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## Value-At-Risk

### The Next 10 VAR Disasters

*Aaron Brown, professor at Yeshiva University, predicts how VAR is likely to be used and abused*

During World War II, England's Royal Air Force was losing too many airplanes as they landed in bad weather. Some physics professors had an idea that might help-microwave glide-path radar. Early results showed that the system was a major aid to pilots. But in a famous test, the system mistakenly tried to land an airplane in the Atlantic ocean, 20 miles from the airfield. It did not help that a skeptical general was observing the test aboard the aircraft.

In the last 50 years, microwave glide-path radar has saved countless lives and airplanes. But it created new kinds of disasters. No human pilot would try to land an airplane in the ocean. New technology is always subject to spectacular disasters-spectacular because they are different from familiar disasters.

The same high-tech problem applies to Value-at-Risk. It is being pushed on just about every derivatives user by the Bank for International Settlements, the Federal Reserve Bank and the Securities and Exchange Commission. Like microwave glide-path radar, it is a useful tool that will prevent many disasters. But before it becomes familiar and well-understood it will land some airplanes under a thousand feet of saltwater. Even if the new system saves 10 airplanes for every crash it causes, the crashes will be remembered far longer than the successes.

Here are some of the mistakes I see just over the horizon.

#### Disaster One: Living By VAR Alone

Inevitably a trader will be asked: "How could you lose \$100 million when VAR was only \$10 million?"

The simple answer is that VAR does not measure the worst-case loss, but the loss you have some specified probability of exceeding. So there will be losses greater than the VAR. Moreover, VAR assumes passive management over short periods. With active management over longer periods, larger losses are possible.

If VAR is part of a well-designed and validated risk management system it should prevent catastrophes. But some institutions are using VAR to replace traditional limits on nominal size, delta and gamma. VAR cannot be used as the sole measure of risk. If it is, aggressive traders will find ways to keep VAR risk within limits while boosting risks VAR ignores.

#### Disaster Two: The Delta Blues

An institution that understands the risk of Disaster One will decide to implement VAR limits and retain its delta limits. But the trader will be unable to meet both limits at once.

This will happen when a company decides to hedge its natural long-term exposure by rolling short-term contracts. In market shocks, short-term volatility increases much more than long-term volatility. VAR increases in proportion to short-term volatility, and VAR limits can be maintained only by reducing position amounts. The market shock will also reduce the correlation between the long-term natural position and the short-term hedge. As a result, the delta limits will demand a larger hedge position just as the VAR limits demand a smaller one.

Traders at Metallgesellschaft hedged long-term oil supply contracts with one- to three-month oil

futures. When oil prices jumped they faced a dilemma. Increasing, or even maintaining, their hedge would cause huge short-term cash losses. Yet reducing their hedge risked even larger long-term losses.

The problem is that VAR looks at the short-term risk of an unmanaged position, while delta considers the long-term economic fundamentals. In a market upheaval, these usually point in opposite directions. It is analogous to a traffic emergency. The VAR philosophy, since it is computed on an unmanaged position, assumes you cannot steer. Therefore, it always recommends hitting the brakes. Yet in some situations, accelerating gives you more control over the car. The only solution, in finance and driving, is to have a strategy for dealing with emergencies. Either try to steer your way out or shut your eyes, hit the brakes and hope for the best. But don't try both at once.

#### **Disaster Three: The Chicken Little Syndrome**

A corporation will see VAR rising for several weeks before a major loss. The officers will be criticized for doing nothing to stop the rise. One business magazine will call it "Asleep at the Switch," while another will scold "Fiddling While Rome Burns."

When VAR rises, responsible managers will determine whether the cause is internal or external. They will alert key personnel, clarify lines of authority and verify reporting systems. They may increase liquidity or eliminate speculative positions. One thing they should not do is insist on a reduction in VAR.

Consider two investors, A and B, in an S&P 500 index fund. A invests a constant amount, while B maintains a constant VAR. A never buys and sells, while B moves some funds to money markets when market volatility is high and margins up when volatility is low. If A and B maintain the same average investment, B will have 25 percent more standard deviation of long-term return. Once VAR goes up, it is too late to get out by blindly slashing positions.

