Other alternatives to VAR

While value-at-risk has become widely adopted by many institutions as a standard measurement of risk, Justin Myatt argues that other at-risk measures may be more relevant for corporate treasurers

Value-at-risk has become such a widely adopted risk measurement tool that it can seem heretical to question the relevance of the VAR concept. But some risk managers in the corporate and government sectors have done just that, arguing that VAR models as used by financial intermediaries are counter-productive to their own identification and management of risk. Instead, these entities have found it more beneficial to apply alternative methodologies – including profit-at-risk (PAR), earnings-at-risk (EAR) and cashflow-at-risk (CFAR)[1] – which are related to VAR but view risk from a fundamentally different angle.

This article explains each of the at-risk measures and how they are related. While the choice of methodology may seem inconsequential, all risk management behaviour is influenced by the exposures recognised, and therefore the methodology selected to measure exposures. Put simply, which at-risk methodology you choose does matter.

What is meant by at-risk?

Risk is normally defined in terms of the chance and extent of an unfavourable impact on financial performance. Risk management is about conscious changes to the spectrum of potential outcomes. Every entity is faced with the trade-off in managing returns and the riskiness of those returns. Companies aim to increase returns without being exposed to additional risk, or to reduce risk without reducing returns. Riskiness in return can be represented graphically as a spectrum of outcomes.

Suppose figure 1 (right) presents the distribution of profit outcomes for a project. The area under the bell-shaped curve represents the total probability of achieving any outcome, and by definition amounts to one. The probability of achieving any particular outcome in a given range of values is equal to the area under the curve between that range of values. Here the graph shows that the chance of an outcome near the expected outcome is much greater than an outcome at extremely low levels (say $7 million) or extremely high levels (say $17 million).

The two collections of extreme outcomes (lows and highs) are termed the tails of the distribution. Which tail is the favourable or unfavourable depends upon the variable being measured. For example, if the variable is profit the unfavourable tail is the left-hand tail, while if the variable is cost the unfavourable tail is the right-hand tail. All at-risk methodologies summarise the distribution of potential outcomes

1. Risk as a spectrum of outcomes
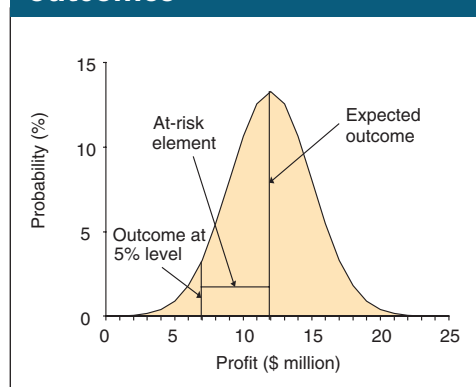
using two components from that distribution. Specifically, the 'at-risk' element is the difference between the expected outcome and the outcome at a defined point in the unfavourable tail, as specified using a particular confidence level. So assuming the cumulative 5% distribution in figure 1 equals $7 million[2], and the expected outcome is $12 million, the above project has an 'at-risk' component of $5 million.

Where the individual at-risk methodologies differ is primarily in the variable being modelled and the source of the variations in the modelled outcomes. These differences are the keys to understanding the related at-risk methodologies.

Value-at-risk

VAR is widely applied to analysing the potential fall in the market value of a portfolio of securities. Specifically, it is the potential loss in market value of a portfolio, as derived from the set of possible price movements in spot and forward prices implied by a particular holding period and confidence interval. A typical confidence interval is 99%. Accordingly, VAR focuses on the spectrum of potential market value outcomes, and the fall in market value implied by the unfavourable tail relative to the expected value.

The sources of risk (the risk factors) for VAR are those spot and forward prices used to value the securities in this portfolio. In estimating the change in value, a time horizon is specified over

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1 PAR, EAR and CFAR are referred to as the alternative at-risk methodologies in this article. There are of course as many at-risk measures as there are performance targets. We have focused on these measures as they appear to be obtaining the widest appeal.
2 The cumulative 5% point corresponds to that value such that the chance of that or any worse outcome is 5%. In other words, the total area occupied by that outcome and any worse outcome represents 5% of the total area occupied by the graph

A. Risk concepts and at-risk measures

Concept	VAR	PAR, EAR and CFAR
Measured variable	Market value (a stock)	Profit, earnings or cashflow (a flow)
Example	The market value of a portfolio of foreign exchange contracts for a trading desk at a bank	The future cashflows from expected gold sales from a gold mine, inclusive of hedging contracts
Representation of risk	Variability in market value	Variability in future profit, earnings of cashflow
Exposures analysed	Portfolio of securities and transactions, including hedge transactions	Future flows resulting from assets and liabilities, and associated hedging contracts
At-risk quantification	Difference between expected outcome and the defined tail event (typically 99% level)	Difference between expected outcome and the defined tail event (typically 95% level)
Source of variation (or risk factors)	Changes in those spot and forward prices used to value the portfolio	Changes in future spot prices used to calculate future profit, earnings or cashflow
Holding period for variation in prices	Typically very short holding periods (days) and shorter than the term of the exposure	Typically very long holding periods (years) and equal to the term of exposure

which the market prices may vary. Because the users of VAR typically operate in liquid markets, the time horizon used to calculate VAR is usually relatively short (often measured in days), representing the period over which prices may move before the net exposures to those prices can be liquidated.

