Applicability of Sharpe's Single Index Model in Indian Security Market

*** Dr. Sushil Kumar Mehta**
**** Prof. M.S.Turan**

The past decade in many ways has been remarkable for Securities Market in India. It has grown exponentially as measured in terms of amount raised from the market, number of stock exchanges and other intermediaries, the number of listed stocks, market capitalisation, trading volumes and turnover on stock exchanges, and investor population. Despite the expansion of the securities market, a very small percentage of household savings are channelised into the securities market. The disenchantment of household sector with securities is confirmed by various SEBI-NCAER surveys, which found that a very small percentage of investments of all households were in securities and a large percentage in non-securities, thus, indicating low priority of investor for securities. What is of further worry is the intentions revealed in the survey that majority of existing shareholders are unlikely to invest in the securities market in the future years. This indicates a lack of confidence by the investors in the securities market. The lack of awareness about securities market and absence of a dependable infrastructure and distribution network coupled with aversion to risk inhibited non-investor households from investing in the securities market. Therefore, there is a need to have a simplified model for constructing optimal portfolio, which can work in the Indian Security Market.

The paper attempts to test the Sharpe's Single Index Model in Indian Security Market. The Mean-Variance Model proposed by Harry Markowitz is conceptually sound and theoretically elegant. However, its serious limitation is that it related each security to every other security in the portfolio, demanding the sophistication and volume of work beyond the capacity of most analysts. William Sharpe simplified this model by relying upon the correlation between the security and a broad based market index, the underlying assumption of investors maximising terminal wealth was borrowed from the Markowitz model. According to the Sharpe model, also known as the market model, the total risk of any security can be measured by its variance and consists of two parts – Market Risk (Systematic risk) and Unique risk (Unsystematic risk). Beta, the ratio of change in the security's excess return to a change in the excess market return, is a measure of the systematic risk or non-diversifiable risk. The beta value indicates the nature of the security. Security, having beta value greater than one, is an aggressive security and a security, having beta value lesser than one, is a defensive security. The key assumption of the model is that the return on a security is linearly related to the market / market index.

1. REVIEW OF LITERATURE

Elton, Edwin J., Gruber, Martin J. and Padberg, Manferd W. are among the prominent researchers, who have worked on Sharpe's Single Index Model. They (1977)[i] presented a new method for selecting optimal portfolios when upper bound constraints on investments in individual stocks were present and when the variance-covariance matrix of returns possessed a special structure such as that implied by standard single index model. Extending their previous work, more commonly called as EPG approach to Portfolio optimization, it was shown that upper bounds could be dealt within a more complex fashion that shares many of the features of ranking procedures of standard single index model.

Bawa, Vijay S., Elton, Edwin J. and Gruber, Martin J. (1979)[ii] showed that the construction of optimal portfolio could be simplified by using simple ranking procedures when returns followed a stable distribution and the dependence structure had any of several standard forms. The ranking procedure simplified the computations necessary to determine an optimum portfolio.

Faaland, Bruce H. and Jacob, Nancy L. (1981)[iii] examined alternative solution procedures to achieve the objective of choosing 'n' securities from a universe of 'm' securities in order to maximise the portfolio's excess-return-to Beta ratio. The paper concluded with computational experience on problems with 'n' ranging from 10 to 200 and 'm' from 500 to 1245.

Chen, Son-Nan and Brown, Stephen J. (1983)[iv] demonstrated that the estimation risk must be properly reflected in the process of optimal portfolio selection. The results of the study indicated that the presence of estimation risk reduced the relative impact of estimated systematic risk on optimal portfolio choices. Madhusoodanan, T.P. (1996)[v] analysed the problem of optimum asset allocation among risky investment avenues and tested the performance of the constructed portfolios for the following quarter, half year and a full year. The results were encouraging with an average return significantly higher

Assistant Professor, College of Management, Shri Mata Vaishno Devi University, Kakryal,Katra - 182121, Jammu and Kashmir
E-mail : sushilmehta2@rediffmail.com
Former Dean, Faculty of Management Studies, Guru Jambheshwar University, Hisar –125001, (Haryana)

than the market return for all the three test periods. The annualized portfolio return was 7 to 17 per cent over and above the market return. The portfolios formed using National index as proxy for market generated a higher return. In the volatility front, the portfolios using sensex as market proxy had a lesser volatility than the market, while the portfolios formed using National index as market proxy had a higher volatility than the market. In general, National index produced a lower return and volatility was compared to sensex.

