TESTING THE VALIDITY OF FAMA-FRENCH THREE FACTOR MODEL ON INDIAN STOCK MARKET

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ABSTRACT

This paper studies the financial performance of Indian Stocks by implementing the Fama French Three Factor model to 30 stocks of the Bombay Stock Exchange using daily Stock (closing) data with SENSEX as the benchmark Index.

The main objective of this study is to test the ability of the Fama - French three factor model to explain the variation in stocks rate of return over the period from April 2005 to March 2015.

This thesis uses models to analyze data from BSE SENSEX (S&P Bombay Stock Exchange Sensitive Index), also-called the BSE 30 by taking daily closing prices of stocks which are listed on SENSEX, the study also investigates the existence of the size and value effects. The study found a strong size and strong positive value effects in testing. The study results indicated that the Fama & French three factor model provide better explanation to the variation in stocks rates of return than the CAPM. The study also suggests that besides the three factors suggested by the Fama and French, there must be factors that account for the Sector performance.

Keywords: Fama-French Three Factor Model, Capital Asset Pricing Model, SENSEX, Performance, Risk Return, Value effect, Size effect, beta.

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Introduction: Testing Fama French on SENSEX.

Study of Stocks through various financial models has always been a topic of interest to Analysts. The capital assets pricing model (CAPM) was developed by Sharpe (1964), linter (1965) and Mossin (1966). This model aims to answer the question on how we can price one security taking into consideration the risk and the return that this security poses, this principle was developed by Harry Markowitz (1952). A vast amount of researches has been conducted to test the validity of the CAPM in explaining the variation in rate of return. However, these studies provide no evidences to support this model (Ross (1976) and Chen *et al*. (1986). Motivated by the weakness and limitations of the CAPM, Fama & French (1992) motivated by Banz study (1981) provided an alternative way to predict stocks' returns, Fama & French (1992), used sample of non financial firm drawn from three major US financial market(NYSE,AMEX and NASDAQ), over the period from 1963 to 1990, FF tests the ability of the market beta coefficient, size, E/P, leverage and book to market equity ratio, to predict the cross-section rate of return, they found no relationship between market beta factor and stocks rate of return. Inspired by the results of their previous study, Fama & French (1993) developed what become known the Fama & French three factor model. This paper is organized as follows: Section 2 introduces the related literature. Section 3 discusses the data and methodology. Empirical results are presented in Section. 4. Section 5 Provides the Summary and Conclusions.

Literature Review

Many studies have been conducted to test the ability of the Fama & French three factor model to explain and predict the variation in the stocks rate of return, while other studies investigate if the Fama & French three factor model perform better than the traditional capital assets pricing model.

Pablo Rogers and José Roberto Securato (2007) conducted tests on portfolios, in accordance with the Fama and French's (1993) and Bornholt's (2007) methodology, and applied in two sub-samples of stocks with availabledata 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. Jan Bartholdy and Paula 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. Bhavna 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 The Current value factor (HML). The study concluded that the Fama and French fairs better in explaining the cross-section of returns in the portfolios than its variants and the CAPM. Yash Pal 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, can not be ignored in India but either of the two factors (size and value) might improve the model. Vanita 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. The objective of this study is to measure and analyze the performance of Indian Stocks listed on the benchmark Index- SENSEX by using Fama French Three Factor Model. Before starting to perform this study, a huge body of financial articles and books concerning the subject of Fama French Model have been studied. More details are discussed in the 'Methodology' part of the study. This work does an empirical investigation to the performance of Indian Stocks for the period between January 2012 to November 2014.

Data and Methods

This section gives an overview of the data used in this study. All calculations are based on the Monthly returns. The data used for calculations in this report Cover the period from January 2012 to November 2014. Though there are a number of Stock Exchanges in India, the data for this study has been taken from the Bombay Stock Exchange, and SENSEX has been considered as the Benchmark Index for the study. The S&P BSE SENSEX (S&P Bombay Stock Exchange Sensitive Index), also-called the BSE 30 or simply the SENSEX, is a free-float market capitalization- weighted stock market index of 30 well-established and financially sound companies listed on BSE Ltd. The 30 component companies which are some of the largest and most actively traded stocks are representative of various industrial sectors of the Indian economy. Published since 1 January 1986, the S&P BSE SENSEX isregarded as the pulse of the domestic stock markets in India. The base value of the S&P BSE SENSEX is taken as 100 on 1 April 1979, and its base year as 1978–79. On 25 July 2001 BSE launched DOLLEX-30, a dollar-linked version of S&P BSE SENSEX. As of 21 April 2011, the market capitalization of S&P BSE SENSEX was about 29,733 billion (US$511 billion) (47.68% of market capitalization of BSE), while its free-float market capitalization was 15,690 billion (US$270 billion). The BSE Sensex currently consists of the following 30 major Indian companies, as listed below:

