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Sequences of bias-adjusted covariance matrix estimators under heteroskedasticity of unknown form

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Abstract The linear regression model is commonly used by practitioners to model the relationship between the variable of interest and a set of explanatory variables. The assumption that all error variances are the same, known as homoskedasticity, is oftentimes violated when cross sectional data are used. Consistent standard errors for the ordinary least squares estimators of the regression parameters can be computed following the approach proposed by White (Econometrica 48:817–838, 1980). Such standard errors, however, are considerably biased in samples of typical sizes. An improved covariance matrix estimator was proposed by Qian and Wang (J Stat Comput Simul 70:161–174, 2001). In this paper, we improve upon the Qian–Wang estimator by defining a sequence of bias-adjusted estimators with increasing accuracy. The numerical results show that the Qian–Wang estimator is typically much less biased than the estimator proposed by Halbert White and that our correction to the former can be quite effective in small samples. Finally, we show that the Qian–Wang estimator can be generalized into a broad class of heteroskedasticity-consistent covariance matrix estimators, and our results can be easily extended to such a class of estimators.

Keywords Bias · Covariance matrix estimation · Heteroskedasticity · Linear regression