

Fama-French Three Factor Model in Indian Stock Market

Abstract:

The quantification of the tradeoff between risk and expected return is one of the important problems of modern financial economics. The Capital Asset Pricing Model (CAPM) developed by Sharpe (1964) and Lintner (1965) suggests that the only relevant risk measure for investments is the beta coefficient and a positive trade-off between beta and expected return should exist. Though there is no consensus in the literature as to which model should be used to estimate stock returns in the emerging markets. Various factor models have been proposed to overcome the shortcomings of the CAPM. Fama and French (1992) had provided most influential work in the field of Financial Economics. A few studies including Connor and Sehgal (2001), Bahl (2006), Taneja (2010), Mehta and Chander (2010) and Tripathi (2008) have used or tested the Fama French model or its variants in the Indian markets with relatively small number of firms over relatively short periods of time. This paper studies whether Fama French Three Factor model (i.e. Beta, size and value) can be applied to stocks of the National Stock Exchange using daily Stock (closing) data with NIFTY as the benchmark Index. Daily data allow us to reliably evaluate a stock's performance over shorter time horizons. This is important for two reasons: performance persistence is often a short-lived phenomenon and a stock's risk exposures can change over time. The results suggest that Fama and French three factor model captures the returns of 23 out of 49 stocks considered in this study. The result also suggests that there has to be some other factors besides those mentioned in the Fama French Three Factor Model that would explain return variation among various Industries.

Keywords: Fama-French Three Factor Model, Capital Asset Pricing Model, NIFTY, Risk-Return trade - off.

Introduction

The quantification of the trade-off between risk and expected return is one of the important problems of modern financial economics. The risk-return relationship is very important to investors and portfolio managers, as their main task is to estimate the investment risk (Tang and Shum, 2003). The Capital Asset Pricing Model (CAPM) developed by Sharpe (1964) and Lintner (1965) suggests that the only relevant risk measure for investments is the beta coefficient and a positive trade-off between beta and expected return should exist. They built on Markowitz's (1952) work to develop economy-wide implications of the model (Campbell, Lo, MacKinlay, 1997).

More recently, Fama and French (1993, 1996, 1998) have shown that the return premia associated with size and book-to-market are compensation for risk, as described in the Arbitrage Pricing Theory or in the Intertemporal Capital Asset Pricing Model (ICAPM) of Merton (1973) (Daniel, Titman and Wei, 2001). They introduce in their model two additional non-market risk factors such as the SMB (the return on a portfolio of small stocks less the return on a portfolio of large stocks) and the HML (the return on a portfolio of high book-to-market value stocks less the return on a portfolio of low book-to-market value stocks).

Fama and French (1996) show that their model captures the returns to portfolios formed according to value strategies. This value strategies call for buying stocks that have low prices relative to earnings, dividends, book assets or other measures of value (Lakonishok et al.). The reason for which value strategies appear to be profitable remains controversial. One explanation is that value stocks may deliver higher returns because investors assume that stocks that have had low growth in the past will continue to have low earnings growth into the future, depressing their price. Another interpretation refers to that value stocks deliver higher returns because they are fundamentally riskier (Gregory et al., 2001).

Literature Review

Fama and French (1993) argued that simple CAPM model is inadequate to explain the cross sectional stock market returns due to market anomaly and proposed the three factor model incorporating two new variables i.e. size and value in addition to market factor.

Conner and Seghal (2001) empirically examined the applicability of Fama and French three factor model in Indian stock market and concluded that pervasive market, size and book to market factors are capturing the cross sectional mean return of the stock.

Rogers and Securato (2007) conducted tests on portfolios, in accordance with the Fama and French (1993) and Bornholt (2007) methodology, and applied in two sub-samples of stocks with available data in the São Paulo Stock Exchange (BOVESPA). They concluded that the results tend to support the Fama and French Three-Factor model to explain future returns.

