Testing of Fama and French Factors in Indian Capital Market

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We tests whether Fama and French factors explain the portfolio returns as envisaged in Fama and French (1995). We use National Stock Exchange continuously traded stocks, Nifty Index and other relevant data from July 1996 to June 2010. We have formed portfolios based on size and value which are regressed over factors portfolios-market, size and value. The results show that portfolio returns are not explained by factors portfolios with the exception of big stocks portfolios are explained to some extent. Further results show that portfolio returns of small stocks are not explained by factor portfolios.

Keywords: Earnings, Earnings Growth, Portfolios, Factor Portfolios, Size, Value, Market.

1. Introduction

The security/portfolio returns are dependent on many factors. The Fama and French model (1992; 1993; 1995 and 1996) suggests that portfolio excess returns (R_p-R_f) are influenced by three factors: market excess returns (R_m-R_f), size factor (SMB) and value (HML) factor. Fama and French (1992) tested CAPM using stock returns data between 1941and 1990 from NYSE, AMEX and NASDAQ. They found the combination of size and book-to-market equity captures the cross-sectional variation in average stock returns associated with market beta. Fama and French (1993) identified a model with three common risk factors in the stock returns - an overall market factor, factors related to firm size (SMB) and those related to book-to-market equity (HML). They used a time-series regression approach of Black, Jensen, and Scholes (1972) whose results suggest that size and book-to-market factors were proxies for explaining the differences in average returns across stocks. Kothari and Shanken (1995) questioned the validity of the results of Fama and French (1992) and argued in defence of beta. Kothari *et al*., (1995) argued that the relation between book-to-market equity and returns was weaker and less consistent than that in Fama and French (1992). Fama and French (1995) studied whether the behaviour of stock prices, in relation to size and book- to-market equity (BE/ME), reflected the behaviour of earnings. They opined that the market and size factors in earnings help explain the market and size factors in returns. But they found no evidence for returns responding to the book-to-market factor in earnings. Fama and French (1996a) questioned the validity of the results of Kothari *et al.,* (1995) and argued against beta. They also showed that annual and monthly betas produced the same inferences about the beta premium. They argued that beta premium was more and could not save the CAPM; given the evidence that beta alone cannot explain expected return. Fama and French (1996 b) showed that average returns on common stocks were related to firm characteristics like size, earnings/price, cash flow/price, book to market equity, past sales growth, long term past return, and short term past return. Barber and Lyon (1997) documented that the results of Fama and French (1992) model were similar for financial and non-financial firms. Loughran (1997) found that Fama and French (1992) empirical findings were driven by two features of the data: a January seasonal in the book-to-market effect, and exceptionally low returns on small, young, growth stocks. Fama and French (1998) studied returns on market, value, and growth portfolios for U.S and twelve major countries from 1975 to 1995 and found that value stocks have higher returns than growth stocks in markets around the world. Davis *et al.,* (2000) found that there was a positive relationship between average returns and book-to-market equity and was as strong for 1929 to 1963 period, as for the subsequent period studied in previous papers. Beltratti and Tria (2002) studied multi-factor models with Italian stock market data for the period 1990–2000 and found the CAPM to be a relevant benchmark for its simplicity and the extended Fama and French (1992) model to be the best candidate for substituting the CAPM. Faff (2004) testing the Fama and French three-factor model, using daily data drawn from the Australian stock market, found the evidence quite favorable to the model based on formal asset pricing tests. However, when the estimated risk premiums were taken into account, the support for the Fama-French model was less persuasive. In particular, a negative size premium was uncovered questioning its continued existence over the years. Gaunt (2004) studied the Fama and French three factor model in the Australian market and found that the betas were less than one which was contrary to Fama and French who found them to be close to one. Nartea and Djajadikerta (2005) found a significant size effect and a weak BE/ME effect in the case of New Zealand. The French case examined by Ajili (2005) found evidence for the three factor model being of higher explanatory power than the CAPM. Bundoo (2007) studied the emerging African stock markets for evidence of size and value premium, and found that the three factor model holds for the stock exchange of Mauritius but cautioned that the results may be sample specific. Kapur (2007) found that neither of the factors SMB and HML showed a consistent superior ability to explain excess returns for all industries. Homsud *et al.,* (2009) for the stock market of Thailand found that when size and book factors were added into the CAPM it could explain portfolio returns better. There is not much prior study as to whether size and value premiums are present in the Indian emerging market, other than the work of Connor and Sehgal (2003). They found that in the three-factor model, the market factor ranks highest in explanatory power, while no clear ranking can be given to the size

