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CAPM: EMPIRICAL EVIDENCE FROM INDIA

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Abstract

The objective of the paper is to empirically examine the validity of CAPM by examining that whether risks of the stocks are related to their expected return and further to analyze that whether the expected rate of return is linearly related to its systematic risk through β. The stock return of 15 companies listed on National Stock Exchange (NSE) have been analyzed for a period of 5 years from January 2006 to December 2010. Cross-sectional and Portfolio analysis were the two methods adopted to test the validity of CAPM. In both the cases, the findings did not support the CAPM's basic hypothesis that higher risk (beta) is associated with a higher level of return. Also, the zero intercept hypothesis of CAPM was negated. The finding of the study empirically concluded that CAPM is not valid in Indian capital market.

Key Words: CAPM, Cross-sectional Analysis, Portfolio Analysis.

I. INTRODUCTION

The national economy and the market sentiments are very well reflected by the state of capital market. The capital market not only plays an important role in development of an economy but also the state of capital market helps in predicting the state of business cycles. Several models have been suggested to assess the manner in which the securities are valued in a capital market. The risk-return relationship has been unanimously accepted and used in these models by the researchers since the time of Markowitz (early 1960s). Models such as efficient frontier model, single index model etc. have been proposed by the experts based on the risk return relationship. Amongst these, Capital Asset Pricing Model (CAPM) given by Sharpe (1964) is one of the most popular models and has a high academic utility. At the same time Lintner (1965) and Mossin (1966) also gave independent CAPM models. Almost five decades later, the CAPM is still widely used in applications, such as estimating the cost of capital for firms and evaluating the performance of portfolios.

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While talking about the risk associated with a security, there are two components of risk namely, systematic risk and unsystematic risk. The systematic risk is that component of risk which is caused by the variations in market conditions and similarly affects the securities in the market. On the other hand, nonsystematic risk is that component of risk which is not because of the market risk and includes firm specific and is therefore unique to that security. While the nonsystematic risk can be diversified by appropriate selection of portfolio, the systematic risk is non diversifiable and cannot be eliminated by diversification.

Although, conceptually, the hypotheses of CAPM seems to be logical, there are doubts amongst the financial experts on the empirical validity of CAPM. While some of the work found empirical evidence, most of the studies found inconclusively in various hypotheses of the CAPM. Further, the studies which empirically found evidence of the CAPM for asset valuation were carried out in the matured capital markets like USA. The empirical evidence in most of the immature markets like India were concluded negating most of the hypotheses of CAPM.

Indian capital market is still immature evident from the fact that variability is highly dependent on the sentiments and emotions rather than risk-return valuation. The factors affecting the market are exhaustive especially those caused because of political and regulatory instability. The investors are few as compared to the population and the markets have not penetrated the common population. High volatility and low stability has been a discouraging factor. A intraday variation of as high as 5% to 7% in the indices is not a rare phenomenon. The volume and breadth of daily trading is quite low as compared to matured markets. The daily volumes are by and large limited to the Blue Chip companies. Notwithstanding, Indian capital market is a sample case for examination of the empirical evidence of CAPM.

Fundamentals of Capital Asset Pricing Model

William Sharpe was awarded Noble price for his work on CAPM. The CAPM relation provides a powerful analytical tool in wide-ranging problems in capital budgeting, cost benefit analysis, portfolio selection, and for other economic problems requiring knowledge of the relation between risk and return. The stock return R_i given by the CAPM is widely used for determining the cost of capital to the company in the capital budgeting decision.

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CAPM model is used to assess the returns of risky assets. The fundamental result of the model is the relation between the expected risk premiums on individual assets and their systematic risk. The model is based on certain assumptions:-

(a) In a particular period, the investors equally risk averse and prefer maximization of utility of terminal wealth.

(b) The investors choose the portfolio solely on the basis of mean and variance to judge the return and risk involved in the transaction. This implies that the investors are targeting the efficient frontier of Markowitz and hence referred as Markowitz efficient investors.

