Vol 6 Issue 9 June 2017

ISSN No : 2249-894X

Monthly Multidisciplinary Research Journal

Review Of Research Journal

Welcome to Review Of Research

RNI MAHMUL/2011/38595 **ISSN No.2249-894X**

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ISSN: 2249-894X IMPACT FACTOR : 3.8014(UIF)

REVIEW OF RESEARCH

VOLUME - 6 | ISSUE - 9 | JUNE - 2017

CAPM: AN EMPIRICAL APPROACH

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ABSTRACT

The paper tests the relevance of Capital Asset Pricing Model in Indian stock market. The study is based on all the companies that are listed on Bombay Stock Exchange BSE 500 index and covers a period of 15 years – from 1st October 2001 to 30 September 2016 using monthly data from CMIE Prowess- the widely used database for academic research in India. Fama and French (1993) methodology has been used to make the portfolios. The empirical results show that the Capm cannot fail in the Indian equity market. The beta coefficients are significant implying that the market return plays an important role in the return generating process.

KEYWORDS: *CAPM, Market Return, BSE, Indian Stock Market .*

1. INTRODUCTION

Asset Pricing Models explain the relationship between risk and return. The Single Index Model developed by Sharpe (1964) explains that only one factor (namely market return) is sufficient to explain variations in returns of a security. The model also suggests that the security or portfolio risk can be divided into two parts, namely, unsystematic risk (also known as diversifiable risk), and systematic risk (also known as non-diversifiable risk). Unsystematic risk is the security specific risk and can be eliminated by changing the portfolio suitably whereas Systematic risk is associated with overall movements in the general market and thus cannot be eliminated. It is also referred to as the market risk. Since unsystematic risk can be diversified , there is a need to diversify the systematic risk in order to maximize the wealth of the shareholder.

Based on the Single Index Model, Sharpe (1964), Lintner (1965) and Mossin (1966) independently developed a model known as the Capital Asset Pricing Model (CAPM). The Capital Asset Pricing Model (CAPM) relates the expected rate of return of a security to its systematic risk which is measured through beta. CAPM is the oldest complete model of asset pricing, and explains the differences in expected returns due to differences in the systematic risks of assets.

After the development of Single Index Model and CAPM, there were many empirical studies that tested whether the model adequately describes the way stock market prices behave in practice. Many empirical researchers have found that there are influences beyond the market that cause stocks prices to move together and this laid to the development of multi-index (multifactor) models. Specifically, these studies have found through their empirical researches that single factor (market) is not sufficient in explaining differences in security returns, as stated by single index model and CAPM. Company characteristics like Firm size (measured in terms of market capitalization) , earning- yield , Leverage Cash flow to price (C/P ratio) and the firm's book-to-market equity ratio. These company characteristics together were found to provide a better explanation than market

factor alone for the cross-section of average stock returns.

Fama and French developed a three-factor model in 1992. They empirically examined the joint role of market return, firm's size, firm's book-to-market equity ratio, earning yield (E/P ratio) and leverage in the cross-section of average stock returns using a multifactor approach. They found that (a) the excess market return has some information about average returns; and (b) the combination of size (market capitalization) and book-to-market absorbs the role of leverage and earning yield (E/P) in average stock returns. Based on their empirical findings in Fama and French (1992), Fama and French (1993) propounded a three-factor model, comprising of the market factor and two mimicking portfolios that proxy for common factors in returns relating to size and book to market equity. They showed that their three-factor model captures much of the variations in the cross-section of average stock returns in a portfolio, which is missed by Sharpe's Single Index Model.

2. REVIEW OF LITERATURE

The CAPM model developed by Sharpe (1964), Lintner (1965) and Mossin (1966) independently stated that the expected returns of a security (or a portfolio) can be explained by the expected market risk premium, and the degree of sensitivity defined as the 'beta' of the security (or portfolio). The risk of a stock can be decomposed into two components. The first component is the systematic risk (beta), which is related to the overall market and the second component is non-systematic risk, which is specific to the individual stock. Investors are rewarded only for the systematic risk as the unsystematic risk can be diversified away by holding a diversified portfolio of assets.

