

Beta Analysis of Equity Returns: An Empirical Study About The Significance of Beta And Its Linearity.

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Abstract: This paper studies the relationship between beta and equity returns based on the closing prices of 20 stocks of different industries listed in Bombay Stock Exchange in India over a period of 15 years from 1999 to 2013. The study empirically examined the significance of beta and its impact on stock's returns during the period. The linearity between beta and equity returns is put to test and attempted to study whether the market price and value of stocks coincide. There is considerable difference between the expected and actual returns. Student's *t* stat and *P* values were employed to test the significance of beta. The study finds that there is significant relation between the beta and equity returns. But the relationship cannot be exactly defined as linear. The *t* test, *P* values, and R^2 values have rejected linearity of beta and equity returns. It is also found that high beta stocks are earning more returns than low beta stocks. Rampant mispricing- both under and overpricing- is found.

Keywords: Actual, Beta, Expected, Linearity, Mispricing, Overpricing, Returns.

I. Introduction

Pricing of assets is a major task in capital market. Pricing of assets in the market is usually viewed as somewhat similar to the pricing of goods in the commodity market. In the commodity market prices are determined by the interaction of demand and supply through price mechanism. But contrary to the commodity market, the factors that determine the demand and supply for the capital assets are complex. The Capital Asset Pricing Model (CAPM) formulated by William Sharpe in 1964 is a highly applied financial solution for many asset pricing problems. It helps the determination of fair prices for the assets. In an efficient market the market price of stocks is supposed to reflect their fundamental value. The fundamental value of a stock is the present value of expected cash flows over period discounted by a most appropriate rate. CAPM is a method to find that most appropriate rate i.e. cost of equity or required rate of return (RRR) on a stock. CAPM reveals the relationship between the risk and return of stock investment. An investor can expect a return only in consonant with the risk to which he is exposed of. He cannot expect more or less than it. He has to strike a balance between the risk and return. For taking an optimal investment decision a risk-return trade-off is to be achieved. The model asserts that an investor can hope to make only a risk-adjusted return which is legitimate or fair and not more than that implies the proverb "there are no free lunch" in an efficient capital market. The risk and return are related. Returns are linearly related to the risk. In that sense return is a reward for the risk borne by the stock holder. The greater the risk the greater is the return. The return from a risky asset will have to be more than the return from a risk-free asset on the assumption that investors are generally risk-averse. Hence the return expected from a risky asset will be a risk-free return added with a risk premium. Risk-free return thus becomes an intercept value in the risk-return space constituting the starting point of the slope of the regression line that depicts the relation between the risk and return.

The fundamental assumption of CAPM is that every risky stock has a risk premium over and above the risk free rate of return. An asset which is uncorrelated to the market will definitely have a risk free return that an asset holder has to get. If the asset is risky he has to get an additional return in proportion to the degree of risk the investment is exposed to. Therefore it is irrational to expect a return over and above the risk adjusted rate. Accordingly, to be fair, the expected return from a risky stock *i* reveals a linear relation with the risk of the asset in relation to the market.

It is also supposed that the market return from the market portfolio will be more than the return expected from a stock uncorrelated to the market i.e. market return is higher than the risk free rate ($R_M > R_F$). The difference between the R_M and R_F is the market premium expected from a risky asset. The risk of the asset is commensurate with the covariance of the stock with the return of the market portfolio which is represented by the benchmark β (beta). Since the market return is supposed to be higher than the risk free rate the market premium will be always positive. If the market premium is negative why should an investor purchase a risky stock? Only a positive market premium can induce a potential investor to buy and hold a risky stock. The risk premium of the stock *i* will be beta times the market premium. Therefore, CAPM defines expected return of an individual stock *i* for time *t* as: $E(R_{it}) = \alpha_{it} + \beta_{iM}(R_M - \alpha_{it})$. Where, $E(R_i)$ is the expected return of stock *i* for time

α_{it} is the return of the asset if uncorrelated with the market or risk-free rate, β_{iM} is the risk of the stock i in relation to the market and R_M is the expected market return.

The implications of the CAPM are mainly

1. The expected returns of risky assets are linearly related to their betas.
2. The beta premium is positive.
3. The risk-free assets have the expected returns equal to risk-free interest rate.

According to the first implication the average returns of the stocks are said to be linearly related to the betas. It implies that the average returns of the stocks can be explained only by betas. The stocks expect beta times the market premium over and above an intercept value. The second implication is that the market portfolio earns a return higher than the stock uncorrelated. Therefore there will be a positive market premium. It also implies that all stocks will move positively with the market and hence the betas of individual stocks are all positive. As it is so, the risk premium or beta premium of the stocks will also be positive. And the third implication is that when the assets are not correlated with the market portfolio, they are only to have a risk-free return at the risk-free interest rate. Such stocks cannot expect a risk premium since they are not bearing any market risk.

Capital Asset Pricing Model provides a way to find the cost of equity which is used to discount the future expected cash-flows from a stock to find its intrinsic value. The intrinsic value is the fundamental value of a stock. In an efficient market, the market price is the right price. It discloses fully all information related to the stock. It is the market equilibrium price.

Market efficiency presumes the coincidence of fundamental value equal with the market price. The difference between the fundamental value and market price is called mispricing. Mispricing will not stay in the market for long. Mispricing may be either above the fundamental value or below it. When the price of a stock is above the fundamental value it is overvalued. On the contrary, if the price is below the fundamental value it is undervalued. Whether the stock is undervalued or overvalued it is subject to mean-reverse. Such a price is not sustainable.

As a strategy, overvalued stocks are disposed in the market as they are to regress back to the fundamental value sooner. Investors will buy and hold undervalued stocks since their prices have to go up soon to coincide with the fundamental value.

In the case of equity returns CAPM ascertains the required rate of return (RRR) or fair return of a stock in terms of its risk in relation to market. This rate is the cost of equity which will be used as the discount rate to find the present value of future cash-flows in order to arrive to the fundamental value of a stock. RRR represents the fair price of an asset. Under conditions of market efficiency, the investors' actual returns based on the observation of historical prices should be equal to the RRR. The difference between RRR and actualized returns, which is called 'alpha', causes mispricing. If the RRR is lower than the actual return, the stock is undervalued or underpriced and vice versa. In the case of undervaluation the alpha is positive and a negative alpha denotes overvaluation.

