Testing Of Capital Asset Pricing Model (CAPM) During An Upward Trend In The Indian Stock Market

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INTRODUCTION

The past few decades have witnessed economists, statisticians and financial experts taking keen interest in developing and listing models about the stock price behaviour in the capital markets. Such a keen interest has led to greater application of the tools and techniques of contemporary investment management in a quest to outperform the benchmark of the market. This paper tests whether Capital Assets Pricing Model (CAPM) holds in the Indian stock market by applying the test for the intercept and the slope for the standard form of CAPM. Now- a- days, people are more interested and attracted towards capital markets than ever before, Today's well regulated market has given more scope for proper valuation of securities and is a safer and more transparent place where they can materialize the gains of their transactions, which are affected to a lesser degree by the erratic market movements.

CAPITAL ASSET PRICING MODEL (CAPM)

The Capital Assets Pricing Model was developed in mid-1960s by three researchers - William Sharpe, John Lintner and Jan Mossin independently. Consequently, the model is often referred to as Sharpe-Lintner-Mossin capital assets pricing model. The capital Assets Pricing Model or CAPM is really an extension of the portfolio theory of Markowitz. The portfolio theory is a description of how rational investors should build efficient portfolios and selects the optimal portfolio; the capital asset pricing model drives the relationship between the expected return and risk of individual securities and portfolios in the capitals markets if everyone behaved in the way the portfolio theory suggested.

$$E(R_i) = r_f + \beta_i (E(R_m) - R_f) \quad \text{... (1)}$$

Where $E(R_i)$ is the expected return on security i, $E(R_m)$ is the expected return of the market portfolio, r_f is the risk-free rate and β_i is a measure of risk for security i.

ASSUMPTIONS

Some assumptions relating to CAPM are summarized as below:

1. An Investor evaluates portfolios by looking at the expected returns and standard deviations of the portfolios over a one - period horizon.

2. Investors are never satiated, so when given a choice between other two otherwise identical portfolios, they will choose the one with the higher returns.

3. Investors are risk-averse, so when they are offered a choice between two otherwise identical portfolios, they will choose the one with lower standard deviations.

4. Individual assets are infinitely divisible, meaning that an investor can buy a fraction of shares if he or she desires.

5. There is risk free rate at which an investor may either lend (that is, invest) or borrow money.

6. Taxes and transactions costs are irrelevant.

In addition to the above, the following assumptions are added:

7. All investors have the same one-period horizon.

8. The risk free rates are the same for all the investors.

9. Information is freely and instantly available to all investors.

10. Investors have homogenous expectations, meaning that they have the same perceptions in regard to the expected returns. Standard deviations and covariance's of securities.

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REVIEW OF LITERATURE

In the literature, several hypotheses have been advanced to test the adequacy of the CAPM in describing asset return. These includes:

(i) Stock return bears a linear relation with its betas (β).
(ii) Higher return is associated with higher risk;
(iii) Non market risks cannot be priced in equilibrium.
(iv) Investment ensures a fair game model in a general equilibrium framework.
(v) Firm-specific risk is uncorrected to average return.

If the result supports any of these hypotheses, then the CAPM is considered as a valid in describing asset return. All the above mentioned hypotheses, either directly or indirectly attempts to establish that the variation of stock return is only due to variation in the stock market index. But in reality, the stock return variation may be influenced by many other potential factors such as the presence of derivatives securities, dividend and uncertain inflation. For instance, a rational investor may attempt to plan a strategy where his investment may earn profits in both bullish (rising) influenced by many other potential factors such as the presence of derivative securities, dividend and uncertain inflation. For instance, a rational investor may attempt to plan a strategy where his investment may earn profits in both bullish (rising) and bearish (falling) market trend. For this purpose, he may resort to combine his securities with deviate securities such as option and futures. In pursuit of this objective, he can undertake an option contract where he can have the option of either to sell or not to sell his securities at a specified price during or at the end of certain period of time.

Many tests have been performed on the CAPM which have shown both its validity as well as have challenged it.

