Risk-Return Analysis of BSE Sensex Companies

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INTRODUCTION

Investment in securities market requires the study of the relationship between risks and returns. Researchers in securities market have attempted to understand the relationship between risk and returns and the way securities are priced in the market. These researchers have assumed rational investors and constructed the general equilibrium models of security prices and returns. Sharpe (1964), Lintner (1965) and Mossin (1968) have independently developed the standard form of general equilibrium model for asset returns in securities market. This model has come to be known as Sharpe-Lintner-Mossin form of Capital Asset Pricing Model (CAPM).This model is based on many assumptions about capital market. However, it was served to understand the complex relationship between securities returns and risks. To make this model reflective of the real life situations, researchers have attempted to relax some of the assumptions of the standard form of CAPM. Some of the assumptions relaxed by the researchers are absence of personal taxes, unrestricted borrowing and lending at risk-less rate of return, and homogeneous expectations of investors about risks and returns. The studies conducted by Brennan(1971), Black(1972), Fama and Macbeth(1973), Black, Jensen and Scholes (1972), Fama and French(1992,1996) have focused on some of the issues related to CAPM. Research findings of these studies have been debated again and again. The empirical evidence against the CAPM by Fama and French (1992) has generated a lot of debate in the west and has called for major re-examination of the CAPM model. While many studies have been conducted on CAPM in the capital markets of the western countries, there are few studies in the Indian context. Studies by Varma (1988), Yalwar (1988), Srinivasan (1988) have generally supported the CAPM theory. Sudies by Basu (1977), Gupta and Sehgal (1993), Vaidyanathan(1995), Madhusudhan (1997), Sehgal(1997), Ansari(2000), Rao(2004), Manjunatha and Mallikarjunappa (2006,2007)have questioned the validity of CAPM in Indian markets. But Ansari (2000) has opined that the studies of CAPM on the Indian markets are scanty and no robust conclusions exist on this model. In the light of these findings, a sample of Bombay Stock Exchange SENSEX companies listed on the Bombay Stock Exchange have been selected for studying the risk-return relationships. These companies have been selected based on their importance in the early part of the 2000s.

OBJECTIVES

This study is undertaken with the following objectives:

1. To ascertain the relationship between returns of securities and market returns.
2. To test the empirical validity of the standard CAPM model in the Indian context.

HYPOTHESES

The findings of many of the western researchers have supported the CAPM. But the more recent findings of Fama and French (1992, 1996) have doubted the validity of the CAPM. Researchers are still working to find the reasons for contrary conclusions by Fama and French (1992, 1996). Based on the available evidence on the CAPM, the following hypothesis is formulated.

Ho: There is no positive relationship between the expected return on securities and their betas. This hypothesis is proposed to be tested in the Indian context.

DATA AND METHODOLOGY

SAMPLE

The sample for this study is 30 companies which are listed on the BSE and included in BSE sensitive index, referred to as the Sensex.

DATA

The daily closing pricing of the companies and the Sensex were taken from the CMIE data base and BSE websites. The daily price data for the period January 1993 to December 2008 were collected to estimate the

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Alpha and Beta of the Model. The daily prices have been adjusted for stock split, bonus and right issues. The sample size represents the broad spectrum of aggregate wealth. The 30 companies of the Sensex represent almost 50% of the BSE total market capitalization. These firms are engaged in various industrial and trading activities like automobile, bank, cement, engineering, entertainment, FMCG, housing finance, information technology, Oil, petroleum, pharma, power, steel, telecommunications etc. The number and diversity of the assets represented by these companies' leads us to speculate that the size taken as a whole is an approximately efficient portfolio of securities. The proxy used for the return on the agrregate economic wealth is BSE Sensitive Index of Equity prices (base year1978-79=100) which is also taken daily for the period January 1993 to December 2008. BSE sensitive index returns corresponding to each company are used as market returns. The risk-free rate of return is taken as 8.22 % per annum (0.022833% per day), which was the yield of Govt. of India securities for most part of the study period. Since this is the maximum rate of returns an investor can get without assuming any risk, this rate has been chosen as risk-free rate.

