Asset Pricing Models : A Study of CNX Nifty 500 Index Companies

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Abstract

The objective of the study was to explore the applicability of the widely used asset pricing models, namely, the capital asset pricing model, Fama and French three - factor model (1993), Fama and French four - factor model (2012), and Fama and French five - factor model (2015) in the Indian stock market. The study was conducted on the constituent companies of CNX Nifty 500 index for a time period of 15 years spanning from October 2001 to September 2016. The asset pricing models were examined by forming portfolios for the explanatory variables considering four variables - market capitalization, ratio of book-to-market equity, profitability, and investment using the Fama - French methodology (1993, 2015). Portfolios for dependent variable side were formulated using quintiles for each of the following variables. VIF test was conducted to check the degree of multicollinearity and the four step hierarchical multiple regression was run. It was found that the three - factor model performed better than the other asset pricing models, namely, capital asset pricing model, Fama - French four - factor model, and Fama - French five - factor model in elucidating average stock returns. Thus, the study provided a substantiation of the presence of the Fama - French three - factor model in elucidation of the variations in the stock returns. The study could be helpful in future research for a generalized asset pricing model comprising of multiple risk factors.

Keywords: **Fama - French three - factor model, Fama - French four - factor model, Fama - French five - factor model, investment, market capitalization, profitability, ratio of book-to-market equity**

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The relationship between return and risk is explained by the asset pricing models. Sharpe (1964) developed the single index model which explains that market return is the only and adequate factor to explain differences in returns of the stocks. The model also suggested that the security or portfolio risks are segregated into two categories, namely unsystematic risk (diversifiable risk) and systematic risk (non - diversifiable). Unsystematic risk is the risk which is associated with individual security, and hence, can be easily diversified ; whereas, systematic risk is related with overall movements in the general market and thus cannot be eliminated. Mossin (1966), Sharpe (1964), and Lintner (1965) autonomously developed a model called the capital asset pricing model (CAPM), which is based on the single index model. This model explains the association between the expected rate of return of a security and beta, which is a measure of systematic risk. Following the development of the single index model and CAPM, many empirical researchers found that there were influences

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beyond the market that caused stock prices to move together and this led to the development of multifactor models. The contemporary asset pricing models were not able to completely explain the returns, which became a motivation for the development of the different versions of the asset pricing models. Each succeeding model provides a better explanation by amending the explanatory variables. Irregular patterns in returns recognized at various intervals assisted in identifying the different additional explanatory variables.

Fama and French developed the three - factor model in 1993 considering size and book to market equity as explanatory variables along with the market return as explained by CAPM. In 2012, Fama and French came up with a four-factor model, which was an extension of the three-factor model by incorporating profitability as an explanatory variable. In 2015, Fama and French again extended the four-factor model by incorporating investment as an explanatory variable. We have made an attempt to compare and assess the applicability of the asset pricing models, namely, capital asset pricing model and Fama - French three, four, and five factor models in the Indian stock market.

Review of Literature

Fama and French (1993) developed a three - factor asset pricing model by including two factors along with the systematic risk component (i.e. CAPM beta). A time-series regression approach was used. It was found that the excess market returns contain some information about the average stock returns. They also found that the amalgamation of size (market capitalization) and book-to-market (BE/ME) also proxied for leverage and price earning yield in stock returns. Gupta and Kumar (2009) studied the effectiveness of Fama and French three factor model in the Indian stock market. Both the effects, size and value, were found to have a strong existence in the Indian stock market.

Dash and Rishika (2011) did a comparative study of two asset pricing models, namely, capital asset pricing model (CAPM) and arbitrage pricing model (APM) on 50 stocks, which formed a part of the CNX Nifty 500 index and associated with the most booming industries of the Indian economy. It was found that the capital asset pricing model had better explanatory power as compared to the arbitrage pricing model (APM) in the Indian capital market. It was also suggested that interest rates (the MIBOR factor) played a significant role in elucidating the stock returns along with the market return, which was found to be the most vital factor.

Cakici, Fabozzi, and Tan (2013) undertook a study of few of the emerging economies. Their study revealed that book to market equity ratio was extremely vital in elucidating the stock returns and thus, could not be disregarded with respect to asset pricing. However, the study also suggested that there was evidence that the three - factor model was unable to completely elucidate the deviations in returns with respect to the two variables, namely, investment and profitability. Novy - Marx (2013) revealed that not only book to market equity ratio, but also gross profitability had a similar strength in elucidation of the variation in average stock returns.

Zaremba and Konieczka (2014) studied the characteristics of inter-country premiums based on size, value, and momentum on listed stocks of 66 countries during the period spanning from 2000 and 2013. The study provided evidence for size, value, and momentum premiums in the stock returns of the countries. Also, it was found that these country - level value, size, and momentum premiums provided strength to each other in double - sorted portfolios and were robust towards changes in countries' representative indices or functional currencies. Hou, Xue, and Zhang (2015) suggested that apart from the two variables, namely, market capitalization and book to market ratio, investment and profitability also played a vital role in explaining stock return variation.

Singh and Yadav (2015) did a comparative study of the three asset pricing models, namely, Fama and French three (1993), four (2012), and five factor models (2015) along with the capital asset pricing model in the Indian stock market. The study was conducted on the companies that are listed on the CNX Nifty 500 index. The three-

factor model was found to be better than the capital asset pricing model. However, the five-factor model performed better than the other models when investment was also considered for portfolio formation.

