

## **TESTING OF CAPM IN INDIAN CONTEXT**

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### **ABSTRACT**

*CAPM relates the return of the stocks and portfolios to the market factor captured by beta. The studies on asset pricing in initial years supported the CAPM (Fama-Macbeth, 1973). However, there were many studies conducted later such as by Stattman (1980), Banz (1981), Basu (1983) and Bhandari (1988) that found some anomalies such size effect, leverage, value effect etc. which were not explained by CAPM. We conduct the test of CAPM in India with the help of data relating to the CNX S&P 500 index and its constituents. We take a comprehensive view of the CAPM of asset pricing by taking 15 years data from January 2001 to January 2015. We test the applicability of the model by dividing the data in 4 sub periods which includes pre and post 2008 financial crisis framework. The results suggest that CAPM does not have much explanatory power and we should search for the alternative models for the asset pricing in India.*

**KEYWORDS:** CAPM, Beta, Asset Pricing

### **INTRODUCTION**

Asset pricing is one of the central theme in finance literature. The initial work in this field was done by Sharpe (1964), Lintner (1965) and Black (1972). The capital asset pricing model (CAPM) is the first attempt of asset pricing. Capital Asset Pricing Model (CAPM) of Sharpe (1964) is the breakthrough asset pricing equilibrium model that provides the relationship between expected return and risk of capital assets. This is based on the work of Markowitz (1952). According to this model, the expected return of the securities is based on the market factor. This market factor is captured by the beta of the stock. The beta measures the sensitivity of the stock's return to the changes in the market conditions. The CAPM model divides the risk into two component i.e. systematic risk and unsystematic risk. The risk associated with the market cannot be diversified and hence non diversifiable, this is the systematic risk. The other component of the risk is firm specific and it can be diversified away, this is the unsystematic risk. The CAPM says that the risk premium is thus based on the market risk and not on the unsystematic risk. This is the reason that the only factor which is considered in CAPM is the market risk factor and it is captured by beta of the stock.

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In the 1960s and 70s, CAPM received good support of academicians. However, studies by Stattman (1980), Banz (1981), Basu (1983) and Bhandari (1988) and various other researchers found many anomalies. We empirically test the standard CAPM for the Indian stock market. We conduct the test for complete 10 years data from January 2006 to December 2015 and further divide it into 4 sub periods to assess the impact of financial crisis on the applicability of CAPM. The main motivation of the study is to test the applicability of the model for pre and post crisis period as this was not yet conducted for the Indian context. The contribution of this paper is to assess the applicability of CAPM by using the latest data and also take into account the pre and post crisis period for testing CAPM. We use the blend of Black, Jensen and Scholes (1973) and Fama and Macbeth (1973) methodology to test the CAPM in India.

This study is mainly covered under six sections. The second section presents the review of literature of asset pricing models. The third section describes the data which is used for conducting various tests in the study and the methodology. The fourth section presents the results of various tests. The fifth section provides empirical results of various sub periods. The final section of the study provides summary and scope for further study.

## **REVIEW OF LITERATURE**

The portfolio selection on the basis of quantitative techniques was initiated by Markowitz (1952). This study gave the concept of diversification which people knew earlier through the adage, “do not put your all eggs in one basket”. The major contribution of Markowitz is to use the statistical tools to formalise it as a separate branch of studies. This study relies on the first two moments of the return distribution, namely, mean and variance. This is the reason that this theory is also called mean variance approach. This work is later improved by his student Sharpe (1964), and Lintner (1965) who developed the capital asset pricing model. This model states the relationship between risk and return of financial assets. It states that return of a stock is related to the beta of the stock which measures the responsiveness of the stock return to the market conditions. Among the vast galaxy of literature on asset pricing, the most important and the relevant paper for this study are reviewed in this section.

The CAPM has been tested for its practical utility by various researchers. One of the leading papers in early 70s is by Fama and MacBeth (1973) wherein the authors attempt to test the relationship between average return and risks for common stocks. The data pertains to New York Stock Exchange common stocks. The time span ranges from January 1926 to June 1968. The data is obtained by them from centre for research in securities prices. The result on the basis of data analysis revealed that the relationship between risk and return is linear, beta is the proper

measure of risk and risk premium is positive. Thus, this study concluded that CAPM is a good model of asset pricing and it can be used to identify return of the stocks and portfolio, given the level of risk which is adequately measured by beta.