METHODOLOGY PHASE I: TIME SERIES REGRESSION

The Phase 1 of the CAPM test consists of Time Series regression for each security and a simple regression is run over time. Over the years, researchers have used quarterly, monthly, weekly or daily data to study relationship between risk and return. We feel that quarterly, monthly, weekly data do not provide more meaningful relationship between risk and return; hence, daily prices/indices were used in this study.

The returns of companies and market are calculated using the arithmetic mean. Various risk measures like standard deviation, variance and beta, alpha have been used for measuring the risks. The returns are calculated using the following models:

$$Rit = \frac{Pit - Pit\text{-}1}{Pit\text{-}1} \qquad Rmit = \frac{Iit - Iit\text{-}1}{Iit\text{-}1} \qquad \ldots(1)$$

Mean return of security i is given by:

$$Ri = \frac{\sum_{t=1}^{N} Rit}{N}$$

Mean return of market m is given by:

$$Rm = \frac{\sum_{t=1}^{N} S\,Rmt}{N} \qquad \ldots(2)$$

Risk measures are calculated using the following models:

Variance is given by:

$$\sigma i2 = \frac{\sum_{i=1}^{N} (Rit - Ri)2}{N}$$

$$\text{Standard Deviation} = \sigma i = \sqrt{\frac{\sum_{i=1}^{N} (Rit - Ri)^2}{\sqrt{N}}} \qquad \ldots(3)$$

Where,

Rit = Return on security i during time period t.; Rmt =Return on market index (BSE Sensitive Index) m during time period t.

Pit = Closing price of security i for time t ; Pit-1 =Closing price of security i for time t-1

Iit = Closing value of market index corresponding to the period of security i for time t

Iit-1 = Closing value of market index corresponding to the period of security i for time t-1

N = Number of observations

Standard Deviation and Variance of market returns are calculated in a similar way.

Sharpe's Single Index model is used to represent expected returns on security. The risk measures like beta, systematic risk and unsystematic risk are calculated using this model. Alpha, the intercept in Sharpe's model, and risk-free rate of return in CAPM model, is also computed using this model. The Single Index Model is:

$Ri = \alpha i + \beta i\ Rm + ei$, for i =1,…N. …(4)

Mean of (ei) = E(ei) = 0 ; Variance of ei = E(ei2) = $\sigma ei\ 2$;

Variance of Rm = E (Rm - Rm) 2 = $\sigma m2$

Variance of security i is: $\sigma i2 = \beta i2\ \sigma m2 + \sigma ei\ 2$

Where,

Ri = Expected return on Security 'i'; αi = Intercept of a straight line or alpha coefficient of security i;

βi = Slope of a straight-line or beta coefficient of security i; Rm = Expected return on index m

ei = Error term with mean zero and a standard deviation which is constant. This term captures the variations in security i that are not captured by the market index m; σm = Standard deviation of market index m

$\sigma m2$ = Variance of market index m.

Mean Return = $Ri = \alpha i + \beta i\ Rm$

$$\text{Beta} = \beta i = \frac{N \sum_{t=1} Rmt\ Rit - \left(\sum_{t=1} Rmt\right)\left(\sum_{t=1} Rit\right)}{N \sum_{t=1} (R2mt) - \left(\sum_{t=1} Rmt\right)2} \quad \text{….(5)}$$

$$\text{Alpha} = \alpha i = (Rit - \beta i\ Rmt) \quad \text{…(6)}$$

$$\text{Total Risk of i is: } \sigma i2 = \beta i2\ \sigma m2 + \sigma ei\ 2 \quad \text{…(7)}$$

Total Risk = Systematic Risk + Unsystematic Risk

Systematic Risk of security i = $\beta i2\ \sigma m2$

The Unsystematic risk of the security i is: $\sigma ei\ 2 = \sigma i2 - \beta i2\ \sigma m2$

N = Number of pairs of observations

Given the assumption of market model, equation (4) is a regression equation in terms of the realized returns .If market model and equation (4) are valid, then the intercept (αi) will be zero. Thus, a direct test of the model can be obtained by estimating equation (4) for a security over some time period and testing to see if ai is significantly different from zero.

