The Fama-French Three Factor Model and the Capital Asset Pricing Model : Evidence from the Indian Stock Market

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Abstract

The study aimed to provide empirical evidence on the validity of various asset pricing models for India. Specifically, it examined the behaviour of stock returns in relation to market beta, firm size (market equity), and book-to-market equity factors. I tested for the capital asset pricing model (CAPM), introduced by Sharpe (1964), Lintner (1965), Mossin (1966), and Black (1972) and then for a well-known extension to CAPM provided by Fama and French (1992), that is, the three factor model which moves away from the oversimplified relation between excess portfolio returns and excess market returns as prophesized by CAPM. I differed from the previous studies on this topic, in the Indian market, in three significant ways. First, I constructed a higher number of portfolios to minimize variability within a portfolio. Second, I considered post-2008 stock market data, so as to exclude any impact of the economic crisis. Third, I also carried out a joint test on the constant term in the portfolio regressions using the GRS test statistic. Given the time period in consideration, the empirical tests conducted support the Fama-French three-factor model in explaining the variation of stock returns better than the single factor CAPM for the Indian stock market.

Keywords : **CAPM, stock market, Fama-French model, asset pricing, expected returns**

JEL Classification : C58, E44, G11, G12

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The fundamental requirement of economic growth and development necessitates the need for funds and hence, it is imperative to have a mechanism in place which ensures smooth transactions amongst the savers (investors) and the dis-savers in an economy so that funds are allocated efficiently. Stock markets lead in fulfilling the place of the above mentioned mechanism.

Stock markets throughout the world are well known for their volatile nature and sudden surges. An investor's lexicon starts and ends with the terms '*risk*' and '*return*'. The relationship between the two is what the investor yearns to understand and master. The capital asset pricing model (CAPM), developed by Sharpe (1964), Lintner (1965), Mossin (1966), and Black (1972), is the first model in asset pricing. It establishes a linear relationship between the asset return and exposure to a single market factor. Even though it is prone to criticism, it is still the most widely used asset pricing model by virtue of its simplicity and sufficient accuracy (Ajao & Igbinosa, 2014).

The relationship, as prophesied by CAPM, offers a benchmark return for judging potential investments by comparing the expected forecast of return with the "fair" return of the security for a given amount of risk. However, due to its excessive simplicity, the empirical record of the model is very poor. Several anomalies of CAPM were ascertained during 1980s and 1990s which challenged the validity of CAPM (Bhatnagar & Ramlogan, 2012).

Over the years, it was argued that it is not the best approach for investors to consider only the market risk (market beta) because in reality, they face several other types of risks as well. According to Fama and French, "the

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attraction of the CAPM is that it offers powerful and intuitively pleasing predictions about how to measure risk and the relation between expected return and risk. Unfortunately, the empirical record of the model is poor - poor enough to invalidate the way it is used in applications. The CAPM's empirical problems may reflect theoretical failings, the result of many simplifying assumptions" (2004, p.1).

In 1992, the results from the study by Fama and French challenged the predictions of CAPM. The study found that the main prediction of CAPM, that is, a linear cross sectional relationship between mean excess return and exposure to the market factor was violated for the U.S. stock market. Rather, exposures to two other factors - a size factor and a book-to-market equity based factor- explained a significant part of the cross sectional dispersion in mean returns. Fama and French interpreted the risk premiums associated with the size and book-to-market equity ratio as 'distress premiums'. They said that small sized and high book-to-market equity firms were going through financial distress and ,therefore, investors required higher premiums for investing in the stocks of these firms (Connor & Sehgal, 2001).

This paper attempted to test for both the capital asset pricing model (CAPM) and the Fama-French three factor model (FF) in the case of the Indian stock market over the time period from 2009-2015.

Literature Review

The development of CAPM, one of the fundamental tenants in financial theory, marked the birth of asset pricing models and became the most widely recognized explanation of stock prices and expected returns. The model states that the correct measure of the riskiness of an asset is its beta and that the risk premium per unit of riskiness is the same across all assets. Given the risk free rate and the beta of an asset, the CAPM predicts the expected risk premium for an asset. The Sharpe-Lintner CAPM equation, which describes individual asset return, is given by:

$$E(R_i) = R_f + \beta_{im} [E(R_m) - R_f] \qquad i = 1, 2, \ldots\ldots, n$$

where,

$E(R_i)$: Expected return of stock 'i',

R_f : Risk-free rate of return,

$E(R_m)$: Expected return on market portfolio,

$\beta_{im} = \dfrac{Cov(Ri, Rm)}{Var(Rm)}$: Measure of systematic risk of stock.