❁ **Sriniwas and Sivakumar (2004)** explained the importance of estimating the required rate of return for investment analysis and portfolio management. It discusses the CAPM model and its significance in estimating the required rate of return. Taking clue from the study by the paper empirically tests the validity of CAPM during down trends in the Indian stock market. The study clearly shows that it would be difficult to accept the validity of CAPM in the Indian capital market, even during down trends.

❁ **Yurtsever and Zahor (2007)** empirically tested CAPM in the Indian Capital Markets, even during down trends using UK Stock Market Data-set. We have checked whether higher risk is associated with higher expected return and risk-aversion. We have found evidence that the relationship between the expected return on a security and its risk is non-linear for individual securities and neutral for portfolios. The condition that higher risk is associated with higher expected return and risk-aversion is applicable to securities and not to portfolios. Therefore, our empirical results show that the relevance of the CAPM is none.

❁ **Dhankar and Kumar (2007)** examined the monthly return of composite portfolio of 100 stocks of BSE 100 for the period from June 1996 to May 2005. It involves the testing of relationship between risk and return of stocks of 100 companies and a set of ten portfolios. The empirical findings are in favor of the model by asserting a positive and linear relationship between risk and return. The study also reports that as diversification is carried out, non-market risks successively decline. These findings support CAPM in the Indian stock market in establishing a trade-off between risk and return. It provides how a risky security is priced in competitive capital markets.

❁ **Manjunatha, Mallikarajunappa and Begum's (2007)** paper tested whether capital Asset Pricing Model (CAPM) holds in the Indian market by applying the test for the intercept and the slope for the standard form of CAPM. The result of the study indicates that the intercept is significantly different form risk-free rate of return and the slope is not equal to the difference between the market returns and the risk-free rate of returns. Therefore, both the intercept and slope tests indicate that the CAPM does not hold in the Indian context. The result also shows that there is inverse relationship between the portfolio returns and their betas. Further, low beta portfolios have yielded higher returns than the high beta portfolios. One of the reasons for this inverse relationship between returns and betas could be the short period considered for the study.

RESEARCH METHODOLOGY

The current study was undertaken with the objectives of empirically testing the validity of CAPM during the upward trends in the Indian stock market.

❁ The study is based on BSE Sensex companies that were part of the index from the beginning - 1 July, 2007 to 31

Dec., 2007. The Sensex consisted of 30 companies. However, the other companies that replaced a number of companies that were a part of the Sensex during a different time in history of the index have been included in the study. The final list of 30 companies was drawn up based on two criteria **(a)** The companies selected should have been constituents of the BSE Sensex, and **(b)** They should have traded for a minimum of one week in the six months in a year during the study period.

The final list of 30 companies was drawn up based on two criteria **(a)** The companies selected should have been constituents of BSE Sensex, and **(b)** They should have traded for a minimum of one week in the six months in a year during the study period. For the purpose of analysis, weekly returns were used.

$$R_{it} = \left(\frac{Pt}{P_{t-1}}\right) \times 100 \qquad \text{..... (1)}$$

Where, R_{it} is return on stock i in time period t, P_t is the opening price.

The same method has been used for calculating the return on market index (BSE 30). Symbolically, it can be written as:

$$X_t = \left(\frac{I_t}{I_{t-1}}\right) \times 100 \qquad \text{..... (2)}$$

Where X_t is return on index, I_t is closing number, and I_{t-1} is the opening number. The CAPM asserts that return on security i, R_{it} in time period t is a linear function of market return X_t and independent factor unique to security i.e. symbolically, it can be written as: To conduct the test of camp, beta for each the securities was calculated by regressing weekly return of these securities on the corresponding return of market index (first pass regression over the six month period by using the following market model.

Equation relates to the expected return of i_{th} security to two principal factors viz., market independent factor α_i and the market related factor β_i. The independent factor is unique to i_{th} security while β_i exhibits the systematic influence of general market movements on i_{th} security.

