

## Second-year Paper

Jingwei Jin

**Title:** Test of Asset Pricing Models using Different Performance Metrics: Effects of Factors

### **Abstract:**

Based on the three-factor model of Fama and French (1993), more factors are considered and added to the model to see if they have a role in describing the average returns. A small set of right-hand-side (RHS) factors are used to explain the average returns for a cross section of left-hand-side (LHS) portfolios.

There are different kinds of performance metrics that show whether the models look good, such as GRS, average absolute intercept,  $sh^2(f)$ , and so on. GRS and t-statistics are used in hypothesis tests. The null hypothesis is that time-series intercepts (pricing errors) are all zero.

The four-factor models combine market factor, size factor, and pairs of value, profitability and investment factors. Additionally, there is one more kind of four-factor model which is the three-factor model (FF, 1993) enhanced with a momentum factor. International data from the four regions (North America, Europe, Japan and Asia Pacific) is used to find that both average value returns and average momentum returns decrease with size, except for Japan. The four-factor models capture the value and momentum patterns in average returns. And local models that use local factors perform much better than the global models. However, even the local models are less successful in describing average returns on the portfolios formed on size and momentum.

With the addition of profitability and investment factors, the five-factor model performs better than the three-factor model (FF, 1993). And the different sets of factors provide similar descriptions of average returns on the portfolios. Based on the international data from the four regions (North America, Europe, Japan and Asia Pacific), average returns generally increase with value and profitability factors, and are negatively related to investment factor.

Like four-factor models, local five-factor model is a better choice in application where the LHS portfolios are local. The value factor becomes redundant for US for describing average returns, and the investment factor is redundant for Europe and Japan. The main problem of the five-factor model is failure to capture the low average returns on small stocks whose returns behave like those of firms that invest a lot despite low profitability.

The six-factor model is formed by adding a momentum factor to the five-factor model (FF, 2015), where cash profitability factors dominate operating profitability factors only if  $sh^2(f)$  is used as the performance metric. Judged on  $sh^2(f)$ , the best model combines market factor, size factor, and small stock spread factors, and this model also wins on other metrics (lowest average absolute intercept, and lowest proportion of unexplained dispersion of LHS average returns). And the excess return factors can also produce higher  $sh^2(f)$  than spread factors.