

# Innovated power enhancement for testing multi-factor pricing models with a large number of assets

Xiufan Yu

*Pennsylvania State University*

*E-mail: xzy22@psu.edu*

**Abstract:** Testing multi-factor pricing models with a large number of assets is instrumental for asset pricing theory and practice. Due to the accumulation of errors in estimating high-dimensional parameters, traditional quadratic-form tests such as the Wald test perform poorly against the sparse alternative hypothesis in the presence of a few mis-priced assets. Fan et al. (2015) introduced a powerful testing procedure by adding a power enhancement component to the Wald test statistic and proved the power enhancement properties. To provide a promising alternative to Fan et al. (2015), we first introduce a new maximum-form test statistic and then study the asymptotic joint distribution of the Wald test statistic and the maximum test statistic. Surprisingly, we prove that two test statistics are asymptotically independent. Given their asymptotic independence, we propose an innovated power enhancement testing procedure to combine their respective power based on the celebrated Fisher's method (Fisher, 1925). Theoretically, we prove that the innovated power enhancement test retains the desired nominal significance level and achieves the asymptotically consistent power against the more general alternative. Furthermore, we demonstrate the finite-sample performance of our proposed innovated power enhancement test in simulations and a real application to testing market efficiency using asset returns of the Russel-2000 portfolio.