The expected return of portfolio $R\rho$ is given by:

$$E(R_\rho) = \sum_{i=1}^{n} W_i\alpha_i + W_i\beta_i\overline{R}_m \qquad \text{..... (3)}$$

W_i is the value weighted proportion of i_{th} security such that $\sum Wi=1$. The Equation reveals that the expected return $E(R_\rho)$ is equal to the sum of security specific return and market related return of all securities in that portfolio. The variance (risk) of i_{th} security is given by:

Portfolio beta, β_p is defined as a weighted average of individual $\beta_{i's}$ on each security in the portfolio. That is,

$$\beta_\rho = \sum W_i\beta_i \qquad \text{..... (4)}$$

And similarly portfolio alpha (α) is given by :

$$\alpha_\rho = \sum W_i W_j\alpha_i \qquad \text{..... (5)}$$

$$E(R_\rho) = \alpha_\rho + \beta_\rho R_m \qquad \text{..... (6)}$$

$E(R_\rho)$ is the portfolio expected return which is equal to expected market return when $\alpha_\rho = 0$ and $\beta_\rho = 1$. In other words, when R_ρ is taken as market portfolio R_m .Then $\beta_\rho = 1$ assures the equality between expected return of a portfolio R_m and market portfolio. Hence, market portfolio $\beta_\rho\,\sigma$ must be equal to one, further, if a portfolio's $\beta_\rho > 1$, then that portfolio is considered as risky (i.e. aggressive portfolio) while $\beta_\rho < 1$ accepts a portfolio as less risky (i.e. defensive portfolio) than market portfolio. By

$$\beta = \frac{n\sum xy - (\sum x)(\sum y)}{n\sum x^2 - (\sum x)^2} \qquad \text{..... (7)}$$

Alpha (α) is a constant intercept indicating a minimum level of return that is expected from security i, if market

$$\alpha_i = Y - \beta_i X \quad \text{..... (8)}$$

remains flat (neither going up nor coming down), is calculated in this way:

The Equation formulates that the expected return on the i_{th} security is equal to return on risk free asset R_f plus proportional market risk premium (the difference between market index $E(R_m)$ and riskless return (R_f) or βi. This equation is popularly referred to as capital Asset Pricing Model (CAPM) or otherwise, security market line. It gives the expected return for all assets in the economy and is applicable to both efficient and non-efficient portfolios. Where, α_i is a constant intercept of security i, Y is mean return of security i, X is a mean market return of index, and β_i is the slope of security i. R is the correlation of coefficient.

$$R = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{n\sum x^2 - (\sum x)^2}\sqrt{n\sum y^2 - (\sum y)^2}} \quad \text{..... (9)}$$

Equation may be rewritten as:

$$E(R_i) = R_f + \beta[ER_m - R_f] \quad \text{..... (10)}$$

The Equation referred to as CAPM in risk premium form, and states that the expected security risk premium is equal to its β factor multiplied by the expected risk premium. This relation also holds goods for portfolios consisting of individual securities. Various researchers, however, considered CAPM in risk premium for as superior to the standard CAPM given in the equation.In order to provide focus to upward trend in the stock markets, an upwarding period was defined as a period wherein the value of the stock index is up at least by 10 percent. The index used for the study was BSE (Sensex) ordinary share index. This index is more representative than the other popular indices like the NSE Nifty. Thus upward in this index would represent broader based upward in the stock market values. Using this definition, six periods were identified (Table-1).

Table 1: Classification Of The Study Period Into Different Upwarding Periods

Sl. No.	Period	No. of days	Index values at beginning	Index value at end	Percentage upward
1	03-07-07 to 31-07-07	29	14664.26	15260.91	04.06
2	07-08-07 to 29-08-07	23	14903.03	14919.19	00.10
3	04-09-07 to 27-09-07	24	15422.05	16921.39	09.72
4	02-10-07 to 30-10-07	29	17328.62	19977.67	15.28
5	01-11-07 to 28-11-07	28	19837.99	19929.06	00.45
6	04-12-07 to 28-12-07	25	19603.41	20216.72	03.12