In this paper an attempt is made to study the risk-return trade off of equity enlisted in the Bombay Stock Exchange in India. It is also intended to study the undervaluation or overvaluation of stocks due to mispricing.

II. Literature Review

Malcom Baker and Jeremy C Stein (2004)¹ in their paper titled 'Market Liquidity as a Sentiment Indicator' builds a model that helps explain why increases in liquidity - due to mispricing that leads to undervaluation, lowers the bid-ask spreads, a lower price impact of trade or a higher share turnover - predict lower subsequent returns. The model features a class of irrational investors who underreact to the information thereby boosting liquidity. The model says that under conditions of short-sales constraints, unusually high liquidity is a symptom of the fact that the market is currently dominated by these irrational investors and hence is overvalued. The model also explains how managers successfully time the market seasoned equity offerings by simply following the rule of thumb that involves issuing when the market particularly is liquid. De Long, J Bradford & Andrei Shleifer & Lawrence H. Summers & Robert J. Waldmann (1990)² in their jointly authored paper titled as "Noise Trader Risk in Financial Markets," present a model of an asset market in which irrational noise traders with erroneous stochastic beliefs both affect prices and earn higher expected returns. The stochastic beliefs of the noise traders in the price of the assets deter the rational arbitrageurs to bet effectively against them. As a result, prices can diverge significantly from fundamental values even in the absence of fundamental risk. Poterba, James M. & Summers, Lawrence H. (1988)³ in their paper entitled "Mean Reversion in Stock Prices: Evidence and implications" analyze the statistical evidence bearing on whether transitory components account for a large fraction of the variance in common stock returns. The study finds that stock

returns have positive serial correlation over short periods and negative correlation over longer periods. The transitory components in stock prices are quantitatively important, accounting for the bulk of variance in returns.

The expected returns from a stock not only depends on the fundamental risks explained by the standard CAPM but also by the type and degree of asset mispricing (Michael J. Brennan and Ashley Wang 2006)⁴. Carl R. Chen, Peter P. Lungb, and F. Albert Wanga (2006)⁵ state that the stocks with low mispricing substantially outperform stocks with high mispricing. Mispricing also explains another important economic phenomenon that the investors overreactions towards growth. An empirical test (Cohen 2001)⁶ to study the ability of CAPM to explain value and growth stocks' prices results in the suggestion that mispricing relative to CAPM is not important factor in determining the prices of value and growth stocks. Fama and French (2003)⁷ view that the CAPM has never been an empirical success. The authors argue that whether the model's problems reflect weaknesses in the theory or in its empirical implementation, the failure of the CAPM in empirical tests implies that most applications of the model are invalid. The researches during 1970 reveals the impact of size, price ratios and momentum on the average return which is supposed to be explained by beta as per CAPM. These problems are serious which invalidate the most of the applications of the model.

Jianhua Zhang and Clas Wihlborg (2004)⁸ empirically establishes the validity of CAPM in its conditional forms. According to them, there exists a conditional relationship between beta and returns. The study provides evidences for the fact that the local markets integrate with the international market. The study affirmed the usefulness of beta as a strong measure of risk of investors. Kent D. Daniel and David Hirshleifer (2000)⁹ jointly in their work state that cross section of expected returns of stocks is jointly determined by covariance risks and mispricing. Harry Markowitz¹⁰ in his seminal work Portfolio Selection considers the rule that the investor should consider expected return a desirable thing and variance of return an undesirable thing. He illustrated the relations between beliefs and choice of portfolio according to "the expected returns-variance of returns" rule. Anticipated returns involve a risk and therefore expected returns vary with risks. Expected returns from risky assets should differ from riskless assets by beta times the market premium due to systematic risk according to CAPM.

Robert C. Merton (1973)¹¹ in his paper confutes this tenet and empirically states that the expected returns on risky assets differ from riskless assets even in the absence of market risk or systematic risk. Dev R. Mishra and Thomas J. O'Brien (2014)¹² have of the view that Fama-French Three factor Model (FF3FM) is a better empirical fit than the CAPM in estimating cost of equity.

Emmanuel Farhi and Stavros Panageas (2004)¹³ in their study empirically establish that mispricing causes more inefficiencies than it corrects. William F Sharpe (1964)¹⁴ has of the view that in equilibrium, capital asset prices have adjusted so that the investor, if he follows rational procedures (primarily diversification), is able to attain any desired point along a capital market line. He may obtain a higher expected rate of return on his holdings only by incurring additional risk. In effect, the market presents him with two prices: the price of time, or the pure interest rate and the price of risk, the additional expected return per unit of risk borne.

III. Objectives Of The Study

The present paper intends to study the following:

1. The expected rate of return on stocks as per CAPM.
2. Mispricing of stocks under study.
3. Whether the stocks are undervalued or overvalued.
4. Whether the market premium is positive or negative.
5. Whether beta of stocks under study is linear so that it fully explains stocks' return.

IV. Data And Methodology

Secondary data are used in the study which are collected from the official website of Bombay Stock Exchange. The study is related to 20 stocks belonging to 20 different industries. They all are actively traded and grouped as A class under BSE. All stocks are included in the sensitive index of BSE 30. The study covers the period from January 1, 1999 to December 31, 2013 for a period of 15 years. The stocks included in the study are 1) ACC 2) Appollo Tyres, 3) Aravind Mills, 4) Ashok Leyland, 5) Asian Paints, 6) Axis Bank, 7) Ballarpur Industries, 8) Castrol, 9) Colgate Palmolive, 10) Crompton Greaves, 11) Garware Polyester, 12) Gujarat Narmada, 13) Harrisons Malayalam, 14) Hindalco, 15) Indian Hotels, 16) Indian Reyons (Aditya-Birla Nuvo), 17) ITC, 18) ONGC, 19) Tata Steel Ltd, and 20) WIPRO.