(SMB) and value (HML) factor. They showed that the three-factor asset-pricing model provided a better description of cross-sectional security returns than the single factor CAPM in the Indian capital markets.

Bahl (2007) found that the three small size portfolios have higher average returns than the three large size portfolios confirming the inverse relation between the size and average return of the portfolios. With respect to value effect the study found that for both the size groups, the average returns increase from low to medium book-to-market ratio and then decrease from medium to high book-to-market ratio. This is contrary to the results of Fama and French (1992) who found a strong positive relation between average return and book to market equity for US stocks as well as Connor and Sehgal (2003) for Indian stocks who found this relation to be positive for small stocks and negative for big stocks. Bahl (2007) suggested for testing the model on portfolios based on different criteria.Taneja (2010) found average returns for both the size groups (Small and Big) decrease from low to medium and from medium to high value effects while the dispersion from mean increases for the same portfolios of size and value. The study rejected the inverse relationship hypothesis between size and average monthly returns of the portfolio as stated by Fama French (1992; 1993; 1996b, and 2000), Connor and Sehgal (2003), Ajili (2005), Bundoo (2007) and Bahl (2007). With regard to value factor, an inverse relationship with average monthly returns was found. The study revealed almost perfect positive correlation for size and value factors. It implied that either of the two factors could explain the portfolio returns. Mehta and Chander (2010) studied BSE-500 companies from Feb 1999 to December 2007 and using monthly stock returns found that the return behavior of the six size-value based portfolios could be more significantly explained by adding size and value factors to the market factor. They found this combination of factors could explain the portfolio returns better and in conformity with the Fama and French model. The literature review shows that the Fama and French three factors model offers better explanation of portfolio returns when portfolios are formed by intersection of size and value of stocks. Hence, there is a need to test if the portfolios formed on different criteria could be explained in a similar manner. Bahl (2007) has suggested for this approach, and hence an attempt is made in this study to test the model for portfolios formed on the basis of BE/ME ranking. The paper is organized in four parts. Part 1 is the introduction; part 2 presents objectives, hypotheses, data and methodology; part 3 analyses the results; part 4 presents the summary and conclusions. References are given after part 4 and the Tables are presented after the references.

2. Objectives, Hypothesis, Data and Methodology

2.1 We Have Set Following Objective

- Test the relationship between returns of portfolios based on book-to-market ratio and the returns of three factor portfolios.

2.2 Hypothesis*:* Based on the Available Evidence on Fama and French (1992; 1993; 1996) Model and Bahl (2007) the following Null hypothesis is formulated

- H_o: None of the book-to-market ratio based portfolio returns are explained by the returns of the three factor portfolios

The negation of the null hypothesis is the alternate hypotheses. In this study this hypothesis is tested in the Indian context.

2.3 Data and Sample

The study is based on National Stock Exchange of India traded stocks from July 1996 to June 2010.The number of stocks was 387 for the year 1996-97 and this number increased to 1108 for the year 2009-10 (Box 1). Brown & Warner (1985) suggest that the daily prices are better and it is felt that quarterly, monthly, weekly data do not provide a very meaningful relationship between risk and return and hence daily prices and indices are used in this study. The daily adjusted share prices and Nifty index data collected from the Capital Line are used for calculating daily stock and index returns. The data pertaining to T-91 bills collected from the Reserve Bank of India website was used for calculating daily risk-free returns.

