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The Effectiveness of Fama French 3 Factor Model in Predicting Globally Diversified Portfolio Returns

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ABSTRACT: The Fama French Model which followed the CAPM has been widely debated by various researchers on issues like whether value and size premiums are caused by the underlying risk factors of firms falling within these categories or due to the incorrect extrapolation of past earnings growth by the market and subsequent correction of the mispricing errors. The current study aims at testing the effectiveness of the Fama French Model in predicting portfolio returns especially during the crisis periods. In other words, using an extensive and well diversified sample of Global stocks listed on the Dow Jones Index, we test whether the Fama and French Model is able to significantly capture the systematic risk present in the Macroeconomy. We also shed some light on the possible additional factors which overpower the Fama French factors in explaining the systematic risk prevailing in the economy.

KEYWORDS: Fama and French factors, leverage risk, liquidity risk, idiosyncratic risk.

I. INTRODUCTION

Several mutual funds and hedge funds have shown tremendous growth in the last few decades. Mutual fund managers always hunt for stocks which generate maximum positive alphas, i.e. the difference between the expected returns based on an asset pricing model and the actual returns. However it is important for fund managers to check whether their positive alphas are statistically significant. For example, suppose we consider a stock A which has a beta of 1.6 and the risk free rate is 3%. Suppose the market premium is 8%. According to the Capital Asset Pricing model the fund manager can expect a return of 3+ 1.6*8 = 15.8% on this stock. Suppose the stock returns 20% in a real scenario. The difference of 4.8% is attributed to random error or management impact. However the problem arises when the CAPM model does not correctly price systematic risk. In that case this difference of 4.8% is merely a result of incorrect asset pricing. Using a model which does not correctly price risk leads to inefficient active portfolio management and hence distorted alphas.

II. FAMA AND FRENCH 3 FACTOR MODEL – A REVIEW

Fama and French (1992) concluded that the combination of book to market equity and size described the cross section of average returns and absorbed the apparent roles of other variables like leverage and E/P. Fama and French (1993) extended the asset pricing tests in Fama and French (1992) by considering bond returns in addition to common stocks. Instead of using Fama – Macbeth regressions as in Fama and French (1992), they used the time series regression approach of Black, Jensen and Scholes (1972). They concluded that a market factor and returns on the portfolios constructed to proxy for the risk factors related to size and book to market equity presented a better explanatory power in explaining the cross section of average returns. In other words, they indicated that the expected return on a portfolio in excess of the risk free rate is explained by the sensitivity of its return to three factors (i) the excess return on a broad market portfolio (Rm - Rf); (ii) the difference between the return on a portfolio of small stocks and the return on a portfolio of large stocks (SMB, small minus big); and (iii) the difference between the return on a portfolio of high-book-to-market stocks and the return on a portfolio of low-book-to-market stocks (HML, high minus low). Specifically, the expected excess return on portfolio *i* is:

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$$r_{it} - r_{ft} = \alpha + \beta_0(r_{mt} - r_{ft}) + \beta_1(R_{SMB})_t + \beta_2(R_{HML})_t + \varepsilon_t \quad (1)$$

where $r_{mt} - r_{ft}$, R_{SMB}, and R_{HML} are expected premiums. β_0 β_1 β_2, are the slopes in the above time-series regression. The mimicking portfolios SMB and HML captured common factors in stock returns related to size and book to market equity.

One of the major criticisms of the Fama French model was that the value premium was sample specific and was likely to be a "mere artifact of data mining" as indicated by Black (1993). Black (1993) argued that the existence of value premium is a mere chance unlikely to recur in future returns. MacKinlay (1995) also supported this argument. Kothari Shanken and Sloan (1995) indicated the problem of survivorship bias and postulated that the high explanatory power of the book to market ratio was only due to survivorship bias and mis-measurement of beta. Jagannathan and Wang (1996) supported the existence of a conditional CAPM after including the time varying component of the market betas. The paper also argued that the failure of CAPM to explain the cross section of expected returns was majorly because of an incorrect proxy for market returns. Inclusion of the human capital component in the market wide returns explained the variation in asset returns as much as the Fama and French model did.

At the same time, Penman et al (2007) conferred an argument that book to market ratio of a firm centrally demonstrated the accounting phenomenon and is in accordance with the method used by the accountants who measure "book value" of a firm rather than the risk exposure of the firm. The authors extend an interesting example of a pure investment fund where accountants employ "mark to market" accounting principles because of which the "net asset value" equals the market value. They explain that these methods used by accountants might result in a risky hedge fund and a money market fund having the same B/M ratio irrespective of their risk exposures. As a result the book to market factor does not capture precisely the distress risk of the firm and varies considerably in conjunction with the different accounting procedures and principles used by accountants.

