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PRINCIPLES OF

MACROECONOMICS

Eighth Edition

CHAPTER

12

Production and Growth

Learning outcomes

After this lecture, students are expected to understand:

- What are the facts about living standards and growth rates around the world?
- Why does productivity matter for living standards?
- What determines productivity and its growth rate?
- How can public policy affect growth and living standards?

Incomes and Growth Around the World

Country	Period	Real GDP per Person: At Beginning of Period[a]	Real GDP per Person: At End of Period[a]	Growth Rate (per year)
Brazil	1900–2014	$ 828	$15,590	2.61%
Japan	1890–2014	1,600	37,920	2.59
China	1900–2014	762	13,170	2.53
Mexico	1900–2014	1,233	16,640	2.31
Germany	1870–2014	2,324	46,850	2.11
Indonesia	1900–2014	948	10,190	2.10
Canada	1870–2014	2,527	43,360	1.99
India	1900–2014	718	5,630	1.82
United States	1870–2014	4,264	55,860	1.80
Pakistan	1900–2014	785	5,090	1.65
Argentina	1900–2014	2,440	12,510	1.44
Bangladesh	1900–2014	663	3,330	1.43
United Kingdom	1870–2014	5,117	39,040	1.42

[a]Real GDP is measured in 2014 dollars.

FACT 1: Vast differences in living standards around the world.
FACT 2: Great variation in growth rates across countries.

Economic Growth around the World

- Because of differences in growth rates
  - Ranking of countries by income changes substantially over time
    - Poor countries are not necessarily doomed to poverty forever, e.g. Singapore incomes were low in 1960 and are quite high now
    - Rich countries can't take their status for granted: They may be overtaken by poorer but faster-growing countries

Economic Growth around the World

- Questions:
  - Why are some countries richer than others?
  - Why do some countries grow quickly while others seem stuck in a poverty trap?
  - What policies may help raise growth rates and long-run living standards?

Productivity

A country's standard of living depends on its ability to produce goods and services

- Productivity
  - Quantity of goods and services
  - Produced from each unit of labor input
  - Productivity = Y/L (output per worker), where
    - Y = real GDP = quantity of output produced
    - L = quantity of labor

Productivity

- Why productivity is so important
  - Key determinant of living standards
    - When a nation's workers are very productive, real GDP is large and incomes are high
  - Growth in productivity is the key determinant of growth in living standards
    - When productivity grows rapidly, so do living standards
  - An economy's income is the economy's output

Determinants of Productivity

- Physical capital, K
  - Stock of equipment and structures used to produce goods and services
- Physical capital per worker, K/L
  - Productivity is higher when the average worker has more capital (machines, equipment, etc.).
    - An increase in K/L causes an increase in Y/L

Determinants of Productivity

- Human capital, H
  - Knowledge and skills workers acquire through education, training, and experience
- Human capital per worker, H/L
  - Productivity is higher when the average worker has more human capital (education, skills, etc.).
    - An increase in H/L causes an increase in Y/L.

Determinants of Productivity

- Natural resources, N
  - Inputs into production that nature provides (land, rivers, and mineral deposits)
- Natural resources per worker, N/L
  - Other things equal, more N allows a country to produce more Y
    - An increase in N/L causes an increase in Y/L

Determinants of Productivity

- Technological knowledge
  - Society's understanding of the best ways to produce goods and services
  - Technological progress means:
    - A faster computer, a higher-definition TV, or a smaller cell phone
    - Also, any advance in knowledge that boosts productivity: allows society to get more output from its resources
    - e.g., Henry Ford and the assembly line.

Determinants of Productivity

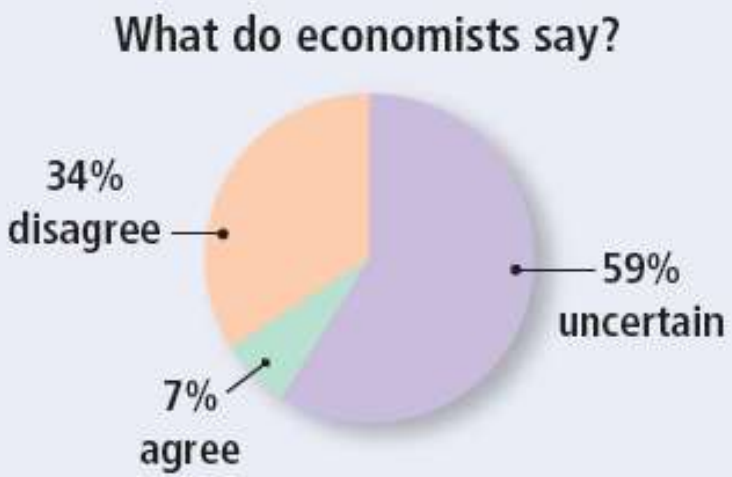
Technological knowledge vs. Human capital

