Production and Growth

PRINCIPLES OF
Economics

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Lecture 5

In this chapter, look for the answers to these questions:

- 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?

(1) Incomes and Growth

- ***A Country:***
- Life expectancy at birth < 50 years.
- About 1 in 10 children died before their first birthday.
- Smallpox, cholera etc. affect the health of citizens.
- 3% of the homes: electricity.
- 15%: indoor flush toilets.
- …
  - Which country?

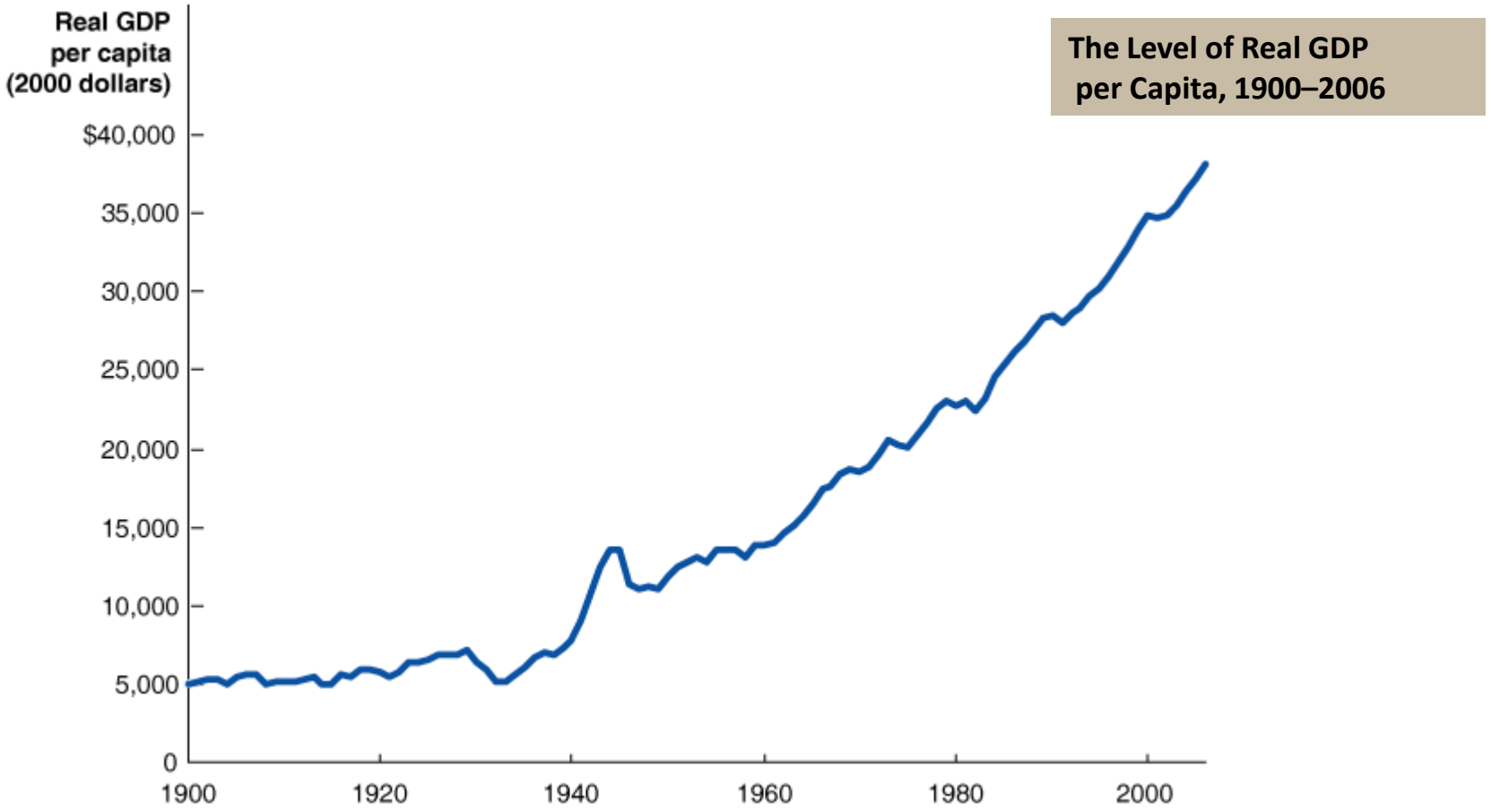
Incomes and Growth

- *USA in 1900 (see pp. 276-8 of Hubbard and O'Brien, 2008).*
- ***Surprised?***

  - Why?
  - Sustained economic growth

US Real GDP Per Capita

Although real GDP per capita fluctuates because of the short-run effects of the business cycle, the trend is clearly upward over the long run.



