

# **Panel Data**

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Complementary course notes  
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## 1 INTRODUCTION

Example macro panel data:

Maddison, 2007, and IFS

- Formatting data
- Descriptive statistics
- Graphs
- Maps

## 2 FIXED EFFECTS ESTIMATORS

### 2.1 Simultaneous equations models with exogenous explanatory variables

Four different models:

M1:  $\alpha \neq, \beta \neq$  . Estimation individual by individual (GLS).

M2:  $\alpha =, \beta =$  . Equal constant terms and slopes (presence of homogeneity).

M3:  $\alpha \neq, \beta =$  . Equal slopes, different constant terms.

M4:  $\alpha =, \beta \neq$  . Equal constant terms, different slopes.

Choosing between them using

#### Test for Homogeneity:

- a. Estimate the extended/unrestricted model.
- b. Estimate the restricted model.
- c.  $H_0$  : Homogeneity (the unrestricted is not better than the restricted).  
Reject  $H_0$  if the F-value is higher than the critical value of the F-distribution.

$$F = \frac{(SSR_R - SSR_{UR})/r}{SSR_{UR}/df}$$

In ML we maximize the probability.

In OLS we don't care about the variance.

### 2.2 The fixed effects model

### 2.3 Within and between estimators

### 2.4 Effects of group and time

## 3 RANDOM EFFECTS ESTIMATOR

### 3.1 The random effects model

### 3.2 The generalized least squares estimation

### 3.3 Feasible Generalized Least squares (unknown )

## 4 FIXED EFFECTS VS. RANDOM ESTIMATOR

4.1 The Breush Pagan test

4.2 The Hausman test

5 HETEROSKEDASTICITY AND AUTOCORRELATION IN PANEL DATA

5.1 Heteroskedasticity in fixed effect model

5.2 Heteroskedasticity in random effects model

5.3 Autocorrelation in the fixed effect model

5.4 Autocorrelation in the random effects model

6 INCOMPLETE PANELS

6.1 Fixed effects

6.2 Random effects

7 DYNAMIC PANELS