III. SAMPLE DESCRIPTION

Our initial sample included weekly data for approximately 4,578 stocks traded globally from January 1992 to October 2012. Out of these, we eliminate the stocks having negative book values to prevent distortion of results. We also eliminate cases with missing data. Also, in accordance with Fama and French (1992) we eliminate stocks with negative book to market equity as well as financial stocks for the construction of Fama and French factors as well as our additional risk factors.

IV. MODEL DESCRIPTION

We test for the significance of the traditional Fama French 3 factor model and test for its significance during the aggregate period, tranquil period and the crisis period. To be more specific, we test the significance of the sensitivities of the asset returns to the Fama French factors, SMB and HML along with the market factor. As stated earlier, the tranquil period includes January 1992 to June 2007 while the crisis period spans over July 2007 to December 2012. Empirically speaking, we use a firm specific GARCH specific with Generalized Error Terms (which takes care of the heteroskedasticity and autocorrelation) and test for the below model during the aggregate period, tranquil period and the crisis period.

$$r_{it} - r_{ft} = \beta_0 + \beta_1(r_{mt} - r_{ft}) + \beta_2 R_{t,SMB} + \beta_3 R_{t,HML} + \varepsilon_t$$

$$\varepsilon_t | \psi_{t-1} \sim N(0, \sigma_t^2),$$

$$\sigma_t^2 = \Omega + \sum_{i=1}^{q} \alpha_i \varepsilon^2_{t-i} + \sum_{j=1}^{p} \delta_i \sigma_{t-j}$$

where, r_i is the return on portfolio i; r_f is the return on the risk free asset and r_m is the return on the market portfolio. R_{SMB} is the return on the size mimicking portfolio constructed by taking the simple average of the returns each week of all "Small" portfolios minus "big" portfolios. R_{HML} is the return on book to market mimicking portfolio constructed by taking the simple average of the returns each week of all "High BE/ME" portfolios minus "Low BE/ME" portfolios.

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the variance equation models the conditional variance as a GARCH(p,q) process where p and q denote the lag length. Ω is the intercept term, α_i are ARCH terms and δ_j are GARCH terms. α and δ terms are expected to be positive and significant determinants of the conditional variance of changes in the excess return. The primary reason for using the GARCH model is that preliminary diagnostics suggest that the weekly excess returns have time varying variance with volatility clustering and fat tails.

We first test for the above model considering an aggregate sample containing all the non financial stocks. We consider portfolios with extreme characteristics for the purpose of our analysis; i.e. small and big sized portfolios (Size measured in terms of market capitalization of stocks), low book to market equity portfolios and high book to market equity portfolios, low leverage and high leverage portfolios, low liquidity risk and high liquidity risk portfolios and lastly low idiosyncratic risk and high idiosyncratic risk portfolios. Re-iterating on the arguments raised by Fama and French (1992) we believe negative book to market companies and financial stocks may lead to distortion of results. Hence we eliminate such stocks from the sample. Next, to test for the robustness of the results and to evaluate their application in portfolio management, we form various sub portfolios and test the sensitivities of such portfolios returns to these systematic risk factors. These sub portfolios are formed by sub categorizing each of these extreme characteristic stocks into Conventionally traded, Islamic, OECD market stocks and Emerging markets.

V. RESULTS AND ANALYSIS

Tables 1 and Table 2 present the regression results explaining the relationship between expected portfolio returns and the explanatory risk factors during the aggregate period, tranquil period and the crisis period respectively for different stylized portfolios. We consider four different stylized portfolios viz. OECD market portfolios, Emerging market portfolios, Islamic stocks and conventionally traded stocks. A common observation across the coefficients of all the portfolios across both the periods, tranquil and crisis is that the market factor makes the maximum contribution (all the coefficients are above 0.9) explaining expected returns. The estimated R-squares for all the regressions is less than 60% which indicates that the Fama French factors are losing their explanatory power especially during the crisis periods. This observation is consistent across all the stylized portfolios as shown in each of the tables below. Each of the portfolios ranging from p1 to p10 indicate the following extreme characteristic portfolios as follows: small and big sized portfolios (Size measured in terms of market capitalization of stocks), low book to market equity portfolios and high book to market equity portfolios, low leverage and high leverage portfolios, low liquidity risk and high liquidity risk portfolios and lastly low idiosyncratic risk and high idiosyncratic risk portfolios.

Table 1: Regression coefficients showing the impact of Market factor, SMB, HML factors on conventionally traded portfolio returns during aggregate, tranquil and crisis period.

