Modelling Stock Returns in India: Fama and French Revisited

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Abstract

Since reforms, Indian security market has gone through significant changes and as result the efficiency of many models developed earlier might have been affected. The same may be true with three factors CAPM. This study aims to test the validity of three factors CAPM model proposed by Fama and French (1993) in changed Indian context. For the study, assessment period is 1999-2013 and BSE-500 has been taken as proxy for market. Results show that in Indian market, no size effect and a weak value effect exists but size or value of stocks cannot discriminate stocks robustly. Beta is significant and none of the three factors alone can explain the variations in the expected return but two or three factors together can explain to some degree. The ability of three factors CAPM in explaining the expected return increases during low GDP growth period and falls during high GDP growth period.

Keywords: Fama and French Model, CAPM, Value Effect, Size Effect

Introduction

Ever since the publication of Fama and French (1993) version of Capital Asset Pricing Model, much discussion has occurred globally regarding the validity reliability and ability of factors identified by them in predicting asset prices. A number of researchers have worked on Fama and French's Three Factors Model in Indian context and have arrived at conflicting results and conclusions. Studies like Yalwar (1988), Srinivasan (1988) and Varma (1988) find CAPM to be a good descriptor of security returns but studies like Gupta & Sehgal (1993), Vaidyanathan (1995), Madhusoodanan (1997), Sehgal (1997), Rao (2004), Dhankar & Singh (2005), Manjunatha & Mallikarjunappa (2006), (Manjunatha, Mallikarjunappa, & Begum, 2006 & 2007) and Manjunatha & Mallikarjunappa (2009) have argued against the CAPM as the empirical evidence shows that standard CAPM fails to explain the security returns. While Ansari (2000) finds that it would be premature to discard CAPM as he does not find a robust conclusion. Mohanty (1998 & 2002), Sehgal (2003), Cannon & Sehgal (2003) have supported the 3 Factors Model over the standard CAPM. These conflicting results of various studies and support for 3 Factor model encourages to test the validity of the 3 Factor model using recent data in Indian context and for that we have used dara for the period of 1999 to 2013.

Literature Review

For an investor it is very important to understand the relationship between the risk and return before taking any investment decision. A number of studies have been carried out by various researchers across the world with the same goal. The first major breakthrough in this direction of the development of CAPM by Sharpe (1964), Lintner (1965), and Mossin (1968) through their independent explorations utilizing different data sets. CAPM created great excitement among the practicenors as well as academicians. Consequently a number of studies were carried out to examine the relevance and validity of the standard form of CAPM. While the early studies standard CAPM to be empirically sound and capable of explaining security return although certain studies pointed towards the restrictive nature of standard CAPM and highlighted the need to consider variables/factors other than the beta/market risk premium.

Ball (1978) found that earning to price ratio explained the expected returns from market better than the CAPM. Similarly Banz (1981) observed that the size of the market capitalization of stocks (size effect) was superior predictor of stock returns. Likewise, Chan (1991) discovered what is termed as value effect, that the low books to market value stocks outperform high value stocks. Fama and French (1993) proposed 3 Factors model of CAPM that included SMB and HML as factors. These factors along with the market factor (Rm – Rf) were able to explain the expected stocks returns. Although even after the 3 Factor Model was considered to be very important in this discourse study like Kothari, Shanken, and Sloan (1995) were supportive of standard CAPM over 3 Factor Model. Things changed with the changes in economic realities and 3 Factor Model also came under question and Guo and Whitelaw (2006) proposed Intertemporal Capital Asset Pricing Model (ICAPM) that identifies two separate components of expected returns namely risk component and the component due to desire to hedge change in investment opportunities. The coefficient of relative risk aversion was estimated to be positive and statistically significant with reasonable magnitude.

Indian experiences with CAPM have been same as have been globally. Many studies like Yalwar (1988), Srinivasan (1988) and Varma (1988) empirically supported standard CAPM but a number of studies like Gupta & Sehgal (1993), Vaidyanathan (1995), Madhusoodanan (1997), Sehgal (1997), Rao (2004), Dhankar & Singh (2005), Manjunatha & Mallikarjunappa (2006), Manjunatha, Mallikarjunappa, & Begum (2006 & 2007) and Manjunatha & Mallikarjunappa (2009) have argued against the validity of standard CAPM while Ansari (2000) finds no robust conclusion. Also Mohanty (1998 & 2002), Sehgal (2003), Cannon & Sehgal (2003) have been supportive of the Factors Model.