The model asserts that there is a linear relationship between the expected return in a risky asset and its β and also that β is a sufficient measure of risks that captures the cross section of average returns. The CAPM equation shows that given investors are risk averse, high risk (high market beta) stocks should have higher expected returns as compared to low risk (low market beta) stocks.

One of the earliest empirical studies that found supportive evidence for CAPM was that of Black (1972). Using monthly return data and portfolios, the study tested whether the cross-section of expected returns is linear in beta and the data was found to be consistent with the predictions of the CAPM. However, soon, it was concluded that the empirical evidence of the failures of CAPM were numerous. Fama and French (1992) found that the cross section of average stock returns for the period from 1963-1990 for U.S. stocks was not fully explained by the CAPM beta and that stock risks were multidimensional. Two of these dimensions of risk, they suggested, are size and the ratio of book value of common equity to its market value (BE/ME). This made it imperative for the market factor to be included in the regression to explain the above, which led to the formulation of the Fama and French's three-factor model :

$$E(R_i) - R_f = \beta_{im}[E(R_m) - R_f] + \beta_{is}[SMB] + \beta_{ih}[HML]$$

where,
$E(R_i)$: Expected return of stock,
R_f : Risk-free rate of return,
$E(R_m)$: Expected return on market portfolio,
SMB : *Small Minus Big*, that is, difference between the returns on small and big stocks,
HML : *High Minus Low*, that is, difference between the returns on high and low (BE/ME) stocks,
β_{im} : Exposure to market factor,
β_{is} : Exposure to size factor,
β_{ih} : Exposure to value factor.

Fama and French (1993) suggested that *HML* captures the variation of risk factor that is related to relative earnings performance of the firms. They showed that firms with persistently low earnings tend to have high BE/ME ratio and positive slopes on *HML*, and firms with persistently high earnings have low BE/ME ratio and negative slope on *HML*.

Since its introduction in 1992, the Fama-French three factor model has been subject of much academic debate and empirical application. Connor and Sehgal (2001) found that in the three-factor model, the market factor ranked highest in explanatory power, while no clear ranking could be given to the size *(SMB)* and value *(HML)* factors. The French case examined by Ajili (2002) provided evidence for the three factor model being of higher explanatory than the CAPM. In the three factor regression, they found the intercept to be close to zero, implying that the model was a good explanation of the cross-section of average stock returns.

Drew and Veeraraghavan (2003) tested the Fama and French three factor model in the Asian region (Hong Kong, South Korea, Malaysia, and the Philippines) and found that size and value effects could be identified in these four markets using a cross section approach and that the Fama-French model explained the variation in returns better than the single index model. Charitou and Constantinidis (2004) empirically examined the Fama-French three factor model using Japanese data over the period of 1992 to 2001. The findings revealed significant relationship between the three factors and the expected stock returns in the Japanese market.

Bundoo (2008) studied the emerging African stock markets for evidence of size and value premium, and found that the three-factor model held for the Mauritius Stock Exchange. Even after taking into account the time-varying betas, the results for size and BE/ME effects were statistically significant. However, the author cautioned that the results may be sample specific, and this model should be tested across other stock exchanges for checking robustness.

Homsud, Wasunsakul, Phuangnark, and Joongpong (2009) found that the Fama and French model was more appropriate to describe the stock exchange of Thailand as compared to the CAPM. Bhatnagar and Ramlogan (2012) ran multiple regression models to compare the performance of the CAPM and the three factor model in explaining observed stock returns and value premium effects in the United Kingdom market. Their findings showed that the three factor model held for the United Kingdom market and was superior to the CAPM in explaining both stock returns and value premium effects. Hence, the real world application of the CAPM was not supported by the United Kingdom data.

Ajao and Igbinosa (2014) conducted a study to determine the risk factors in asset pricing in the Nigerian Stock Market through a comparative analysis of the three factor model and the CAPM. The empirical findings made it very clear that the Fama and French three factor model provided significant improvement over the conventional one factor CAPM in capturing and explaining the cross section of expected returns on quoted stocks in the Nigerian Stock Market.

