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A STUDY TO CHECK THE APPLICABILITY OF FAMA AND FRENCH, THREE-FACTOR MODEL ON S&P BSE-500 INDEX

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Abstract

This paper empirically examines the Fama-French three-factor model for the Indian stock market. In this study, the Fama French Model have been examined by taking a sample of top **96** companies on basis of market capitalization in BSE for a study period of five years, ranging from Nov,2012 to Nov,2017. In order to validate the results, the sample selection was made on the basis of continuous presence in S&P BSE 500 index for at least five years without fail. The study showed that market betas do not explain expected returns which are inconsistent with CAPM. The study observes a significant and zero intercept viz; portfolio returns are not being explained by factors outside of SMB and LMH. The size (SMB) - and value (LMH)-factors as surrogates for non-market-specific risk should have positive returns and negative returns respectively as per Fama and French. However, three portfolios S/L, B/M, B/H have significant negative SMB betas. Similarly S/M, S/H, B/M, B/H have significant positive LMH betas. These results do not support Fama and French model findings.

Keywords:

Fama French Three Factor Model;

Value Effect(LMH);

Size Effect(SMB);

Stocks;

Market Beta;

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1. Introduction

Academicians and practitioners all over the world have used Sharpe's (1964) and Lintner's (1965) Capital Asset Pricing Model (CAPM), to explain the relationship between risk and expected returns of an asset. However, under this model only one risk factor is taken into consideration to show that variation in excess returns viz, market beta or the sensitivity to excess market portfolio return (Market premium). An empirical study by Fama and French in 1992 shows that market beta, which is the covariance of portfolio return and market return does not explain the excess portfolio return changes. The study found that value stocks outperform growth stocks. Similarly, small-cap stocks tend to outperform large-cap stocks.

This paper empirically examines the Fama-French three-factor model for the Indian stock market.The study has been divided into three sections. First section being introductory exploring model specification for Fama Model with second section presenting review of the literature with regard to developing and emerging economies with an emphasis on India, third section being the heart of the paper describes the research methodology in detail,fifth section gives a comprehensive discussion on results and analysis followed by sixth section presenting the concluding remarks.

1.1. Fama-French Three Factor Model Specification

Fama and French, three factor model states that the expected excess returns on a portfolio Ri–Rf is explained by the sensitivity of its return to three factors:

1. Excess return on market portfolio i.e. market premium Rm–Rf
2. The difference between the return on small stock portfolio and big stock portfolios i.e. size premium (SMB)
3. The difference between returns of high Price to book value stock portfolios and low Price to book value stocks portfolio i.e. value premium (LMH)

Therefore, this model tries to show that variation in excess returns can be better explained by firm specific variables like size and value along with market beta.

Model/Formula

$$\boldsymbol{R_i - R_f = \alpha_i + \beta_{im}(R_m - R_f) + \beta_{is}SMB + \beta_{il}LMH + \varepsilon}$$

Where,

$$R_i = Total\ return\ of\ individual\ stock\ /portfolio\ i$$

$$R_m = Total\ maket\ portfolio\ return$$

$$R_i - R_f = Expected\ excess\ return$$

$$R_m - R_f = Excess\ return\ on\ mraket\ portfolio\ index$$

$$SMB = Size\ premium$$

$$LMH = Value\ Premium$$

2. Literature Review

Table 1: Findings of previous studies

Connor& Sehgal(2001)	This study empirically examined the Fama-French three-factor model of stock returns for India. It found evidence for pervasive market, size, and book-to-market factors in Indian stock returns. It found that cross-sectional mean returns are explained by exposures to these three factors, and not by the market factor alone. The study found mixed evidence for parallel market, size and book-to-market factors in earnings and did not find any reliable link between the common risk factors in earnings and those in stock returns. The empirical results, as a whole, are reasonably consistent with the Fama-French three-factor model.
Taneja(2001)	In this study, the Capital Asset Pricing Model and Fama French Model have been examined by taking a sample of 187 companies for a study period of five years, ranging from June 2004 to June 2009. In order to validate the results, the sample selection was made on the basis of continuous presence in S&P CNX 500 index for at least ten years without fail. The study showed that efficiency of Fama French Model, for being a good predictor, can not be ignored in India but either of the two factors (size and value) might improve the model. It is so because a high degree of correlation is found between the size and value factor returns.
Mehta&Chander(2010)	The study considered companies listed under the BSE 500 index series for the empirical tests. The overall findings indicated that the three factor model given by Fama and French is more powerful, than its other variants of taking one or two factors in explaining the variability in the returns of all six portfolios.
Blanco(2012)	This work tested the American NYSE market, the expected returns of a portfolios selection according to the CAPM and Fama and