Chaudhary, Ashish et al (1998)[vi] conducted a study to construct an efficient portfolio using the Sharpe's Single Index model and to observe the performance of the portfolio vis-à-vis the market. Taking 100 securities constituting the BSE-100 index and BSE-100 index as proxy for the market, the portfolio was constructed on the basis of average weekly returns for a period ranging from 1st January 1995 to 7th August 1998. It was observed that the portfolio considerably outperformed the market, giving a compounded return of 40 % while the market gave a return of –4%.

Bansal, S.P. and Gupta, Sunil (2000)[vii] used EPG approach to identify the most efficient securities from a sample of 24 securities, randomly selected from the Bombay Stock Exchange Official Directory and then proportion of these efficient securities to form the final optimal portfolio was determined.

2. RESEARCH METHODOLOGY

Weekly data has been collected for a period of 7 years ranging from April 1995 to March 2002. Weekly data on market prices of shares and 30 stock BSE Sensitive Index have been collected. The data source was the website of Bombay Stock Exchange. Three samples namely sample 1, sample 2 and sample 3 containing 15, 15 and 20 Equity Stocks, respectively, listed on Bombay Stock Exchange have been drawn (refer Appendix). Simple random sampling technique has been used to select samples from the securities listed on the Bombay Stock Exchange. A composite sample, consisting of all the 50 stocks, has also been used to construct optimal portfolios. Six holding periods of one year (1995-96), two years (1995-97), three years (1995-98), four years (1995-99), five years (1995-2000) and six years (1995-2001) have been taken to calculate returns and variances and beta value of securities. Using four samples of securities and six holding periods twenty-three portfolios have been constructed. This has happened because portfolio formed on the basis of holding period of 2 years, from sample 3 securities, has been dropped because it included just one security in the portfolio. Input values for the model are the security returns, unsystematic variance of security return, beta values of securities and market variance.

A) Portfolio Construction

Optimum portfolio construction involves the following steps: -

a) Calculation of excess returns to beta ratio for each stock under review and ranking the securities from highest to lowest based on the ratio. Mathematically,

$$\text{Excess return to beta ratio} = (R_i - r_f)/\beta_I \qquad \text{eqn. i}$$

where $r_f \rightarrow$ average weekly risk-free return

$\beta_i \rightarrow$ beta value of the security, which is calculated as follows: -

$$\beta_i = \{\sum(r_i - R_i)(r_m - R_m)\}/\sum(r_m - R_m)^2 \qquad \text{eqn. ii}$$

where $r_m \rightarrow$ weekly market return

$R_m \rightarrow$ Average weekly market return

$$R_m = (1/N)^* \sum r_m \qquad \text{eqn. iii}$$

Risk free return has been taken to be the yield to maturity of the Treasury bill or Government bond of maturity period equal to the holding period considered.

b) The optimum portfolio consists of investing in all stocks for which $(r_i - r_f)/\beta_i$ is greater than a particular cutoff point C^*.

To find out cutoff point C^*, C_i s, which include i stocks, are calculated as follows –

$$C_i = \frac{\sigma_m^2 \sum \{(r_i - r_f)/\sigma_{ei}^2\} ß_i}{1 + \sigma_m^2 \sum ß_i^2/\sigma_{ei}^2} \qquad \text{eqn. iv}$$

where $\sigma_m^2 \rightarrow$ variance in the market index

$\sigma_{ei}^2 \rightarrow$ variance in the stock's movement that is not associated with the movement of the market index i.e. the unsystematic variance.

