Group Assignment

Fama and French 3 factor model

Group No. - 7

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INTRODUCTION

Market anomalies have always been the subject of great interest in financial research as these create huge opportunities for high gains that can be earned by profitable investment decisions based on historical information. Fama and French gave a 3-factor model which is an extension of the Capital Asset Pricing Model (CAPM). They suggested that there can be various other factors that can affect stock returns. The focus is to find the various other fundamental factors which affect the expected return from a stock that was not taken into consideration in CAPM.

Financial Econometrics in stock valuation is focused mainly on developing models that can be used with the same effect for all potential firms under normal financial circumstances. Fama and French developed a 3-Factor model in 1992. In their study, they empirically examined the joint role of market return, firm's size (market capitalization), firm's book-to-market equity (BE/ME) ratio, in the cross-section of average stock returns using a multifactor approach. The gave the equation,

$$E\ (R_a) = \alpha + \beta_1\ (MKT) + \beta_2\ (SMB) + \beta_3\ (HML)$$

Where,

MKT = Excess Return on Market Portfolio

SMB = the difference in returns between small-capitalization stocks and large-capitalization stocks (size)

HML = the difference between the return from High Book-to-Market Value Firms and that from Low Book-to-Market Value Firms

Carhart (1997) further introduced the **momentum factor** constructed by the monthly return difference between the returns on the high and low prior returns portfolios, to capture the cross-sectional return patterns. It is meant to represent the risk factor in returns related to the momentum of a stock.

$$r_i - r_f = \alpha_i + \beta_{i,m}(r_m - r_f) + \beta_{i,SMB}SMB + \beta_{i,HML}HML + \beta_{i,MOM}MOM + \varepsilon_i$$

METHODOLOGY

1. We are doing the analysis for the Chinese Stock market. The dataset had monthly data for 15 years. We selected those 60 months for our analysis which had the least number of empty data entries for better results. The 5 year time interval used was 28/01/2014-28/12/2018.

2. First of all, we separate six different portfolios on the basis of market capitalization (small and big) and return on equity (value, neutral and growth) which we then use to find **SMB** and **HML** factors. The market return is found using the last 25 years' closing price of China's market index.

3. Then we calculate the **Momentum** factor of Carhart's Four Factor Model by classifying stocks into Winners & Losers (based on the return of the last 11 months).

   Above three steps are done in python. We have also attached the "**group7.py**" python file. The output of the code is two .csv file - **regression.csv(It stores the SMB, HML, the return of Industrial_And_Comm for each month between 2014-2018)** and **momentum_factor_data.csv(It stores the momentum factor for each month in between 2014-2018)**.

4. Now we apply **regression analysis** using SMB, HML, (Rm-Rf) as independent variables and (Ri-Rf) as dependent variable for Fama french model and also did same for Carhart model and CAPM as well in Excel for the same stock, Industrial and Communication, of all different models - CAPM, Fama French 3 factor model, and Carhart Four Factor Model. We compare the errors of different models by plotting a graph with time. We also plot the individual return of each factor and total return with time.

5. **Assumptions** - We calculated equally weighted portfolio returns for all the portfolio - small-value, small-neutral, small-growth, big-value, big-growth, big-neutral, small-losers, small-winners, big-losers, big-winners. For returns of stocks, we use logarithmic returns across the years. Risk-free rate taken is **2.5%**.

RESULTS (Obtained from Excel)

Here all the results are for a single stock - Industrial_And_comm.

1. **Coefficients** of different factors in CAPM, Fama French 3 factor model, the Carhart model using regression analysis are shown -

Fama French Coeff.	
	Coefficients
Alpha(intercept)	1.064
Beta SMB	-0.631
Beta HML	0.108
Beta Market	1.367

Only CAPM model Coeff.	
	Coefficients
Alpha (intercept)	1.333
Beta Market	1.421

Four Factor Coeff.	
	Coefficients
Alpha	0.819
Beta SMB	-0.621
Beta HML	0.076
Beta Market	1.375
Beta Mom	0.006

	Standard Error	R Square
Fama French Model	3.808593192	0.63551623
CAPM	4.541041577	0.46614299
Carhat four factor model	4.100279659	0.63180883