Another attempt to test CAPM is conducted by Reinganum (1981) to test whether the security's return varies according to the beta as stated in theory. It is assumed by CAPM that the high beta stocks have high return and vice-versa. The data for the study is related to the time period 1963 to 1979 of all the stocks traded in New York Stock Exchange. The methodology is to first of all compute beta for each security and rank them. On the basis of this ranking ten portfolios are formed. The return of each of these ten portfolios is calculated by taking average of the securities included in it. This results in the time series of return of these ten portfolios which are later tested to check whether all have different return or not. The study concluded that for the said time period, there is no significant evidence is found among the return of these portfolios, thus beta is not systematically related to the average return. This finding does not outrightly reject the CAPM rather insinuates that the beta factor alone is not sufficient to explain the cross section average return. Banz (1981) found on the basis of data starting from 1936-1975 that the return from the small company stocks is higher than the return from the large sized company. The above result of not significant relationship between beta and average return is later confirmed by one more study (Lakonishok and Shapiro 1986). This study is based on the work of Reinganum (1981) and Banz (1981). They conducted their study for the time period 1962-1981 and found that it is the size which matter the most. Later a few more factors were identified which are assumed to explain the average return. Bhandari (1988) found that there is positive relationship between average return and leverage. Similarly, for US stock market, it was found that book-to-market equity and average return are positively related. All these theories shook the faith in CAPM and the research began to identify the variables which are able to explain the cross section variations in return.

DeBondt and Thaler (1985) found a long-term reversal effect. It means that past winners become loser over the long term horizon of 3-5 years time and the past losers appear as a winner in the long term period. The study showed that the best performing stocks of a particular time period had the tendency to become the bad performers in the subsequent time period whereas the bad performing stocks of a particular time period turned out to be the best performers in the later time period. They assign the cause of it to the over reaction of the investors. People tend to over react to the increase or decrease in price but in the long run they realise the mistake and take corrective actions which reverse the performance of the stocks. This is also called the mean reversion of stock return. Lakonishok, Shleifer and Vishny (1994) in their study give the behavioural explanation for the relationship between the firm specific variables and the return of

the stocks. They state that the reason for the low price to earnings stocks generating high return is not due to the risk characteristic of these stocks. The true reason is the naive behaviour of the investors who too far extrapolate the past into the future and believe that the stocks that have high return now would be generating the high return in future as well. The participants correct the error as they realise the mistake and there is mean reversion of the return.

Fama-French (1993) responded to these anomalies in their study based on the US data for the time period of 1962-1989 of all non-financial firms which is obtained from the Center for Research in Security Prices (CRSP). Book-to-market ratio, leverage and earnings-price ratios for year  $t - 1$  are computed on the basis of market equity at the end of December  $t - 1$  and size is measured by using market equity for June of year  $t$ . The rationale of this study originates with the observation that there is positive relationship between beta factor and average return, however this relationship does not hold for 1960s till 1990s. This study also supports the new findings at that time of irrelevance of CAPM. It led to the search for the variable which can help explaining the cross section of average return. Some of the variables which are presumed to be anomalies are used as an input to figure out whether these are able to explain the above mentioned relationship. The size and value factor estimated on the basis of market equity and book-to-market equity are used along with market returns to search for better model of asset pricing. The size factor states that smaller the size higher the return. This makes way for the phenomenon that small size companies generate high return. The value factor is captured by book-to-market equity which shows that high ratio is associated with poor performance. Thus, these factors are assumed to be proxies for risk factors not captured by the standard CAPM. These models can be used to evaluate performance of portfolios by classifying them in appropriate category on the basis of size and value and using the respective benchmarks assuming that the markets are rational. The drawback of this model is that it does not provide any economic reasoning behind the use of these proxies for risk and critiques think of it just as a piece of data manipulation which cannot be justified on appropriate theoretical grounds. Fama and French (1996) study confirmed that the Three Factor Model which was introduced in Fama and French (1993) captures the CAPM anomalies. These anomalies are associated with size, BE/ME ratio, E/P ratio, past sales growth and long term past returns. This study is conducted on the basis of data taken from NYSE, AMEX and NASDAQ. The time period for the study is 1963-1993. They test the model using portfolios formed on Fama French (1993) double sorted size-BE/ME portfolios. They also conducted their test by constructing the portfolios using Lakonishok, Shleifer and Vishny (1994) technique and their double sorted portfolios obtained by combining sorts on sales rank with sorts on BE/ME, E/P. The other portfolios formed on the basis of studies by DeBondt and Thaler (1985) and Jegadeesh and Titman (1993). They found that all these factors disappear in the long run other than the three factors.