	Name of comanies	**Industry**
1	Axis bank	Banking
2	hero moto corp	Auto mobile
3	sun pharma Ins ltd	Pharmaceutical
4	bajaj auto	Auto mobile
5	Cipla	Pharmaceutical
6	reliance ltd	Oil and gas
7	HDFC bank	Banking
8	ICICI bank	Banking
9	SBI	Banking
10	ITC	FMCG

11	coal India	Metals and Mining
12	Tata motors	Auto mobile
13	Maruti suzuki	Auto mobile
14	Dr reddy	Pharmaceutical
15	Tata steel	Steel
16	Bharti airtel	Telecom
17	Bhel	Electrical Equipment
18	GAIL	Oil and gas
19	HUL	FMCG
20	HDFC	Banking
21	Infosys	IT
22	Hindalco	Metals and Mining
23	L&T	Conglomerate
24	M&M	Auto mobile
25	NTPC	Power
26	ONGC	Oil and gas
27	Sesa sterl	Metals and Mining
28	TCS	IT
29	Tata power	Power
30	Wipro	IT

Table1: List of the company Industry wise

The historical data for these stocks and the Index has been taken from the website: www.moneycontrol.com .In asset pricing and portfolio management the Fama-French three factor model is a model designed by Eugene Fama and Kenneth French to describe stock returns The traditional asset pricing model, known formally as the Capital Asset Pricing Model (CAPM) uses only one variable, beta, to describe the returns of a portfolio or stock with the returns of the market as a whole. In contrast, the Fama–French model uses three variables. Fama and French started with the observation that two classes of stocks have tended to do better than the market as

a whole: (i) small caps and (ii) stocks with a high book-to-market ratio. They then added two factors to CAPM to reflect a portfolio's exposure to these two classes:

$$r = R + \beta\, K - R + \beta\, SMB + \beta\, HML + \alpha\, f$$

Here, r is the portfolio's expected rate of return, Rf is the risk-free return rate, and Rm is the return of the whole stock market. The "three factor" is analogous to the classical but not equal to it, since there are now two additional factors to do some of the work. SMB stands for "small (market capitalization) minus big" and HML for "high (book-to-market ratio) minus low". They measure the historic excess returns of small caps over big caps and of value stocks over growth stocks. These factors are calculated with combinations of portfolios composed by ranked stocks (BtM ranking, Cap ranking) and available historical market data. "Moreover, once SMB and HML are defined, the corresponding coefficients are determined by linear regressions and can take negative values as well positive values. The Fama-French three factor model explains over 90% of the diversified portfolios returns. The signs of the coefficients suggested that small cap and value portfolios have higher expected returns—and arguably higher expected risk—than those of large cap and growth portfolios."

In our study we will calculate the SMB and HML on Monthly basis for the companies listed in the SENSEX, and then we carry out a regression between the (Ri-Rf) and Rm-Rf, SMB and HML to obtain the corresponding coefficients. These results are discussed in more detail in the next section.

Empirical results

Calculating SMB

We begin our study by arranging the list of companies in the increasing order of their Assets. Through this we shall determine five companies that have least and most assets.

List of BSE SENSEX companies as of 30 Jul 2014	**total asset (A-Z)**	**List of BSE SENSEX companies as of 30 Jul 2014**	**book value per share Rs**	**Market capitalization in Rs(Cr)**	**B/M ratio**
Hindustan Unilever Ltd	3277.07	Hindustan Unilever Ltd	15.15	172439	0.009