#### **Disaster Four: Jumping Ship Too Soon**

A CEO, frightened by rising VAR numbers, will order VAR reduced-by slashing positions. VAR may be reduced in the short term, but it may not stay down as the reduced portfolios are managed.

There are times to reduce VAR as a long-term strategy, but not as a reaction to yesterday's market movement. You can reduce the VAR limit of each portfolio segment, but this works only if the segments are highly correlated or if losses are "leptokurtotic," that is, if big losses result from disasters in one segment rather than the cumulative effect of smaller losses in many segments. Both of the above situations, however, are undesirable.

Sensible reduction of VAR is a subtle, long-term process. It requires understanding the rationale of each segment of the portfolio and how the segments fit together. And getting from a \$10,000,000 to a \$5,000,000 VAR may require a temporary stopover at \$15,000,000 VAR.

#### **Disaster Five: The Mirror Has Two Faces**

A corporation will try to compute VAR on its financial portfolio combined with the underlying hedged assets and revenues, a common approach. But it will still be surprised unexpectedly by market crises-and will hear alarm bells when things are OK.

How could this happen? A company may hedge long-term Deutsche mark (DM) revenues by using rolling short-term futures contracts. Reported VAR will be small since the corporation regards any losses in the futures position to be offset by corresponding gains in their natural position. Reported VAR will thus give no indication of short-term risks; therefore the corporation will have no warning of market crises.

Small changes in the relative shapes of the U.S. dollar and DM yield curves will cause VAR to increase sharply, however. VAR will ignore the true risks but set off alarm bells for phantom risks.

#### **Disaster Six: The PR Problem**

Another corporation that understands the problem of phantom risks will compute VAR only on its

derivatives portfolio. This too will turn out badly.

At first, the CFO of this corporation will consider VAR a valuable tool for measuring liquidity and capital risk. VAR will give early warnings of portfolio problems and market crises, and it will make it possible to compute the risk-adjusted costs of various hedging strategies.

But other people will be horrified that VAR is larger than net income or even stockholders' equity. The CFO will appear to be risking the financial stability of the company on derivatives bets. When VAR goes up, analysts will ask how the company will reduce it. They will be shocked to learn that there will not be a reduction. The result: an investor-relations fiasco.

The truth is that many corporations are already uncomfortable with derivatives reporting. Asking them to mark positions to market is like asking a shy person to take off his shirt in public. VAR is like asking them to get naked.

#### **Disaster Seven: The Double Whammy**

The managers of a bank will implement VAR on their trading portfolios but not on their hedge portfolios, another common practice. The bank will thus set itself up for a double disaster.

Hedge portfolios contain deals done with customers partially offset with marketable positions taken to reduce risk. Proprietary trading portfolios are run for speculative profit. The customer portion of the hedge portfolio cannot be managed. The bank must quote prices and allow customers to cash-out in any market but cannot ask its customers for these courtesies. In a market emergency, the customers will be trading frantically and the bank may not be able to lay off risk at a reasonable price. The VAR of the hedge portfolios will balloon.

At the same time, the VAR of trading portfolios will increase because of increased volatility. Proprietary traders will have to reduce positions. There is a 50-percent chance that the forced reductions will be contracts that would have offset the risks of the hedge portfolios.

Suppose, for example, that interest rate volatility increases and the bank's customers want to avoid floating rate payments. They cash out of their fixed-for-floating swaps and buy new floating-for-fixed swaps. The hedge portfolio finds itself long interest rates; it loses money if interest rates increase. But the yield curve has steepened and bid/ask spreads have increased, so this risk cannot be reduced without losses. Meanwhile, the proprietary traders have correctly foreseen this steepening and are short interest rates. This is a natural hedge for the bank. But the increase in interest rate volatility forces proprietary traders to liquidate this position.

The final result: interest rates go up. The hedge portfolios lose because they couldn't lay off risk from customer trades. Proprietary traders have no profits, because they sold the positions that would have offset the hedge portfolio's losses.

