

Evaluating Stock Performance: Insights from CAPM and Fama-French Models

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Abstract. This study compares the Capital Asset Pricing Model (CAPM) and the Fama-French three-factor model (FF3) in predicting stock returns. The study uses historical data from three comparable companies in the technology field to analyze the strengths and limitations of the two models in real-world Settings. In total, this study consisted of 750 experiments. The technology sector was chosen because its dynamic nature and significant impact on financial markets made it an ideal candidate for this type of analysis. Excel is a very good tool for comparison of experimental data, and this study uses its calculation methods. After a careful study in the field, including regression statistics and coefficient table data analysis, research regression model data in Excel were compared. Moreover, three groups of R Square data that could be compared were obtained. Through analysis, this study obtains a fact that Fama French model has found processes a higher accuracy. This study suggests that while CAPM offers a more straightforward method for estimating expected returns, the FF3 provides a more comprehensive and more accurate cognition by an increase of size and value factors.

Keywords: Fama-French three-factor models; Capital Assets Pricing Model; Excess Return; Regression Statistics; Coefficient table.

1. Introduction

Accurate stock return is the primary goal of financial markets. Capital Asset Pricing Model (hereafter CAPM) is a traditional asset pricing model. The research shows that CAPM has shortcomings caused by being too theoretical [1]. As measured by Jensen's Alpha, the actual market performance provides a distinct perspective on how well companies perform relative to their risk-adjusted expectations [2]. In contrast, Fama-French three-factor models (hereafter FF3) can evaluate expected returns from a more realistic perspective. This has been seen in the case that FF3 can predict the stock return by incorporating additional factors that capture the effects of company size and value, enhancing the accuracy of the results [3-5], ultimately making the FF3 a more comprehensive tool than CAPM.

The research shows that the FF3 was developed in response to the results of decades of research on American stock returns. It is worth emphasizing in this study that the three-factor model cannot clearly explain the characteristics of the world's largest emerging Chinese stock market [6]. Thus, this study will ignore the research on the Chinese stock. It contains three world-famous and representative companies in the technical field to compare which of the two asset pricing methods can be processed with higher reliability, accuracy, and feasibility.

2. Methodology

2.1. Sample

Data includes daily stock returns, market returns, and the risk-free rate from publicly available financial databases: Yahoo Finance, Investing and U.S. Department of the Treasury. The Fama-French factors (SMB and HML) are also collected from Kenneth R. French's data library.

This study selected three technology companies based on their comparable market size, industry relevance, and historical data. The selected companies are Apple Inc. (AAPL), Microsoft Corporation



(MSFT), Alphabet Inc. (GOOG). Additionally, the following data sources were utilized. Yahoo Finance for the daily stock prices (stock return) [8], Investing for supplementary market indices (market return) [9], U.S. Department of the Treasury for the risk-free rate [10], and Kenneth R. French's Data Library for the Fama-French three-factor model data [11], including the size premium (SMB) and value premium (HML). This research report contains the above data and compares accurately and in detail which model has the accuracy of predicting stock returns

2.2. Models Specification

This study includes two methods, CAPM and FF3. The detailed introduction of these two methods is presented below.

The single regression equation for CAPM is described as Equation (1).

$$R_i - R_f = \alpha + \beta_m(R_m - R_f) + \epsilon \quad (1)$$

Where α represents the intercept (Jensen's alpha) of the formula; β_m represents the market beta; ϵ represents the error term; R_i represents the return of the stock; R_f represents the risk-free rate. This model contains a dependent variable, stock excess return ($R_i - R_f$). And an independent variable, Market Risk Premium ($R_m - R_f$).

The multiple regression equation for FF3 describes as Equation (2).

$$R_i - R_f = \alpha + \beta_m(R_m - R_f) + \beta_s SMB + \beta_h HML + \epsilon \quad (2)$$

The FF3 regression formula has some differences in comparing the CAPM formula and it exists two more independent variables: SMB (Small Minus Big), which represents returns spread from within the difference between small-cap and large-cap stocks; HML (High Minus Low), which represents the return spread between high book-to-market and low book-to-market stocks. Moreover, β_s and β_h represents the coefficients of the underlying assets. The others stay the same.