The next part in the study was to identify appropriate stocks for analysis, in order to keep the number of stocks at a manageable level, without sacrificing any statistical rigour, 30 stocks were selected for analysis. The next part was the calculation of the beta values for these stocks; a separate beta value was calculated for each these stocks (totaling to 6 beta values) for each of these up warding periods using a 6 months data. The weekly price and index data were used to calculate the beta values. The beta values thus calculated were arranged in order of increasing magnitude for each period. In the next part, equally weighted portfolios were constructed using these stocks, with each portfolio comprising of 6 stocks. As betas had been arranged in increasing order of magnitude, the first portfolio consisted of stocks with the lowest betas and every succeeding group consisted of stocks with higher betas, the average beta of each portfolio was calculated, next the returns of each stock during the declining periods studied were calculated. These individual returns were in turn converted into portfolio returns corresponding to the portfolios constructed in the previous part. In the final step, the portfolio betas and the portfolio returns were compared and analyzed (Table-2).

ANALYSIS OF RESULTS

In case of weekly data, 28 companies had positive beta values and its mean shows that there is positive relationship between stock return and market return. The remaining 2 companies had negative value of beta and its mean shows that there is negative relationship between individual stock return and market return. In the above Table 2 , the

Table 2: Distribution Of Estimated Betas

Value of Beta	Number of securities
	Weekly data
0.00-0.50	8
0.50-1.00	9
1.00-1.50	8
1.50-2.00	3
Negative value	2
Total	**30**

distribution of estimated betas of maximum companies (9 co.) comes under the value of beta 0.50-1.00 and few companies' (3 co.) come in the value of beta 1.50-2.00.

Table 3: Portfolio Returns And Betas In Different Upward Periods

Portfolio	Weekly Data	
	Mean Beta (βp)	Mean Return (R_p)
1	0.03	3.1806
2	0.45	15.729
3	0.73	25.5496
4	1.025	35.7485
5	1.475	52.4796

Under the CAPM, the portfolio with higher beta is expected to generate higher return and a low beta portfolio is expected to yield less return. Results indicate a positive risk-return relation as is evident from the slope coefficient of mean beta (βp) and mean return (Rp). Further results shoes that on the portfolio No. 1, βp is 0.03, the mean return (Rp) is 3.1806 and on the portfolio No. 5, the mean beta (βp) is 1.475 and mean return (Rp) is 52.4796.

Table 4 : Distribution of R^2

Values	No. of companies	Variance in the stock return
Less than .25	12	Low
.26 to .50	7	Moderate
.51 to .75	8	Moderate
.76 to 1.00	3	High

Distribution of R^2 shows the correlation co-efficient which measures the nature and the extent of relationship between the stock market index return and the stock return in the particular period. Adjusted R^2, Square of the correlation coefficient of determination gives the information about the %age of variance in the stock return. The square of the correlation coefficient of the determination is high. It means that variance in the stock return is very high and vice-versa (Refer to Table 4).

Table 5: Distribution T-statistic

No. of Companies	Decision	Result
2	Negative relationship exists in variable	Negative t-statistic
28	Positive relationship exists in variable	Positive t-statistic

The Table 5 shows that t-statistic of R^2 for two companies is negative so the no relationship exists between the stock return and market return, but other 28 companies display positive results so their is a relationship between the variables - stock return and market return. In the 28 companies, the variable - security return is explained by the index and the other return not explained, but in the 28 companies, the variance of the security return is explained by the index

by the help of R^2.

❁ **Required Rate Of Return:** The paper explains the importance of estimating the required rate of return for investment analysis and portfolio management. It discusses the CAPM model and its significance in estimating the required rate of return. The study clearly shows that it would be difficult to accept the validity of CAPM in the Indian Capital Markets, even during upward trends. The required rate of return is defined as the rate of return that the investor expects as compensation for deferring his current consumption to some future date, while taking into consideration the risk perceived by the investor in his investment. Estimating the required rate of return forms the corner stone of portfolio management .The required rate of return defines whether a particular investment has to be made or not. Unless an investor would get return at least equal to the required rate of return, he would end up losing his wealth over a period of time.

