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A COMPARATIVE ANALYSIS OF CAPITAL ASSET PRICING MODEL (CAPM) AND FAMA FRENCH (FF) MODEL BASED ON VARIABLE FACTORS ON INDIAN STOCK MARKET DURING A PERIOD OF 2014-2015

Mitalee A.Pithawala[1]

[1]Lecturer,
Navnirman Institute of management,
NIM-BBA,
Surat, Gujarat,
India

ABSTRACT

The aim of this research is to use the Indian stock market index for pricing security expected return 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. Monthly data allow us to reliably evaluate a stock's performance over shorter time horizons. 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 2014 to 2015 and variable factors beta, SMB (Small minus Big), HML (High minus Low) and $R_m - R_f$ are compared

By using the tool of MS EXCEL 2007, Researcher estimate regression equations and test which factor model's variables 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)).

KEYWORDS: *Fama-French Three Factor Model, Capital Asset Pricing Model, SENSEX, Intercept,Performance, Risk Return, size value (SMB), book-to-market value (HML), P value, t value*

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:

$$\mathbf{E(R_i) = R_f + [E(R_m) - R_f]\beta_i} \qquad \mathbf{i = 1, 2, \ldots N}$$

Where $\mathbf{E(R_i)}$ the expected is return on any asset i,

$\mathbf{R_f}$ is the risk-free interest rate,

$\mathbf{E(R_m)}$ is the expected return on the market portfolio,

β_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 $\frac{cov(R_1,R_m)}{\sigma_m^2}$.

Fama and French's three-factor model:

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

Where $[E(R_M) - R_f]$,$E(SMB)$and$E(HML)$ 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.

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 theBombay stock exchange from November 2004 to October 2009. Dividing the data in to5 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.

RESEARCH METHODOLOGY

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 β 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 2014 to 2015 and compare stock require rate of return with Actual return.
- ✓ The study will also test relationship between asset return & corresponding β 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 2014 to 2015 and compare stock require rate of return with Actual return.

Research Design:-

- ✓ This study used descriptive research design.

Hypothesis:-

- ✓ To test whether the CAPM model explains expected stock returns of sample companies better than Fama French three factor models for the period 2014-2015.

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 2014 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.

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 2014 to 2015. **B.** Calculate returns of securitiesas

$$\frac{\textit{current closing price} - \textit{previous closing price}}{\textit{previous closing price}}$$

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 (β) 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.

$$\mathbf{E(R_i) = R_f + [E(R_m) - R_f]\beta_i} \qquad \mathbf{i = 1, 2, \ldots N}$$

$E(R_i)$ 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, β_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 $\frac{\mathbf{cov(R_1, R_m)}}{\sigma_m^2}$.

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:**

$$\mathbf{E(R_i) = R_f + [E(R_M) - R_f]\beta i + E(SMB)s_i + E(HML)h_i}$$

Where $[E(R_M) - R_f]$, $E(SMB)$ and $E(HML)$ 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 $\mathbf{R_i - R_f}$

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

$$\frac{\textit{current closing price} - \textit{previous closing price}}{\textit{previous closing price}}$$

Calculate $R_i - R_f$, wherein $R_f$the risk free rate is for that particular period.

Step2: Calculate $\mathbf{[E(R_M) - R_f]}$

Obtain the closing SENSEX prices on a monthly basis for the given period. Calculate the market return using

$$R_M = \frac{\textit{current closing price} - \textit{previous closing price}}{\textit{previous closing price}}$$

Step3: Calculate **SMB**

Obtain the Market equity (size) (price time's shares outstanding) of the selected 30 sample companies for the assigned period of 2014 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 2014 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

DATA ANALYSIS AND INTERPRETATIONS

Table 1 Comparative analysis of CAPM and FF models based on variable factors (2014-15)

2014-15								
	FF factors(Rm-Rf, SMB, HML)						CAPM factor(Beta)	
company name	Rm-Rf P value	SMB P value	HML P value	Rm-Rf significant/ insignificant	SMB significant/ insignificant	HML significant/ insignificant	Beta P value	beta significant/ insignificant
Axis Bank	0.02	0.42	0.94	significant	insignificant	insignificant	0.00	significant
Bajaj Auto	0.10	1.00	0.05	insignificant	insignificant	insignificant	0.07	insignificant
Bharti Airtel	0.83	0.89	0.12	insignificant	insignificant	insignificant	0.98	insignificant
BHEL	0.02	0.09	0.24	significant	insignificant	insignificant	0.00	significant
Cipla	0.56	0.39	0.91	insignificant	insignificant	insignificant	0.82	insignificant
Coal India	0.82	0.00	0.27	insignificant	significant	insignificant	0.21	insignificant
Dr Reddys Labs	0.43	0.03	0.24	insignificant	significant	insignificant	0.80	insignificant
GAIL	0.26	0.56	0.11	insignificant	insignificant	insignificant	0.11	insignificant
HDFC	0.01	0.02	0.62	significant	significant	insignificant	0.11	insignificant
HDFC Bank	0.00	0.87	0.34	significant	insignificant	insignificant	0.00	significant
Hero Motocorp	0.77	0.23	0.16	insignificant	insignificant	insignificant	0.31	insignificant
Hindalco	0.28	0.63	0.86	insignificant	insignificant	insignificant	0.11	insignificant
HUL	0.00	0.01	0.08	significant	significant	insignificant	0.03	significant
ICICI Bank	0.04	0.29	0.19	significant	insignificant	insignificant	0.01	significant
Infosys	0.01	0.02	0.09	significant	significant	insignificant	0.15	insignificant
ITC	0.49	0.69	0.48	insignificant	insignificant	insignificant	0.61	insignificant
Larsen	0.02	0.23	0.99	significant	insignificant	insignificant	0.00	significant
M&M	0.23	0.69	0.40	insignificant	insignificant	insignificant	0.12	insignificant
Maruti Suzuki	0.07	0.12	0.33	insignificant	insignificant	insignificant	0.01	significant
NTPC	0.38	0.00	0.01	insignificant	significant	significant	0.10	insignificant
ONGC	0.05	0.39	0.67	significant	insignificant	insignificant	0.01	significant
Reliance	0.02	0.11	0.60	significant	insignificant	insignificant	0.00	significant
SBI	0.09	0.22	0.15	insignificant	insignificant	insignificant	0.02	significant
Sesa Sterlite	0.07	0.00	0.00	insignificant	significant	significant	0.06	insignificant
Sun Pharma	0.41	0.05	0.46	insignificant	significant	insignificant	0.78	insignificant
Tata Motors	0.01	0.07	0.89	significant	insignificant	insignificant	0.03	significant
Tata Power	0.01	0.01	0.34	significant	significant	insignificant	0.00	significant
Tata Steel	0.02	0.22	0.92	significant	insignificant	insignificant	0.00	significant
TCS	0.63	0.59	0.84	insignificant	insignificant	insignificant	0.80	insignificant
Wipro	0.05	0.07	0.57	insignificant	insignificant	insignificant	0.27	insignificant