(c) There are no transaction costs involved which means that the cost of acquisition and selling of the stock are same at a point of time.

(d) All the investors have homogenous views regarding parameters of joint probability distribution of all security returns.

(e) Every investor has an option to lend and borrow at a given risk free rate of interest. Further, there is no inflation or change is interest rates or at least they are fully anticipated.

(f) All investments are infinitely divisible which means that it is possible to buy and sell whatever fraction of the asset.

This CAPM relationship says that:

"*the expected excess return on any asset is directly proportional to its systematic risk.*"

The '*excess returns*' over the returns from the risk free assets lies in the centre stage. A risk free asset implies an asset which has zero variance. Such an asset should have zero correlation with any other asset. The returns earned from risk free asset are the free returns and there is no uncertainty in this return.

The systematic risk of an asset is represented by the index represented by β which is defined as:

$$\beta = Cov_{i,M} / \sigma_M^2$$

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The relationship given by CAPM is translated into the following mathematical equation:-

$$R_i = R_f + \beta_i(R_M - R_f)$$

where, R_i: Expected return of security i
R_f : Risk free return and
R_M: Market return
β : index of systematic risk
$Cov_{i,M}$:Covariance of i^{th} security and market portfolio
σ_M : Standard deviation of the market portfolio

Alternately, the equation can be written in the terms of excess returns in following form:-

$$r_i = \beta_i\, r_M$$

where, r_i : $E(R_i) - R_f$ *and*
r_M :R_M-R_f

Interpretation of Stock Beta

The CAPM gives the relationship between the excess return on market portfolio represented by r_M and the excess return r_i which a stock/portfolio of stocks would seek in a varying market. The risk and return is related through the stock β. The β can be a positive or a negative number. For a stock with β=1, the stock return is equal to the market return. A β>1 implies that the variation in the stock return would be more than the market return. In the rising (bullish) market such stock would outperform the market however, in a declining (bearish) market, these stocks will underperform the market. β<1 implies that variation in stock return will be less than the market variation in the same direction. A negative β is an adverse condition which implies that the variation on stock return is opposite to the variation in market return. In real life such stocks are not seen in the capital markets. The CAPM relationship indicates that the a stock with β=0 is nothing but a risk free stock and the returns are same as R_f.

β represents the systematic risk of a stock. It is the risk arising from the market conditions due to existing macroeconomic environment. Therefore, βrepresents the risk which cannot be diversified merely by enlarging the portfolio.

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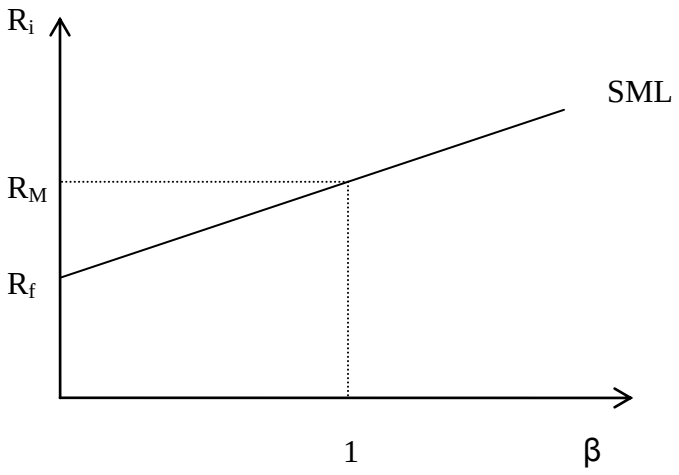
It needs to be understood that β is specified for a period of time and there is a certain amount of stability required in the value of β to be of any value for consideration. However, in actual world, it does not happen and therefore it is important to tie it to a particular period of time by statistical articulations.

