GMM for Panel Data using Stata - Exercises

1. Use the production data in usbal89 to replicate the AR(1) specifications for log employment, log capital and log sales, reported in Table 3 of Bond (2002), and also in Table 3 of Blundell-Bond (2000).

2. More appropriate unit root tests can be obtained by using pooled OLS to estimate the Augmented Dickey-Fuller type specifications

   $$y_{it} = c_t + \alpha y_{i,t-1} + \xi_1 \Delta y_{i,t-1} + \xi_2 \Delta y_{i,t-2} + \varepsilon_{it}$$

   Implement these tests for the log employment, log capital and log sales series.

   Compared to the pooled OLS results you obtained in question 1, does this increase or reduce the confidence with which you reject the null hypothesis that $\alpha = 1$, i.e. that these are I(1) series?

3. Imposing constant returns to scale, the Cobb-Douglas production function can be written as

   $$y_{it} = \beta_n n_{it} + (1-\beta_n)k_{it} + \eta_i + v_{it}$$

   $$(y_{it} - k_{it}) = \beta_n(n_{it} - k_{it}) + \eta_i + v_{it}$$

   Letting $v_{it} = \rho v_{i,t-1} + e_{it}$ gives the representation

   $$(y_{it} - k_{it}) = \rho(y_{i,t-1} - k_{i,t-1}) + \beta_n(n_{it} - k_{it}) - \rho\beta_n(n_{i,t-1} - k_{i,t-1}) + (1-\rho)\,\eta_i + e_{it}$$

   Or, not imposing the common factor restriction,

   $$(y_{it} - k_{it}) = \pi_1(y_{i,t-1} - k_{i,t-1}) + \pi_2(n_{it} - k_{it}) + \pi_3(n_{i,t-1} - k_{i,t-1}) + (1-\rho)\,\eta_i + e_{it}$$

   Use the production data in usbal89 to replicate the dynamic production function specifications in the upper panel of Table 5 in Blundell-Bond (2000), which impose constant returns to scale.

   NB. The specifications in Blundell-Bond (2000) used the equivalent of gmm(y n k, lag(3 .)) rather than gmm(yk nk, lag(3 .)).

4. The constant returns to scale restriction can be tested using the parameterization

$$y_{it} = \beta_n n_{it} + \beta_k k_{it} + (1-\beta_n)k_{it} - (1-\beta_n)k_{it} + \eta_i + v_{it}$$

$$y_{it} = \beta_n n_{it} + (1-\beta_n)k_{it} + (\beta_n+\beta_k-1)k_{it} + \eta_i + v_{it}$$

$$(y_{it} - k_{it}) = \beta_n(n_{it} - k_{it}) + (\beta_n+\beta_k-1)k_{it} + \eta_i + v_{it}$$

   Use this to test the constant returns to scale restriction, allowing $v_{it} = \rho v_{i,t-1} + e_{it}$ and e_{it} to be MA(1).

   NB. To test the linear restrictions that the coefficients on k and l.k are both zero, you can use the command

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   test k l.k
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   after estimating the model.

   What do the system GMM estimates suggest about the validity of the constant returns to scale restriction?

   Comment on the first-differenced GMM estimates when this restriction is imposed.

5. Apply the unit root test suggested in question 2 to the series on the log of the sales-capital ratio (yk) and the log of the labor-capital ratio (nk).

   Do your results shed any light on the relatively good performance of the first-differenced GMM estimator in the dynamic production function specification where constant returns to scale is imposed?