

# TESTING THE VALIDITY OF CAPM AND FF (FAMA FRENCH) MODELS BASED ON INTERCEPT VALUES OF PORTFOLIOS DURING A PERIOD OF APRIL 2005 TO MARCH 2015

**Mitalee A.Pithawala**

*Teaching assistant, Navnirman institute of management, NIM-BBA, Surat, (India)*

## ABSTRACT

*The aim of this research is to use the Indian stock market index for pricing security expected return and construct different portfolios to test the possible differences in the validity between the capital asset pricing model (CAPM) and the Fama and French three-factor model for the Indian market.*

*CAPM uses market sensitivity Beta to describe the variation of stock returns whereas F&F model uses Size of the firm, Book to market equity and risk premium to explain the variation in returns. The models are developed for BSE SENSEX listed 30 companies during the period 2005 to 2015 and results are compared with the actual returns. It is found that the CAPM gives better results for pricing single security that are closer to the actual returns than those obtained by Fama French Three factor model with narrow margin result difference.*

*In this study, comprehensive analysis of the two models, and form risk factors that are applied with advanced methods from recent literatures. By using the tool of MS EXCEL 2007, I estimate regression equations and test which factor model can better explain the return of stock. In a time-series regression approach and different hypotheses tests to check the statistical significance of key parameters (intercepts, P value, t value, market beta, size (SMB), value (HML)).*

*Study compares the estimated parameter intercept and checks which model has a better explanation on the relationship between risk factors and stock returns. The research concludes that the Fama and French three-factor model has more explanatory power than the single-factor CAPM, in explaining the variation of the portfolio returns. Research also finds that the market beta is the key factor, no matter if look at the capital asset pricing model or the FF three-factor model.*

**Keywords:** *Fama-French Three Factor Model, Capital Asset Pricing Model, Intercept, Size Value (SMB), Book-To-Market Value (HML),*

## I. INTRODUCTION

Study of Stocks through various financial models has always been a topic of interest to Analysts. Several Researchers have immensely contributed in evaluating the performance of Stocks from time to time. Sharpe

(1964), Lintner (1965) and Black (1972) developed the Capital Asset Pricing Model (CAPM). Several authors inclusive of Fama and French (2004) suggest that the CAPM marks “the birth of Asset Pricing models”. The CAPM is defined by the following equation:

$$E(R_i) = R_f + [E(R_m) - R_f]\beta_i \quad i = 1, 2, \dots, N$$

Where  $E(R_i)$  the expected is return on any asset  $i$ ,

$R_f$  is the risk-free interest rate,

$E(R_m)$  is the expected return on the market portfolio,

$\beta_i$  is the asset’s market beta which measures the sensitivity of the asset’s return to variation in the market return and it is equal to  $\frac{\text{cov}(R_i, R_m)}{\sigma_m^2}$ .

Studies in the 1980’s identified other factors that influence average stock returns. Fama and French (1993) find that two (2) factors; firm Size and BE/ME ratio which explain the differences in the average returns of stocks. Fama and French (1996) also find that two variables, SMB (Small minus Big- Size proxy) and HML (High minus Low- BE/ME proxy), inclusive of the market factor, explain significant return patterns.

**Fama and French’s three-factor model:**

$$E(R_i) = R_f + [E(R_M) - R_f]b_i + E(\text{SMB})s_i + E(\text{HML})h_i$$

Where  $[E(R_M) - R_f]$ ,  $E(\text{SMB})$  and  $E(\text{HML})$  are the factor risk premiums.

The objective of this study is to measure and analyze the performance of Indian Stocks listed on the benchmark Index- S&P BSE SENSEX (S&P Bombay Stock Exchange Sensitive Index), also-called the BSE 30 or simply the SENSEX, by using capital asset pricing Model and Fama French Three Factor Model.

## II. REVIEW OF LITERATURE

**Das and Pattanayak (2013)** also identify the critical fundamental factors that have significant effect on stock price movements mirrored by indices Sensex and Nifty.