For example, VAR models may analyse the variability over a 10-day period of a five-year forward exchange rate or a five-year swap rate. Of particular note is that the time horizon over which prices are modelled is usually shorter than the term of the exposure being analysed. VAR is widely applied by intermediaries managing trading books in securities and commodities.

Profit-at-risk, earnings-at-risk and cashflow-at-risk

PAR, EAR and CFAR are the result of applying VAR principles to analysing the volatility of financial variables other than market values – namely earnings, profit and cashflow respectively. These measures refer to the variability of flows in current and future periods, rather than the variability of the stock of market value estimated from these flows.

For example, PAR is the potential fall in future profits, relative to the level of expected future profits in that period, as derived from the set of possible future spot prices. In turn, these possible future prices reflect the confidence interval selected and the time horizon required to elapse for the spot price in that period to be observed. A typical confidence interval is 95%. The set of future spot prices reflects the quantitative model used to calculate those prices, including the forward price for that future period.

In contrast to VAR, the conventional application of PAR, EAR and CFAR uses only projected spot prices in future periods as the risk factors. This is because the variable being modelled is usually only affected by variations in future spot prices, with variations in forward prices for that period having no effect on the variable being analysed.

While VAR uses short-term time horizons to model the variations in prices, PAR, EAR and CFAR use longer-term horizons to analyse future spot prices for all future periods where there are net exposures. Accordingly, different time horizons are used within the same model and are typically set equal to the term of the individual exposure being modelled. For example, a PAR model with one- and two-year exposures requires the estimation of spot prices in one and two years' time.

PAR, EAR and CFAR are most often applied by corporate entities modelling their profits, earnings and cashflows in future periods.

Table A (left) provides a comparison of some of the key characteristics of at-risk measures.

Comparison of VAR and PAR estimates

Suppose an entity has a long one-year forward position of 10,000 tonnes of copper. A VAR model, as typically used by a commodi-

B. Criteria for choosing

Criteria	VAR	PAR, EAR and CFAR
Balance sheet	Assets and liabilities are largely comprised of liquid, tradable instruments with transparent pricing	Assets are largely illiquid with opaque pricing
Business planning time horizon	Short- to medium-term	Long-term (10 years)
Internal business value assessment	Market value of balance sheet	Stream of expected future earnings
Income assessment	Mark-to-market	Accrual
Exposure to market risk	Typically incidental to business of acting as an intermediary	Fundamental aspect of the business
Relevant peer group	Banks, asset managers, trading houses, commodity merchants/intermediaries (for example, cotton merchants, energy retailers)	Resource companies, utilities, governments, manufacturers, distributors, agribusiness

ty trader, analyses the variation in the market value of this position over a short-term time horizon. For example, a 10-day holding period examines the variation in the value of the forward price over 10 days, and is therefore driven by the 10-day volatility of the one-year forward price. Assuming a forward price of $1,500 per tonne, an annualised volatility for the one-year forward of 18% and a normal distribution of forward prices, this implies a VAR of $0.888 million for a 10-day holding period and a 95% confidence interval.[3] This means there is a 5% chance that the fall in the market value of the portfolio in 10 days' time will exceed $0.888 million.

A PAR model, as typically used by a corporate, analyses the variation in the future earnings stream over the longer term. As the earnings stream is dependent on the future spot prices, it is therefore driven by the volatility of the spot price when the copper is delivered, for instance in one year's time. Assuming an expected spot price of $1,500 (as per the market forward), an annualised volatility for the spot price in one year's time of 22% and a normal distribution of spot prices, this implies a PAR of $5.249 million for a 95% confidence interval. This means there is a 5% chance that the fall in the earnings relative to the current estimate will exceed $5.249 million.[4] Note that this is much higher than the VAR for the intermediary, because the probability-derived range of spot prices in one year's time is much wider than the range of forward prices in 10 days' time.

Which at-risk measure is right for my organisation?

The example above shows that, while there is considerable similarity in the mathematics used to derive VAR and alternative at-risk measures, the conceptual underpinnings of the risk measures are quite different. An emerging trend is

a clear demarcation between the risk measure adopted by different types of organisation. In particular, many large non-financial companies (corporates) have adopted one of the alternative at-risk measures over more traditional VAR methodologies. While the initial response from many bankers has been that PAR is somehow a 'poor man's' VAR, we would contend that these alternative measures are based on very sound risk management principles. And, from a practical viewpoint, these alternative at-risk measures are better aligned with the performance targets of many corporates and result in a significant improvement in decision-making.

Based on our experience, some of the key decision criteria for determining appropriate at-risk measures are listed in table B (above).

As the table illustrates, it is not whether an organisation is a bank or a corporate that determines the appropriate risk measure – it is the nature of the underlying business's risk and performance characteristics. Despite what we might hear from the purists, there is no single right or wrong at-risk measure. The main focus should not be on the mathematical model used, but on matching the at-risk methodology with an individual entity's underlying risk profile and its own approach to risk. **AR**

Justin Myatt is a former senior vice-president of risk and value advisory business at Zurich Capital Markets in Sydney, Australia. He has also held senior risk advisory roles at PricewaterhouseCoopers and Bankers Trust. E-mail: jmyatt@zip.com.au

[3] Potential fall in market value = tonnage × forward price × volatility × time horizon × normal dist multiplier = 10,000 × $1,500 × 0.18 × (10/250) × 1.645 = $0.888 million
[4] Potential fall in earnings = tonnage × expected spot price × volatility × time horizon × normal dist multiplier = 10,000 × $1,500 × 0.22 ×1 × 1.645 = $5.249 million