Bartholdy and Peare (2002) compared the performance using CAPM and Fama French Three Factor Model for individual stocks. First, they estimated individual stock returns based on CAPM using different time frames, data frequencies, and indexes. Then, they obtained individual stock returns based on the Fama and French model using five years of monthly data.

Rahim & Mohd. (2006) compared Fama & French model & liquidity- based Three-Factor models using common stocks of 230 to 480 listed firms & constructed 27 double sorted test portfolios. The forecast errors are measured using mean absolute percentage errors and Theil's Inequality Coefficient. The preliminary results clearly document that three-factor models outperform CAPM. While the hypotheses of no significant differences cannot be rejected, the marginal difference in the errors of the competing three-factor models indicate that predicting returns on stocks traded on Bursa Malaysia can be slightly improved by incorporating illiquidity risk in a three-factor model in the form of DiLiq.

Bahl (2006) studied the Fama and French three-factor model of stock returns along with its variants, including the one-factor Capital Asset Pricing Model for 79 stocks listed on the BSE-100 stock market index for India and found that factor portfolios that explain the returns are the market factor, size factor (SMB) and value factor (HML). The study concluded that the Fama and French fares better in explaining the cross-section of returns in the portfolios than its variants and the CAPM.

Tripathi (2008) examined the relationship between four company fundamental variables (viz. market capitalization, book equity to market equity ratio, price earnings ratio and debt equity ratio) and equity returns in Indian stock market using monthly price data of a sample of 455 companies forming part of S&P CNX 500 Index over the period June 1997 to June 2007. The

results concluded that the Fama-French three factor model (based on market risk premium, size premium and value premium) explains cross sectional variations in equity returns in India in a much better way than the single factor CAPM.

Manjunatha & Mallikarjunappa (2009) attempted to test the validity of the combination effect of the two parameter CAPM to determine the security /portfolio returns. Analysis in this paper has shown that beta, with some of the combinations of the independent variables (β and $\ln(BE/ME)$, β and $(R_m - R_f)$, $size$ and (E/P) and (E/P) and (BE/ME)), explains the variation in security/portfolio returns. However, beta alone, when considered individually in the two parameter regressions, does not explain the variation in security/ portfolio returns. This casts doubt on the validity of the standard form of CAPM.

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

Eraslan (2013) attempted to test the validity of the Fama and French three-factor asset pricing model on the Istanbul Stock Exchange (ISE). Monthly excess stock returns over the period from 2003 to 2010 are used in the analysis. The study concluded that Size factor has no effect on portfolios having big-size firms but can explain the excess return variations on portfolios having small and medium-sized firms. Book-to-market ratio factor has an effect on portfolios with high book-to-market ratio firms. Fama and French three-factor model has power on explaining variations on excess portfolio returns but this power is not strong throughout the test period on the ISE.

Agarwalla, Jacob & Varma (2013) analyzed four factor model i.e Fama French & momentum factor. The study computed the Fama-French and momentum factor returns for the Indian equity market for the October 1993 - December 2013 period. The main objective of this paper was to create a data base for online data library. It covers 6943 firms listed in BSE.

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

Nandakumar & Damodaran (2013) did empirical study on testing of three factor models in Indian stock market with respect to Indian oil & gas sector Industries. The results indicated evidence of applicability of three factor model for predicting returns of Indian oil & gas

industry stocks in Indian stock market. The study also implies apart from (systemic) market risks, value and size factor also affect the return of these stocks and hence the influence of size and value premium may also be leveraged by the fund managers and other investors for optimising the portfolio.

Objective:

Literature review suggest that very few studies have been done to empirically verify the applicability of Fama-French's three factor model in explaining the return of Individual stocks in Indian stock market. The objective of this study is to analyze the impact of three factors on Indian Stocks listed on the benchmark Index- NIFTY by using Fama French Three Factor Model. As also to understand return variability of the sectors to which these stocks belong.

