Evidence of Fama-French Three Factor Model in Indian Stock Market in Respect of Indian Oil and Gas Firms

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Abstract -- **Indian oil and gas industries are capital intensive and risk prone. It is very essential to understand the risk & return of these firms for making better investment decision and efficient portfolio management. This study aims to understand the influence of size and value effect apart from market risks on the returns of Indian oil and gas firms by applying the Fama and French three factor model. The empirical results obtained provide evidence that cross-sectional mean returns of these firms are better explained by three factors, and not by the market factor alone.**

Keywords: Three factor model, Risk and return, Capital Asset Pricing Model.

I. INTRODUCTION

THE Capital Asset Pricing Model (CAPM) developed by of William Sharpe (1964) and John Linter (1965) is widely used for estimating the cost of capital for firms, cost benefit analysis and evaluating the performance of managed portfolios. The CAPM is concerned with pricing of assets in equilibrium and the 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 (Eugene F. Fama; Kenneth R. French, 2004) The CAPM defines that the risk of a stock should be measured relative to a comprehensive "market portfolio" which in a narrow definition indicates the common stocks.

The fundamental of CAPMis built on the model of portfolio choice (Mean-variance model) developed by Harry Markowitz (1959). Since its introduction various empirical tests are carried out to validate the CAPM model. Literature evidences are plenty for both successful *(e.g.* Black, Gensen & Scholes - 1972) and failed validation (Basu-1977) of CAPM.

Fama & French developed a three factor asset pricing model in response to failed validation of CAPM in explaining the excess return. Fama & French argue that apart from market beta, two other important factors representing the size of firm and value factor indicated by the book to market value of the firms' plays an important role in determining the mean return of stock. According to this model the risk-return are well captured by the size effect & B/M ratio and this captures the evidence for risk premium in terms of distress premium. Firms representing small stocks with high –book to market ratio are performed poorly as a consequence they are highly vulnerable to financial distress and as a result the investors command a risk premium called distress premium for the case. They formulated the three factors Model as indicated below;

$$E(R_i)-R_f=\hat{a}_{im}(E(R_m-R_f))+\hat{a}_{is}E(SMB)+\hat{a}_{ih}E(HML) \quad (1)$$

where

$E(R_i)$ = Expected Rate of return an asset i

R_f = Risk free return

$E(R_m)$ = Expected rate of return on market

$E(R_m-R_f)$ = Expected rate of excess market portfolio return.

âim = Assets market beta =Covariance(Ri,Rm)/ó2m

E(SMB) =Expected value ofthe difference between the excess return on a portfolio of small stocks and the excess return on a portfolio of big stocks(Small minus Big)

E(HML) =Expected value of the difference between the excess return on a portfolio of high-book-to-market stocks and the excess return on a portfolio of low-book-to-market stocks i.e high & low BE/ME stocks.

âim, âis, âih are of sensitivities of state variables.

As per this model, HML captures the risk factor associated with the relative earning performance & SMB capture the risk associated with the size of the firm. This paper empirically tests the validity of this three factor model in Indian stock market with respect to Indian Oil & gas Industry.

II. LITERATURE REVIEW

Fama and French (1993) argued that simple CAPM model is inadequate to explain the cross sectional stock market returns due to marketanomaly 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.

Bhavna Bhal (2006) evaluated the Fama and French three factor model along with the CAPM in Indian stock market and concluded that three factor model better explaining the returns on stock as compare to CAPM.

Yash pal Taneja (2010) studied 187 listed companies in Indian stock market and showed that efficiency of Fama and French cannot be ignored in Indian context and concluded that either size or value plays an important role due to high degree of correlation between these factors.

Sahil Jain (2013) studied the performance of Indian Stocks by implementing the Fama French Three Factor model to 27stocks 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.

Literature survey indicates there is a gap in empirical study on testing of three factor models in Indian stock market with respect to Indian oil & gas sector Industries. This paper tries to bridge this gap by carrying out empirical testing of three factor model in Indian Stock exchange for Indian oil & gas Industries.

III. MOTIVE & OBJECTIVE OF THIS STUDY

The motive behind this study is to estimate the risk & return aspects of Indian oil &gas Industriesin Indian Stock market as energy is the prime mover of Indian economy with70% of Crude oil and 40% of natural gas is imported in India to meet the huge energy demand. Thus these industries are backbone for Indian economy and these industries are not subject to market risk alone. Hence, the main Objective of this study is to empirically verify the applicability of Fama-French's three factor modelin explaining the return of Indian oil &gas Industries stock in Indian stock market.