Model 1

$$r_{it} - r_{ft} = \beta_0 + \beta_1(r_{mt} - r_{ft}) + \beta_2 R_{t,SMB} + \beta_3 R_{t,HML} + \varepsilon_t$$

$$\varepsilon_t | \psi_{t-1} \sim N(0, \sigma_t^2),$$

$$\sigma_t^2 = \Omega + \sum_{i=1}^{q} \alpha_i \varepsilon^2_{t-i} + \sum_{j=1}^{p} \delta_i \sigma_{t-j}$$

where, r_i is the return on portfolio i; r_f is the return on the risk free asset and r_m is the return on the market portfolio. R_{SMB} is the return on the size mimicking portfolio constructed by taking the simple average of the returns each week of all "Small" portfolios minus "big" portfolios. R_{HML} is the return on book to market mimicking portfolio constructed by taking the simple average of the returns each week of all "High BE/ME" portfolios minus "Low BE/ME" portfolios.

Aggregate Period									
Conventionally traded stocks					**OECD countries stocks**				
Portfolio	c	R_{MKT}	R_{SMB}	R_{HML}	Portfolio	c	R_{MKT}	R_{SMB}	R_{HML}
p1	0.00	0.98	0.95	0.33	p1	0.00	0.98	0.80	0.23
p2	0.00	0.98	-0.03	0.14	p2	0.00	0.98	-0.05	0.16
p3	0.00	0.97	0.27	-0.15	p3	0.00	1.02	0.33	-0.24

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p4	0.00	0.98	0.47	0.72	p4	0.00	0.97	0.36	0.69
p5	0.00	0.94	0.34	0.19	p5	0.00	0.96	0.30	0.09
p6	0.00	1.06	0.41	0.39	p6	0.00	1.07	0.31	0.40
p7	0.00	0.94	0.29	0.12	p7	0.00	0.96	0.23	0.12
p8	0.00	0.95	0.36	0.25	p8	0.00	0.96	0.33	0.26
p9	0.00	0.99	0.35	0.25	p9	0.00	1.02	0.29	0.28
p10	0.00	0.91	0.07	0.11	p10	0.00	0.92	0.08	0.07

Tranquil Period

Conventionally traded stocks					**OECD countries stocks**				
Portfolio	c	R_{MKT}	R_{SMB}	R_{HML}	Portfolio	c	R_{MKT}	R_{SMB}	R_{HML}
p1	0.00	1.02	0.92	0.36	p1	0.00	0.99	0.76	0.24
p2	0.00	0.99	-0.03	0.15	p2	0.00	0.98	-0.05	0.16
p3	0.00	0.98	0.14	-0.09	p3	0.00	1.03	0.29	-0.20
p4	0.00	1.00	0.44	0.76	p4	0.00	0.97	0.31	0.69
p5	0.00	0.98	0.32	0.22	p5	0.00	0.99	0.22	0.09
p6	0.00	1.03	0.39	0.46	p6	0.00	1.04	0.30	0.44
p7	0.00	0.97	0.20	0.11	p7	0.00	0.99	0.18	0.10
p8	0.00	0.94	0.04	0.13	p8	0.00	0.91	0.06	0.16
p9	0.00	1.00	0.30	0.28	p9	0.00	1.01	0.27	0.31
p10	0.00	0.92	0.03	0.11	p10	0.00	0.92	0.04	0.08

Crisis Period

Conventionally traded stocks					**OECD countries stocks**				
Portfolio	c	R_{MKT}	R_{SMB}	R_{HML}	Portfolio	c	R_{MKT}	R_{SMB}	R_{HML}
p1	0.00	0.89	1.14	0.18	p1	0.00	0.97	0.96	0.12
p2	0.00	0.94	0.26	0.02	p2	0.00	0.95	0.12	0.14
p3	0.00	0.97	0.57	-0.36	p3	0.00	0.99	0.54	-0.42
p4	0.00	0.94	0.64	0.53	p4	0.00	0.98	0.59	0.69
p5	0.00	0.76	0.75	-0.07	p5	0.00	0.88	0.63	0.04
p6	0.00	1.09	0.56	0.15	p6	0.00	1.11	0.48	0.19
p7	0.00	0.91	0.67	0.09	p7	0.00	0.94	0.52	0.16
p8	0.00	0.94	0.63	-0.02	p8	0.00	1.05	0.45	-0.03
p9	0.00	0.98	0.54	0.10	p9	0.00	1.02	0.41	0.14
p10	0.00	0.87	0.96	-0.07	p10	0.00	0.90	0.74	0.01

The above table indicates the regression coefficients for each of the systematic risk factors, i.e. the market factor, the SMB and the HML factors on the returns of a portfolio. As can be seen from the tables, the market factor is very prominent in explaining the systematic risk of the firm. The impact of the size factor, i.e. SMB has been very significant in the crisis periods since all the coefficients are above 50%. However during the tranquil period the size factor is not as effective s as the market factor. On the other hand HML factors shows mixed results. HML shows significant relationship with portfolio returns for most of the portfolios; however the impact is far less as compared to the market and the SMB factor. One reason for this could be that HML is not efficiently capturing the distress risk of the firm and there could be some other factors which could be more efficient than HML in capturing the systematic risk exposure of a firm.

