

## Chapter 7 - *Production and Growth*

- *Rule 72*

$$\text{How long it takes GDP to double} = \frac{72}{\% \text{ growth}}$$

- E.g.  $72/10\% = 7$  years until GDP doubles when growth rate is 10%

- *Production and Growth*

- A country's standard of living depends on its ability to produce goods and services
- Within a country there are large changes in the standard of living over time
- In Canada, over the past century, average income as measured by real GDP per person has grown by about 2 percent per year

- *Incomes and Growth Around the World*

- Living standards, as measured by real GDP per person, vary significantly among nations
- The poorest countries have average levels of income that have not been seen in the developed world for many decades
- Annual growth rates that seem small become large when compounded for many years
- Compounding refers to the accumulation of a growth rate over a period of time

- *Productivity*

- A country's standard of living depends on its ability to produce goods and services
- This ability depends on productivity: the average quantity of goods and services produced per unit of labour input

- $Y = \text{Real GDP} = \text{Quantity of Output Produced}$

- $L = \text{Labour}$

- $\text{Productivity (Output per worker)} = \frac{Y}{L}$

- *How is Productivity Determined?*

- Factors of production directly determine productivity
- The Factors of Production:

- **Physical Capital per Worker**

- The stock of equipment and structures used to produce goods and services, denoted **K**

$$\text{Capital per Worker} = \frac{K}{L}$$

- Productivity is higher when the average worker has more capital

$$\uparrow \text{ in } \frac{K}{L} \Leftrightarrow \uparrow \text{ in } \frac{Y}{L}$$

- **Human Capital per Worker**

- The knowledge and skills workers acquire through education, training, and experience, denoted **H**

$$\text{Average Worker's Human Capital} = \frac{H}{L}$$

- Productivity is higher when the average worker has more human capital (*e.g. education, skills*)

$$\uparrow \text{ in } \frac{H}{L} \Leftrightarrow \uparrow \text{ in } \frac{Y}{L}$$

- **Natural Resources per Worker**

- The input into production that nature provides (*e.g. land, mineral deposits*) denoted **N**
- Other things equal, more **N** allows a country to produce more **Y**

$$\uparrow \text{ in } \frac{N}{L} \Leftrightarrow \uparrow \text{ in } \frac{Y}{L}$$

- Some countries are rich because they have abundant natural resources (*e.g. Saudi Arabia has lots of oil*)
- But countries need not have much **N** to be rich (*e.g. Japan imports the **N** it needs*).

- **Technological Knowledge per Worker**

- Society's understanding of the best ways to produce goods and services
- Technological progress means any advance in knowledge that boosts productivity

- *Technological Knowledge Versus Human Capital*

- **Technological Knowledge** - society's understanding about how the world works
- **Human Capital** - the resources expended transmitting the understanding to the labour force
- Both are important for productivity

- *The Production Function*

- The production function is a graph or equation showing the relation between outputs and inputs

$$Y = A \times F(L, K, H, N)$$

- $F()$  - a function that shows how inputs are combined to produce output
- $A$  - is the level of technology

- $A$  multiplies the function  $F(\cdot)$ , so improvements in technology allows more output to be produced from any given combination of inputs
- The production function has the property **Constant Returns to Scale**:
  - Changing all inputs by the same percentage causes outputs to change by that percentage

$$2Y = A \times F(2L, 2K, 2H, 2N)$$

- Increasing all outputs by 10% causes output to increase by 10%

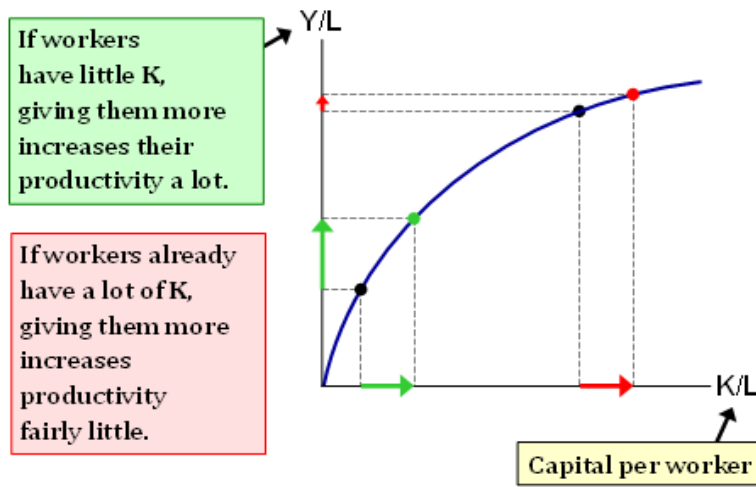
$$1.1Y = A \times F(1.1L, 1.1K, 1.1H, 1.1N)$$