The intercept (αi) and Beta (βi) measures are presented in Table 2.

METHODOLOGY PHASE: II

CROSS SECTIONAL REGRESSION

In Phase II of the study, the set of all stocks are arranged in ascending order of Beta and portfolios of 5 stocks are made. Each portfolio is assumed to consist of 5 stocks with equal weightage. The portfolio beta and the realized returns of each portfolio are calculated by using the following formula:

$$\beta p = \sum_{j=1}^{5} Wi\ \beta i \quad \text{….(8)}$$

$$Rp = \sum_{j=1} Wi \; Ri \qquad \ldots.(9)$$

Where βp is the portfolio Beta, βi is Beta of individual stock, Rp is portfolio return and Ri is the return on individual stock. Then second pass regression is run for the following:

$$(Rp- Rf)=Yo+Y1\ \beta p+ ei \qquad \ldots.(10)$$

Where Rf is risk free rate and Yo and Y1 are estimates for intercept and slope.

If the CAPM holds good, we expect Yo not to be significantly different from zero and Y1 to be equal to (Rm-Rf), where Rm is the market return and Rf is the risk free rate. The calculations are presented in Table 4a and 4b. The realized portfolio returns are calculated for the period between January 1, 2004 to February 19, 2004 by using formula (10).

ANALYSIS OF RESULTS

As already pointed out, CAPM model depicts the direct relationship between returns and beta. Investment in equity market presupposes the existence of risk for which higher returns are expected. Further, investors in equities and market index expect higher returns than risk-free returns in the long-run. Otherwise, nobody will invest in risky assets like equities and market indices. The results of these computations for Sensex companies are shown in Tables 1 and 2.

Table 1: Shows Alpha and Beta Measures of Companies

Companies	Beta arranged in ascending order	Alpha
Housing Development Finance Corpn. Ltd.	0.302468	0.113858
Cipla Ltd.	0.387331	-0.00269
H D F C Bank Ltd.	0.443765	0.056849
Hindalco Industries Ltd.	0.546412	0.106022
Bajaj Auto Ltd.	0.619725	0.15934
I T C Ltd.	0.655025	0.004737
Ranbaxy Laboratories Ltd.	0.688663	0.099379
Bharti Tele-Ventures Ltd.	0.702696	0.153909
Dr. Reddy's Laboratories Ltd.	0.734289	0.018026
Reliance Energy Ltd.	0.745326	0.117079
Grasim Industries Ltd.	0.794733	0.177758
Gujarat Ambuja Cements Ltd.	0.826797	0.008633
Oil and Natural Gas Corpn. Ltd.	0.843691	0.284472
Larsen and Toubro Ltd.	0.851288	0.115321
I C I C I Bank Ltd.	0.892943	0.159349
State Bank Of India	0.905889	0.120589
Bharat Heavy Electricals Ltd.	0.932807	0.168189
Mahanagar Telephone Nigam Ltd.	0.943771	-0.06236
Hindustan Lever Ltd.	0.970752	-0.11873
Hero Honda Motors Ltd.	1.012585	0.022988
Hindustan Petroleum Corpn. Ltd.	1.049707	0.146233
Tata Power Co. Ltd.	1.054472	0.082607
Associated Cement Cos. Ltd.	1.106199	-0.01164
Reliance Industries Ltd.	1.179615	-0.00184
Tata Iron and Steel Co. Ltd.	1.216643	0.202383
Tata Motors Ltd.	1.229644	0.176559
Zee Telefilms Ltd.	1.441597	-0.05907
Wipro Ltd.	1.464556	-0.11882
Infosys Technologies Ltd.	1.465593	-0.07347
Satyam Computer Services Ltd.	1.994023	-0.09684

Table 2: Shows Number of Companies Having Positive/ Negative Values of Returns, Risk, Alpha and Beta Measures of Companies

Description of the Results	σI	σi2	Alpha = αI	Beta = βI	Realized returns
Positive Values	30	30	27	30	16
Negative Values	0	0	3	0	14
Total	30	30	30	30	30
Maximum Value	3.26819	10.6810	0.284472	1.994023	1.17272
Minimum Values	1.61553	2.60994	-.11882	0.302468	-0.50146