Table 2 below indicates the regression coefficients showing the impact of the market factor, SMB and HML factors on two stylized portfolios: Islamic stock portfolios and emerging stock portfolios. The reason for choosing these portfolios is that these stocks have certain distinct characteristics like low debt, high growth potential, higher level of corporate social responsibility and more volatile markets. As can be seen from the table below market factor seems to be persistently significant in explaining all the portfolio returns. However SMB and HML factors show varying sensitivities in explaining portfolio returns.

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Table 2: Regression coefficients showing the impact of Market factor, SMB, HML factors on Islamic portfolio returns and Emerging stock portfolios during aggregate, tranquil and crisis period.

Aggregate Period									
Islamic stock portfolios					**Emerging stock portfolios**				
Portfolio	c	R_{MKT}	R_{SMB}	R_{HML}	Portfolio	c	R_{MKT}	R_{SMB}	R_{HML}
p1	0.00	0.96	0.84	-0.03	p1	0.00	0.73	0.19	-0.04
p2	0.00	0.96	0.00	0.05	p2	0.00	1.05	0.06	0.00
p3	0.00	1.02	0.40	-0.34	p3	0.00	0.86	0.24	-0.18
p4	0.00	0.92	0.52	0.41	p4	0.00	0.91	0.05	0.12
p5	0.00	0.93	0.42	0.00	p5	0.00	0.75	0.12	-0.03
p6	0.00	1.01	0.09	0.08	p6	0.00	0.96	0.11	0.01
p7	0.00	0.93	0.18	-0.02	p7	0.00	0.82	0.15	-0.05
p8	0.00	0.91	0.39	0.01	p8	0.00	0.81	0.11	-0.01
p9	0.00	0.97	0.30	0.04	p9	0.00	0.88	0.14	-0.06
p10	0.00	0.99	0.53	-0.06	p10	0.00	0.86	0.18	-0.05
Tranquil Period									
Islamic stock portfolios					**Emerging stock portfolios**				
Portfolio	c	R_{MKT}	R_{SMB}	R_{HML}	Portfolio	c	R_{MKT}	R_{SMB}	R_{HML}
p1	0.00	0.89	0.82	-0.03	p1	0.00	0.66	0.14	-0.02
p2	0.00	0.94	0.00	0.06	p2	0.00	0.98	0.04	0.03
p3	0.00	1.01	0.38	-0.32	p3	0.00	0.80	0.20	-0.14
p4	0.00	0.88	0.48	0.42	p4	0.00	0.85	0.03	0.11
p5	0.00	0.94	0.41	0.00	p5	0.00	0.69	0.09	-0.02
p6	0.00	0.93	0.05	0.08	p6	0.00	0.83	0.06	0.04
p7	0.00	0.92	0.11	0.00	p7	0.00	0.78	0.12	-0.03
p8	0.00	0.81	0.08	0.03	p8	0.00	0.71	0.06	0.02
p9	0.00	0.94	0.29	0.07	p9	0.00	0.81	0.10	-0.04
p10	0.00	0.96	0.48	-0.03	p10	0.00	0.81	0.12	-0.03
Crisis Period									
Islamic stock portfolios					**Emerging stock portfolios**				
Portfolio	c	R_{MKT}	R_{SMB}	R_{HML}	Portfolio	c	R_{MKT}	R_{SMB}	R_{HML}
p1	0.00	1.12	1.00	-0.07	p1	0.00	1.01	1.45	-0.23
p2	0.00	1.00	0.09	-0.19	p2	0.00	1.15	0.35	-0.37
p3	0.00	1.06	0.61	-0.49	p3	0.00	1.06	0.93	-0.60
p4	0.00	1.06	0.65	0.37	p4	0.00	1.12	1.10	0.06
p5	0.00	0.94	0.58	-0.08	p5	0.00	0.93	1.05	-0.34
p6	0.00	1.21	0.53	-0.15	p6	0.00	1.20	0.97	-0.25
p7	0.00	0.98	0.53	-0.10	p7	0.00	0.99	0.82	-0.31
p8	0.00	1.11	0.75	-0.26	p8	0.00	1.02	1.02	-0.25
p9	0.00	1.03	0.47	-0.12	p9	0.00	1.08	0.76	-0.17
p10	0.00	1.04	0.74	-0.18	p10	0.00	1.09	1.31	-0.28

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