After calculating the excess returns for both the stock and the market. The study uses multiple regression analyses to estimate the coefficients for each model by using Excel's Data Analysis Toolpak, and these two models will return statistical outputs for this study, i.e., Regression Statistics, R Square, Coefficients, and P-Value, which will be used later for data analysis.

3. CAPM Result & Analysis

This study totally collects 750 samples by analyzing three technology companies respectively: Apple Inc. (AAPL), Microsoft Corporation (MSFT) and Alphabet Inc. (GOOG). The reason for choosing these is the development of these companies tends to be smooth and competitive. In this study, 250 data of each company are collected daily from January 1st, 2021, to December 30th, 2021.

Table 1. CAPM Regression Statistics

	Multiple R	R Square	Adjusted R Square	Standard Error	Observations
AAPL	0.680221583	0.462701402	0.460534875	0.011586009	250
MSFT	0.712802243	0.508087037	0.506103517	0.00928378	250
GOOG	0.691643505	0.478370737	0.476267394	0.010816953	250

Table 1 shows the CAPM regression statistics, it indicates that, by averaging the R Square of three comparable data, it can explain an approximately 48.30% of the variance in the excess returns of these stocks, the average Adjusted R Square of 0.4810, which is relatively close to the average R Square, this confirms the model's robustness. The average standard error of 0.0106 indicates that the

predictions are close to the actual excess returns, this part reflects that the CAPM model has certain forecasting accuracy for these companies. Overall, the CAPM model provides a moderate fit for explaining the excess returns of AAPL, MSFT, and GOOG.

Table 2. CAPM Coefficient table

	Coefficients	Standard Error	t Stat	P-value
AAPL				
Intercept	0.000794412	0.000743176	1.06894247	0.286134927
MRP (Market Risk Premium)	1.305564575	0.089336712	14.61397615	2.60843E-35
MSFT				
Intercept	0.001040735	0.000595501	1.747663243	0.081760001
MRP (Market Risk Premium)	1.145702078	0.07158482	16.00481891	4.40338E-40
GOOG				
Intercept	0.00395623	0.000693845	5.701890092	3.35719E-08
MRP (Market Risk Premium)	1.257848149	0.08340672	15.08089686	6.53734E-37

Table 2 explains the CAPM Coefficient Table for three companies, It reveals the deep relationship between market risk premium and stock excess return. The average intercept coefficient of 0.0018, with an average standard error of 0.0007, suggests a small number of the intercept, while not statistically significant, the high average t statistics and extremely low p-values for the MRP coefficients reinforce the significance of the market risk premium in explaining the excess returns of these companies. In general, the market risk premium still possesses significance of predicting the excess return.

4. FF3 Result & Analysis

Table 3 provides the FF3 regression statistics for AAPL, MSFT, and GOOG. The model includes three factors, including two additional factors: size (SMB) and value (HML).

Table 3. FF3 Regression Statistics

	Multiple R	R Square	Adjusted R Square	Standard Error	Observations
AAPL	0.756651041	0.572520797	0.567307636	0.010376282	250
MSFT	0.830890648	0.690379268	0.686603406	0.007395269	250
GOOG	0.738611974	0.545547648	0.540005546	0.010137396	250

Through data analysis, this study proves that FF3 model can provide a more synthetical and precise assessment for the asset value. When FF3 uses these additional factors, the average R square of the model is 0.6028, which explains the correctness of the excess returns of these stocks is 60.28%, indicating a more suitable for explaining the excess returns of the three companies than the CAPM model. The table again shows the highest adjusted R-square, indicating that the model is robust in explaining its gains.

Table 4 shows the coefficient analysis of FF3 regression results. As a three-factor model, there are three different factors involved. The MRP is again a significant predictor for all three companies, with highly significant value of approximately 1.2364, indicating that higher market risk is strongly associated with higher returns. The SMB factor is only significant for MSFT and GOOG with a negative average coefficients of approximately -0.0015, which means that smaller firms tend to have higher returns for these companies. However, the SMB factor it is not significant for AAPL. This can be explained by AAPL's large market capitalization, market dominance, and the perception of stability that comes with its size. Nonetheless, the HML factor is significant and negative for all three companies, which explains a fact that higher book-to-market ratios (value stocks) tend to have lower returns. The average coefficient for HML is approximately -0.0041.

