Production and growth

LECTURE: 6

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?

Theory of Production and the Production Function

Let us make an in-depth study of the theory of production and the production function in economics.

- *"Knowledge is the only instrument of production that is not subject to diminishing returns – J. M. Clark, 1957."*

Productivity

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

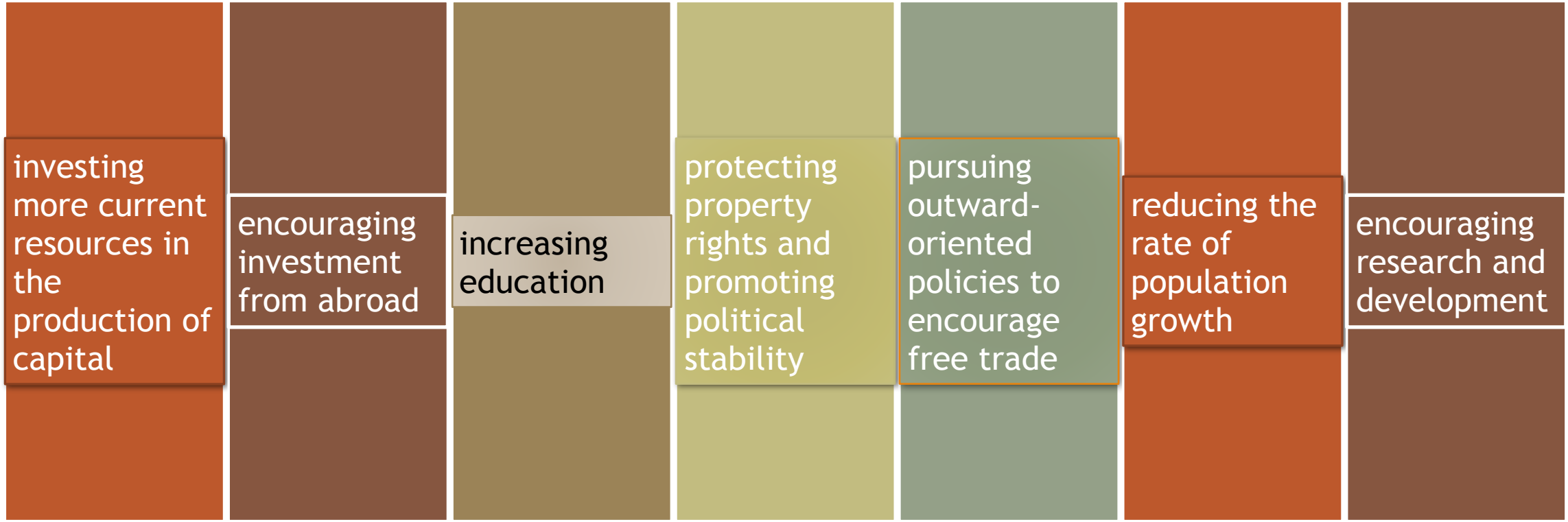
L = quantity of labor

so productivity = **Y**/**L** (output per worker)

The four determinants of a country's productivity are:

Physical capital, which is the stock of equipment and structures that are used to produce goods and services;	Human capital, which is the knowledge and skills that workers acquire through education, training, and experience;	Natural resources, which are inputs into production that are provided by nature, such as land, rivers, and mineral deposits;	Technological knowledge, which is society's understanding of the best ways to produce goods and services.

Ways in which a government policymaker can try to raise the growth in living standards in a society



Why Productivity Is So Important?

When a nation's workers are very productive, real GDP is large and incomes are high.

When productivity grows rapidly, so do living standards.

What, then, determines productivity and its growth rate?

Role of Average Labor Productivity

We can define real GDP per person as the product of two terms- average labor productivity and the share of the employed population

- Y = total real output
- N = number of employed workers
- POP = total population

$$GDP\ per\ person = \frac{Y}{POP} = \frac{Y}{N} \times \frac{N}{POP}$$

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( ) 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

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

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:

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

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

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

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**.

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).

Natural Resources Per Worker

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

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

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

Small Differences Matter

Small differences in growth rates can have large long-run effects

- Because of the power of compound interest

Compound interest

- The payment of interest not only on the original deposit but on all previously accumulated interest

Question :

Which of the following does not belong in the production function?