Based on the empirical review highlighted above, it is obvious that most of the application of Fama-French three factor model has been predominantly carried out in the developed markets. This study, therefore, aims to contribute to the extant literature through a comparative analysis of the CAPM and the Fama-French three factor model on the Indian stock market.

Methodology

(1) Data Sources : Data were obtained from Centre for Monitoring Indian Economy (CMIE) Prowess- NSE 500, as majority of capitalization is by top 10% of the listed companies and the remaining market is traded thinly, so a market index is a good representative of the entire market. NSE 500 captured 94% of the total market capitalization as of March 2016. Some companies in NSE 500 were listed post the starting period of the study, and hence, the data was missing for them. Excluding these, we are left with a total of 396 companies, for which data was obtained for month end adjusted share prices for the period from 2009-2015. In addition, I took data for number of shares outstanding, price/book ratio, 30-days NSE index returns, and 30-days returns over a period for all the 396 companies from 2009-2015. The price data has been adjusted for capitalization changes such as bonus rights and stock splits. The risk-free proxy has been taken as the implicit yield on 91- day T bill for month end auction (Connor & Sehgal, 2001). This was obtained from the RBI website [1]. Since the yield is published weekly, I considered the simple average of weekly returns to get average risk free return for a given month.

(2) Construction of Portfolios : According to Sharpe (1964), Lintner (1965), Mossin (1966), and Black (1972), the expected excess return on a particular asset under CAPM is equal to the expected return on market portfolio multiplied by its market beta. Hence, if information on expected returns and market beta was available, then empirical testing of CAPM would just involve regressing the expected return against market beta. Such data is, however, not available and hence, estimates of expected return and market beta need to be used. This introduces measurement errors as the ordinary least squares (OLS) estimators will be biased. The empirical testing of Fama-French model also faces similar problems. To cope up with this problem, Fama-French (1995) proposed grouping securities together to form portfolios so that the measurement error is minimised and maximum possible dispersion of market beta is obtained (Bundoo, 2008).

The firm specific risk is diversified by grouping the stocks of companies into portfolios. In other words, rather than directly using the data on individual stocks for estimating the CAPM and Fama-French equations, 16 portfolios of the stocks have been formed and data on the returns and risks of these portfolios has been utilized for the purpose of testing the models. Construction of more number of portfolios helps minimize the variability within a portfolio. The method for constructing these portfolios is explained below.

(3) Sorting on the Basis of Size : The financial year in India begins in April and the stock market is highly volatile for at least some period after the start of the financial year, since investors would be inclined to sell loss-making stocks in March and earlier months, and reposition their portfolios in April (Connor & Sehgal, 2001). In order to ensure that the results did not get affected by such high level of fluctuations, I use size data for September (a gap of 6 months from April) by when such volatility is expected to more or less settle down.

In September of each year *t*, all the sample stocks are arranged in ascending order on the basis of size. Size, in this context, is defined as the market capitalization of the stock, that is,

$$Size = Price\ of\ stock\ \ in\ September \times No.\ of\ shares\ outstanding\ in\ September$$

The quartile breakeven points for sizes are then determined and the stocks are divided into four size quartiles. The

[1] URL: http://dbie.rbi.org.in/DBIE/dbie.rbi?site=statistics, under the main heading 'Financial Market' and sub-heading 'Government Securities Market'.

bottom 25% of the stocks (the ones with the smallest size) form the first quartile and are denoted *'Small'*. Similarly, the next 25% of the stocks in terms of size form the third quartile, denoted *A*. Third quartile is denoted as *C* and the last quartile, consisting of the largest sized companies, is denoted as *'Big'*.

(4) Sorting on the Basis of Value : In March end of each year *t*-1, all the sample stocks are arranged in ascending order on the basis of value, where value is defined as the ratio of book equity to market equity. The returns are calculated from October of year *t*, to ensure that value for year *t*-1, that is, March is known to investors at the time of portfolio formation. For the purpose of the present study, I used data on price/ book value per share and inverted it to obtain book equity/market equity (BE/ME), that is,

$$Value = \frac{Book\,Equity}{Market\,Equity} = \frac{1}{\left(\frac{P}{B}\right) ratio} = \frac{B}{P}\ ratio$$

The stocks are once again allocated to four value quartiles with the first quartile (companies having the least value) being denoted as *Low*, the second quartile as *X*, the third quartile as *Y*, and finally, the last quartile (companies with highest values) as *High*.

