

PhD Programme: Applied Econometrics

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## Computer Exercise II

### Panel Data Econometrics

References:

Bond, S.R. (2002) 'Dynamic panel data models: a guide to micro data methods and practice', Portuguese Economic Journal, 1, 141-162. An almost identical working paper version can be found at: <http://cemmap.ifs.org.uk/docs/cwp0902.pdf>

Blundell, R.W. and Bond, S.R. (2000), 'GMM estimation with persistent panel data: an application to production functions', Econometric Reviews, 19, 321-340 ([http://www.ifs.org.uk/publications.php?publication\\_id=2722](http://www.ifs.org.uk/publications.php?publication_id=2722))

#### 1. AR(1) specifications for company investment rates

Use the investment data in **invrat1** to replicate the AR(1) specifications for investment rates reported in Table 1 in Bond (2002). Note: the within estimates will be slightly different, the other estimates should be identical.

What do the results imply regarding the persistence of investment rates? What economic mechanisms might explain why the persistence is high (or low)?

#### 2. Estimating production functions based on micro panel data

Consider the following Cobb-Douglas production function:

$$[1] \quad y_{it} = \beta_n n_{it} + \beta_k k_{it} + \alpha_i + \varepsilon_{it} + v_{it},$$

where  $y$ ,  $n$ ,  $k$  denote output, labour and capital (in logs), respectively,  $\alpha_i$  is a firm fixed effect which is interpretable as time invariant total factor productivity,  $\varepsilon_{it}$  is a serially uncorrelated and homoskedastic measurement error in output, and  $v_{it}$  is time varying total factor productivity. Assume that  $v_{it}$  is serially correlated:

$$[2] \quad v_{it} = \rho v_{i,t-1} + e_{it},$$

where  $e_{it}$  is the productivity innovation, and  $\rho$  is the AR1 coefficient.

Both  $\alpha_i$  and  $v_{it}$  are assumed observed to the manager and unobserved to the econometrician. We can therefore expect the factor inputs (capital and labour) to be correlated with both  $\alpha_i$  and  $v_{it}$ , simply because these unobserved productivity terms affect the marginal product of capital and labour, and so determine factor demand.

Blundell and Bond (2000) propose the following equation as a basis for estimation of the production function:

$$[3] \quad y_{it} = \pi_1 n_{it} + \pi_2 n_{i,t-1} + \pi_3 k_{it} + \pi_4 k_{i,t-1} + \pi_5 y_{i,t-1} + \alpha_i^* + \varepsilon_{it}^* + v_{it}^*,$$

see eq. (2.3) in their paper.

### Questions:

- (a) Explain how [3] is related to [1] and [2]. Write down the non-linear (common factor) restrictions in [3] implied by [1] and [2].
- (b) Blundell and Bond report results for various estimators that control for firm fixed effects. In some of their regressions, they also address the potential problem that capital and labour may be correlated with the time varying part of total factor productivity, by using lags of capital and labour as instruments. Why are lagged factor inputs more convincing instruments if we are estimating [3], compared to [1]?
- (c) Use the production data in **usbal89** to replicate the dynamic production function specifications in columns 1 (OLS) and 2 (WITHIN) in the upper panel of Table 4 in Bond (2002). Interpret the results. Test if the common factor restrictions in [3] can be accepted. What do the results indicate with regards to the returns to scale? Interpret the time trend.
- (d) Take first differences of [3] in order to remove the firm fixed effect. Do you expect output, capital and labour lagged 2 periods (t-2) to be valid and informative instruments, for the first-differenced equation? What are the advantages and disadvantages of using these variables dated t-3 as instruments instead?
- (e) Replicate the results in columns 3 and 4 in the upper panel of Table 4 in Bond (2002). Interpret the results. Test if the common factor restrictions in [3] can be accepted. Is there any evidence that these models are mis-specified? What do the results indicate with regards to the returns to scale?