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Value at risk

New tool focuses the hunt for built-in risk

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Value at risk came into prominent use by banks and financial institutions in the 1988-96 period. That's when Bank for International Settlements (BIS), Basel, Switzerland, developed a system of capital requirements for the trading risks of banks and securities firms.

The document outlining the system, known as the Basel Accord, allows for a standardized approach to defining capital needs as percentages of holdings of different assets, reflecting the inherent volatility of those assets. However, the accord's requirements did not recognize the hedging or diversification that might exist in a bank's portfolio.

As a result of opposition from globally diversified banking organizations, the Basel Commission on Banking Supervision allowed an alternative approach, which would require the

(continued on page 4)

Inside this issue

Editorial: The right questions 2
by Robert D. Shapiro

Op-ed: Growing with change 3
by William C. Cutlip

EIPs explained
The cure for our savings problem? 6
by Richard D. Farrell

Hot product group gets scrutiny ..6
by Donna R. Claire

Consulting via the Web 8
by Paul Polchert

Part 2: "What is an actuary?" 10
by David M. Holland

The complete actuary: *The Actuary's Career Planner* 12
by Michael M. Braunstein

SOA team visits Asia 14
by David M. Holland and Yuan Chang

E&E conversion rules 16
by Linda Heacox

Letters to the editor 22

Puzzle 24

VaR: The world is watching

by Selig Ehrlich
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It's not often that a risk measurement methodology gets a mention in a publication like *Business Week*. But an article on value at risk (VaR), a set of such methodologies, rated two pages in the July 14 issue — a sign that the business community sees this tool as something dramatically new and different.

According to *Business Week*, European banks are now allowed to base their capital requirements on VaR calculations. In the United States, the Federal Reserve is considering accepting VaR measurements as well. Canada's banks generally use VaR for managing trading risks. The *Business Week* story noted that "VaR is expanding in two dimensions: It's being used for risks other than market movements ... . And it's being used by people other than traders, ... even CFOs at nonfinancial companies."

In fact, the concepts behind value at risk, another term for capital or risk exposure, go back a century or more and parallel analyses that actuaries have done for years. As such, VaR and other emerging risk measurement methodologies will be the topic of an SOA conference, "Integrated Approaches to Risk Measurement in the Financial Services Industry," Dec. 8-9 in Atlanta, Ga. (See story, page 5.)

The accompanying story takes a close look at VaR from an actuarial perspective.

Value at risk (continued from page 1)

building of large computer models of the bank's portfolios. The models could recognize diversification and hedging and would be subject to standards set by the commission. The standards relate to the quality of the models used (including "stress testing") and the integration of the model into daily management procedures.

In 1995, the G-10 countries (the world's major economic powers) carried out a study on the size of their derivatives markets. It was estimated that — based on the underlying values — the total amount of outstanding currency derivatives was $13 trillion, the amount of interest rate derivatives $26 trillion. The daily traded volume of currency derivatives in April 1995 was estimated at $15 billion, and of interest rate derivatives $7 billion. This information was presented by BIS in its May 1996 report, "Central Bank Survey of Foreign Exchange and Derivatives Market Action." The size of the derivatives markets underline the importance of value at risk (VaR) models.

VaR modeling

Most VaR discussions relate to various aspects of building and implementing such models. The models typically incorporate statistical models of short-term interest rate, stock price, and exchange rate movements. Because of the size of asset portfolios, the relationship of derivative securities to the underlying assets, and swap and other arrangements (that have a zero value when initiated), the actual computer implementation is technically very complex. Key questions center on what kind of approximations can be used without causing a significant error.

In the simplest form of a statistical model, the changes in asset values are assumed to follow a multivariate normal distribution. Actuaries will immediately recognize deficiencies in this model when considered for possible application to insurance risks. Skewed returns are not reflected, since only mean variance and correlations are used. Also, correlation is not adequate to recognize nonlinear relationships between assets — for example, between a stock and a put option on the same stock.

The ultimate object of the VaR exercise is to determine the distribution of aggregate losses and to determine the amount of capital required so that the probability of the capital disappearing is small (for example, 5% and 1%, corresponding to the 95th and 99th percentiles).

Actuaries will recognize that this is, in its most basic form, one of the fundamental questions of actuarial science for more than a century: How much capital is required to keep the insurance company solvent with high probability over some time period? For actuaries, the time period was typically one year, five years, or infinitely long.

Differences

While theoretical similarities exist, how might VaR analyses differ from the types of analyses actuaries perform to deal with classic insurance solvency investigations?

One key assumption in actuarial insurance theory is that insurance risks are usually assumed to be independent of each other. This means a loss on one policy does not influence the probability or size of loss on other policies. The extent to which this assumption is violated is not significant in life insurance; for example, it's rare that one death is the cause of another. However, it may be significant in health insurance, where a common cause — inflation, for example — can affect the losses in all individual policies. The assumption of independence reduces correlations to zero, thus simplifying the problem for actuaries in insurance. In the VaR banking application, security and derivative prices may be highly correlated (sometimes positively and sometimes negatively).

