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FAMA FRENCH THREE FACTOR MODEL: THEORETICAL APPROACH

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Abstract
The paper describes the evolution of asset pricing models and the developments made in the past years. It makes an attempt to explain the different asset pricing model with special reference to the Fama French Three Factor Model. Complete methodology of the model has been described to make it easy for the researchers to apply. The Fama-French three-factor model is a better performer than the Capital asset pricing model in explaining the cross-sectional differences in returns in Indian stock market as suggested by the literature. The Fama French model is formed on the basis of portfolios which are constructed using two variables – market capitalization (size effect) and ratio of book-to-market equity (value effect). This study may provide a strong support for a broader and generalized asset pricing model having multiple risk factors.

Key words: Asset Pricing Models, CAPM, Fama French three factor Model, Size effect, Value effect.

1. Introduction

Asset Pricing Models explain the relationship between risk and return. The Single Index Model developed by Sharpe (1964) explains that only one factor (namely market return) is sufficient to explain variations in returns of a security. The model also suggests that the security or portfolio risk can be divided into two parts, namely, unsystematic risk (also known as diversifiable risk), and systematic risk (also known as non-diversifiable risk). Unsystematic risk is the security specific risk and can be eliminated by changing the portfolio suitably whereas Systematic risk is associated with overall movements in the general market and thus cannot be eliminated. It is also referred to as the market risk. Since unsystematic risk can be diversified , there is a need to diversify the systematic risk in order to maximize the wealth of the shareholder.

Based on the Single Index Model, Sharpe (1964), Lintner (1965) and Mossin (1966) independently developed a model known as the Capital Asset Pricing Model (CAPM). The Capital Asset Pricing Model (CAPM) relates the expected rate of return of a security to its systematic risk which is measured through beta. CAPM is the oldest complete model of asset pricing, and explains the differences in expected returns due to differences in the systematic risks of assets.

After the development of Single Index Model and CAPM, there were many empirical studies that tested whether the model adequately describes the way stock market prices behave in practice. Many empirical researchers have found that there are influences beyond the market that cause stocks prices to move together and this laid to the development of multi-index (multifactor) models. Specifically, these studies have found through their empirical researches that single factor (market) is not sufficient in explaining differences in security returns, as stated by single index model and CAPM. Company characteristics like Firm size (measured in terms of market capitalization) , earning- yield (E/P Ratio) , Leverage Cash flow to price (C/P ratio) and the firm's book-to-market equity ratio. These company characteristics together were found to provide a better explanation than market factor alone for the cross-section of average stock returns.

Fama and French developed a three-factor model in 1992. They empirically examined the joint role of market return, firm's size, firm's book-to-market equity ratio, earning yield (E/P ratio) and leverage in the cross-section of average stock returns using a multifactor approach. They found that (a) the excess market return has some information about average returns; and (b) the combination of size (market capitalization) and book-to-market absorbs the role of leverage and earning yield (E/P) in average stock returns. Based on their empirical findings in Fama and French (1992), Fama and French (1993) propounded a three-factor model, comprising of the market factor and two mimicking portfolios that proxy for common factors in returns relating to size and book to market equity. They showed that their three-factor model captures much of the variations in the cross-section of average stock returns in a portfolio, which is missed by Sharpe's Single Index Model.

2. Review of Literature

The CAPM model developed by Sharpe (1964), Lintner (1965) and Mossin (1966) independently stated that the expected returns of a security (or a portfolio) can be explained by the expected market risk premium, and the degree of sensitivity defined as the 'beta' of the security (or portfolio). The risk of a stock can be decomposed into two components. The first component is the systematic risk (beta), which is related to the overall market and the second component is non-systematic risk, which is specific to the individual stock. Investors are rewarded only for the systematic risk as the unsystematic risk can be diversified away by holding a diversified portfolio of assets.

Basu (1977) found that stocks with lower price to earnings (P/E) ratios provided higher risk adjusted returns than stocks with higher P/E ratios. Banz (1981) found that stocks of firms of smaller size provided higher risk adjusted returns than stocks of firms of larger size. Similar anomalous patterns were found with respect to other fundamentals like leverage , and book-to-market equity.

Fama and French (1992) studied the joint roles of market beta, size, earnings/price (E/P) ratio, leverage and book-to-market equity ratio in the cross-section of average stock returns for NYSE, Amex and NASDAQ stocks over the period 1963-1990. In that study, the authors found that beta has almost no explanatory power. On the other hand, when used alone, size, E/P, leverage and book-to-market equity have significant power in explaining the cross-section of average returns. When used jointly however, size and book-to-market equity are significant and they seem to absorb the effects of leverage and E/P in explaining the cross section average stock returns. Fama and French (1992), therefore, argued that if stocks are priced rationally, risks must be multidimensional.