- If we multiply each input by  $1/L$ , the output is multiplied by  $1/L$

$$\frac{Y}{L} = A \times F\left(1, \frac{K}{L}, \frac{H}{L}, \frac{N}{L}\right)$$

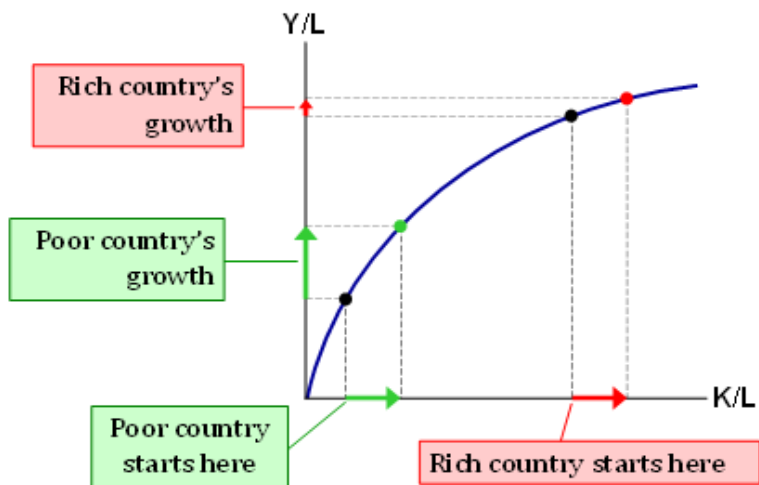
- This equation shows that productivity depends on:
  - The level of technology ( $A$ )
  - Physical capital per worker
  - Human capital per worker
  - Natural resources per worker
- *Economic Growth and Public Policy*
  - There is considerable scope for using public policy to affect long-run growth in productivity and living standards
  - Government policies that raise productivity and living standards...
    - ... Encourage saving and investment.
    - ... Encourage investment from abroad.
    - ... Encourage education and training.
    - ... Establish secure property rights and maintain political stability.
    - ... Promote free trade.
    - ... Promote research and development.
- *Saving and Investment*
  - We can boost productivity by increasing  $K$ , which requires investment.
  - Since resources are scarce, producing more capital requires producing fewer consumption goods.
  - Reducing consumption = increasing saving. The extra saving funds the production of investment goods. Hence, a trade-off between current and future consumption.
  - **Diminishing Returns and the Catch-Up Effect**
    - As the stock of capital rises, the extra output produced from an additional unit of capital falls
    - Because of diminishing returns, an increase in the saving rate leads to higher growth only for a while
    - In the long run, the higher saving rate leads to a higher level of productivity and income, but not to higher growth in these areas.

- **The Production Function and Diminishing Returns**



- **The Catch-Up Effect**

- The property whereby poor countries tend to grow more rapid than rich ones



- **Example of the Catch-Up Effect:**

- Over 1960-1990, Canada and South Korea devoted a similar share of GDP to investment, so you might expect they would have similar growth experience
- But, growth was 7% for Korea and only 2.5% for Canada
- **Explanation:**
  - The Catch-Up Effect.
  - In 1960, K/L was far smaller in Korea than in Canada, hence Korea grew faster.