The Level of Real GDP per Capita, 1900–2006

A typical family with all their possessions in the U.K., an advanced economy

GDP per capita: $35,580

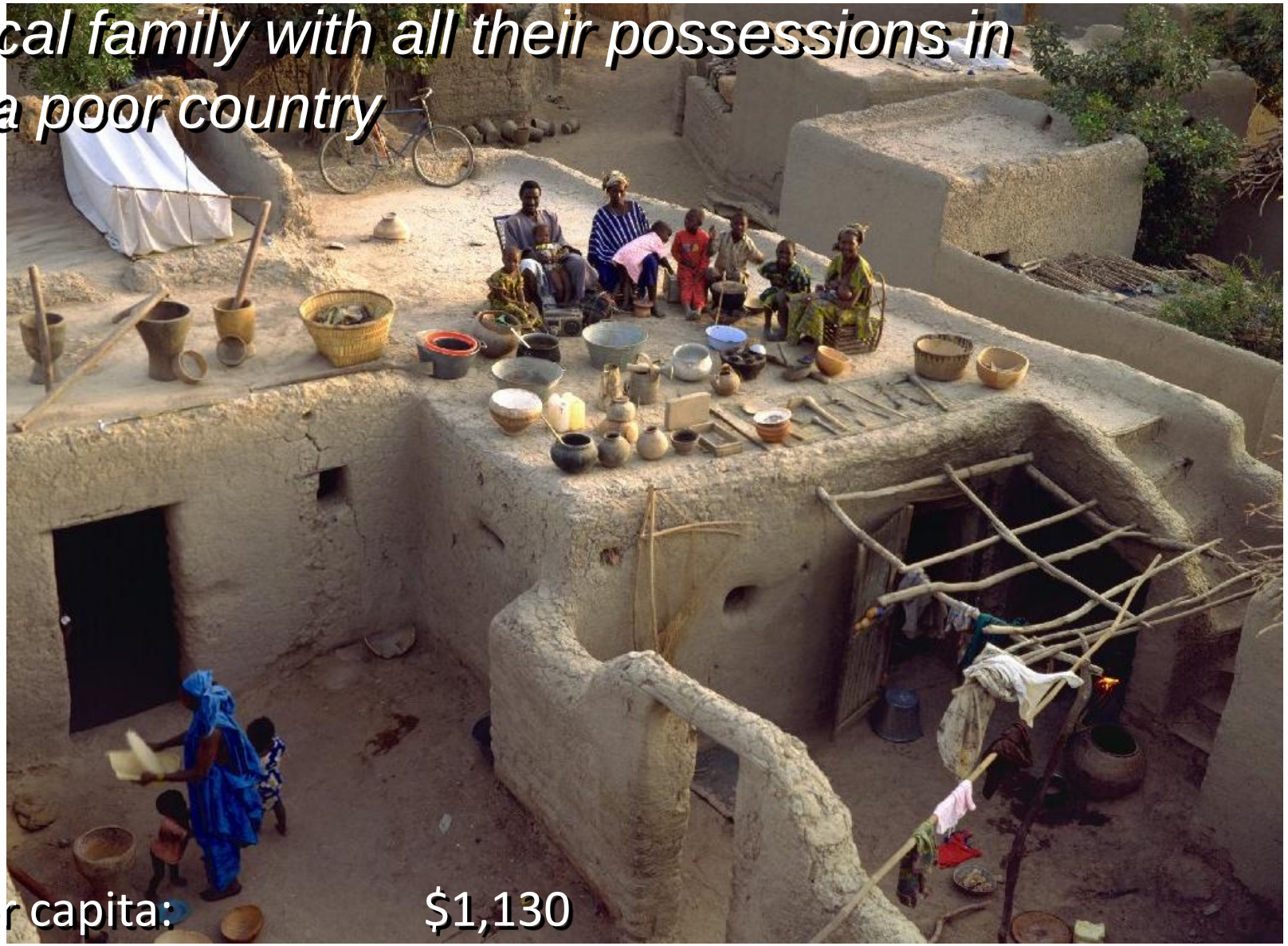
Life expectancy: 79 years

Adult literacy: 99%

A typical family with all their possessions in Mexico, a middle income country

GDP per capita:	$11,410
Life expectancy:	76 years
Adult literacy:	92%

A typical family with all their possessions in Mali, a poor country



GDP per capita:	$1,130
Life expectancy:	50 years
Adult literacy:	46%

Incomes and Growth Around the World

FACT 1:

There are vast differences in living standards around the world.

	GDP per capita, 2005	Growth rate, 1960-2005
China	$6,572	5.8%
Singapore	29,921	5.4%
Japan	30,821	3.8%
Spain	26,125	3.2%
India	3,486	2.7%
Israel	25,670	2.7%
United States	41,854	2.2%
Canada	32,886	2.1%
Colombia	7,769	1.8%
New Zealand	22,511	1.4%
Philippines	4,920	1.4%
Argentina	14,421	1.0%
Saudi Arabia	14,729	0.8%
Rwanda	1,333	0.3%
Haiti	1,836	–1.2%

Incomes and Growth Around the World

FACT 2:

There is also great variation in growth rates across countries.

	GDP per capita, 2005	Growth rate, 1960-2005
China	$6,572	5.8%
Singapore	29,921	5.4%
Japan	30,821	3.8%
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Incomes and Growth Around the World

Since growth rates vary, the country rankings can change 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.

Growth Rates and the Rule of 70

- Growth rate from one year to the next: standard formula

$$g_{t,t+1} = \left(\frac{y_{t+1} - y_t}{y_t} \right) \times 100\%$$

Growth Rates and the Rule of 70

- For longer periods of time, it is helpful to calculate the **average annual growth rate**