(5) Forming the Portfolios : The 16 portfolios are then formed from the intersection of these four size groups and four value groups. List of the portfolios formed is as given below :

Small/Low, Small/X, Small/Y, Small/High
A/Low, A /X, A /Y, A /High
C /Low, C /X, C /Y, C/High
Big/Low, Big/X, Big/Y, Big/High

For instance, the portfolio *Small/Low* consists of all stocks which have both (i) a small size (i.e. belonging to the group *Small*), and (ii) a low value (i.e. belonging to group *Low*). The interpretation is similar for all the other portfolios.

Monthly equally - weighted return on the 16 portfolios is then calculated from October of year *t* to September of year *t*+1. The portfolios are then reformed in September of year *t* + 1.

The 16 portfolios are constructed to be equally-weighted, as suggested by Lakonishok, Shliefer, and Vishny (1994). Fama and French (1996) suggested that the three factor model fairs better in explaining equally weighted portfolios as compared with value-weighted portfolios.

(6) Factor Portfolios : As a next step, I constructed the explained and explanatory variables to be used for testing the asset pricing models. In all, I required data on the following four variables :

(i) Excess Return of Portfolio *i (Ri - Rf)* : This is the dependent variable to be used in testing both CAPM and Fama-French models. It is the monthly equally weighted return which is calculated for each of the 16 portfolios. From this, I subtracted the risk free return *(Rf)* to get the excess return of portfolio *i*.

(ii) Excess Market Return *(Rm - Rf)* : The 30 days NSE 500 index returns is taken as the return over market portfolio *(Rm)*. From this, I again subtracted risk free return *(Rf)* to get the excess return over market portfolio.

(iii) Small Minus Big *(SMB)* : This is one of the two additional factors proposed by Fama and French. It captures the risk factor in returns related to size. This is also termed as size-exposure. The simple average of the monthly returns of the four big sized portfolios is subtracted from the average of the four small sized portfolios to get the *SMB* factor (Malin & Veeraraghavan, 2004). This factor is free from BE/ME effects as it has about the same weighted-average BE/ME, and hence, it mainly focuses on different behaviour of small and big stocks.

$$SMB = \{(Small/Low + Small/X + Small/Y + Small/High)\}/4 - \{(Big/Low + Big/X + Big/Y + Big/High)\}/4$$

(iv) High Minus Low *(HML)* : The *HML* factor is meant to mimic the risk factor in returns which is related to the value. It is calculated as the difference between the simple average of the returns on the four high BE/ME portfolios and the four low BE/ME portfolios. It captures the different behaviour of high and low value stocks and is free from size effects.

$$HML = \{(Small/High + A/High + C/High + Big/High)\}/4 - \{(Small/Low + A/Low + C/Low + Big/Low)\}/4$$

Testing

(1) Model Specifications : A time series is used to test the asset pricing models. Data is taken from October 2009 to September 2015 (72 observations) and standard multivariate regression technique is used to estimate the following equations:

$$R_{it} - R_{ft} = a_i + \beta_{im}[R_{mt} - R_{ft}] + e_{it}$$
(Testing CAPM - equation 1)

$$R_{it} - R_{ft} = a_i + \beta_{im}[R_{mt} - R_{ft}] + \beta_{is}[SMB_t] + \beta_{ih}[HML_t] + e_{it}$$
(Testing Fama-French Model - equation 2)

where,

R_{it} : Return of portfolio 'i' at time 't',
R_{ft} : Risk free rate of return at time 't',
R_{mt} : Return on market portfolio at time 't',
SMB_t : *Small* minus *Big* at time 't',
HML_t : *High* minus *Low* at time 't',
a_i : Abnormal mean return of portfolio 'i',
β_{im} : Exposure to market factor for portfolio 'i',
β_{is} : Exposure to size factor for portfolio 'i',
β_{ih} : Exposure to value factor for portfolio 'i'.

The intercept represents the difference in the expected return of portfolio estimated from its time series average with the expected return predicted by the Fama - French model. Therefore, it can be interpreted as a measure of abnormal performance or pricing error of portfolio. If the model correctly describes the expected returns, the intercepts of all portfolios will be zero. Also, note that the explanatory variables have only time subscripts and no portfolio subscript. This implies that for a given time, the value of, say, *SMB* will be the same for all of the portfolios. A similar statement can be made about the value of *HML*. Different variants of Fama-French model can be estimated by forcing some of the coefficients to be zero.