A. Labor
B. Human capital
C. Consumption demand
D. Physical capital

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.

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.

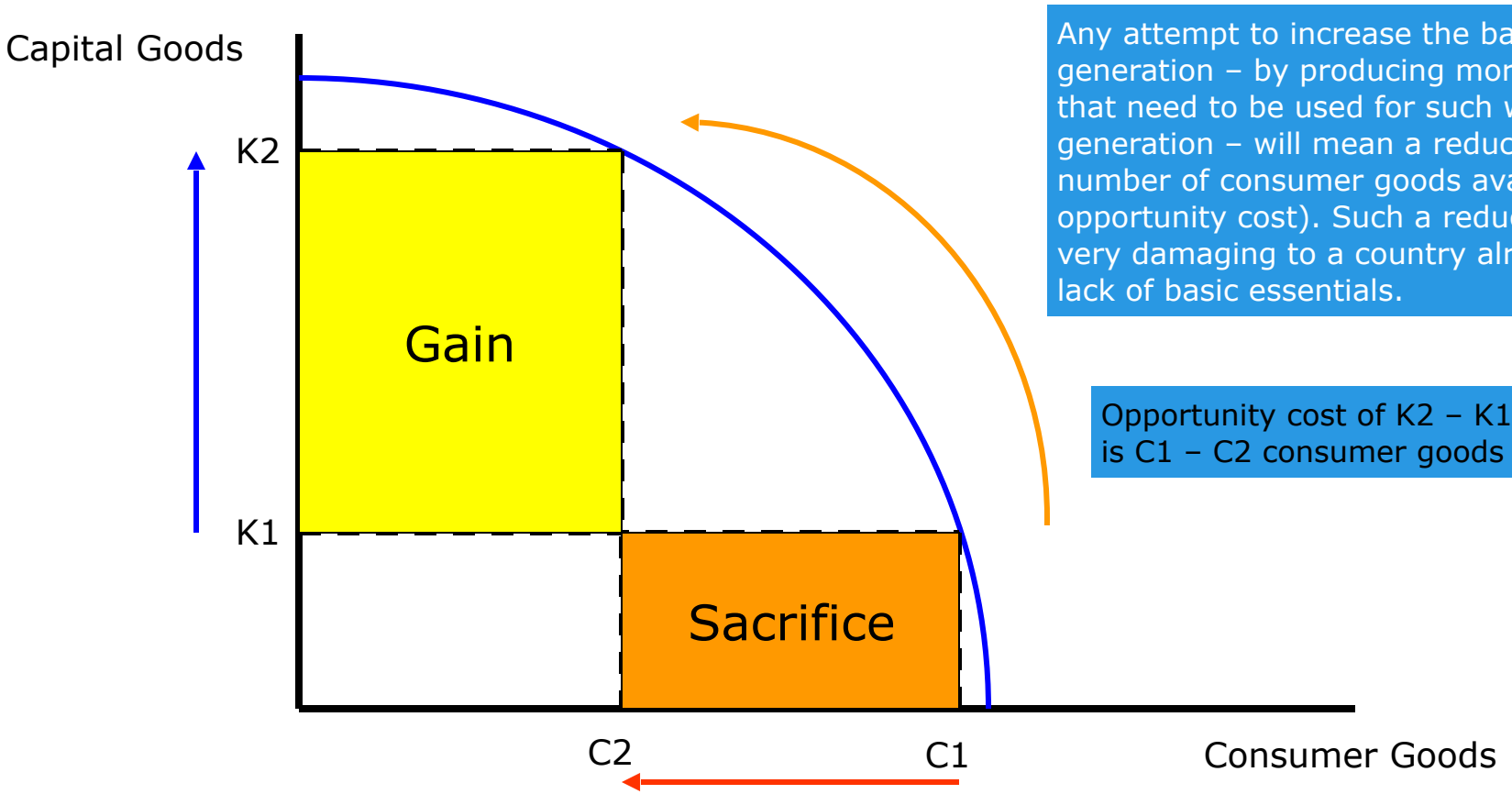
Opportunity Cost of Growth

Resource allocation
- Consumer Goods?
- Capital Goods?