3

2. Graph of **error(firm-specific excess return) vs time** for different models

    error = (Actual excess return of the stock - excess return of stock calculated from a different model)
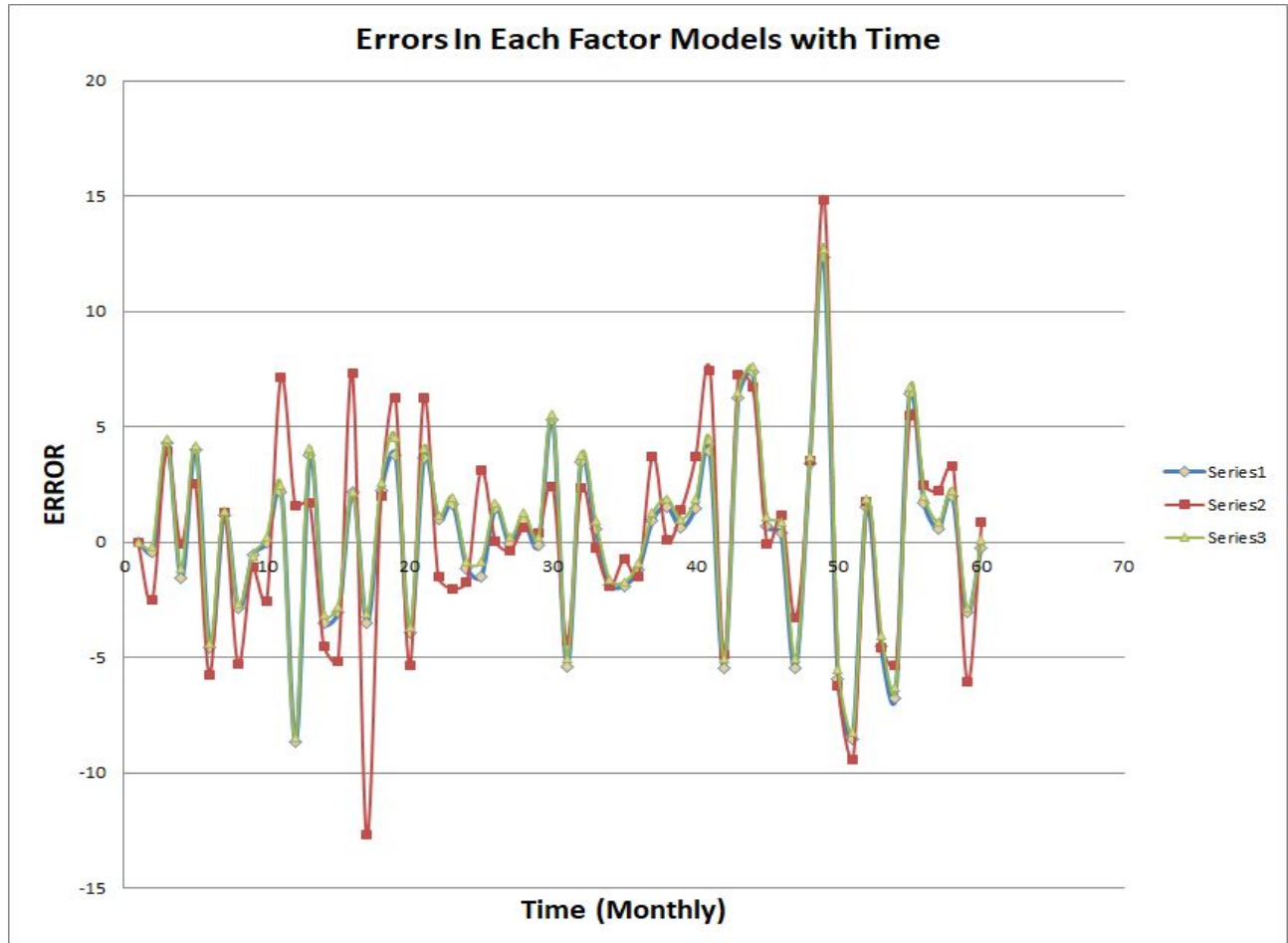
3. Graph for **comparing risk premium coming from each individual factors and total risk premium of the stock**