The Present Study

The present study tends to test the 3 Factors Capital Asset Pricing Model proposed by Fama and French (1993) in context of the Indian security market for the period of 1999 to 2013 using BSE-500 companies and BSE-500 has been used a market proxy.

Method

The study uses data for the period of 1st January 1999 to 31st December 2013 for the BSE-500 stocks. Monthly closing prices of 267 stocks were collected for assessment period. These 267 companies have been trading regularly during the assessment period. BSE-500 has been taken as proxy for the market and 91 days treasury bills as risk free rate.

Following the method of Fama and French (1993), three factors have been studied. The monthly returns of stocks and returns for two portfolios have been regressed on excess return to market index BSE-500 to figure out whether these factors can explain the undiversifiable variation in stock portfolios. 267 stocks are ranked on basis of size and divided in two groups as small (S) and big (B). These two groups are further divided on the basis of book to market value in three subgroups; 30% low (L), 40% medium (M) and 30% high (H) making six portfolios SL, SM, SH, BL, BM and BH. Negative book to market value stocks are excluded from the study. The two portfolios SMB and HML are used as proxy for size and value respectively. For size, it is difference of the average returns from small size stocks and big size stocks and for value it is difference of the average returns from high value stocks and low value stocks. The third factor is Rm-Rf that is the excess return on market proxy BSE-500. Three sub periods have also been studies on the basis of GDP growth rate. These three sub periods are categorized as 1999-2002, 2003-2008 and 2009-2013.

Data Analysis

Table I: Average Monthly Returns and Standard Deviations

Summary Statistics		
	Mean	Standard deviation
SL	-0.022	0.066
SM	-0.028	0.061
SH	-0.040	0.062
BL	0.015	0.120
BM	-0.019	0.071
BH	-0.039	0.049

Rm	0.024	0.031
Rm-Rf	0.018	0.032
SMB	-0.021	0.055
HML	-0.039	0.055
Small	-0.032	0.062
Big	-0.011	0.074
High	-0.036	0.055
Low	0.003	0.095

From the above table I, it is clear that the monthly mean returns from all the portfolios are negative besides portfolio BL and Low and are ranging between -0.04 to 0.015 or -4% to 1.5%. Also the monthly mean returns for the factors HML and SMB are negative during this assessment period. The standard deviations of these portfolios have been found to be raging between 0.049 to 0.12.

Table II: Correlations Matrix for Six Portfolios

	SL	SM	SH	BL	BM	BH
SL	1	0.921379	0.864742	0.890814	0.984488	0.930394
SM		1	0.854597	0.845546	0.918265	0.874815
SH			1	0.604682	0.84774	0.956184
BL				1	0.914361	0.737808
BM					1	0.925747
BH						1

From table II it is clear that the relationships between the six portfolios are strong as the value of R is ranging between 0.6046 to 0.9845.

Table III: Correlation Matrix for Factors

	Rm-Rf	SMB	HML
Rm-Rf	1	0.221517	0.057915
SMB		1	0.90178
HML			1

From the table III, it can be said that the relationship between two factors namely SMB and HML and Rm-Rf is week as the highest R value is 0.2215. But the relationship between the two factors is high as value of R is as high as 0.9018 indicating strong relationship.

Table IV: Correlation Matrix for Four Portfolios and Rm-Rf

	Small	Big	High	Low	Rm-Rf
Small	1	0.920304	0.983963	0.859117	0.552438
Big		1	0.942533	0.988348	0.376429
High			1	0.884507	0.564292
Low				1	0.301818
Rm-Rf					1

From table IV it is clear that the correlations between the four portfolios are very high ranging from 0.86 to 0.984 but the correlation between the portfolios and Rm-Rf is not very high.