❁ **Real Risk Free Rate (RFR):** It is the basic interest rate, assuming there is no inflation and no uncertainty about future flows. An investor in an inflation free economy who knew with certainty what cash flows he or she would receive at what time would demand the real risk free rate on an investment. Both subjective and objective factors influence this rate, the subjective factor is the time preference of individuals for the consumption of income. The objective factor that influences the real risk free rate is the set of investment opportunities available in the economy.

❁ **Expected Inflation:** When an investor expects the price level to increase during the investment period, they would require the rate of return to include compensation for inflation also. The nominal risk free rate is a function of the real risk free rate and expected inflation rate.

❁ **Risk Premium:** An investor typically is not completely certain of the income to be received or when it will be received. Investments can range in uncertainty from basically risk free securities such as T-bills to highly speculative investments such as the common stock of small companies engaged in very high-risk enterprises such as oil exploration. Most investors require higher rates of return on investments to compensate for any uncertainty. This increase in the required rate of return over nominal risk free rate is the risk premium. The major types of risks in the investment are business risk, financial risk, liquidity risk, exchange rate risk and country risk. All these risks together affect the required rate of return.

❁ **Alpha:** The intercept of the characteristic regression line is alpha i.e. the distance between the intersection and the horizontal axis. It indicates that the stock return is independent of the market return. A positive value of alpha is a healthy sign. Positive alpha value would yield profitable return. According to the portfolio theory, in a well diversified portfolio, the average value of alpha of all stocks turns out to be zero. The Table no 3 (in appendix) shows that 10 companies have negative values of alpha and it is not good for companies' profitable return and the remaining 20 companies shows positive result referred to alpha value and this is a healthy sign for the companies' profitable return.

❁ **Correlation:** The correlation co-efficient measures the nature and the extent of relationship between the stock market index return and the stock return in a particular period. The square of correlation co-efficient is the co-efficient of determination. It gives the percentage of variation in the stock's return explained by the variance in the market's return. The interpretation is that %age of variations in stock's return is explained by the variations in the BSE index return.

The evidence from Tables shows a strong positive relation between individual stock excess return and market index, both in the entire and sub-period. The results evidence that the value of β is highly significant for all securities in the periods. However, the value of R^2 confirms that the power of stocks is highly pronounced during the study period. For the study, the researcher selected the few companies which are prominent ones and can give the overall idea regarding the CAPM. Coefficient of the determination gives an idea of the percentage of the variance of the securities' return that is explained by the variations of return on the index (or market).The variance of the security return of companies is explained by the index and other returns are not explained.

CONCLUSION

Though CAPM was found to be valid in the Indian Stock market, adequately explaining the behaviour of stock returns, the proposition that low (high) return is associated with low (high) risk was not supported by the empirical evidence reported in the study. In addition, the test of CAPM was also conducted based on portfolios constructed by ranking of β estimates of individual securities as well as portfolios constructed by methodology. Adjusted R^2, Square of the correlation coefficient of determination gives the information about the %age of variance in the stock return. The

square of the correlation coefficient of the determination is high. It means that the variance in the stock return is very high and vice-versa. The result from the tests revealed that the CAPM was valid in describing the stock return. Though the CAPM describes stock return well in the Indian context, it is preferable that investors' investment decision may be decided with the help of other relevant factors such as P/E ratio, EPS, dividend , bonus and right issues besides the CAPM estimates. There is an on-going debate that a company presents a picture of financial estimates by manipulating its financial statements such a profit and loss account and balance sheet. In such a case, it is difficult to assess the true and fair view of its financial position and hence, investment decisions based on these statements may not provide a meaningful estimation of stock returns. Thus, investors are required to take extra care in estimating stock return to construct the portfolio of securities.

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APPENDICES

We use t-test and calculate the test statistic as under :-

$$t = r_{xy}\sqrt{\frac{n-2}{1-r_{yx}^2}}$$

Within (n-2) degrees of freedom r_{yx} being coefficient of simple correlation between x and y. This calculated value of t is then compared with table value less than the table value, we accept the null hypothesis at the given level of significance and may infer that there is no relationship of statistical significance between the two variable.