There are various studies conducted in India with references to test the applicability of CAPM in India. Yalwar (1988) conducted the test of CAPM for the period 1963-1982. The study finds evidence in support of the CAPM for Indian capital market with references to the period of the study. Srinivasan (1988) conducted the empirical test of CAPM for the period starting from 1982 to 1985. This study also supports the CAPM for Indian capital market on the basis of their data from 1982-1985. Gupta and Sehgal (1993) examined the applicability of CAPM by using the monthly returns of 30 securities that are included in SENSEX. The data pertains to the time period from April 1979 to March 1989. The study found that the CAPM is not perfectly fit due to the presence of non linearity in risk return relationship which is not captured by standard CAPM. A view similar to this study is noted in the study of Madhusoodanan (1997) which rejects the CAPM validity for Indian stock market. The time period of their study is from 1987 to 1995. The study concluded that high risk high return strategy is not lucrative in Indian stock market.

Sehgal (1997) also finds that there is a negative relationship between beta and returns in the study for the period 1984 to 1993. Another study conducted by Ansari (2000) by using the data from January 1990 to December 1996 pertaining to 96 stocks of Bombay stock exchange. This study finds very weak relationship between risk and return. The betas are also not stable for the Indian stock market as found by Manickaraj and Lokanathan (2004). The unstable beta are not good for assessing the riskiness of the securities and portfolios. The size effect Sehgal and Tripathi (2005) and value effects Sehgal and Tripathi (2007) are also visible in Indian stock market. Thereafter, there is not much evidence available to test the CAPM in Indian context taking into account data related to the pre and post 2008 financial crisis time period.

## **DATA AND METHODOLOGY**

### **Data**

The data pertains to the January 2001 to December 2015 for the Indian capital market. The first five years data is used to estimate the parameters and then the next year data is used to construct 25 portfolios and its return. The 25 portfolios are constructed and their monthly returns are calculated from January 2006 to December 2015. This time frame is further divided into 4 sub periods to re-examine the results. The four sub period consists of 30 months each from January 2006 – June 2008, July 2008 – December 2010, January 2011 – June 2013 and July 2013 – December 2015.

The Indian capital market data pertains to the CNX NSE 500 for the proxy of market portfolio and its constituent stocks are taken for computing 25 portfolios on the basis of beta. The data is

obtained from the Prowess database. Only those companies are selected for the study whose complete data for the 15 years is available. The companies with missing information for some of the time period are excluded. The final set consists of 250 companies for which full period data is available. These companies are used for portfolio formation and testing the model. The risk free rate for India is 91 days treasury bills rate and the data for the same is obtained from the Reserve Bank of India website.

### Methodology

The logarithmic return is computed for all the companies and the market proxy by using the following formula:

$$r_{t+1} = \ln\left(\frac{P_{t+1}}{P_t}\right) = \ln(P_{t+1}) - \ln(P_t) \quad 1$$

Where  $r_{t+1}$  is the simple return,  $P_{t+1}$  is the value of the index or price at the time t+1 and  $P_t$  is the price or the value of the index at the time period t.

The empirical studies have found that returns of financial asset exhibit limited liability, which is contrary to the normal distribution. Since the normal distribution stretches from  $-\infty$  to  $+\infty$  and the lower bound of -1 violates this property of normality. The log return takes care of this drawback.

