Chapter 7

Summary and Conclusions

Portfolio optimization problem has always been at the forefront of financial research. It plays a crucial role in the success of an investment. The process of investment involves the construction and management of optimal portfolio. A perfect roadmap to achieve the investors pre-defined investment objectives can be designed through the selection of a proper model and an appropriate strategy to construct and manage the optimal portfolio. One of the approaches to construct the optimal portfolio is to use portfolio theory. This theory was pioneered by Markowitz in 1952. Portfolio theory is one of the important contributions of modern finance. It is grounded on diversification concept which aims to reduce the total risk of portfolio without sacrificing portfolio return. Markowitz portfolio theory is also called the mean-variance optimization model due to the fact that it is based on expected return (mean) and variance of the portfolio. Markowitz mean-variance model attempts to minimize risk for a given level of expected return, or equivalently maximize portfolio expected return for a given amount of portfolio risk. Theoretically, Markowitz model is considered as a superior approach in constructing optimal portfolio. However, it has hardly become an operational tool for portfolio managers and investors, since this model requires a large number of inputs and involves computational complexity. To overcome these problems, Sharpe (1963) proposed a model that requires fewer inputs and computational simplicity. The most important issue is whether the results of this simplified model are similar to those obtained using Markowitz model. The approaches suggested by Markowitz and Sharpe have opened up a new debate in the portfolio theory. Many research studies have been conducted to compare the results obtained using Markowitz and Sharpe single index approaches. Some of these studies have resulted in contradictory conclusions. Several studies have evidenced that there is no difference in the characteristics of portfolios constructed using Markowitz and Sharpe models; however, others have concluded that there is difference in the characteristics of the portfolios obtained by two models. Surprisingly, given the practical importance of comparison between these two approaches, very few research studies have been conducted on this issue in the Indian context. The present study has attempted to fill this gap. This study has compared Markowitz approach with Sharpe single index model and investigated how Sharpe single index model performs relative to Markowitz model and whether the results of Sharpe model are similar to those obtained using Markowitz model. This study has
constructed optimal portfolios using Markowitz and Sharpe single index models and analysed the various characteristics of these portfolios one year following their construction. It has examined whether the portfolios constructed using these two approaches perform equally well.

In the case of management of optimal portfolio, selection of an appropriate portfolio management strategy has always attracted the attention of the investors. Formulation of portfolio management strategies are based on two broad choices, namely, active and passive portfolio management strategies. Among various strategies applied to manage the optimal portfolios, the buy-and-hold approach may be linked with a passive investment strategy and tactical asset allocation can be considered as a moderately active strategy. Tactical asset allocation can be considered as a minor form of market timing approach searching for investment opportunities through monitoring monetary, economic and other market indicators in order to take advantage of perceived differences in relative values of the various asset classes. In addition, a number of studies support the predictability of security returns by economic and monetary variables. The probability of investment opportunities through tactical asset allocation and predictability of security returns by monetary variables have created a new research idea in the portfolio management on how one can exploit such information to earn economically significant excess returns by employing tactical asset allocation approach. In spite of the economic importance of this research area, no studies have been conducted on this issue in the Indian context. The present study has attempted to fill this gap. This study has employed buy-and-hold strategy and tactical asset allocation based on turning points in monetary cycle. It has analysed the risk-adjusted returns obtained by these two strategies and investigated whether any potential profit can be achieved through applying tactical asset allocation based on monetary turning points. In other words, the study has investigated whether investors can earn profit in excess of a buy-and-hold approach through tactical asset allocation based on monetary cycle points. A broad introduction on construction and management of optimal portfolio has been outlined in Chapter 1. An overview of Indian capital market has been presented in Chapter 2. Evolution of Indian stock exchanges, history of BSE and NSE, securities market segments, regulatory framework, and trading mechanism have been covered. To provide a comprehensive theoretical framework of the study, the concepts of portfolio theory, portfolio risk and return, diversification, efficient frontier, optimal portfolio, single index model, and portfolio management strategies have been discussed in detail in Chapter 3. In Chapter 4, the research studies carried out over the years in the areas of construction and management of optimal portfolio have been reviewed.
Different portfolio construction models and portfolio management strategies have been highlighted.