Since we have constructed 16 portfolios, testing CAPM (Fama-French) will involve estimating equation I (equation II) 16 times, each time for a different portfolio.

(2) Testing the Cross Sectional Restriction on Mean Return : In order to find out whether the risk factors incorporated in a model truly capture cross section of mean returns, I need to examine the zero intercept hypothesis, that is, testing the restriction of setting the intercept equal to zero. The intercept being zero is equivalent to establishing that there are no pricing errors for the particular portfolio. There are two ways in which this can be done.

(i) Using *t*-test : This approach entails checking the significance of the intercept term using the *t*- test. More specifically, in the case of this study, if I wish to do this test for the Fama-French model, then I will have to test the significance of the intercept for each of the 16 regressions done using equation (2). If intercepts are different from zero, then the model does not capture cross-section of expected stock returns. However, *t*-statistic does not tell us about the model as a whole. Therefore, I need to conduct a test which jointly tests intercepts equal to zero. This is the GRS *F*-test.

(ii) Using GRS *F*-test : Since the use of the individual portfolio intercept and associated *t*-tests are not enough to make statistical inference, the GRS *F*-test, which was introduced by Gibbons, Ross, and Shanken (1989) is used to make appropriate statistical inferences (Bahl, 2006). It is described as :

$$\left(\frac{T}{N}\right)\left(\frac{T-N-L}{T-L-1}\right)\left[\frac{\hat{\alpha}'\hat{\Sigma}^{-1}\hat{\alpha}}{1+\bar{\mu}'\hat{\Omega}^{-1}\bar{\mu}'}\right] \sim F\,(N,\, T - N - L)$$

where,

T = Number of observations (72 in the present study),
N = Number of portfolios (16 in the present study),
L = Number of factors (3 in the present study),
$\hat{\alpha}$ = $N \times 1$ vector of estimated intercepts,
$\hat{\Sigma}$ = unbiased estimate of the residual covariance matrix,
$\bar{\mu}'$ = $L \times 1$ vector of the factor portfolios' sample means,
$\hat{\Omega}$ = unbiased estimate of the factor portfolios' covariance matrix.

The larger alphas are in absolute value, the larger is the GRS test statistic and one would tend to reject the null hypothesis that all alphas equal zero. This implies that the factors of the regression model do not explain return variations for the portfolios.

Analysis and Results

(1) Summary Statistics : A comparison on the basis of size indicates that the average returns decrease as I move from small to big size portfolios, as seen in the Table 1. However, this holds true only for the low valued portfolios. For the high value based portfolios, the results are counterintuitive and do not confine with the conjecture of declining average returns as size increases. The average returns fall from the range of 2.98% to 3.29% for small sized portfolios to about 1.59% to 0.33% for high sized portfolios.

With respect to the value effect, there is a clear increase in the average returns both for small sized portfolios as I go from low to high value stocks. However, for the other three sized portfolios, there is a decrease in the average returns. For these portfolios, the results are contrary to the findings of the Fama and French (1992), who found a significantly positive relationship between returns and value as defined by book to market equity for U.S. stocks.

As seen in the Table 2, the correlation coefficient between *SMB* and *HML* is -0.1252. Such a low correlation

Table 1 . Mean Returns for 16 Portfolios

		Value			
		Low	***X***	***Y***	***High***
	Small	2.98	3.72	3.38	3.29
Size	***A***	1.24	2.02	1.29	0.83
	C	1.90	1.24	0.41	-0.04
	Big	1.59	0.74	-0.07	0.33

Table 2. Coefficient of Correlation

Variable	R_m - R_f	*SMB*	*HML*
R_m - R_f	1		
SMB	0.0213	1	
HML	0.5936	-0.1252	1

Table 3. Fama - French Model Results

Regressions: $R_{it} - R_{ft} = a_i + \beta_{im} [R_{mt} - R_{ft}] + \beta_{is} [SMB_t] + \beta_{ih} [HML_t] + e_{it}$