Basu (1977) found that stocks with lower price to earnings (P/E) ratios provided higher risk adjusted returns than stocks with higher P/E ratios. Banz (1981) found that stocks of firms of smaller size provided higher risk adjusted returns than stocks of firms of larger size. Similar anomalous patterns were found with respect to other fundamentals like leverage , and book-to-market equity .

Fama and French (1992) studied the joint roles of market beta, size, earnings/price (E/P) ratio, leverage and book-to-market equity ratio in the cross-section of average stock returns for NYSE, Amex and NASDAQ stocks over the period 1963-1990. In that study, the authors found that beta has almost no explanatory power. On the other hand, when used alone, size, E/P, leverage and book-to-market equity have significant power in explaining the cross-section of average returns. When used jointly however, size and book-to-market equity are significant and they seem to absorb the effects of leverage and E/P in explaining the cross section average stock returns. Fama and French (1992), therefore, argued that if stocks are priced rationally, risks must be multidimensional.

Fama and French (1993) extended the Fama and French (1992) study by using a time-series regression approach. The analysis was extended to both stocks and bonds. Monthly returns on stocks and bonds were regressed on five factors: Returns on a market portfolio, a portfolio for size and a portfolio for the book-to-market equity effect, a term premium and a default premium. For stocks, the first three factors were found to be significant and for bonds, the last two factors. As a result, Fama and French (1993) construct a three-factor asset pricing model for stocks that includes the conventional market (beta) factor and two additional risk factors related to size and book-to-market equity. They find that this expanded model captures much of the cross-section of average returns amongst US stocks. Thus, Fama and French proposed a three factor asset pricing model by adding these two variables with the CAPM beta. While Fama and French (1992) adopted a cross-sectional regression approach of Fama and MacBeth (1973), Fama and French (1993) used a time-series regression approach.

Fama and French (1995) explored the relationship between risk factors and profitability. They found that high book-to-market equity (BE/ME) firms tend to be persistently distressed and low BE/ME firms are associated with sustained profitability. The returns to holders of high BE/ME stocks are therefore a compensation for holding less profitable and riskier stocks. They showed that book-to-market equity and slopes on HML in the three-factor model proxy for relative distress. Weak firms with persistently low earnings tend to have high BE/ME and positive slopes on HML; strong firms with high earnings have low BE/ME and negative slopes on HML. Singh and Yadav (2015) did a comparative study on the Capital Asset Pricing Model, the three factor model of Fama and French (1993), and the five factor model of Fama and French (2015) – on Indian stock market . The

study is based on the constituent companies of CNX 500. It was found that the three factor model performs better than the Capital Asset Pricing Model. For portfolios formed on investment, the five factor model performs better than the other models. However, the four factor model (without an investment factor) is a more parsimonious model.

3. OBJECTIVES

The objective of the study is to test the significance of the CAPM model in Indian Stock Market.

4. METHODOLOGY

4.1Sample

The monthly data for the study has been collected for all the firms listed on Bombay Stock Exchange(BSE) 500 index from the CMIE Prowess database- the widely used database for academic research in India from 1st October 2011 to 30 September 2016. After doing the sorting as per the availability of data, the sample companies differ each year from October 2001 to September 2016.

4.2 Definitions

a) Market factor: Market factor refers to the coefficient of risk premium that is (Rm- Rf). It is obtained by regressing assts' excess return with Risk Premium. BSE SENSEX 500 index has been used as the proxy of Market Return to calculate the Risk Premium.

b) Size: Market equity (ME) has been used as the proxy for the size. Market Capitalization (ME) is calculated by multiplying market price per share by the number of shares outstanding. Market capitalization has been calculated in the beginning of October of each year t. Time lag of six three months has been assumed from the end of the financial year as the financial information will be available to the public by companies.

c) BE/ME: BE/ME refers to the ratio of Book value and market value per equity share. It is also termed as value factor. BE/ME has been calculated as book value per share in March-end of year t, divided by the market value per share March-end of year t .