Raghuram and Erickson (2017) tested the applicability of the Fama - French three factor model in the Indian stock market for the period ranging from April 1991 till March 2015. They revealed a structural break in November 2001 because of the significant increase in the value factor coefficient post break point. The study concluded that the Fama - French three factor model could better elucidate returns in the Indian stock market. The coefficient of value factor premium was found to be statistically significant for all the six portfolios in the post-break point period ; whereas, this coefficient was statistically significant for only four of the six portfolios in the pre-break point period.

Balakrishnan and Maiti (2017) studied the cross sectional relationship on different time horizons between two firm characteristics, namely, size and value with expected returns and risks in the Indian stock market. The study employed various tests, including Fama - MacBeth cross sectional test, GRS, residual graphs, goodness of fit, and average stock return patterns. The results confirmed that both CAPM and Fama - French three factor model were unable to depict the risk-return relationship in a better way. The results also suggested that there was mild value effect and a strong size effect in the Indian stock market.

Data and Methodology

(1) Data : The study was conducted on the companies that form a part of the CNX Nifty 500 Index for a period of 15 years spanning October 2001 to September 2016. The companies that have their financial year closing in March were taken into consideration for the study. The adjusted closing price data for the sample companies were obtained from the CMIE Prowess (Database of Center for Monitoring Indian Economy) ; 91 day treasury bills rate was obtained from the central bank, Reserve Bank of India's website, which acts as a risk-free rate proxy. The time-series data of stock prices was used to construct monthly return series. The CNX Nifty 500 index returns was taken as the proxy for returns on the market.

(2) Methodology : The methodology stated by Fama and French (1993, 2015) has been used for consideration and computation of variables. In September end every year (year *t*), the portfolios are formed by sorting and allocating companies depending upon four variables – market capitalization, ratio of book to market equity, profitability, and investment. The variables are defined as follows :

- **Market Capitalization (Represented by Size) :** This is computed by multiplying the outstanding shares (number) and the market value (adjusted closing price per share). These values are taken as on September end each year, say year *t*.

- **Book to Market Equity (Represented by BM):** This is computed by dividing book equity by market equity (book value and market value per equity share). These values are taken as on March end each year, say year *t*.

- **Profitability (Represented by OP/ Pr):** It is defined as the ratio of earnings before taxes (EBT) to book equity, both taken as on March end each year, say year *t*.

- **Investment (Represented by Inv):** This refers to the ratio [(*Total Assets (t) – Total Assets (t)) / Total Assets (t-1)*] as on March end each year, say year *t*.

- **Market Factor:** Market factor refers to the risk premium - (*Rm - Rf*).

↳ **Return :** It is calculated using the formula [$P(t) / P(t - 1)$] -1.

where,

$P(t)$: Price of the security at the end of month (t).
$P(t-1)$: Price of the security at the end of month $(t - 1)$.

The methodology includes calculating monthly returns which are equally weighted for each portfolio from October of year t to September of year $t + 1$. In this way, a time series of 180 (15 years × 12 months) monthly returns for each portfolio were obtained. Also, the companies having negative book values do not form a part of the study (Fama & French, 1993). It is important to understand here that only those companies are part of the study for which the data for all the four variables were available and could be used for computing the factors. We have taken a time interval of two quarters from the end of the accounting year (March) to the date of creation of the portfolio (September). We took a lag of two quarters because the firms have a time period of six months to publish their accounting data from the end of the accounting year. Therefore, we expected to get the accounting figures by September end of year t. This needs to be followed to avoid the look ahead bias.

(i) Methodology Used to Create Size Portfolios : Size portfolios are created on the basis of the market capitalization as on September end each year from 2001 to 2016. The sample companies were arranged in descending order of their size and bifurcated into two categories depending upon the value of the median as the breakpoint. The bottom 50% was termed as Small and the top 50% was termed as Big. This led to the creation of two size portfolios of stocks falling under each group namely Small and Big named as S and B, respectively.

(ii) Methodology Used to Create Value Portfolios : Value portfolios are calculated in March end depending upon the book to market equity value (BE/ME ratio) and then arranged in descending order to create three value portfolios which are termed as Low (bottom 30%), Neutral (middle 40%), and High (top 30%).

(iii) Methodology Used to Create Profitability Portfolios : Profitability portfolios are calculated in March end based on the earnings before taxes/ book equity value (EBT/BE ratio). The sample companies' stock were filtered in descending order based on their value. Three value portfolios were created using 30th and 70th percentile values as the break points which are termed as Weak (bottom 30%), Neutral (middle 40%), and Robust (top 30%).

(iv) Methodology Used to Create Investment Portfolios : Investment portfolios are formed in March end depending upon the [*Total Assets (t)* - *Total Assets* $(t-1)$ / *Total Assets* $(t-1)$] ratio. The sample companies' stocks were filtered in descending order based on the value of the ratio and the three investment portfolios were created as Conservative (bottom 30%), Neutral (middle 40%), and Aggressive (top 30%).

(v) Calculating Size, Value, Profitability, and Investment Portfolio Returns : A total of 18 portfolios are created from the combination of the categories formed based on the size, BE/ME ratio, EBT/BE ratio, and [*Total Assets (t)* - *Total Assets* $(t-1)$ / *Total Assets* $(t-1)$] ratio as shown in the Tables 1, 2, and 3. After forming these portfolios, equally weighted returns are computed for each of the portfolios every month each year starting from October of year t till September of year $t+1$.

