Efficient calculation methodologies for Value at Risk (VaR) measure: A comparative study for the Indian and US financial markets

Authors:

Puneet Prakash
Assistant Professor
Department of Finance, Insurance and Real Estate
VCU, School of Business
Richmond, VA 23284
Email: pprakash@vcu.edu
Ph: (804)-828-7180, Fax: (804)-828-3972

Raghu Nandan Sengupta[1]
Assistant Professor
Industrial and Management Engineering Department
Indian Institute of Technology Kanpur
Kanpur-208016, UP, INDIA
Email: raghus@iitk.ac.in
Email: raghunandan.sengupta@gmail.com
URL: http://www.iitk.ac.in/ime/raghus/index.htm
Ph:+91-512-259-6607, Fax: +91-512-259-7553

[1] Corresponding Author.

Efficient calculation methodologies for Value at Risk (VaR) measure: A comparative study for the Indian and US financial markets

Abstract

Recently we have seen financial markets have been increasingly exposed to both exogenous and endogenous shocks. Hence one of the most exciting work has been predicting these financial shocks and estimating the „Srisk exposure„S faced due to these instabilities. Rather than forecast the exact time for the financial volatility, stress is laid more on the prediction of the 'risk exposure' and how it can be accurately measured. One of the most extensively used models to evaluate this 'risk exposure' is the well known 'Value at Risk (VaR)'. The universal appeal of VaR as the risk measure for financial institutions (FIs) throughout the world has been due to its simplicity in implementation and ease in the data collection. Yet, recently the choice of VaR as an universal metric for risk measure has been put to the spotlight as it has some fundamental drawbacks like (i) non convexity; (ii) non-linearity; (iii) difficulty in estimating the correlation structure between different financial assets (as independent and constant values of variances is practically not feasible), constituting the portfolio for which we are interested in calculating the VaR; (iv) non-normality of returns of financial assets; (v) non-sub-additivity; etc. Added to that, some recent noteworthy milestones like (i) advances in mathematical and statistical techniques; (ii) availability of enormous computational power and (iii) regularity of occurrence of financial losses, have posed serious questions about the efficacy of using VaR, to both theoreticians as well as practitioners in the financial world. In order to measure risk more accurately we have recently come up with other different risk measures such as, (i) conditional value at risk (CVaR); (ii) expected regret (ER); (iii) expected shortfall (ES); (iv) worst conditional expectation (WCE); (v) tail conditional expectation (TCE); (vi) tail mean (TM); etc. One can refer to Artzner, et al. (1999); Dowd (1998); Duffie and Singleton (1997); Gordy (2002); Jorion (1996); Jorion (2000); and Szego (2002) to get a good idea about different risk measures for different types of risk and their respective properties. The financial sector reforms in India in the nineties have opened up the financial markets to competition. Undoubtedly India now has a world class infrastructure in equity markets, debt markets and banking, but along with this, FIs have also being exposed to a whole gamut of financial risks, like, (i) currency risk; (ii) credit risk; (iii) market risk; (iv) operational risk; (v) foreign exchange risk; etc, which were not of much consequences prior to the nineties. Added to that, the introduction of different type of derivatives in the Indian market has also opened up many avenues of investments for different players in the Indian financial markets, be it the FIs; investors; foreign financial institutions (FIIs); companies; etc. Hence in order to manage its operations it is incumbent for these players to implement different metrics of risk evaluation depending on the exposures they anticipate or face.

In the first step, we determine the analytical VaR as expounded in Jorion (2000). The normality assumption is critical for applying this technique. To achieve normality, we apply a sequence of transformations to a non-normal variable. This technique has also been applied in the Indian context by Samanta (2005) to Indian stock market data. We go one step further and in order to determine the VaR for the original variable, we apply the inverse of the original transforms in reverse order. We demonstrate this technique to a firm's default risk obtained from the Merton (1974) model for a U.S. firm. In the next step we apply it to the Indian context. We use the managerial science framework expounded in Nerkar and Paruchuri (2005) and Paruchuri *et al* (2006) to theorize about the subject firm's probability of default.

Reference

Artzner P., Delbaen F., Eber J.M., and Heath D. (1999). Coherent measures of risk. Mathematical Finance, 9(3), 203–228.

Dowd, K.(1998): Beyond Value-at-Risk. *Wiley, New York.*

Duffie D. and Singleton, K.J. (1997): An Econometric Model of the Term Structure of Interest-Rate Swap Yields. *The Journal of Finance, 52(4), 1287-1321.*

Gordy, M. (2002). A risk factor foundation for ratings-based bank capital rules. *Finance and Economics Discussion Series No. 55, Board of Governors of the Federal Reserve System.*

Szego, G. P. (2002). Measure of Risk. Journal of Banking and Finance. *1253-1272.*

Jorion, P. (1996). Measuring the risk in Value-at-Risk. *Financial Analysts Journal, 52 (6), 47-56.*

Jorion, P. (2000). Value at Risk: The New Benchmark for Managing Financial Risk, 2nd Edition, *McGraw-Hill.*

Merton R. C (1974): On the Pricing of Corporate Debt: The Risk Structure of Interest Rates. *Journal of Finance, 29, 449-470.*

Nerkar, A. and Paruchuri, S. (2005). Evolution of R&D capabilities: The role of knowledge networks within a firm. *Management Science, 51, 771-785.*

Paruchuri, S., Nerkar, A., and Hambrick, D.C. (2006). Acquisition Integration and Productivity Losses in the Technical Core: Disruption of Inventors in Acquired Companies. *Organization Science, 17, 545-562.*

Samanta, G.P. (2005): On the new transformation based approach to value at risk: An application to Indian Stock Market. Working paper, Indian Institute of Technology, Mumbai, India.