An alternative way to look at how rapidly an economic variable grows is to calculate the number of years it would take to double

If real GDP per capita doubles every 10 years, most people in the country would experience significant increases in the living standard over the course of their lives; if real GDP per capita doubles only every 100 years, then the increase in living standard is much lower.

Thus, the **time to double** is a useful measure.

Growth Rates and the Rule of 70

$$\text{Number of years to double} = \frac{70}{\text{Growth rate}}$$

- Assumption: constant growth rate (interpreted as average growth rate)

  Number of years to double does not depend on the current level of income

Incomes and 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?

Why are some countries **richer** than others?

Productivity

- Recall one of the Ten Principles from Chap. 1:
  A country's standard of living depends on its ability to produce g&s.
- This ability depends on **productivity**, the average quantity of g&s produced per unit of labor input.
- **Y** = real GDP = quantity of output produced
  L = quantity of labor
  so productivity = **Y/L** (output per worker)

Why Productivity Is So Important

- When a nation's workers are very productive, real GDP is large and incomes are high. ("**level**")
- When productivity grows rapidly, so do living standards. ("**growth**")
- What, then, determines productivity and its growth rate?

Physical Capital Per Worker

The stock of equipment and structures used to produce g&s is called **physical capital** (or just **capital**), denoted **K**.

- **K/L** = capital per worker.
- Productivity is higher when the average worker has more capital (machines, equipment, etc.).
- *i.e.*,

  an increase in **K/L** causes an increase in **Y/L**.