**Sahil Jain (2013)** studied the performance of Indian Stocks by implementing the Fama French Three Factor model to 27stocks of the Bombay Stock Exchange and concludes that besides the three factors suggested by the Fama and French; there must be factors that account for the Sector performance.

**Mahapatra and Biswaroy (2011)** identify and quantify the impact of a wide range of fundamental and technical factors on the prices of equity shares in India.

**Singh and Babbar (2010)** attempt to predict the volatility pattern in bank stock returns in India. Stock sensitivity to market (Beta) is correlated to market volatility.

**Subrahmanyam (2010)** documents more than fifty variables used to predict stock returns. Nevertheless, the CAPM remains the foundational conceptual building-block for these models.

**Yash Pal Taneja (2010)** examined the CAPM and the Fama French Three factor model by taking a sample of 187 companies for a study period of five years, ranging from June 2004 to June 2009. The study concluded that efficiency of Fama French Model, for being a good predictor, cannot be ignored in India but either of the two factors (size and value) might improve the model.

**Diwani (2010)** examined the validity of the CAPM for the Bombay stock exchange. The study has used weekly stock returns from 28 companies listed on the Bombay stock exchange from November 2004 to October 2009. Dividing the data in to 5 subsamples and arrived a better results but still not supportive in favor of the CAPM in the BSE I.

**Lazar and Yaseer (2009)** investigated the validity of CAPM in Indian Market. The study used the data of 70 companies of BSE100 and tested the validity of CAPM, test of SML and test of Non-linearity. Further the study compared the relationship between beta and portfolio return. The analysis gives mixed result and we could not find conclusive evidence in support of CAPM in the selected study periods.

**Abbilash et al (2009)** analyzed the relevance of factors other than beta that affect asset returns in the Indian stock market. Only non-financial firms included in the BSE100 index were considered for the analysis. BSE 100 index comprises of 100 scripts representing different industries. As compared to BSE Sensex which has only 30 scripts, and NSE Nifty which comprises of only 50 scrips, BSE 100 is a much broader based index. The improved version of Fama and MacBeth (FM) cross-sectional regression was performed in the study.

**Dash and Sumanjeet (2008)** support Fama and French hypothesis. The result suggests that in multivariate analysis, B/M equity and leverage have significant power; however, market beta has insignificant explanatory power.

### III. RESEARCH METHODOLOGY

#### 3.1 Research Objectives

- ✓ One of the first ideas will be present the Fama French Three-Factor Model and CAPM in practice based on the given data BSE SENSEX in chosen periods.
- ✓ The **main objective** of this study is to measure and analyze the performance of Indian Stocks listed on the benchmark Index- SENSEX by using Fama French Three Factor Model and Capital asset pricing model
- ✓ The study will also examine whether of the relationship between stock return & corresponding  $\beta$  value as posed by CAPM is valid in Indian context or not. For that reason study will examine the validity of CAPM for 30 stocks listed at BSE during a period of 2005 to 2015 and compare stock require rate of return with Actual return.
- ✓ The study will also test relationship between asset return & corresponding  $\beta$  value, Size and value factor as posed by FF three model is valid in Indian market or not. For that reason study will examine the validity of FF three model for 30 stocks listed at BSE during a period of 2005 to 2015 and compare stock require rate of return with Actual return.

## Research Design

✓ This study used descriptive research design.

## IV. Data Collection

For CAPM, this study used secondary data which was the monthly closing prices of the 30 listed stocks in the BSE for the period of 10 years (1st April 2005 to 31st March 2015). The data was obtained from the BSE website. For the Fama French Three Factor Model, the same secondary data was used for analysis.