$$\sigma_m^2 = \sum(r_m - R_m)^2 \qquad \text{eqn. v}$$

$$\sigma_{ei}^2 = \sigma_i^2 - ß_i^2\sigma_m^2 \qquad \text{eqn. vi}$$

Starting from the top ranked security, the value of C_i is calculated upto a point when excess return to beta ratio, for all the 'i' securities included in the calculation of C_i, is more than the value of C_i and for all other securities, the ratios are less than the C_i values. Securities, included upto that point, constitute optimal portfolio. The percentages to be invested in each security is given by[viii]

$$x_i = \frac{Z_i}{\sum Z_i} \qquad \text{eqn. vii}$$

where $Z_i = (ß_i / \sigma_{ei}^2) \{((r_i - r_f)/ \beta_i) - C^*\}$ eqn. viii

B) Portfolio Evaluation

Evaluation of constructed portfolios has been done using well-established risk adjusted performance measures of Sharpe, Treynor, Jenson and Fama, during one year immediately after their formation. Basically, these measures are developed on the assumptions of ' The Capital Asset Pricing Model' (CAPM) propounded by Sharpe, Lintner and others. The CAPM specifies that in equilibrium, the return and risk are in linear relationship called as Security Market Line (SML)[ix].

$$R_p = r_f + ß(R_m - r_f) \qquad \text{eqn. ix}$$

where $R_p \rightarrow$ portfolio return

For a properly diversified portfolio, the above relationship can be specified in terms of the total risk (σ_p) of portfolio return, called as Capital Market Line (CML).

$$R_p = r_f + \sigma_p (R_m - r_f)/ \sigma_m \qquad \text{eqn. x}$$

where $\sigma_m \rightarrow$ standard deviation of the return on the market index

$\sigma_p \rightarrow$ standard deviation of the portfolio return

Though SML and CML are for the purpose of security return, every security of the portfolio must be plotted on SML and CML. However, well-diversified portfolios plot both on the CML and SML, undiversified portfolio plot only on the SML[x]. The measures suggested by Jensen (1968) and Treynor (1965) are based on the SML, whereas the measure evolved by William F. Sharpe (1966) is based on the CML. A brief description is given below: -

a) Sharpe's Ratio

William F. Sharpe developed a method of measuring return per unit of risk in 1966. The reward to variability ratio attempted by Sharpe is referred as the Sharpe Ratio[xi]. In fact, this ratio is simply the ratio of the reward, defined as the realised portfolio return Rp in excess of the risk free rates, to the variability of return as measured by the standard deviation of returns (σ_p).

$$RVARp = (R_p - r_f) / \sigma_p \qquad \text{eqn. xi}$$

where RVARp is reward to variability ratio.

R_p is calculated as follows: -

$$R_p = \sum x_i R_i \qquad \text{eqn. xii}$$

σ_p is calculated as follows: -

$$\sigma_p = (\sum \sum x_i x_j \sigma_{ij})^{1/2} \qquad \text{eqn. xiii}$$

One sample two-tailed test has been used to see whether the mean value of reward to variability ratio is significantly different from zero.

Here, the benchmark is additional return of market over risk free return related with market portfolio's total risk

$$RVAR_m = (R_m - r_f) / \sigma_m \qquad \text{eqn. xiv}$$

where $RVAR_m$ is the reward to variability of the market.

In case RVARp is greater than $RVAR_m$ (benchmark), portfolio's performance is better than market. One sample two-tailed test has been used to see whether the mean value of difference between $RVAR_m$ and $RVAR_p$ is significantly different from zero.

The Sharpe's index is superior to Treynor ratio as the former considers the point whether investors have been reasonably rewarded with the total risk taken by the portfolio in comparison to the market. A portfolio, which may have outperformed according to Treynor ratio, may indicate inferior performance according to Sharpe ratio. Hence, the two measures may give different performance.

It is important to understand here that a portfolio, which outperforms the benchmark according to the Treynor ratio, may result in inferior performance according to Sharpe ratio. The reason behind this is that the portfolio may have a relatively large amount of unique risk. Treynor ratio will not be affected by such a risk, since only market risk is the denominator of the Treynor ratio. But, such risk would be included in the denominator of the Sharpe ratio, as this ratio is based on total risk (i.e. market risk and unique risk). Resultantly, Sharpe ratio would indicate the portfolio underperforming the market, while at the same time, reverse may hold true according to Treynor ratio.

A portfolio, which performs better according to Jensen and Treynor's measures and not according to the Sharpe's ratio, indicates the direction in which a portfolio manager has to change the portfolio structure.

b) Treynor's Ratio

A key to understanding Treynor's portfolio performance is the concept of a characteristic line. The graphic presentation of the linear regression relationship between the return of an individual security and the return on market portfolio is commonly referred to as the 'Characteristic Line'.