- Technological knowledge
  - Refers to society's understanding of how to produce goods and services
- Human capital
  - Results from the effort people expend to acquire this knowledge
- Both are important for productivity

ASK THE EXPERTS

Innovation and Growth

"Future innovations worldwide will not be transformational enough to promote sustained per-capita economic growth rates in the United States and western Europe over the next century as high as those over the past 150 years."



The Production Function

- The production function $Y = A\,F(L, K, H, N)$
  - A graph or equation showing the relation between output and inputs
  - F( ) is a function that shows how inputs are combined to produce output
  - "A" is the level of technology
  - "A" multiplies the function F( ), so improvements in technology (increases in "A") allow more output (Y) to be produced from any given combination of inputs.

The Production Function $Y = A\,F(L, K, H, N)$

- The production function has the property constant returns to scale:
  - Changing all inputs by the same percentage causes output to change by that percentage.
    - Doubling all inputs (multiplying each by 2) causes output to double:

      $$2\mathbf{Y} = \mathbf{A}\,\mathbf{F}(2\mathbf{L}, 2\mathbf{K}, 2\mathbf{H}, 2\mathbf{N})$$

    - Increasing all inputs 10% (multiplying each by 1.1) causes output to increase by 10%:

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

The Production Function $Y = A F(L, K, H, N)$

- If we multiply each input by 1/L, then output is multiplied by 1/L:

$$Y/L = A F(1, K/L, H/L, N/L)$$

- This equation shows that productivity (Y/L, output per worker) depends on:
  - The level of technology, A
  - Physical capital per worker, K/L
  - Human capital per worker, H/L
  - Natural resources per worker, N,L

Active Learning 1 Discussion question

Which of the following policies do you think would be most effective at boosting growth and living standards in a poor country over the long run?

a. Offer tax incentives for investment by local firms
b. Offer tax incentives for investment by foreign firms
c. Give cash payments for good school attendance
d. Crack down on government corruption
e. Restrict imports to protect domestic industries
f. Allow free trade

Economic Growth and Public Policy

- The ways public policy can affect long-run growth in productivity and living standards:
  - Saving and investment
  - Diminishing returns and the catch-up effect
  - Investment from abroad
  - Education
  - Health and nutrition
  - Property rights and political stability
  - Free trade
  - Research and development
  - Population growth

Saving and Investment

- Raise future productivity
  - Invest more current resources in the production of capital, K
  - Trade-off: since resources are scarce, producing more capital requires producing fewer consumption goods
  - Reducing consumption = increasing saving
    - This extra saving funds the production of investment goods (More details in the next chapter.)