### 4.1 Methodology

#### 1 Calculating Expected returns of a ‘security’ using Capital assets pricing Model (CAPM).

**A.** Obtain the monthly closing prices of the selected 30 companies of BSE SENSEX for the assigned period of 2005 to 2015. **B.** Calculate returns of securities as  $\frac{\text{current closing price} - \text{previous closing price}}{\text{previous closing price}}$ . **C.** At the end of every year, Average Annual monthly Return, Holding Period Return (HPR) of BSE SENSEX and the selected companies are calculated. **D.** Beta ( $\beta$ ) for every year is calculated by running a simple regression, wherein market returns are taken as the independent variable and company returns are taken as the dependent variable. **E.** STANDARD DEVIATION function in EXCEL gives the Risk and SUM function in EXCEL gives Holding Period Return (statistical). **F.** But in this case, Financial HPR is used by calculating the percentage change between first value and last value of percentage monthly change for the year. Then CAPM is calculated by using formula.

$$E(R_i) = R_f + [E(R_m) - R_f]\beta_i \quad i = 1, 2, \dots, N$$

$E(R_i)$  is the expected return on any asset  $i$ ,  $R_f$  is the risk-free interest rate,  $E(R_m)$  is the expected return on the market portfolio,  $\beta_i$  is the asset's market beta which measures the sensitivity of the asset's return to variation in the market return and it is equal to  $\frac{\text{cov}(R_i, R_m)}{\sigma_m^2}$ .

#### 2 Calculating Expected returns of a ‘security’ using Fama and French three factor model.

To calculate expected return with Fama and French Model, we need to calculate betas and values of three independent variables. The equation used for calculating expected return in Fama and French is as under:

**Fama and French's three-factor model:**

$$E(R_i) = R_f + [E(R_M) - R_f]\beta_i + E(\text{SMB})s_i + E(\text{HML})h_i$$

Where  $[E(R_M) - R_f]$ ,  $E(\text{SMB})$  and  $E(\text{HML})$  are the factor risk premiums.  $[E(R_M) - R_f]$  This is the annual risk premium on market portfolio. Simply add up all the monthly  $[E(R_M) - R_f]$  values and obtain the annual  $[E(R_M) - R_f]$ . (SMB) This is the annual size premium which can be obtained by adding up all the SMB

values in all of the 12 months of each year. (HML) This is B/M ratio premium and can be obtained by adding up the HML values of all of the 12 months of each year.

**Step1:** Calculate  $R_i - R_f$

Obtain the closing share prices of the 30 sample companies on a monthly basis for the period of a given study.

Calculate returns of securities as  $\frac{\text{current closing price} - \text{previous closing price}}{\text{previous closing price}}$ . Calculate  $R_i - R_f$ , wherein  $R_f$  the risk free rate is for that particular period.

**Step2:** Calculate  $[E(R_M) - R_f]$

Obtain the closing SENSEX prices on a monthly basis for the given period.

Calculate the market return using  $R_M =$

$\frac{\text{current closing price} - \text{previous closing price}}{\text{previous closing price}}$ . Calculate  $[E(R_M) - R_f]$ , where in  $R_f$  the risk free rate is for that particular period.

**Step3:** Calculate **SMB**

Obtain the Market equity (size) (price time's shares outstanding) of the selected 30 sample companies for the assigned period of 2005 to 2015. Sort the companies based on size. Divide the companies into two groups i.e. Small and Big, based on the median of the market capitalization (price time's shares outstanding) values. Obtain monthly (end-of-month) closing share prices for the BIG companies with reference to BSE SENSEX of the period 2005 to 2015. Calculate monthly returns for each company in the BIG group. Calculate monthly average return of the companies constituting the BIG group. Repeat the same process for SMALL group to calculate average monthly return Subtract the average returns of BIG from the average returns of SMALL in each of the sample months. These monthly differences are the SMB values.

**Step4:** Calculate HML

Calculate the Book value per share of the selected companies for the assigned period. Book value per share data is taken from balance sheet of the company. Obtain the Market value per share of the selected Companies for the assigned period. Market value per share = price time's shares outstanding (market capitalization). Calculate BE/ME ratio = Book value / Market value. Sort the companies based on BE/ME ratio from HIGH to LOW B/M ratio. Remove the companies with negative returns and for the given period and retain only those companies that have positive returns. Divide the companies into two groups i.e. High and Low, based on the median of BE/ME values. Obtain monthly (end-of-month) closing share prices for sample months for the HIGH companies. Calculate monthly returns for each company in the HIGH group. Calculate average return for the HIGH in each month by averaging the returns. Repeat the same process for LOW group to calculate average monthly return. Subtract the average returns of LOW from the average returns of HIGH in

each of the sample months these monthly differences are the HML values.