Human Capital Per Worker

- **Human capital** (**H**):
  the knowledge and skills workers acquire through education, training, and experience
- **H**/**L** = the average worker's human capital
- Productivity is higher when the average worker has more human capital (education, skills, etc.).
- *i.e.*,
  an increase in **H**/**L** causes an increase in **Y**/**L**.

Natural Resources Per Worker

- **Natural resources** (**N**): the inputs into production that nature provides, *e.g.,* land, mineral deposits
- Other things equal,
  more **N** allows a country to produce more **Y**.
  In per-worker terms,
  an increase in **N/L** causes an increase in **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

- **Technological knowledge**: society's understanding of the best ways to produce g&s
- Technological progress does not only mean
  a faster computer, a higher-definition TV,
  or a smaller mobile phone.
- It means any advance in knowledge that boosts productivity (allows society to get more output from its resources).
  - *E.g.*, Henry Ford and the assembly line.

Tech. Knowledge vs. Human Capital

- Technological knowledge refers to society's understanding of how to produce g&s.
- Human capital results from the effort people expend to acquire this knowledge.
- Both are important for productivity.

The Production Function

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

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

F( ) – a function that shows how inputs are combined to produce output

"**A**" – 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

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

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

  $$\mathbf{Y}/\mathbf{L} = \mathbf{A}\,\mathbf{F}(1, \mathbf{K}/\mathbf{L}, \mathbf{H}/\mathbf{L}, \mathbf{N}/\mathbf{L})$$

- This equation shows that productivity (output per worker) depends on:
  - the level of technology (**A**), which can be freely shared among different people/firms
  - physical capital per worker
  - human capital per worker
  - natural resources per worker

(3) ECONOMIC GROWTH AND PUBLIC POLICY

Next, we look at the ways public policy can affect long-run growth in productivity and living standards.

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. " " " " " 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

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(a) Saving and Investment

"Offer tax incentives for investment by local firms"

- 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. This extra saving funds the production of investment goods. *(More details in the next chapter.)*
- Hence, a tradeoff between **current** and **future** consumption.