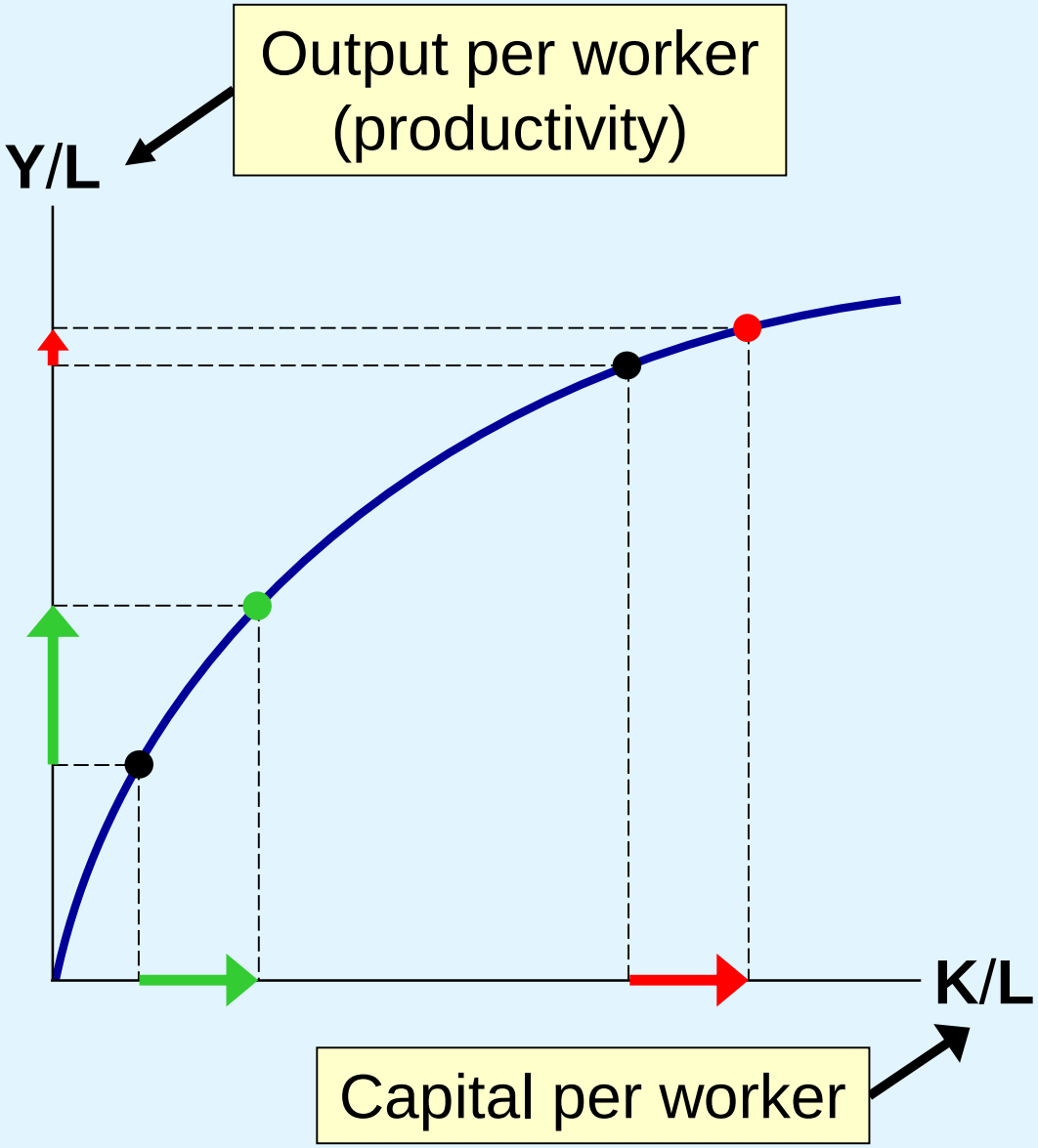
Diminishing Returns

- Policies that raise saving and investment
  - Fewer resources are used to make consumption goods
  - More resources: to make capital goods
  - K increases, rising productivity and living standards
  - This faster growth is temporary, due to diminishing returns to capital: As K rises, the extra output from an additional unit of K falls….