RISK (STANDARD DEVIATION AND VARIANCE) V/S. REALIZED RETURNS

Generally, we can expect a positive relationship between risk and returns. The results show that the realized daily returns of companies vary between -0.50146 and 1.17272 and standard deviation (SD) of returns vary between 1.61553 and 3.26819. The results indicate that companies, which recorded highest (lowest) returns, have not recorded highest (lowest) SD. All companies have yielded very low returns. The analysis of Table 2 shows that all the companies have yielded lower returns than the risk-free rate as well as the market rate. The comparison of weekly returns of companies with those of market index shows that 14 out of 30 (47%) companies have negative returns but higher risk than that of the market. The remaining 16 (53%) companies have lower returns and risk than those of the market. This indicates that investors have lost more with assuming higher risk in 47% of the cases.

BETA VS. REALIZED RETURNS

CAPM theory has established a direct positive relationship between returns and beta of the securities. As discussed in Part 1, while some studies have concluded that this relationship holds well in reality, others have challenged and disagreed. The results shows that the realized daily returns of companies vary between -0.50146 and 1.17272 and Beta of securities vary between 0.302468 and 1.994023. The results indicate that companies, which recorded highest (lowest) returns, have not recorded highest (lowest) Beta. All companies have yielded lower returns. The analysis of Table 2 shows that all the companies have yielded lower returns than the risk-free rate as well as the market rate. The comparison of weekly returns of companies with those of market index shows that 14 out of 30 (47%) companies have negative returns but higher betas. The remaining 16 (53%) companies have lower returns with positive betas . This indicates that investors have lost more with assuming higher risk in 47% of the cases. The values presented in Table 2 reveal that the mean returns of the companies have very low inverse relationship with beta. The unusually high number of high betas (11 out of 30) pose problem about generalizing this relationship.

PORTFOLIO BETA VS. REALIZED PORTFOLIO RETURNS

The Phase II results of cross sectional regression shows that the realized daily returns of companies vary between -0.30935 and 0.392165, and Beta of portfolios vary between 0.45994 and 1.519083. The results indicate that portfolios, which recorded highest (lowest) returns, have not recorded highest (lowest) portfolio Beta. All portfolios have yielded lower returns. The analysis of Table 3 shows that all the companies have yielded lower returns. The comparison of realized portfolio returns and betas show that 16 out of 55 (29%) portfolios have negative returns with positive portfolio betas. The remaining 39 (71%) portfolios have lower returns with positive betas. This indicates that investors have lost more with assuming higher risk in 29% of the cases. The values presented in Table 3 reveal that the mean returns of the portfolio have a very low inverse relationship with portfolio beta. From this we can conclude that the linear (positive) relationship between beta and returns is questionable. This casts a shadow on CAPM. The unusually high number of high betas (16 out of 55) pose problem about generalizing this relationship.

SUMMARY AND CONCLUSIONS

Investments are made in stock markets in expectation of returns in excess of the risk-free rate. This investment naturally involves assuming some risks. Therefore, it is important to understand the rate of returns and the degree of risks to be assumed. Rational investors would assess the risk-return profiles of securities before choosing the securities. Different measures have been used for assessing these. This paper has attempted to assess the risk-returns relationship of automobile companies listed on the BSE. Arithmetic average is used as a measure of

return, and risks are computed using standard deviation, variance and other measures. Further, taking Sensex as the market index, and using Sharpe's Single Index model, the risk measures like beta, systematic risk, and unsystematic risk are worked out. Returns of companies are compared with the risk-free returns, market returns and various measures of risk.

Table 3: Shows Number of Portfolios Having Positive/ Negative Values of Realized Returns and Beta Measures of Portfolios

Description of the Results	Realised Portfolio returns (Rp)	Realised Portfolio returns (Rp-Rf)	Portfolio Betas
Positive Values	39	39	55
Negative Values	16	16	
Total	55	55	55
Maximum Value	0.414998	0.392165	1.519083
Minimum Values	-0.28652	-0.30935	0.45994

When returns and standard deviations of different companies are compared with the corresponding returns and standard deviations of the market, 14 out of 30 (47%) companies have shown negative returns but higher standard deviations than those of corresponding market measures.