Closing stock prices of the 20 stocks for 15 years are used to calculate the annual return. Actual historical return of individual stocks and the BSE Sensex 30 are computed by way of averaging the annual returns for 15 years. BSE Sensex 30 is taken as proxy to market throughout the study. The actual historical return, being the average of 15 years of annual returns, is construed to be the actual return in the study. The correlation between the individual stocks and the market is calculated. Similarly standard deviation of the returns of the stocks and market are worked out. Covariance of the individual stocks and the market are

calculated. Accordingly beta coefficients are worked out for the stocks in relation to the market. The expected return from the individual stocks is calculated based on CAPM. The expected and actual are compared to determine mispricing. Repo rate for a period of 15 years since 1999 are collected and averaged to arrive at risk-free rate for the study. Standard Error (S.E.) for betas of the stocks are calculated. Student's t test and P values are employed to test the linearity of returns.

V. Empirical Test

5.1. Expected rate of return

The paper is intended to study the expected returns or fair returns of the 20 stocks of different industries of BSE. The expected returns different from the historical return is in effect cost of equity which is used to discount the cash-flows to find the value of stocks according to the discounted cash-flow technique (DCF). Alternatively, as per the dividend model, the value of a stock is determined by dividing the expected dividend after one year from a stock by the difference between the cost of equity and rate of growth in dividend. Stating symbolically,

$$P_0 = \frac{D_1}{k_e - g} \dots\dots\dots(1)$$

Where P_0 is the current value of stock at time 0, D_1 is the expected dividend in the year-end at time 1, k_e is the cost of equity and g is the rate of growth of dividend.

Whether DCF or dividend model, the value of stock is affected by the K_e , the cost of equity, which is linearly related with the risk.

According to CAPM the expected return on stock i found as shown below:

$$E(R_i) = R_F + \beta_{iM} [E(R_M) - R_F] \dots\dots\dots(2)$$

Where,

$E(R_i)$ = Expected return from stock i .

R_F = Risk-free rate

β_{iM} = Relative covariance of return of stock i in relation to the market portfolio

$E(R_M)$ = Expected return on market index (BSE Sensex 30).

5.2. Risk-free rate

The model is employed to find the cost of a risky security. As the model assumes, the existence of risk-less assets the investor can have an alternative investment opportunity. Govt. securities are usually considered as risk-free. In this paper Repos issued by the reserve bank of India is taken as the risk-free asset and the rate at which the repos dealt is considered as the risk-free rate. In this study repo rates for 15 years since 1999 are collected and the average of the same is construed as risk free rate.

Table 5.2.1: Repo rates* from 1999 to 2013

Year	Rate (%)
1999	9.00
2000	11.62
2001	8.75
2002	7.75
2003	7.05
2004	6.00
2005	6.25
2006	6.88
2007	7.63
2008	5.00
2009	4.50
2010	5.62
2011	7.53
2012	8.00
2013	7.64
Average	7.28

*(Source: Official website of RBI)

According to TABLE 5.2.1 the risk-free rate for the period 1999-2013 is arrived at 7.28%. The fair rate of return as per CAPM is the risk-free rate added with beta times the market premium. Market premium is the difference between the market return and the risk-free rate.

5.3. Mispricing of stocks

Under conditions of equilibrium the price quoted at the market will be fair. The market price reflects all the available information about the stock. It will be market clearing price in the sense that demand and supply

for the stocks are equal. The ruling price in the market is the right price as there is no incentive for the price to change. The rate of return on stocks which is the cost of equity will be the right rate commensurate with the risk exposure of the investment. There is linear relation between return and risk. Therefore, there is no 'free lunch'. Under this situation the actual return earned and the fair return expected cannot be different. They should be one and the same. In case of any differences the rational investors are expected to arbitrage and make them equal. Any how the difference between the actual and the expected return is a challenge and found to be persisting to cause the mispricing of assets. Mispricing takes place in two ways (1) underpricing and (2) overpricing. Underpricing occurs when the actual return lies above the fair rate (also above the Security Market Line). That is the actual return is more than what it ought to be. On the contrary, overpricing occurs when the actual return lies below the fair rate i.e. beneath the SML.

The actual returns earned on the individual stocks are compared with their fair rate or expected rate or required rate of return to determine mispricing. The difference between the actual and expected is the amount of mispricing and it is called alpha. The difference between the actual return on a security and its fair return as per the Security Market Line (SML) is called the security's alpha, denoted by the symbol ' α '¹⁵. If the actual return is higher than the fair return, the actual will be lying above the SML and is subject to underpricing. On the converse, if the actual is lower than the fair, the actual will be lying below the SML and the security is overpriced. In the case of underpricing, the alpha will be positive whereas it is negative in the case of overpricing.

5.4. Actual rate of return

Actual rate of return is based on the historical returns made by the stock in the past years. It is a method in which expectations are made on the basis of annual returns generated by the stock in the bygone years. It is customary to expect a return in the future on a stock in terms of the average return earned by it in the previous ten or fifteen years. In this study annual returns of the individual stocks for a period of 15 years from 1999 to 2013 have been averaged and that is taken as the actual rate of return on stocks under study. Annual returns are calculated on the basis of the following equation:

$$R = \frac{W_t - W_1}{W_1} \dots\dots\dots (3)$$

Which is equal to

$$W_t = RW_1 + W_1 \dots\dots\dots (4)$$

Where R is the return on investment, W_t is the terminal value of the investment at time t, and W_1 is the original investment¹⁶.

5.5. Undervaluation or overvaluation of stocks

On the basis of the computation of expected returns or required rate of returns (RRR) and the actual returns on average earned for 15 years, whether a stock is undervalued or overvalued can be understood. If the actual returns are greater than the expected, the actual will remain above the Security Market Line. So the return has to come down to the SML. It means the price is drifted away from the value. The stock when discounted by the actual return will reduce the value of stock and subject to undervaluation. Therefore the stock is undervalued. Undervalued stock's return will have to plunge in the future. The returns have to go up. When the actual return is in excess over the expected, the difference represented by the alpha (α) will be positive. Hence positive alpha represents undervaluation of stocks. On the contrary, if the actual returns are lower than the expected returns, it remains below the SML and has to rise and coincide with the expected later. The lower actual return will overvalue the stock. The difference between the actual and expected will be represented by a negative alpha. Hence negative alpha represents overvaluation of stocks.

