1 Long-Run Economic Growth

- Goal: to understand factors that affect long-term performance of an economy.

- long-term $\rightarrow$ usually 20-30 years. Fixed vs. variable factors. Long run: all factors of production including capital stock etc. are variable.

- Trend vs blips. Ignore blips.

- Why should we care about the long-run?

- **"Rule of 72":** 72 divided by the rate of growth of an economy will approximately give the number of years it takes for an economy to double in size. E.g., an economy growing at 4% per year doubles in size in 18 years.

- Wide disparity in cross country growth rates
- GDP per capita: The dollar value of a country's final output of goods and services in a year (its GDP), divided by its population. It reflects the *average* income of a country's citizens.
- GDP or GDP per capita?
- Countries with a GDP per capita in 2003$ of $9,386 or more are classified as "high income", between $3036 and $9,385 as higher-middle income, between $761 and $3,035 as lower-middle income, and $765 or less as low income.
- Caveats with GDP per capita: purchasing power (PPP), fulfilling? Index of human development.

- US real GDP per capita grew at 3.7 % p.a from 1947-1973 (size doubled in 19.5 years); from 1974-1992 grew at 2.2 % p.a (32.7 years); since 1890, US GDP per capita has increased by a factor of 25.

- **Cross-Section** versus **Time-Series** view of data

- cross-section: large disparities in per capita income across countries

- Nigeria's per capita income is about 5% that of the US! Not always like this.

- The example of the Philippines and Korea. GDP per-capita $640 in 1975 US$; 28 million people in Philippines versus 25 million in Korea, 27% of Filipinos lived in Manila versus 28% in Seoul; all boys of primary school age were in school in both nations; 1960-1988 $\longrightarrow$ Philippines grew at 1.8% per year while Korea grew at 6.2% per year.

- Crucial to understand what constitutes an economy's physical capacity to produce goods and services.

1.1 Growth Accounting

- Output is produced by "factors of production"; e.g. **capital** goods, **people**, land, energy...more of all these factors translates into more output.

- How effectively are these used?

- This is summarized in a mathematical relationship called the production function:

$$Y_t = AF(K_t, N_t) \tag{1}$$

  where Y = real output produced at time t, A = a measure of productivity, K_t = capital stock at time t, N = number of workers employed at time t (usually assumed to be the size of the adult work force).

- Connecting K, N, A with Y is a function F.

- Assume that there is only firm in the economy and all households rent their capital and labor services to this one firm; then (1) measures the *maximum* amount of output (GDP) this firm can produce at any given date t.

- For the US, the relationship is

$$Y_t = AK_t^{\frac{1}{3}}N_t^{\frac{2}{3}}.$$

- A is called "total factor productivity".

- The "missing ingredient"

- What does (1) look like?

- To draw a picture showing how Y changes with change in *both* K and N would require a 3-D picture. Instead we will hold N fixed and see how Y changes with K.

- For example: Fix $N = 129.6$ million workers; and $A = 16.45$. Then
  $Y_t = AK_t^{\frac{1}{3}} N_t^{\frac{2}{3}} = Y_t = 16.45 K_t^{\frac{1}{3}} (129.6)^{\frac{2}{3}} = (495.4) K_t^{\frac{1}{3}}$.

- Two important features:

1. Slopes upward from left to the right

2. Slope becomes flatter from left to right.

- Figure

- Notion of marginal product of capital MPK.

- $MPK =$ increase in output (ΔY) resulting from a one-unit increase in the capital stock (holding labor fixed)

- MPK at a point $= \left(\frac{\Delta Y}{\Delta K}\right)$ at that point $=$ slope of the production function at that point $=$ derivative of the function F with respect to K at that point.

- Diminishing marginal productivity of capital; example

- Marginal product of labor (same as MPK)

- $MPK = \left(\frac{\Delta Y}{\Delta K}\right) \Rightarrow \Delta Y = MPK \times \Delta K$

- Example: suppose labor is fixed and $MPK = 1/5$. If we increase K by 10 units, i.e. $\Delta K = 10$, we can calculate ΔY by

$$\Delta Y = MPK \times \Delta K = \frac{1}{5} \times 10 = 2$$

- We use the MPK to convert changes in K to changes in output.

- Similarly, holding capital K (and A) fixed, we use the MPN to convert changes in N to changes in output.

- If we allow both N and K to change, then combined change in K and N adds up to produce final change in output:

$$\Delta Y = (MPN \times \Delta N) + (MPK \times \Delta K)$$

- More generally:

$$\frac{\Delta Y}{Y} = \frac{\Delta A}{A} + a_N \frac{\Delta N}{N} + a_K \frac{\Delta K}{K} \qquad (2)$$

- $\frac{\Delta N}{N}$ = growth rate of labor

- $\frac{\Delta K}{K}$ = growth rate of capital

- a_N = percentage change in output resulting from a 1% change in labor use = elasticity of output with respect to labor

- Called "growth accounting equation". Breaks up output growth into its components.

- Contribution of capital to output growth: $a_K \frac{\Delta K}{K}$

- For the US, $a_K = 0.3$, $a_N = 0.7$.

- Example: Suppose $\frac{\Delta N}{N} = \frac{\Delta K}{K} = 0$ and $\frac{\Delta A}{A} =$ 10%. Then (2) says that $\frac{\Delta Y}{Y} = 10\%$.

- Example: Suppose $\frac{\Delta A}{A} = \frac{\Delta K}{K} = 0$ and $\frac{\Delta N}{N} =$ 10%. Then (2) says that $\frac{\Delta Y}{Y} = (a_N) \times 10\% = (0.7) \times 10\% = 7\%$

- Thus, a 10% increase in labor use, with capital and productivity unchanged, leads to only a 7% increase in output. Why?

- Table

- Note the small or even negative contribution of productivity in recent decad