Informative Covariates, False Discoveries and Mutual Fund Performance

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Abstract

We present a novel multiple hypothesis testing framework for selecting outperforming mutual funds, named the functional False Discovery Rate "plus" ($fFDR^+$) . Our method incorporates informative covariates in estimating the False Discovery Rate (FDR). It gains considerable power in simulations over the Barras–Scaillet–Wermers (BSW, 2010) approach. We show that portfolios based on four new informative covariates and five well-known ones demonstrate truly positive performance and surpass the BSW portfolios and those based on sorted covariates. We note that all covariates carry valuable information in mutual fund selection that is persistent, even over the recent period.

Objective

We aim to detect active equity mutual funds that truly beat passive benchmarks with control of luck. The desired method should be more powerful and perform better than previous ones.

The $fFDR^+$ framework

Suppose we have m mutual funds and we assess each fund via testing its alpha:

$$H_0: \alpha = 0 \qquad H_1: \alpha \neq 0$$

which gives a p-value p. Suppose a procedure which selects R^+ funds as truly positive alpha but F among them are wrongly selected. We define:

$$FDR^+ = \mathbb{E}\left(\frac{F}{max\{R^+,1\}}\right).$$

Suppose there exists a covariate $Z \sim U[0,1]$ conveying information about the true alpha of the funds. To control the FDR^+ at a given target, we introduce a two-step procedure, namely $fFDR^+$:

1. We consider only group of funds having positive estimated alpha.
2. In this group, we estimate a null proportion function $\widehat{\pi_0}(z)$, and a joint density function $\hat{f}(p,z)$. Then the FDR^+ is estimated based on the two functions and a rejection region

$$\Gamma_\theta = \{(p,z) \big| \widehat{\pi_0}(z)/\hat{f}(p,z) \leq \theta\}.$$

At the given target, the θ can be determined, and funds are selected accordingly. This step is based on the $fFDR$ framework of Chen *et al.* (2021).

We benchmark the $fFDR^+$ to the FDR^+ procedure of BSW where the FDR^+ is estimated based on the significant threshold of p-value and the $\widehat{\pi_0}$, which is estimated as a constant.

Results

- **The $fFDR^+$ controls well the type I error FDR^+ at any given targets.**
- **At FDR^+ target of 10%, the gain in power of the $fFDR^+$ over the FDR^+ procedure of BSW varies from 10% to 30%.**
- **Portfolios based on $fFDR^+$ gain positive and higher alpha than the one of BSW.**
- **We propose four covariates based on asset pricing models and show that they are as informative as five well-known covariates under our framework.**
- **The $fFDR^+$ based portfolios also outperform the ones based on sorting on the corresponding covariate and the past funds' performance.**

Specifically, given an FDR target τ, we construct yearly rolling forward $fFDR\tau$ and $FDR\tau$ portfolios by implementing $fFDR^+$ and FDR^+ procedures on past five years data to select positive alpha funds with control of FDR^+ at the same level. Nine covariates, listed in legends of figures below, are used for $fFDR\tau$.

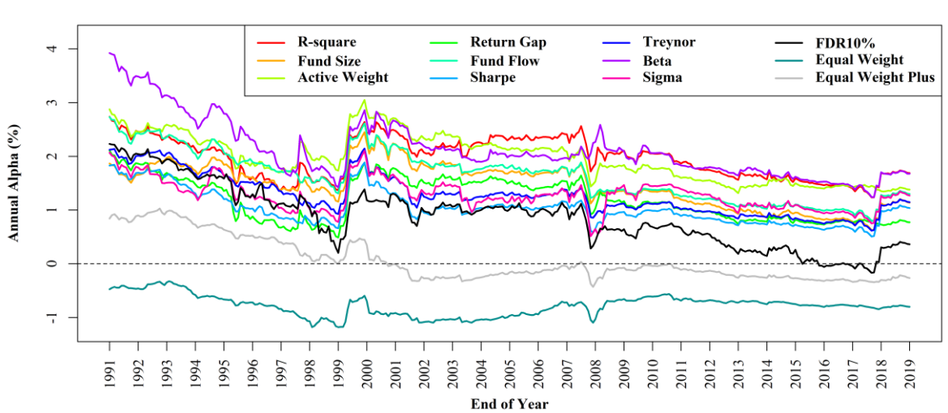

Fig. 1. The Carhart four-factor alpha evolution of the portfolios calculated based on their return from 1982.

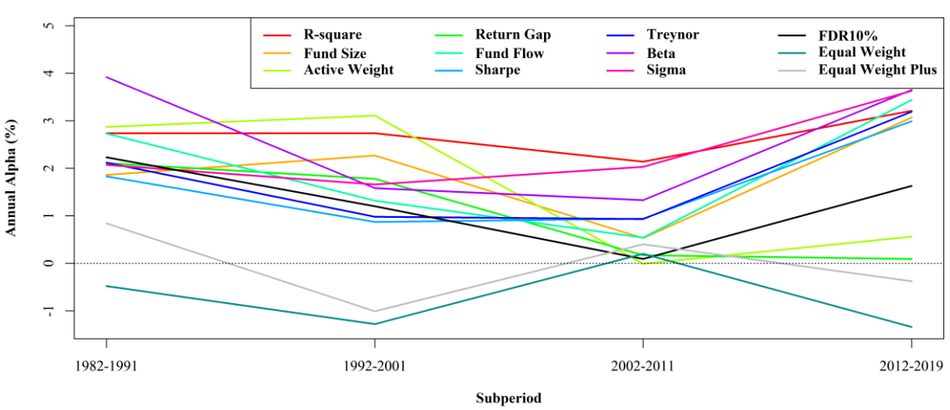

Fig. 2. The alpha of the portfolios in four sub-periods. It shows the persistence of the covariates' informativeness under the $fFDR^+$ framework, even for resent period.

Robustness checks

- The simulation results are robust regardless distributions of alpha, the structure of panel data, the forms of $\pi_0(z)$ and the cross-sectional dependence of error term.
- The analogous $fFDR^-\tau$ successfully selects unprofitable funds.
- The empirical results are robust to alternative target τ, proxies of covariate and restricted sub-sample.

Concluding discussion

- This paper introduces the $fFDR^+$ that incorporates informative covariates to raise the power of detecting outperformers and apply it to mutual fund investing.
- We conduct experiments to understand how well our method performs in controlling FDR and raising power compared to the FDR^+ method of BSW.
- We then construct empirical portfolios based on our new method and nine covariates. They generate positive and higher alpha than the one controlling FDR only or the ones based on sorting on the covariate and the past funds' performance.
- Thus, the paper has both methodological and empirical contributions.
- Caveats: the method requires large datasets. Otherwise, to gains remarkable discoveries one might need to set a higher FDR target. In era of big data, this is not worrisome for its applications, however.

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