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Testing portfolio efficiency with an unobservable zero-beta rate and non-Gaussian distributions: a finite-sample identification-robust approach

We consider the problem of testing portfolio efficiency when the zero-beta rate is unknown [Black Capital Asset Pricing Model (BCAPM)]. It is well known that standard asymptotically justified tests and confidence intervals are quite unreliable in this setup. We point out that this feature is associated with the fact that the zero-beta rate may be interpreted as a structural parameter that may be weakly identified, leading to a breakdown of standard asymptotic procedures based on estimated standard errors. The available exact procedures for the BCAPM, however, rely heavily on the assumption that model disturbances follow a Gaussian distribution, which does not appear to be satisfied by many financial return series. We propose exact simulation-based procedures for testing mean-variance efficiency of the market portfolio and building confidence intervals for the unknown zero-beta rate. The proposed methods are based on likelihood-ratio-type statistics, allow for a wide class of error distributions (possibly heavy-tailed) and are robust to weak identification of the zero-beta rate. Further, we suggest a general method which yields tighter bounds in both Gaussian and non-Gaussian cases. In order to build confidence intervals for the zero-beta rate in finite samples, a technique based on generalizations of the classic Fieller method (for the ratio of two parameters) is proposed. Empirical results on NYSE returns show that exact confidence sets are very different from the asymptotic ones, and allowing for non-Gaussian distributions substantially decreases the number of efficiency rejections.