We use the following procedure to test the asset pricing model:

Step 1: The first step is to compute the excess return for various companies and market proxy by deducting the risk free return from the actual return.

Step 2: The second step is to compute the beta for all the securities by using market model as given below:

$$R_{it} - R_{ft} = \alpha_i + \beta_i(R_{mt} - R_{ft}) + e_{it} \quad 2$$

where  $R_{it}$  is the returns on security for the month 't',  $R_{ft}$  is the returns on the risk free security and  $R_{mt}$  is the returns on the market proxy for the month 't' and  $e_{it}$  is the residual term.

Step 3: we use the first five years data for the purpose of beta computation for various securities. We use the return data from January 2001 to December 2005 for the computation of beta. The next computation of beta would be on the basis of data for the period January 2002 to December 2006 and so on.

Step 4: We use the betas computed above for the purpose of portfolio formation. The procedure is simple; first we sort the betas from highest to lowest for each year at the end of December.

Then, we form 25 portfolios by taking 10 securities in each of the portfolio starting from the highest beta stocks to lowest beta stock. In this way, we have 25 beta sorted portfolios for 10 years starting from year 2006.

Step 5: We compute the on monthly return of each portfolio as a simple average of the return of constituent stocks for each month. It will result in portfolio return data for 25 portfolios from January 2006 to December 2015.

Step 6: We compute the portfolio beta by regressing the monthly return for each portfolio on the excess return of market portfolio by using the following equation:

$$Z_{pt} = \alpha_p + \beta_p z_{mt} + e_{pt} \quad 3$$

Where,  $Z_{pt}$  is the excess monthly return of the portfolio,  $\beta_p$  is the beta of the portfolio,  $z_{mt}$  is the excess monthly return of market portfolio and  $e_{pt}$  is the residual term.

This step will give us 25 beta relating to each of the 25 portfolios.

Step 7: The next step is to use the second pass regression which is a cross sectional regression by using the following formula to test the CAPM in India:

$$Z_{pt} = \lambda_0 + \lambda_1 \beta_p + e_{pt} \quad 4$$

Where,  $Z_{pt}$  is the average of excess return of portfolios over risk free rate for 10 years period,  $\lambda_0$  is the intercept,  $\beta_p$  is the beta of the portfolio computed in previous step,  $\lambda_1$  is the market risk premium which is the regression coefficient for this equation and  $e_{pt}$  is the residual term. If CAPM holds, the value of  $\lambda_0$  should be zero and  $\lambda_1$  should be positive.

Step 8: The next step is to test the non-linearity of the model. The CAPM states that the assets returns are linearly related to the betas of the assets. We use the following equation to perform non-linearity test:

$$Z_{pt} = \lambda_0 + \lambda_1 \beta_p + \lambda_2 \beta_p^2 + e_{pt} \quad 5$$

Where,  $\beta_p^2$  is the square of the beta of portfolios. If CAPM holds, the value of  $\lambda_2$  should be zero.

Step 9: We also test for the non-systematic risk. The CAPM states that the only risk which is relevant is the systematic risk which is captured through beta factor. We add another variable in the above equation to test the impact of non-systematic risk by using the following equation:

$$Z_{pt} = \lambda_0 + \lambda_1 \beta_p + \lambda_2 \beta_p^2 + \lambda_3 RV_p + e_{pt} \quad 6$$

Where,  $RV_p$  refers to the variance of the residuals of portfolio p. If CAPM holds, the value of  $\lambda_3$  should be zero.

## EMPIRICAL ANALYSIS OF TEST OF CAPM

This section discusses the result of empirical data analysis of Indian capital market data. In order to test the applicability of CAPM in Indian context, we conduct two stages of regression, the first pass regression is on the time series data to compute the beta of the portfolios and the second pass regression equation is cross sectional regression equation to test the CAPM.

The table 1 gives the results relating to the first pass regression equation showing intercept and beta for 25 beta sorted portfolios with their significance.

**Table 1:** This table shows the result of the regression equation  $Z_{pt} = \alpha_p + \beta_p z_{mt} + e_{pt}$  computed on the basis of monthly return data. The time period of the study is from January 2006 to December 2015. \* means significance at 5% level of significance and \*\* means that it is significant at 1% level.