The slope of the characteristic line is the *Beta* coefficient, a measure of the portfolio's systematic risk as a type of volatility measure. Thus, by comparing the slopes of characteristic lines, the investor gets an indication of the fund's volatility. Treynor has proposed incorporating these various concepts into a single index to measure portfolio performance more accurately.

According to Treynor's ratio, the additional returns of the portfolio over risk free return is expressed in relation to portfolio's systematic risk measured by *Beta* (ß). This is known as reward to volatility (RVOL) and expressed as

$RVOLp = (R_p - r_f) / ß_p$ eqn. xv

where RVOLp $\rightarrow$ Reward to volatility of the portfolio

$\beta_p \rightarrow$ Beta of the Portfolio

It is calculated as follows: -

$\beta_p = \Sigma x_i ß_I$ eqn. xvi

One sample two-tailed test has been used to see whether the mean value of RVOLp is significantly different from zero. Here, additional average returns of market over average risk free return $(R_m - r_f)$ is the benchmark. Greater value of the portfolio over the market indicates a superior performance of the fund. Here, again, one sample two-tailed test has been used to see whether the mean value of difference between RVOLp and the benchmark is significantly different from zero.

c) Jenson Measure

The Sharpe and Treynor models provide measures for ranking the relative performance of various portfolios on a risk-adjusted basis. Jensen attempts to construct a measure of absolute performance on a risk adjusted basis that is, definite standard against which performance of various funds can be measured. According to Jensen, equilibrium average return is the return of the portfolio by the market with respect to systematic risk of the portfolio. This is a return the portfolio should earn with the given systematic risk,

$EAR_p = r_f + (r_m - r_f)\, ß_p$ eqn. xvii

where $EAR_p \rightarrow$ Equilibrium Average Return of portfolio

Difference between equilibrium average return and average return of the portfolio indicates superior / inferior performance of the fund. This is called as *Alpha* (α)

$\alpha_p = R_p - EAR_p$ eqn. xviii

If *Alpha* is positive, the portfolio has performed better and if it is negative, it has not shown performance upto the benchmark i.e. the market index. One sample two-tailed test has been used, here also, to see whether the mean value of *Alpha* is significantly different from zero.

d) Fama's Measure

Eugene Fama has provided an analytical framework that elaborates on the three previously discussed risk adjusted return methods and allows a more detailed breakdown of a fund's performance[xii]. Fama has given the following components of the portfolio return: -

a) Risk free return, r_f
b) Compensation for systematic risk, which is known as the risk premium. Mathematically, it is given by following equation-

Risk premium = $\beta * (R_m - r_f)$ eqn. xix

c) To achieve above average returns, sometimes the managers have to forsake some diversification, which will have its cost in terms of additional portfolio risk. An additional component of return is needed to compensate for this additional risk. It is given as follows-

Compensation for inadequate diversification = $(R_m - r_f)*((\sigma_p / \sigma_m) - ß)$ eqn. xx

d) After deducting all these components, the remaining return is the net superior return due to selectivity and is given by

Net portfolio return due to selectivity = $(R_p - r_f) - (\sigma_p / \sigma_m)(r_m - r_f)$ eqn. xxi

A positive value for the fourth component indicates the superior portfolio performance due to stock selection techniques. One sample two-tailed test has been used to see whether the mean value of 'net portfolio return due to selectivity' is significantly different from zero.

3. RESULTS AND DISCUSSIONS

The results of the evaluation have been presented in Table I. Out of 23 portfolios constructed 14 (60.87 per cent) have posted positive return. The average weekly returns of the constructed portfolios vary from –1.71 per cent to 2.61 per cent. The average value of the weekly return for all the portfolios is 0.1739 per cent. When one sample t-test is used on the return data for all the portfolios, it is found that the returns are not significantly different from zero at 10 per cent level of significance. Portfolio variance is observed to be 13.06 and 124.60 at the minimum and maximum level among the various constructed portfolios. Beta of the portfolios ranges between 0.20 and 1.43. Two portfolios have a beta value of one. No constructed portfolio has negative beta during the year following its construction. R_f is the average weekly risk free return, which is represented by yield to maturity of 365 days Government of India Treasury bill of the relevant period. R_m is the average weekly return on Sensex. A wide variation is observed in this return between –0.53 and 0.85 at the lowest and highest level. Market variance at its lowest ebb happens to be at 14.75 and highest level is observed at 22.44.