	Book-to-Market Equity (BE/ME) Quartiles							
	Low	***X***	***Y***	***High***	***Low***	***X***	***Y***	***High***
Size		a_i				$t(a_i)$		
Small	1.30	1.14	0.73	-0.24	**1.11**	**1.65**	**1.04**	**-0.57**
A	-1.06	0.13	-0.18	0.57	**-1.67**	**0.20**	**-0.31**	**0.93**
C	0.48	-0.80	0.05	-1.17	**0.81**	**-1.32**	**0.09**	**-1.62**
Big	0.10	1.38	-0.22	1.66	**0.34**	2.95	**-0.33**	**1.90**
		β_{im}				$t(\beta_{im})$		
Small	1.19	0.99	1.06	0.90	8.67	12.07	12.84	17.90
A	0.93	0.97	1.02	1.11	12.30	12.98	14.48	15.46
C	1.00	0.89	1.11	0.90	14.15	12.51	15.89	10.53
Big	0.91	1.13	0.98	1.12	25.52	20.35	12.37	10.84
		β_{is}				$t(\beta_{is})$		
Small	0.92	0.78	1.03	1.03	6.25	8.96	11.70	19.15
A	0.45	0.45	0.46	0.43	5.65	5.62	6.12	5.63
C	0.22	0.30	0.32	0.24	2.96	3.95	4.33	2.67
Big	0.00	-0.09	-0.04	-0.11	**0.06**	**-1.51**	**-0.53**	**-0.98**
		β_{ih}				$t(\beta_{ih})$		
Small	0.12	0.32	0.41	0.70	**0.84**	3.89	4.99	13.85
A	0.10	0.19	0.35	0.94	**1.35**	2.56	5.00	13.07
C	-0.17	0.22	0.48	1.08	-2.45	3.12	6.85	12.67
Big	-0.28	0.18	0.59	1.05	-7.93	3.23	7.48	10.23

Note : The *t*-values in bold represent the ones which are insignificant (between -1.96 and 1.96).

implies that *SMB* provides a measure of size premium which is relatively irrespective of BE/ME effects and vice versa.

(2) Fama-French Model Results : From the Table 3, it can be seen that the excess market return factor (*Rm - Rf*) explains the returns across all the 16 portfolios. All the 16 exposure factors (b) are obtained to be positive and significant at the 95% level of significance, indicating the prime role that the market factor plays in explaining variation in stock market returns.

In case of the size effect, the size exposure comes out to be significant in case of 12 out of 16 portfolios. Four portfolios formed by the intersection of the Big sized portfolios generate insignificant exposure factors. The coefficients decrease as we move from the small to big sized portfolios, keeping the value constant across the value-based portfolios, clearly confirming the existence of the size effect.

In terms of the value effect, the exposure of the value effect comes out to be significant in 14 out of the 16 portfolios. The two portfolios that generate insignificant coefficients are the *A/Low* and the *Small/Low* portfolios. Across all the size-based portfolios, the exposure increases as we move from the low valued to high valued portfolios, again substantiating the existence of the value effect.

The analysis reveals that the excess market factor has 16 significant exposures, the *SMB* factor has 12 significant exposures, and the *HML* factor has 14 significant exposures, clearly attributing the maximum explanatory power to the excess market factor in explaining the stock return variation. Amongst the size and the value factors, an unambiguous supremacy of any of the factors cannot be inferred. Also, it can be seen that Fama-French is explained best in case of 12 portfolios. The Big portfolios and High valued portfolios have adjusted R^2 of more than 90%, as shown in the Table 4.

Table 4. Overall Fit for Fama - French Model

	Adjusted R^2			
	Low	***X***	***Y***	***High***
Small	0.71	0.85	0.88	0.96
A	0.81	0.84	0.88	0.94
C	0.79	0.83	0.91	0.90
Big	0.91	0.92	0.88	0.89

(3) CAPM Results : It can be seen that the significance of the risk factor, β, in case of CAPM is higher than the Fama French model as is evident from the Table 5. If I undertake the analysis using the excess market factor, the CAPM regression alone generates an average adjusted R^2 , which is low as compared to the three factor regression adjusted R^2, as shown in the Table 6.

Comparing between the CAPM and the Fama-French reveals the superiority of the latter in explaining stock market returns for the Indian stock market if we use the adjusted R^2 as the criterion. Hence, on the basis of these results, it can be inferred that the excess market factor, if modelled along with other risk factors associated with size and value of stocks, better explains the Indian stock market volatility in terms of returns compared to the same being modelled alone as in CAPM.

