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Production and Growth

PRINCIPLES OF
MACROECONOMICS
FOURTH CANADIAN EDITION

N.GREGORY MANKIW
RONALD D.KNEEBONE
KENNETH J.McKENZIE
NICHOLAS ROWE

PowerPoint® Slides
by Ron Cronovich
Canadian adaptation by Marc Prud'Homme

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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?

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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.

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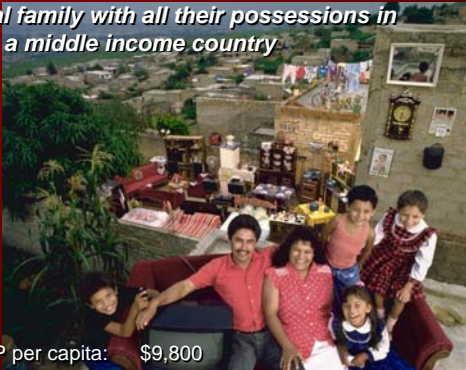
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A typical family with all their possessions in the U.K., an advanced economy



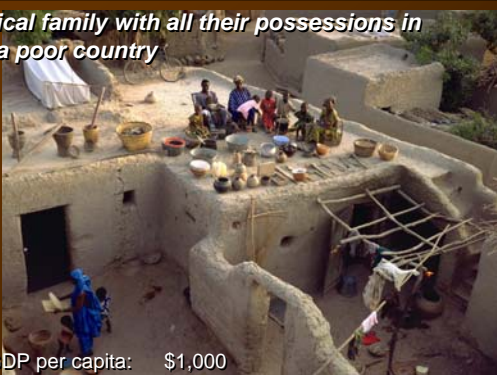
Real GDP per capita: \$30,800
Life expectancy: 78 years
Adult literacy: 99%

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



Real GDP per capita: \$9,800
Life expectancy: 74 years
Adult literacy: 92%

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



Real GDP per capita: \$1,000
Life expectancy: 41 years
Adult literacy: 46%

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.

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TABLE 7.1: The Variety of Growth Experiences

Country	Period	Real GDP per Person at Beginning of Period ^a	Real GDP per Person at End of Period ^a	Growth Rate (per Year)
Japan	1890-2003	\$1794	\$40 110	2.79%
Brazil	1900-2003	929	10 483	2.38
Mexico	1900-2003	1383	12 543	2.16
China	1900-2003	855	6 993	2.06
Germany	1870-2003	2605	38 484	2.05
Canada	1870-2003	2834	41 679	2.04
United States	1870-2003	4782	52 555	1.82
Argentina	1900-2003	2736	15 304	1.69
India	1900-2003	806	4 036	1.58
United Kingdom	1870-2003	5738	38 750	1.45
Indonesia	1900-2003	1064	4 499	1.41
Pakistan	1900-2003	880	2 887	1.16
Bangladesh	1900-2003	744	2 621	1.16

^aReal GDP is measured in 2003 Canadian dollars.

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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?

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Productivity



- Recall one of the Ten Principles from Chapter 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 labour input.
- Y = real GDP = quantity of output produced
 L = quantity of labour
so we can write productivity as Y/L (output per worker)

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PRODUCTIVITY: ITS ROLE AND DETERMINANTS

- **Productivity** plays a key role in determining living standards for all nations in the world.
- **Productivity** refers to the amount of goods and services that a worker can produce from each hour of work.

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Why Productivity Is So Important

- To understand the large differences in living standards across countries, we must focus on the production of goods and services.
- But seeing the link between living standards and productivity is only the first step.
- Why are some economies so much better at producing goods and services than others?

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How Productivity Is Determined

- The inputs used to produce goods and services are called the **factors of production**.
- The factors of production directly determine productivity.
- The Factors of Production
 - Physical capital per worker
 - Human capital per worker
 - Natural resources per worker
 - Technological knowledge per worker

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Physical Capital Per Worker

- Recall: The stock of equipment and structures used to produce g&s is called **[physical] 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 .

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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 .

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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).

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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 cell 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.

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Tech. Knowledge vs. Human Capital

- Technological knowledge refers to society's understanding about how the world works.
- Human capital refers to the resources expended transmitting this understanding to the labour force..
- Both are important for productivity.

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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.