	$\alpha_p$	$\beta_p$
P1	-1.486*	1.944**
P2	-0.329	1.708**
P3	-0.713	1.554**
P4	-0.302	1.421**
P5	-0.528	1.421**
P6	-0.200	1.325**
P7	-0.280	1.383**
P8	-0.510	1.246**
P9	0.107	1.227**
P10	-0.296	1.131**
P11	0.380	1.171**
P12	-0.00741	1.100**
P13	0.0904	1.126**
P14	0.826*	1.065**
P15	-0.418	0.983**
P16	-0.286	0.952**
P17	0.333	0.930**
P18	0.499	0.898**
P19	0.419	0.905**
P20	0.126	0.818**
P21	0.401	0.755**
P22	0.583	0.655**
P23	0.255	0.595**
P24	0.979**	0.473**
P25	0.657*	0.348**

The result of the first pass regression shows that the intercept term is significant only for portfolios 1, 14, 24 and 25. The beta is significant for all the portfolios which suggest that the

beta helps capture systematic risk. The next task is to run the second pass regression equation and test whether the risk premium indicated by the beta is positive and significant or not. This test would indicate whether stand alone beta is an important factor for explaining the cross sectional return or not.

The results of the second pass regression equation are based on beta factor, square of beta factor and the variance of residuals. The relevant input for the cross sectional regression equation is given in table 2.

**Table 2: Regression input used to run cross sectional regression equation**

Portfolio	Average Return	Beta	Beta square	Variance of Residuals
P1	-0.9610	1.9438	3.7784	50.4873
P2	0.1327	1.7079	2.9169	25.8277
P3	-0.2929	1.5542	2.4155	26.7021
P4	0.0825	1.4215	2.0206	17.8579
P5	-0.1437	1.4209	2.0191	18.2435
P6	0.1577	1.3248	1.7552	13.8239
P7	0.0935	1.3829	1.9124	17.2901
P8	-0.1728	1.2458	1.5521	18.8900
P9	0.4383	1.2272	1.5061	19.7500
P10	0.0094	1.1306	1.2783	20.1080
P11	0.6967	1.1713	1.3719	16.4622
P12	0.2900	1.1005	1.2111	15.8557
P13	0.3947	1.1258	1.2673	16.9649
P14	1.1139	1.0648	1.1339	14.1439
P15	-0.1520	0.9833	0.9668	12.0895
P16	-0.0289	0.9520	0.9064	16.2351
P17	0.5845	0.9298	0.8645	12.6436
P18	0.7421	0.8983	0.8070	18.1964
P19	0.6635	0.9055	0.8199	11.4265
P20	0.3472	0.8178	0.6688	10.9933
P21	0.6056	0.7554	0.5707	14.5710
P22	0.7601	0.6549	0.4289	15.8996
P23	0.4161	0.5950	0.3541	14.8043
P24	1.1072	0.4732	0.2239	10.5373
P25	0.7513	0.3482	0.1212	12.1046

The above table suggest that the average return of portfolios is not always in commensuration with the risk denoted by high betas. The average return of high beta portfolios is not necessarily high and we find that the maximum return is provided by P14 which is followed by P24. These two portfolios are low beta portfolios whereas P24 is the just one above the lowest beta portfolio. On the other hand, the least return is generated by P1 which is followed by P3. The P1 portfolio is the highest beta portfolio and the return expectations are also high for this portfolio. However, the evidence suggests that return is least for this portfolio.

### Test of relevance of beta factor

The result of the second pass regression using equation 4 is given in table 3.

**Table 3: Output of second pass regression**

	Regression results	t-Statistic	Prob.
$\lambda_0$	1.298974	6.39599	0
$\lambda_1$	-0.91535	-5.16808	0
R-squared	0.537307		
Adjusted R-squared	0.51719		

The result of the second pass regression shows that the intercept term is significantly different from zero and the risk premium though significant but its sign is negative which is contrary to the CAPM. Thus, it gives us indication that the beta factor is not relevant for Indian stock market. Therefore we continue the search for alternative to beta in the form of taking into account the non-linear form of beta and non-systematic risk.