4.3 Portfolio Formation

The Fama-French methodology involves a cross classification of stocks on two dimensions – size, measured by market capitalization (Number of outstanding shares X closing price), and value, measured by the ratio of book value per share to market price per share – B/M ratio. This classification is tabulated below:

Table I

		Value as measured by B/M ratio		
		High (H)	Medium (M)	Low (L)
Size	Big (B)	BH	BM	BL
	Small (S)	SH	SM	SL

4.3.1 Methodology used to create Size portfolios

Size portfolio is created at the beginning of October each year based on market capitalization of the firm as on March end of the year t. Top 10% firms by market capitalization are defined as big firms (B) and remaining firms are classified as small firms (S).

4.3.2 Methodology used to create Value portfolios

Value portfolios are calculated at the beginning of October each year based on BE/ME ratio. The sample stocks are sorted in descending order on the basis of value. For the value breakpoints,

For the value breakpoints Fama and French (1993) strategy has been followed and the stocks were

grouped as below:

- High value group, H , consisted of the top 30% stocks in terms of the B/M ratio.
- Low stocks (low value group), L, comprised the bottom 30% stocks in terms of the B/M ratio.
- The remaining stocks were grouped as Medium (M) stocks.

Thus, six portfolios are created from the intersection of two sizes and three BE/ME Groups and are named as S/L, S/M, S/H, , B/L, B/M, and B/H. for example, S/L portfolio contains stocks of small ME(Market Equity) and low BE/ME companies, while B/H portfolio represents big ME companies with high BE/ME ratio. After calculating these portfolios, monthly weighted returns on the six portfolios are calculated for each portfolio starting from October of year *t* till September of year *t+1*. The portfolios are reformed every year in October of year *t+1*.

4.3.3 Portfolio formation date

Fama and French (1993)formed their portfolios in June of each year after considering a 6-month gap from the fiscal year ends (December) to account for the time taken for the publication of accounting data. As the fiscal year ends for most Indian firms is March, assuming a 6-months gap for publication of accounting data, we formed our portfolio in September of each year. In the size-value portfolio creation the firms with negative book values have been excluded from the sample.

4.4 Computation of Returns

The adjusted closing price (Adjusted Close) provided by CMIE Prowess is already adjusted for stock splits and other corporate actions but not for dividends. The total return including dividends of day t was computed using prices from BSE for each unique firm identifier using the following formula:

$$\text{Total Return}_t = \frac{\ln(\text{Adjusted Close}_t + \text{DPS}_t\,(\text{Adjusted Close}_t / \text{Close}_t)}{\text{Adjusted Close}_{t-1}}$$

where DPS denotes the dividend per share. Using the above formula, buy-and-hold returns have been for each size-value portfolio). The weight of each stock in a portfolio was based on the market capitalization on the portfolio reconstitution date (the September year end for the size and value portfolios).

4.5 Estimation of Market Risk Premium

The risk-free rate Rf , computed using the 91-days T-bill rate, is deducted from the return of the market portfolio (BSE Sensex 500 index) to obtain the market risk premium or Rm - Rf. The 91-day T-bill rate is sourced from the Reserve Bank of India's weekly auction data. The implied yields have been converted to monthly rates.

5. EXAMINATION OF EXPLANATORY FACTORS OF RETURNS

Time series regression is run to examine whether Market factors captures variations in returns. For this purpose, the time series regression equation is given below:

$$Rp - Rf = c + b(Rm - Rf) + e$$

Where:

Rp is the monthly return of a certain portfolio (S/L, S/M, S/H, B/L, B/M, B/H). Rf is the monthly risk free rate. Rm is the monthly return on market. For the purpose of this study, the BSE SENSEX 500 index has been used as a surrogate for market.