**Step5:** Running Regression We makes use of multiple regressions. Run a multiple regression with  $[(R_M) - R_f]$ , (SMB) and (HML) as independent variables and  $R_i - R_f$  as the dependent variable. Obtain corresponding coefficients for the independent variables and the intercept along with their significance coefficients (p-value) and (t value). The model is valid if the significance coefficient (p-value) of the intercept is greater than 0.01, as the model is tested at a significance level of 0.01. In case any of the models is not valid for a given company, comparison of CAPM and F&F is not applicable and hence N/A is assigned in such case. Besides comparison of returns, the overvalued and undervalued stocks are identified. If the actual return is above benchmark return, the stock is overvalued; similarly the stock is undervalued if the actual return is below the benchmark return.

## V. CONSTRUCTING THE SIZE AND VALUE SORTED PORTFOLIOS

The firm specific risk is diversified by grouping the stocks of companies into portfolios. This leads to estimating more accurate betas and therefore I construct portfolios which are sorted on size and value for my analysis. I will further discuss the way in which the portfolios are constructed.

At the end of fiscal year from 2005 to 2015, companies are selected to be included in the study. To be included, the company must have a closing price recorded at the end of each month and also publically available accounting data as of march of the year. The selected companies are ranked by size (market capitalization as of march) and sorted into two groups with median size of the market. So All companies were divided into 2 groups; companies have market value more than median point are big company (B) while companies have market value less than median point are small company (S).

The companies are also ranked by BE/ME than the stocks are divided to 3 groups according to BE/ME ratio. First group, 30 percentage of whole stock has BE/ME highest (called High: H group) second group, 40 percentage of whole stock has BE/ME in medium (Medium: M group) and the last group, 30 percentage of whole stock has BE/ME lowest (called Low: L group). According to the BE/ME ranking. Group 1 is made up of companies with the highest Book-to- Market while group 3 is made of companies with the lowest Book-to-Market.

Third step organize stock to be 6 groups according to cross of stock group that invent in first and second step is S/L, S/M, S/H, B/L, B/M, B/H.

For example group S/L consist of the stock that exist in small group has BE/ME at the lowest or B/H group consist of stock that exist in large (Big) stock group has BE/ME highest, etc

## VI. FACTOR PORTFOLIOS

The Fama and French model uses three explanatory variables for explaining the cross section of stock returns. The first is the excess market return factor that is the market index return minus the risk-free return. This is calculated from the BSE-SENSEX index.

The second is the risk factor in returns relating to size – small minus big (SMB). The simple average of the

monthly returns of the three big size portfolios (B/L, B/M, B/H) is subtracted from the average of the three small size portfolios (S/L, S/M, S/H) to get the monthly return of the SMB factor.

SMB (Small minus Big) = Average Returns of Small Size firms minus Average Returns of Big Size firms =  $1/3 (S/H + S/M + S/L) - 1/3 (B/H + B/M + B/L)$

The third factor is related to value - high minus low (HML). Each month, the difference between the simple averages of the returns on the two high BE/ME and two low BE/ME is calculated.

HML = High minus Low = Average Returns of High BE/ME Ratio minus Average Returns of Low BE/ME ratio =  $1/2 (S/H + B/H) - 1/2 (S/L + B/L)$ .

## VII. IMPORTANCE OF A STUDY

In order to test the practicality of the model, study will helpful to know which model has more explanatory power than other.

For investing purpose, investors will get clear difference among the expected return of different samples and they will invest in that stock of particular company only.

## VIII. DATA ANALYSIS AND INTERPRETATION

Intercepts from excess stock return regressions for six stock portfolios formed on size and value factor: April 2005 to March 2015, 120 months.