### Non-linearity test

Next, we perform the non-linearity test to identify whether nonlinear relationship between asset return and beta factor holds or not. The results of the second pass regression using equation 5 are given below in table 4.

**Table 4: Cross sectional regression for non-linearity test**

	Regression results	t-Statistic	Prob.
$\lambda_0$	0.8461	1.9294	0.0667
$\lambda_1$	-0.0012	-0.0015	0.9988
$\lambda_2$	-0.4102	-1.1630	0.2573
R-squared	0.5641		
Adjusted R-squared	0.5245		

The regression results suggests that  $\lambda_0$  is zero as claimed by CAPM, however  $\lambda_1$  is negative and insignificant which refutes the CAPM. The result related to  $\lambda_2$  states that this coefficient is not significantly different from zero.

### Non-systematic risk test

The non-systematic risk test is performed with the help of equation 6. The results are given in table 5 provided below:

**Table 5: Cross section regression for non-systematic risk**

	Regression results	t-Statistic	Prob.
$\lambda_0$	1.4361	2.2884	0.0326
$\lambda_1$	-0.7788	-0.7829	0.4424
$\lambda_2$	0.1074	0.2029	0.8412
$\lambda_3$	-0.0241	-1.2959	0.2091
R-squared	0.5964		
Adjusted R-squared	0.5387		

Here we find that the coefficients hat  $\lambda_0$  ,  $\lambda_1$  ,  $\lambda_2$  and ,  $\lambda_3$  are not significant but  $\lambda_0$  is significantly different from zero at 1% level of significance. Thus, all our evidences give us an indication that the traditional model of asset pricing i.e. CAPM is not applicable for the Indian stock market.

### EMPIRICAL ANALYSIS OF TEST OF CAPM FOR VARIOUS SUB-PERIODS

This section discusses the results of tests performed for various sub periods. The idea of dividing the sample period into four sub period is to assess the applicability of the model under different time frame which includes pre and post 2008 financial crisis. We denote the time period from Jan 2006-Jun 2008 as sub period 1 i.e. **SP1**, Jul 2008-Dec2010 as **SP2**, Jan 2011-Jun2013 as **SP3** and Jul 2013-Dec 2015 as **SP4**.

The table 6 gives the results relating to the first pass regression equation showing intercept and beta for 25 beta sorted portfolios with their significance.

**Table 6: result of the regression equation  $Z_{pt} = \alpha_p + \beta_p z_{mt} + e_{pt}$  computed on the basis of monthly return data for various sub periods.**