Fama and French (1993) extended the Fama and French (1992) study by using a time-series regression approach. The analysis was extended to both stocks and bonds. Monthly returns on stocks and bonds were regressed on five factors: Returns on a market portfolio, a portfolio for size and a portfolio for the book-to-market equity effect, a term premium and a default premium. For stocks, the first three factors were found to be significant and for bonds, the last two factors. As a result, Fama and French (1993) construct a three-factor asset pricing model for stocks that includes the conventional market (beta) factor and two additional risk factors related to size and book-to-market equity. They find that this expanded model captures much of the cross-section of average returns amongst US stocks. Thus, Fama and French proposed a three factor asset pricing model by adding these two variables with the CAPM beta. While Fama and French (1992) adopted a cross-sectional regression approach of Fama and MacBeth (1973), Fama and French (1993) used a time-series regression approach.

Fama and French (1995) explored the relationship between risk factors and profitability. They found that high book-to-market equity (BE/ME) firms tend to be persistently distressed and low BE/ME firms are associated with sustained profitability. The returns to holders of high BE/ME stocks are therefore a compensation for holding less profitable and riskier stocks. They showed that book-to-market equity and slopes on HML in the three-factor model proxy for relative distress. Weak firms with persistently low earnings tend to have high BE/ME and positive slopes on HML; strong firms with high earnings have low BE/ME and negative slopes on HML.

Singh and Yadav (2015) did a comparative study on the Capital Asset Pricing Model, the three factor model of Fama and French (1993), and the five factor model of Fama and French (2015) – on Indian stock market. The study is based on the constituent companies of CNX 500. It was found that the three factor model performs better than the Capital Asset Pricing Model. For portfolios formed on investment, the five factor model performs better than the other models. However, the four factor model (without an investment factor) is a more parsimonious model.

3. Propositions

1. Is there a significant size effect in Indian stock returns?
2. Is there a significant value (BE/ME) effect in Indian stock returns?
3. Is the Fama-French three-factor model a better descriptor of return generating process in Indian context as compared to Single Factor Model?

4. Methodology used in Fama French Three Factor Model

4.1Sample

The data can be collected from the CMIE Prowess database- the widely used database for academic research in India

4.2 Definitions

a) Market factor: Market factor refers to the coefficient of risk premium that is (Rm- Rf). It is obtained by regressing assts' excess return with Risk Premium. BSE SENSEX 500 index has been used as the proxy of Market Return to calculate the Risk Premium.

b) Size: Market equity (ME) has been used as the proxy for the size. Market Capitalization (ME) is calculated by multiplying market price per share by the number of shares outstanding. Market capitalization has been calculated in the beginning of October of each year *t.* Time lag of six three months has been assumed from the end of the financial year as the financial information will be available to the public by companies.

c) BE/ME: BE/ME refers to the ratio of Book value and market value per equity share. It is also termed as *value* factor. BE/ME has been calculated as book value per share in March-end of year *t,* divided by the market value per share March-end of year *t* .

4.3 Portfolio Formation

The Fama-French methodology involves a cross classification of stocks on two dimensions – size, measured by market capitalization (Number of outstanding shares X closing price), and value, measured by the ratio of book value per share to market price per share – B/M ratio. This classification is tabulated below:

		Value as measured by B/M ratio		
		High (H)	Medium (M)	Low (L)
Size	Big (B)	BH	BM	BL
	Small (S)	SH	SM	SL

4.3.1 Methodology used to create Size portfolios

Size portfolio is created at the beginning of October each year based on market capitalization of the firm as on March end of the year t. We defined big firms (B) as the top 10% by market capitalization and classified the remaining firms as small firms (S). The approach of classifying all firms above the median as large and the rest as small was considered inappropriate for the Indian market given the size distribution of firms, because the Indian market is dominated by a large number of small firms. So it would be inappropriate to give it 50% weightage.

4.3.2 Methodology used to create Value portfolios

Value portfolios are calculated at the beginning of October each year based on BE/ME ratio. The sample stocks are sorted in descending order on the basis of value. Following the Fama and French (1993) methodology, the stocks are grouped as below:

- High value group, H , consisted of the top 30% stocks in terms of the B/M ratio.
- Low stocks (low value group), L, comprised the bottom 30% stocks in terms of the B/M ratio.
- The remaining stocks were grouped as Medium (M) stocks.