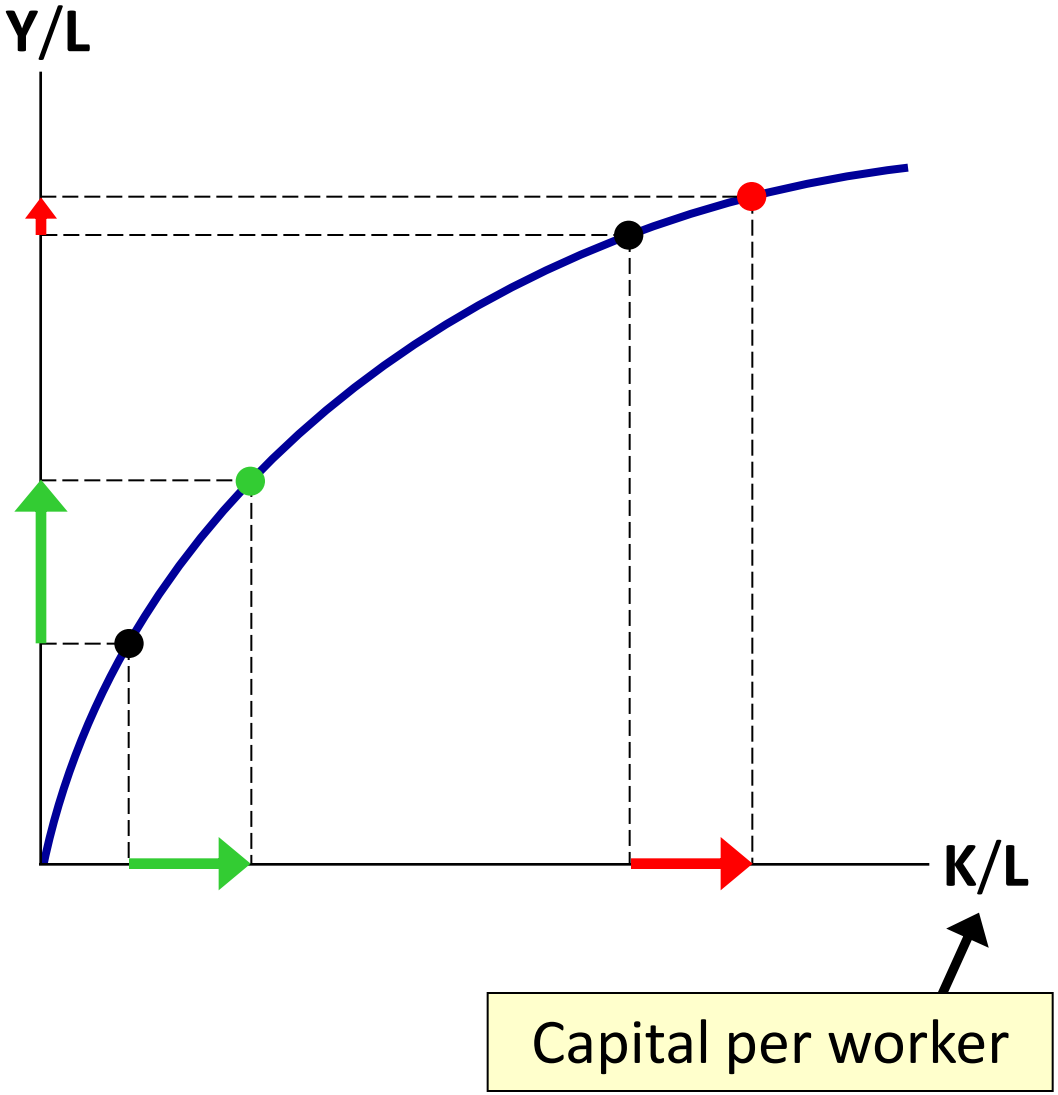
Diminishing Returns and the Catch-Up Effect

- The government can implement policies that raise saving and investment. *(Details in next chapter.)*
  Then **K** will rise, causing productivity and living standards to rise.
- But this faster growth is temporary,
  due to **diminishing returns to capital**:
  As **K** rises, the extra output from an additional unit of **K** falls….