Table 1: Name Of The Companies Used In The Analysis

1.	CIPLA	16.	BHARTI AIRTEL
2.	HLL	17.	HDFC BANK
3.	INFOSYS Tech	18.	ITC
4.	SATYAM Comp.	19.	BHEL
5.	HDFC	20.	TATA STEEL
6.	RANBAXY Lab.	21.	NTPC
7.	RELIANCE Comm.	22.	RELIANCE ENG.
8.	DR. REDDY's	23.	GRASIM Ind.
9.	SBI	24.	HERO HONDA
10.	RELIANCE Ind.	25.	TATA CONSULT.
11.	ONGC	26.	TATA MOTOR
12.	ICICI BANK	27.	HINDALCO
13.	L & T	28.	BAJAJ AUTO
14.	AMBUJA CEMENT	29.	MARUTI SUZUKI
15.	WIPRO	30.	ACC

Table 2: Return And Betas In Different Up-warding Periods

Sr. No.	Company Name	Beta	Average Return	Alpha	R	R^2	t-statistic
1.	DR. REDDY's	-0.40	1.28	1.77	-0.19384	.03757	-5.2917
2.	TATA STEEL	-0.33	9.63	10.03	-0.02538	.00064	-5.3086
3.	CIPLA	0.12	0.17	0.03	0.12541	.01573	5.2911
4.	RANBAXY Lab.	0.23	0.47	0.20	0.29409	.08649	5.2914
5.	AMBUJA CEME.	0.27	0.63	0.31	0.42261	.17860	5.2914
6.	BAJAJ AUTO	0.29	.86	0.50	0.33593	.11285	1.8872
7.	ITC	0.31	1.04	0.67	0.33886	.11483	5.2914
8.	GRASIM Inds.	0.42	1.29	0.74	0.29084	.08459	5.2914
9.	HLL	0.44	0.51	-0.02	0.55997	.31357	5.2914
10.	TATA CONSULT.	0.45	-0.02	-0.56	.47792	.22841	5.2914
11.	INFOSYS Tech	0.52	-0.12	-0.75	.44466	.19772	5.2915
12.	HERO HONDA	0.54	0.72	0.06	.55739	.31068	5.2915
13.	ACC	0.65	0.42	-0.36	.48382	.23408	5.2915
14.	WIPRO	0.66	.036	-0.44	.57135	.32644	5.2915
15.	ONGC	0.72	1.25	0.37	.72883	.53120	5.2914
16.	HDFC	0.75	1.38	0.48	.63115	.45835	5.2915
17.	ICICI BANK	0.75	1.10	0.48	.88206	.77802	5.2915
18.	SATYAM Comp.	0.80	0.02	-0.94	.61870	.38279	5.2915
19.	TATA MOTOR	0.83	0.38	-0.62	.66291	.43945	5.2915
20.	RELIANCE Com.	1.01	1.26	0.04	.82053	.67327	5.2915
21.	BHARTI AIRTEL	1.02	.69	-0.53	.71267	.55790	5.2915
22.	SBI	1.09	1.72	0.41	.76687	.58808	5.2915
23.	MARUTI SUZUKI	1.11	1.05	-0.29	.82440	.67963	5.2915
24.	HDFC BANK	1.12	1.61	0.26	.75999	.57759	5.2914
25.	NTPC	1.12	1.79	0.43	.88396	.78139	5.2914
26.	HINDALCO	1.20	1.28	-0.17	.67805	.45975	5.2915
27.	RELIANCE Ind.	1.21	2.04	0.58	.92906	.86315	5.2915
28.	BHEL	1.64	2.11	0.13	.86649	.75082	5.2914
29.	L & T	1.79	2.58	0.42	.80854	.65374	5.2914
30.	RELIANCE ENG.	1.89	4.96	2.68	.73112	.53454	5.2914
Number of t-value that are not significant at 5% level of significance						0	28
Number of t-value that are not significant at 5% level of significance						30	2