We have carried out the research with specific objectives of construction of optimal portfolios by applying Markowitz mean-variance optimization approach and Sharpe single index model, comparison of portfolios constructed using these two approaches, management of optimal portfolios by applying buy-and-hold approach and tactical asset allocation based on monetary cycle turning points, and comparison of results obtained by these two approaches. We have formulated and tested three hypotheses. We have investigated on construction and management of the optimal portfolios in Chapters 5 and 6, respectively.

7.1 Results of the Study

The procedures, results and findings of the research in Chapters 5 and 6 are summarized below.

7.1.1 Construction of Optimal Portfolio

We have constructed optimal portfolios using Markowitz and Sharpe single index models in three sub-periods of the study. The universe of investment for each sub-period consists of the components of CNX-200 index listed on NSE before the beginning date of that sub-period. In each sub-period, four samples are drawn with sample sizes of 10, 30, 50, and 70, applying simple random sampling selection technique from the universe of investment of that sub-period. The sample size indicates the number of stocks that are candidates for investment. All inputs required for portfolio problem are taken on weekly basis. To construct optimal portfolios by Markowitz approach, mathematically we have maximized the utility function at twelve levels of risk aversion which are 1, 1.25, 1.66, 2, 2.5, 3, 4, 5, 10, 50, 90, and 100. To solve utility maximization problem which is quadratic programming problem we have used MATLAB software version 7. To construct optimal portfolios by Sharpe single index model, we have calculated excess return to Beta ratio for all stocks in each sample, ranked them from highest to lowest, and found the cutoff rate. The optimal portfolio consists of all stocks which have excess return to Beta ratio greater than the cutoff rate. The CNX Nifty and weighted average yields of Government of India securities are considered as market and risk free rate of return, respectively.

According to literature, typical risk aversion coefficients range between 2.0 and 4.0. Therefore, among portfolios constructed by Markowitz approach, we have considered those obtained at risk aversion levels of 2, 3, and 4 and compared with those constructed by Sharpe approach. To compare the portfolios constructed using two approaches, we have used some
well-established risk-adjusted performance measures, namely, Sharpe ratio, Treynor ratio, Jensen measure, Fama measure and Modigliani-Modigliani measure ($M^2$ measure) to evaluate portfolio performances one year following their construction. The results obtained by comparing the two approaches in three sub-periods of the study are summarized below.

7.1.1.1 Results of the First Sub-Period 1995-2002

- The returns of portfolios constructed using Markowitz approach have higher average value than those of Sharpe approach. However, the difference is not statistically significant at five percent level of significance.
- Portfolios constructed using Sharpe approach show higher average Beta than those constructed using Markowitz approach. However, the difference is not statistically significant at five percent level of significance.
- Portfolios constructed using Sharpe approach report higher average standard deviation than those constructed using Markowitz approach. Although, the difference is not statistically significant at five percent level of significance.
- The mean value of Sharpe ratios of portfolios constructed using Markowitz approach is higher than those of Sharpe approach. In addition, series of excess of Sharpe ratios over the benchmarks of portfolios constructed using Markowitz approach show higher mean value than those of Sharpe approach. The p-values of t-tests are more than 0.05 indicating that the differences are not statistically significant at five percent level of significance.
- Portfolios obtained by Markowitz approach have higher mean value of Treynor ratio than those constructed using Sharpe approach. Likewise, series of excess of Treynor ratios over the benchmarks of portfolios constructed using Markowitz approach show higher mean value than those of Sharpe approach. However, the p-values of more than 0.05 imply that the differences are not statistically significant at five percent level of significance.
- Alphas of portfolios constructed using Markowitz approach have higher average value than those of Sharpe approach. Nevertheless, from the p-value of more than 0.05, it can be inferred that the difference between two series of Alphas is not statistically significant at five percent level of significance.
- The Fama measures of portfolios constructed using Markowitz approach have higher average value than those of Sharpe approach. Although, the p-value of more than 0.05 implies that the difference is not significant at five percent level of significance.
• Markowitz approach yields higher average $M^2$ measure than that of the Sharpe approach. However, the p-value is more than 0.05 and from this it can be concluded that the difference between the averages of $M^2$ measures in two approaches is not significant at five percent level of significance.

