Chapter 3

The Present State of Art

3.1 Major Directions of Research

A vast literature has evolved regarding different risk measurement and management with competing theoretical framework. After the implementation of Basle Accord, which makes the firm-level risk management mandatory, the necessity was felt by the regulatory authorities of different countries to enforce prevention of bankruptcy and excessive volatilities by VaR-based compliance method. There has been surge of new methods of risk measurement and corresponding empirical applications. Many studies evolve around comparative performance of historical simulation and variance-covariance approaches under normal distribution assumption. Some studies examined the evolution of VaR models along with their comparisons. Some empirical studies attempted to compare variance–covariance method and Monte Carlo methods when the distribution is non-linear. Studies also exist on examining the forecasting ability of a VaR model based on extreme value theory (EVT). Furthermore, there are several studies on various Auto regressive Conditional Heteroskedasticity (ARCH) models and generalized Auto regressive Conditional Heteroskedasticity (GARCH) models. In case of
EVT methods, there are studies on Generalized extreme Value (GEV) distribution, Generalized Pareto Distribution (GPD), and the tail index estimator. There are also studies in respect of backtesting of the VaR models. A brief review of those methodologies is enumerated below.

3.2 Theoretical Researches/Innovations

The initial attempt was taken by J. P. Morgan who pioneered a firm-wide Value at Risk system during the 1980’s; the Bank’s staff developed an internal system that would measure risk in response to the Chairman’s demand to be daily updated of the likely loss exposure for the next 24 hours. This report combined P&L and VaR numbers with comments from the treasury group and was submitted daily at 4.15 PM to the Chairman. The measure was based on Standard Portfolio theory and utilized value at risk as a measure (Dowd\textsuperscript{10}, 2005a). Conceivably, the finest of VaR system is the J.P. Morgan Riskmetrics\textsuperscript{11} System. However, other systems were also noteworthy and financial institutions were competing with each other to create the benchmark system. VaR systems were rapidly adopted among different financial and non-financial institutions: pension funds, investment and commercial banks, and mutual funds. The VaR approach was considered as a simple, interpretable measure of risk, consistent with the MPT (Modern Portfolio Theory) and focuses on normal market conditions which assume that returns are normally

\textsuperscript{10} Dowd, K., 2005a. Measuring Market Risk, John Wiley & Sons Ltd.

distributed. In spite of this, in 1993 Thomas Wilson a project manager for McKinsey and Co. presented the first thorough description of VaR measurements to be utilized on trading floors. He developed a more sophisticated VaR method based on stochastic covariance; instead of using the common normal distribution he incorporated the t-distribution, which has fatter tails (In, Holton\(^\text{12}\), 2003).

In an attempt to develop and promote VaR measures and establish their method as the industry standard, J.P. Morgan unveiled their Riskmetric system to the public in October 1994 and made it available without charge via the Internet. Their linear VaR measure was not as sophisticated as the other VaR measures; but it greatly publicized the use of VaR, particularly for those who were not able to build their own; and increased knowledge about the establishment and operation of VaR techniques. While discussing the development of VaR, it is worth mentioning the origins of its name: during its development in the 1990’s, similar names were used such as ‘dollars-at-risk’ (DaR); ‘capital-at-risk’ (CaR); ‘income-at-risk’ (IaR); ‘earnings-at-risk’ (EaR); and ‘value-at-risk’ (VaR); because of the publicity of VaR that Riskmetric attracted to this name, the others fell out of use. (Holton\(^\text{13}\), 2003)

Further, there is development of other models like Historical Simulation and Monte Carlo methods which takes care of non-linearity which violates basic assumption of conventional Variance Covariance

---


\(^{13}\) Ibid.
method. The pioneering work is of the work of Allen\textsuperscript{14} (1994) which evolves around comparative performance of historical simulation and variance-covariance approaches under normal distribution assumption. Furthermore, here are a variety of ARCH models like as generalized ARCH (GARCH) of Bollerslev\textsuperscript{15} (1986), exponential GARCH (EGARCH) of Nelson (1991), and threshold GARCH (TGARCH) of Glosten, Jaganathan and Runkle\textsuperscript{16} (1993). Hill\textsuperscript{17} (1975) developed a nonparametric EVT method and dwelt on the methodological issues of this method, which is known as Hill method.

3.3 Empirical Studies – General

There is a plethora of empirical works the results of which generate further development of the existing models on a continuous basis. Crnkovic and Drachman\textsuperscript{18} (1995) developed a metric for comparison between standard variance-covariance method and historical simulation approach. The work of Beder\textsuperscript{19} (1995) dwells on eight common VaR methodologies and their comparative performance. The gradual evolution of VaR models along with their comparisons was

\textsuperscript{14} Allen, M. (1994), "Building a Role Model", Risk, 7, 73-80


\textsuperscript{16} Glosten, L. R., R. Jaganathan and D. Runkle (1993), "On the Relationship Between the Expected Value and the Volatility of the Nominal Excess Return on Stocks", Journal of Finance, 48, 1779-1801.