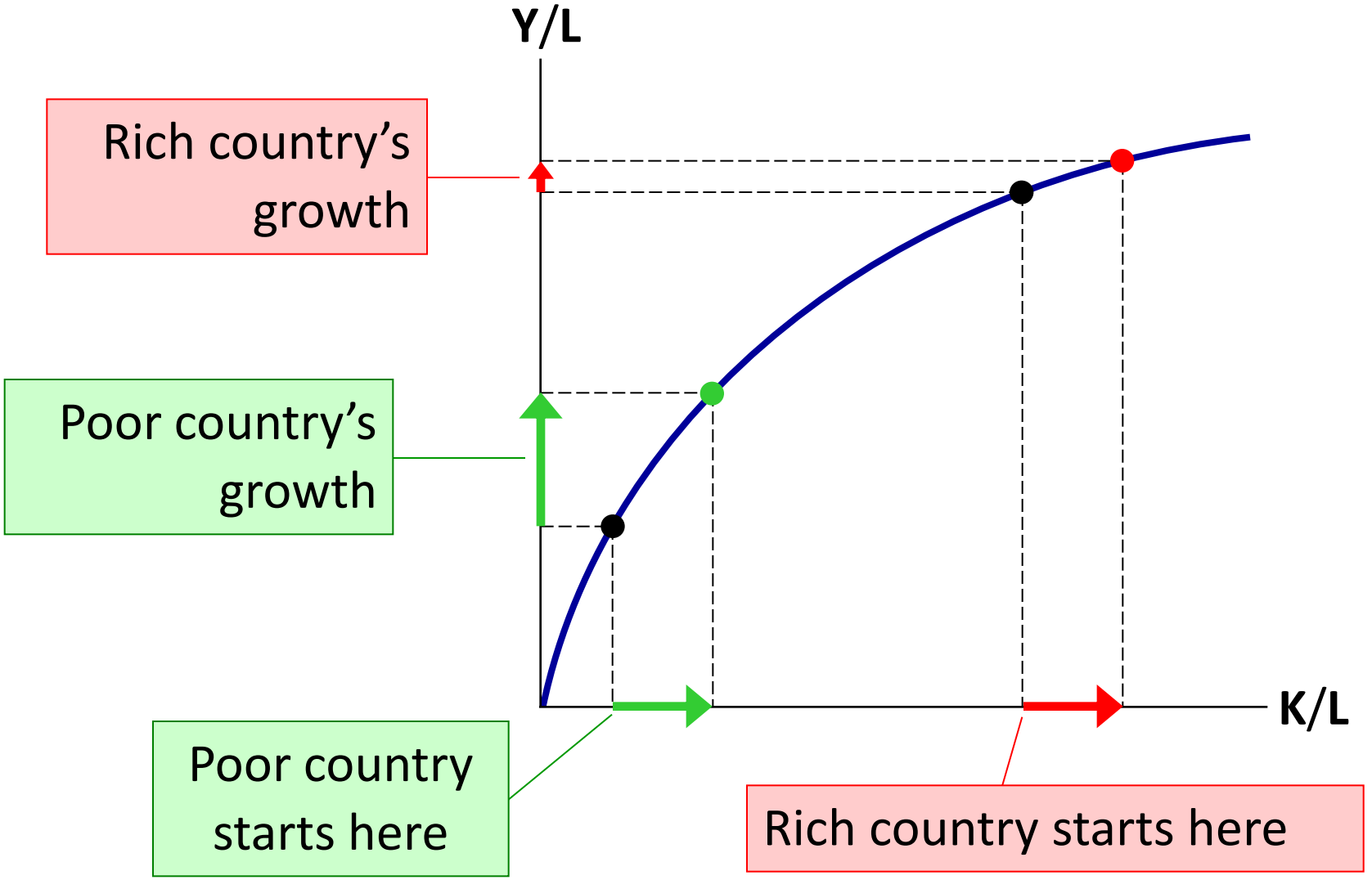
The Production Function & Diminishing Returns

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

- Over 1960-1990, the U.S. and S. Korea devoted a similar share of GDP to investment, so you might expect they would have 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.

(b) Investment from Abroad

"Offer tax incentives for investment by foreign firms"

- To raise **K**/**L** and hence productivity, wages, and living standards, the government can also encourage
  - **foreign direct investment**:
    a capital investment (*e.g.*, factory) that is owned & operated by a foreign entity
  - **foreign portfolio investment**:
    a capital investment financed with foreign money but operated by domestic residents
- Some of the returns from these investments flow back to the foreign countries that supplied the funds.

Investment from Abroad

- 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 other countries.

(c) Education

"Give cash payments for good school attendance"

- Government can increase productivity by promoting education–investment in human capital (**H**).
  - Public schools, subsidized loans for college
- Education has significant effects: In the U.S., each year of schooling raises a worker's wage by 10%.
- But investing in **H** also involves a tradeoff between the present & future:
  Spending a year in school requires sacrificing a year's wages now to have higher wages later.

Education

- Bangladesh has implemented a policy which gives families cash payments if their children attend school faithfully.
- Other developing countries have similar policies, which experts predict will raise productivity and living standards in the long run.

(d) 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 1962-95, caloric consumption rose 44% in S. Korea, and economic growth was spectacular.
  - Robert Fogel (Nobel winner):
    30% of Great Britain's growth from 1790-1980 was due to improved nutrition.

(e) Research and Development

- Technological progress is the main reason why living standards rise over the long run.

- Policies to promote technological progress:
  - Patent laws
  - Tax incentives or direct support for private sector R&D
  - Grants for basic research at universities

(f) Property Rights and Political Stability

- Recall:

  Markets are usually a good way to organize economic activity.

  The price system allocates resources to their most efficient uses.