Security Market line

The important outcome of the CAPM is the relationship between the β of the stock and the expected stock returns. The Markowitzian index of risk represented by σ is replaced by β in the CAPM model. The variability in the stock return with respect to the market returns indicated by stock βis indicative of the risk inbuilt in the stock. Therefore, similar to the Capital Market Line (CML) of the Markowitz model, there is a Security Market Line (SML) in CAPM. SML is the relation between the expected returns of a stock to the β of the stock. The SML can be drawn with intercept = R_f when the absolute expected stock return is considered. Alternately, SML can also be drawn with intercept =0 when the excess return of the stock over the risk free asset return is considered. Both the forms of SML are shown below:-



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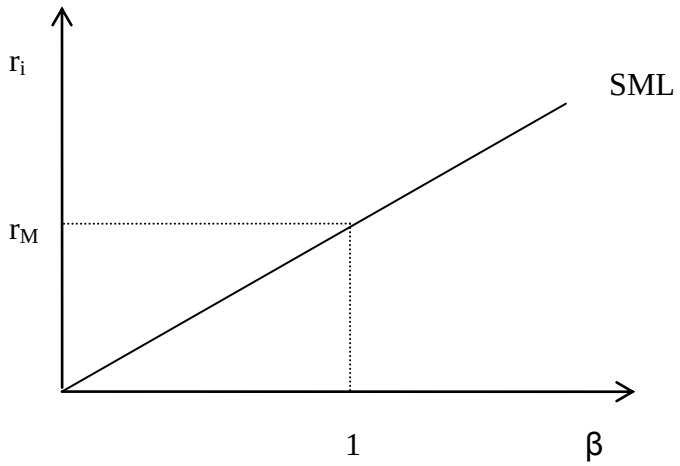

It is the second form of the SML which is often used because of the ease in the statistical calculations.

II. LITERATURE REVIEW

Jagannathan, Ravi & Zhenyu Wang (1993) "The CAPM is alive and well", according to this empirical studies of the CAPM, it is commonly assumed that, **(a)** The return to the value-weighted portfolio of all stocks is a reasonable proxy for the return on the market portfolio of all assets in the economy, and **(b)** Betas of assets remain constant over time. Under these assumptions, they argue that these two auxiliary assumptions are not reasonable. We demonstrate that when these assumptions are relaxed, the empirical support for the CAPM is very strong. When human capital is also included in measuring wealth, the CAPM is able to explain 28% of the cross sectional variation in average returns in the 100 portfolio studied by Fama and French. When, in addition, betas are allowed to vary over the business cycle, the CAPM is able to explain 57%. More important, relative size does not explain what is left unexplained after taking sampling errors into account.

JACOB STUDY (1971) study deals with 593 New York stock exchange stocks for the period from 1946 to 1965. Regression analysis is performed for the period from 1956 to 1955 and from 1956 to 1965 using both monthly and annual security returns. The result shows a significant positive relationship between realized return and risk during each of

the ten-year period. Although the relationship launched as positive, they are not stronger than predicted by CAPM.

Fama, Eugene F. & Kenneth R. French (2006) "The value premium and the CAPM", they examine (1) how value premiums vary with firm size, (2) whether the CAPM explains value premiums, and (3) whether, in general, average returns compensate β in the way predicted by the CAPM. During the period from 1926 to 2004, it was felt that CAPM's more general problem is that the variation in β unrelated to size and the value-growth characteristic goes unrewarded throughout the period. Based on these results, they conclude that the CAPM has fatal problems throughout the 1926 to 2004 period. Specifically, size and *B/M* or risks related to them are important in expected returns, whether or not they relate to β in a way that would support the CAPM, and β has little or no independent role. It seems safe to predict, however, that challenges are forthcoming.