IV. METHODOLOGY

To test the Fama-French three factor model std.multivariate regression of the following equation on excess asset (portfolio return) on excess market return, SMB, & HML are carried out.

$$R_{it}-R_{ft}=\acute{a}_i+\hat{a}_i\,(R_{mt}-R_{ft})+s_i(SMBt)+h_i(HMLt)+e_i \qquad (2)$$

where
R_{it} = Rate of return on assest'i' in time- 't'
R_{mt} = Rate of return in market portfolio in time-'t'
R_{ft} = Rate of risk free assets 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 marke value stocks in time-'t'
$\acute{a}_i$ Measure of abnormal return or pricing error.
âi,si,hi = The market,size and value factor exposure of portfolio/ asset 'i'

V. DATA FOR STUDY

The sample data for this study pertains to the following Oil &gas stocks which are actively traded in Bombay stock exchange. These organisations numbering eight represent both public & private sector oil & gas industries;

i. Oil & Natural Gas Corporations Ltd (ONGCL)
ii. Gas Authority of India ltd –GAIL(India)Ltd
iii. Indian Oil Ltd-IOC
iv. BPCL
v. HPCL
vi. Reliance Industries Ltd-RIL
vii. Essar Oil Ltd
viii. Cairn Energy India Ltd.

The monthly data pertaining to this study are taken from BSE, yahoo finance and RBI web sites for the period of April-2009-April-2012. The data considered includes the closing price of these stocks and for the market risk the BSE SENSEX index is used as the proxy and for risk free return Government of India T-bills return is used as the proxy.

To capture the size effect of the Industries, market capitalisation of these industries and to capture the value effect, the ratio of book value to market value of these firms for the year 2012 was used.

VI. CALCULATION OF VARIABLES IN THE REGRESSION EQUATION

The variables in the above regression equation (2) is calculated as follows

i. R_f- Risk free return is calculated using return on 1 year GOI T-bill

TABLE 1- MARKETING CAPITALIZATION VALUE OF SELECTED FIRMS

Orgnisations	Market Capitilasion (INR-Cr)	SMALL-S	BIG-B
ONGC	244473	GAIL	ONGC
GAIL	42278	HPCL	IOC
IOC	49299	BPCL	RIL
RIL	344623	ESSAR	CAIRN
ESSAR	8162		
HPCL	6713		
BPCL	26103		
CAIRN	63536		
Total	98148.375		
Average	49074.1875		

ii. To capture the size effect factor SMB, the above firms are in to Small & Big by their Market capitalisation. If the market capitalisation value of organisations less than 50% of the average of total market capitalisation of all above energy industries is termed as the Small(S)one & others are classified as Big(B) one as indicated below.

iii. The value effect 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% by M and 30% by S.

The Details are indicated below

TABLE 2 - PORTFOLIO FORMATION

Organisation	BV/MV Ratio	HIGH-H (<.6)	MEDIUM-M (0.6-1.0)	LOW-L (>1.0)
ONGC	0.509	ESSAR	BPCL	HPCL
GAIL	0.571	ONGC	IOC	
IOC	1.23	RIL		
RIL	0.523	CAIRN		
ESSAR	0.135	GAIL		
HPCL	2.04			
BPCL	0.639			
CAIRN	0.534			

Small (S)	Big(H)	
SH-GAIL,ESSAR	BH-ONGC,RIL,CAIRN	H(30%)
SM-BPCL	BM-IOC	M(40%)
SL-HPCL	BL-NIL	L(30%)

iv. The variable SMB_t is calculated as follows;
SMB (Small minus Big) is meant to mimic the risk factor in returns related to

Size.SMB is the difference each month 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=Small – Big=Average returns of Small –Big=1/3(SH+SM+SL)-1/3(BH+BM+BL)

v. The variable HML_t is calculated as follows:
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 month 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=High-Low=Average returns of High BM ratio portfolio-LoW BM ratio portfolio
HML_t=1/2(SH+BH)-1/2(SL+BL)

vi. Rit-Return on portfolio is arrived as follows;
$R_{it}=Ln(P_{it}/P_{it-1})$
P_{it}- Closing Price index of asset 'i' at time 't'
P_{it-1} Closing -Price Index of asset 'i' at time 't-1'

vii. Rmt-Return on Market portfolio is calculated as follows;
$R_{mt}=Ln(P_{mt}/P_{mt-1})$
P_{mt}-Closing price Index of BSE-Sensex at time 't'
P_{mt-1}-Closing Price Index of BSE-Sensex at Time 't-1'

The regression results and the chart showing return vs size factor and valueare depicted below.