5.6. Market Premium

Market premium is the excess of market return over the risk-free rate of return. Market premium is the incentive for a risk averse investor to invest on risky assets. If there is no market premium or the market premium is negative, the investment becomes discouraging. CAPM envisages a positive market premium on risky assets if the portfolio is on the SML.

$$\text{Market premium or excess return} = (R_M - R_F) \dots\dots\dots (5)$$

Here, R_M is the market return and R_F is the risk-free rate of return.

5.7. Beta as a tool to explain stock's return or linear to stocks' returns

Stock's return and beta are having linear relationship. Beta of a stock shows the covariance of the stock's return with the return of the market portfolio. It is the coefficient which represents the ratio of covariance of returns of stock with the market index to the market variance. Beta is the slope of the line which shows the linear relationship between the expected return from a stock and the risk to which the stock is exposed

to. If the slope of the line is zero, then, it can be concluded that there is no linear relationship. On the contrary if the slope is significantly different from zero it can be concluded that there is linear relationship.

Generally, null hypothesis holding that the slope is zero will be followed. The alternative hypothesis will be that the slope will be significantly more than zero. It can be symbolically stated as:

$$H_0: B_1 = 0$$

$$H_a: B_1 \neq 0$$

In order to test the hypothesis, Standard Error (SE) of the slope is worked out. The standard error of slope measures the dispersion about an average line, called the regression line. The equation used to calculate the S.E of the slope is as follows:

$$S.E. = \sqrt{[\sum(Y-\bar{Y})^2 / (N-2)] / \sqrt{[\sum(X-\bar{X})^2]}} \dots \dots \dots (6)$$

Here, Y is the dependent variable, \bar{Y} is the mean of the dependent variable, N is the size of the sample, X is the independent variable and \bar{X} is the mean of the independent variable.

The smaller the S.E. the greater the accuracy of the prediction. The standard error then will be used to calculate regression t statistics score. T statistics for the slope is calculated by:

$$t = b_1 / SE \dots \dots \dots (7)$$

Here, t is student's t statistic score, b_1 is beta and SE is the standard error of beta.

If t score is greater than the critical value/ t value of the table at a given confidence level at the given degree of freedom the test is significant and if the t score is lower than the table value the test is insignificant. Similarly, if the P value of the t score is less than the confidence level, the null hypothesis that the slope of the line is zero will be rejected. On the contrary if the P value is greater than the significance level the null hypothesis will be accepted.

VI. Empirical Analysis

The expected return of 20 stocks belonging to 20 different industries was calculated according to the CAPM based on the closing prices of the stocks for the period ranging from 1999 to 2013. The average repo value for 15 years from 1999 to 2013 had been taken as the risk-free rate and used as the intercept value on the assumption that the intercept value was a perfect substitute for the risk-free rate. Market premium was calculated as the difference between actual expected return on market index BSE Sensex30 and the risk-free rate which was multiplied by the beta of the respective stock to obtain risk premium. The risk premium was added to the risk-free rate to get the expected return.

6.1. Risk free rate

As per TABLE 5.2.1 the risk free-rate for the period under study was presumed to be 7.28% which was the average of the repo rates of 15 years since 1999.

6.2. Beta for the stocks under study

The beta, the relative volatility of the stock in relation to the market index, a benchmark of systematic risk was calculated as a ratio of covariance of the stock with the market index to the market variance.

Stating symbolically,

$$\beta_{iM} = \frac{Cov_{iM}}{\sigma_M^2} \dots \dots \dots (8)$$

Here,

B_{iM} = Beta of stock i in relation to market index

Cov_{iM} = Covariance of stock i in relation to market index

σ_M^2 = Market variance

The beta for 20 stocks under study for the period under study has been calculated and given as below.

Table 6.2.1: Regression Coefficients

Sl.No.	Name of Stocks	Cov_{iM}	σ_M^2	B_{iM}
1	Ashok Leyland	2946.74	1392.24	2.117
2	Crompton Greaves	2584.17	1392.24	1.856
3	Tata Steel LTD	2326.03	1392.24	1.671
4	Gujarat Narmada	2271.26	1392.24	1.631
5	Hindalco Industries	2094.06	1392.24	1.504
6	Axis Bank	1882.73	1392.24	1.352
7	Harrisons Malayalam	1845.16	1392.24	1.325
8	Aditya Birla Nuvo	1829.94	1392.24	1.314
9	Apollo Tyres	1776.07	1392.24	1.276
10	Indian Hotels	1650.06	1392.24	1.185
11	Ballarpur Industries	1626.20	1392.24	1.168

12	Wipro LTD	1315.17	1392.24	0.945
13	ONGC	1294.61	1392.24	0.930
14	Garware Polyester	1104.44	1392.24	0.793
15	Asian Paints	1088.13	1392.24	0.782
16	ACC	932.76	1392.24	0.670
17	Arvind Mills	810.59	1392.24	0.582
18	Colgate Palmolive	613.06	1392.24	0.440
19	Castrol	486.17	1392.24	0.349
20	ITC	322.41	1392.24	0.232

TABLE 6.2.1 provides covariance and beta particulars of the stocks. Stocks were shown arranged according to their beta values. It could be seen from the table that Ashok Leyland was having the highest beta of 2.117. Stock ITC Ltd had been placed in the last for having the lowest beta of 0.232. Hence Ashok Leyland was the riskiest asset of all in the table. Similarly, ITC was the least risky asset of all. TABLE 6.2.1 gives further details of covariance of the stocks. In terms of covariance Ashok Leyland tops the list whereas ITC finishes the last. It can be seen from the table that greater covariance engenders higher beta while market variance (σ^2_M) remains constant for individual stocks.

Table 6.2.2: Correlation, Covariance and Beta.

