Conventional assumptions about VaR are put through their paces.

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Financial risk managers are faced with several key issues when measuring and reporting portfolio risk: choosing a meaningful risk measure; forecasting risk; backtesting the risk model, and; stress testing. The objective of this brief is to synthesize recent academic findings on these topics.

Value-at-Risk (VaR) has become the industry benchmark for risk reporting because it captures an important aspect of risk, namely the loss such that the institution will suffer a worse loss with only a small and prespecified probability. A key drawback of VaR, therefore, is that the magnitude of the potential losses is ignored. The Expected Shortfall (ES) measure offers an improvement in that it captures the loss magnitude. ES is defined as the expected value of losses in the cases where the loss is larger than the VaR. ES can much better capture risk arising from options and non-normality in returns due to market liquidity issues, for example.

Historical Simulation (HS) calculates VaR using the empirical percentile on a window of past returns. HS is widely used in practice because of the ease with which it is calculated and because of its model-free nature. While it is true that heavily parameterized models can lead to overfitting and thus to poor out-of-sample VaRs, tightly parameterized dynamic models may nevertheless be superior to HS. HS models tend to react slowly to dramatic events such as the 1987 stock market crash. A well-specified dynamic volatility model such as GARCH will instead promptly incorporate sudden large returns (and losses) and forecast increased market uncertainty going forward. A key challenge for academics and practitioners alike, however, is to built volatility models which can predict market uncertainty over the relatively long horizons relevant for pension fund managers.

BACKTESTING RISK MODELS

Daily historical VaRs and profits and losses from large U.S. commercial banks show a strong tendency for VaR violations (i.e. losses larger than the VaR) to occur on adjacent days. This clustering of VaR violations is a serious sign of model misspecification and it motivates the use of rigorous, conditional backtesting techniques. We can, for example, regress a zero-one indicator variable of VaR violations on information variables known at the time the VaR forecast was made. If this information was incorporated properly then no variable in the regression should be significant.

Standard stress testing does not tell the risk manager anything about the probability of the stress scenario happening; thus it is not clear what the risk management action (if any) should be from a given scenario outcome. But if risk managers are willing to assign scenario probabilities, then stress testing can be useful. Data can be drawn from the "real" data set as well as from the set of scenarios. Once data has been simulated from these two sources we can calculate the risk measure on the combined data set. If risk is inappropriately high, then the portfolio can be rebalanced. Backtesting of the risk model can be done on the extended data set as well.

There is a four-part message to risk managers: the Value-at-Risk measure is adequate but Expected Shortfall is better; the Historical Simulation technique does not properly capture the variance dynamics in returns; conditional backtesting techniques can catch inadequate models in a constructive fashion, and coherent stress testing using prespecified scenario probabilities enables proper risk management to be taken. ▮