Table V

THREE FACTOR FAMA FRENCH TYPE UNIVARIATE REGRESSIONS					
$R_t - R_{ft} = a + b(R_{mt} - R_{ft}) + sSMB_t + hHML_t + e_t$					
	Independent variable: Market return - Risk free rate				
Dependent variable	Constant %	t-value	Slope (beta)	t-value	Adj R sq
SL-RF	-0.047	-2.65	1.054	2.094	0.195
SM-RF	-0.047	-2.65	0.731	1.448	0.072
SH-RF	-0.068	-4.44	1.262	2.878	0.342
BL-RF	-0.007	-0.21	0.934	0.923	-0.010
BM-RF	-0.045	-2.387	1.123	2.103	0.196
BH-RF	-0.061	-4.970	0.926	2.649	0.301
	Independent variable: Return on small - big portfolio (SMB)				
Dependent variable	Constant %	t-value	Slope	t-value	Adj R sq
SL-RF	-0.044	-2.173	-0.79	-1.371	0.06
SM-RF	-0.05	-2.648	-0.776	-1.45	0.073
SH-RF	-0.044	-2.098	0.07	0.118	-0.076
BL-RF	-0.050	-1.880	-2.880	-3.760	0.484
BM-RF	-0.045	-2.188	-1.016	-1.720	0.122
BH-RF	-0.050	-3.149	-0.290	-0.641	-0.043

	Independent variable : Return on high - low portfolio (HML)				
Dependent variable	Constant %	t-value	Slope	t-value	Adj R sq
SL-RF	-0.059	-3.56	-0.802	-3.139	0.387
SM-RF	-0.062	-3.937	-0.729	-2.989	0.361
SH-RF	-0.058	-2.871	-0.329	-1.048	0.006
BL-RF	-0.068	-4.200	-1.996	-7.946	0.816
BM-RF	-0.059	-3.593	-0.908	-3.535	0.45
BH-RF	-0.060	-4.086	-0.402	-1.776	0.133

From the table V it is clear that the values of intercepts for all the portfolios in univariate regression are found to be negative and the t-values are also negative but have value higher than 2 ignoring sign. The slopes for all the six portfolios are found to be negative and but when SMB and HML are taken as independent variable as slope is ranging between -0.402 and -2.88 with t-values ranging between -7.946 to 0.118. But when Rm-Rf is taken as independent variable, the slop is found to be positive and significant as slope values range from 0.732 to 1.262 and t-values are ranging between 0.923 to 2.878. the values of Adjusted R square are ranging between -0.017 to 0.816.

Table V I

THREE FACTOR FAMA FRENCH TYPE MUL TIVARIATE REGRESSIONS					
$R_t - R_{ft} = a + b(R_{mt} - R_{ft}) + sSMB_t + hHML_t + e_t$					
	Independent variables- Market and SMB				
Dependent variable	Constant %	Market-Rf	SMB	HML	Adj R sq
SL-RF	-0.074	1.274	-1.081		0.39
SM-RF	-0.071	0.933	-0.989		0.247
SH-RF	-0.0743	1.309	-0.229		0.30
BL-RF	-0.087	1.594	-3.245		0.640
BM-RF	-0.077	1.393	-1.334		0.485
BH-RF	-0.074	1.033	-0.526		0.354
	Independent variables - Market and HML				
Dependent variable	Constant %	Market-Rf	SMB	HML	Adj R sq
SL-RF	-0.08	1.107		-0.826	0.66
SM-RF	-0.077	0.779		-0.746	0.492
SH-RF	-0.083	1.286		-0.356	0.394
BL-RF	-0.088	1.064		-2.019	0.894
BM-RF	-0.082	1.182		-0.933	0.733
BH-RF	-0.078	0.953		-0.423	0.493
	Independent variables – SMB and HML				
Dependent variable	Constant %	Market-Rf	SMB	HML	Adj R sq
SL-RF	-0.054		2.70	-2.134	0.669
SM-RF	-0.058		-1.792	2.156	0.55
SH-RF	-0.053		3.147	-1.881	0.41
BL-RF	-0.065		-2.977	1.989	0.857
BM-RF	-0.056		2.425	-2.104	0.643
BH-RF	-0.056		-1.342	1.906	0.359
	Independent variables - Market, SMB and HML				
Dependent variable	Constant %	Market-Rf	SMB	HML	Adj R sq
SL-RF	-0.070	0.776	1.926	-1.77	0.78
SM-RF	-0.069	0.493	-1.560	1.663	0.576
SH-RF	-0.072	0.899	2.25	-1.46	0.563
BL-RF	-0.083	0.871	-2.567	1.120	0.90
BM-RF	-0.075	0.924	1.502	-1.669	0.791
BH-RF	-0.0724	0.755	-0.987	1.152	0.546