(vi) Size, Value, Profitability, and Investment Factor Returns : Factor returns of each of the four variables, namely, SMB, HML, RMW, and CMA are calculated as stated by the Fama - French methodology. The market factor has been calculated as $(Rm - Rf)$. The $SMB_{B/M}$ is the arithmetic mean of the return on three small size portfolios, that is,

Table 1. *Size* and *B/M* (2 × 3) Bivariate Sorting

Size	*B/M* Ratio		
	High (H)	Neutral (N)	Low (L)
Small (S)	SH	SN	SL
Big (B)	BH	BN	BL

Table 2. *Size* and *Profitability* (2 × 3) Bivariate Sorting

Size	*Profitability*		
	Robust (R)	Neutral (N)	Weak (W)
Small (S)	SR	SN	SW
Big (B)	BR	BN	BW

Table 3. *Size* and *Investment* (2 × 3) Bivariate Sorting

Size	*Investment*		
	Conservative (C)	Neutral (N)	Aggressive (A)
Small (S)	SC	SN	SA
Big (B)	BC	BN	BA

Table 4. Factor Calculation

Factor	Formula
$SMB_{B/M}$	$(SH + SN + SL)/3 - (BH + BN + BL)/3$
SMB_{OP}	$(SR + SN + SW)/3 - (BR + BN + BW)/3$
SMB_{INV}	$(SC+SN+SA)/3 - (BC+BN+BA)/3$
SMB	$(SMB_{B/M} + SMB_{OP} + SMB_{INV})/3$
HML	$(SH+BH)/2 - (SL+BL)/2$
RMW	$(SR+BR)/2 - (SW + BW)/2$
CMA	$(SC + BC)/2 - (SA + BA)/2$

Note. SMB - Small minus big ; HML - High minus low ; RMW - Robust minus weak ; CMA - Conservative minus aggressive.

average of (S/M, S/L, S/H) minus the average of return on the big size portfolios, that is, (average of (B/M, B/L, B/H)).These returns are computed every month over a period of 12 months after the portfolio formation. SMB_{OP} and SMB_{INV} are computed in a similar way as $SMB_{B/M}$. SMB is the average of three computed SMB portfolios based on book to market equity ratio, profitability, and investment. The process was replicated until the portfolios were reconstructed. HML is calculated as $(B/H + S/H)/2 - (B/L + S/L)/2$. Similarly, RMW and CMA are calculated as shown in the Table 4.

(vii) Portfolios for Dependent Variables : Quintiles have been used as breakpoints to make univariate portfolios for the dependent variables, where P5 is the highest value portfolio and P1 is the lowest value portfolio of the respective variables - size, BE/ME, profitability, and investment.

(viii) Models : The study has used hierarchical multiple regression on the time series data. We have made an attempt to run the hierarchical regression in four steps, which are explained below :

Step 1: One factor CAPM,
Step 2: Three factor model,
Step 3: Four factor model,
Step 4: Five factor model.

The Table 5 shows the equations of the asset pricing models and Table 6 provides the description of the variables.

(ix) Test of Multicollinearity : Gujarati (2009) stated that multicollinearity is associated with degree and the assumptions of the classical linear regression model (CLRM) for no-multicollinearity must be tested before

Table 5. Equations of the Asset Pricing Model

Model	Regression Equation
CAPM	$R_{it} - R_{Ft} = a_i + b_i (R_{Mt} - R_{Ft})$
Three - Factor Model	$R_{it} - R_{Ft} = a_i + b_i (R_{Mt} - R_{Ft}) + {}_{si} SMB_t + h_i HML_t + e_{it}$
Four - Factor Model	$R_{it} - R_{Ft} = a_i + b_i (R_{Mt} - R_{Ft}) + {}_{si} SMB_t + h_i HML_t + r_i RMW_t + e_{it}$
Five - Factor Model	$R_{it} - R_{Ft} = a_i + b_i (R_{Mt} - R_{Ft}) + {}_{si} SMB_t + h_i HML_t + r_i RMW_t + c_i CMA_t + e_{it}$

Table 6. Explanation of Variables of the Asset Pricing Models

Variable	Explanation
R_{it}	Portfolio *(i)* return for period *t*.
R_{Ft}	Risk-free rate of return for period *t*.
R_{Mt}	Market return for period *t*.
a_i	Intercept
b_i, s_i, h_i, r_i, c_i	Coefficient
e_{it}	Residual term
SMB_t	Returns on portfolios of small capitalization securities minus big market capitalization securities for period *t*.
HML_t	Returns on portfolios of high B/M ratio securities minus low B/M ratio securities for period *t*.
RMW_t	Returns on portfolios of robust profitability securities minus weak profitability securities for period *t*.
CMA_t	Returns on portfolios of conservative investment securities minus aggressive investment securities for period *t*.

running regression models. Variance inflating factor (VIF) test is used to check the degree of multicollinearity. If VIF = 1, it implies the absence of multicollinearity and the acceptable limit is < 10. Corrective action needs to be taken if VIF > 20 (St - Pierre & Glamocic, 2000). The VIF test is conducted and the results are highlighted in the Appendix.

The variance inflating factor refers to :

$$VIF_k = \frac{1}{1 - r^2_{12}}$$

where,

VIF_k - variance inflating factor k,

r_{12} - correlation coefficient between factors f_1 and f_2 .