6. ANALYSIS AND RESULT

The analysis has been done using Eviews 8.

Table II: Mean monthly excess returns on the Size (ME)– Value (BE/ME) sorted portfolios

		Value		
		Low	Medium	High
Size	Small	0.029155	0.042096	0.059906
	Big	0.028214	0.049687	0.019745

Table-II shows the mean monthly returns over the risk free return (excess return) on the Size and BE/ME sorted portfolios. The six Size-BE/ME portfolios exhibit an excess return ranging from 0.029% to 0.019%. The portfolio returns confirm the Fama (1993, 1995) evidence that there is a negative relation between size and return except for the BH portfolio here. As shown in table II, the relation between BE/ME and excess return is positive except for the BH portfolio. Various researchers attempted to explain the value premium in stock returns. Fama and French (1992) suggested that it is possible that the risk captured by BE/ME is the relative distress factor. The market judges this relative risk distress factor and accordingly, price the stock which are signaled through BE/ME ratios in the market. Hence, it can be inferred that stocks with high ratios of book equity to market equity is signaling high distress risk and therefore, have higher expected returns than those firms having low BE/ME ratio. Hence, it seems as per Table-II that the Indian equity market is exhibiting a strong size effect and value effect.

Table III shows the regression results taking market factor as explanatory variable of the stock returns. The coefficients of the market factor is represented by b. The table shows that the slopes of the market factor (b) indicate that betas are not varying significantly between. The results (see Table III) show that the market factor coefficient (b) is positive and highly significant for each of the six portfolios. The t statistics of all the beta (b) values, have also been reported and are more than 7, and P-values, as reported in the table, are not different from 0, implying statistical significance of beta in explaining cross section of expected returns. The adjusted R2 is value ranges from 0.36 to 0.97 for the sample portfolios. The highest adjusted R2 value is seen for BL portfolio. The average of adjusted R2 is 68.70%. It implies that market factor does explain a proportion of the common variation in stock returns.

CAPM regression model was run for each of the six portfolios with the following Independent (Explanatory variables) as shown in the table:

Table III: Regression Analysis

CAPM					
Explanatory Variable	**Portfolio**	**B**	**t(b)**	**P–value t (b)**	**Adjusted R Square**
Market	BH	1.143	54.283	0	0.36453
	BM	1.1043	137.2	0	0.7691
	BL	0.9952	463.83	0	0.97441
	SH	0.8585	87.506	0	0.57535
	SM	0.8412	113.53	0	0.69519
	SL	0.7879	128.04	0	0.74365

6.1 Testing of significance of intercept

The regression results in Table IV suggest that the market proxy for common risk factor in returns. After this, it was verified whether the proxy risk factors suffice to explain the returns on portfolio. If the explanatory factors are suitable and sufficient proxies for underlying common risk factors, the intercept of the time series regression of excess returns on the mimicking portfolios should not be significantly different from 0. Table IV shows the intercept values of the regression equations , the t-values of intercepts and; the significance of the t-

values i.e. P- Values of the intercepts.

Table IV: Intercept

PANEL A				
Explanatory Variable	**Portfolio**	**C**	**t(c)**	**P-value t (c)**
Market	BH	0.0000805	0.00257	0.9979
	BM	0.015778	1.344064	0.179
	BL	-0.00235	-0.74927	0.4537
	SH	0.033543	2.344145	0.0191
	SM	0.016265	1.505144	0.1323
	SL	0.004959	0.552579	0.5806

7. CONCLUSION

The study tested the relevance of CAPM model in explaining the cross sectional differences in portfolio returns in the Indian context.the study reveals that CAPM is a very strong model and cannot be ignored or avoided. The Indian equity market has a strong presence of this asset pricing model. Other researches that can be done in this area are to test the significance of the other asset pricing models like the ICAPM, Fama French three, four and five factor models.

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