	Jan 2006-Jun 2008		Jul 2008-Dec2010		Jan 2011-Jun2013		Jul 2013-Dec 2015	
	$\alpha_p$	$\beta_p$	$\alpha_p$	$\beta_p$	$\alpha_p$	$\beta_p$	$\alpha_p$	$\beta_p$
P1	-0.241	1.486**	-2.401*	2.021**	-1.342	2.422**	-2.003	2.799**
P2	1.233	1.619**	-1.062	1.754**	-1.269	1.841**	-0.00155	1.544**
P3	-0.740	1.340**	-1.630	1.752**	-1.867**	1.328**	0.915	1.741**
P4	-0.432	1.338**	-0.643	1.493**	-0.654	1.301**	0.242	1.603**
P5	-0.181	1.193**	-1.531	1.555**	-0.861	1.375**	0.107	1.798**
P6	-0.685	1.293**	0.524	1.308**	-1.284*	1.254**	0.426	1.596**
P7	-1.771*	1.291**	0.156	1.405**	-1.535*	1.371**	1.913*	1.553**
P8	-1.315	1.258**	0.949	1.191**	-1.791**	1.218**	0.0423	1.401**
P9	-0.0208	1.148**	0.00839	1.282**	-0.772	1.145**	1.020	1.353**
P10	-1.216	1.047**	-0.252	1.207**	-0.532	0.966**	0.461	1.354**
P11	0.278	1.098**	-0.254	1.202**	-0.161	1.111**	1.427	1.420**
P12	-1.384	0.961**	0.452	1.144**	-0.535	1.140**	1.314	1.348**
P13	-1.589*	1.201**	0.480	1.124**	-0.0894	0.850**	1.180	1.272**
P14	-0.338	0.973**	2.121**	1.042**	-0.107	1.179**	1.649*	1.278**
P15	-1.500	0.972**	0.709	1.009**	-0.799	0.923**	-0.115	0.913**
P16	-2.239*	0.939**	0.910	1.031**	-0.157	0.751**	0.122	0.881**
P17	-1.288	0.907**	1.664**	0.900**	0.583	0.926**	0.232	1.196**
P18	-0.843	0.754**	0.879	0.994**	-0.0044	0.806**	1.685**	1.115**
P19	-0.865	0.818**	0.587	0.986**	1.299**	0.921**	0.646	0.860**
P20	-0.871	0.772**	1.369*	0.805**	-0.228	0.782**	0.0358	1.111**
P21	-0.923	0.605**	1.156	0.864**	0.472	0.916**	1.192*	0.451*
P22	-0.218	0.640**	1.613*	0.643**	-0.101	0.718**	1.177*	0.563**
P23	-1.701*	0.682**	1.536	0.536**	-0.196	0.529**	1.383*	0.549**
P24	0.520	0.476**	1.575*	0.452**	1.104	0.508**	0.748	0.510**
P25	-0.164	0.413**	1.329*	0.348**	1.076	0.298**	0.457	0.139

Note: \* means significance at 5% level of significance and \*\* means that it is significant at 1% level.

Thus we find that the beta factor is significant for almost all the portfolios barring P25 that is only for the last sub period. Now we proceed towards testing various propositions with the help of second pass regression equations.

### Test of relevance of beta factor

The result of the second pass regression using equation 4 is given in table 3.

**Table 7: Output of second pass regression**

		Regression results	t-Statistic	Prob.
January 2006 to June 2008	$\lambda_0$	-1.0407	-1.8690	0.0744
	$\lambda_1$	0.6318	1.1968	0.2436
	R-squared	0.0586		
	Adjusted R-squared	0.0177		
July 2008 to December 2010	$\lambda_0$	3.2125	9.6863	0.0000
	$\lambda_1$	-1.4675	-5.2691	0.0000
	R-squared	0.5469		
	Adjusted R-squared	0.5272		
January 2011 to June 2013	$\lambda_0$	1.0596	3.0408	0.0058
	$\lambda_1$	-2.3078	-7.5846	0.0000
	R-squared	0.7144		
	Adjusted R-squared	0.7020		
July 2013 to December 2015	$\lambda_0$	1.4695	3.9838	0.0006
	$\lambda_1$	-0.0138	-0.0498	0.9607
	R-squared	0.0001		
	Adjusted R-squared	-0.0434		

The data analysis reveals that the risk premium is positive for SP1 but it is not statistically significant, and for SP2 and SP3 it is significant but it is negative and for SP4 we have negative and insignificant risk premium. Thus, the sub period analysis confirms the fact that CAPM's beta factor is not very important in explaining the risk return relationship.

### Non-linearity test

The non-linearity test is performed with the help of cross sectional regression equation 5 and the results are provided in the following table.

**Table 8: Cross sectional regression for nonlinearity test**

		Regression results	t-Statistic	Prob.
January 2006 to	$\lambda_0$	2.9922	2.5023	0.0203
	$\lambda_1$	-8.3333	-3.3338	0.0030

*Continued...*

June 2008	$\lambda_2$	4.5058	3.6399	0.0014
	R-squared	0.4125		
	Adjusted R-squared	0.3590		
July 2008 to December 2010	$\lambda_0$	1.5501	2.6388	0.0150
	$\lambda_1$	1.8095	1.7315	0.0974
	$\lambda_2$	-1.4202	-3.2181	0.0040
	R-squared	0.6919		
	Adjusted R-squared	0.6639		
January 2011 to June 2013	$\lambda_0$	2.1681	3.3138	0.0032
	$\lambda_1$	-4.2870	-4.0828	0.0005
	$\lambda_2$	0.7592	1.9596	0.0628
	R-squared	0.7568		
	Adjusted R-squared	0.7347		
July 2013 to December 2015	$\lambda_0$	0.3034	0.6171	0.5435
	$\lambda_1$	2.0836	2.8971	0.0084
	$\lambda_2$	-0.7827	-3.0892	0.0054
	R-squared	0.3026		
	Adjusted R-squared	0.2392		