Analysis and Results

The Table 7 highlights the monthly average excess returns (returns net of risk-free rate of return) on the portfolios based on size, B/M (book to market equity ratio), OP (profitability), and Inv (Investment), respectively. It can be seen from the Table 7 that there exits an inverse relationship between firm size and excess returns as the excess returns on the portfolios based on size falls from P1 to P5. Similar results were obtained by Sehgal and

Balakrishnan (2013) ; Sehgal, Subramaniam, and Morandiere (2012) ; and Sehgal and Tripathi (2005). There exists a direct relationship between B/M ratio and returns as the excess returns on the portfolios based on B/M ratio increases from P1 to P5. This was also depicted in the past by Sehgal and Pandey (2014), Sehgal and Balakrishnan (2013), and Sehgal et al. (2012). For portfolios based on profitability, there exists a direct relationship between profitability and returns as excess returns increase as we move from P1 to P2. This result was depicted for the U.S. market as well (Fama & French, 2008). For portfolios based on investment, a clear pattern is not evident for the Indian stock market as the excess returns fall from P1 to P4 and then rise suddenly for P5. Fama and French (2006) revealed that the returns and variables (size, book to market equity ratio, profitability, and investment) relationship was restricted to controlling for the remaining variables. Also, we have used univariate sorting whereby controlling for other variables is not allowed. Thus, this can be the reason that a clear pattern is not visible in the returns of the portfolios based on investment.

The Table 8 shows the descriptive statistics of the explanatory variables. It can be seen from the Table 8 that the mean of market (return in excess of risk-free rate of return) is 1.13%, which is the highest as compared to SMB (0.54%), HML (0.4%), RMW (0.35%), and CMA (0.13%). The standard deviation is also maximum for the excess return (referred by Market here), that is, 7.31 as compared to SMB (1.54), HML (1.12), RMW (0.99), and CMA (0.74).

The Table 9 shows the correlation between the explanatory variables. Correlation between market and SMB is 0.10, market and HML (0.26), market and RMW (0.33), market and CMA (0.12), SMB and HML (0.68), SMB and RMW (-0.02), SMB and CMA (0.35), HML and RMW (0.20), HML and CMA (0.26), and RMW and CMA (0.07). Fama and French (1993, 2015) stated that the intercept term (denoted by *a*) should not be significantly different from zero if the explanatory variables of the regression model completely elucidate the variation in the dependent variable.

Table 7. Excess Average Monthly Returns (Expressed in %) on Portfolios Based on Univariate Sorting - October 2001 to September 2016

Portfolio	*Size*	*BM*	*OP*	*Inv*
P1	3.604974	1.449103	1.469292	2.765286
P2	2.302081	1.907608	1.581697	2.196429
P3	1.971652	2.150006	1.973177	1.965525
P4	1.799391	2.378118	2.457725	1.942538
P5	1.323169	3.111639	3.508201	2.131945

Table 8. Descriptive Statistics of the Explanatory Variables

	MARKET	*SMB*	*HML*	*RMW*	*CMA*
Mean	1.13202851	0.542362	0.405224	0.352705	0.134997
Median	1.13421587	0.39224	0.234092	0.403292	0.136132
Maximum	34.1623627	6.017787	5.467737	3.42572	3.142911
Minimum	-27.908776	-2.65365	-1.62227	-5.09062	-2.50263
Std. Dev.	7.31544821	1.549262	1.124749	0.997197	0.742116
Skewness	-0.0883412	0.63847	1.045427	-1.39324	0.206821
Kurtosis	6.18483995	3.805583	5.357524	10.36835	4.863586
Observations	180	180	180	180	180

Table 9. Correlation Coefficients among *Market, SMB, HML, RMW,* and *CMA* Factors

	MARKET	*SMB*	*HML*	*RMW*	*CMA*
MARKET	1	0.107017	0.263398	-0.33278	-0.12997
SMB		1	0.680062	-0.0276	0.35087
HML			1	-0.20785	0.268204
RMW				1	0.072318
CMA					1

Table 10. Regression Intercepts Based on the Single Sorted Portfolios for the Four Asset Pricing Models for the Period Spanning from October 2001 to September 2016

	Size		*BM*		*OP*		*Inv*	
	a	Sig	*a*	Sig	*a*	Sig	*a*	Sig
Panel A : CAPM								
P1	2.302645	0.0000*	0.311327	0.1532	0.024632	0.9369	1.449476	0.0000*
P2	1.016081	0.0000*	0.694203	0.0019*	0.287890	0.2631	1.005340	0.0003*
P3	0.704408	0.0125*	0.896072	0.0008*	0.796106	0.0028*	0.789399	0.0008*
P4	0.547178	0.0074*	1.062656	0.0002*	1.300186	0.0000*	0.687241	0.0012*
P5	0.166881	0.1191	1.768694	0.0000*	2.320138	0.0000*	0.807355	0.0045*
Panel B : Three - Factor Model								
P1	0.750229	0.00*	0.191877	0.3124	-0.827760	0.0028*	0.428830	0.0589
P2	-0.161928	0.4534	0.224606	0.2870	-0.437583	0.0500	0.134612	0.5406
P3	-0.039826	0.8723	0.150268	0.5095	0.033219	0.8818	0.088525	0.6474
P4	0.218599	0.2830	0.167157	0.4246	0.598522	0.0030*	0.079284	0.6548
P5	0.237747	0.0362*	0.277120	0.1387	1.637595	0.0000*	0.280962	0.2875
Panel C : Four - Factor Model								
P1	1.032028	0.0000*	0.632140	0.0010*	0.160418	0.4860	0.793540	0.0010*
P2	0.281415	0.2014	0.541989	0.0154*	0.245910	0.2268	0.383865	0.1041
P3	0.498953	0.0473	0.565691	0.0172*	0.405165	0.0837	0.552298	0.0044*
P4	0.596459	0.0049*	0.297221	0.1914	0.653110	0.0030*	0.236567	0.2169
P5	0.316594	0.0103*	0.691668	0.0003*	1.260828	0.0000*	0.765068	0.0055*
Panel D : Five - Factor Model								
P1	1.056036	0.0000*	0.662736	0.0003*	0.150038	0.5149	0.762444	0.0011*
P2	0.293938	0.1816	0.523959	0.0183*	0.261781	0.1958	0.356800	0.1241
P3	0.500675	0.0500	0.581177	0.0141*	0.411833	0.0795	0.550205	0.0047*
P4	0.612085	0.3800	0.315562	0.1629	0.666180	0.0024*	0.249010	0.1926
P5	0.307030	0.1230	0.689663	0.0003*	1.280090	0.0000*	0.856625	0.0001*

Note. Level of significance- 5%

The Table 10 highlights the intercept terms and the significance *p* - value of the single sorted portfolios for the four asset pricing models, namely, CAPM and Fama - French three factor model, four - factor model, and five - factor model.

