

ECONOMICS 6002 CLASS 8  
PANEL DATA MODELS

1. Two types of econometric models: cross-section and time series
  - a. Each has advantages and disadvantages
    - i. Cross-section captures individual variability
    - ii. Time series captures dynamic adjustment
  - b. Panel data models incorporate elements of both types of models, and capture both aspects. Data has both a unit and a time dimension.
  - c. Two types of panel data models
    - i. Short, wide panels -
      - (1) time dimension short
      - (2) panels sometimes unbalanced
    - ii. Long, narrow panels
      - (1) time dimension long - usually longer than unit dimension
      - (2) usually balanced
  
2. Estimation of panel data models
  - a. Panel aspect enables the estimation of individual-specific effects, which OLS over the entire sample does not take into account.
    - i. The resultant cross-sectional correlation means that the disturbance is not IID. This reduces the efficiency of OLS in utilizing panel data. OLS ignores the panel structure of the data, and so does not use all available information.
    - ii. If the independent variables are correlated with the individual effects, the CLRM assumption that the disturbance is uncorrelated with the independent variables is violated. OLS is biased as a result.
  - b. Fixed effects model
    - i. The fixed effects model incorporates the effects specific to individual units into a fixed but unknown parameter.
    - ii. Total variation and cross-variation in the model variables can be decomposed into within-group and between-group variability. OLS uses total variability, the fixed effect model only within-group variability.
      - (1) Utilizing only within-group variability eliminates the effect of the fixed individual-specific parameters.
      - (2) But because some sampling variation (between-group) is discarded, this may not be fully efficient in estimation of slope terms  $\beta$
    - iii. FE model cannot estimate the effect of independent variables that do not vary *within* groups
  - c. Between-groups (group means) estimator likewise only uses between-groups variation
    - i. Because only some of the sample variation is utilized in estimation, this is not fully efficient either.
    - ii. If the independent variables are correlated with the individual effects, this estimator is biased as well, for the same reasons as OLS.
  - d. Random effects model
    - i. The random effects model treats the individual-specific effects as a *random variable*, incorporated in the disturbance term, and not as a fixed parameter.
    - ii. OLS does not estimate this model efficiently, because of the presence of stochastic interdependence in the disturbance within a group.
      - (1) If  $\eta_{it} = u_i + \varepsilon_{it}$ ,  $\text{cov}(\eta_{it}, \eta_{is}) = \text{var}(u)$
    - iii. FGLS can estimate this model efficiently if consistent estimators of  $\text{var}(u)$  and  $\text{var}(\varepsilon)$  are available.
    - iv. If the random effects are correlated with the independent variables  $x$ , the random effects model is biased (whether estimated by GLS or OLS), but the FE model is unbiased.
      - (1) The Hausman test can be used to test for this. If the FE and RE estimators converge to the same value, there should be no significant difference between the two estimates. In this case, RE is better because it is more efficient.