\textsuperscript{17} Hill, B.M. (1975),"A Simple General Approach to Inference about the tail of a Distribution", Annals of Statistics, 19, 1547-1569.


chronicled by Hendricks\textsuperscript{20} (1996), and Dave and Stahl\textsuperscript{21} (1997). Jamshidian and Zhu\textsuperscript{22} (1996, 1997) mainly focused on non-linear positions (such as options) with the result showing the proficiency of Monte Carlo methods over variance-covariance approach. There is a noteworthy work by Zangari (1996). Schinassi\textsuperscript{23} (1999) studied that VaR models are dependent on historical relationships between price movements in many markets and they tend to break down during times of stress and turbulence when there are structural breaks in relationships across markets. Danielsson and Morimoto\textsuperscript{24} (2000) have examined the forecasting ability of a VaR model based on extreme value theory (EVT) in capturing the Japanese market risk. The work of Danielsson\textsuperscript{25} (2000) dwells on the predictive performance of various GARCH models and also the EVT method. EVT models, which use the statistical techniques for studying extreme events, and are accepted as a significant tool for capturing extreme price movements at the time of financial crisis. Embrehcts, Klüppelberg and


\textsuperscript{21} Dave, R. and G. Stahl (1997), "On the Accuracy of VaR Estimates Based on the Variance-Covariance Approach", \url{http://www.olsen.ch/research}


\textsuperscript{25} Danielsson, J. (2000), "The Emperor has No Clothes: Limits to Risk Modelling", London School of Economics, \url{http://www.risk.is}. 

36
Mikosch 26 (1997) and Diebold (2000) worked towards critical evaluation of EVT models. Christoffersen 27 (1998) evaluated backtesting based on confidence interval. There are studies on the three most popular EVT models, namely, generalized extreme value (GEV) distribution, generalized Pareto distribution (GPD), and the tail index estimator. In GEV approach, various different parametric distribution functions that aim to model the tail behaviour of return distributions are tested. Longin 28 (1996) and Ho (2000) used that approach in modeling the risk forecasts. In GPD approach, the tail behaviour of a return distribution over a high threshold is modeled using a Pareto distribution. The work of Neftci 29 (2000) is an application of this approach. Several studies have emerged in recent times to analyse the extreme variations that occur in financial markets mainly because of currency crises, stock market crashes and large credit defaults. There also exist studies analyzing the tail behaviour of financial series. These are undertaken by Koedijk, Schafgans and de Vries 30 (1990), Daracogna, Muller, Pictet and de Vries (1995), Loretan and

Phillips (1994). Among plethora of studies on this issue only a brief literature survey is provided here. The broad contours of related literature are provided here.

3.4 Indian Context

In Indian context, some remarkable studies have so far been undertaken with a few work on EVT. Srinivasan, Shah, Ganti and Shah\textsuperscript{31}, (2000) described Value at Risk (VaR) as a popular measure of the financial risk of a portfolio though the computational cost involved is pointed out as one of the drawbacks of the method. They proposed that computational geometry techniques can be used, in particular, range search, to obtain significant increases in speed for a particular class of VaR problems. Sarma, Thomas and Shah\textsuperscript{32} (2000) described as Value at Risk as a widely used tool for measuring the market risk of asset portfolio and evaluated performance of a few alternative VaR models, using India's Nifty stock market index as a case study. They adopted a bi-direction approach i.e., statistical model selection and model selection based on a loss function. Dharba\textsuperscript{33} (1999) presented a new method for computing the VaR for a set of fixed-income securities based on extreme value theory that models the tail probabilities directly without making any assumption.


about the distribution of entire return process. Nath & Reddy\textsuperscript{34} worked on foreign exchange market in India and studied various VaR methods using the Rupee-Dollar exchange rate data to understand which method is best suited for Indian system. Varma\textsuperscript{35} (1999) empirically tested different risk management models in the Value at Risk (VaR) framework in the Indian stock market with special emphasis on EWMA model and GARCH-GED specification. Samanta & Nath\textsuperscript{36} (2003) studied three categories of VaR methods, viz., Variance- Covariance (Normal) methods including RiskMetrics, Historical Simulation (HS) and Tail-Index Based approach.

Raina & Mukhopadhyay\textsuperscript{37} (2004) find out optimal allocation of a unit capital between the portfolio elements so as to maximize VaR. The algorithm has been validated using a three-asset portfolio example. Samanta G.P. and Thakur, S.K.\textsuperscript{38} (2006) assess the accuracy of VaR estimates obtained through the application of tail-index. The data base consists of daily observations on two stock price indices. BSE Sensex and BSE 100 from 1999 to 2005. Results

\textsuperscript{34} Nath, Golaka ; Reddy, Y. V. (2003). Value at Risk: Issues and Implementation in Forex Market in India : November, pages 26 ; www.nse-india.com
show that tail index based methods provide relatively more conservative VaR estimates and have greater chances of passing through the regulatory backtesting.

3.5 Summary

The brief survey of the existing literature highlights the fact that while increasing number of researchers are being undertaken in the Indian context, which are mostly on VaR methods, there remains an utmost need of further researches to complement the existing ones given the complexities of multiple risk dimensions in the contemporary financial functioning. This study covers market risk dealing with different VaR methods, credit risks involving credit ratings methods and extreme value theory, focusing of Peak Over Threshold (POT) method in the Indian context. For all these three types of risk applications, Indian firm level data have been considered. A critical evaluation and assessment of all these risk management techniques in the Indian context addresses the lacuna in the existing literature and thereby contributes towards it.