Hero MotoCorp Ltd	5599.87	ITC Ltd	33.02	315355	0.010
Bajaj Auto Ltd	9665.76	Coal India Ltd	26.04	228591	0.011
Sun Pharmaceutical Industries Ltd	9816.89	Sun Pharmaceutical Industries Ltd	35.77	172572	0.021
Cipla Ltd	10968.98	Tata Motors Ltd	59.58	164411	0.036
Dr. Reddy's Laboratories Ltd	11993.5	Tata Consultancy Services Ltd	224.9	491712	0.046
Coal India Ltd	16445.24	Oil and Natural Gas Corporation Ltd	159.81	308811	0.052
Mahindra and Mahindra Ltd	20536.35	HDFC Bank Ltd	181.23	225190	0.080
Maruti Suzuki India Ltd	22663.1	Wipro Ltd	119.03	136291	0.087
Tata Power Company Ltd	23382.88	NTPC Ltd	104.08	111809	0.093
ITC Ltd	26313.16	Housing Development Finance Corporation Ltd	179.14	172865	0.104
Tata Motors Ltd	33692.18	Bharti Airtel Ltd	166.93	141308	0.118
Wipro Ltd	33866.2	Sesa Goa Ltd	113.59	66009	0.172
Bharat Heavy Electricals Ltd	35701.82	Reliance Industries Ltd	609.78	301528	0.202
GAIL (India) Ltd	36598.42	Bharat Heavy Electricals Ltd	135.02	61949	0.218
Infosys Ltd	42092	Tata Power Company Ltd	55.32	23530	0.235

Tata Consultancy Services Ltd	44141.57	Cipla Ltd	125.69	52136	0.241
Larsen & Toubro Ltd	45120.75	Larsen & Toubro Ltd	363.16	143541	0.253
Hindalco Industries Ltd	63099.4	ICICI Bank Ltd	633.92	204133	0.311
Sesa Goa Ltd	67447.13	Infosys Ltd	734.64	225531	0.326
Bharti Airtel Ltd	75250.7	Mahindra and Mahindra Ltd	272.63	78588	0.347
Tata Steel Ltd	87274.77	GAIL (India) Ltd	213.42	57615	0.370
Oil and Natural Gas Corporation Ltd	136725.01	10. Hero MotoCorp Ltd	280.43	63329	0.443
Housing Development Finance Corporation Ltd	140478.98	Bajaj Auto Ltd	332.04	74240	0.447
NTPC Ltd	148221.07	Hindalco Industries Ltd	177.92	31844	0.559
Reliance Industries Ltd	282572	State Bank of India	1584.34	235992	0.671
AXIS Bank	383244.89	Maruti Suzuki India Ltd	694.45	100329	0.692
HDFC Bank Ltd	491599.5	AXIS Bank	813.47	115587	0.704
ICICI Bank Ltd	594641.6	Dr. Reddy's Laboratories Ltd	548.41	57952	0.946
State Bank of India	1792234.6	Tata Steel Ltd	629.6	41985	1.500

Table 2. Total Assets of Companies and Book to Market Ratio of Companies

As shown in Table 2, the five companies with least assets are- Hindustan Unilever, Bajaj Auto, Hero Moto corp, Sun Pharmaceuticals and Cipla Ltd. Similarly, five companies that have the greatest assets are- Reliance Industries,Axis bank, HDFC Bank, ICICI Bank and State Bank of India. Next, we list the stock value (Closing) of these companies on monthly basis and calculate the SMB.

Calculating HML

Now, we calculate the Book to Market Ratio for these companies. First we list the Book value per share for these companies, which is easily available on the websites such as www.moneycontrol.com and then we find the corresponding Book to Market Ratio. From the above table we find that five companies with least Book to Market Ratio are Hindustan Unilever, ITC, Sun Pharmaceuticals, Tata Motors and Coal india. Similarly, five companies with the highest B/M ratio are State Bank of India, Maruti Suzuki, Axis bank, DR.Reddy ,Tata Steel. Then we list the monthly Stock- closing values, for the period january 2012 to Nov 2014, of these companies and calculate the HML.

Calculating Coefficients and Expected Rate of Return

After obtaining the SMB and HML, we obtain the coefficient corresponding to Rm-Rf, SMB and HML for individual stocks. We obtain these coefficients by regressing Ri-Rf with SMB, HML and Rm- Rf. The results are summarized in Table 3:

Summary Statistic and Conclusion

	Name	Industry	SMB	Rm-Rf	HML	FF-Expected rate of return=	Actual Return	Difference
1	sun pharma Ins ltd	Pharmaceutical	0.256883	1.149405	-0.69886	0.43	2.07	1.64
2	tcs	IT	0.372047	0.192449	-0.12921	0.17	1.34	1.17
3	Maruti suzuki	Auto mobile	0.280867	1.914836	0.683291	0.71	1.81	1.1
4	Dr reddy	Pharmaceutical	0.522357	0.32082	0.290513	0.24	1.13	0.9