SI, in the table, represents the Sharpe's index. The value is negative in case of the 43.48 percent of the constructed portfolios. Negative value of SI indicates that the risk premium generated by the portfolios for the assumption of total risk by the investors is not only insufficient but also negative. Therefore, a good majority of the constructed portfolios have produced negative risk premium. However, when a one-sample t-test is performed on the SI values, the average value of SI is found to be 0.0122 and the value of SI is not found to be significantly different from zero at 10 per cent level of significance. BMS represents the benchmark for Sharpe's Index. The benchmark, here, is the additional return of the market over risk free return related with market portfolio's total risk. To evaluate performance of the portfolio vis-à-vis market, the value of SI for a portfolio is compared with the benchmark for Sharpe's Index. The positive or negative value of the difference between SI and BMS indicates whether the portfolio is outperforming or underperforming the market, respectively. It is clearly evident from the table that in 65.22 percent of cases, the portfolios have outperformed the market, that is, the Sensex. This means that in case of these portfolios, the additional return of portfolio over the risk free return is more than the additional return of market over risk free return.

However, application of one sample t-test on SI-BMS values reveals that though average value of SI-BMS is 0.0353 (positive), but it is not significantly different from zero at 10 per cent level of significance.

TM represents the Treynor's measure. TM is indicative of the risk premium of the portfolio, where the risk premium equals the difference between the return of the portfolio and the risk free return. This risk premium is related to the amount of systematic risk assumed in the portfolio. The value of TM is also observed to be negative in 43.48 percent of the portfolios, which is the same as obtained in case of SI. This means that the risk premium generated by the portfolios for assumption of systematic risk is also negative in good majority of the portfolios during testing period. Again, though the average value of TM is –0.0014, it is not significantly different from zero at 10 per cent level of significance. BMT represents the benchmark for Treynor's measure. BMT is the excess of average market return over the average risk free return. As positive or negative value of the difference between TM and BMT indicates the superior or inferior performance respectively, of the portfolio in comparison with the market. 56.52 per cent of the total portfolios gave superior performance in comparison with the market. The average value of TM-BMT is found to be –0.0003. But t-test reveals that it is not significantly different from zero at 10 per cent level of significance.

Contrary to Sharpe and Treynor models, which are relative measures for ranking performance of various portfolios on a risk-return basis, Jensen Model attempts to construct a measure of absolute performance. Under this measure, the equilibrium average return on portfolio (EAR_p) provides the benchmark. This is the return the portfolio should earn with the given systematic risk. Alpha in the table represents the excess portfolio return over EAR_p. The positive value of Alpha is an indicator of the performance of a portfolio better than the market and vice versa. Thus the table clearly discerns that 56.52 per cent of the total portfolios have performed better than the market. The results obtained through this measure conform to the results obtained through Treynor's measure. The average value of Alpha is found to be 0.0008, but the value is not significantly different from zero at 10 per cent level of significance.

FM, in the table, represents the Fama's measure. A positive value for the net portfolio return due to selectivity (FM) indicates the superior portfolio performance due to superior stock selection techniques. Therefore, it can be inferred from the table that 65.22 per cent of the portfolios have posted positive net return due to selectivity. The average value of FM is 0.0018, but it is not significantly different from zero at 10 per cent level of significance.

Table I: Performance Evaluation of Portfolios Constructed through Sharpe's Approach during the Year following their Construction