Another difference is that distributions of insurance losses are usually highly skewed. Unless this is accounted for explicitly in VaR, simple properties of distributions, such as the multivariate normal, cannot be used. There has been a lot of evidence of heavy tails and of heteroskedasticity (variation in volatility over time) in stock price returns. When this is taken into account, the VaR problem becomes much more challenging, particularly in view of the dependence between risks. That's why extensive literature has appeared recently on VaR modeling using such models as ARCH, GARCH, and EGARCH (autoregressive conditional heteroskedastic; generalized ARCH; exponentially generalized ARCH).

Another difference is the time horizon. For managing trading risk using VaR, a time horizon (or "holding period") of up to 10 days is typically used, while time horizons for insurance risks are usually measured in years. This extreme time difference alters the focus of risk measurement and management. Because trading positions can change dramatically within minutes, it is important for financial institutions to monitor portfolios for their immediate risk exposure. In contrast, insurance portfolios are not actively traded, and they change slowly as events (e.g., death, disability, hurricanes, and earthquakes) occur. Risk is modified through reinsurance and trading blocks of insurance business. Security and derivatives trading, however, needs daily portfolio monitoring because of the almost-instantaneous impact and reaction of markets and because traders might be tempted to take major exposures to gain profits. In insurance, risk exposure is typically reviewed annually.

Another key difference from classical VaR for the actuary in insurance is the interaction between valuation and capital needs. In the financial marketplace, security values are largely given based on trading information. The only concern is the fluctuation in these values. In insurance, the values of the relevant securities (i.e., insurance contracts or policies) are not given. The insurer performs a "valuation" to determine the value of the insurance liabilities. This value typically (explicitly or implicitly) contains safety margins that are subjectively determined to reflect the uncertainty in the

"assumptions," an uncertainty often referred to as parameter risk. So uncertainty is separated into (at least) two parts: parameter risk and random fluctuation. One part is reflected in the "values," the other in the capital. In VaR, the values are given. Concern is with the fluctuation in these values over a short time period. Since all forms of uncertainty are wrapped up in the value of the security, the key question relates to the movement of these values. The focus of research and development is on getting better models of such movement.

The future

Is there a future for VaR in dealing with longer horizons or other types of risk such as insurance risks? Clearly the answer is "yes," since the fundamental underlying questions are the same. Extending VaR to the longer term is the subject of much research. This parallels the movement of actuarial risk theory from the infinite horizon to finite horizons of, say, five years.

There is also the issue of approach. Actuaries have developed cash flow testing methods in which economic scenarios are analyzed to identify which would threaten the company. This is a kind of plausible "worst case analysis" without any formal probabilities attached to the scenarios. (These methods include dynamic solvency testing, capital adequacy testing, dynamic financial testing, and dynamic financial condition analysis.)

On the other hand, VaR immediately attempts to get the entire distribution of losses without identifying scenarios. The probability associated with any scenario can be obtained from the model.

Supplementing VaR with scenario analysis is a hot topic today among researchers. Actuaries also have been working on determining the exact distribution of losses over a fixed time period and studying the distribution of losses and the "probability of ruin" using complex probabilistic models.

Security analysts around the world are closely following the developments in the field of risk management models. Analysts expect to find a positive correlation between the implementation of sound risk management concepts and the value of the share price of the firm implementing such procedures.

What is the future for VaR? More research is important. There are a wide range of interesting topics waiting for a closer look.

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Integrated approaches to measuring risk is topic of December SOA conference

Recognizing the needs of today's financial services industry, the Society of Actuaries is sponsoring a conference to compare, contrast, and propose various approaches to risk measurement.

The one-and-a-half-day conference, "Integrated Approaches to Risk Measurement in the Financial Services Industry," will be held Dec. 8-9, 1997, in Atlanta, Ga. The conference is especially timely in light of the U.S. Securities and Exchange Commission's recent issuing of market risk disclosure rules.

As consolidation in the industry continues, risk measurement and management practitioners will need to develop a common terminology and methodology while also recognizing the inherent differences between classes of risk. The SOA conference is designed to raise dialogue on important issues and encourage further research into integrated approaches.

Guest speakers represent both industry and the academic community. Speakers include:

- Philippe Artzner, professor of economics and management, Institute of Advanced Mathematics, Louis Pasteur University, Strasbourg, France
- Paul Embrechts, professor of mathematics, ETH (Swiss Federal Institute of Technology), Zurich
- Thomas S.Y. Ho, executive vice president, BARRA-GAT Inc., New York, and former professor of finance at New York University's Stern School of Business
- Thomas J. Linsmeier, assistant professor of accountancy, University of Illinois at Urbana-Champaign
- Liam Mason, vice president, Risk Management Research Group, J.P. Morgan Securities, Inc., New York
- William Panning, executive vice president, Advanced Risk Management Services Division, Willis Coroon, Nashville, Tenn.
- Peter Zangari, vice president, Risk Management Research Group, J.P. Morgan Securities, Inc., New York

Early registration fees are $600 for members of any actuarial organization and $650 for nonmembers. Members of the SOA Investment Section can attend for $550 because the Section is cosponsoring the conference. All fees are $50 higher for registrations postmarked after Nov. 17, 1997.

Details and a brochure are available from the SOA Continuing Education Department (phone: 847 / 706-3545; fax: 847 / 706-3599; e-mail: *sberg@soa.org*).

The brochure also can be downloaded from the SOA Web site (go to Continuing Education), and a special page will give updates about the conference (go to Research). The Web address is *www.soa.org*.