Methodology:

To test the Fama-French three factor model standard multivariate regression of the following equation on excess security return from excess market return, SMB, & HML is carried out.

$$R_{it}-R_{ft}=\hat{\alpha}_i+\hat{\alpha}_i (R_{mt}-R_{ft}) +s_i (SMB_t) +h_i (HML_t) +e_i$$

Where

R_{it} = Rate of return on assest 'i' in time-'t'

R_{mt} = Rate of return on market portfolio in time-'t'

R_{ft} = Rate of risk free asset in time-'t'

SMB_t = Small minus Big is the difference on return of the small & big stocks in time-'t'

HML_t =High minus Low is the difference on the returns between High & Low Book to market value stocks in time-'t'

$\hat{\alpha}_i$ =Measure of abnormal return.

$\hat{\alpha}_i, s_i, h_i$ = The market, size and value factor exposure of portfolio/asset 'i'

The variable in the above regression equation is calculated as follows:

- R_f - Risk free return is calculated using return on GOI T-bill
- R_{it} (Return on Asset) = $(P_{it}- P_{it-1}/P_{it-1})*100$
 - P_{it} - Closing Price of asset 'i' at time't'
 - P_{it-1} Closing -Price of asset 'i' at time't-1'
- R_{mt} (Return on Market portfolio) = $(P_{mt}- P_{mt-1}/P_{mt-1})*100$
 - P_{mt} -Closing price Index of CNX-Nifty at time't'
 - P_{mt-1} -Closing Price Index of CNX-Nifty at Time't-1'
- To capture the size effect factor SMB, the firms are divided in to Small & Big by their Market capitalisation. The market capitalisation value of organisation

less than average of total market capitalisation is termed as the Small(S)one & others are classified as Big(B) one.

- The value effects is calculated from the B/M ratio of these organisations and are divided in to High (H), Medium (M) and Low (L) group based on their Book Value to Market value ratio. Then the group portfolio is formed by 30% of H, 40% of M and 30% of S.
- SMB (Small minus Big) is meant to mimic the risk factor in returns related to Size.SMB is the difference each day 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) $SMB_t = \text{Small} - \text{Big} = \text{Average returns of Small} - \text{Big} = 1/3(SH+SM+SL) - 1/3(BH+BM+BL)$.
- HML (High minus Low) is meant to mimic the risk factor in returns related to value (that is book-to-market ratios). HML is the difference each day between the simple average of the returns on two high BE/ME portfolios (S/H and B/H) and the average returns on two low BE/ME portfolios (S/L and B/L). $HML_t = \text{High} - \text{Low} = \text{Average returns of High BM ratio portfolio} - \text{Low BM ratio portfolio}$ i.e $HML_t = 1/2(SH+BH) - 1/2(SL+BL)$.

In this study the daily data of all of the stocks which are listed on NSE & part of Nifty are analyzed, except Coal India Ltd due to unavailability of information regarding closing prices for the sample period. The data used for calculations cover the period from June 2009 through June 2014. Though there are a number of Stock Exchanges in India, the data for this study has been taken from the National Stock Exchange, and Nifty has been considered as the Benchmark Index for the study.

To capture the size effect of the companies, market capitalisation of these companies and to capture the value effect, the ratio of book value to market value of these firms for the year 2014 was used.

Results & Analysis:

Regression Results:

Coefficients Of Determination ,Excess Market Returns, SMB & HML						
Sr.No.	Stock	R ²	á	β	SMB	HML
1	Cairn India Ltd.	0.13***	0.01	0.32***	0.21***	0.17***
2	GAIL(India)Ltd.	0.13***	0.02	0.40***	0.20***	0.07***
3	Grasim Industries Ltd.	0.15***	0.02	0.45***	0.14***	0.12***
4	Hero Motocorp ltd.	0.09***	0.04	0.36***	0.12***	0.12***
5	Hindalco Industries Ltd.	0.33***	0.06	0.79***	(0.13)***	0.54***
6	IDFC Ltd.	0.30***	0.01	0.80***	0.35***	0.32***
7	Jaiprakash Associates ltd.	0.88***	0.00	0.58***	1.23***	1.18***
8	Maruti Suzuki Ltd.	0.17***	0.05	0.57***	0.12***	0.11***
9	NMDC Ltd	0.12***	-0.08	0.44***	0.18***	0.20***
10	Power grid Corporation of India Ltd.	0.09***	-0.01	0.25***	(0.19)***	0.13***
11	Punjab National Bank.	0.23***	0.02	0.64***	0.19***	0.21***
12	Ranbaxy laboratories ltd.	0.05***	0.06	0.22***	(0.28)***	0.25***
13	Reliance Industries Ltd.	0.16***	-0.05	0.46***	(0.42)***	0.32***
14	Sesa Sterlite Ltd.	0.23***	0.06	0.48***	(0.70)***	0.54***
15	State bank of India	0.22***	0.02	0.49***	(0.39)***	0.35***
16	Tata motors Ltd.	0.1***	0.10	0.49***	(0.23)***	0.43***
17	Tata power co. ltd.	0.03***	-0.08	0.35***	(0.25)***	0.12**
18	Tata steel Ltd.	0.87***	0.04*	0.41***	(1.23)***	1.02***
19	Jindal Steel & Power Ltd.	0.10***	-0.07	0.57***	0.19**	0.29***
20	Larsen & Toubro Ltd.	0.23***	0.01	0.67***	0.09**	0.26***
21	Lupin Ltd.	0.04***	0.06	0.38***	0.27***	(0.11)**
22	Bank of Baroda	0.06***	0.04	0.37***	(0.26)***	0.05*
23	Bajaj Auto Ltd.	0.02***	0.09	0.44***	0.17*	(0.15)**
24	Bharat Heavy Electricals Limited	0.1***	-0.10	0.53***	(0.13)*	0.39***
25	Ultratech cement Ltd.	0.08***	0.08*	0.28***	(0.06)*	0.16**

Coefficients Of Determination , Excess Market Returns, SMB & HML						
Sr.No.	Stock	R ²	ái	β	SMB	HML
26	ACC	0.3***	0.01	0.78***	0.15***	0.01
27	Asian Paints Ltd.	0.04***	0.04	0.41***	0.26***	0.03
28	Itc Ltd.	0.09***	0.03	0.49***	0.14***	0
	Bharat Petroleum Corporation	0.05***	0.02	0.43***	0.12**	0.03
29	Dr. Reddy's Laboratories Ltd.	0.06***	0.08**	0.30***	0.06**	-0.03
30	Hindustan Unilever Ltd.	0.07***	0.05	0.34***	0.08**	0.01
31	Ambuja Cements Ltd.	0.01***	0.05	0.018***	0.08*	-0.01
32	DLF Ltd.	0.1***	-0.04	0.72***	0.03	0.13***
33	HCL Technologies Ltd.	0.11***	0.15***	0.52***	0.02	0.09***
34	ICICI Bank Ltd.	0.32***	0.04	0.88***	0.01	0.23***
35	Indusind Bank Ltd.	0.22***	0.15***	0.87***	0.01	0.18***
36	Kotak Mahindra Bank Ltd.	0.16***	0.01	0.74***	-0.03	0.15***
37	Mahindra & Mahindra Ltd.	0.15***	0.03	0.71***	0.08	0.09***
38	NTPC ltd.	0.13***	-0.04	0.38***	-0.04	0.15***
39	Infosys Ltd.	0.07***	0.03	0.38***	-0.04	0.05*
40	Wipro.	0.03***	0.01	0.26***	-0.08	0.06*
41	Bharti Airtel	0.05***	-0.07	0.47***	0.00	0.00
42	Cipla ltd.	0.07***	0.03	0.32***	0.04	0.02
43	HDFC Bank Ltd.	0.08***	-0.01	0.63***	-0.01	0.02
	Housing Development Finance Corporation Ltd.	0.08***	-0.03	0.7***	-0.09	0.05
44	ONGC	0.08***	-0.05	0.68***	-0.03	0.03
	Sun Pharmaceutical Industries Ltd.	0.02***	0.02	0.27***	0.00	0.07
45	Tata consultancy services Ltd.	0.03***	0.09	0.31***	0.00	0.00
46	Axis Bank Ltd.	0	0.07	0.1*	-0.09	-0.05
*** indicate statistically significant level of 1%						
** indicate statistically significant level of 5 %						
* indicate statistically significant level of 10 %						