The Table 10 - Panel A shows regression intercepts for the capital asset pricing model. For the size sorted portfolios, the intercept terms are larger and significant for the small size portfolios, which shows the persistence of size effect. P5 being the portfolio of the large size firms, it has insignificant intercept with smaller intercept value. Parallel results were depicted by Balakrishnan (2014), Sehgal and Tripathi (2005), and Kumar and Sehgal (2004). For the portfolios sorted based on book to market equity ratio, there exists value effect as the intercept values are larger for larger book to market equity portfolios. Also, portfolios of larger B/M firms tend to provide returns more than the model's estimation ; whereas, the returns provided by the smaller B/M firms are similar to the model expectations. Similar results were depicted by Balakrishnan (2014). Likewise, for the portfolios sorted on profitability, the intercept term values are larger and significant for higher OP portfolios, implying that higher OP portfolios provide excess returns than the model estimation. Portfolios sorted on investment seem to have significantly higher returns than the model estimation. Smaller investment portfolios have larger intercept terms ; whereas, larger investment portfolios have smaller intercept terms. It can be seen from the Table 10 that for the investment sorted portfolios, all the intercept terms are significant, implying that CAPM does not completely explain the returns of any of the investment sorted portfolios. Similarly, results have been shown for other asset pricing models in Panels B, C, and D.

Panel A of the Table 10 shows that CAPM gives significant intercepts in 16 out of 20 regression models ; whereas, Panel B of Table 10 shows that the three factor model gives only five significant intercepts and thus is

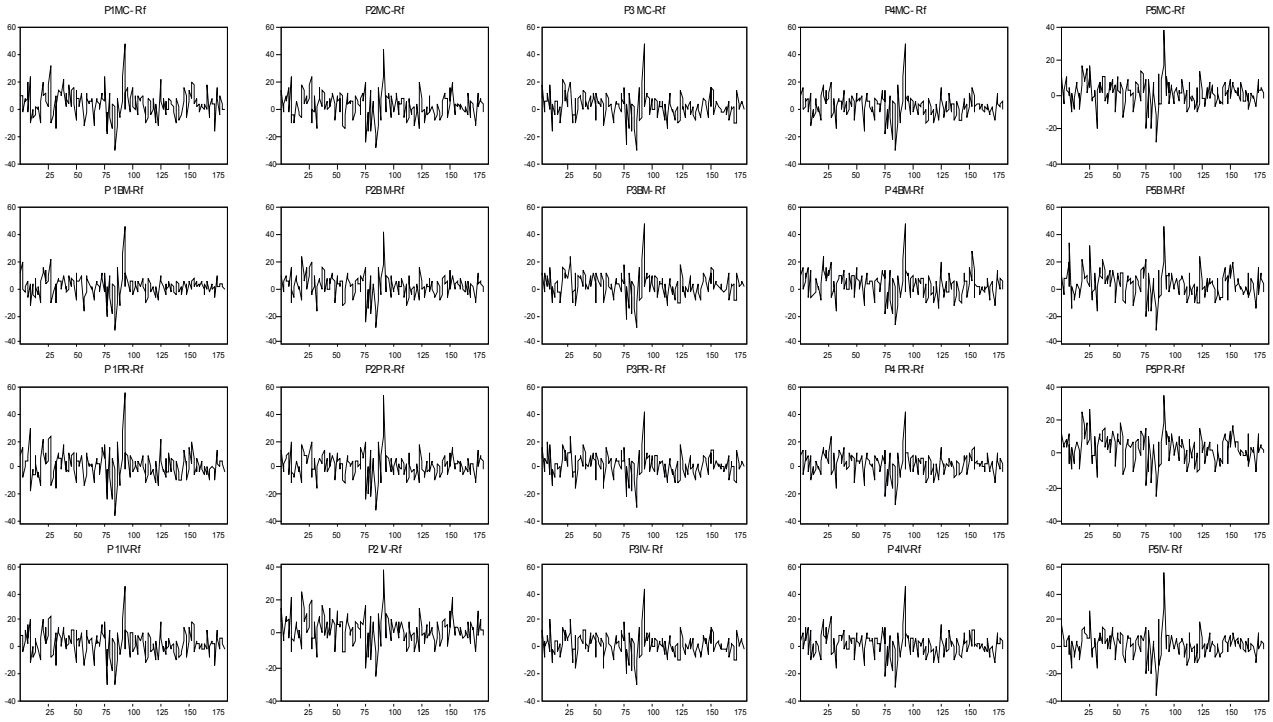
Table 11. Adjusted R^2 Values Produced by the Asset Pricing Models for Single Sorted Portfolios - October 2001 to September 2016