Necessity of generating growth through allocating resources to the sources of growth – capital goods

Makes population poorer as fewer consumer goods initially available – often these consumer goods represent the basic essentials of life

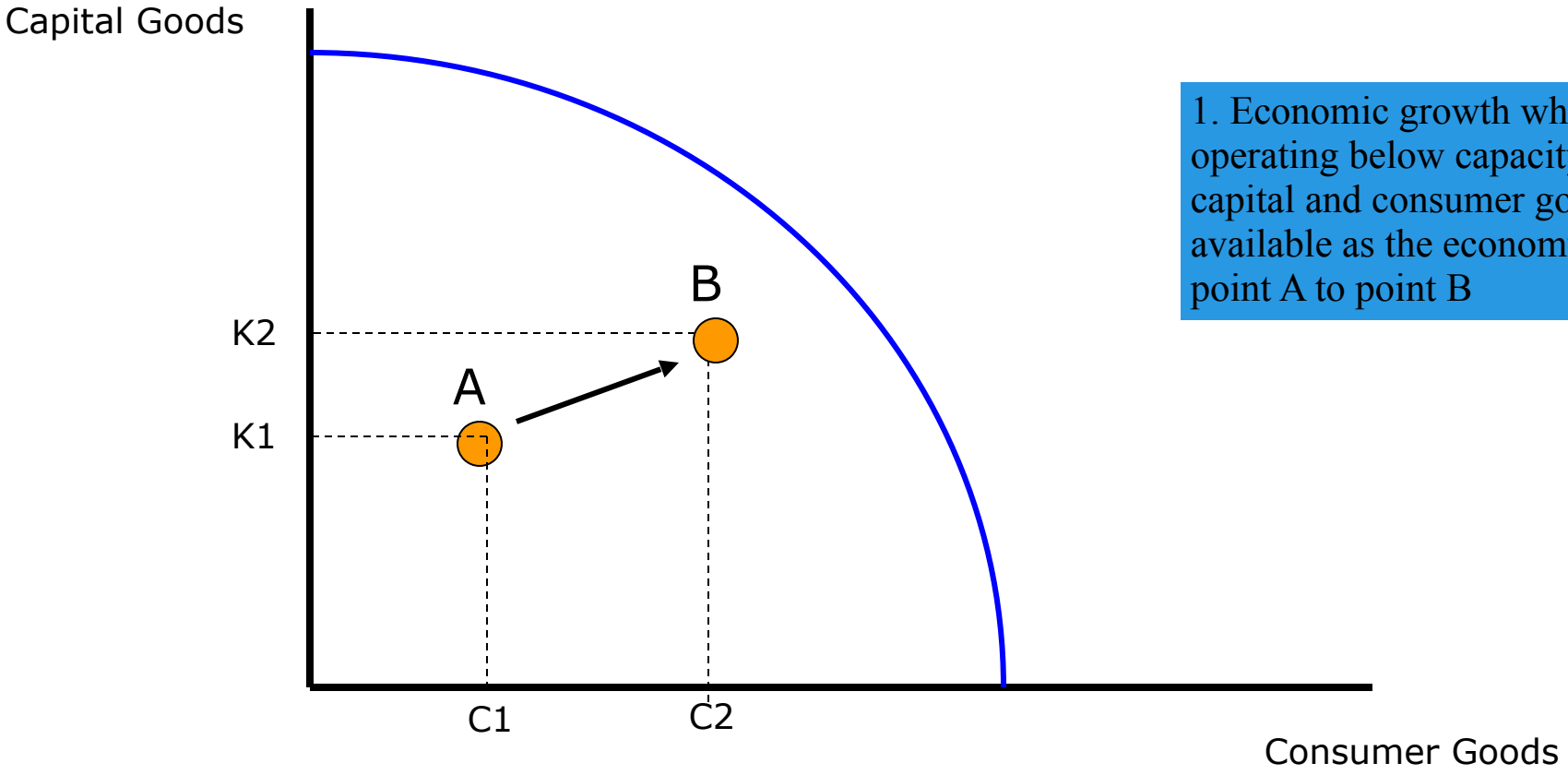
Opportunity Cost of Growth



Any attempt to increase the basis for wealth generation – by producing more capital goods that need to be used for such wealth generation – will mean a reduction in the number of consumer goods available (the opportunity cost). Such a reduction can be very damaging to a country already suffering a lack of basic essentials.