Altogether, the results indicate that portfolios based on Markowitz approach have economically superior performances compared to those using Sharpe single index model. However, there is no statistical difference between performances of portfolios (risk-return characteristics and risk-adjusted performance measures) constructed using two approaches at five percent level of significance in the first sub-period.

7.1.1.2 Results of the Second Sub-Period 2001-2008

• The returns of portfolios constructed using Markowitz approach have higher average value than those of Sharpe approach. Although, the p-value of more than 0.05 implies that the difference is not statistically significant at five percent level of significance.

• Portfolios constructed using Markowitz approach have higher average Beta than those constructed using Sharpe approach. The corresponding p-value of t-test for difference between the means of two series of Betas is less than 0.05 indicating that at five percent level of significance two series of Betas are statistically different.

• The standard deviations of portfolios constructed using Markowitz approach have higher average value than those of Sharpe approach. The corresponding p-value of t-test is $1.65 \times 10^{-5}$ implying that two series of standard deviations are statistically different even at one percent level of significance.

• The Sharpe ratios of portfolios constructed using Sharpe approach have higher average value than those of Markowitz approach. However, the difference is not statistically significant at five percent level of significance. In the case of excess of Sharpe ratios over the benchmarks, the p-value of t-test for two series of excess of Sharpe ratios over the benchmarks is more than 0.05 implying that the difference is not statistically significant at five percent level of significance.

• The Treynor ratios of portfolios constructed using Sharpe approach have higher average value than those of Markowitz approach. Likewise, series of excess of Treynor ratios over the benchmarks of portfolios constructed using Sharpe approach show higher mean value than those of Markowitz approach. However, the p-values of more than 0.05 imply that the differences are not statistically significant at five percent level of significance.
• Portfolios constructed using Sharpe approach have higher average Alpha than those constructed by Markowitz approach. The p-value of t-test for difference between the means of two series of Alphas is more than 0.05, therefore, at five percent level of significance two series of Alphas are not significantly different.

• There are positive average values of Fama measures for two series indicating that both the series of portfolios have earned superior returns because of selectivity on the part of the portfolio manager. These positive values reveal that the portfolios have offered the advantages of proficiency of selectivity to the investors. Portfolios constructed using Sharpe approach report higher average Fama measure than those constructed using Markowitz approach. However, the p-value of difference between the means of two series of Fama measures is more than 0.05 implying that the difference is not statistically significant at five percent level of significance.

• Portfolios obtained by Sharpe approach report higher average $M^2$ measure than those constructed using Markowitz approach. The p-value of t-test for difference between the means of two series of $M^2$ measures is more than 0.05 implying that the difference is not statistically significant at five percent level of significance.

In sum, the results indicate that portfolios based on the Sharpe single index model have economically superior performances compared to those using Markowitz approach. However, the mean returns of Markowitz portfolios are higher than those of Shape portfolios, although there is no statistical difference between them. From the results it can be inferred that except in risk parameters (Betas and standard deviations) in all other parameters of portfolio performance, there is no statistical difference between two approaches at five percent level of significance in the second sub-period. In terms of risks, the average of series in two approaches show significant difference and portfolios constructed using Markowitz approach report higher average risk.

7.1.1.3 Results of the Third Sub-Period 2005-2012

• The returns of portfolios constructed using Sharpe approach have higher average value than those of Markowitz approach. The p-value of t-test for difference between the means of two series of returns is more than 0.05 implying that the difference is not statistically significant at five percent level of significance.

• Portfolios constructed using Markowitz approach show higher average Beta than those constructed using Sharpe approach. However, the difference is not statistically significant at five percent level of significance.
• In spite of lower average return, portfolios constructed using Markowitz approach report higher average standard deviation than those constructed using Sharpe approach. Although, the difference is not statistically significant at five percent level of significance.