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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. For example,
- Doubling all inputs (multiplying each by 2) causes output to double:

$$2Y = A F(2L, 2K, 2H, 2N)$$
- Increasing all inputs 10% (multiplying each by 1.1) causes output to increase by 10%:

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

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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 (output per worker) depends on:
 - the level of technology (A)
 - physical capital per worker
 - human capital per worker
 - natural resources per worker

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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 govt corruption
- e. restrict imports to protect domestic industries
- f. allow free trade
- g. give away condoms

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ECONOMIC GROWTH AND PUBLIC POLICY

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

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Economic Growth and Public Policy

- 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.

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



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Diminishing Returns and the Catch-Up Effect

- As the stock of capital rises, the extra output produced from an additional unit of capital falls; this property is called *diminishing returns*.
- 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.

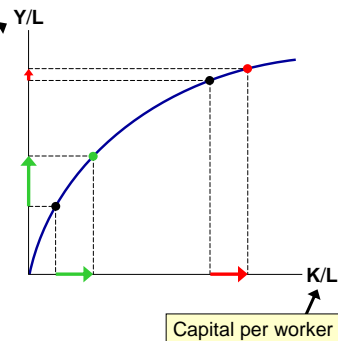
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The Production Function & Diminishing Returns

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

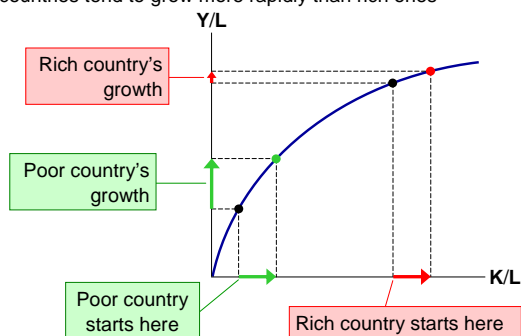
If workers already have a lot of **K**, giving them more increases productivity fairly little.



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



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Example of the Catch-Up Effect

- Over 1960-1990, Canada and S. Korea devoted a similar share of GDP to investment, so you might expect they would have similar growth performance.
- But growth was 7% in Korea and only 2.5% in Canada
- Explanation: the catch-up effect.
In 1960, K/L was far smaller in Korea than in Canada, hence Korea grew faster.

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Investment from Abroad

- To raise K/L and hence productivity, wages, and living standards, the govt 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.

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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.

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Education

- Govt can increase productivity by promoting education—investment in human capital (**H**).
 - public schools, subsidized loans for college
- Education has significant effects: In Canada., 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.



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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.
 - Nobel winner Robert Fogel:
30% of Great Britain's growth from 1790-1980 was due to improved nutrition.

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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.



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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 govt officials for permits
- Political instability (e.g., frequent coups) creates uncertainty over whether property rights will be protected in the future.

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Property Rights and Political Stability

- When people fear their capital may be stolen by criminals or confiscated by a corrupt govt, 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 govt officials.

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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.

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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.

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Research and Development

- Technological progress is the main reason why living standards rise over the long run.
- One reason is that knowledge is a **public good**: Ideas can be shared freely, increasing the productivity of many.
- Policies to promote tech. progress:
 - patent laws
 - tax incentives or direct support for private sector R&D
 - grants for basic research at universities

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Population Growth

...may affect living standards in 3 different ways:

1. Stretching natural resources

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

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Population Growth

2. Diluting the capital stock

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

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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

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Population Growth

3. Promoting tech. progress

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

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ACTIVE LEARNING 2: Productivity

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

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ACTIVE LEARNING 2: Answers

Determinants of productivity:

physical capital per worker (**K/L**)
human capital per worker (**H/L**)
natural resources per worker (**N/L**)
technological knowledge (**A**)

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**

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ACTIVE LEARNING 2: Answers

Determinants of productivity:

- physical capital per worker (**K/L**)
- human capital per worker (**H/L**)
- natural resources per worker (**N/L**)
- technological knowledge (**A**)

Policies to boost productivity:

- Patent laws or grants, to increase **A**
- Control population growth, to increase **K/L**

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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.

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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.

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CHAPTER SUMMARY

- There are great differences across countries in living standards and growth rates.
- Productivity (output per unit of labour) 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.

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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.

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End: Chapter 7

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