Box 1: Year-Wise no. of NSE Traded Stocks Studied for the Period 1996-2010

Year	**1996-97**	**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**
No, of stocks	387	405	411	469	441	449	499
Year	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
No, of stocks	537	608	662	787	961	1035	1108

Daily returns for all the stocks, market and T-91 bills are calculated from July of year t to June of year t+1 for the study period. For each year, average daily returns of the stocks, market (Nifty index) and risk-free returns are calculated from these daily values. Nifty returns are used as market proxy. The portfolios are formed each year at the end of June. These portfolios are constructed on equal weight basis as suggested by Lakonishok, Shliefer and Vishny (1994) and the portfolio returns are found as an average of the returns of stocks in the portfolio.

Box2: Definition of Different Variables used in the Study

Variables	Definition
S/H, S/M, S/L, B/H, B/M, and B/L	Returns of portfolios formed from the intersection of the two sizes (small and big) and three BE/ME groups (high, medium and low)
S/H	*Returns of portfolio of small cap stocks with high BE/ME ratio*
S/M	Returns of portfolio of small cap stocks with medium BE/ME ratio
S/L	Returns of portfolio of small cap stocks with low BE/ME ratio
B/H	Returns of portfolio of big cap stocks with high BE/ME ratio, also called "value stocks"
B/M	Returns of portfolio of big cap stocks with medium BE/ME ratio
B/L	*Returns of portfolio of big cap stocks with low BE/ME ratio, also called "growth stocks"*
5.5,15.5……37.5	Portfolios of stocks having first top ten ranks, second ten…….. Last ten…ranks based on BE/ME ratio. Returns of these are tested over the returns of the three factor portfolios.
SMB	Referred to as size factor portfolio return found as SMB =(S/H+S/M+S/L)/3 – (B/H+B/M+B/L)/3
HML	Referred to as value factor portfolio return found as HML=(S/H+B/H)/2—(S/L+B/L)/2
R_m-R_f	Market factor: Market returns minus risk-free-return
R_p- R_t	*Portfolio –excess-return: Portfolio return minus risk-free-return*
a, b, s, h and ε	Intercept and slope coefficients of independent variables used in a regression.

Note: *Each year the stocks are split into two size groups- small (S) and big (B) - based on market capitalization at the end of June. Each group now is split into - low (L) consisting of the bottom 30%, medium (M) with middle 40% and high (H) with top 30% of the BE/ME sorted stocks. These return values are used for deriving factor portfolio returns. Also, each year the stocks are ranked based on BE/ME ratio and ten stocks portfolios are formed as explained in the box. The returns of these are regressed over the returns of factor portfolios*.

2.4 Methodology

2.4.1 Constructing the Size and Value Sorted Portfolios

In each year of the sample period, the stocks are split into two groups- big (B) and small (S) - based on whether their market capitalization at the end of June of every year in the sample period is above or below the median for the stocks of the companies included. The financial year end for Indian companies being March, the book equity to market equity ratio (BE/ME) is calculated in this month for all the companies. The stocks are now split into three BE/ME groups- low (L) consisting of the bottom 30%, medium (M) with middle 40% and high (H) with top 30% of the value of BE/ME for the stocks in the sample. The next step is to construct six portfolios – S/L, S/M, S/H, B/L, B/M, and B/H – which are formed from the intersection of the two sizes and three BE/ME groups

S/H-a portfolio of Small cap stocks with High BE/ME ratio
S/M-a portfolio of Small cap stocks with Medium BE/ME ratio
S/L- a portfolio of Small cap stocks with Low BE/ME ratio
B/H-a portfolio of Big cap stocks with High BE/ME ratio
B/M-a portfolio of Big cap stocks with Medium BE/ME ratio
B/L-a portfolio of Big cap stocks with Low BE/ME ratio

Daily returns series for all the portfolios are calculated from July of year t to June of year t+1. The process of dividing stocks into portfolios is carried out every year in June. By this time of the year, the accounting information to calculate BE/ME for the previous year is publicly available by the annual reports published at the end of the financial year. Fama and French [48] documented that the three-factor model does a better job in terms of both the magnitudes of the intercepts and the GRS tests when equal weighted portfolios are constructed like the ones by Lakonishok, Shleifer and Vishny (1994). The annual average daily return of each portfolio is obtained as an average of returns of securities in that portfolio.