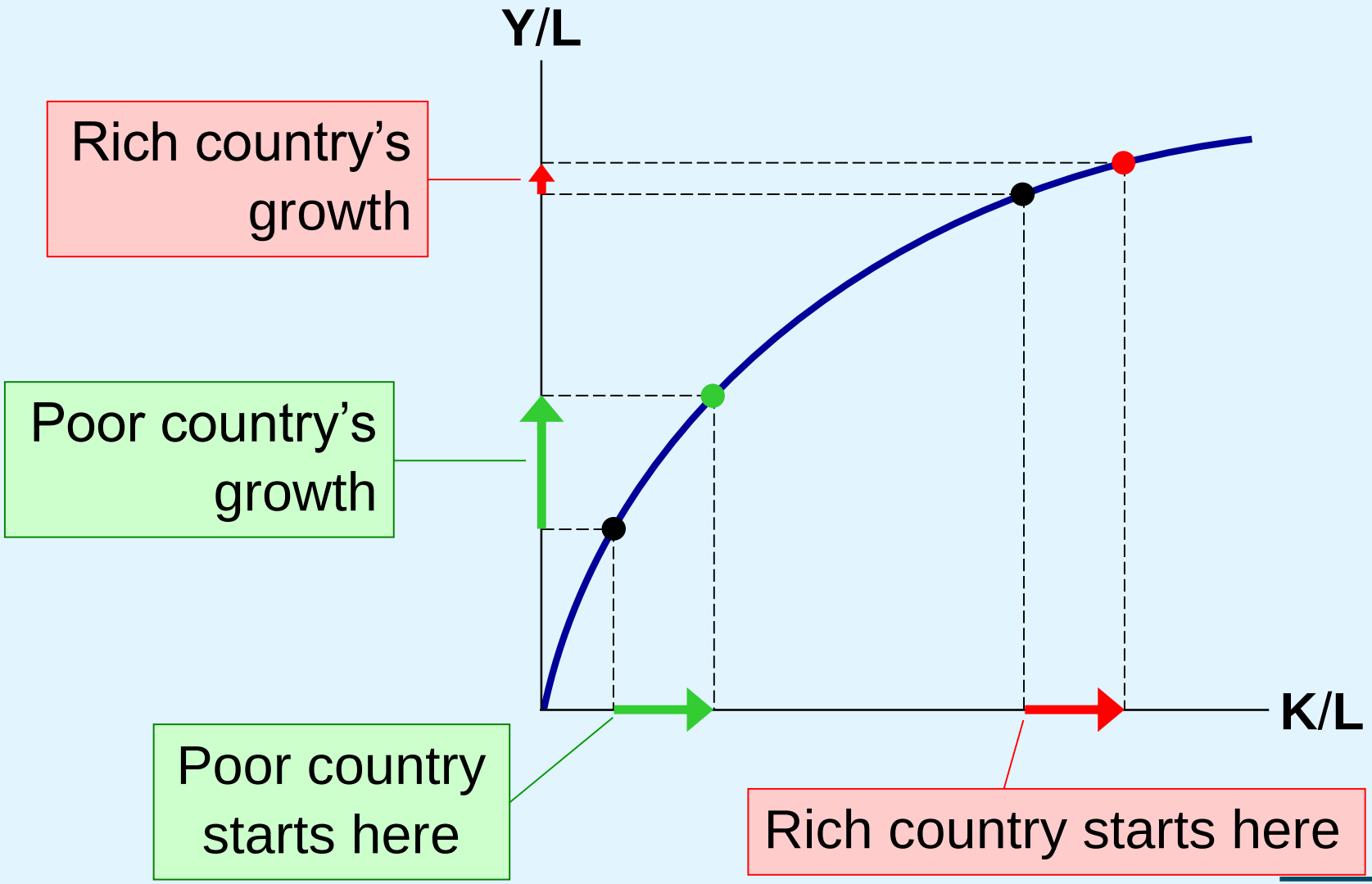
The Production Function & Diminishing Returns

If workers have little **K**, giving them more increases their productivity a lot.

If workers already have a lot of **K**, giving them more increases productivity fairly little.



The catch-up effect: the property whereby poor countries tend to grow more rapidly than rich ones



Example of the Catch-Up Effect

- 1960–1990
  - The U.S. and S. Korea devoted a similar share of GDP to investment
    - Expect: similar growth performance
  - But growth was >6% in Korea and only 2% in the U.S.
  - Explanation: the catch-up effect
    - In 1960, K/L was far smaller in Korea than in the U.S., hence Korea grew faster

Investment from Abroad

- Investment from abroad
  - Another way for a country to invest in new capital
  - Foreign direct investment
    - Capital investment that is owned and operated by a foreign entity
  - Foreign portfolio investment
    - Investment financed with foreign money but operated by domestic residents

Investment from Abroad

- Benefits from investment from abroad
  - Some benefits flow back to the foreign capital owners
  - Increase the economy's stock of capital
  - Higher productivity and higher wages
  - State-of-the-art technologies developed in other countries
  - Especially good for poor countries that cannot generate enough saving to fund investment projects themselves

Education

- Education, investment in human capital
  - Gap between wages of educated and uneducated workers
    - In the U.S., each year of schooling raises a worker's wage by 10%
  - Opportunity cost: wages forgone
    - Spending a year in school requires sacrificing a year's wages now to have higher wages later
- Problem for poor countries: Brain drain

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:
  - 1962–1995, caloric consumption rose 44% in S. Korea, and economic growth was spectacular.
  - Nobel winner Robert Fogel: 30% of Great Britain's growth from 1790–1980 was due to improved nutrition

