CSSS/POLS 512 - Time Series and Panel Data Methods

Lab 5: Fixed and Random Effects in Panel Data Analysis

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Preview

- Panel Data Modeling
  - Fixed Effects
    - LSDV Estimator
    - FD Estimator
    - Two-way Fixed Effects
  - Random Effects
    - Estimation and packages
  - Counterfactuals

Fixed Effects

- Unit fixed effects

$$y_{it} = \alpha_i + \beta' x_{it} + \varepsilon_{it}$$

- Period fixed effects

$$y_{it} = \tau_t + \beta' x_{it} + \varepsilon_{it}$$

Fixed Effects

The FE model can control for omitted unobservable variables if we assume that these unobservables are **constant over time**.

- if we add α_i: control for time-invariant unit-level heterogeneity, such as some features of a country's culture.
  - A model with only unit fixed effects, will be equivalent a *within-estimator*.
- if we add τ_t: control for common shocks at each period, such as global economic conditions each year.
  - A model with only period fixed effects, will be equivalent a *between-estimator*.

Within Estimator

- Unit fixed effects are equivalent at adjusting to group-level means:

$$
\begin{aligned}
\tilde{y}_{it} =& y_{it} - \bar{y}_i \\
=& (\alpha_i - \bar{\alpha}_i) + \beta' \underbrace{(x_{it} - \bar{x}_i)}_{\tilde{x}_{it}} + \underbrace{(\varepsilon_{it} - \bar{\varepsilon}_i)}_{\tilde{\varepsilon}_{it}} \\
=& \beta' \tilde{x}_{it} + \tilde{\varepsilon}_{it}
\end{aligned}
$$

Uncertainty in panel data

- In panel linear models with no random effects, you must adjsut the standard errors.

$$\widehat{\sigma}^2 = \frac{1}{NT - N - K} \sum_{i=1}^{N} \sum_{t=1}^{T} \widehat{\widetilde{\varepsilon}}_i^2$$

Random effects

$$
\begin{aligned}
y_{it} &= \beta_0 + \beta_1 x_{it} + \alpha_i + \varepsilon_{it} \\
\alpha_i &\sim \mathcal{N}\left(0, \sigma_\alpha^2\right) \\
\varepsilon_{it} &\sim \mathcal{N}\left(0, \sigma_\varepsilon^2\right)
\end{aligned}
$$

- Partial pooling, random effects, multilevel, hierarchical. . .
  - all the same thing, different jargon.

An Overview of Panel Data Models

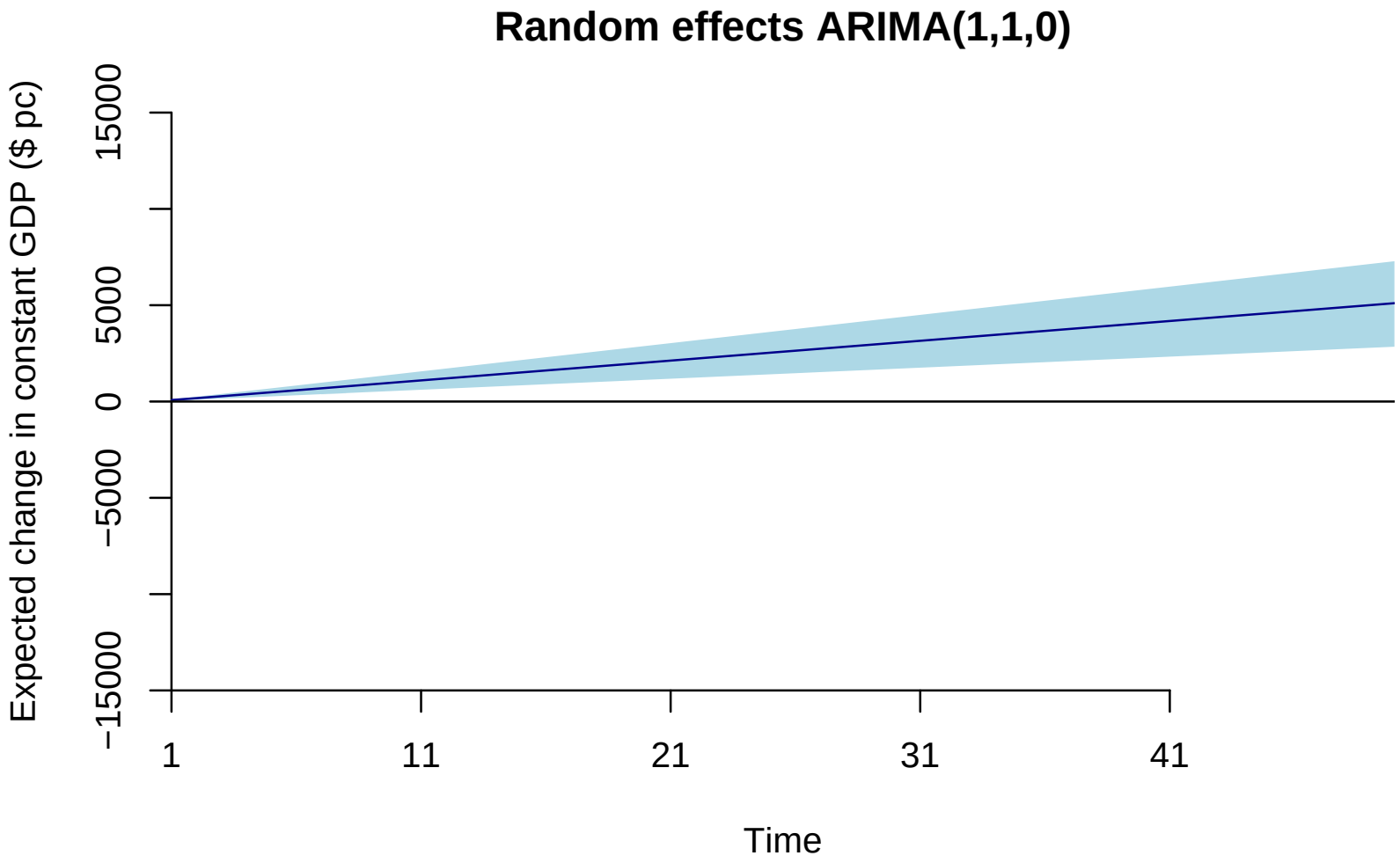
The full flexibility model:

$$\Delta^{di} y_{it} = \alpha_i + X_{it}\beta_i + \sum_{p=1}^{P_i} y_{i,t-p}\phi_i + \sum_{q=1}^{Q_i} y_{i,t-q}\rho_i + \epsilon_{it}$$

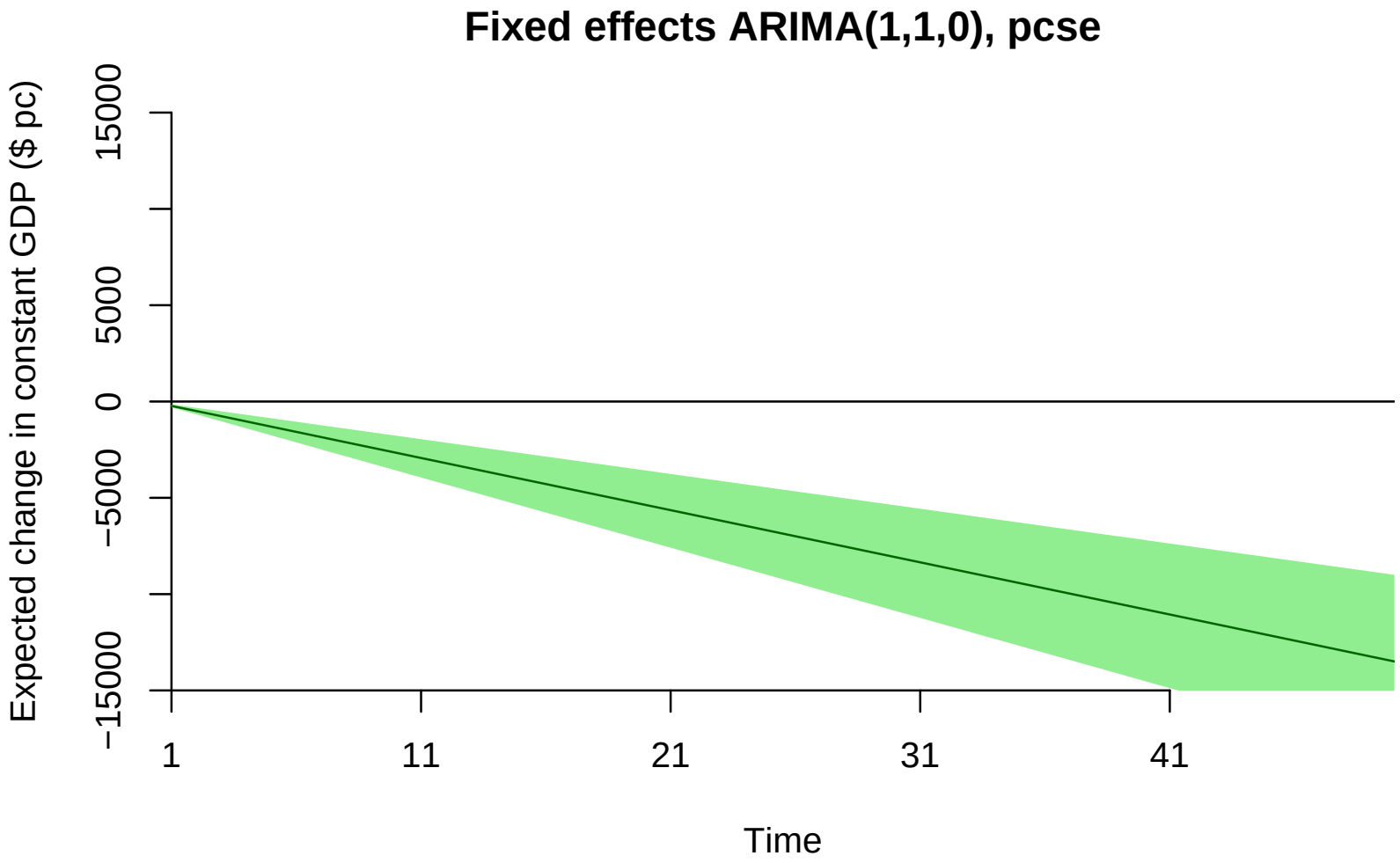
Counterfactual

- For today's lab, you will need to install Chris's package simcf
- We will be suing `simcf::ldvsimev` to simulate counterfactuals.

Counterfactual: random effects ARIMA



Counterfactual: fixed effects ARIMA



Let's get started!

Please, open the file Lab5.Rmd.