Lettau Martin & Sydney Ludvigson (1999), "Resurrecting the (C)CAPM: A Cross-Sectional Test When Risk Premia Are Time-Varying", This paper explores the ability of theoretically-based asset pricing models such as the CAPM and the consumption CAPM referred to jointly as the (C)CAPM-to explain the cross-section of average stock returns. They specified the pricing kernel as a conditional linear factor model, as would be expected if risk premia vary over time. Central to their approach is the use of a conditioning variable which proxies for fluctuations in the log consumption-aggregate wealth ratio and is likely to be important for summarizing conditional expectations of excess returns. They demonstrate that such conditional factor models are able to explain a substantial fraction of the cross-sectional variation in portfolio returns. These models perform much better than unconditional (C) CAPM specifications, and about as well as the three-factor Fama-French model on portfolios sorted by size and book-to-market ratios. This specification of the linear conditional consumption CAPM, using aggregate consumption data, is able to account for the difference in returns between low book-to-market and high book-to-market firms and exhibits little evidence of residual size or book-to-market effects.
They argue that the results presented in this paper go a long way toward resolving this controversy. They provide an empirical test of the (C) CAPM by positing that the true unobservable discount factor may be approximated as a linear function of the model's fundamental factors. Instead of assuming that the parameters of this function are fixed over time, as in many previous studies, we model the parameters as time-varying by scaling them with conditioning information. Unlike the simple static CAPM or unconditional consumption CAPM, we find that these scaled multifactor versions of the

(C) CAPM can explain a substantial fraction of the cross-sectional variation in average returns on stock portfolios sorted according to size and book-to-market equity ratios. These results seem to be especially supportive of a habit-formation version of the consumption CAPM, where the multiplicative, or scaled, consumption factor is important. This scaled consumption CAPM does a good job of explaining the celebrated value-premium: portfolios with high book-to-market equity ratios also tend to have returns that are more highly correlated with the scaled consumption factors we consider, and vice versa. Furthermore, the scaled consumption model eliminates residual size and book-to-market effects that remain in the CAPM. Thus, these findings lend support to the view that the value-premium can, at least in part, be attributed to the greater no diversifiable risk of high book-to-market portfolios, and not simply to elements bears no relation to risk such as firm characteristics or sample selection biases.

Adrian, Tobias & Francesco Franzoni (2009), "Learning about Beta: Time-varying Factor Loadings, Expected Returns, and the Conditional CAPM", this paper explores the theoretical and empirical implications of time-varying and un- observable beta. Investors infer factor loadings from the history of returns via the Kalman filter. Due to learning, the history of beta matters. Even though the conditional CAPM holds, standard OLS tests can reject the model if the evolution of investor's expectations is not properly modeled. They use their methodology to explain returns on the twenty-five size and book-to-market sorted portfolios. Our learning version of the conditional CAPM produces pricing errors that are significantly smaller than standard conditional or unconditional CAPM and the model is not rejected by the data.

Torrez, jimmy & Mohammad Al-Jafari & Ahmad H Juma'h (2006) "Corporate valuation: A Literature Review" they discussed the ways and methods of corporate valuations that include the discounted cash flow models, the Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Models (APM), Tobin's q, sales accelerator and cash flow models of investment, and economic base performance measures such as Economic Rent and Excess Market Value. It seems that more innovated methods to detect changes in companies' financial positions are needed. Also, managers' financial experiences are essential for companies to compete in a world with a constant change. Multiple theories of corporate valuation have been examined in this paper. Although, empirically there is not a clear-cut winner, it seems that this area of study is going in the direction of performance based measures to explain valuation. This is not to say that other theories have not made major contributions to an understanding of what adds value to the company. In fact, the majority of empirical studies often use assumptions from other theories of valuation when testing the predictions in the theory in question. For example, to estimates ER the majority of empirical work uses the CAPM framework

to estimate cost of capital. Performance based measures are intellectually attractive because of the use of Microeconomic and Corporate Finance theory to explain valuation. The theory is still in its infancy; however at this early stage it seems to provide a better explanation of valuation than theories that rely on accounting based measures of performance.