Size Portfolios	Book To Market Equity Portfolios						
	$E(R_i) - R_f = \alpha + [E(R_m) - R_f]\beta_1$						
	Low	Medium	High	Low	Medium	High	
	$\alpha$ coefficient				$t(\alpha)$		
Small	-0.005	-0.003	0.018	-0.456	-1.002	4.021	
Big	-0.013	-0.007	0.022	-3.090	-2.139	2.853	
	$E(R_i) - R_f = \alpha + E(SMB)s_1 + E(HML)h_1$						
	$\alpha$ coefficient			$t(\alpha)$			

<b>Small</b>	-0.048	-0.064	-0.056	-4.716	-11.627	-10.494
<b>Big</b>	-0.060	-0.064	-0.053	-10.636	-11.679	-7.248
	$E(R_i) - R_f = \alpha + [E(R_M) - R_f]\beta_1 + E(SMB)s_1 + E(HML)h_1$					
	<b><math>\alpha</math> coefficient</b>			<b>t(<math>\alpha</math>)</b>		
<b>Small</b>	0.009	-0.005	0.001	1.269	-1.266	0.321
<b>Big</b>	0.000	-0.003	0.006	-0.077	-0.971	1.079

**Intercept And T Values Using Regressions Of Monthly Excess Returns Of Size And Value Sorted Portfolios**

As can be seen from that all the t-values of two factors SMB and HML regressions are less than critical value of t which shows that intercept is significant to zero. However, in one factor  $E(R_m) - R_f$ , four (4) portfolios out of six (6) are significant to zero. However, in three-factor regression hypothesis test, all intercept values are less than the critical t-value; we cannot reject the null hypothesis based on the critical t-value in three-factor regression. Thus our three-factor regression seems to have a good explanation on the average stock returns of the time series regression.

## IX. CONCLUSION

The main objective of this research work is to evaluate the forecasting accuracy of two model, CAPM and Fama French three-factor models. Using 30 stocks, this study finds security expected return by CAPM and Fama French three factor models. The study sets the periods of April 2005 to March 2015 for estimation. The difference between actual return and CAPM return and actual return and Fama French return forecast the better model for future investment for the listed stocks. To sum up, our FF three-factor hypothesis testing proves the model to be reliable, and all the three factors have some degree of the explanatory power to the portfolios' excess returns.

## REFERENCES

- [1] Niladri Das and Pattanayak J K (2013): “The Effect of Fundamental Factors on Indian Stock Market: A Case Study of Sensex and Nifty”, The ICFAI Journal of Finance, Vol. 19 (2), pp.84-99
- [2] S. Jain, “Fama-French Three Factor Model in Indian StockMarket”, The Current global trends, Vol.2, 2013, pp.7-13.

# International Conference on “Latest Innovations in Science, Engineering and Management”

Indian Federation of United Nations Associations, New Delhi, India

1st October 2016, [www.conferenceworld.in](http://www.conferenceworld.in)

ICLISEM - 16

ISBN : 978-93-86171-08-5

- [3] Rudra P. Mahapatra, Prasanna K. Biswaroy (2011): “Impact of Fundamental and Technical Factors on the Prices of Equity Shares in India: An Econometric Analysis”, Finance India, Vol. XXV (4), pp. 1259-1272
- [4] Singh Y P and Babbar S K (2010): “Volatility Patterns in Bank Stock Returns in India”, The Indian Journal of Commerce, Vol. 63 (1), pp. 1-20
- [5] Subrahmanyam, A. 1010. “The Cross-Section of Expected Stock Returns: What Have We Learnt from the Past Twenty-Five Years of Research?” European Financial Management, vol. 16: 27–42
- [6] Y.P. Taneja, “Revisiting Fama French Three-Factor Model in Indian Stock Market” The Journal of Business Perspective, Oct. vol. 14, 2010, pp. 267-274.
- [7] Mazen Diwani' A study that investigates the validity of the CAPM in Bombay Stock Exchange SENSEX30-2010 Lund University