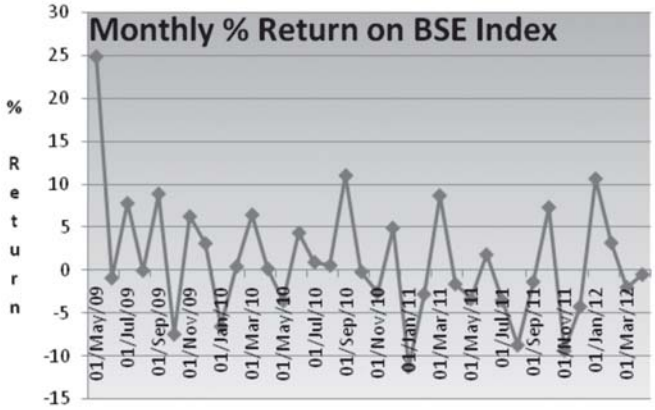

Figure 1. % Return on BSE Index.

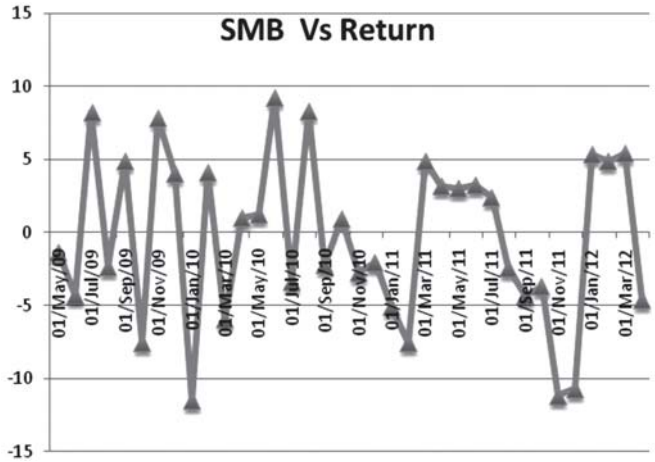

Figure 2. SMB factors vs. Returns.

VII. DISCUSSION OF RESULTS

The model is considered valid if all three factors must contribute substantially to the risk of well-diversified portfolios. The results of regression are indicated below (Table 3) and the model fit is having an R value of 0.9 and R^2 value of 0.810

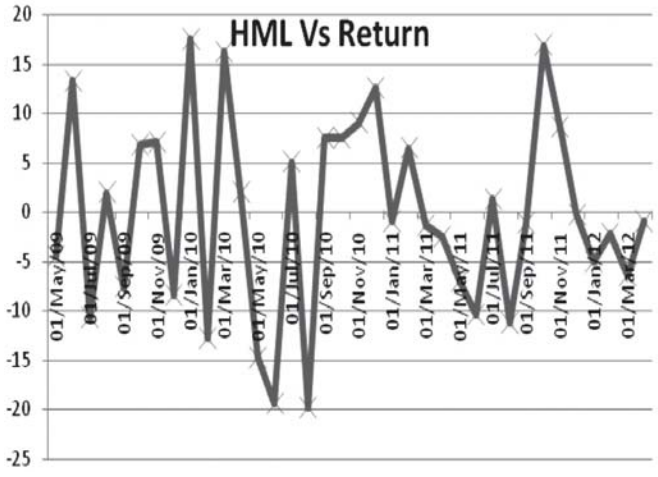

Figure 3. HML factors vs returns.

TABLE 3
REGRESSION RESULTS OF THREE FACTOR MODEL

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.900641
R Square	0.811154
Adjusted R	0.79345
Standard E	6.413073
Observatio	36

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	5652.996	1884.332	45.81683	1.09572E-11
Residual	32	1316.08	41.12751		
Total	35	6969.076			

	Coefficients	*tandard Erı*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*
Intercept	-0.51724	1.086651	-0.476	0.63731	-2.73067972	1.696192906	-2.73067972
SMB	0.235914	0.291476	0.809378	0.424275	-0.357802762	0.829631516	-0.357802762
HML	-0.58599	0.15389	-3.80786	0.000599	-0.899456896	-0.272528051	-0.899456896
Rm-Rf	1.42042	0.179615	7.908139	5.04E-09	1.054556323	1.786283656	1.054556323

indicating that the three factors can explain considerable part of the return. The significance of F-test is 0 indicating well fit of the model.The null hypothesis for the intercept term is that it is zero. If the intercept term is significantly indifferent from zero, than the three factors model is correct. The result also shows value effect is significant with more significant market effect but size effect is insignificant.

VIII. MANAGERIAL IMPLICATION

The above results indicate 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.

IX. CONCLUSION

The present study empirically evaluates the applicability of Fama and French three factor model on the Indian Oil & gas sector stocks in order to capture the individual effects of the three risk factors more precisely on the sector base.The results indicate apart from market risks, value risks and to less extend size risks also affect the return of these stocks. But one significant aspects of above results is that market risks is predominating the others indicating that in Indian Context, variation in BSE-SENSEX index incorporates or captures the other risks effectively.

Further, as oil &and gas industries returns are greatly subject to volatility of crude and natural gas prices, its effect also to be tested against the three factors Fama and French model. This comparison can lead to more efficiently constructed portfolios.

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