(4) Testing the Cross Sectional Restriction on Mean Return

(i) *t*-test : The intercepts in Fama-French model are insignificant. Also, the magnitude of intercepts is higher in CAPM for each portfolio than in the Fama-French model. This implies that there is something unexplained in CAPM which is captured by the intercept term. However, individual *t*-test does not give us a conclusive evidence of whether Fama-French better explains expected returns or CAPM. Hence, I move to the GRS *F*-test.

Table 5. CAPM Results

Regressions: $R_{it} - R_{ft} = a_i + \beta_{im} [R_{mt} - R_{ft}] + e_{it}$								
Book-to-Market Equity (BE/ME) Quartiles								
	Low	*X*	*Y*	*High*	*Low*	*X*	*Y*	*High*
Size		a_i				$t(a_i)$		
Small	4.25	4.40	5.01	4.98	3.62	5.25	5.01	5.11
A	0.55	2.03	2.28	4.93	**0.88**	3.25	3.57	5.25
C	0.53	0.79	2.56	3.14	**0.98**	**1.42**	3.97	2.95
Big	-0.85	1.74	1.65	4.89	-2.48	4.16	2.23	4.28
		β_{im}				$t(\beta_{im})$		
Small	1.28	1.19	1.33	1.34	9.39	12.28	11.47	11.84
A	0.99	1.09	1.24	1.68	13.83	15.13	16.69	15.46
C	0.90	1.03	1.40	1.55	14.39	15.97	18.78	12.57
Big	0.74	1.24	1.34	1.75	18.87	25.62	15.63	13.21

Note : The *t*-values in bold represent the ones which are insignificant (between -1.96 and 1.96).

Table 6. Overall Fit for CAPM

Adjusted R^2				
	Low	*X*	*Y*	*High*
Small	0.55	0.68	0.65	0.66
A	0.73	0.76	0.80	0.77
C	0.74	0.78	0.83	0.69
Big	0.83	0.90	0.77	0.71

(ii) GRS *F*-test : The above results in Table 7 reject the null hypothesis of alphas (intercept terms) equalling to zero, jointly for all 16 portfolios for CAPM. However, in case of Fama French model, the test does not reject the null, indicating jointly that the intercepts are zero. This implies that CAPM does not explain cross-section of average stock returns, while the Fama-French model does.

Table 7. GRS *F* - Test Results

GRS *F* - test Results		
16 portfolios	**GRS statistic**	***p* - value**
CAPM (1-factor)	4.0206	0.00004
Fama - French (3-factor)	1.5840	0.1031

Conclusion

In this study, I tested the capital asset pricing model and the three factor model of Fama and French on the Indian stock market, on a sample of 396 stocks over a period of 72 months. The conclusions drawn are in line with the research objectives of this study based on the regressions on each asset-pricing model. I have successfully checked for the efficiency of the Fama and French three-factor model in India, over and above the one factor CAPM. Both the size exposure as well as value exposure are found to be significant for as many as 13 out of 16 portfolios. Using the adjusted R^2 for testing the explanatory power of the three factor model, I see that it has increased considerably for all 16 portfolios as compared to the one factor (CAPM) model. The GRS *F*-test for testing intercepts jointly equal to zero rejects the null hypothesis for CAPM but not for Fama-French. Hence, the findings are generally supportive of the Fama-French model applied to Indian equities.

Research Implications, Limitations of the Study, and Scope for Further Research

This paper examines the central findings of Fama and French (1992) on the Indian equity market. The results found using the three factor model provide a good description of the cross-section of average returns and can be used in applications like portfolio selection, portfolio performance evaluation, measuring abnormal returns in event studies, and cost of capital estimation (Fama & French, 1993). However, in the process of achieving this specific empirical research objective, there are several new issues such as extending the study to other indexes of stock return, forming portfolios for larger number of companies sorted on characteristics other than size or value, checking for seasonality effects in portfolio returns, and studying the model's results on different industry categories, which should be given due attention.

In addition, the three factor model can be further extended into a four-factor model suggested by Carhart, which includes an additional factor sorted on momentum. Owing to the limited scope of the study and time constraints, the analysis was restricted only to the level presented above. India is a very large emerging market with a growing and fast maturing equity market. Hence, a better understanding of the risk and return characteristics of this market is an important research problem.

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