Portfolio	Return (%)	Risk	Beta	Rf (%)	Rm (%)	Mar. Var.	SI	BMS	SI-BMS	TM	BMT	TM-BMT	EARp	Alpha	FM
S 1	-0.08	104.37	1.17	0.24	0.08	21.08	-0.0309	-0.0359	0.0049	-0.0027	-0.0016	-0.0010	0.0005	-0.0012	0.0005
S 2	0.60	42.37	1.02	0.17	0.27	14.75	0.0667	0.0271	0.0396	0.0043	0.0010	0.0032	0.0027	0.0033	0.0026
S 3	-0.43	63.61	1.43	0.16	-0.16	17.33	-0.0736	-0.0764	0.0028	-0.0041	-0.0032	-0.0009	-0.0030	-0.0013	0.0002
S 4	0.08	47.57	0.99	0.19	0.85	20.71	-0.0165	0.1444	-0.1609	-0.0011	0.0066	-0.0077	0.0084	-0.0076	-0.0111
S 5	-1.20	28.68	0.43	0.17	-0.53	22.44	-0.2562	-0.1489	-0.1073	-0.0320	-0.0071	-0.0250	-0.0013	-0.0107	-0.0057
S 6	0.28	49.74	0.53	0.16	0.02	15.62	0.0171	-0.0366	0.0537	0.0023	-0.0014	0.0037	0.0009	0.0020	0.0038
S 7	0.24	34.73	0.86	0.24	0.08	21.08	0.0007	-0.0359	0.0366	0.0000	-0.0016	0.0017	0.0010	0.0015	0.0022
S 8	1.08	26.67	0.95	0.17	0.27	14.75	0.1774	0.0271	0.1503	0.0097	0.0010	0.0086	0.0027	0.0082	0.0078
S 9	0.74	13.06	0.64	0.16	-0.16	17.33	0.1611	-0.0764	0.2374	0.0091	-0.0032	0.0122	-0.0004	0.0079	0.0086
S 10	0.30	28.99	0.47	0.19	0.85	20.71	0.0199	0.1444	-0.1246	0.0023	0.0066	-0.0043	0.0050	-0.0020	-0.0067
S 11	-1.61	124.60	0.37	0.17	-0.53	22.44	-0.1599	-0.1489	-0.0110	-0.0477	-0.0071	-0.0407	-0.0009	-0.0152	-0.0012
S 12	-0.17	17.31	0.20	0.16	0.02	15.62	-0.0812	-0.0366	-0.0447	-0.0170	-0.0014	-0.0156	0.0013	-0.0031	-0.0019
S 13	-1.71	81.46	1.02	0.24	0.08	21.08	-0.2164	-0.0359	-0.1805	-0.0192	-0.0016	-0.0175	0.0007	-0.0178	-0.0163
S 14	2.61	46.34	0.72	0.16	-0.16	17.33	0.3605	-0.0764	0.4369	0.0341	-0.0032	0.0372	-0.0007	0.0268	0.0297
S 15	1.81	65.16	1.00	0.19	0.85	20.71	0.2011	0.1444	0.0566	0.0162	0.0066	0.0097	0.0085	0.0097	0.0046
S 16	-0.69	75.52	1.37	0.17	-0.53	22.44	-0.0989	-0.1489	0.0499	-0.0063	-0.0071	0.0008	-0.0079	0.0011	0.0043
S 17	0.70	50.24	0.55	0.16	0.02	15.62	0.0759	-0.0366	0.1124	0.0098	-0.0014	0.0112	0.0008	0.0062	0.0080
S 18	-0.72	46.44	0.95	0.24	0.08	21.08	-0.1402	-0.0359	-0.1043	-0.0101	-0.0016	-0.0085	0.0008	-0.0080	-0.0071
S 19	0.77	29.83	1.00	0.17	0.27	14.75	0.1101	0.0271	0.0829	0.0060	0.0010	0.0050	0.0027	0.0050	0.0045
S 20	0.83	21.87	0.94	0.16	-0.16	17.33	0.1427	-0.0764	0.2191	0.0071	-0.0032	0.0103	-0.0014	0.0097	0.0102
S 21	1.20	39.72	0.71	0.19	0.85	20.71	0.1608	0.1444	0.0163	0.0142	0.0066	0.0076	0.0066	0.0054	0.0010
S 22	-1.18	45.19	0.99	0.17	-0.53	22.44	-0.2016	-0.1489	-0.0528	-0.0137	-0.0071	-0.0067	-0.0052	-0.0066	-0.0035
S 23	0.55	39.33	0.49	0.16	0.02	15.62	0.0623	-0.0366	0.0989	0.0079	-0.0014	0.0093	0.0009	0.0046	0.0062
Average Value	0.1739						0.0122		0.0353	-0.0014		-0.003		0.0008	0.0016
t- Statistic	0.786						0.381		1.209	-0.379		-0.101		0.392	0.945
Significance Level (2-Tailed)	0.44						0.707		0.239	0.708		0.921		0.699	0.355

Rf – Risk free return, Rm – return on market portfolio, Mar. Var. – market variance, SI – Sharpe's index, BMS – benchmark for Sharpe's index, TM – Treynor's measure, BMT – benchmark for Treynor's measure, EARp – equilibrium average return on portfolio, FM – Fama's measure

4. CONCLUSION

Thus based on all the four models of portfolio evaluation, it can be concluded that in case of 56.52 to 65.22 per cent of the portfolios, the performance appears to be superior to the market. However, it is not significantly superior at 10 per cent level of significance.