- *Investment from Abroad*
  - To raise K/L and hence productivity, wages, and living standards, the government can also encourage
    - **Foreign Direct Investment**
      - A capital investment that is owned and operated by foreign entities
    - **Foreign Portfolio Investment**
      - A capital investment financed with foreign money but operated with domestic residents
  - Some of the returns from these investments flow back to the foreign countries that supplied the funds
  - Especially beneficial in poor countries that cannot generate enough saving to fund investment projects themselves
  - Also helps poor countries learn state-of-the-art technologies developed in their countries
  
- *Education*
  - Government can increase productivity by promoting education - investment in Human Capital (**H**)
  - Education has significant effects
    - In Canada, each year of schooling raises a worker's wage by 10%
  - By investing in H also involves a trade-off between the present and the future
    - Spending a year in school requires sacrificing a year's wages to now have higher wages later
  
- *Health and Nutrition*
  - Health Care expenditure is a type of investment in human capital - healthier workers are more productive
  - In countries with significant malnourishment, raising workers' caloric intake raises productivity
    - Over 1962-1965, caloric consumption rose 44% in South Korea, and economic growth was spectacular
  
- *Property Rights and Political Stability*
  - Markets are usually a good way to organize economic activity.. The price system allocates resources to their most efficient uses
  - Requires respect for property rights, the ability of people to exercise authority over the resources they own
  - In many poor countries, the justice system doesn't work very well
    - Contracts aren't always enforced
    - Fraud, corruption often go unpunished
    - Bribery common
      - Firms must bribe government officials for permits
  - **Political Instability**
    - Creates uncertainty over whether property rights will be protected in the future
  - When people fear their capital may be stolen or confiscated, there is less investment, including from abroad, and the economy functions less efficiently.
    - Result:
      - Lower living standards
  - Economic stability, efficiency, and healthy growth require law enforcement, effective courts, a stable constitution, and honest government officials

- *Free Trade*
  - **Inward-Oriented Policies**
    - (e.g. tariffs, limits on investment from abroad) aim to raise living standards by avoiding interaction with other countries
  - **Outward-Oriented Policies**
    - (e.g. the elimination of restrictions on trade or foreign investment) promote integration with the world economy
  - Trade can make everyone better off
  - Trade has similar effects as discovering new technologies
    - It improves productivity and living standards
  - Countries with inward-oriented policies have generally failed to create growth
  - Countries with outward-oriented policies have succeeded
- *Research and Development*
  - Technological process is the main reason why living standards rise over the long-run
  - One reason is that knowledge is a public good
    - **Public good:** ideas can be shared freely, increasing the productivity of many
  - Policies to promote technological progress
    - Patent laws
    - Tax incentives or direct support for private sector Research and Development
    - Grants for basic research at universities
- *Population Growth*
  - May affect living standards in 3 ways:
    - **Stretching Natural Resources**
      - 200 years ago, Malthus argues that the population growth would strain society's ability to provide for itself
      - Since then, the world population increased six fold.
      - If Malthus was right, living standards would have fallen. Instead, they have risen
      - Malthus failed to account for technological progress and productivity growth
    - **Diluting the Capital Stock**

$$\uparrow \text{ population} = \uparrow K = \downarrow \frac{K}{L}$$

- Countries with fast population growth tend to have lower educational attainment

$$\uparrow \text{ population} = \uparrow L = \downarrow \frac{H}{L}$$

- To combat this, many developing countries use policy to control population growth
  - China's one child per family law
  - Contraception education and availability
  - Promote female literacy to raise opportunity costs of having children

- **Promote Technological Progress**
  - More People
    - = more scientists, inventors, engineers
    - = more frequent discoveries
    - = faster technological progress and economic growth
  - Evidence from Michael Kremer
    - Over the course of human history, ...
      - ... growth rates increased as the population increased
      - ... more populated regions grew faster than less populated ones
  
- *Are Natural Resources a Limit to Growth?*
  - Some argue that population growth is depleting the Earth's non-renewable resources, and thus will limit growth in living standards
  - But technological progress often yields ways to avoid these limits:
    - Hybrid cars use less gas
    - Better insulation in homes reduces the energy required to heat or cool them
  - As resources become scarcer, its market price rises, which increases the incentive to conserve it and develop alternatives
  
- **CONCLUSION**
  - ***In the long-run, living standards are determined by productivity***
  - ***Policies that affect the determinants of productivity will therefore affect the next generation's living standards***
  - ***One of these determinants is saving and investment***