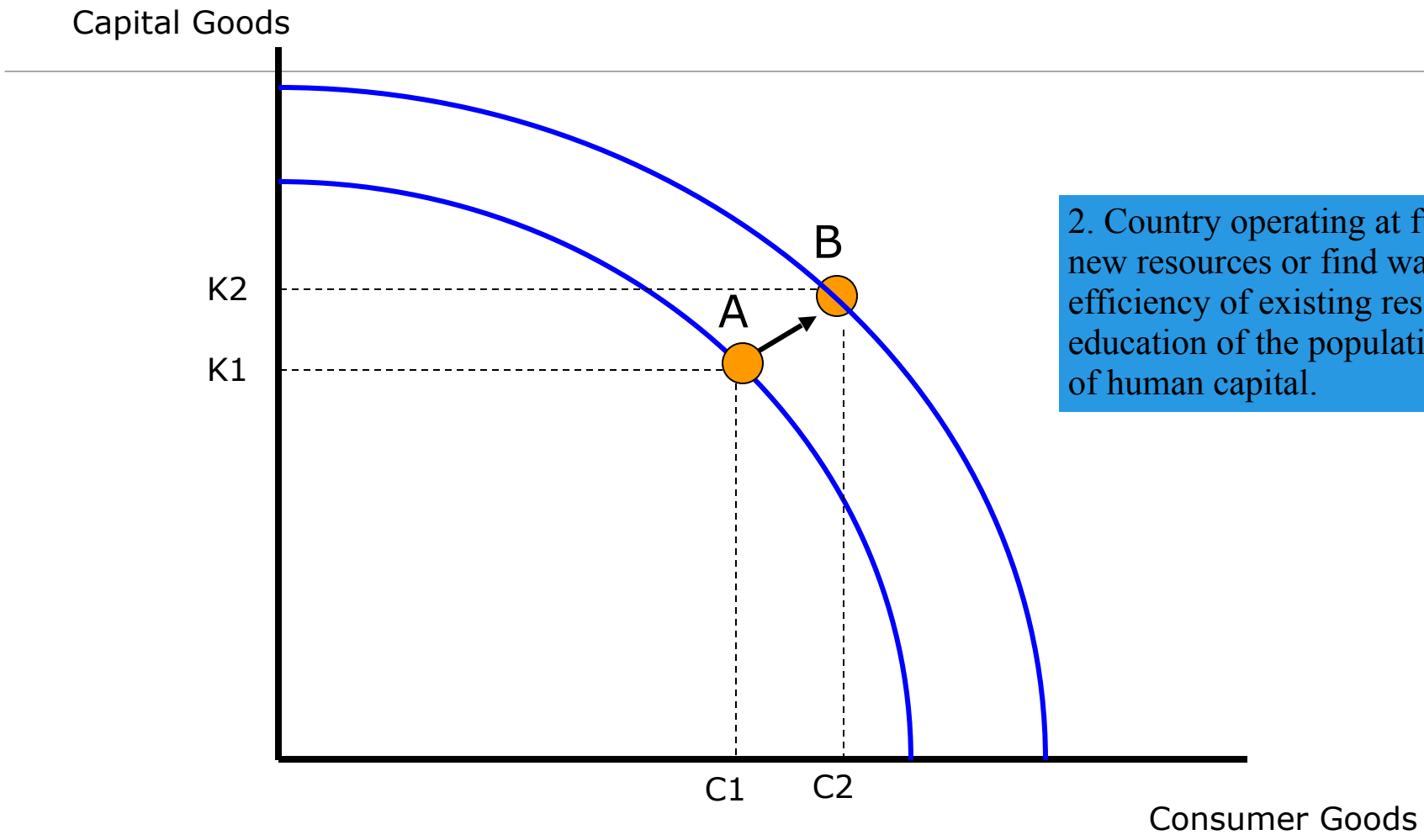
Opportunity cost of K2 – K1 capital goods is C1 – C2 consumer goods sacrificed.