	French Three Factor Model. The portfolios were constructed according to the size and BV/MV. The author employed a database based on expected returns and factors related to each model, from July 1926 to January2006. Empirical results pointed out that Fama and French Three Factor Model is better than CAPM according to the goal of explaining the expected returns of the portfolios. However, the paper showed that the results vary depending on howthe portfolios is formed.
Dolinar, (2013)	This paper empirically examined the Fama-French three-factor model of stock returns for Croatia. In contrast to the results of Fama and French (1993) for the U.S. stock market, their three-factor model did not show so successful when describing risk-return relation of Croatian stocks. This paper shows that the Fama-French three-factor model is a valid pricing model, since it explains cross-section of average returns on stocks in Croatia, and that has a greater explanatory power in comparison to the CAPM. In the case of Croatian stock market, size and B/M factors are not always significant, but on average they individually have certain marginal explanatory power. Namely, they capture small common variation in returns that is missed by the market factor. Moreover, B/M factor has shown as a stronger common risk proxy in relation to size factor. Finally, there is still a large portion of common variation in stock return that may be explained by other factors. Because emerging capital markets bear their own specificity, special care needs to be taken when applying existing or developing new pricing models
Aziz & Ansari(2014)	This paper examined the performance of the three factor model of Fama&French (1993) in the Indian Stock Market for the period 2000-2012 using BSE-500 stocks as sample. The results suggested the presence of significant size and value premiums in the Indian Stock Markets during the sample period.

Abbas, Khan, Aziz, & Sumrani(2015)	This study aimed to test the explanatory power of Fama and French three factor model (1993) in explaining cross-sectional average return for Pakistan's equity market for the time frame of 10 years from 2004-2014. The sample included firms that traded on KSE-100 index from 2004-2014. Six portfolios were formed by the intersection of two size portfolios and three value portfolios. Excess monthly returns of the six portfolios i.e. the dependent variable were individually regressed against market premium, size premium and value premium (MRP, SMB and HML) i.e. the independent variables to test the validity of Fama and French three factor model. Along the line of original Fama & French, this study aims to provide valuable insights into components of excess returns and lay ground work towards further studies in this domain. An important insight it is bound to show is whether BE/ME & size factors hold as proxies for time-varying systematic risk as is proclaimed by past researches.
Manjuantha(2016)	The study tested whether Fama and French factors explained the portfolio returns as envisaged in Fama and French (1995). The study used National Stock Exchange continuously traded stocks, Nifty Index and other relevant data from July 1996 to June 2010. The study formed portfolios based on size and value which were regressed over factors portfolios-market, size and value. The results showed that portfolio returns are not explained by factors portfolios with the exception of big stocks portfolios are explained to some extent. Further results showed that portfolio returns of small stocks are not explained by factor portfolios.

3. Research Methodology

3.1. Objectives

1. To test Fama- French Three factor model in Indian context.
2. To explore size and value effect in Indian Equity market.

3.2. Collection of Data

An Application using S&P BSE-500 Index

Time period	November 2012 to November, 2017
Sample	96 stocks
Market index	S&P BSE500 Index
Data	Monthly
Test	Time Series multiple Regression Test using Excel

3.2.1. Market Capitalization & Market Price to Book Value Ratio:

The sample companies account for a major portion of market capitalization on Bombay Stock exchange. These are top companies on bse as per market capitalization. To capture the size effect of the Industries, market capitalization of these industries and to capture the value effect, the ratio of book value to market value of these firms as on Nov, 31, 2017 was used

3.2.2. Monthly stock closing prices:

The share price data consists of month-end adjusted share prices. A maximum of 60 observations is available for each monthly return series based on these prices. The sample companies form part of the S&P BSE-500 list. Risk free rate of return (Rf):The implied yield on the month-end India 10-Year Bond Yield Historical Data has been used as a risk-free proxy. The data source for monthly adjusted closing process of stocks is www.in.finance.yahoo.com and for India 10-Year Bond Yield is www.in.investing.com. The formula for changing India 10-Year Bond Yield from an annual percentage rate to a monthly one is

Monthly rate = $(1 + \text{annual rate})^{(1/12)} - 1$

3.2.3. Market returns (Monthly Market Index return):

The proxy for Market return is S&P BSE 500 Index. S&P BSE 500 index represents nearly 93% of the total market capitalization on BSE. S&P BSE 500 covers all 20 major industries of the economy.

3.3. Construction of Six Portfolios on basis of size and value:

Firstly the median sample size is used to split the sample companies into two groups: small (S) and big (B). Then the sample stocks are broken into three Price to Book Value groups based on the breakpoints for the bottom 30% (low), middle 40% (medium) and top 30% (high) of the ranked values of Price to Book Value for the sample stocks. The six Size-Price to Book Value portfolios are constructed to be equally-weighted, as suggested by Lakonishok, Shliefer and Vishny (1994).