From the table VI for multivariate regression, it is found that the values of intercepts for all the portfolios and combinations of factors are negative and very small and ranging between -0.088 to -0.053. The regression coefficients for Rm-Rf are ranging between 0.933 to 1.294 when independent variables are Rm-Rf and SMB and for SMB it is ranging between -3.245 to -0.526. When Rm-Rf and HML are taken as independent variable, the coefficients are ranging between 0.779 to 1.182 for Rm-Rf and -2.019 to -0.356 for HML. When SMB and HML are taken as independent variables, regression coefficients are ranging between -2.977 to 3.147 for SMB and -2.134 to 2.156 for HML. And when Rm-Rf, SMB and HML are taken as independent variables, regression coefficients are varying between 0.493 to 0.924 for Rm-Rf, -2.567 to 2.25 for SMB and -1.77 to 1.663 for MHL. The adjusted R square is ranging between 0.24 to 0.89.

Table VII

Adjusted R Square Over Three Sub Periods			
Sub Period	1999-2002	2003-2008	2009-2013
Dependent Variable	**Independent Variable: Market Return – Risk Free Rate (Rm - Rf)**		
SL-RF	0.977	-0.102	0.789
SM-RF	0.385	-0.064	0.8181
SH-RF	0.999	-0.170	0.841
BL-RF	0.708	-0.077	0.776
BM-RF	0.982	-0.119	0.815
BH-RF	0.974	-0.194	0.904
	Independent Variable: Return on Small minus Big (SMB)		
SL-RF	0.697	0.509	0.815
SM-RF	-0.111	0.325	0.811
SH-RF	0.779	-0.158	0.811
BL-RF	0.172	0.780	0.811
BM-RF	0.734	0.571	0.689
BH-RF	0.906	0.202	0.629
	Independent Variable: Return on High minus Low (HML)		
SL-RF	0.167	0.748	-0.233
SM-RF	-0.458	0.591	-0.216
SH-RF	0.327	0.009	-0.247
BL-RF	-0.115	0.936	-0.204
BM-RF	0.199	0.755	-0.240
BH-RF	0.478	0.391	-0.313
	Independent Variable: Rm-Rf and SMB		
SL-RF	0.969	0.388	0.898
SM-RF	0.655	0.186	0.919
SH-RF	0.999	-0.482	0.938
BL-RF	0.980	0.747	0.885
BM-RF	0.967	0.457	0.826
BH-RF	0.999	-0.057	0.894
	Independent Variable: Rm-Rf and HML		
SL-RF	0.998	0.666	0.911
SM-RF	0.947	0.471	0.987
SH-RF	0.999	-0.305	0.964
BL-RF	0.613	0.915	0.747
BM-RF	0.993	0.673	0.937
BH-RF	0.974	0.191	0.928
	Independent Variable: SMB and HML		
SL-RF	0.566	0.782	0.776
SM-RF	-0.220	0.687	0.756
SH-RF	0.616	0.228	0.787
BL-RF	-0.575	0.927	0.943
BM-RF	0.629	0.720	0.579
BH-RF	0.833	0.332	0.617
	Independent Variable: Rm-Rf, SMB and HML		
SL-RF		0.687	0.849
SM-RF		0.535	0.975
SH-RF		-0.122	0.940
BL-RF		0.891	0.891
BM-RF		0.589	0.904
BH-RF		0.066	0.862

Table VII indicates that Adjusted R squares for the six portfolios is ranging between -0.575 to 0.999 for period of 1999-2002, -0.305 to 0.936 for 2003 to 2008 and -0.247 to 0.987 for 2009 to 2013.