Model	Portfolio	Size (Adjusted R^2)	Sig	*BM*	Sig	*OP*	Sig	*Inv*	Sig
CAPM	P1	0.730843	0.00	0.867091	0.00	0.836729	0.00	0.820110	0.00
Three - Factor Model		0.919415	0.00	0.910425	0.00	0.888959	0.00	0.910147	0.00
Four - Factor Model		0.922898	0.00	0.924855	0.00	0.933390	0.00	0.916887	0.00
Five - Factor Model		0.924895	0.00	0.930577	0.00	0.933432	0.00	0.920907	0.00
CAPM	P2	0.795625	0.00	0.878237	0.00	0.858018	0.00	0.817096	0.00
Three - Factor Model		0.916673	0.00	0.901656	0.00	0.906678	0.00	0.896433	0.00
Four - Factor Model		0.927086	0.00	0.908009	0.00	0.933704	0.00	0.899961	0.00
Five - Factor Model		0.929435	0.00	0.909383	0.00	0.934591	0.00	0.903528	0.00
CAPM	P3	0.830241	0.00	0.843385	0.00	0.827057	0.00	0.858857	0.00
Three - Factor Model		0.881901	0.00	0.896620	0.00	0.889252	0.00	0.913605	0.00
Four - Factor Model		0.898503	0.00	0.906685	0.00	0.898126	0.00	0.928481	0.00
Five - Factor Model		0.897934	0.000000	0.909998	0.00	0.897801	0.00	0.928097	0.00
CAPM	P4	0.901392	0.00	0.840698	0.00	0.849768	0.00	0.895330	0.00
Three - Factor Model		0.911710	0.00	0.920986	0.00	0.906604	0.00	0.933635	0.00
Four - Factor Model		0.920649	0.00	0.921481	0.00	0.906288	0.00	0.934873	0.00
Five - Factor Model		0.921570	0.00	0.922634	0.00	0.906813	0.00	0.935362	0.00
CAPM	P5	0.965482	0.00	0.765757	0.00	0.832478	0.00	0.841255	0.00
Three - Factor Model		0.965851	0.00	0.945000	0.00	0.881246	0.00	0.876021	0.00
Four - Factor Model		0.966172	0.00	0.953090	0.00	0.890206	0.00	0.888247	0.00
Five - Factor Model		0.966626	0.00	0.952837	0.00	0.891723	0.00	0.927061	0.00

found to be a better model in explaining returns. Using the Fama - French five factor model as seen from Panel D of Table 10, 10 portfolios give significant intercepts. Thus, we can conclude that the Fama - French three factor model is better as compared to other models in elucidating the return generating process in the Indian stock market for the sample data. These results are similar to those of Sobti (2018) and Singh and Yadav (2015).

The performance of any model can be judged by analyzing its goodness of fit, which is denoted by adjusted R^2. This value of adjusted R^2 provides the explained variation in returns by the model. The Table 11 reveals the adjusted R^2 values for the four models, which are based on the single sorted portfolios formed using four variables : size, book to market equity, profitability, and investment. It can be seen from the Table 11 that CAPM elucidates 73% variation in returns for P1 and 96% for P5 for the size sorted portfolios. Thus, adjusted R^2value (goodness of fit) increases from P1 to P5, showing evidence of size effect. Similarly, for the portfolios based on B/M value, the results show evidence of the value effect, as the adjusted R^2 value decreases from 86% for P1 to 76% for P5, thereby showing that there exists inverse relation between returns and value factor. However, no significant change is seen for OP sorted portfolios as 83.6% variation is explained for P1 portfolios and 83.2% for P5 portfolios. For investment sorted portfolios, the explained variation increases from 82% for P1 to 84% for P5. It is observed that the goodness of fit improves for all the portfolios as we shift from CAPM to the three-factor model. This is apparent from the significant *F* change values which are 0.00 for all the portfolios under consideration. The variation in returns explained by the three-factor model ranges from 88% to 96% for size sorted portfolios. Similar results were obtained by Das (2015), Balakrishnan (2014), Sehgal and Balakrishnan (2013), and Sehgal et al.

Figure 1. Graphical Representation of the Excess Returns on the Portfolios Based on Univariate Sorting



Note. MC denotes size sorted portfolios; BM denotes book to market equity ratio sorted portfolios ; PR denotes profitability sorted portfolios ; IV denotes investment sorted portfolios.

(2012), Taneja (2010), Mehta and Chander (2010), and Connor and Sehgal (2001) that the three-factor model is better than the CAPM in elucidating the variation in returns in the Indian stock market.

For B/M sorted portfolios, adjusted R^2 value increases from 91% for P1 to 94% for P5. However, no significant change is depicted for profitability sorted portfolios from 88.8% for P1 to 88.1% for P5. Similarly, for investment sorted portfolios, the adjusted R^2 value is found to reduce from 91% for P1 to 87% for P5.

On switching from Fama - French three - factor model to the five-factor model, no significant improvement is seen. It can be seen from the Table that the adjusted R^2 value for the size sorted portfolios improve from 91% to 92% only for P1, 91% to 92% for P2, 88% to 89% for P3, 91% to 92% for P4, and 96.5% to 96.6% for P5. For portfolios based on book to market equity ratio, the adjusted R^2 value improves from 91% to 93% for P1, 90.1% to 90.9% for P2, 89% to 90% for P3, 92.09% to 92.26% for P4, 94% to 95% for P5. For portfolios based on profitability, the change in adjusted R^2 value is 88% to 93% for P1, 90% to 93% for P2, 88% to 89% for P3, 90.66% to 90.68% for P4, and 88% to 89% for P5. Likewise, for investment sorted portfolios, the values are 91% to 92% for P1, 89% to 90% for P2, 91% to 92% for P3, 93.3% to 93.5 % for P4, and 87% to 92% for P5.