Sl.No.	Name of Stocks	COV _{IM}	Corre	B _{IM}
1	Ashok Leyland	2946.74	0.822	2.117
2	Crompton Greeves	2584.17	0.665	1.856
3	Tata Steel LTD	2326.03	0.815	1.671
4	Gujarat Narmada	2271.26	0.875	1.631
5	Hindalco Industries	2094.06	0.742	1.504
6	Axis Bank	1882.73	0.758	1.352
7	Harrisons Malayalam	1845.16	0.417	1.325
8	Aditya Birla Nuvo	1829.94	0.795	1.314
9	Apollo Tyres	1776.07	0.696	1.276
10	Indian Hotels	1650.06	0.681	1.185
11	Ballarpur Industries	1626.20	0.812	1.168
12	Wipro LTD	1315.17	0.621	0.945
13	ONGC	1294.61	0.549	0.930
14	Garware Polyester	1104.44	0.184	0.793
15	Asian Paints	1088.13	0.596	0.782
16	ACC	932.76	0.514	0.670
17	Arvind Mills	810.59	0.315	0.582
18	Colgate Palmolive	613.06	0.594	0.440
19	Castrol	486.17	0.366	0.349
20	ITC	322.41	0.234	0.232

TABLE 6.2.2 shows the relation that exists within correlation, covariance and beta of the stocks. The correlation of returns of Ashok Leyland with the market index BSE Sensex 30 was 0.822 indicating a significant statistical relation. There was high positive correlation that paved the way for a high covariance and beta coefficient. Therefore it is very clear that beta reflects the level of covariance of the stock in relation to the market index. Covariance is a product of standard deviation of the stock, market standard deviation and the correlation of the stock in relation to the index. In the case of ITC as TABLE 6.2.2 reveals, the correlation of it with the market is only 0.234. Therefore its beta is also lower.

6.3. Expected rate of return on stocks

Expected rate of return is calculated for the stocks under study on the principles of CAPM. Accordingly, it is the sum of risk-free rate and beta times the market premium.

Table 6.3.1: Showing Expected Return of Stocks

Risk-free Rate	COMPUTATION OF RETURN				Risk Premium	Expected return %	Name of Stocks
	Market Return	Market Premium	β				
7.28	19.4	12.12	2.117	25.658	32.94	Ashok Leyland	
7.28	19.4	12.12	1.856	22.495	29.78	Crompton Greeves	
7.28	19.4	12.12	1.671	20.253	27.53	Tata Steel LTD	
7.28	19.4	12.12	1.631	19.768	27.05	Gujarat Narmada	
7.28	19.4	12.12	1.504	18.228	25.51	Hindalco Industries	
7.28	19.4	12.12	1.352	16.386	23.67	Axis Bank	
7.28	19.4	12.12	1.325	16.059	23.34	Harrisons Malayalam	
7.28	19.4	12.12	1.314	15.926	23.21	Aditya Birla Nuvo	

7.28	19.4	12.12	1.276	15.465	22.75	Apollo Tyres
7.28	19.4	12.12	1.185	14.362	21.64	Indian Hotels
7.28	19.4	12.12	1.168	14.156	21.44	Ballarpur Industries
7.28	19.4	12.12	0.945	11.453	18.73	Wipro LTD
7.28	19.4	12.12	0.93	11.272	18.55	ONGC
7.28	19.4	12.12	0.793	9.611	16.89	Garware Polyester
7.28	19.4	12.12	0.782	9.478	16.76	Asian Paints
7.28	19.4	12.12	0.67	8.12	15.4	ACC
7.28	19.4	12.12	0.582	7.054	14.33	Arvind Mills
7.28	19.4	12.12	0.44	5.333	12.61	Colgate Palmolive
7.28	19.4	12.12	0.349	4.23	11.51	Castrol
7.28	19.4	12.12	0.232	2.812	10.09	ITC

As the TABLE 6.3.1 shows the risk-free return 7.28%, which had been the average repo rate for the 15 years from 1999 to 2013, is common to all shares. The actual return of the market (BSE Sensex 30) was 19.4% (See TABLE 6.5.1). The excess return or the market premium, the difference between the market return and the risk-free rate, was 12.12% (19.4-7.28). Column risk premium in TABLE 6.3.1 shows beta times excess return due to the stock in relation to its covariance with the market. Ashok Leyland had an expected return of 32.94%. Its beta was the highest. The beta of Crompton Greeves was the next highest in the table. Its expected return 29.78 was the next highest among the stocks. The beta coefficient of Tata steel was the next highest and its expected return was the third highest next to Tata Steel and Ashok Leyland. Stock ITC had the lowest beta of 0.232 and its expected return 10.09 was the lowest of all. In this way the expected return of stocks and their beta are having linear relationship. The higher the coefficient of beta of the stocks the higher the expected return and vice versa.

6.4. Mispricing of stocks

A stock is said to mispriced when there is difference between the fundamental value and ruling market price. If the market is efficient the fundamental value and market price both will coincide with one another. If they differ the stock is said to be mispriced. Fundamental value of a stock is its cash flow discounted by the expected return. In this sense the expected return is the cost of equity. As the cash flows are given the value differs according to the amount of expected returns. The higher the expected returns the lower will be the value of the stock and vice versa. When the market is in equilibrium the expected return which is the required return for a given class of risk exposure and the actual return should coincide with one another. If there is any discrepancy between the actual and expected returns it amounts to mispricing. If actual is more than the expected or what it should be, the difference will be positive and the stock is underpriced or undervalued. On the contrary if the difference is negative where the actual is lower than the expected it is overpriced or overvalued.

6.5. Actual returns

Annual returns of 20 stocks for 15 years were worked out and were averaged to find out the actual returns. These actual returns are compared with the expected returns to determine the mispricing of stocks.