Table: VIII

T- Statistics of Intercept Over Three Sub Periods			
Sub Period	1999-2002	2003-2008	2009-2013
Dependent Variable	***Independent Variable: Market Return – Risk Free Rate (Rm-Rf)***		
SL-RF	-7.824	0.573	-6.591
SM-RF	-1.367	0.463	-6.973
SH-RF	-65.565	0	-7.299
BL-RF	-1.140	0.065	-4.934
BM-RF	-9.381	0.653	-6.695
BH-RF	-8.983	-0.215	-13.322
	Independent Variable: Return on Small minus Big (SMB)		
SL-RF	0.9569	-1.794	-1.478
SM-RF	0.066	-1.803	-1.358
SH-RF	1.078	-1.198	-1.239
BL-RF	0.649	-1.351	-0.236
BM-RF	0.953	-1.625	-1.053
BH-RF	1.524	-2.26	-2.576
	Independent Variable: Return on High minus Low (HML)		
SL-RF	0.6812	-2.752	-1.059
SM-RF	-0.109	-2.588	-1.090
SH-RF	0.855	-1.553	-0.987
BL-RF	0.572	-2.648	-0.969
BM-RF	0.684	-2.311	-1.000
BH-RF	1.024	-2.784	-1.016
	Independent Variable: Rm-Rf and SMB		
SL-RF	-2.557	-0.376	-2.685
SM-RF	-2.048	-0.301	-3.027
SH-RF	-16.482	-0.482	-3.439
BL-RF	-6.451	-0.003	-1.533
BM-RF	-2.341	-0.350	-2.309
BH-RF	-45.018	-0.821	-5.262
	Independent Variable: Rm-Rf and HML		
SL-RF	-12.734	-0.978	-4.823
SM-RF	-5.842	-0.751	-12.844
SH-RF	-70.244	-0.305	-7.217
BL-RF	-0.965	-0.858	-5.574
BM-RF	-6.281	-0.885	-5.495
BH-RF	-1.570	-1.191	-5.353
	Independent Variable: SMB and HML		
SL-RF	-0.082	-2.652	0.308
SM-RF	-0.721	-2.609	0.219
SH-RF	0.132	-1.438	0.463
BL-RF	0.070	-2.295	0.418
BM-RF	-0.102	-1.981	0.200
BH-RF	0.337	-2.449	0.227
	Independent Variable: Rm-Rf, SMB and HML		
SL-RF		-1.251	-1.045
SM-RF		-1.068	-3.416
SH-RF		-0.759	-1.752
BL-RF		-0.871	-1.371
BM-RF		-0.918	-2.248
BH-RF		-1.265	-1.689

Table VIII indicates that t-values of intercepts for the six portfolios is ranging between -70.244 to 1.524 for period of 1999-2002, -2.752 to 0.65 for 2003 to 2008 and -13.322 to 0.463 for 2009 to 2013.

Results and Interpretation

From Table I, it is clear that any categorization on the basis of either size or value is not helpful in anyways for the investors as the average expected monthly returns from all the portfolios are negative besides the BL and Low for the sample data. The returns for the two factors SMB and HML is also negative. These results altogether indicate that the average expected monthly returns for the two portfolios namely Big and Low respectively consisting big size stocks and low book to market value stocks are higher than that of the Small and High portfolios respectively consisting small size stocks and high book to market value stocks. This result is inconsistent with the size effect Banz (1981) that says that small size stocks outperform other stocks but is consistent with the value effect of Chan (1991) which says that the low book to market value stocks outperform high book to market value stocks. So any clear cut categorization either on the basis of size or value is not useful for the investors and no discrimination is possible on these two parameters. Also small cap and high book to market value stocks have lower standard deviation than that of the high cap and low book to market value stocks respectively. This result is in line with general perception about the stock trading because it has been historically seen that high cap and low book to market stocks witness higher activities.

From the table II, it is clear that there is very high correlation between the six portfolios constructed on the basis of both size and value. So the average expected monthly returns from the stocks cannot be discriminated on the basis of size or value. This result in line with the results presented in the table I. From the table III, it is clear that the two factors SMB and HML are highly related but the correlation between the excess market returns and two factors are low. This indicates that the return from any stock is not very much dependent on the excess market returns. Rather it is more affected by the returns from the other stocks in the market. From table IV, it is clear that there is very high correlation between the four portfolios but all the four portfolios have lower correlation with market factor Rm-Rf. These results altogether indicate that stocks cannot discriminated on the basis of either size or value or both because the average expected monthly return from one stock is correlated with returns from other stocks in the market and also the average expected monthly returns from stock are weakly related to average excess market return. So in other words it can be said that expected return from any stock in Indian market cannot be explained by either size effect or value effect or both or the excess market return. Rather there are some other factors that can help in explaining the expected returns.