Srinivasan (1988) uses a two phase regression, to test the relationship and the effect of diversification in Indian stock market. **Sehgal (1997)** study does not support the CAPM in determining the required rate of return of an asset in the Indian stock market, thereby, doesn't support any relationship between risk and return. **Dhankar and Kumar (2006)** examined BSE 100 stocks' monthly adjusted opening and closing prices for the period 1996-2005. The study estimate expected return, market risk and non-market risk by applying the CAPM.

Manjunatha, T. & T. Mallikarjunappa & Mustiary Begum (2007), "Capital Asset Pricing Model: Beta and Size Tests", the tests on CAPM have been conducted to test intercept, beta and a number of risk factors. This study tests intercept, beta and size coefficients for sample companies. The results of the study show that intercept is not significantly different from zero and neither beta nor size explains variation in portfolio returns. Therefore, we conclude that the intercept of the CAPM is equal to the risk-free rate of returns but the beta and size factors do not explain the portfolio returns in Indian market. The exception is market value weighted portfolios when percentage returns are used. In this case beta explains the portfolio returns. Investments are made in stock markets in expectation of returns above the risk-free rate. Over the years, researchers have worked to find the relationship between risk and returns. Establishment of the relationship between returns and risks by way of CAPM was considered as one of the most important contribution of the researchers in the securities market . Ever since Sharp-Lintner-Mossin proposed CAPM, a large number of studies have been conducted to test CAPM. Although CAPM remains as one of the most popular models in both professional as well as academic parlance, a large number of researchers have come up various extensions of the basic CAPM to include a number of risk factors such as size, book-to-market equity, EPS/Price, leverage and market factors to explain portfolio returns.

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III. OBJECTIVE AND RESEARCH METHODOLOGY

A. Objective

In order to broadly verify the methodology of these two papers, a sample of 15 stocks was picked from the National Stock Exchange (NSE) and a limited analysis was carried out to examine the following:-

(a) whether risk of the stocks is related to their expected return.

(b) whether the expected rate of return is linearly related to its systematic risk through **β**.

B. Sample Selection and Data

The paper examines the empirical evidence validity of CAPM in Indian context. The stock return of 15 companies listed on National Stock Exchange (NSE) have been analyzed for a period of 5 years from January 2006 to December 2010.

This time period was characterized by volatility and historically high and low returns for the Indian stock market. The selected sample consists of 15 stocks that are listed on NSE and each series consists of 60 observations of the monthly closing prices.

The Nifty index of NSE consisting of 50 stocks was taken as the proxy for the market portfolio. All securities included in the study are traded on the NSE on a continuous basis throughout the full trading day.

In order to obtain better estimates of the value of the beta coefficient, the study utilizes monthly stock returns. Returns calculated using a longer time period (e.g. annual) might result in changes of beta over the examined period introducing biases in beta estimates. On the other hand, high frequency data such as daily/weekly observations covering a relatively short and stable time span can result in the noisy data and thus yield inefficient estimates.

The 91 days Treasury Bill was used as the proxy for the risk-free asset. The yields were obtained from the tradingeconomics.com, a website dealing with financial markets.

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C. Methodology

The objective of the paper is to test the validity of CAPM. To achieve the said objective the following two methods were adopted.

In the first method, the CAPM was tested on the cross section of 15 stocks for the period of five years. Individual observed Stock betas were determined using regression of excess portfolio returns over the excess returns of the stock. Returns on 91 days T bill was used as risk free return. EViews version 8 was used for running the regression.

In the second method, the methodology proposed by Black et al. (1972) was employed wherein five portfolios of three stocks each were examined for CAPM validity. It may be noted that Black et al. (1972) had proposed that individual stock analysis of CAPM is full of statistical problems and therefore it is better to use the CAPM on the portfolio of similar stocks.