2.4.2 Constructing the Factor Portfolios

The Fama and French model uses three explanatory variables for explaining the cross section of stock returns. The first is the market-excess-return factor that is the market index return minus the risk-free return. This is calculated from the Nifty index which is a weighted average of popular securities reflecting market movements at the national level and Treasury bill yields.

R_m-R_f= NIFTY return-minus-T-91 bills return

The second is the size factor-a risk factor in returns relating to size – small minus big (SMB). The simple average of the three big size portfolios (B/L, B/M, B/H) is subtracted from the simple average of the three small size portfolios (S/L, S/M, S/H) to get the return for the SMB factor. This factor is free from BE/ME effects as it has about the same weighted-average BE/ME.

SMB =(S/L+S/M+S/H)/3 – (B/L+B/M+B/H)/3 (1)

The third factor is value factor, related to value - high minus low (HML). Each year, the difference between the average of the returns on the two high BE/ME portfolios (S/H and B/H) and the two low BE/ME portfolios (S/L and B/L) is calculated. It is free of size effects.

HML=(S/H+B/H)/2—(S/L+B/L)/2 (2)

Since market factor R_m-R_f, size factor SMB and value factor HML are hypothesised to influence the portfolio excess returns as predicted by the Fama and French [44, 45 and 48] model, multiple regressions of portfolio excess returns over the three factors are carried for testing the same. All these variables and their definitions are provided in Box2.

2.4.3 Constructing ten Stocks Portfolios based on BE/ME Ranking

The stocks are sorted each year on book to market ratio (BE/ME) and given rank number 1, 2.....n from highest to lowest. First ten stocks followed by second ten and so on, form portfolios. The average rank of the first portfolio is 5.5, second portfolio 15.5 and so on. The daily returns for the portfolios are found for all the years of the study and their portfolio excess returns of these are regressed over the daily returns of market factor (R_m - R_f), size factor (SMB) and value factor (HML). This is done to see if the Fama and French multi factor model holds well when the portfolios are formed on BE/ME criteria.

2.4.4 Multiple Regression over Market Factor (R_m-R_f), size Factor SMB and Value Factor HML for Excess Returns of Portfolios Consisting of First Top Ten, Second Top Ten…etc Based on BE/ME Ratio

$$R_p - R_f = a + b(R_m - R_f) + s(SMB) + h(HML) + \varepsilon \quad (3)$$

The values of a, b, s and h; their t values; the adjusted R^2 value; F value and p values are studied to see if the factors together capture the cross-sectional variation in portfolio-excess-returns. The purpose is to see if the returns of portfolios formed on BE/ME ratio criteria alone are explained by the three factors of Fama and French.

3. Results and Analysis

Referring to the Table 1 given at the end, a summary of observations is given below

High and medium BE/ME portfolios	Explained by all 3 factors
Low BE/ME portfolios	Explained largely by market factor

Table 1 *Regression of BE/ME-Rank-Based- Ten-Stocks Portfolio Excess Returns Over Market (Mkt.), Size (SMB) and Value (HML) Factors*