Growth and Production Possibility Frontiers



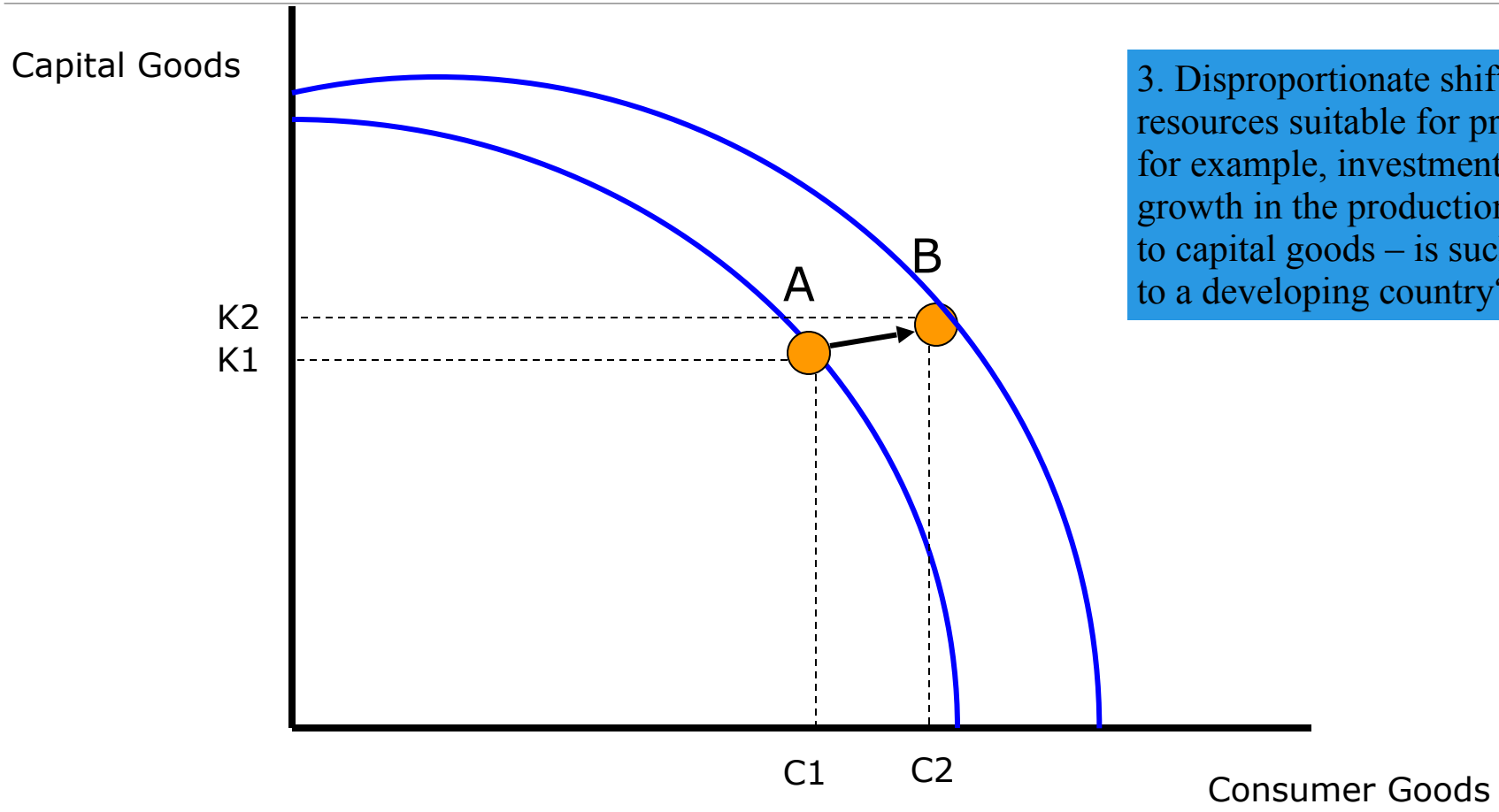
1. Economic growth when a country is operating below capacity – more of both capital and consumer goods are made available as the economy moves from point A to point B