Table 6.5.1: Showing the Actual Returns of the Stocks

	Annual returns for 15 years from 1999 to 2013															Average
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Return
BSE	64	-26	-18	4	72	12	41	47	46	-52	76	17	-25	25	8	19.40
ACC	-75	-41	-5	12	49	31	56	105	-6	-54	76	18	6	26	-22	11.73
Apollo Tyres	145	-48	-10	75	92	-14	16	26	-85	-66	140	30	-14	53	20	24.00
Arvind Mills	-37	-45	-32	141	3	94	-29	-47	73	-80	118	88	-8	54	34	21.80
Ashok Leyland	155	-64	56	44	199	-92	29	43	12	-71	220	22	-66	19	-37	31.27
Asian Paints	30	-29	0	2	4	-5	80	24	49	-21	102	61	-10	70	-89	17.87
Axis Bank	47	75	-42	71	210	35	52	63	107	-48	91	66	-41	1	-5	45.47
Ballarpur Ind.	109	0	-36	7	91	13	14	-5	59	-89	20	62	-52	25	-40	11.87
Castrol	-60	-17	-32	12	13	-9	16	-10	62	-4	82	-23	-10	-29	3	-0.40
Colgate Palmo	9	-27	-2	-19	18	6	51	42	4	-1	61	26	14	59	-13	15.20
Crompton	-4	-47	-27	119	256	77	165	-72	82	-65	197	-28	-60	-7	8	39.60
Garware Poly	-7	-29	-43	554	70	-12	0	-17	108	-80	146	234	-37	-18	-22	56.47
Gujarat Narma	165	-49	-24	51	121	-7	61	-19	107	-75	85	11	-40	7	-8	25.73
Harris Mala	-27	-46	-3	-54	104	360	56	-17	38	-71	231	-39	-24	-9	-17	32.13
Hindalco	56	-15	-14	-7	141	2	-90	19	21	-76	197	65	-53	16	-9	16.87
Indian Hotels	-11	-29	-37	20	140	21	82	-84	2	-74	124	-9	-46	13	-4	7.20
Indian Reyons	2	-33	-21	33	190	44	70	84	57	-72	51	-8	-12	51	11	29.80
ITC	-12	25	-24	-3	49	32	-89	25	19	-21	46	-31	15	45	12	5.87
ONGC	2	-44	11	156	128	0	42	-27	41	-47	72	9	-80	3	8	18.27
Tata Steel	15	-15	-34	77	194	-14	-2	27	95	-77	170	7	-52	26	-3	27.60
Wipro	43	-18	-33	2	5	-57	-38	31	-14	-55	174	-29	-17	-1	41	2.27

TABLE 6.5.1 shows the annual returns of the stocks. In 1999 ACC's annual return was -75%. It was -41 in 2000. In 2013 it was -22%. The annual returns earned by the stock through 1999 to 2013 on an average is

worked at 11.73% which is shown at the right end column of the table. Accordingly Apollo Tyres earns an annual average return of 24%. Tata Steel 27.6% and Wipro 2.27%.

Table 6.5.2: Showing Mispricing Particulars of Stocks

SL.No.	Name of stock	Returns		Alpha	Misprice
		Actual	Expected		
1	Ashok Leyland	31.27	32.94	-1.67	Over
2	Crompton Greaves	39.6	29.78	9.84	under
3	Tata Steel LTD	27.6	27.53	0.07	Over
4	Gujarat Narmada	25.73	27.05	-1.32	Over
5	Hindalco Industries	16.87	25.51	-8.64	Over
6	Axis Bank	50.13	23.67	26.46	under
7	HarrisonsMalayalam	32.13	23.34	8.79	under
8	Aditya Birla Nuvo	29.8	23.21	6.59	under
9	Apollo Tyres	24	22.75	1.25	under
10	Indian Hotels	7.2	21.64	-14.44	Over
11	Ballarpur Industries	11.87	21.44	-9.57	Over
12	Wipro LTD	2.27	18.73	-16.46	Over
13	ONGC	18.3	18.55	-0.25	Over
14	Garware Polyester	56.47	16.89	39.58	under
15	Asian Paints	19.2	16.76	2.44	under
16	ACC	11.73	15.4	-3.67	Over
17	Arvind Mills	21.8	14.33	7.47	under
18	Colgate Palmolive	15.2	12.61	2.59	under
19	Castrol	-0.4	11.51	-11.91	Over
20	ITC	5.87	10.09	-4.22	Over

Mispricing of stocks under study can be seen from TABLE 6.5.2. The actual return of Ashok Leyland was lower than the expected. The difference denoted by alpha is 1.67 (negative). 32.94% is the required return as per the beta of the stock. So the cash-flows of the stock should be discounted with the 32.94%. If it is discounted by the actual 31.27%, a lower rate, the stock value would be higher than it would be by the expected return. Therefore, the stock was overvalued/priced. The actual will be lying below the Security Market Line (SML). Sooner or later the price is expected to go down to coincide with the value or the actual return should go up to the expected. In the case of stock Crompton Greaves the actual return 39.6 was higher than the expected 29.78 by 9.84(alpha). The stock was undervalued. The present market price of the stock will go up to coincide with the intrinsic value of the stock in the future. The positive alpha in this case denotes undervaluation of the stock. Similarly, Tata Steel, Gujarat Narmada, Hindalco, Indian Hotels, Ballarpur Industries, Wipro, ONGC, ACC, Castrol and ITC are all having negative alpha and are overvalued. The stocks Axis Bank, Harrisons Malayalam, Indian Reyons (Aditya Birla Nuvo), Apollo Tyres, Garware Polyester, Asian Paints, Aravind Mills and Colgate Palmolive were all having positive alpha telling underpricing.

TABLE 6.5.2 shows that 11 stocks were overpriced and 9 were underpriced. The underpriced stocks were currently priced in the market below their potential or intrinsic value. Therefore sooner or later the prices were expected to go up to their value. Rational investors customarily buy and hold underpriced securities expecting a future rally. On the other side, the overpriced stocks' prices are above the value and their prices are expected to regress back to the value in the near future. Therefore rational investors dispose such stocks fearing a future downswing.

Table 6.5.3: List Showing Underpriced and Overpriced Stocks

Sl.No	Underpriced Stocks	Sl.No.	Overpriced Stocks
1	Crompton Greaves	1	Ashok Leyland
2	Axis Bank	2	Tata Steel LTD
3	Harrisons Malayalam	3	Gujarat Narmada
4	Indian Reyons (Aditya Birla Nuvo)	4	Hindalco Industries
5	Apollo Tyres	5	Indian Hotels
6	Garware Polyester	6	Ballarpur Industries
7	Asian Paints	7	Wipro LTD
8	Arvind Mills	8	ONGC
9	Colgate Palmolive	9	ACC
		10	Castrol
		11	ITC

The underpriced and overpriced stocks are listed above in the TABLE 6.5.3. On the left hand side there are 9 stocks which are underpriced. Right hand side of the table shows 11 overpriced stocks.

6.6. Market Premium

CAPM assumes that the risk-free rate which is the intercept value will be always lower than market return. The market return is expected to be more than the returns of the stocks or securities uncorrelated to the market. If it is not so there will not be any incentives for the investors to invest in risky assets. So it is presumed that the return on market portfolio will be more than the risk-free rate. The difference between the market return and the risk-free rate is called as the market premium. It can also be called as excess return. The market premium available to the stocks under study is listed below.