#### **Disaster Eight: Too Much See, Not Enough Saw**

Another bank will realize the risk of Disaster Seven. It will implement VAR on its trading portfolios and hedge portfolios combined. Proprietary trading profits will plummet.

Why? In normal markets the trading portfolio will have most of the VAR, but in a crisis hedge portfolio VAR will increase. If VAR limits are to be maintained, the proprietary traders will effectively be enlisted to hedge the hedge portfolios. Proprietary traders do not earn bonuses in quiet markets. They need risk to make money. Tying their hands in violent markets eliminates most of their opportunities for profit.

It may seem that corporations and banks are damned if they do and damned if they don't. This is not the case. Different systems for VAR computation can make sense as part of overall risk management plans. But a strategy must be set in advance to manage limits under all conceivable market scenarios. Otherwise, VAR can end up reducing profits and increasing risk.

#### **Disaster Nine: Enter the lawyers**

A stockholder will file suit over VAR. The suit may allege that management misrepresented risk by disclosing a small VAR, or concealed risk by not disclosing a large VAR. Management could be accused of negligence for ignoring VAR, for relying on VAR or for not computing VAR at all.

VAR, like any other useful number, is a compromise between what we want to know and what we can measure accurately. We would like to know the actual probability of worst-case losses. But catastrophic losses are too rare, and active portfolios are too complicated, to be analyzed reliably. So we settle for VAR and hope it indicates the overall level of risk.

Implementations of VAR often make adjustments to make it closer to a worst-case loss number. Conservative assumptions may be made about correlations and volatility changes. Statistical methods that weigh extreme events too heavily may be chosen.

On the other hand, VAR computations often include assumptions that tend to reduce the reported number. Volatilities and correlations may be considered constant. Skewness and kurtosis may be ignored. Illiquid securities may be modeled as actively managed portfolios of liquid securities. Certain types of risk and certain portfolios may be excluded from VAR.

The result is a number that is different from VAR computed by any other institution. It will not correspond to the technical definition, nor will it be the worst-case number many people will think it is. In some market scenarios it will overstate risk, while in others it will understate risk. A good lawyer can make any of these assumptions or adjustments look like management manipulation.

Board and management responsibility for derivatives risk is an unsettled area of law. VAR was originally designed outside the framework of existing legal theory, and then was suddenly thrust in the middle of it by regulatory agencies. Is management responsible for maintaining a stable VAR? Keeping VAR low? Fully disclosing VAR? Acting on VAR information? Understanding VAR? Ensuring VAR is accurate? Ensuring VAR is conservative? Nobody knows, but it will be expensive to find out.

#### **Disaster Ten: The Next Generation**

Disasters One through Nine will pave the way for a new risk measure, premium- equivalent (PE). A reinterpretation will show that every trader who was good under VAR is now terrible and the people who flopped under VAR really were great.

Say you want to know the risk of your house burning down. Statisticians tell you to survey 1,000 similar houses. Finance professors tell you to get a fire-insurance premium quote. Statistical methods estimate probabilities by sampling. Financial methods determine how much someone would charge to assume the risk.

Five years ago, financial measures such as option-adjusted spread were popular. They depend only on observable prices, not guesses about probability distributions or time series properties. They give precise answers; two people with the same complete price data should give the same financial risk measures. Also, financial risk measures can be added across portfolios. The risk of a portfolio is the sum of the risks of its parts.

Financial risk measures do not measure the probability of risk directly, however. Large risks with zero betas will not show up because one theoretically could get someone to accept this risk for nothing. Also, they only measure what the market "thinks." Many regulators are concerned about what happens if the market is wrong.

Statisticians fought back with VAR and similar schemes. Compared with financial measurements, these encourage high beta risk, doing what everyone else does. VAR assigns equal risk to being long or short the S&P 500 while financial measures assign a higher risk to being long. The statistician will argue that the probability of short-term losses for both the long and short positions are equal. The finance professor will argue that there is unlikely to be a liquidity crisis if the stock market goes up sharply.

Both arguments have some truth to them, and sensible risk management policies have always combined both approaches. But regulators have their fads and fashions. Today's wisdom rewards those who follow the crowd; tomorrow's wisdom may celebrate the contrarian.

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