Thus, six portfolios are created from the intersection of two sizes and three BE/ME Groups and are named as S/L, S/M, S/H, , B/L, B/M, and B/H. for example, S/L portfolio contains stocks of *small* ME(Market Equity) and *low* BE/ME companies, while B/H portfolio represents *big* ME companies with *high* BE/ME ratio. After calculating these portfolios, daily weighted returns on the six portfolios are calculated for each portfolio starting from Octobet of year *t* till September of year *t*+1. The portfolios are reformed every year in October of year *t*+1.

4.3.3 Size and Value factors return

After calculating the portfolio returns, the next step is to calculate the size and value factor returns namely SMB and HML as stated by the Fama- French Model. The market factor is calculated as (Rm – Rf). To calculate SMB and HML returns, as explained earlier, companies are divided into six groups based on size and the BE/ME ratio. The intersections of the two sizes and three BE/ME groups produce six portfolios of stocks which are used to compute the SMB and HML factor returns. The SMB factor return is the average of return on three small size portfolio i.e. average of (S/L, S/M, & S/H) minus the average of return on three big size portfolios i.e.(average of (B/L, B/M, B/H).

SMB is calculated as : (S/L+ S/M + S/H)/3 - (B/L+ B/M+ B/H)/3

Daily returns are calculated for each of the portfolio after the portfolio formation. The process was repeated until the portfolios were reconstructed. Similarly, the HML factor return is the average of return on two high BE/ME portfolios i.e. average of (H/S & H/B) minus the average of return on two low BE/ME portfolios i.e. average of (L/S & L/B).The process was repeated until the portfolios were reconstructed.

HML is calculated as : (H/S + H/B)/2 - (L/S+ L/B)/2

4.3.4 Portfolio formation date

Fama and French (1993) formed their portfolios in June of each year after considering a 6-month gap from the fiscal year ends (December) to account for the time taken for the publication of accounting data. As the fiscal year ends for most Indian firms is March, assuming a 6-months gap for publication of accounting data, we formed our portfolio in September of each year. In the size-value portfolio creation we have excluded all the firms with negative book value from the sample.

4.4 Estimation of Market Risk Premium

The market portfolio is estimated as the value-weighted portfolio of all the stocks involved in the estimation of SMB and HML factors. The risk-free rate Rf , computed using the 91-days T-bill rate, is deducted from the return of the market portfolio (BSE Sensex 500 index) to obtain the market risk premium or Rm −Rf. The 91-day T-bill rate is sourced from the Reserve Bank of India's weekly auction data. The implied yields have been converted to daily rates based on the number of trading days in the year following the issue.

5. Examination of explanatory factors of returns

Time series regression is run to examine whether different risk factors, individually or collectively, capture variations in returns. For this purpose, the time series regression equations used are listed below in equations :

a. Regression using the market factor (Rm – Rf) as explanatory variable .

Rp-Rf= c + b(Rm-Rf) + e

b. Regression using market and SMB as explanatory factors.

Rp-Rf= c + b (Rm-Rf) + s(SMB) + e

c. Regression using market and HML as explanatory factors.

Rp-Rf= c + b(Rm-Rf) + h(HML) + e

d. Regression using SMB and HML as explanatory factors.

Rp-Rf= c + s(SMB) + h(HML) + e

e. Regression using market, SMB and HML factors (the Fama French Model)

Rp-Rf= c + b(Rm-Rf) + s(SMB) + h(HML) + e

Where:

Rp is the daily return of a certain portfolio (S/L, S/M, S/H, B/L, B/M, B/H). *Rf* is the daily risk free rate. Rm is the daily return on market. For the purpose of this study, the BSE SENSEX 500 index has been used as a surrogate for market. *SMB* (Small minus Big) represents the size factor. HML (High minus Low) represents the BE/ME (value) factor. The loadings *b* , *s* ,*and h* are the slope coefficients in the time series regression.

The significance of the explanatory factor(s) is tested using t-test. The test examines the null hypothesis that the slope of a regression line does not differ significantly from 0.The statistical significance of the t-value is specified using P-Value.

7. Conclusion

The study explains the methodology of the Fama- French three-factor model in a lucid manner to make it easy and convenient for the researchers. The model is a better performer than the Capital asset pricing model as suggested by literature in explaining the cross sectional differences in portfolio returns, in the Indian context systematically and robustly .Literature suggests that the empirical results are better for the Fama French model. It gives an insight that the asset pricing models needs to be worked upon and multiple risk factors needs to be considered. This study provides support for a broader, rational asset pricing model in which there are multiple risk factors.

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