White's Test

The Goldfeld–Quandt test is not as useful as the LM tests because it cannot accommodate situations where several variables jointly cause heteroscedasticity, as in Equations (8.2a), (8.2b), and (8.2c). Also, by discarding the middle observations, we are throwing away valuable information. The Breusch–Pagan test has been shown to be sensitive to any violation of the normality assumption. (See Koenker, 1981, for a modification of their test in the presence of nonnormality.) Also, all the previous tests require a prior knowledge of what might be causing the heteroscedasticity. White (1980) has proposed a direct test for heteroscedasticity that is very closely related to the Breusch–Pagan test but does not assume any prior knowledge of the heteroscedasticity. **White's test** is also a large-sample LM test with a particular choice for the *Z*s, but it does not depend on the normality assumption. For these reasons, this test is recommended over all the previous ones. One might also carry out all the tests and see if the results are robust. The steps for carrying out White's test for heteroscedasticity are described for the following model. The extension for more general models is straightforward.

$$Y_t = \beta_1 + \beta_2 X_{t2} + \beta_3 X_{t3} + u_t \tag{8.3}$$

$$\sigma_t^2 = \alpha_1 + \alpha_2 X_{t2} + \alpha_3 X_{t3} + \alpha_4 X_{t2}^2 + \alpha_5 X_{t3}^2 + \alpha_6 X_{t2} X_{t3} \tag{8.4}$$

Step 1 Estimate (8.3) by the OLS procedure and obtain $\hat{\beta}_1$, $\hat{\beta}_2$, and $\hat{\beta}_3$.

Step 2 Compute the residual $\hat{u}_t = Y_t - \hat{\beta}_1 - \hat{\beta}_2 X_{t2} - \hat{\beta}_3 X_{t3}$, and square it.

Step 3 Regress the squared residual $\hat{u}_t^2$ against a constant, X_{t2}, X_{t3}, X_{t2}^2, X_{t3}^2, and $X_{t2} X_{t3}$. This is the auxiliary regression corresponding to (8.4).

Step 4 Compute the statistic nR^2, where n is the size of the sample and R^2 is the *unadjusted* R-squared from the auxiliary regression of Step 3.