Procyclicality and Value at Risk

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In the years leading up to the financial crisis, banks around the world, including those in Canada, became more heavily involved in financial markets. Securities and derivatives that banks actively buy and sell in financial markets make up the "trading book." Prudential regulations governing the trading book differ in many important respects from those governing the "banking book," which is the more traditional stock of loans and mortgages originated and held by banks. In the initial phase of the current financial crisis, banks suffered severe losses from instruments held in the trading book: in many cases, several times what standard models would have predicted (Standard & Poor's 2008). Given the significance of the trading book to international banks and its prominent role in the recent crisis, it is important that regulatory reforms aimed at reducing the procyclicality in the financial system address rules regarding trading book capital.

There is widespread agreement that, prior to the crisis, banks did not set aside sufficient capital to cover risks related to the trading book, especially credit, liquidity, and event risk. The Basel Committee on Banking Supervision (BCBS) has proposed amendments to strengthen capital requirements for the trading book (BCBS 2009b, 2009c) that would increase capital to cover these risks. The proposals may also moderate procyclicality, but more work remains to be done in overhauling the framework for measuring trading book risks, with particular focus on the systemic consequences of prudential capital requirements.

CURRENT FRAMEWORK FOR TRADING BOOK CAPITAL

Capital requirements for the trading book are based on the "Market Risk Amendment" (MRA) to the Basel I accord (BCBS 1996, 1997). Value-at-risk (VaR) models are the foundation of the MRA, and are an early example of the internal-models approach of Basel II, whereby banks are permitted to compute regulatory capital based on their own models, subject to certain qualitative and quantitative standards.[1]

Simply stated, a VaR model is a model of the distribution of future profits and losses of a bank's trading portfolio. VaR models combine information on a bank's trading positions across various products with statistical estimations of the probability distribution of the underlying market factors and their relation to each other. The final output of a VaR model is a VaR estimate, which is defined as the maximum amount of money that a bank would expect to lose over a defined period and with a defined confidence level. For example, if a bank has a 99 per cent, 1-day VaR of $100 million, this means that 99 times out of 100, the bank's trading portfolio should not lose more than $100 million the next day. Put another way, one day out of 100, the bank should expect to lose $100 million or more.

VaR models came into widespread use in the 1990s, as the trading activities of large international banks increased dramatically. The MRA does not specify the exact type of VaR model that a bank must use, but it does specify that banks must hold capital equivalent to three times the 99 per cent VaR with a 10-day holding period, averaged over the past 60 trading days. Banks must also use a minimum of one year of data to estimate the statistical behaviour of the market risk factors. Today, major banks use complex computer models to aggregate trading positions across the bank and to model the joint probability distribution of hundreds, or even thousands, of risk factors.

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[1] The MRA also provides the option of using a standardized approach. Large financial institutions, including the major Canadian banks, use the internal-models approach for assessing general market risk, although some use the standardized approach for determining specific risk in part, or all, of their trading portfolios.

THE PROCYCLICALITY OF VAR MODELS

Value-at-risk models have several widely recognized shortcomings and have been heavily criticized by academics and practitioners. While banks have developed many variants of VaR models, all of them still rely on historical data to estimate the probability distribution of future outcomes. Most banks use a relatively short period of data (the "lookback period") to estimate the probability distribution of market factors, and some use weighting schemes, whereby within the lookback period, more recent data points are given a higher weight. These techniques can ensure that estimated VaRs accurately reflect the stylized fact that many financial time series exhibit time-varying volatility. In this sense, such VaR models are "risk sensitive," in that they relate capital to current estimates of risk. This risk sensitivity results in VaRs that are cyclical: rising and falling with market volatility. Charts 1 and 2 show daily VaR estimates for Canadian equity and corporate bond markets, estimated with different lookback periods.[2]

Chart 1: One-day 99% VaR for BBB corporate bonds
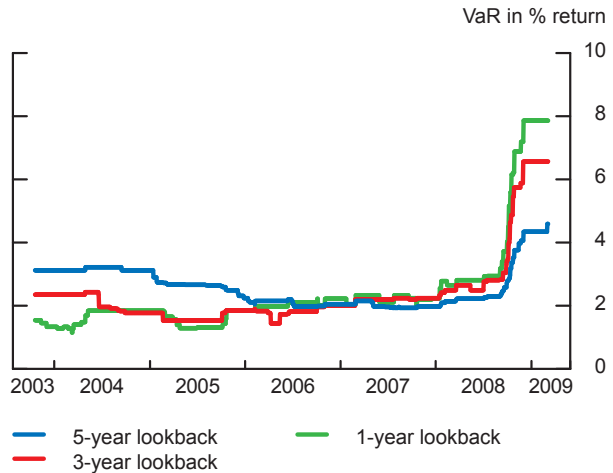
VaR in basis points
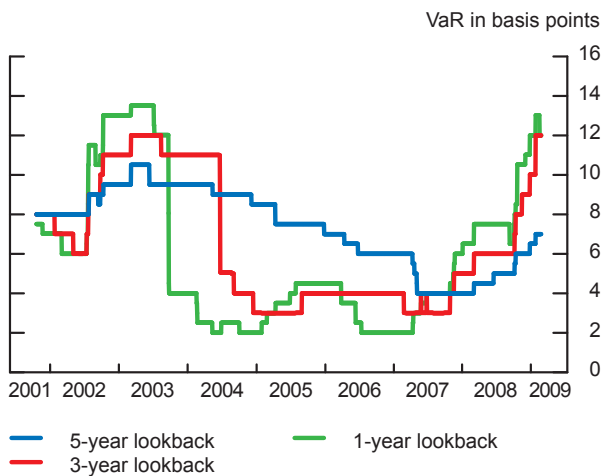
Sources: Bloomberg, Merrill Lynch, author's calculations