S/L	Represented the group of portfolio that have a small size and low Price to Book Value
S/M	Represented the group of portfolio that have a small size and medium Price to Book Value
S/H	Represented the group of portfolio that have a small size and high Price to Book Value
B/L	Represented the group of portfolio that have a big size and low Price to Book Value
B/M	Represented the group of portfolio that have a big size and medium Price to Book Value
B/H	Represented the group of portfolio that have a big size and high Price to Book Value

3.2.4. Calculation of Average Returns of each portfolio:

a. Calculation of average return of each observed stock:Since the data collected were the adjusted closing prices of the stocks, they were converted to returns using the following equation:

$$R_{it} = \frac{P_t - P_{t-1}}{P_{t-1}}$$

Where: P_t= price of the asset at time t, P_{t-1}= price of the asset at time t-1

Thereafter simple average of individual stock returns is calculated.

b. Calculation of average return of six constructed portfolios: A monthly simple weighted average return of the portfolios is calculated.

3.2.5. Calculation of SMB:

SMB (Small minus Big) is meant to mimic the risk factor in returns related to size. SMB is the difference each month between the simple average of the returns of the three small stock portfolios (S/L, S/M and S/H) and the average of the returns on the three big portfolios (B/L, B/M, B/H). It is clear of Price to Book Value effect.

SMB=1/3(Small Low+ Small Medium+ Small High)-1/3(Big Low+ Big Medium+ Big High)

3.2.6. Calculation of LMH:

LMH (Low minus High) is meant to mimic the risk factor in returns related to value (that is Price-to-book value ratios).; LMH is computed by subtracting monthly simple weighted average returns on two growth stock portfolios namely S/H and B/H from monthly simple weighted average returns on low value stock portfolios namely S/L and B/L. It is constructed to be relatively free of the size effect.

LMH=1/2(Small Low+Big Low)-1/2(Small High+Big High)

3.7. Calculation of excess portfolio returns (Ri–Rf) and excess market index returns ($R_m - R_f$)

3.8. Running multiple regression

4. Results

Table.2.Regressions of size and book-to-market sorted portfolio excess returns ($R_i - R_f$) on combinations of the market (MKT), size (SMB) and value (LMH) factor portfolios

$R_i - R_f = \alpha_i + \beta_{im}(R_m - R_f) + \beta_{is}SMB + \beta_{il}LMH + \varepsilon$

Portfolio	Coefficients				ρ- value of the coefficients				Model
	α_i	β_{im}	β_{is}	β_{il}	ρ_{α_i}	$\rho_{\beta_{im}}$	$\rho_{\beta_{is}}$	$\rho_{\beta_{il}}$	R^2
S/L	0.012713	0	-0.0031	-0.03053	0.301975		0.91552	0.488162	0.009541
S/M	0.070134	0	0.035925	0.066212	0.027174		0.62811	0.552711	0.012591
S/H	0.017277	0	0.065368	1.131807	0.484078		0.26867	2.27E-18	0.759617
B/L	0.027877	0	0.001217	-0.06738	0.065632		0.97271	0.2108	-0.02417
B/M	0.048934	0	-2.83577	0.464594	0.239828		2.64E-35	0.00265	0.93723
B/H	0.023313	0	-0.06725	0.770276	0.289626		0.20141	7.84E-14	0.634479

- The alpha term is the intercept and it shows the excess return the portfolio earned. In other words, if the alpha is positive, the asset earned a return greater than it should have given its level of risk; if the alpha is negative, the asset earned a return lower than it should have given its level of risk. Here the estimates of alpha values for all portfolios are positive but statistically indistinguishable from zero. The study observes a significant and zero intercept. It would mean the portfolio returns are not being explained by factors outside of SMB and LMH. It holds Fama and French findings true that intercept should be equal to zero.
- Table.2.shows that coefficients of market premium (beta) are zero for all portfolios. It can be inferred from these results that one of the three factors, market risk premium, is not a determinant of required return for stocks. This result is not consistent with the CAPM model.
- The size- and value-factors as surrogates for non-market-specific risk should have positive returns and negative returns respectively as per Fama and French. Therefore, value stocks should have higher returns than growth stocks; small stocks should have higher returns than large stocks; and small value stocks should have the highest returns of all. However, the regression results presented in the table show that three portfolios S/L, B/M, B/H have significant negative SMB betas. Similarly S/M,S/H,B/M,B/H have significant positive LMH betas. These results do not support Fama and French model findings.
- R^2 shows that model is not a good fit in S/L, S/M and B/L.

5. Conclusion

The study run regression on the 6 portfolios and observed a significant and zero intercept viz; portfolio returns are not being explained by factors outside of SMB and LMH. It holds Fama and French findings true that intercept should be equal to zero.The size (SMB) - and value (LMH)-factors as surrogates for non-market-specific risk should have positive returns and negative returns respectively as per Fama and French. However, three portfolios S/L, B/M, B/H have significant negative SMB betas. Similarly S/M, S/H, B/M, B/H have significant positive LMH betas. These results do not support Fama and French model findings.

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