Table 6.6.1: Showing Market Premium

SL.No.	Name of stock	Market Return	Risk-free Return	Market premium
1	Ashok Leyland	19.4	7.28	12.12
2	Crompton Greeves	19.4	7.28	12.12
3	Tata Steel LTD	19.4	7.28	12.12
4	Gujarat Narmada	19.4	7.28	12.12
5	Hindalco Industries	19.4	7.28	12.12
6	Axis Bank	19.4	7.28	12.12
7	HarrisonsMalayalam	19.4	7.28	12.12
8	Aditya Birla Nuvo	19.4	7.28	12.12
9	Apollo Tyres	19.4	7.28	12.12
10	Indian Hotels	19.4	7.28	12.12
11	Ballarpur Industries	19.4	7.28	12.12
12	Wipro LTD	19.4	7.28	12.12
13	ONGC	19.4	7.28	12.12
14	Garware Polyester	19.4	7.28	12.12
15	Asian Paints	19.4	7.28	12.12
16	ACC	19.4	7.28	12.12
17	Arvind Mills	19.4	7.28	12.12
18	Colgate Palmolive	19.4	7.28	12.12
19	Castrol	19.4	7.28	12.12
20	ITC	19.4	7.28	12.12

The market premium/excess return of market return over the risk free rate of return was 12.12% to all stocks. Here, the market return is 19.4% and the risk-free rate is 7.28%. It can be observed from the TABLE 6.6.1 that the market premium for stocks was positively 12.12% i.e. the market return is higher than the risk-free return (19.4>7.28).

6.7. Beta and stock's return

The stock's returns are expected to have linear relation with the beta. The beta is supposed to be the only factor that determines the returns on stocks. Here in this section the significance of beta as a tool to explain the returns and its linearity with the stocks' return were intended to examine in detail.

Table 6.7.1: Showing the Significance of Beta

Stock	beta	SE	t - stat	Table value	P value
ACC	0.67	0.35	1.91	2.160	5% -10%
Apollo	1.28	0.49	2.612	2.160	2% - 5%
Aravind	0.58	0.5	1.164	2.160	5% -10%
Ashok	2.117	0.69	3.068	2.160	5% -1%
Asian	0.782	0.35	2.234	2.160	5% -2%
Axis	1.352	0.48	2.817	2.160	2% -1%
Ballar	1.168	0.39	2.995	2.160	2% -1%
Castrol	0.349	0.26	1.342	2.160	5% -10%
Colgate	0.44	0.2	2.2	2.160	5% -2%
Crompton	1.856	0.75	2.475	2.160	5% -2%
Garware	0.793	1.16	0.684	2.160	20%-30%
Gujarat	1.631	0.5	3.262	2.160	1% -0%
Harrisons	1.325	0.85	1.559	2.160	10% -20%
Hndalco	1.5	0.54	2.778	2.160	2% -1%
I.Hotels	1.185	0.47	2.521	2.160	5% -2%
I.Reyons	1.314	0.45	2.92	2.160	2% -1%
ITC	0.232	0.26	0.892	2.160	20% -30%
ONGC	0.93	0.46	2.022	2.160	5% -10%
Tata steel	1.671	0.55	3.038	2.160	1% -0%
Wipro	0.945	0.41	2.305	2.160	5% -2%

Constant/ α = 7.28% D.F = N-2=13 Significance level = 0.05

TABLE 6.7.1 shows the reliability of the beta coefficient to explain the returns of the stocks. The underlying principle of CAPM is that there exists a linear relationship between the stocks' returns and the beta. The analysis of the empirical test with the null hypothesis that $b_1 = 0$ brings forth that t scores of 7 stocks are lower than the $t_{0.05}$ table values implying the insignificance of beta (See TABLE 6.7.1). The P values of all these 7 stocks were above the confidence level of 5%. Referring to the TABLE 6.7.1 it can be seen that stock ACC's t score 1.91 is lower than the table value 2.160 at 5% level of significance with the degree of freedom of 13. Since t score calculated is lower than the table value ($1.91 < 2.160$) the slope is insignificant. The P value of the t score is above 5%. It means the null hypothesis is acceptable in the sense that there is no linear relationship between the returns and the beta of the stock. That is the null hypothesis that beta is equal to zero, cannot be rejected. This is true in the case of the other 6 stocks viz. Aravind Mills, Castrol Ltd., Garware Polyester, Harrisons Malayalam, ITC Ltd., and ONGC.

But in the case of the other 13 stocks, the t scores of theirs were higher than the table values denoting high level of test significance. Their P values were less than the confidence level of 5%. Therefore, in the case of these 13 stocks viz. Apollo Tyres, Ashok Leyland, Asian Paints, Axis Bank, Ballarpur Industries, Colgate Palmolive, Crompton Greeves, Gujarat Narmada, Hindalco Ltd., Indian Hotels, Indian Reyons (Aditya-Birla Nuvo), Tata Steel, and Wipro Ltd., the alternative hypothesis that $H_a: b_1 \neq 0$ is accepted implying the linear relationship.

Table 6.7.2: The Co-Efficient of Determination R^2

Name of Stock	R^2	Name of Stock	R^2
ACC	0.246	Garware Polyester	0.031
Apollo Tyres	0.452	Gujarat Narmada	0.714
Aravind Mills	0.093	Harrisons Malayalam	0.163
Ashok Leyland	0.63	Hndalco	0.514
Asian Paints	0.331	Indian Hotels	0.433
Axis Bank	0.536	Indian Reyons	0.59
Ballarpur Industries	0.615	ITC	0.051
Castrol	0.125	ONGC	0.281
Colgate Palmolive	0.33	Tata steel	0.62
Crompton Greeves	0.413	Wipro	0.359
Average			0.3763

The coefficient of determination R^2 accounts for the quantity of variance of stocks explained by the market. TABLE 6.7.2 shows the R^2 values for the stocks. Accordingly it can be read from the table that only 24.6% of the total variance of ACC was explained by the market. 45.2% of the total variance of Stock Apollo Tyres was explained by the market. Wipro's R^2 is 0.359. It implies that 35.9% of the total variance was explained by the market. While 71.4% of the variance of Gujarat Narmada was explained by the market only 3.1% of Garware Polyester's total variance was explained. On an average 37.63% of total variance of stocks are explained by the betas and left 62.37% unexplained.

