

The Value at Risk Revolution

WITH RISK A MAJOR CONCERN FOR THE BANKING SECTOR, NEW WAYS AND MEANS HAVE BEEN FORMULATED TO EVALUATE MARKET RISK, AND SYSTEMS DEVELOPED FOR RISK MANAGEMENT. RALPH YIEHMIN LIU EXPLAINS THE CONCEPTS AND APPROACHES



The latest buzzwords in risk management, such as Value-at-Risk (VAR), RiskMetrics and RORAC, have become familiar references to many finance professionals.

Developments in risk management concepts and methodologies are going on in the US and Europe, with many market professionals preparing themselves for the risk management revolution.

WHAT IS VAR?

The VAR approach is a set of methodologies to measure risk. The VAR concept (money-at-risk or dollar-at-risk), although not familiar to many until recently, is practised by financial institutions all around the world in one form or another as a means of managing trading books.

However, the systematic approach was first brought to the attention of the financial community by the Group of 30 in their recommendations published in July 1993. At the moment, VAR is only used to measure market risk, although proposals have been raised to implement the same concept to measure credit and operation risk.

VAR is a statistical estimate that measures, at a certain confidence interval, the amount of value in a certain currency that an organisation may stand to lose within a certain time period due to the potential changes in the market price of the underlying assets. The possible time horizons for analysis could be only one day for most trading positions or it could be a month or longer for an investment portfolio.

VAR is significant because it represents the first collective effort by the market participants and regulators to create a standardised approach to assess risks, whether it is for a particular security, an investment portfolio or the entire balance sheet of the organisation.

However, it is very important to emphasise that VAR is a statistical estimate usually based on historical data. It is a forecast number and cannot be accurately

determined with 100% confidence. The most common methods used to calculate this estimate number are explained below.

Historical Price Modelling

Historical price modelling calculates a series portfolio values based on a given time series of historical market prices for a given time horizon. From the distribution of the portfolio value we can calculate the total portfolio profit and loss of the holding time horizon from the net present value changes from one date to the next.

Having derived the time series of portfolio net present value changes, it is possible to use many statistical techniques to determine the probability of loss for the portfolio. For example, assume the net present value changes follow a normal distribution with time, the VAR under any level of confidence can be easily calculated from the standard deviation of the net present value changes (see Table 1).

Historical Variance/Covariance

A more pragmatic approach is to create a series of historical volatility and correlation matrix data on simplified financial instruments and then apply them to those instruments in a portfolio. Most portfolios can be broken down into simplified instruments such as FX spot rates, money market rates, money market futures prices, government bond prices and swap rates.

A typical portfolio can be converted into a delta or spot equivalent amount and present-valued zero-coupon cash flows in a process called cashflow mapping. This is a means of standardising the component cashflows of most portfolios to facilitate the process of calculating VAR. Once cashflow's time buckets have been standardised, it becomes much easier to compute the VAR of the portfolio through volatility and correlation data.

The advantages of this methodology to produce VAR risk reports are the convenience of the system and the time



saved, although to some extent at the expense of lost accuracy. Other than the delta risk, none of the other derivatives risks, such as gamma, theta and vega, are captured in this computation process. This methodology is currently used by JP Morgan in its RiskMetrics technique (refer to the following).

Stress Analysis

A VAR calculated solely on a set of historical prices may not give the complete picture of what might happen to an investment portfolio. The Group of 30, in its report 'Derivatives: Practices and

VAR provides a systematic way to approach the measuring task.

Principles', recommended the use of stress simulations in addition to the statistically-based VAR methodologies.

In a stress analysis, instead of using historical market prices data, a set of arbitrary scenario prices can be created to test the performance of the portfolio. The non-linear risks in the portfolio will be captured automatically. The stress analysis method is quite straightforward, and has been used extensively by traders to manage their trading books.

For example, it is very common for an option trader to run a report at the end of the day to see the P&L impact on their own portfolio if the spot moves up or down 3%, or if the volatility moves up or down by 1%.

Monte Carlo Simulation

In a Monte Carlo simulation, a set of randomly generated market prices will be used to test the net present value changes of a portfolio instead of the historical prices. The methodology is much more forward looking than methods that rely on historical prices.

Implied volatility currently traded in the market place may be used in the computation process. The forward-looking characteristics of the implied volatility are widely viewed as a better choice over the historical volatility. However, due to the lack of liquid correlation derivatives markets and computational difficulties, the correlation can not easily be implied from market prices. In practice, a combination of implied volatility and historical correlation have been widely used.