- This requires respect for **property rights**, the ability of people to exercise authority over the resources they own.

Property Rights and Political Stability

- In many poor countries, the justice system doesn't work very well:
  - Contracts aren't always enforced
  - Fraud, corruption often go unpunished
  - In some, 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 or confiscated by a corrupt government, 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.

(g) 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.

Free Trade

- Recall: ***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.
  - *E.g.,* Argentina during the 20th century.
- Countries with outward-oriented policies have often succeeded.
  - *E.g.,* South Korea, Singapore, Taiwan after 1960.

(h) Population Growth

…may affect living standards in 3 different ways:

1. Stretching natural resources

- 200 years ago, Malthus argued that population growth would strain society's ability to provide for itself.
- Since then, the world population has increased sixfold. If Malthus were right, living standards would have fallen. Instead, they've risen.
- Malthus failed to account for technological progress.

Population Growth

2. Diluting the capital stock

- Bigger population = higher **L** = lower **K/L**
  = lower productivity & living standards.
- This applies to **H** as well as **K**:
  fast population growth = more children
  = greater strain on educational system.
- Countries with fast population growth tend to have lower educational attainment.

Population Growth

2. Diluting the capital stock

To combat this, many developing countries use policy to control population growth.

- China's one child per family laws
- Contraception education & availability
- Promote female literacy to raise opportunity cost of having babies

Population Growth

3. Promoting technological progress

- More people
  = more scientists, inventors, engineers
  = more frequent discoveries
  = faster technological progress & economic growth
- Evidence from Michael Kremer (1993, QJE):
  Over the course of human history,
  - growth rates increased as the world's population increased
  - more populated regions grew faster than less populated ones

Are Natural Resources a Limit to Growth?

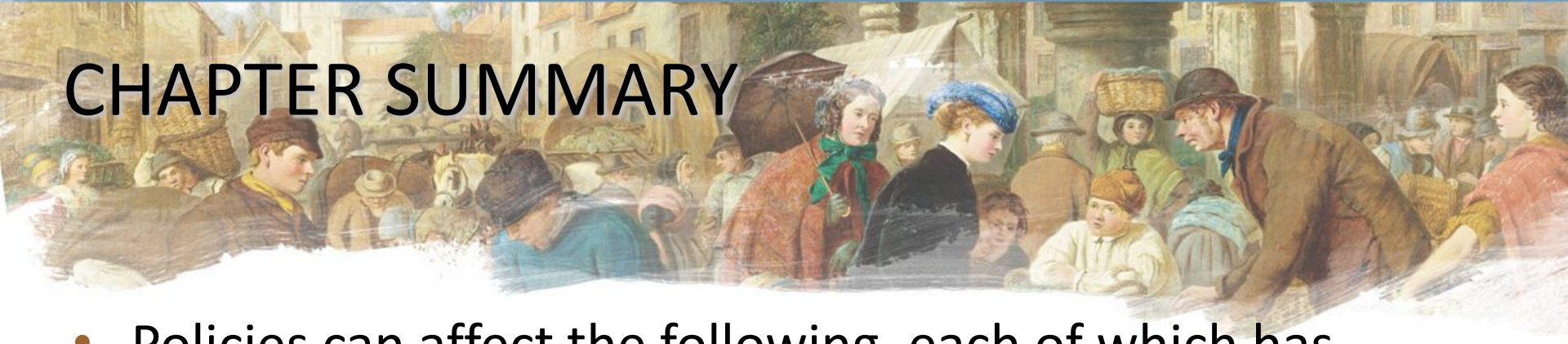
- Some argue that population growth is depleting the Earth's non-renewable resources, and thus will limit growth in living standards.
- But technological progress often yields ways to avoid these limits:
  - Hybrid cars use less gas.
  - Better insulation in homes reduces the energy required to heat or cool them.
- As a resource becomes 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.
- In the next chapter, we will learn how saving and investment are determined, and how policies can affect them.

CHAPTER 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.



CHAPTER 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.