Growth and Production Possibility Frontiers



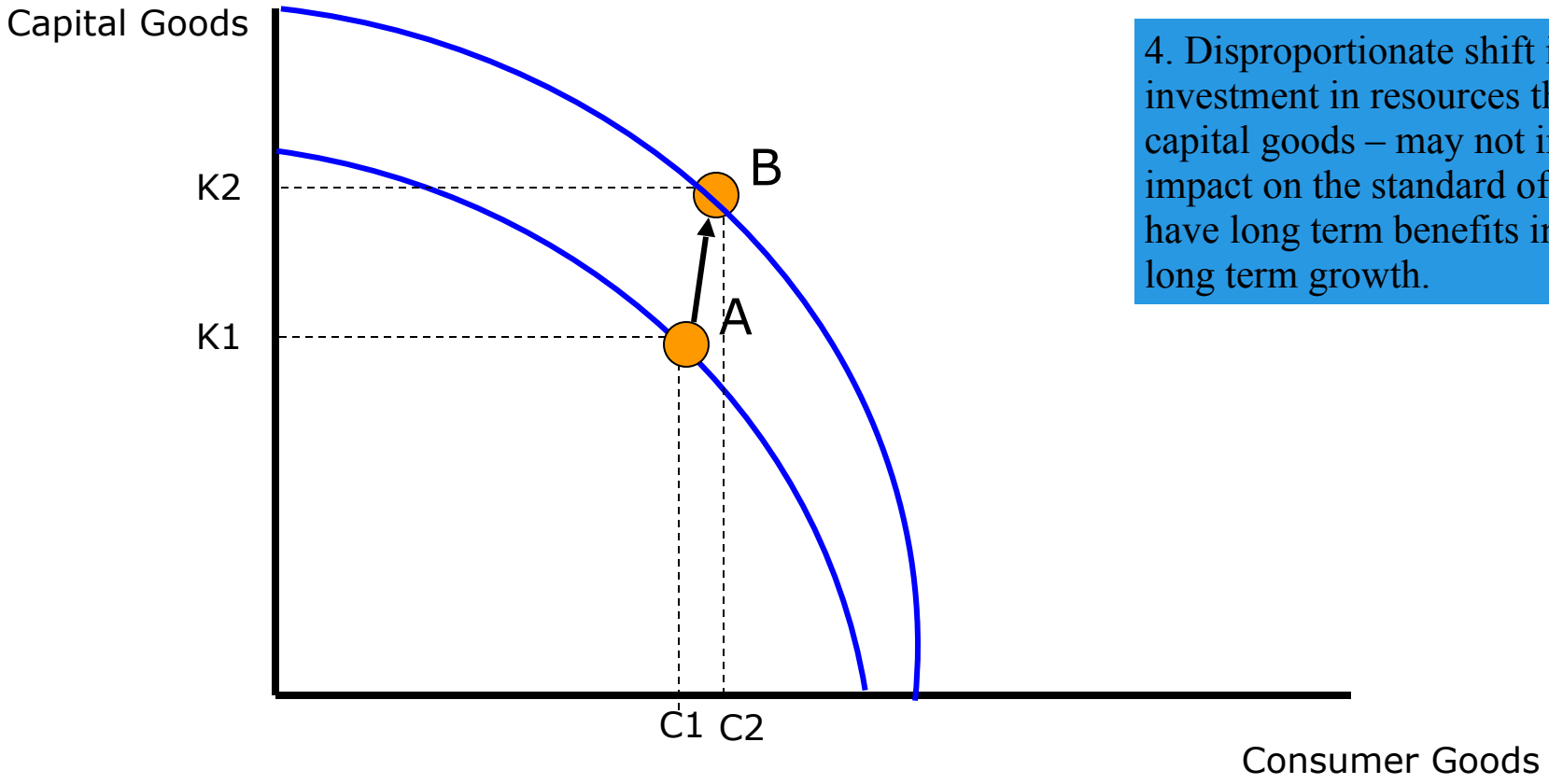
2. Country operating at full capacity but discovers new resources or find ways of improving the efficiency of existing resources, for example, education of the population to improve the quality of human capital.

Growth and Production Possibility Frontiers



3. Disproportionate shift in PPF caused by investment in resources suitable for producing certain types of goods – for example, investment from overseas may generate growth in the production of consumer goods as opposed to capital goods – is such investment of long term benefit to a developing country?

Growth and Production Possibility Frontiers



4. Disproportionate shift in PPF as a result of investment in resources that favour generation of capital goods – may not initially seem to have major impact on the standard of living of the country but may have long term benefits in enabling more sustainable long term growth.

ACTIVE LEARNING :

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

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.

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

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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.

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.

Thanks for your attention!