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Alternative HAC Covariance Matrix Estimators with Improved Finite Sample Properties

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Abstract

HAC estimators are known to produce test statistics that reject too frequently in finite samples. One neglected reason comes from the OLS residuals used to construct the HAC estimator. If the design matrix contains leverage points, such as from outliers, then the OLS residuals will be downward biased. This makes the OLS residuals smaller than otherwise, thereby reducing their variance. Transformations to offset the bias via inflating the OLS residuals have been available in the related HC literature for some time, but these have been overlooked so far in the HAC literature. Using HC-inspired techniques and a range of simulations, this paper provides strong support for replacing the OLS residual-based HAC estimator with two new alternatives called HAC-PE and HAC-MDE when estimating coefficient standard errors to produce test statistics because they display much less size distortion in practice.

Keywords:

Covariance matrix estimation, Finite sample analysis, Leverage points, Hypothesis testing, Monte Carlo simulation, Inference.

1. Introduction

Accurate inference about the estimated coefficients from an ordinary least squares (OLS) regression model relies on a consistent estimator of the coefficient covariance matrix. If the OLS residuals have heteroskedasticity and/or serial correlation, then the usual coefficient covariance matrix will be inconsistent and using it to perform inference will lead to erroneous conclusions. As a result, alternative covariance matrix estimators have been proposed which are consistent to unknown forms of heteroskedasticity (HC) and/or autocorrelation (HAC), see for example [Eicker \(1963\)](#) and [White \(1980\)](#) for the HC estimator and [Newey and West \(1987\)](#) for the HAC estimator. However, the performance of these robust estimators deteriorates in finite samples.

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