

Appendix D

Appendix D.1

Newey-West HAC Standard Errors & Covariance

The Newey-West HAC Standard Errors & Covariance are the standard errors that have been calculated specifically to avoid the consequences of heteroskedasticity and serial correlation. They have been introduced by Newey and West (1987) and are based on the logic that, given the fact that heteroskedasticity and serial correlation affects only the variances and standard errors of the estimated coefficients without causing any bias of the estimates themselves then there is no need to adjust these estimates rather than to improve their variances and standard errors. The Newey-West HAC Standard Errors & Covariance is given by the following equation:

$$\hat{\Sigma} NW = \frac{T}{T-K} (X'X)^{-1} \hat{\Omega} (X'X)^{-1},$$
$$\hat{\Omega} = \frac{T}{T-K} \left\{ \sum_{t=1}^T u_t^2 x_t x_t' + \sum_{u=1}^q \left(1 - \frac{u}{q+1}\right) \sum_{t=u+1}^T (x_t u_t u_{t-u} x_{t-u}' + x_{t-u} u_{t-u} u_t x_t') \right\}$$

where T is the number of observations, K is the number of regressors, q , the truncation lag, is a parameter representing the number of autocorrelations used in evaluating the dynamics of the OLS residuals, u_t . Following the suggestion of Newey and West (1987), E-Views sets q using the formula:

$$q = \text{floor} (4(T/100)^{2/9})$$

Many studies have used the Newey-West HAC Standard Errors & Covariance to adjust for heteroskedasticity and serial correlation. Examples are Ackert and Smith (1993), Wu (2002), Chou et al. (2007) and Mazouz et al. (2009).

Appendix D.2

Wilcoxon Signed Ranks Test.

The Wilcoxon Signed Ranks test is a non-parametric test of the differences between two related samples or repeated measurements on a single sample. It is used instead of the paired Student's t-test when the population cannot be assumed to be normally distributed. It has been proposed by Wilcoxon (1945). The null hypothesis of the test assumes no significant differences between the two samples. Thus, the null hypothesis tested is $H_0: \theta = 0$. The test statistic W_+ is computed by ordering the absolute values $|Z_1|, \dots, |Z_n|$, the rank of each ordered $|Z_i|$ is given a rank of R_i . Denote the positive Z_i values with $\varphi_i = I(Z_i > 0)$, where $I(\cdot)$ is an indicator function. The Wilcoxon signed ranked statistic W_+ is defined as:

$$W_+ = \sum_{i=1}^n \varphi_i R_i.$$

Many studies have used the Wilcoxon Signed Ranks test. Examples are Dhillon and Johnson (1994), Park and Krishnamurti (1995), Mun et al. (2000), Mengoli (2004) and Coelho and Taffler (2008).