

## 2) Productivity, efficiency and factor accumulation

a) Development accounting:

$$Y_U = A_U k_U^\alpha h_U^{1-\alpha}, \text{ where } U \text{ denotes USA.}$$

$$Y_M = A_M k_M^\alpha h_M^{1-\alpha}, \text{ where } M = \text{Mexico.}$$

$$\Rightarrow \frac{Y_U}{Y_M} = \frac{A_U k_U^\alpha h_U^{1-\alpha}}{A_M k_M^\alpha h_M^{1-\alpha}}$$

$$\Rightarrow \frac{A_U}{A_M} = \frac{\frac{Y_U/Y_M}{k_U^\alpha h_U^{1-\alpha}}}{\frac{k_M^\alpha h_M^{1-\alpha}}{A_M}}$$

This equation represents the development accounting method for estimating productivity ratios.

$$\Rightarrow \frac{A_U}{A_M} = \frac{\frac{37267}{9564}}{\left(\frac{162508}{44507}\right)^{\frac{1}{3}} \left(\frac{1}{0.79}\right)^{\frac{2}{3}}}$$

Using the actual numbers provided for each country.

$$\Rightarrow \frac{A_U}{A_M} = \frac{3.897}{(1.54)(1.17)} = 2.163$$

$$\Rightarrow \frac{A_M}{A_U} = 0.46$$

TFP in Mexico is 46% that of the USA's value.

b) We assume that TFP, technology and efficiency follow the following relation:

$$A = T \cdot E \quad \text{where } T = \begin{array}{l} \text{technology} \\ \text{level} \end{array} \\ E = \begin{array}{l} \text{efficiency} \\ \text{level} \end{array}$$

Assume further that Mexico lags 10 years behind the USA in its technology level:\*

$$T_{M,2005} = T_{U,1995}$$

$$\text{We have } T_{U,2005} = T_{U,1995} \cdot (1.0066)^{10}$$

since technology growth in the USA is equal to 0.66% per year.

$$\Rightarrow T_{M,2005} = T_{U,2005} (1.0066)^{-10}$$

$$\Rightarrow \frac{T_{M,2005}}{T_{U,2005}} = 0.936$$

For 2005, this implies

$$\frac{A_M}{A_U} = \frac{T_M \cdot E_M}{T_U \cdot E_U} \Rightarrow 0.46 = 0.936 \cdot \frac{E_M}{E_U}$$

$$\Rightarrow \frac{E_M}{E_U} = 0.49$$

If Mexico lags 10 years behind the USA in its level of technology, then Mexico's efficiency level is 49% that of the USA.

\* REMARK: You may have assumed other values of technological lags. The

following table lists some results for other lag choices. A lag of more than 30 years would not be very realistic.

tech. lag (years)	5	20	30
$\frac{E_m}{E_v}$	47.5%	52.5%	56%

c) We have discussed many examples in class. Possible explanations include:

- Corruption
- Crime
- Absence of property rights
- Non-free movement of labor
- Inadequate regulation
- Inefficient monopoly
- Inefficient state firms
- Rent seeking

...

d) Mexico's income level is 25.7% that of the USA. This ratio can be broken down into the following contributing factors:

$$\text{Technology: } 93.6\% = T_M/T_U$$

$$\text{Efficiency: } 49\% = E_M/E_U$$

$$\text{physical capital: } 65\% = \left(\frac{K_M}{K_U}\right)^{2/3}$$

$$\text{human capital: } 85.5\% = \left(\frac{h_M}{h_U}\right)^{2/3}$$

Those results suggest that efficiency is the most important factor explaining lower income in Mexico, followed by physical capital, then human capital and finally technology. Indeed we have:

$$.936 \times .49 \times .65 \times .855 = 25.7\%$$

which identifies each factor's contribution to Mexico's lower income.