The major drawback of the Monte Carlo simulation technique is its computational

complexity. With the consistent progress in the computer technology, this methodology will continue to gain favourable support from market participants.

WHAT IS RISKMETRICS?

RiskMetrics is a particular methodology developed by JP Morgan to quantify market risk. The market risk is defined as the maximum loss of a portfolio, given a confidence interval and time horizon. The methodology is based on, but not exactly the same as JP Morgan's own in-house market risk management systems.

JP Morgan made the concept and the products available in October 1994 to promote greater transparency of market risk, providing a benchmark for market risk measurement and making sound advice available to the public.

The RiskMetrics products include the VAR methodology and three datasets that are composed of daily and monthly volatility and correlation estimates on over 400 instruments and a separate regulatory dataset that complies with the requirements of the April 1995 Basle

Committee proposals for calculating regulatory capital requirements on market risks.

Since its inception, the RiskMetrics methodology has been put in the public domain and the datasets with daily updates have been made available free to the public through the Internet. They have been intentionally left to the end users as well as third-party consultants and advisers to implement and further improve on.

RELEVANCE

The traditional risk management cycle starts from understanding and identifying risks, to assessing and measuring risks, and then managing and controlling risks, to the final monitoring and reporting of the risk management performance. The most tedious and logistically challenging step is the measuring step. VAR provides a systematic way to approach the measuring task.

Benefits

Management Information

VAR information could be used by senior management, an independent risk management committee, and internal and external auditors. VAR makes the reporting process transparent by making the information needed for decision-making more specific.

Trader Limits

To set traders' limits in terms of VAR in addition to maximum outright exposure, the use of VAR has many advantages, among which the most significant is that positions in different markets or on different products can now be compared with one another.

Portfolio Risk Performance

By computing the VAR of the components of a benchmark index one can track and compare it to the VAR of an investment portfolio, similar to the method used to track an index for its returns.

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Resource Allocation

Having VAR information, risk takers can make better informed decisions about their trading strategy. Position-taking should be geared towards maximising returns given a risk tolerance level. Bank management can use the risk ratio (refer to the following information) to make decisions regarding the allocation of resources to specific businesses.

Investment Performance Evaluation

To compare return/risk performance across different portfolios, for example, to measure the cumulative trading revenues over time of different traders in similar markets and compare them on the basis of the:

- Sharpe ratio (P&L/volatility (of P&L));

- risk ratio (P&L/VAR); or
- efficiency ratio (VAR/volatility (of P&L)).

In most dealing-room environments, the performance of traders or position takers has been measured so far by returns only. By using the efficiency ratio, which gives the comparison of estimated risks versus realised volatility of profits, bank management can, therefore, add another way to gauge the performance of its traders.

Regulatory Compliance

Financial institutions have to comply with capital adequacy requirements set by the respective regulators. The currently existing and pending regulatory requirements are:

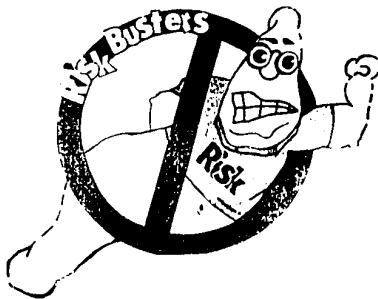
- European Union's Capital Adequacy

Directive (EEC 6-93), which requires banks and investment firms to set capital aside to cover market risks, effective since January 1996.

- Basle Committee on Banking Supervision of the Bank for International Settlements consultative proposal, 'Internal Model-Based Approach to Market Risk Capital Requirements', which is due to come into effect in 1997.
- Security and Exchange Commission's proposed amendments to Regulation S-X, Regulation S-K and Form 20-F. The proposal requires registered corporations to provide quantitative information on market risks of derivatives and other financial instruments. **ARM**

RiskBusters

The spreadsheet-based *Capital Charges Calculator* based on BIS Standardised Approach



ARE YOU
PREPARED
FOR 1997?

You may be aware of the latest BIS proposal, BUT are you using the BIS standardised method to calculate your market risk exposure? ARMS' team of financial engineers has developed the **RiskBusters** which strictly uses the BIS Standardised methodology proposed in the January 1996 Amendment to the Basle Capital Accord. **RiskBusters** not only ensures that you set aside the minimum required capital but also helps you verify whether your internal model will generate lower capital charges for your portfolio. **RiskBusters** covers the interest rate risk, equity risk, FX risk, commodities risk and options risk.

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RISK MANAGEMENT is our middle name