The first step was to estimate a beta coefficient for each stock using weekly returns during the period of January 2006 to December 2010. The beta was estimated by regressing each stock's monthly return against the market index according to the following equation:

$$R_{it} - R_f = ai + \beta_i (R_{Mt} - R_f) + eit \qquad (1)$$

where,
R_{it} is the return on stock i (i=1…15),
R_f is the rate of return on a risk-free asset,
R_{Mt} is the rate of return on the market index,
β_i is the estimate of beta for the stock i , and
eit is the corresponding random disturbance term in the regression equation.

The securities were ordered according to their beta coefficient computed by Equation (1). The next step was to compute average portfolio excess returns of stocks (r_{pt}).

$$r_{pt} = \frac{\sum_{i=1}^{k} r_{it}}{k} \qquad (2)$$

where,
k is the number of stocks included in each portfolio (k=1…3),

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p is the number of portfolios (p=1…5),
$r_{it}$is the excess return on stocks that form each portfolio comprised of k stocks each.

This procedure generated 5 equally-weighted portfolios comprised of 3 stocks each.

The following equation was used to estimate portfolio betas:

$$r_{pt} = \alpha_p + \beta_p . r_{Mt} + \varepsilon_{pt} \quad (3)$$

Further, by estimating the SML by regressing the portfolio returns against the portfolio betas obtained by Equation 3. The following relation is examined:

$$r_p = \gamma_0 + \gamma_1 \beta_p + e_p \quad (4)$$

where,
$r_p$is the average excess return on a portfolio p (the difference between the return on the portfolio and the return on a risk-free asset),
β_p is an estimate of beta of the portfolio p,
$\gamma_1$is the market price of risk, the risk premium for bearing one unit of beta risk,
γ_0 is the zero-beta rate, the expected return on an asset which has a beta of zero, and
e*p* is random disturbance term in the regression equation.

If the CAPM is true, $\gamma_0$should be equal to zero and γ_1, the slope of SML, is the market portfolio's average risk premium.

IV. RESULTS AND DISCUSSIONS

A. Cross Sectional Analysis-First Method

As per the first method, the estimation of betas for individual stocks was determined using EViews 8. The results are as given in the table below. The range of the estimated stock betas is between 0.250 the minimum and 2.088 the maximum. All the beta coefficients for individual stocks were statistically significant at 90% level.

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Table 1: Estimation of Betas for Individual Stocks

Sl. No.	Stock	β_i	Excess return r_{it}
1.	Cipla	0.250	-1.80
2.	SPB	0.677	1.30
3.	Maruti	0.782	1.22
4.	HCL	0.802	-3.17
5.	BHEL	0.860	0.70
6.	PNB	0.895	1.75
7.	ONGC	0.966	0.33
8.	HDFC	0.996	1.48
9.	TCS	1.116	1.35
10.	SBI	1.151	2.34
11.	Thermax	1.274	2.63
12.	LIC HF	1.611	3.73
13.	Tata Steel	1.747	1.96
14.	Punj Llyod	1.902	-1.24
15.	Aban offshore	2.088	3.10

The following graph indicates the relationship between β and excess return. The SML is drawn using two points, excess market portfolio return of 1.45 with $\beta=1$ and zero excess return with $\beta=0$. Broadly, there is a trend of increasing returns with increasing beta but there are several exceptions apparently visible scattered across the SML. Therefore, for individual stocks, the Higher returns for higher beta is not conclusively established from the graph.

