Technology Gaps

- Given some level of techology and a technology growth rate, how long would it take for a country to achieve some level of technological sophistication?
- T_t is the technology level in time t
- Instead of thinking T levels, let's think about technology gaps

- Example
  How far "behind" is India from the US in terms of technology?
  * $T^{India}_{2018} = T^{USA}_{2018-G}$

  G is the number of years behind India is.
- 2018 - G is the year in which the US had the same technology as India does now.

$$\uparrow T = \left(\frac{T_{t+G}}{T_t}\right)^{1/G} - 1$$

Solve for T_{t+G}:

$$\hat{T}+1 = \left(\frac{T_{t+G}}{T_t}\right)^{1/G}$$

$$(\hat{T}+1)^G = \frac{T_{t+G}}{T_t}$$

$$T_{t+G} = T_t(\hat{T}+1)^G$$

multiply both sides by $(\hat{T}+1)^{-G}$

$$(\hat{T}+1)^{-G}T_{t+G} = T_t(\hat{T}+1)^G(\hat{T}+1)^{-G}$$

$$\underline{T_t = T_{t+G}(\hat{T}+1)^{-G}}$$

$$\frac{T_t}{T_{t+G}} = (\hat{T}+1)^{-G}$$

$$T_{t+G} = T^{US}_{2018}$$

$$T_t = T^{US}_{2018-G} = T^{I}_{2018}$$

$$\underline{\frac{T^I_{2018}}{T^{US}_{2018}} = (\hat{T}+1)^{-G}}$$

Example: $\hat{T} = 0.0054$

$G = 10$

$$\frac{T^I_{2019}}{T^{US}_{2019}} = (1.0054)^{-10} = 0.95$$

- India has 95% of the technology level as the US

Suppose we have a production function

$$Y_t = A_t K_t^{\alpha} (h_t L_t)^{1-\alpha}$$

A_t: productivity

- Suppose productivity is a combination of technology and efficiency

$$A_t^{us} = T_t^{us} \cdot E_t^{us}$$

$$A_t^{I} = T_t^{I} \cdot E_t^{I}$$

$$\frac{A_t^I}{A_t^{us}} = \frac{T_t^I}{T_t^{us}} \cdot \frac{E_t^I}{E_t^{us}}$$

↑ we can calculate this using "development accounting"

Efficiency gap:

$$\frac{E_t^I}{E_t^{us}} = \frac{A_t^I / A_t^{us}}{T_t^I / T_t^{us}}$$

$$\frac{E_t^I}{E_t^{us}} = \frac{A_t^I / A_t^{us}}{(\uparrow + 1)^{-\sigma}}$$

From the data, $A^{I}_{2009} / A^{us}_{2009} = .31$

- Suppose $G = 10$:

$$\frac{E^{I}_{2009}}{E^{us}_{2009}} = \frac{0.31}{(1.0054)^{-10}} = 0.33$$

→ If India is 10 years behind the US in terms of technology, then India is 33% as efficient as the US

- Suppose $G = 30$

$$\frac{E^{I}_{2009}}{E^{us}_{2009}} = \frac{0.31}{1.0054^{-30}} = 0.36$$

- Suppose $G = 50$:

$$\frac{0.31}{1.0054^{-50}} = 0.41$$

Differences in efficiency are much more important than differences in income in explaining cross-country differences in income