Tom Begley writes;: A key regulatory response to the Global Crisis has involved higher risk-weighted capital requirements. This column documents systematic under-reporting of risk by banks that gets worse when the system is under stress. Thus banks' self-reported levels of risk are least informative in states of the world when accurate risk measurement matters the most.

Following the Global Crisis, there has been a great deal of debate surrounding the risk-taking behaviour and incentives of large, global banks and their potential consequences for the stability of the financial system. Some argue that the privately optimal level of capital for a bank may differ substantially from the socially efficient capital level (see Admati et al. 2011, Thakor 2014). As policymakers consider new micro- and macro-prudential regulations to address these problems, it is important to understand the accuracy of self-reported risk measures generated by the internal models of large banks around the globe.

Value-at-risk and capital requirements

The trading book consists of marketable securities such as those related to equities, interest rates, foreign exchange, and commodities. Basel rules allow banks to measure the risk of their trading portfolios with internal value-at-risk (VaR) models. Broadly, these models provide a statistical measure of risk that estimates a dollar amount of potential losses from adverse market moves. For example, a 99% confidence interval, 10-day holding period a value-at-risk of $100 million for a portfolio means that over the next 10 days, this portfolio will lose less than $100 million with 99% probability. Due to pure statistical chance, we would expect to see one exception, or violation, (i.e., losses exceeding $100 million) every 100 trading days.

Note that a bank may change its risk-taking behaviour in response to changes in its equity capital position, but these changes should only affect the level of value-at-risk, not the frequency of exceptions. This distinction highlights a key strength of our empirical setting. Namely, we relate capital-saving incentives to deviation from self-reported value-at-risk numbers, which is independent of the scale of risk-taking.

The reports from these internal models, in turn, directly influence the banks' market risk capital (MRC) requirements through the formula MRC = k * VaR, where k is a regulatory multiplier based on the past year's model performance – k starts at 3.0 and can increase to 4.0 as a bank has more exceptions – and VaR is the bank's self-reported value-at-risk. Absent any incentive conflict, the number of exceptions should be unrelated to the bank's prior equity capital.

Value-at-risk exceptions and equity capital

We construct a quarterly dataset from large financial institutions from the US, Canada, and Europe for the period 2002-2012. We find that the average number of exceptions per quarter is 0.62. With 60-65 trading days in each quarter and 99% confidence-interval value-at-risk model, this number is roughly equal to the statistical expectation for the number of exceptions. However, we find a great deal of variation both across banks and within banks over time. Figure 1 below presents this variation over time by plotting the

average number of exceptions per bank during each quarter in the sample, along with a dashed line indicating the statistical expectation based on a 99% confidence interval. The average number of value-at-risk exceptions are well below their statistical expectation during 2002-2006 (0.08 per bank-quarter), then increases by a considerable amount during a period of increased systemic risk in the economy during 2007-2009 (1.64 per bank-quarter), and finally falls again for 2010-2012 (0.18 per bank-quarter).

Figure 1. Mean quarterly VaR violations per bank

We next conduct our main empirical tests that relate low levels of equity capital to future value-at-risk exceptions. The main intuition is that when a bank has low equity capital, it has stronger incentives to under-report its risk in order to get capital relief during the current period. However, as a consequence of under-reporting, that bank is more likely to experience model exceptions during the following quarter. Once a bank has more than four exceptions over the past year, the capital multiplier k is increased and the bank also faces large compliance costs that stem from higher regulatory scrutiny (BIS 1996). In sum, a negative relationship between equity capital and future exceptions provides evidence in favour of under-reporting.

Indeed, our regression analysis indicates that a one standard deviation decrease in equity capital leads to 1.32 more exceptions in the following quarter. With a sample average number of 0.62, this is a substantial increase. We also find that the results are strongest among banks where the trading book is a large portion of the bank's business, and is also stronger when banks have recently seen declines in stock price. All of these results include both bank and year-quarter fixed effects, so we are able to control for time invariant unobserved bank characteristics such as modelling skill and risk culture as well as for level effects of macroeconomic shocks on the general reliability of value-at-risk models across banks.

Turning to the systemic implications of this behaviour, we investigate the effect during times of financial sector stress. In these states of the world, the cost of external capital increases for all banks in the economy, tilting further the incentives of banks to under-report to save capital. Focusing on the quarter following Lehman Brothers' collapse as well as using continuous, time-varying measures of aggregate capital shortfall in the financial sector (Acharya et al. 2010), we find that the incentive effects are much stronger during periods of high systemic stress. For example, the effect of equity capital on under-reporting is more than four-times as large in the quarter following Lehman's collapse.

The results are robust to a battery of robustness tests. To name a few, the results are not driven by a particular measure of equity capital, banks' exposure to market or mortgage-backed security risk, or their asset mix in the trading book.

Conclusion

The measurement of bank risk is a key foundation for both micro-prudential and macro-prudential policy. Effective regulation relies on understanding the location and size of risks in the financial sector. In this column, we highlight a strong relationship between

bank capitalisation and the risk reporting behaviour of banks under the current regulatory framework. Banks with low equity capital under-report their trading book risk, and do so more severely in times of system-wide financial stress. These results suggest that banks' self-reported risk measures are least informative precisely during periods when accurate risk measurement is most important.