The model is considered valid if all three factors must contribute substantially to the risk of the security. The results of regression are indicated in the table. The significance of F-test is 0 indicating well fit of the model. Except Axis Bank Ltd, the model fit is having varying R² value ranging from 0.01 to 0.88 which is significant at 1% level of significance indicating that the three factors can explain considerable part of the return. Except Tata steel Ltd, Ultratech cement Ltd, Dr. Reddy's Laboratories Ltd, HCL Technologies Ltd & Indusind Bank Ltd the intercept term is insignificant. If the intercept term is significantly indifferent from zero, than the three factors model is correct.

The result also shows that Excess market return, size & value effects are significant for 23 out of 49 stocks. These are: Cairn India Ltd , GAIL(India)Ltd, Grasim Industries Ltd, Hero MotoCorp ltd, Hindalco Industries Ltd, IDFC Ltd, Jaiprakash Associates ltd, Maruti Suzuki Ltd, NMDC Ltd, Power grid Corporation of India Ltd, Punjab National Bank, Ranbaxy laboratories ltd, Reliance Industries Ltd, Sesa Sterlite Ltd, State bank of India, Tata motors Ltd, Tata power co. ltd, Jindal Steel & Power Ltd, Larsen & Toubro Ltd, Lupin Ltd, Bank of Baroda, Bajaj Auto Ltd, Bharat Heavy Electricals Limited. Whereas for ACC, Asian Paints Ltd, ITC Ltd, Bharat Petroleum Corporation, Hindustan Unilever Ltd & Ambuja Cements Ltd only size effect is significant in addition to Excess market return effect. As far as DLF Ltd, ICICI Bank Ltd, Kotak Mahindra Bank Ltd, Mahindra & Mahindra Ltd, NTPC ltd, Infosys Ltd & Wipro are considered, only value effect is significant in addition to Excess market return effect. For Rest 7 firms, Excess market return factor can explain Excess security returns.

Though majority of stocks from Automobile, banking, cement & oil & gas industries' returns are influenced by these three factors, the results suggests that there has to be some other factors besides those mentioned in the Fama French Three Factor Model that would explain return variation among various Industrial Sectors.

Conclusion:

The present study empirically evaluates the applicability of Fama and French three factor model on Indian stock market in order to capture the effects of the three risk factors on individual securities. The results indicate that apart from market risks, value risks and size risks also affect the return of these stocks. Hence the influence of size and value premium may also be leveraged by the investors for optimizing investments. But one significant aspect of above results is that market risk is dominating the others indicating that in Indian Context, variation in Nifty index can be one of the most important factors in explaining security as well as industry returns.

References:

1. Bhavna Bahl, 2006, "Testing the Fama and French Three-Factor Model and Its Variants for the Indian Stock Returns".
2. Connor and Sehgal, 2001, "Tests of the Fama and French Model in India", Discussion paper-376, London School of Economics, ESRC.
3. Fama, E., and K. French, 1992, "The Cross-Section of Expected Stock Returns", *Journal of Finance*, 47, 427-465.
4. Fama, E., and K. French, 1993, "Common risk factors in the returns of stocks and bonds", *Journal of Financial Economics*, 33, 3-56.
5. Fama, E., and K. French, 1996, "Multifactor explanations of Asset Pricing Anomalies", *Journal of Finance*, 51, 55-84.
6. J. Bartholdy and P. Peare, 2004, "Estimation of expected return: CAPM vs Fama and French", Working Paper, No. 176.
7. Ruzita Abdul Rahim and Abu Hassan Shaari Mohd. Nor, 2006 , " A comparison between Fama & French Model & Liquidity Based Three Factor Models in predicting the portfolio returns", *AAMJAF*, Vol. 2, No. 2, 43-60.
8. Sahil Jain, 2013, "Fama-French Three Factor Model in Indian Stock Market" *The Current Global Trends*, Vol. 2, Issue. 1 ,7-13.
9. Sobhesh K. Agarwalla, Joshy Jacob & Jayanth R. Varma, 2013, "Four factor model in Indian equities market", Indian Institute of Management Studies, Ahmedabad, W.P. No. 2013-09-05.

10. Tang, G., and W. Shum, 2003, "The relationships between unsystematic risk, skewness and stock returns during up and down markets", *International Business Review*, 12, 523-541.
11. T Manjunatha and T Mallikarjunappa, 2009, "Bivariate Analysis of Capital Asset Pricing Model in Indian Capital Market", *Vikalpa*, vol.34, 47-59.
12. T. Nandakumar and Akhil Damodaran ,2013, "Evidence of Fama-French Three Factor Model in Indian Stock Market in Respect of Indian Oil and Gas Firms" ,*AKGEC International Journal of Technology*, Vol. 5, No. 1.
13. Vanita Tripathi, 2008, "Company Fundamentals & Equity Returns in India", SSRN 1134651.
14. Veysel Eraslan, 2013, "Fama & French Three Factor Model: Evidence from Istanbul Stock Exchange", *Business and Economics Research Journal*, Volume 4, ISSN: 1309-2448
15. W.F. Sharpe, 1964, "Capital Asset Prices: A theory of market equilibrium under conditions of risk", *J. of finance*, vol.19, pp.425-442.
16. Yash Pal Taneja, 2010, "Revisiting Fama French Three-Factor Model in Indian Stock Market", *Vision: The Journal of Business Perspective October 2010 14: 267-274.*

Internet Sources

- W1. www.moneycontrol.com
- W2. www.wikipedia.com
- W3. www.in.finance.yahoo.com
- W4. www.scholar.google.com

Appendix:

1. Portfolio construction:

SH	SM	SL
Jaiprakash Associates ltd.	GAIL(India)Ltd.	Hindustan Unilever Ltd.
	Cairn India Ltd.	Ranbaxy laboratories ltd.
	IDFC Ltd.	Sun Pharmaceutical Industries Ltd.
		Asian Paints Ltd.
		Itc Ltd.
		Tata consultancy services Ltd.
		Hero MotoCorp ltd.
		HCL Technologies Ltd.
		Tata motors Ltd.
		Lupin Ltd.
		Bajaj Auto Ltd.
		Dr. Reddy's Laboratories Ltd.
		Mahindra & Mahindra Ltd.
		Wipro.
		Infosys Ltd.
		Ultratech cement Ltd.
		Maruti Suzuki Ltd.
		Cipla ltd.
		Ambuja Cements Ltd.
		Grasim Industries Ltd.
		ACC
		DLF Ltd.
		NMDC Ltd
	Jindal Steel & Power Ltd.	
	Tata power co. ltd.	

BH	BM	BL
Tata steel Ltd.	BHEL	Kotak Mahindra Bank Ld.
	Reliance Industries Ltd.	Housing Development Finance Corporation Ltd.
	State bank of India	HDFC Bank Ltd.
	NTPC ltd.	Larsen & Toubro Ltd.
	Bank of Baroda	Indusind Bank Ltd.
	Punjab National Bank.	Sesa Sterlite Ltd.
	Hindalco Industries Ltd.	ONGC
		Axis Bank Ltd.
		ICICI Bank Ld.
		Bharti Airtel
		Bharat Petroleum Corporation
		Power grid Corporation of India Ltd.