From table V it is clear that the intercept constants are very low and statistically highly significant for all the three factors because out of 18 t-values, 16 t-values are higher than that of 2 and are ranging between 2.17 to 4.97 (ignoring sign). That means expected returns can be completely explained by different variables. This is in line with arbitrage pricing theory but against efficient market hypothesis. Also from table V it is clear that the slope beta is found to be highly significant for 4 portfolios out of six portfolios when Rm-Rf is taken as independent variable in regression analysis. Same results are found when HML is taken as independent variable but when SMB is taken as independent variable beta for only one portfolio is found to be statistically significant. This clearly indicates that standard CAPM's beta can explain expected returns for the market portfolios and portfolios constructed on the basis of book to market values but cannot explain for the portfolios constructed on the basis of market capitalization using univariate regression analysis. But at the same time adjusted R square value for the regression are found to be very low for most of the regression barring a few. The adjusted R square value for univariate regression has been ranging between -0.076 to 0.816. This clearly indicates that data is not fitting in the model. So on the basis of adjusted R square values, no robust conclusion can be arrived upon. But it is interesting to see that when HML is taken as independent variable in the regression analysis, the adjusted R square values are far better than two other factors and is as high as 0.816. So it can be concluded that HML is in better position than that of the other two factors in explaining expected returns.

From table VI it is clear that the value of intercept is very low. That means expected return can be explained using different variable that is in line with APT but against EMH. The market factor in combination with SMB can explain 24.7-64% of variations while HML in combination with market factor can explain 39.4-89.4% of variations. SMB and HML can explain 35.9-85.7% of variations. And market factor in combination with SMB and HML can explain 54.6-90% of the variation in expected return. So it can be said that three factors together can explain most of the variations in expected return. So the factor model found to be working in Indian context in taken time period.

From table VII, it is clear that during low economic growth period of 1999 to 2002 when average GDP growth rate was below 5%, market factor was able to explain 99.9% of the variation in expected return but when GDP growth rate is high at more than 8% during 2003-2008, market factor cannot explain any variation in the expected return. But once average GDP growth rate falls again during 2009-2013, market factor can explain 90.4% of the variation in the expected return. The factor SMB seems to be in better position in explaining the overall variation than market factor but follows the same trend that of the market factor. But HML can explain 1-93.6% variation in expected return during high growth period of 2003-2008 but during low growth period ability falls. Market factor in combination

with the SMB and HML can explain most of the variation during low GDP growth period but during high growth ability significantly falls. SMB and HML as well all the three together can explain most of the variation in expected return. So on overall, market factor and SMB can explain variation in expected return during low economic growth period and HML can do in high GDP growth period although market factor is best in explaining variation. Combination of two or three factors can explain most of the variations in expected return.

Conclusion

From the analysis it can be said that in Indian market no size effect exists and a weak value effect exists but no robust discrimination is possible on the basis of size or value of stocks. So for the investors, size effect and value effects hardly have any significance in Indian security market. The expected return from individual stocks is not related to market factor but beta is significant and useful in Indian market. So it can be said that none of the three factors individually can explain the variations in the expected return from stocks and there should be some other factors that can explain variations but the three factors together can explain expected return to some degree. This result is in line with the Arbitrage Pricing Theory but against the Efficient Market Hypothesis. The value of intercept is very low and insignificant in Indian market and expected return can be predicted with the help of some variables. This again is in line with arbitrage pricing theory but against efficient market hypothesis. During low GDP growth period market factor and SMB can explain most of the variations in expected return but market factor is more efficient. HML can explain variation in return during high GDP growth period. In other words it can be said that during low growth periods market becomes more predictable than the high growth periods and during high growth periods returns expectations of investors increase and to explain these high expectations, some other factors need to be considered which could explain this trend.

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