BIBLIOGRAPHY

i) Elton, Edwin J.; Gruber, Martin J. and Padberg, Manfred W., " Simple Criteria for Optimal Portfolio Selection with Upper Bounds", Operations Research, Nov.-Dec., 1977, pp. 952-967.

ii) Bawa, Vijay S.; Elton, Edwin J. and Gruber, Martin J., " Simple Rules for Optimal Portfolio Selection in Stable Paretian Markets", The Journal of Finance, Sept. 1979, pp. 1041-1047.

iii) Faaland, Bruce H. and Jacob, Nancy L., " The Linear Fractional Portfolio Selection Problem", Management Science, December 1981, pp. 1383-1389.

iv) Chen, Son-Nan and Brown, Stephen J., " Estimation Risk and Simple Rules for Optimal Portfolio Selection", The Journal of Finance, Sept. 1983, pp. 1087-1093.

v) Madhusoodanan, T.P., " Optimal Portfolio Selection: A Performance Analysis with Indian Stock Market Returns", The ICFAI Journal of Applied Finance, July 1996, pp. 121-137.

vi) Chaudhary, Ashish and Barua, Amarjyoti et al, " Portfolio Building: Theory and Practice", Chartered Secretary, Dec. 1998, pp. 1278-1283.

vii) Bansal, S.P. and Gupta, Sunil, " Portfolio Management – The EPG Approach", Finance India, Dec. 2000, pp. 1143 – 1153.

viii) Fischer, Donald E. and Jordan, Ronald J., Security Analysis and Portfolio Management, Prentice Hall of India Private Ltd., N. Delhi Publication, 2000 Ed., pp.598-602.
ix) Sharpe, W.F. and Alexander, Gorden J., Investment, Prentice Hall of India, New Delhi, 1994.
x) Sharpe, W.F. and Alexender, Gorden J., Op cit. p.205.
xi) William F. Sharpe, " Mutual Fund Performance", The Journal of Business, 39, Number 1 (January 1966), pp. 119-138.
xii) Eugene Fama, " Components of Investment Performance," Journal of Finance, June 1972, pp. 551-567.

APPENDIX

Sample 1 Securities

1. ACC
2. Adani Export
3. Apollo Tyres
4. Arvind Mills
5. Ashok Leyland Ltd.
6. Asian Paints (India) Ltd.
7. Atlas Copco Ltd.
8. Bajaj Auto Ltd.
9. BHEL
10. BILT
11. BSL LTD.
12. Cadbury India Ltd.
13. CEAT Ltd.
14. Chennai Petroleum Corporation Ltd.
15. Colgate Palmolive Ltd.

Sample 2 Securities

1. EIH LTD.
2. Escorts Ltd.
3. Grasim Industries Ltd.
4. Gujarat Ambuja Cements Ltd.
5. Gujarat State Fertilizers and Chemicals Ltd.
6. HDFC LTD
7. HINDALCO
8. Hindustan Petroleum Corporation Ltd.
9. HLL
10. Indian Hotels Ltd.
11. Indian Rayon and Industries
12. IPCA Labs Ltd.
13. ITC LTD.
14. J K Corp Ltd.
15. Kochi Refineries Ltd.

Sample 3 Securities

1. L&T LTD
2. Modi Rubber Ltd.
3. Mukand Ltd.
4. Nestle India Ltd.
5. Otis Elevator
6. PFIZER
7. Polychem Ltd.
8. Raymond Ltd.
9. Heatshrink Technologies Ltd.
10. Sakthi Sugars Ltd.
11. Siemens India Ltd.
12. Glaxosmithkline Consumer Healthcare Ltd.
13. Sun Pharmaceuticals Ltd.
14. Tata Chemicals Ltd.
15. Textool Company Ltd.
16. TISCO
17. Tube Investments of India Ltd.
18. Uttam Steel
19. VOLTAS
20. WIPRO