Panel Data Methods

$y_{it} = \beta_0 + \beta_1 x_{it1} + \ldots + \beta_k x_{itk} + u_{it}$

2. Advanced

Ch.14 Advanced Panel Data Methods

1. Fixed Effects Estimation
2. Random effects Models
3. Applying Panel Data Methods to Other Data Structures

14.1 Fixed Effects Estimation

- Fixed effects transformation

  $y_{it} = \beta_1 x_{it} + a_i + u_{it}$ (14.1)

  $\bar{y}_i = \beta_1 \bar{x}_i + a_i + \bar{u}_i$ (14.2)

  $\ddot{y}_{it} = \beta_1 \ddot{x}_{it} + \ddot{u}_{it}$ (14.3)

  - The average of a_i will be a_i, so if you subtract the mean, a_i will be differenced out just as when doing first differences.

Cont. Fixed Effects Estimation

- The general ***time-demeaned*** equation

  $\ddot{y}_{it} = \beta_1 \ddot{x}_{it1} + \ldots + \beta_k \ddot{x}_{itk} + \ddot{u}_{it}$ (14.5)

  - We estimate it by pooled OLS.
  - Under strict exogeneity assumption, the fixed effects estimator is unbiased.
  - In this case, d.f. is $N(T-1)-k$, not $NT-k$, because we used up d.f.s calculating means.

First Differences vs Fixed Effects

- First Differences and Fixed Effects will be exactly the same when T = 2.
- For T > 2, the two methods are different.
- Probably see fixed effects estimation more often than differences – probably more because it’s easier than that it’s better
- Fixed effects easily implemented for ***unbalanced panels***, not just balanced panels.

14.2 Random Effects

- Start with the same basic model with a composite error,

  $y_{it} = \beta_0 + \beta_1 x_{it1} + \ldots + \beta_k x_{itk} + a_i + u_{it}$ (14.7)
- It becomes ***random effect model*** when we assume that;
  - $\text{Cov}(x_{itj}, a_i) = 0,\ t=1,\ldots,T;\ j=1,\ldots,k.$ (14.8)
- OLS would be consistent in that case, but composite error will be serially correlated.

Cont. Random Effects

- Transform the model and do GLS to solve the problem and make correct inferences.
  - End up with a sort of weighted average of OLS and Fixed Effects – use ***quasi-demeaned data***.
  - Many econometrics packages will do Random Effects for us.

$$\lambda = 1 - \left[\sigma_u^2 / \left(\sigma_u^2 + T\sigma_a^2\right)\right]^{1/2} \quad (14.10)$$

$$y_{it} - \lambda\bar{y}_i = \beta_0(1-\lambda) + \beta_1(x_{it1} - \lambda\bar{x}_{i1}) + \ldots + \beta_k(x_{itk} - \lambda\bar{x}_{ik}) + (v_{it} - \lambda\bar{v}_i) \quad (14.11)$$

Econometrics 7

Cont. Random Effects

- If $\lambda = 1$, then this is just the fixed effects estimator.
  - So, the bigger the variance of the unobserved effect, σ_a^2, the closer it is to FE.
  - Similarly, as T gets large, it's close to FE.
- If $\lambda = 0$, then this is just the OLS estimator.
  - The smaller the variance of the unobserved effect, σ_a^2, the closer it is to OLS.

Econometrics 8

Fixed Effects or Random?

- More usual to think need fixed effects, since think the problem is that something unobserved is correlated with the *x*'s.
- If truly need random effects, the only problem is the standard errors.
  - We can just adjust the standard errors for correlation within group.

Econometrics 9

14.3 Other Uses of Panel Methods

- It's possible to think of models where there is an unobserved fixed effect, even if we do not have true panel data.
- A common example is where we think there is an unobserved family effect.
  - Can difference siblings.
  - Can estimate family fixed effect model.

Econometrics 10

Additional Issues

- Many of the things we already know about both cross section and time series data can be applied with panel data.
  - test and correct for serial correlation in the errors.
  - test and correct for heteroskedasticity.
  - estimate standard errors robust to both.

Econometrics 11