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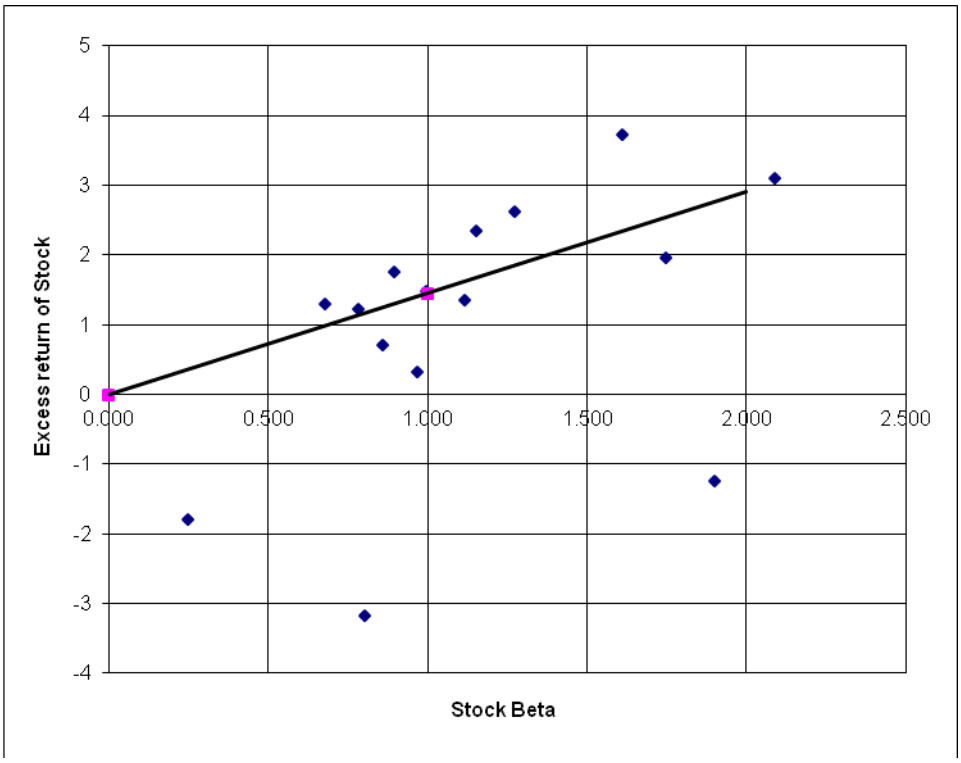

The individual stock betas were regressed on the stocks' excess returns using MS Excel. The following is the summary of the regression:

Table 2: Regression Summary

Regression Statistics	
Multiple R	0.45669
R Square	0.208566
Adjusted R Square	0.147687
Standard Error	0.463404
Observations	15

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	1.013072	0.138222	7.3293	5.75E-06	0.714461
X Variable 1	0.122481	0.066173	1.850914	0.08703	-0.02048

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The following facts are evident from the regression results as given in the above table:-

(a) The p values of the intercept as well as x variable i.e. market excess return are within 10%, therefore, the regression results are significant within 10% level.

(b) NSE Nifty index was used as proxy for the market portfolio. The regression table shows only 20.8% (indicated by R^2) contribution of the proxy market portfolio on the stocks' excess returns. Therefore, NSE Nifty does not prove to be a good proxy of the market portfolio in terms of CAPM.

(c) The intercept i.e. *ai*of Equation (1) is non zero significant to less than 1% level (indicated by a very small p value). A value of 1 on a scale of 3 cannot be approximation of near zero. Therefore, the zero intercept hypothesis of CAPM is empirically not valid.

B. Portfolio Analysis-Second Method

The following portfolios were formed in accordance with the methodology discussed in previous section:-

Table 3: Portfolio Construction

Portfolio	**r_p**	**β_p**	**Var (rp)**	**Var (ε_p)**	**Var (r_p,r_M)**	**R^2**
a1	0.24	0.570	45.63	21.51	24.12	0.727
a2	-0.24	0.852	84.21	30.21	53.99	0.801
a3	1.05	1.026	117.60	39.38	78.22	0.816
a4	2.9	1.345	186.79	52.25	134.54	0.849
a5	1.27	1.912	407.20	135.36	271.84	0.817