Table 4. FF3 Coefficient Table

	Coefficients	Standard Error	t Stat	P-value
AAPL				
Intercept	0.000794412	0.000743176	1.06894247	0.286134927
MRP (Market Risk Premium)	1.305564575	0.089336712	14.61397615	2.60843E-35
SMB	-0.00057031	0.000796794	-0.71576219	0.474817044
HML	-0.00459374	0.000584129	-7.86426009	1.16876E-13
MSFT				
Intercept	0.001040735	0.000595501	1.747663243	0.081760001
MRP (Market Risk Premium)	1.145702078	0.07158482	16.00481891	4.40338E-40
SMB	-0.00204885	0.000567882	-3.60787261	0.000373881
HML	-0.00468722	0.000416314	-11.2588669	5.44293E-24
GOOG				
Intercept	0.00395623	0.000693845	5.701890092	3.35719E-08
MRP (Market Risk Premium)	1.257848149	0.08340672	15.08089686	6.53734E-37
SMB	-0.00196279	0.00077845	-2.52141363	0.012321243
HML	-0.00303971	0.000570681	-5.32646467	2.25988E-07

5. Comparisons

Figure 1 shows a comparison between FF3 and CAPM, it provides a distinct contrast to R Square for the two models. R-squared is a useful metric for evaluating the fit of a regression model, it helps to some extent in understanding the variability of the independent variable explaining the dependent variable. From the graph, the data gap of each group proves that FF3 model explains more variance in the dependent variable than CAPM model in general.

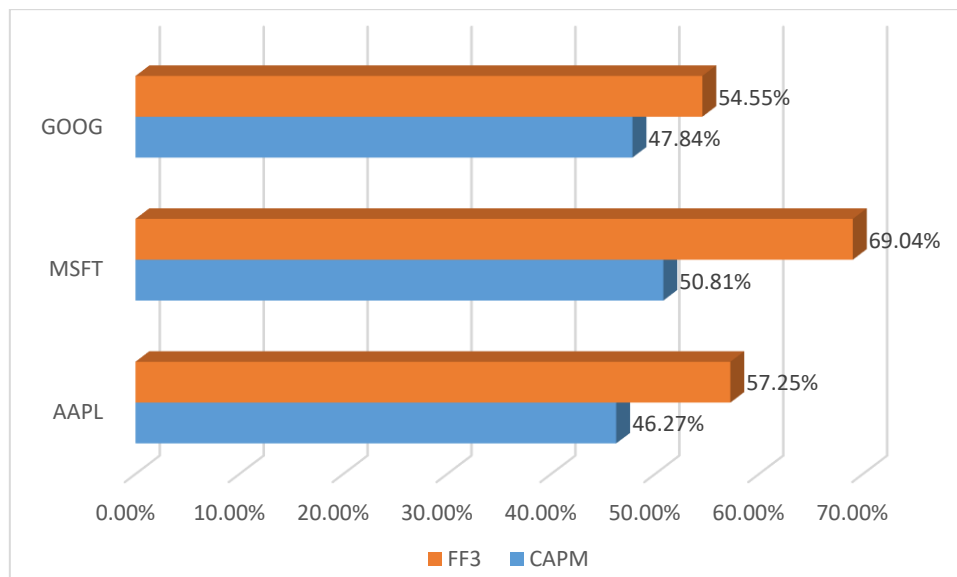


Figure 1. R Square comparison between FF3 and CAPM

6. Conclusion

In summary, this research revolves around the differences between CAPM and FF3. It shows a higher R Square in the results performed by FF3 than CAPM, which indicates a better accuracy on calculating the stock return for companies. A restriction in this study that all the historical data for investigating are not gathered from Chinese stock market since the differences in market parameters affect the accuracy of the FF3. The most significant element in these two models is Market Risk Premium with no debt. The factors causing the difference in accuracy are because of the two market

factors added by FF3: SMB and HML. Although, the limitation still exists. SMB factor shows a mixed significance, showing insignificant for Apple but significant with negative coefficients for Microsoft and Google, this illustrates that the size of the latter two firms is inversely related to stock returns.

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