Interpretation:-

The significance of exploratory variables (Rm-Rf, SMB and HML) can be judged from the value of P of regression analysis. In statistics, the **p-value** is a function of the observed sample results (a statistic) that is used for testing a statistical hypothesis. Before the test is performed, a threshold value is chosen, called the significance level of the test. In these study thresholds value is 5% for significance.

The p-value for each term tests the null hypothesis that the coefficient is equal to zero (no effect). A low p-value (< 0.05) indicates that you can reject the null hypothesis. In other words, a predictor that has a low p-value is likely to be a meaningful addition to your model because changes in the

predictor's value are related to changes in the response variable. Conversely, a larger (insignificant) p-value suggests that changes in the predictor are not associated with changes in the response.

Ho: There is no significant evident of addition to the models (CAPM, FF) due to change in predictors (Rm-Rf, SMB and HML).

H1: There is a significant evidence of addition to the models due to change in predictors

From above table 44, analysis revealed the fact that out of 30, 21 companies stock's SML variable value is insignificance because their P value is greater than 0.05. In this case Null hypothesis is accepted which is support the evidence that change in the value of **SML** are not associated with changes in the response. 70% Stocks which are insignificant are Axis bank, Bajaj auto, Bharti airtel, BHEL, Cipla, Dr , GAIL, HDFC bank, Hero Motocorp, Hindalco, ICICI bank, ITC, Larsen, M&M, Maruti Suzuki, ONGC, Reliance, SBI, Tata Motors, , Tata Steel, TCS and Wipro

Stocks which are significant are Coal India, Dr Reddy Labs, HDFC, HUL,Infosys, NTPC, Sesa Sterlite, Sun Pharma, Tata Power which contain P value of SMB factor less than 0.05. In this case Null hypothesis is rejected and for these stocks SMB value is significant to the model.

Out of 30, 28 stock's **HML** variable value is insignificance because their P value is also greater than 0.05. In this case Null hypothesis is accepted which is support the evidence that change in the value of HML are not associated with changes in the response. Axis bank, Bajaj auto, Bharti airtel, BHEL, Cipla, Coal India, Dr Reddy Labs, GAIL, HDFC, HDFC bank, Hero Motocorp, Hindalco, HUL, ICICI bank, Infosys, ITC, Larsen, M&M, Maruti Suzuki, NTPC, ONGC, Reliance, SBI, Sesa Sterlite, Sun Pharma, Tata Motors, Tata Power, Tata Steel, TCS, Wipro are the stocks which contain P value greater this means there is no significant change in models due to change in HML factor.

Stocks which are significant in term of HML factor are NTPC and Sesa Sterlite which contain P value of HML factor less than 0.05. In this case Null hypothesis is rejected and for these stocks HML value is significant to the model.

Axis bank, Bajaj auto, Bharti airtel, BHEL, Cipla, Dr , GAIL, HDFC bank, Hero Motocorp, Hindalco, ICICI bank, ITC, Larsen, M&M, Maruti Suzuki, ONGC, Reliance, SBI, Tata Motors, , Tata Steel, TCS and Wipro are the stocks which contain both variable SMB and HML factor insignificant. The result shows that SMB and HML have no relationship with the dependent variable (Ri-Rf). This is against the basic foundation of FF model.

From above data, research supported the evidence that P value of 13 **stock's beta** is highly significance. Those stocks are Axis bank, BHEL,HDFC bank, HUL, ICICI bank, Larsen, Maruti Suzuki, ONGC, Reliance, SBI, Tata Motors, Tata Power, Tata Steel, which contains P value less than 0.05.That means Null hypothesis is rejected which support the fact there is a significant addition to the models due to change in beta value.

CONCLUSION

The main objective of this research work is to evaluate the forecasting accuracy of two model, CAPM and Fama French three-factor models based on variable factors. Using 30 stocks, this study finds security expected return by CAPM and Fama French three factor models. The study sets the periods of April 2014 to March 2015 for estimation. In both of the regression outputs of Fama and French and CAPM of 30 stocks, Fama and French model fails to confirm to its own predictions as 70% stocks variable showed no relationship with the actual risk premium (Ri-Rf). On the other hand, CAPM seems to be right in its prediction that 43% securities risk premium is dependent upon the risk premium of market portfolio and a security's beta. This is why CAPM is the preferred model in this case.

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