The Figure 1 depicts the graphical representation of the excess returns on the univariate portfolios formed on the basis of four variables using the Fama - French methodology (2015). The volatility in returns can be clearly seen from the graphs.

Conclusion

In this study, we have created portfolios based on four variables (size, book to market equity, profitability, and investment) and analyzed and tested the performance of the four asset pricing models - the capital asset pricing model, Fama and French three - factor model (1993), Fama and French four - factor model (2012), and Fama and French five - factor model (2015) in the Indian stock market. In order to judge the performance of the asset pricing models, how well the model explains the variations in returns over time needs to be analyzed. The explanatory variables used in the models are based on the excess market returns (market return in excess of risk-free rate), market capitalization of firms, book equity to market equity ratio, profitability, and investment. The study has been conducted on the companies forming a part of CNX 500 index for a period of 15 years spanning October 2001 to September 2016.

The findings of the study reveal that there exists an inverse relationship between returns and market capitalizations, returns and profitability, and returns and investment, though the returns and investment pattern is not very clear ; whereas there exists a direct relationship between returns and value factor (book to market equity ratio). The goodness of fit test (adjusted R^2 values) clearly highlights that the Fama and French three - factor model (1993) of asset pricing performs better than the other asset pricing models discussed in the study for the Indian stock market.

Research Implications

Fund managers use asset pricing behaviour to construct portfolios. If stock returns are sensitive to changes in the asset pricing factors, then this information can be used to generate superior returns for their clients / investors. Equity investors, fund / portfolio managers, as well as investment advisers should embed the explanatory power of market beta, size, value, profitability as well as investment effects on stock/portfolio returns in their operational strategies. Thus, it enables them in building up trading strategies that maximize returns and minimize loss.

Limitations of the Study and Scope for Further Research

The study has been conducted on a limited sample of companies listed on the National Stock Exchange. Also, only four asset pricing models have been discussed in the study. Asset pricing is of huge interest to investors as well as to fund / portfolio managers. There is a vast scope of research in this area, including considering variables which are industry - related, macro - economic, and company-specific in explaining asset returns. This study aimed at analyzing and comparing only four asset pricing models, namely, the capital asset pricing model, Fama and French three - factor model (1993), Fama and French four - factor model (2012), and Fama and French five - factor model (2015) in the Indian stock market.

The study can be further extended to various other asset pricing models, like inter-temporal capital asset pricing model (ICAPM), consumption based capital asset pricing model (CCAPM), Carhart, Fama - Macbeth, etc. Also, the time span considered in the study is limited to 15 years only, which ranges from October 2001 to September 2016.

References

Balakrishnan, A. (2014). Multifactor explanations of CAPM anomalies: An evidence for Indian stock market. *Asian Journal of Finance & Accounting, 6* (1), 337 - 366. DOI: https://doi.org/10.5296/ajfa.v6i1.5241

Balakrishnan, A., & Maiti, M. (2017). Dynamics of size and value factors in stock returns: Evidence from India. *Indian Journal of Finance, 11* (6), 21 - 35. doi:10.17010/ijf/2017/v11i6/115593

Cakici, N., Fabozzi, F. J., & Tan, S. (2013). Size, value, and momentum in emerging market stock returns. *Emerging Markets Review, 16,* 46 - 65. DOI: https://doi.org/10.1016/j.ememar.2013.03.001

Connor, G., & Sehgal, S. (2001). *Tests of the Fama and French model in India* (Discussion Paper 379). London, UK : Financial Markets Group, London School of Economics and Political Science. Retrieved from http://eprints.lse.ac.uk/25057/

Das, S. (2015). Empirical evidence of conditional asset pricing in the Indian stock market. *Economic Systems, 39* (2), 225 - 239. DOI: https://doi.org/10.1016/j.ecosys.2014.07.003

Dash, M., & Rishika, N. (2011). Asset pricing models in Indian capital markets. *Indian Journal of Finance, 5* (11), 4 - 10.

Fama, E. F., French, K. R. (1992). The cross section of expected stock returns. *The Journal of Finance, 47* (2), 427 - 465. DOI: https://doi.org/10.2307/2329112

Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics, 33* (1), 3 - 56. DOI: https://doi.org/10.1016/0304-405x(93)90023-5

Fama, E. F., & French, K. R. (2006). Profitability, investment and average returns. *Journal of Financial Economics, 82* (3), 491 - 518. DOI: https://doi.org/10.1016/j.jfineco.2005.09.009

Fama, E. F., & French, K. R. (2008). Dissecting anomalies. *The Journal of Finance, 63* (4), 1653 - 1678. DOI: https://doi.org/10.1111/j.1540-6261.2008.01371.x

Fama, E. F., & French, K. R. (2012). Size, value, and momentum in international stock returns. *Journal of Financial Economics, 105* (3), 457 - 472. DOI: https://doi.org/10.1016/j.jfineco.2012.05.011

Fama, E. F., & French, K. R. (2015). A five-factor asset pricing model. *Journal of Financial Economics, 116* (1), 1 - 22. DOI: https://doi.org/10.1016/j.jfineco.2014.10.010

Gujarati, D. N. (2009). *Basic econometrics* (4th ed.). New York : Tata McGraw-Hill Education.