BE/ME rank Portfolio	Regrn. output	Intercept	Mkt.	SMB	HML	Adj R^2	F/ Sign F
		A	B	s	h		
5.5 (High BE/ME)	Coeffts.	0.0002	1.3823	1.6007	1.6724	0.6867	10.4985
	t values	0.0045	2.9526	3.2610	4.6165		0.0020
15.5	Coeffts.	-0.0055	1.3306	2.0160	1.1365	0.6935	10.8028
	t values	-0.1162	3.0220	4.3671	3.3358		0.0018
25.5	Coeffts.	-0.0477	1.2723	1.6060	1.0520	0.7013	11.1719
	t values	-1.2004	3.4159	4.1129	3.6505		0.0016
35.5	Coeffts.	-0.0143	1.2883	1.3137	0.9274	0.7482	13.8759
	t values	-0.4519	4.3360	4.2171	4.0338		0.0007
45.5	Coeffts.	-0.0030	1.2449	1.2715	0.5551	0.5325	5.9359
	t values	-0.0675	2.9684	2.8919	1.7108		0.0136
55.5	Coeffts.	0.0117	1.1530	1.2163	0.6523	0.5036	5.3961
	t values	0.2628	2.7554	2.7725	2.0149		0.0181
65.5	Coeffts.	-0.0253	1.1883	1.3580	1.0383	0.6778	10.1152
	t values	-0.6695	3.3525	3.6541	3.7857		0.0023
75.5	Coeffts.	-0.0548	1.5036	1.0627	1.0297	0.8220	21.0169
	t values	-2.0914	6.1238	4.1283	5.4202		0.0001

85.5	Coeffts.	-0.0364	1.5334	1.0424	1.0336	0.6288	8.3402
	t values	-0.8694	3.9127	2.5370	3.4085		0.0045
95.5	Coeffts.	-0.0346	1.2920	1.5863	0.8286	0.6704	9.8148
	t values	-0.8528	3.3958	3.9769	2.8148		0.0025
105.5	Coeffts.	-0.0505	1.3891	1.2857	0.8653	0.6741	9.9625
	t values	-1.3356	3.9246	3.4646	3.1594		0.0024
115.5	Coeffts.	-0.0268	1.3517	1.1243	0.9103	0.5871	7.1613
	t values	-0.6330	3.4151	2.7094	2.9722		0.0075
125.5	Coeffts.	-0.0502	1.8079	1.2780	0.9574	0.6359	8.5685
	t values	-1.0611	4.0834	2.7533	2.7948		0.0041
135.5	Coeffts.	-0.0504	1.2754	1.4087	0.8130	0.7125	11.7396
	t values	-1.4525	3.9247	4.1344	3.2333		0.0013
145.5	Coeffts.	-0.0689	1.3432	1.1922	0.8491	0.5728	6.8098
	t values	-1.5808	3.2912	2.7863	2.6887		0.0088
155.5	Coeffts.	-0.0490	1.5934	1.2687	0.7055	0.6902	10.6554
	t values	-1.2743	4.4217	3.3580	2.5303		0.0019
165.5	Coeffts.	0.0044	0.6737	1.3187	0.6997	0.6323	8.4528
	t values	0.1335	2.1868	4.0825	2.9350		0.0043
175.5	Coeffts.	0.0044	0.8795	0.7367	0.5184	0.2358	2.3369
	t values	0.0927	1.9905	1.5902	1.5163		0.1353
185.5	Coeffts.	-0.0448	1.7523	1.2374	0.8345	0.5697	6.7364
	t values	-0.8737	3.6510	2.4590	2.2472		0.0092
195.5	Coeffts.	-0.0337	1.2691	1.1136	0.6193	0.6386	8.6564
	t values	-0.9501	3.8250	3.2013	2.4124		0.0039
205.5	Coeffts.	-0.0395	1.6016	0.9426	0.5888	0.5701	6.7466
	t values	-0.8918	3.8631	2.1685	1.8356		0.0091
215.5	Coeffts.	-0.0624	1.4680	0.8106	0.7962	0.4305	4.2754
	t values	-1.2194	3.0623	1.6128	2.1467		0.0348
225.5	Coeffts.	-0.0284	1.0670	0.5022	0.6789	0.2762	2.6535
	t values	-0.6012	2.4081	1.0810	1.9801		0.1058
235.5	Coeffts.	-0.0638	1.6996	0.9095	0.9168	0.7822	16.5637
	t values	-2.1329	6.0706	3.0984	4.2320		0.0003
245.5	Coeffts.	-0.0360	1.3865	0.7801	0.6866	0.4926	5.2066
	t values	-0.8268	3.3989	1.8241	2.1755		0.0201
255.5	Coeffts.	-0.0622	1.5605	0.8461	0.7111	0.6853	10.4350
	t values	-1.8200	4.8784	2.5228	2.8728		0.0020
265.5	Coeffts.	-0.0634	1.5965	1.4831	0.4978	0.5277	5.8410
	t values	-1.1395	3.0628	2.7139	1.2343		0.0143
275.5	Coeffts.	-0.0296	1.1086	0.8995	0.4830	0.3968	3.8512
	t values	-0.6602	2.6407	2.0436	1.4871		0.0455
285.5	Coeffts.	-0.0456	1.2058	1.4801	0.7073	0.5560	6.4275
	t values	-0.9824	2.7723	3.2457	2.1015		0.0106
295.5	Coeffts.	-0.0673	1.5823	1.0310	0.6126	0.6384	8.6517
	t values	-1.6970	4.2591	2.6468	2.1311		0.0039
305.5	Coeffts.	-0.0439	1.1018	1.3008	0.5006	0.6201	8.0717
	t values	-1.1970	3.2096	3.6143	1.8848		0.0050