5	axis bank	Banking	-0.74552	1.469859	0.06615	0.46	1.24	0.78
6	hul	FMCG	0.313789	0.818391	-0.12183	0.35	1.07	0.72
7	M&M	Auto mobile	-0.45812	0.936758	-0.52986	0.31	0.97	0.66
8	HDFC bank	Banking	-0.14206	1.051169	-0.03306	0.39	0.95	0.56
9	tata motors	Auto mobile	0.261269	1.813873	-0.20396	0.65	1.19	0.54
10	ITC	FMCG	-0.2562	0.718166	-0.679	0.25	0.79	0.53
11	ICICI bank	Banking	-0.57058	1.572951	-0.02945	0.5	0.95	0.44
12	HDFC	Banking	-0.04104	0.774722	-0.11177	0.31	0.67	0.36
13	cipla	Pharmaceutical	0.978382	0.953499	0.473285	0.48	0.82	0.34
14	l&T	Conglomerate	-0.20147	1.614092	0.290186	0.56	0.87	0.31
15	infosys	IT	0.497317	0.586447	0.131548	0.31	0.59	0.28
16	Wipro	IT	0.60813	0.355043	0.178038	0.25	0.42	0.16
17	SBI	Banking	-0.34423	1.201825	0.532842	0.43	0.56	0.13
18	bajaj auto	Auto mobile	0.592686	1.474105	0.436291	0.6	0.65	0.05
19	ONGC	Oil and gas	-0.33174	1.020646	-0.02209	0.36	0.38	0.02
20	reliance ltd	Oil and gas	-0.31696	0.669536	0.009061	0.26	0.22	-0.04
21	hindalco	Metals and Mining	0.241773	0.887267	0.846116	0.4	0.19	-0.2
22	Sesa sterl	Metals and Mining	0.278408	0.615023	0.914909	0.33	0.06	-0.3
23	GAIL	Oil and gas	0.733293	1.383359	0.603877	0.59	0.31	-0.3
24	coal india	Metals and Mining	-0.53789	1.173367	-0.36407	0.38	0.09	-0.3
25	tata steel	steel	0.324384	0.765862	1.359485	0.39	0.05	-0.3
26	bhel	Electrical Equipment	-0.64997	1.777969	-0.10484	0.56	0.13	-0.4
27	bharti airtel	Telecom	0.099878	1.317786	-0.07729	0.49	0.05	-0.4
28	Tata power	Power	-0.50225	1.434551	-0.30069	0.46	-0.07	-0.5
29	NTPC	Power	-0.26322	1.021219	-0.07409	0.36	-0.17	-0.5
30	hero moto corp	Auto mobile	0.738912	1.569939	0.456666	0.64	-0.43	-1.1

Table 3 Performance of Stocks

The Table 3 above summarizes the results. The Stocks in the above table have been sorted in the decreasing order of the difference between the Actual rate of return and the expected rate of return- as per the Fama –French Three Factor Model. 4th, 5th ,6th columns list the coefficients corresponding to the Rm-Rf, SMB and HML. These coefficients have been obtained by regressing Ri-Rf with Rm-Rf, SMB and HML. After obtaining these coefficients, we substitute them in Fama- French three factor model formulas to obtain the Expected Rate of Return. Additionally, using the historical values, we also calculate the Actual Rate of Return. Then, we list the difference between the two in the last column.

The above results show that 11 out of 30 stocks performed fairly well i.e. the difference between the expected and actual rate of interest is more than 50%. Stocks like: Sun pharma, TCS, Maruti Suzuki,DR.Reddy,hul,M&M,HDFC,tata motors,ITC,ICICI,HDFC.

Moreover, 10 out of 30 stocks performed as per the expectations i.e. the difference between the Actual and Expected Rate of return is in between 5% to 30%. These stocks are: Cipla, Larsen & Turbo, Wipro, SBI, Infosys, Wipro, SBI, Bajaj auto,ONGC, Reliance ltd.

On the other hand, 9 stocks performed terribly i.e. the difference between the expected and the actual rate of return was less than -10%. These stocks are: Hindalco,sesa,Gail,Coal india,Tata steel,bhel,Bahrti airtel,tata power,NTPC,NTPC,Hero moto corp .

Sector Wise Performance

Undoubtedly, Banking Sector, IT, Oil and Gas, pharma have performed the best. The performance of companies that belong to the Industries Conglomerate, Consumer Goods, Electrical n Equipments, , Metals and Mining and Pharmaceuticals has been quite as expected.

The result clearly suggests that there has to be some other factor besides those mentioned in the Fama French Three Factor Model that would explain the performance variation among various Industrial Sectors.

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