• The Sharpe ratios of portfolios constructed using Sharpe approach have higher average value than those of Markowitz approach. However, the difference is not statistically significant at five percent level of significance. In terms of excess of the Sharpe ratios over the benchmarks, the average of series is negative for Markowitz portfolios and positive for Sharpe portfolios implying inferior and superior performance, respectively. However, the p-value of t-test for difference between the two series of excess of Sharpe ratios over the benchmarks is more than 0.05 implying that the difference is not statistically significant at five percent level of significance.

• The Sharpe and Markowitz portfolios have positive and negative mean values of Treynor ratio, respectively. The t-test for the difference between these two series of Treynor ratios shows that the p-value is more than 0.05 implying that there is no significant difference between these two Treynor ratio series at five percent level of significance. Two series of excess of Treynor ratios over the benchmarks show negative and positive mean values for Markowitz and Sharpe approaches, respectively. However, the p-value of more than 0.05 implies that the difference is not statistically significant at five percent level of significance.

• Portfolios constructed using Sharpe approach have higher average Alpha than those constructed by Markowitz approach. Higher value of Alpha indicates superior performance of the portfolios constructed using Sharpe approach in comparison to those constructed using Markowitz approach. Nevertheless, from the p-value of more than 0.05, it can be inferred that the difference between two series of Alphas is not statistically significant at five percent level of significance.

• Portfolios constructed using Sharpe approach report higher average Fama measure than those constructed using Markowitz approach. However, the p-value of more than 0.05 implies that the difference is not statistically significant at five percent level of significance.

• Sharpe approach yields higher average $M^2$ measure than that of Markowitz approach. The p-value for the difference of means is more than 0.05 and it can be concluded that
the difference between the averages of $M^2$ measures in two approaches is not significant at five percent level of significance.

In total, the results indicate that portfolios based on the Sharpe single index model have economically superior performances compared to those using Markowitz approach. However, in all parameters of portfolio performance there is no significant difference between the two approaches at five percent level of significance in the third sub-period.

7.1.2 Management of Optimal Portfolio

We have employed the tactical asset allocation and buy-and-hold strategies. We have used six asset classes, namely, large company stocks, small company stocks, foreign stocks, government bonds, Treasury bills and gold to study these strategies. We have performed tactical asset allocation based on turning points in monetary cycle. We have traced repo rate changes to identify turning points in the monetary cycle and used turning points as informative signals to alter asset allocation. We have analysed the risk-adjusted returns obtained by buy-and-hold strategy and tactical asset allocation based on monetary cycle turning points.

The results achieved from this part of the study are summarized below.

- Over the study period from January 2004 to June 2013, we have identified four turning points in the monetary cycle. In addition, there are three expansive and two restrictive policy phases of the monetary cycle.
- Out of the 114 months in the full period, 53 months (46.49%) are in expansive policy phases and the remaining 61 months (53.51%) are in restrictive policy phases.
- The return and risk characteristics of all asset classes are influenced by the monetary cycle.
- The equity asset classes (large company stocks, small company stocks, and foreign stocks) provide much higher returns in expansive phase compared to restrictive phase. However, the p-value indicates that the difference is not statistically significant at five and ten percent level of significance.
- The fixed income asset classes (government bonds and treasury bills) provide higher returns in restrictive phase compared to expansive phase. Surprisingly, in spite of higher return, the government bonds have lower standard deviation in restrictive phase compared to expansive phase. From the p-value of F-test it is evident that the standard deviation of government bonds in the expansive phase is statistically
different from their standard deviation in the restrictive phase even at one percent level of significance.

• The standard deviations of foreign stocks in two phases are statistically different at ten percent level of significance.

• There is significant difference between mean returns of gold in two phases at ten percent level of significance.

• The correlation structure of returns is influenced by the monetary cycle.

• The equity asset classes are more highly correlated with each other during restrictive phase compared to expansive phase.

• The correlations between returns of large company stocks and foreign stocks are statistically different in two phases at five percent level of significance.

• There is significant difference between return correlations of large company stocks and gold in two phases at five percent level of significance.

• The return correlations of foreign stocks and gold are statistically different in two phases at five percent level of significance.

• At all levels of risk aversion, there are differences between the structures of portfolios in the expansive and restrictive phases.