Table 6.7.3: High Beta Stocks

STOCKS	B	RRR	Actual	Alpha α	Misprice
Ashok Leyland	2.117	32.94	31.27	-1.67	over
Crompton Greeves	1.856	29.78	39.6	9.82	under
Tata Steel LTD	1.671	27.53	27.6	0.07	under
Gujarat Narmada	1.631	27.05	25.73	-1.32	over
Hindalco Industries	1.504	25.51	16.87	-8.64	over
Axis Bank	1.352	23.67	50.13	26.46	under
Harrisons Malayalam	1.325	23.34	32.13	8.79	under
Aditya Birla Nuvo	1.314	23.21	29.8	6.59	under
Apollo Tyres	1.276	22.75	24	1.25	under
Indian Hotels	1.185	21.64	7.2	-14.44	over
Ballarpur Industries	1.168	21.44	11.87	-9.57	over

TABLE 6.7.3 shows that out of the 20 stocks 11 stocks have high beta values i.e. their beta coefficients are more than the market beta, market beta being 1. Among the high beta stocks Ashok Leyland is at the topmost with a beta of 2.117. Ballarpur industries has the lowest among the high beta stocks with beta 1.168. All high beta stocks have high returns both expected and actual. 5 stocks are overpriced where the alpha (the difference between the actual and expected) is negative and 6 are underpriced since their alphas are positive.

In the case of overpricing in spite of having high beta the stocks actual returns are lower than the expected. In the case of the underpricing despite having high betas the stocks expected returns fall short of the actual returns. See the case of Crompton Greeves. It has a beta of 1.856. But the return as per its beta is predicted as 29.78% which is considerably lower than the actual returns earned by the stock during the period of

15 years. That means the difference of returns 9.82% is left unexplained by beta. This is also true in the case of Axis Bank. Axis Bank also is having a high beta of 1.352. Its expected returns/RRR fall short of the actual by 26.46%.

Table 6.7.4: Low Beta Stocks

Name of stock	β	RRR	Actual	Alpha	Misprice
Wipro LTD	0.945	18.73	2.27	-16.46	over
ONGC	0.93	18.55	18.3	-0.25	under
Garware Polyester	0.793	16.89	56.47	39.58	under
Asian Paints	0.782	16.76	19.2	2.44	under
ACC	0.67	15.4	11.73	-3.67	over
Arvind Mills	0.582	14.33	21.8	7.47	under
Colgate Palmolive	0.44	12.61	15.2	2.59	under
Castrol	0.349	11.51	-0.4	-11.91	over
ITC	0.232	10.09	5.87	-4.22	over

As shown by TABLE 6.7.4 nine stocks have low betas, betas lower than the market beta of 1. ITC is having the lowest beta among all stocks (0.232). Out of the 9 stocks 4 stocks are overpriced and 5 are underpriced. Even though Garware Polyester holds a low beta its actual return 56.47% is the highest among the stocks in contrast to its RRR of 16.89%.

VII. Findings

The empirical study and analysis results in the following findings.

1. The expected returns of the stocks vary with the beta. The higher the beta the higher will be the expected returns and vice versa.
2. The covariance and beta were related. A stock having a high covariance with the market had a high beta and a stock with low covariance had only low beta.
3. The coefficient of correlation between the stock and market return significantly affect the magnitude of beta.
4. High beta stocks had high expected returns and actual returns.
5. Low beta stocks had low expected returns and low actual returns.
6. In case of overpricing high beta stocks despite having a high beta had only low actual returns.
7. In case of underpricing high beta stocks in spite of having high beta had low expected return.
8. Mispricing was rampant. All stocks were subject to mispricing. 11 stocks were overpriced and 9 were underpriced.
9. Stock all had market premium.
10. Market premium was positive in all cases.
11. Beta coefficients were not found significant for all stocks. Beta of 7 stocks were found insignificant. The student's t statistics and P values showed evidences for beta not linear with the returns of these seven stocks.
12. In the case of 13 stocks t stat and P values showed evidences for linearity.
13. The total variances of the stocks were not fully explained by the market. Only a part was (on average 37%) explained leaving a major chunk of variance (on average 63%) unexplained. Therefore, beta was not able to explain the returns of stocks completely. Apart from the systematic risk there were other factors which contributed to stocks' returns. Beta (covariance per unit of market variance) was not the only source of returns to the stocks.

VIII. Conclusion

The paper was basically intended to study the equity returns of the risky assets in the light of CAPM. When the market is efficient, it is supposed to be so, the market price of the assets has to express the intrinsic worth. The ruling price will be the right price. There will not be any incentive for the price to vary from the fundamental value. Mispricing of assets is somewhat impossible in a perfect and efficient market where rationality rules the roost over noise. Even if the prices vary at times for temporary informational lag, it can be set right through arbitrage.

But the data related to the closing prices of 20 stocks of BSE India belonging to 20 different industries for a period of 15 years ranging from 1999 to 2013 shows plenty of evidences of mispricing. Mispricing was in the form of either overpricing or underpricing. Majority of stocks, specifically 11, were overpriced and 9 were underpriced.

CAPM envisages a positive market premium for risky asset as an incentive for a risk-averse investor to put in his money on such assets. The study finds positive market premium for all stocks.

The study tested the effectiveness of beta on stocks' returns and found that beta was insignificant for 7 stocks. Though the beta was significant for the other 13 stocks, yet it was not capable of explaining fully the stocks return. The R² statistics revealed that beta represented only 37% of the return and the other 63% was left unexplained. As CAPM believes, the beta is not necessarily the only agent which explains the stocks returns.

But the role of beta as a benchmark of systematic risk cannot be denied its prominence altogether. There were empirical evidences in the study itself for upholding the significance of beta. The stocks with high beta had high expected and actual returns when compared to the low beta stocks. The implication is that beta accounts the returns of the risky assets significantly only to a certain extent. There were no adequate evidences for beta's linearity with returns. Returns were not completely due to the covariance of stocks with the market portfolio, though it was true to a certain significant level but beyond it there ought to be other reasons, for which further researches become necessary.

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