Note the sharp rise in VaRs since late 2008. A bank using VaR to set trading limits would use an increase in VaR as a signal to reduce its trading positions. From the perspective of that bank, the reduction in trading positions during a high-volatility period will reduce risk.

This type of dynamic is troubling if many market participants react to increased volatility in the same way. The herding hypothesis (Persaud 2001) holds that when many financial institutions use VaR to set risk limits, its cyclical

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2 The historical simulation approach was used to compute the VaR used in the charts. This is one of the methods commonly used by banks. The VaR computed for the S&P TSX Index assumes a long position; the VaR for corporate bonds uses the Merrill Lynch BBB corporate bond index and assumes a long position in spreads versus Government of Canada bonds.

Chart 2: One-day 99% VaR for S&P/TSX Composite Index

VaR in % return

Sources: Bloomberg, author's calculations

properties generate destabilizing effects in financial markets, whereby declines in asset prices cause VaRs to increase, which, in turn, leads to breaches of the VaR-based risk limits. Institutions respond to the limit breaches by closing out the risky positions, thus exacerbating the initial price decline and causing more volatility. Thus, the use of risk-sensitive measures that reduce risk for individual firms can create more risk in the system as a whole. While it is unlikely, at least in the short run, that firms react mechanistically to increases in VaR, there is some evidence that this dynamic was at work during the current crisis (Longworth 2009).

Another observation from Charts 1 and 2 is that a longer lookback period produces more stable VaR estimates that do not fall as quickly in quiet times, nor rise as sharply in crisis periods. The use of a longer lookback period may reduce short-run forecasting accuracy, but could reduce systemic risk by discouraging an excessive buildup of trading positions during quiet periods in the markets. With smaller trading positions, volatile periods in the markets would not be as damaging.

Other criticisms of VaR models centre on the difficulties in modelling financial asset prices, especially in the tail of the distribution, which is particularly relevant for risk management. While VaR models can be improved to better account for the statistical properties of financial time series, no model is perfect.

The MRA adjusted for some of the weaknesses discussed above. Setting the capital requirement on the average VaR over the past 60 days, instead of on yesterday's VaR, tends to smooth sharp changes in VaR coming from changes in market volatility (Jorion 2002). Multiplying the VaR by three is an adjustment that may account for the fact that most financial times series are known to have "fat tails," and that

some positions would not be able to be liquidated within the assumed 10-day holding period. In addition, the MRA stipulated that banks using internal models for trading book capital "must have in place a rigorous and comprehensive stress testing program." Stress testing has long been suggested as a way for risk managers to better understand exposures and to assess the impact of tail events, which may not be well captured by VaR models.

VaR Models and Financial Innovation

Over time, financial innovation shifted the focus of banks' trading activities away from traditional instruments and towards more complex securities and derivatives, such as collateralized debt obligations and credit default swaps. Compared with traditional instruments like government bonds and interest rate swaps, these new instruments had higher levels of credit and liquidity risks. In addition to long-standing doubts about VaR and its potential feedback effects on markets, prudential regulators were concerned that existing VaR models, which were focused on "general risk,"[3] were poorly suited to capturing the risks of these new products. This, in turn, led to a concern that the market risk framework gave banks incentives for "regulatory arbitrage," i.e., moving positions from the banking book to the trading book in order to benefit from lower regulatory capital charges (BCBS 2005).

Reflecting these concerns, the BCBS published a revised framework for the trading book in April 2005, often called Basel 2.5 (BCBS 2005). The changes sought to reduce incentives for regulatory arbitrage by establishing a new capital requirement, called the "incremental default risk" charge (IDR), which would cover credit risk in the trading book. A later document (BCBS 2007) laid out detailed qualitative and quantitative standards for the IDR, which were to be implemented in 2010. The new measures proposed by the BCBS, discussed below, have supplanted the IDR.

