Academic Research Review

Smart Beta & Three Factors Asset Pricing Model

Research Analysts: Ling Jiangyue, Lim Xuan Hui, Zhang Zequn

ABSTRACT

This paper introduces the concept of Smart Beta through Fama-French Three Factors Asset Pricing Model. We will first introduce the model in greater detail, followed by an explanation on our methodology for generating the trading algorithm. Finally, we will present our trading strategy, based on two main assumptions - zero transaction fees for maximal return and highly liquidable stocks for ease of acquisition.

INTRODUCTION AND MODEL

In the financial world, the Capital Asset Pricing Model (CAPM) is widely used to describe the returns of a portfolio or stock based on a single risk factor - market risk (Investopedia, n.d.). As an extension of the CAPM, the better performing Three Factors Model designed by Professors Eugene Fama and Kenneth French contains two additional factors - the **outperformance of small firms over big firms (SMB)** and the **outperformance of high book/market valued firms over small book/market valued firms (HML)**. The Fama-French Three Factors Model (Wikipedia, 2017) is given as follows:

$$r = R_f + \beta_1 (R_m - R_f) + \beta_2 * (SMB) + \beta_3 * (HML) + \alpha$$

where r is the return of a particular stock; R_f is the risk-free rate of return; R_m is the market return; α is the unexpected excess return. The coefficients of each factor given by β_1, β_2 and β_3 measure the influence of the corresponding factor on the overall expected return of the portfolio. The strategy of using of these factor-based β coefficients in constructing portfolio is known as Smart Beta strategy. As a combination of both passive and active investment strategies, Smart Beta investing offers the benefit of alpha acquisition by active fund management without the need to pay management fee. In this paper, we will discuss how to use the Smart Beta strategy to generate a profitable portfolio based on the above model.

METHODOLOGY

To ensure the relevance and accuracy of our result, we chose the built-in universe on Quantopian, QTradableStocksUS, which consists of over 1600 stocks that have high dollar trading volume. The top 1000 stocks in terms of market capitalisation are used to calculate the returns for big firm portfolio returns and the bottom 1000 stocks from the same category are used to calculate small firm portfolio returns. Thereafter, we approximated SMB by subtracting the big firm portfolio returns from the small firm portfolio returns. Likewise, we selected the top and bottom 1000 stocks as the high market-to-book ratio portfolio and the low market-to-book ratio portfolio. HML is approximated by taking the difference in returns of the two.

For simplicity, we used S&P 500 to estimate the market return. Risk free rate is estimated by 1-3 months US treasury bill returns. For each stock included in S&P 500, a multivariable linear regression is then performed based on the approximated values of market risk premium, SMB and HML over a period of approximately two months to obtain the values for β_1, β_2, β_3 and α. Based on these values of α and β, we then calculated the weight of each stock in S&P 500. Normalising the weight of each stock in the index allows us to determine the proportion of our capital that we should allocate to each of these stocks to obtain our portfolio.

OLS Regression Results

Dep. Variable:	R	R-squared:	0.319
Model:	OLS	Adj. R-squared:	0.263
Method:	Least Squares	F-statistic:	5.628
Date:	Sat, 30 Dec 2017	Prob (F-statistic):	0.00286
Time:	15:38:34	Log-Likelihood:	133.48
No. Observations:	40	AIC:	-259.0
Df Residuals:	36	BIC:	-252.2
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[95.0% Conf.	Int.]
Constant	-0.0012	0.002	-0.779	0.441	-0.004	0.002
F1	1.5878	0.393	4.035	0.000	0.790	2.386
F2	-0.1488	0.421	-0.354	0.726	-1.002	0.704
F3	-0.0464	0.370	-0.125	0.901	-0.797	0.704

Omnibus:	4.028	Durbin-Watson:	1.520
Prob(Omnibus):	0.133	Jarque-Bera (JB):	3.049
Skew:	-0.358	Prob(JB):	0.218
Kurtosis:	4.147	Cond. No.	314.

The above table shows the regression result of the Apple stock ('AAPL') in S&P 500 with two months worth of data points. The reason for choosing a two months data range is because of compromising between tracking up-to-date factors as well as ensuring adequate data points for regression. This two months data range is fixed and constantly shifts forward for every new trading day by including the latest data point and dropping the oldest.

As S&P 500 is constantly updated both in real world and in our algorithm, this is just an example to illustrate how our regression is done. From the table, we can see that the Prob (F-statistic) is 0.00286 which is smaller than the significance level of 0.05, indicating the regression result is significant. From the output, we can also see that F1, which stands for market risk factor, has a beta of 1.5878 and p-value of 0. This implies that the market risk factor is the main factor contributing to the estimation of the return of Apple stock historically.

TRADING STRATEGY

At the beginning of each trading day, we will collect historical data on stock returns and market risk premium $(R_m - R_f)$ from exactly one year ago to the trading day. As aforementioned, multivariable linear regression will be performed for each stock and respective normalised weight of each stock will also be calculated. A rebalance of the portfolio will be carried out each day based on the newly calculated normalised weights of stocks. This can be done by reallocating our investment capital proportionately against these weights.

IMPROVEMENTS

As Smart Beta strategy is factor-based, our research can be further expanded to use the more well-rounded Five Factors Asset Pricing Model (Fama & French, 2014) to determine expected return of a portfolio. In addition, we can also tap on indices other than the S&P 500 to further diversify our portfolio in order to minimise risk.

CONCLUSION

In conclusion, Smart Beta strategy is a robust method in the investment realm because it allows investors to take into consideration the various factors that are highly impactful on the expected return of their portfolios and alpha acquisition without the need to engage a fund manager. Similar to the discussed Fama-French Three Factors Model, there are countless other Smart Beta strategies that rely on more complicated factor models that involve more factors. One example

being the Arbitrage Pricing Model that involves infinite number of factors. Although it might seem intuitive that taking into account more factors will result in a more efficient portfolio, one should always note that many factors are not independent and may have an unexpected side-effects on the portfolio return.

REFERENCES

Fama, E. and French, K. (2014): *A Five-Factor Asset Pricing Model*
https://www8.gsb.columbia.edu/programs/sites/programs/files/finance/Finance%20Seminar/spring%202014/ken%20french.pdf

Investopedia, (n.d.): *Capital Asset Pricing Model - CAPM*
https://www.investopedia.com/terms/c/capm.asp

Wikipedia, (2017): *Fama-French three factor model*
https://en.wikipedia.org/wiki/Fama%E2%80%93French_three-factor_model