We find that the results are almost on the same lines as discussed in previous section. The regression results suggests that  $\lambda_0$  is significantly different from zero for 3 sub periods barring the last sub period. The value of  $\lambda_1$  is either negative or not significant for the sub period as observed earlier. The result related to  $\lambda_2$  reveals that it is significant for 3 sub periods barring SP3, however, the sign of the coefficient is not stable as it is positive for SP1 and SP3 whereas the sign is negative for SP2 and SP4.

### Non-systematic risk test

The non-systematic risk test is performed with the help of equation 6. The results are given in Table 9 provided below:

**Table 9: Cross section regression for non-systematic risk**

		Regression results	t-Statistic	Prob.
January 2006 to June 2008	$\lambda_0$	2.8616	2.2656	0.0342
	$\lambda_1$	-8.3784	-3.2838	0.0035
	$\lambda_2$	4.5136	3.5752	0.0018
	$\lambda_3$	0.0082	0.3965	0.6958

	R-squared	0.4168		
	Adjusted R-squared	0.3335		
July 2008 to December 2010	$\lambda_0$	2.0890	3.2061	0.0042
	$\lambda_1$	1.2933	1.2289	0.2327
	$\lambda_2$	-1.0381	-2.1501	0.0434
	$\lambda_3$	-0.0296	-1.6623	0.1113
	R-squared	0.7278		
	Adjusted R-squared	0.6889		
January 2011 to June 2013	$\lambda_0$	2.5013	3.4089	0.0026
	$\lambda_1$	-4.2437	-4.0387	0.0006
	$\lambda_2$	0.8429	2.1271	0.0454
	$\lambda_3$	-0.0446	-1.0026	0.3275
	R-squared	0.7679		
	Adjusted R-squared	0.7348		
July 2013 to December 2015	$\lambda_0$	0.9504	1.6111	0.1221
	$\lambda_1$	1.1394	1.3216	0.2005
	$\lambda_2$	-0.1482	-0.3473	0.7318
	$\lambda_3$	-0.0332	-1.8034	0.0857
	R-squared	0.3961		
	Adjusted R-squared	0.3099		

The data analysis reveals that the non systematic risk factor is not significant for any of the above 4 sub periods and overall the model is not appropriate for explaining cross sectional return for different portfolios.

## SUMMARY AND CONCLUSION

### Summary

Asset pricing has found the central place in the financial literature. Sharpe (1964) formulated the first asset pricing model by using the work done by Markowitz (1952). According to CAPM, the expected return of the securities is based on the market factor. This market factor is captured by the beta of the stock. The beta measures the sensitivity of the stock's return to the changes in the market conditions. The CAPM model divides the risk into two component i.e. systematic risk and unsystematic risk.

We conduct the test of asset pricing models with the help of Indian capital market data. The data is related to the stocks included in NSE 500 index to construct 25 portfolios based on beta factor by using the techniques described in methodology section. In this study, we find that CAPM is

not capable of explaining the variations in cross sectional returns for the Indian stock market. The data analysis of the sub period also reveals the incapability of the traditional CAPM. Overall, we conclude that the CAPM is not relevant for asset pricing in India. This is in conformity with the previous studies by Gupta and Sehgal (1993), Ansari (2000), Manickaraj and Lokanathan (2004) etc. The present study is in the light of recent data which is further sub divided into 4 sub periods and confirm to the previous studies.

### **Future scope of research**

As we have found out that the CAPM is not applicable in the Indian context, we need to search for the alternative asset pricing models. There are various models which are available for pricing the financial asset. The one which has gained tremendous attention in recent year is Fama-French 3 factor model. The present study can be extended to incorporate the ideas provided by new models of asset pricing.

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