

# Pandas and Statsmodels

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- Recall human capital-augmented Cobb-Douglas production function:

$$Y = AK^\alpha (hL)^{1-\alpha}, \quad (1)$$

where:

- $Y$ : production of final goods and services
- $K$ : stock of physical capital
- $L$ : labor force
- $h$ : human capital *per worker*
- $A$  *total factor productivity* or TFP

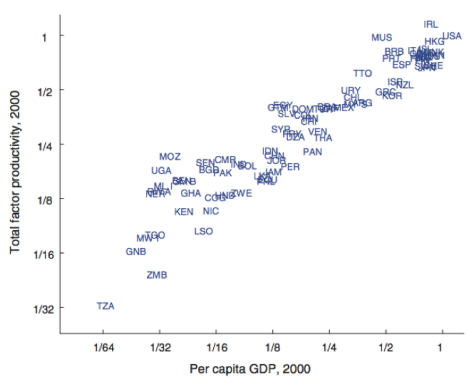
- In the production function, every variable *except*  $A$  is *measured*:
  - $Y$  measured by (real) GDP
  - $K$ : inferred from investment and depreciation data
  - $L$ : measured as number of workers or number of worker hours
  - $h$ : typically measured as average years of education
- Of course macroeconomic measurement is subject to *measurement error*.

- The production function *implies* a value for  $A$ :

$$A = \frac{Y}{K^{\alpha}(hL)^{1-\alpha}} \quad (2)$$

- $A$  captures all other determinants of production that are not reflected in  $K$ ,  $L$ , or  $h$ . For example:
  - Quality of economic and political institutions
  - Degree of technology adoption
  - Public health

**Figure 1: TFP and GDP per capita across countries.** All values relative to the US. Source: Jones and Romer (2010)



- *Even after accounting for their lower levels of human capital per worker and physical capital per worker, workers in lower-income countries are less productive*
- Workers in lower-income countries use what human and physical capital they *do* have less efficiently than workers in higher-income countries.
- Since TFP isn't directly observable, we still don't know exactly why.

**Jones, Charles I. and Paul M. Romer**, “The New Kaldor Facts: Ideas, Institutions, Population, and Human Capital,” *American Economic Journal: Macroeconomics*, 2010, 2 (1), 224–45.