Mitigating Procyclicality in Capital Requirements for Market Risk

The financial crisis exposed some problems in the framework for managing market risk. Many banks posted trading losses well in excess of their VaR estimates, even exceeding the losses generated by stress scenarios (BCBS 2009a). In response to the weaknesses demonstrated by the financial crisis, the BCBS's Trading Book Group set out to strengthen these capital requirements. The group published two documents proposing amendments to the trading book capital framework (BCBS 2009b, 2009c). Final versions of the amendments are expected in September 2009, with implementation planned for the end of 2010. The

BCBS has indicated that the implementation date could be extended if necessary to avoid increasing capital requirements during a stressful period (BCBS 2009d).

The documents propose major changes to capital requirements for the trading book. Among the most prominent are:

- A new "stress VaR" charge for general and specific market risk. The stress VaR is the VaR of current trading positions using an estimation window that includes a stressful period relevant to the bank's trading positions. The stress VaR would be multiplied by three and added to the existing VaR-based capital charge.

- A new Incremental Risk Charge (IRC). The IRC will cover default and migration risk on credit products in the trading book. The IRC will cover non-securitized credit products[4] using a 99.9 per cent confidence level and assuming a constant level of risk over a 1-year horizon. Securitized products are not eligible for the IRC. They will be subject to a capital charge taken from the securitization framework for the banking book. Capital requirements for credit-risky positions in the trading book will be based on the same soundness standard as in the banking book, but the unique characteristics of the trading book will be taken into account in computing capital.[5]

- An explicit requirement for banks to model all relevant pricing factors as risk factors in the VaR model, unless approval is obtained from the supervisor.

Adoption of the proposed amendments would significantly increase trading book capital. An increase is widely thought to be necessary, but it comes at a time when banks' capital is already under pressure. Members of the BCBS will be conducting quantitative impact studies in their respective countries, which should give the BCBS further insight into the appropriate timing for implementing the changes. The impact studies could also highlight areas where the proposals could have an adverse impact on market liquidity, for example, by reducing the willingness of banks to make markets in certain products.

The impact of the changes on procyclicality is difficult to assess. The new IRC should reduce incentives for regulatory arbitrage, which seems to have been an important source of procyclicality. The new stress VaR charge would prevent capital from falling too much in periods of low market volatility but would not reduce the procyclicality of

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[3] "General risk" refers to the risk of loss owing to changes in default-free interest rates, overall credit spreads, FX rates, broad equity market indexes, and commodity prices.

[4] This would include, for example, corporate bonds and single-name credit default swaps.

[5] In particular, the constant level of risk assumption is designed to provide some capital relief for holding positions in a trading book, where positions can be reduced in response to a decline in credit quality. Thus, the IRC charge need not be computed assuming that all positions will be held over the 1-year horizon, but rather that positions could be liquidated after a period of time, called the liquidation horizon. The minimum liquidation horizon is set at three months. Additionally, existing VaR models and the IRC take into account risk reduction that arises from hedging positions, in contrast to the banking book, where capital charges are additive.

other components of trading book capital, namely, the general- and specific-risk VaR models and the new IRC. The higher level of capital required for trading activities may also reduce the ability of banks to make markets in some instruments, thus reducing market liquidity.

FUTURE PRIORITIES FOR POLICY-MAKERS

Given the widespread concern of policy-makers about pro-cyclicality and feedback effects, and given the prominence of trading losses during the financial crisis, more work remains to be done on the overall framework for trading book capital. One possibility is for further refinements to existing VaR models, such as stress VaR, or more medium-term "through the cycle" approaches to estimating VaR.

Given the inherent limitations of VaR modelling, an alternative would be to reduce its central role in a regulatory framework for capital.[6] A revised framework could work from a principles-based approach, designed to capture all types of trading risk to an acceptable soundness standard, giving due consideration to the pitfalls of VaR modelling. For example, stress testing, currently part of Pillar II, could be brought into Pillar I capital requirements. Model-based capital requirements could be supplemented by simple position limits, analogous to the use of a leverage ratio for overall bank capital. This type of principles-based approach should be more resilient to financial innovation, ensuring that new risks are taken into account as they develop.

To complement microprudential reforms, policy-makers could address macroprudential concerns by developing tools to assess the evolution of trading positions and leverage in the financial system. This assessment could be used to identify systemwide vulnerabilities that, in turn, could feed back into the quantitative assessment of capital adequacy.

CONCLUSION

Value-at-risk models—the foundation of regulatory capital requirements for the trading book—have serious weaknesses, including the potential for inducing procyclicality in markets. Recent initiatives taken by the Basel Committee on Banking Supervision address some of the key weaknesses in the existing framework, but more remains to be done. Capital regulation could be improved by exploring the overall approach to risk management in the trading book, with particular attention to the systemwide implications of prudential regulation.

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[6] See Finger (2009) for a discussion of this issue.