Gupta, C. P., & Kumar, R. (2009). *A re-examination of factors affecting returns in Indian stock market.* Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1376236

Hou, K., Xue, C., & Zhang, L. (2015). Digesting anomalies: An investment approach. *The Review of Financial Studies, 28* (3), 650 - 705. DOI: https://doi.org/10.1093/rfs/hhu068

Kumar, M., & Sehgal, S. (2004). Company characteristics and common stock returns: The Indian experience. *Vision: The Journal of Business Perspective, 8* (2), 33 - 45. DOI: https://doi.org/10.1177/097226290400800204

Lintner, J. (1965). Security prices, risk, and maximal gains from diversification. *The Journal of Finance, 20* (4), 587 - 615.DOI: https://doi.org/10.1111/j.1540-6261.1965.tb02930.x

Mehta, K., & Chander, R. (2010). Application of Fama and French three factor model and stock return behavior in Indian capital market. *Asia - Pacific Journal of Management Research and Innovation, 6* (4), 38 - 56. DOI: https://doi.org/10.1177/097324701000600405

Mossin, J. (1966). Equilibrium in a capital asset market. *Econometrica : Journal of the Econometric Society, 34* (4), 768 - 783. DOI: https://doi.org/10.2307/1910098

Novy - Marx, R. (2013). The other side of value : The gross profitability premium. *Journal of Financial Economics, 108* (1), 1 - 28. DOI: https://doi.org/10.1016/j.jfineco.2013.01.003

Raghuram, G., & Erickson, C. (2017). Identifying structural breaks in asset pricing behavior in the Indian context. *Indian Journal of Finance, 11*(6), 7 - 20. DOI: https://doi.org/10.17010/ijf/2017/v11i6/115592

Sehgal, S., & Tripathi, V. (2005). Size effect in Indian stock market : Some empirical evidence. *Vision : The Journal of Business Perspective, 9* (4), 27 - 42.DOI: https://doi.org/10.1177/097226290500900403

Sehgal, S., & Balakrishnan, A. (2013). Robustness of Fama - French three factor model: Further evidence for Indian stock market. *Vision : The Journal of Business Perspective, 17* (2), 119 - 127. DOI: https://doi.org/10.1177/0972262912483526

Sehgal, S., & Pandey, A. (2014). Profitable trading strategies based on price multiple information: Evidence from India. *Afro - Asian Journal of Finance and Accounting, 4* (4), 408 - 425. DOI: https://doi.org/10.1504/aajfa.2014.067015

Sehgal, S., Subramaniam, S., & Morandiere, L. P. (2012). A search for rational sources of stock return anomalies: Evidence from India. *International Journal of Economics and Finance, 4* (4), 121 - 134. DOI: https://doi.org/10.5539/ijef.v4n4p121

Sharpe, W. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *The Journal of Finance, 19* (3), 425 - 442. DOI: https://doi.org/10.1111/j.1540-6261.1964.tb02865.x

Singh, H., & Yadav, S. (2015). Indian stock market and the asset pricing models. *Procedia Economics and Finance, 30,* 294 - 304. DOI: http://doi.org/10.1016/S2212-5671(15)01297-6

Sobti, N. (2018). Does size, value and seasonal effects still persist in Indian equity markets? *Vision, 22* (1), 11 - 21.DOI: https://doi.org/10.1177/0972262917750230

St-Pierre, N. R., & Glamocic, D. (2000). Estimating unit costs of nutrients from market prices of feedstuffs. *Journal of Dairy Science, 83* (6), 1402 - 1411. DOI: https://doi.org/10.3168/jds.s0022-0302(00)75009-0

Taneja, Y. P. (2010). Revisiting Fama French three-factor model in Indian stock market. *Vision : The Journal of Business Perspective, 14* (4), 267 - 274. DOI: https://doi.org/10.1177/097226291001400403

Zaremba, A., & Konieczka, P. (2014).Value, size and momentum across countries. *Indian Journal of Finance, 8* (9), 7 - 31. doi:10.17010/ijf/2014/v8i9/71849

Appendix

Table A1 highlights the VIF results of the Fama - French three - factor model. It can be seen from the table that all the VIF values are less than 2, indicating no serious multicollinearity in the regression equation having *Market, SMB,* and *HML* as the explanatory variables.

Table A1. Variance Inflation Factor for the Regression Equation : Fama - French Three - Factor Model for the Portfolios Based on Univariate Sorting

Portfolio	*Market*	*SMB*	*HML*
Size	1.08584	1.87995	1.996971
BM	1.08584	1.87995	1.996971
OP	1.08584	1.87995	1.996971
Inv	1.08584	1.87995	1.996971

Table A2 shows the VIF results of the Fama - French four - factor model. As shown in the table, all the VIF values are less than 2, indicating no serious multicollinearity in the regression equation having *Market, SMB, HML,* and *RMW* as the explanatory variables.

As shown in Table A3, the VIF values for Fama - French five - factor model are 2 or less than 2, indicating no serious multicollinearity in the regression equation having *Market, SMB, HML, RMW,* and *CMA* as the explanatory variables.

Table A2. Variance Inflation Factor for the Regression Equation : Fama - French Four - Factor Model for the Portfolios Based on Univariate Sorting

Portfolio	*Market*	*SMB*	*HML*	*RMW*
Size	1.180749	1.91499	2.07018	1.165841
BM	1.180749	1.91499	2.07018	1.165841
OP	1.180749	1.91499	2.07018	1.165841
Inv	1.180749	1.91499	2.07018	1.165841

Table A3. Variance Inflation Factor for the Regression Equation : Fama - French Five - Factor Model for the Portfolios Based on Univariate Sorting

Portfolio	*Market*	*SMB*	*HML*	*RMW*	*CMA*
Size	1.21914	2.00785	2.09215	1.16865	1.19213
BM	1.21914	2.00785	2.09215	1.16865	1.19213
OP	1.21914	2.00785	2.09215	1.16865	1.19213
Inv	1.21914	2.00785	2.09215	1.16865	1.19213

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