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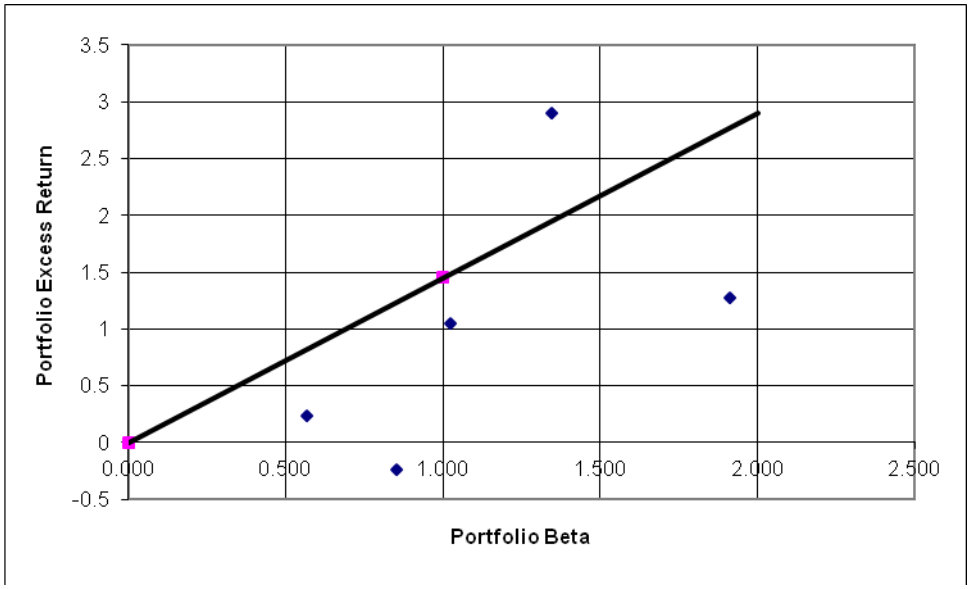
The graph of the portfolio excess returns v/s β_p is as shown below. Like in the first method, the SML is drawn using two points, excess market portfolio return of 1.45 with β=1 and zero excess return with β=0. The portfolio excess return increases for three portfolios with the increase in Beta but decreases for the other two portfolios.



The portfolio beta was regressed on the portfolio excess return using MS Excel. The following is the summary of the regression:

Table 4: Regression Summary

Regression Statistics	
Multiple R	0.55908
R Square	0.31257
Adjusted R Square	0.083427
Standard Error	1.151492
Observations	5

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*

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Intercept	-0.44484	1.376277	-0.32322	0.767746	-4.82478
X Variable 1	1.306251	1.118424	1.167939	0.32721	-2.25308

The following facts are evident from the regression results as given in the above table:-

(a) The p values of the intercept as well as x variable i.e. market excess return are very high indicating insignificant regression results. Therefore, the results of regression cannot be used for fruitful conclusions.

(b) If at all the significance levels are increased too high, the proxy market contribution is not significant The regression table shows only 31.25% (indicated by R2) contribution of the proxy market portfolio on the stocks' excess returns. Therefore, NSE Nifty conclusively does not prove to be a good proxy of the market portfolio in terms of CAPM.

(c) The intercept i.e. αi of Equation (1) is non zero (infact it is negative). Therefore, the zero intercept hypothesis of CAPM is empirically not valid.

V. LIMITATIONS

The limitations of the present study includes the use of only 15 scrips and the time period of 5 years. More studies can be done in the same context with more number of scrips and for a longer time period.

VI. CONCLUSION

The paper examined the stock returns of 15 companies listed on the NSE were examined for five years period from January 2006 to December 2010. EViews version 8 and MS Excel were used for statistical analysis. Two methods i.e. cross sectional analysis and portfolio analysis were adopted. The following are the findings of the study by the two methods:-

(a) The CAPM philosophy of Higher Returns for higher beta could neither be established for individual stocks nor for the portfolios.

(b) The intercept is non zero in both the cases. Hence the zero intercept of the SML is not true in case of the individual scrip as well as portfolios.

In both the cases, the findings did not support the CAPM's basic hypothesis that higher risk (beta) is associated with a higher level of return. Also, the zero intercept hypothesis of CAPM was negated. Within the limited scope of this study, it was empirically found that CAPM is not valid in Indian capital market.

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