Health and Nutrition

- Vicious circle in poor countries
  - Poor countries are poor because their populations are not healthy
  - Populations are not healthy because they are poor and cannot afford better healthcare and nutrition
- Virtuous circle
  - Policies that lead to more rapid economic growth would naturally improve health outcomes, which in turn would further promote economic growth

Property Rights and Political Stability

Markets are usually a good way to organize economic activity

- To foster economic growth
  - Protect property rights (the ability of people to exercise authority over the resources they own)
    - Courts – enforce property rights
  - Promote political stability
- Property rights:
  - Prerequisite for the price system to work

Property Rights and Political Stability

- Lack of property rights, a major problem
  - Contracts are hard to enforce
  - Fraud, corruption often goes unpunished
    - Firms must bribe government officials for permits
- Political instability (e.g., frequent coups)
  - Creates uncertainty over whether property rights will be protected in the future

Property Rights and Political Stability

- When people fear their capital may be stolen by criminals/confiscated by a corrupt government
  - 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, honest government officials

Free Trade

Trade can make everyone better off

- Inward-oriented policies
  - i.e. tariffs, limits on investment from abroad
  - Aim to raise living standards by avoiding interaction with other countries
- Outward-oriented policies
  - i.e. elimination of restrictions on trade or foreign investment
  - Promote integration with the world economy

Free Trade

- Trade has similar effects as discovering new technologies
  - Improves productivity and living standards
- Countries with inward-oriented policies
  - Have generally failed to create growth.
    - e.g., Argentina during the 20th century.
- Countries with outward-oriented policies
  - Have often succeeded
    - e.g., South Korea, Singapore, Taiwan after 1960

Research and Development

- Technological progress
  - Main reason why living standards rise over the long run
- Knowledge is a 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 R&D
  - Grants for basic research at universities

Population Growth

- Large population
  - More workers to produce goods and services: larger total output of goods and services
  - More consumers
- Population growth may affect living standards in 3 different ways…

Population Growth

1. Stretching natural resources

- 200 years ago, Malthus argued that population growth will:
  - Strain society's ability to provide for itself
  - Mankind - doomed to forever live in poverty
- Since then, the world population has increased sixfold and living standards increased
  - Malthus failed to account for technological progress and productivity growth

Population Growth

2. Diluting the capital stock

- High population growth (higher L)
- Spread the capital stock more thinly (lower K/L)
- Lower productivity and living standards

- To combat this, many developing countries use policy to control population growth
  - Government regulation (China's one child law)
  - Increased awareness of birth control
  - Equal opportunities for women (Promote female literacy to raise opportunity cost of having babies)

Population Growth

3. Promoting technological progress

- World population growth
  - Engine for technological progress and economic prosperity
  - More people = More scientists, more inventors, more engineers = More frequent discoveries

- Michael Kremer, human history:
  - Growth rates increased as the world's population increased
  - More populated regions grew faster than less populated ones

Active Learning 2 Review productivity concepts

- List the determinants of productivity.
- List three policies that attempt to raise living standards by increasing one of the determinants of productivity.

Active Learning 2 Answers

- Determinants of productivity:
  - K/L, physical capital per worker
  - H/L, human capital per worker
  - N/L, natural resources per worker
  - A, technological knowledge
- Policies to boost productivity:
  - Encourage saving and investment, to raise K/L
  - Encourage investment from abroad, to raise K/L
  - Provide public education, to raise H/L
  - Patent laws or grants, to increase A
  - Control population growth, to increase K/L

CASE STUDY

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.

CASE STUDY

Are Natural Resources a Limit to Growth?

- Market economy, scarcity is reflected in market prices
  - If the world were running out of natural resources, their prices would be rising over time
  - In real terms, the prices of most natural resources are stable or falling
  - It appears that our ability to conserve these resources is growing more rapidly than their supplies are dwindling

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: saving & investment
  - Next chapter: how saving and investment are determined, and how policies can affect them

Summary

- There are great differences across countries in living standards and growth rates.
- Productivity (output per unit of labor) is the main determinant of living standards in the long run.
- Productivity depends on physical and human capital per worker, natural resources per worker, and technological knowledge.
- Growth in these factors—especially technological progress—causes growth in living standards over the long run.

Summary

- Policies can affect the following, each of which has important effects on growth:
  - Saving and investment; International trade
  - Education, health & nutrition
  - Property rights and political stability
  - Research and development
  - Population growth
- Because of diminishing returns to capital, growth from investment eventually slows down, and poor countries may “catch up” to rich ones.