• By varying the risk aversion coefficient, the structure of optimal portfolio changes. As the level of risk aversion decreases, the return of optimal portfolio increases.

• At all risk aversion levels the monetary cycle approach provides economically greater returns than buy-and-hold approach.

• The p-value of one-tailed two-sample t-test is less than 0.05 indicating that the mean value of returns of monetary cycle approach is statistically greater than that of buy-and-hold approach at five percent level of significance. (without considering transaction costs)

• The p-value of one-tailed one-sample t-test is less than 0.05 indicating that the mean value of series of annual return differences between buy-and-hold and monetary cycle approaches is statistically greater than zero. (without considering transaction costs)

• Tactical asset allocation based on monetary cycle turning points provides higher risk-adjusted returns over a buy-and-hold allocation, even after considering transaction costs.
7.2 Conclusions
The results of comparison of portfolios constructed using Markowitz approach and Sharpe single index model are economically in favour of Sharpe single index model in 2 out of 3 sub-periods. Overall, from the results of this study it can be concluded that except in terms of risk which is in favour of Sharpe approach, in other parameters of portfolio performance, there is no statistical difference between Markowitz and Sharpe single index model at five percent level of significance. Our results accord well with the previous studies such as Omet (1995), and Bekhet and Matar (2012). Simple application of Sharpe single index model due to lower number of inputs and equivalent results obtained using Markowitz and Sharpe single index models can be possible motivation to prefer the Sharpe single index model. Since the Markowitz model requires a larger number of inputs but does not produce superior results than that of Sharpe approach, investors and portfolio managers can use the results of this study and rely on Sharpe single index model for portfolio construction. The implication of this is that market index serves as a representative security to correlate the returns of individual securities. This reduces the necessity of a large number of covariances required in Markowitz approach.

In addition, the study demonstrates how investors can exploit information about economic conditions to earn profits in excess of a buy-and-hold approach. The study exhibits that repo rate as a monetary indicator can be used to identify turning points in the monetary cycle. Consequently, turning points in the monetary cycle can be used as informative signals to rebalance efficient portfolio in order to earn economically meaningful excess returns over the buy-and-hold approach. The study of management of optimal portfolio reveals that tactical asset allocation based on monetary cycle turning points provides higher risk-adjusted returns over a buy-and-hold allocation, even after considering transaction costs. The ex-ante method of identifying the turning points used by Jansen and Mercer (2003) provides practical reallocation that allows investors to extract economically significant excess returns in real time. The results of this study are consistent with the previous studies such as Brocato and Steed (1998), Jensen and Mercer (2003), Calamari (2007), and Chen and Chen (2009).

7.3 Areas for Future Research
We find certain potential areas to be investigated in the further research.

1. This study uses simple random sampling selection technique and does not focus on the selection of securities. The securities are not selected based on security analysis. In practice investors select stocks based on different criteria. These criteria could be
used for portfolio construction and their performances could be compared. Similar analysis can be repeated by selecting securities based on security analysis.

2. In order to compare Markowitz and Sharpe single index models, among portfolios constructed using Markowitz approach, we have considered those obtained by risk aversion levels of 2, 3, and 4 and compared with those constructed by Sharpe approach. It would be interesting to compare two approaches by considering the Markowitz portfolios obtained by levels of risk aversion between 2 and 10.

3. In order to study the different portfolio management strategies (buy-and-hold approach and Tactical asset allocation), we have used NSE indices as representatives of large company stocks, small company stocks and foreign stock asset classes. In addition, CCIL bond and T-bill indices are used as representatives of government bonds and T-bills asset classes. It would be useful to examine whether by considering BSE indices for large company stocks, small company stocks and foreign stock asset classes and NSE government securities indices for government bonds and T-bills asset classes, the results would be consistent with our results.

4. We have used repo rate to identify turning points in the monetary cycle. It would be interesting to explore whether alternative information rather than the repo rate can be used to identify monetary cycle turning points in a similar fashion.

5. It would be useful to investigate whether investors can utilize the other economic and monetary variables, which have predictive power for security returns, to earn economically excess returns through tactical asset allocation.