315.5	Coeffts.	-0.0422	1.4383	0.7781	0.3841	0.5402	6.0918
	t values	-1.0172	3.7034	1.9108	1.2782		0.0126
325.5	Coeffts.	-0.0276	1.4089	0.8412	0.2271	0.6874	10.5292
	t values	-0.8488	4.6295	2.6365	0.9644		0.0019
335.5	Coeffts.	0.0098	1.6006	0.4165	0.0831	0.1975	2.0665
	t values	0.1251	2.1918	0.5440	0.1470		0.1685
345.5	Coeffts.	-0.0359	1.3263	0.6628	0.3466	0.5242	5.7733
	t values	-0.9269	3.6609	1.7451	1.2366		0.0148
355.5	Coeffts.	-0.0024	1.0956	0.4180	-0.1123	0.4350	4.3366
	t values	-0.0574	2.8161	1.0247	-0.3729		0.0335
365.5	Coeffts.	-0.0051	1.2658	0.6644	0.0477	0.4266	4.2236
	t values	-0.1079	2.8689	1.4363	0.1397		0.0359
375.5 Low BE/ME	Coeffts.	-0.0115	1.2273	0.8513	-0.0792	0.5191	5.6775
	t values	-0.2618	2.9715	1.9658	-0.2477		0.0156
Portfolios with t >2 .17		-	37	27	20		3 >0.05Fsig

Intercepts and coefficient estimates of market, size and value factors are significant if their corresponding t values are greater than the critical value of 2.17. Majority of the portfolios belonging to high value and medium value (i.e. between 5.5 and 235.5 ranked portfolios) are explained by all the three factors. This is also supported by higher adjusted R^2 values for these portfolios. But, the low BE/ME portfolios are explained by market factor alone. The low BE/ME stocks are likely to be among leading index stocks; they are likely to have high market price and low book value. Such leading stocks are predominantly explained by market factor and, other stocks could be explained by additional factors. But all the portfolios formed on the BE/ME criteria alone are not explained consistently by the three factors.

4. Summary and Conclusions

The portfolios of high and medium value (BE/ME) stocks are better explained by all the three Fama and French factors. The high and medium BE/ME stocks appear to be distressed due to poor earnings resulting in low stock prices. Hence, perhaps, their returns need to be compensated by size premium and value premium in addition to market-excess-returns. But the low BE/ME portfolios are explained by market factor alone. These portfolios could be among leading stocks whose prices are running high due to persistent positive earnings. These portfolios are better explained by market factor alone. Therefore Fama and French factors can be used selectively for explaining the portfolio returns. For low BE/ME stocks there is no need to derive size factor and value factor; market factor alone can explain the returns. But for high and medium BE/ME portfolios, size and value factors are required in addition to market factor. Such selective approach could save the efforts of fund managers and it could help in cost of capital calculations required for capital investment decisions.

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