When returns and beta of different securities are compared with the corresponding returns and beta of the market, 14 out of 30 (47%) companies have shown negative returns but higher beta than those of corresponding market measures.

When returns of different portfolios are compared with the corresponding betas portfolio, 16 out of 55 (29%) portfolios have shown negative returns but positive portfolio betas.

The conclusions of this study are:

1. Returns are insignificantly correlated with betas.
2. Portfolio Returns are insignificantly correlated with portfolio betas.

The empirical line is different from actual CAPM line suggested by the theory. The discrepancy may be due to non-holding of fundamental assumptions in practice. As outlined earlier, there are several unrealistic assumptions behind CAPM such as free availability of information, homogeneous expectations etc. Further, the CAPM model is a static and partial model and does not capture the entire dynamics involved .To improve the explanatory power of the CAPM model, a new model that has incorporated system dynamics has to be developed.

Further study is warranted on a bigger sample, incorporating correction for beta -the spirit of Blume's latest findings. However, the central aspect of this paper is only to study whether CAPM can be applied to Indian capital market. Although it does not hold good exactly, the spirit of CAPM is holding good, in so far as realized returns are functions of systematic risk. With market information technology, innovation in capital market and economic rationality in decision making, the empirical line is expected to close into CAPM line in the long run.

Table 4: Shows Various Portfolios- Alpha and Beta Measures Without Risk Free Rate of Returns

Portfolio Return(Rp)	Alpha	Alpha SE	Alpha t-value	Beta	Beta SE	Betat-values
26 portfolios	0.073628	0.098399	0.748261	0.028036	0.103145	0.271811
29 portfolios	1.077907	0.448951	2.400944	-1.0784	0.478128	-2.25546
55 portfolios	0.140114	0.116709	1.20054	-0.06162	0.123358	-0.49951

Explanations for Tables-1, 2

No. of observations (Daily) taken for computing various measures = Ni

Return on security i = Ri

Return on market index m = Rmi standard deviation of returns on company security = σI; variance of company = σiz

Positive values denote the No. of observations having positive values for the respective variables. Negative values denote the No. of observations having negative values for the respective variables.

Beta = βi; alpha = αI; Rf = Risk-free rate of Return (0.022833% per day in this paper)

Table 5: Shows List of Companies Studied and Industry Category

	Company Name	Industry category
1	Associated Cement Cos. Ltd.	Cement
2	Bajaj Auto Ltd.	Automobile
3	Bharat Heavy Electricals Ltd.	Engineering

4	Bharti Tele-Ventures Ltd.	Telecommunication
5	Cipla Ltd.	Pharma
6	Dr. Reddy's Laboratories Ltd.	Pharma
7	Grasim Industries Ltd.	Cement
8	Gujarat Ambuja Cements Ltd.	Cement
9	H D F C Bank Ltd.	Banking
10	Hero Honda Motors Ltd.	Automobile
11	Hindalco Industries Ltd.	Cement
12	Hindustan Lever Ltd.	FMCG
13	Hindustan Petroleum Corpn. Ltd.	Petroleum
14	Housing Development Finance Corpn. Ltd.	Housing Financial Institution
15	I C I C I Bank Ltd.	Banking
16	I T C Ltd.	FMCG
17	Infosys Technologies Ltd.	Information Technology
18	Larsen and Toubro Ltd.	Cement
19	Mahanagar Telephone Nigam Ltd.	Telecommunication
20	Oil and Natural Gas Corpn. Ltd.	Oil and Gas
21	Ranbaxy Laboratories Ltd.	Pharma
22	Reliance Energy Ltd.	Power
23	Reliance Industries Ltd.	Textile and Petroleum
24	Satyam Computer Services Ltd.	Information Technology
25	State Bank Of India	Bank
26	Tata Iron and Steel Co. Ltd.	Steel
27	Tata Motors Ltd.	Automobile
28	Tata Power Co. Ltd.	Power
29	Wipro Ltd.	Information Technology
30	Zee Telefilms Ltd.	Entertainment
31	**BSE Sensitive Index**	

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