Comparsion Of Total Return With Individual Factor Return
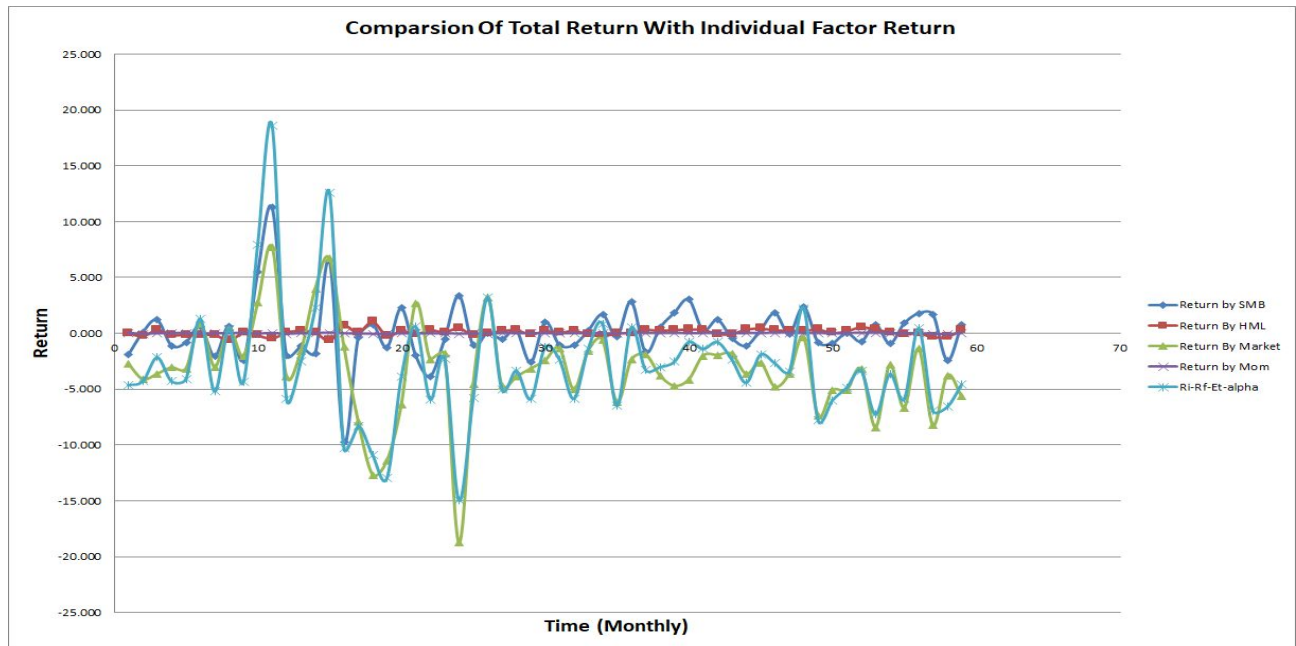
CONCLUSIONS

R-squared measure for each model for Industrial_And_Comm stock is tabulated below -

CAPM	Fama French Factor	Carhart Four Factor
0.466	0.635	0.631

R-squared (R2) is a statistical measure that represents the proportion of the variance for a dependent variable that's explained by an independent variable or variables in a regression model.

So by using this measure, we found that the Fama French factor Model (0.635) has the highest R squared value among CAPM (0.466), Carhart Four factor (0.631) and Fama French factor (0.635).

1. _Comparison By Regression Analysis(Figures of R2)_

> By **R square measure**, Fama French factor Model has the highest R square value among other models.

CAPM -   0.466 | Fama French - 0.635 | Carhat Four Factor - 0.631

>By **Standard Error**, Fama French factor Model has least standard error among others

CAPM -   4.541 | Fama French -3.808 | Carhat Four Factor - 4.100

> For analyzing each factor, we calculate **T-stats** and **P-value** of each factor coefficient mentioned in the excel file.

2. *Comparison By Graphs*

> To check whether the calculated FF factors explain the excess return of individual excess returns, we plotted graphs between Error in return of stock by each model with time (Monthly). We conclude from the graph that CAPM has high error among other models and Fama French and Carhart model have comparatively lower errors with time. (shown in excel). Hence, the Fama French model adequately explains the individual returns.

> Plotted graph between Total Return of stock and individual return contribution by each factor with time. We conclude from the graph that the Momentum factor contribution in return is very less as compared to other factors. and the contribution of the market is highest among others. (shown in excel).

Contribution of **market** in total return > Contribution of **SMB** in total return > Contribution of **HML** in total return > Contribution of **MOM** in total return.