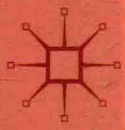
DEVELOPMENTS IN MEAN-VARIANCE EFFICIENT PORTFOLIO SELECTION

MEGHA AGARWAL



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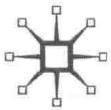

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Foreword

Mean Variance efficiency has been the most popular portfolio selection criterion ever since its discovery by Markowitz (1952). Since that time, this criterion has been much appreciated by both practitioners and academicians. *Developments in Mean Variance Efficient Portfolio Selection* tracks the advances made to this renowned criterion. It provides a thorough summary of the results and issues while addressing the concerns of present day investors. Building on the classical quadratic programming portfolio selection model, the book contributes to the area of portfolio modelling by adding multiple constraints to the mean-variance efficiency criterion and supporting the methodology with new empirical investigations.

The book includes a most comprehensive review of existing theories and empirical studies on portfolio selection starting from Markowitz, Sharpe, and Ross, and then building to the Fama and French model and current research. Desires and needs of the investor are also modelled into the general quadratic programming framework. Constraints are included to include accounting variables as well as market-based indicators. In addition to meeting these constraints, the model then ensures that the resultant portfolios are efficient in the Markowitz sense, producing maximum returns for a given level of risk.

The proposed model is tested using data from two prominent global stock exchanges: the London Stock Exchange and India's National Stock Exchange. Sophisticated statistical software such as SPSS, E-views, and the optimisation software Lingo are used in this empirical testing of the model. Moreover, exhaustive and updated databases, such as Thompson Reuters Eikon and the Centre for Monitoring India's Economy's Prowess, have been used for the purpose of data collection. Using these resources, the book provides a detailed comparison of the performance of model with the existing Markowitz efficient frontier in terms of risk, return, and portfolio utility. Forward tests are also conducted on the portfolios to confirm their robustness.

A key strength of the book is its addressing the limitations of current portfolio selection models in accommodating the multiple objectives of the investor while maintaining a mean-variance efficient portfolio. The book elaborates on the practical equity portfolio creation process, thus reducing the gap between theory and practice. The model then

can actively assist both individual and institutional investors in making rational and systematic investment decisions.

The book provides a solution to the problems faced by investors by consolidating into the model many constraints faced in creating an optimal portfolio in practice. By placing the analysis in the context of the literature and global events, the book appeals to both current and future interests, especially in light of the global recovery from recession. The creation of balanced portfolios is important not only to the retail investor but also to brokerage houses, market participants, finance students, research scholars, and the market at large. All can benefit from the lessons and analysis described in this comprehensive study of the topic.

JOHN R. BIRGE
Jerry W. and Carol Lee Levin Professor of Operations Management,
The University of Chicago Graduate School of Business

Preface

Over the last few years there have been rapid changes in the securities market, more so in the secondary market. Advanced technology and online-based transactions have modernised the stock exchanges. The number of companies listed and the total market capitalisation in the equities market is relatively large as compared to the stage of economic development. A systematic and rational financial investment decision in a rapidly changing world of equities investment forms the core of this book.

The explanatory power of equity variables such as return, dividend, beta, liquidity, etc. have been studied in isolation thus limiting their application in improvement of the existing portfolio selection models. The mathematical complexity of some existing models hinders its applicability. A balanced portfolio which provides an investor with capital protections and opportunities for superior gains is required. A flexible model capable of accommodating the real-world constraints and objectives of an investor has been formulated using the Quadratic programming approach.

The model was tested on real data drawn from two important stock exchanges of the world, London Stock Exchange's FTSE 100 and Indian National Stock Exchange's Nifty 50. Eight portfolio model formulations, namely diversifier's portfolio, satisficer's portfolio, plunger's portfolio, market trend portfolio, capital gain bias portfolio, dividend gain bias portfolio, equal priority portfolio and the ideal portfolio, were created for investors with different priorities and risk appetite. The objective of risk (variance) minimisation was achieved by optimising variables such as earnings per share, dividend, free float, impact cost, institutional holding, market capitalisation, net profit, price to book value ratio, price-earnings ratio, promoter's shareholding, sales, turnover, beta, unsystematic risk and volume across other important portfolio simultaneously. All the portfolios created were compared with the Markowitz's efficient frontier in the risk-return space. Ideal portfolio was found to be the closest to the Markowitz's portfolio.

Two multiple regression equations have been estimated with returns and excess returns to standard deviation as the dependent variables. Regression models explain the relevance of a new variable, namely

impact cost having significant explanatory powers for predicting security return and Sharpe ratio. Granger causality tests were undertaken to find out the relationship of causation between returns on a security and the variables set as constraints in the programming problem. The null hypothesis that dividend, impact cost, net profit, promoter's holding, sales and volume do not cause returns could not be rejected.

The portfolio utility analysis was undertaken to empirically find the utility derived by an investor from alternate portfolios for changing levels of risk tolerance. A direct relationship between the degree of risk tolerance and the value of portfolio utility was found from the quantitative analysis. The portfolio selection model formulations were plotted in the risk-return space along with the utility curves to find the optimal portfolio choice for different types of investors. The evaluation of the alternate portfolio selection model formulations was attempted by using Sharpe ratio (1966) and Treynor ratio (1965). The Sharpe ratio was the highest for Markowitz portfolio followed by the ideal portfolio. The ideal portfolio performed the best, even better than the Markowitz portfolio, when evaluated according to Treynor's ratio. Tests of equality of mean, variance and portfolio utility for ideal portfolio, Markowitz's portfolio and index portfolio were conducted to further investigate the proximity of these portfolios. Forward tests have been conducted to confirm their robustness.

The mean-variance model formulated and applied here will be of immense use for investors, both individual and institutional, brokerage houses, mutual fund managers, banks, high net worth individuals, portfolio management service providers, financial advisors, regulators, stock exchanges and research scholars in the area of portfolio selection.

Acknowledgements

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My sincere gratitude to Mr Mark Wiley, LINDO Systems, Inc, USA, for providing me access to the evaluation copy of LINGO 13.0 used for quadratic programming portfolio selection optimisation with unlimited variables and constraints. I am also thankful to Janis Merton from Thompson Reuters helpdesk for replying to all my queries relating to the database.

I am also thankful to the organisers of various national and international conferences who gave me the opportunity to present my research papers. In particular, I would like to acknowledge the organisers of 2nd IIMA International conference on Advanced Data Analysis, Business Analytics and Intelligence organised by Indian Institute of Management, Ahmedabad; 13th West Lake International Conference on Small and Medium Business (WLICSMB, 2011) organised by Economic Commission, Hangzhou Municipal Government, Zhejiang Provincial Institute of Small and Mid-sized Business and College of

Business Administration, Zhejiang University of Technology, Hangzhou, China and 64th All India Commerce Conference (AICC) organised by Indian Commerce Association, Department of Commerce, School of Management, Pondicherry University, Pondicherry. The comments and suggestions of the participants from these conferences have been duly incorporated.

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I also take this opportunity to express my deep personal gratitude to Dr Manju Agarwal and Prof. Aman Agarwal for their unflinching encouragement and support. It may not be possible for me to adequately thank my husband Prof. Saurabh Agarwal and daughter Vedika who have patiently stood by me and supported me throughout . I dedicate this book to my parents, Mr Ashok Chawla and Mrs Santosh Chawla. I also acknowledge the moral support of my brother Mr Prashant Chawla.

Last but not the least, I am thankful for the immense benefit I have derived from the work of various authors which has enriched my understanding of the subject.

Megha Agarwal

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