The Production Function and Theories of Growth

- The production function shows the relationship between the quantity of inputs used in production and the quantity of output resulting from production.

- The production function for growth has land, labor, and capital as factors of production.

- “A” is an adjustment factor that captures the effect of technology.

\[
Output = A \cdot f(Labor, \ Capital, \ Land)
\]

Describing Production Functions

- Scale economies describe what happens in a production function when all inputs increase equally.
  - Constant returns to scale.
  - Increasing returns to scale.
  - Decreasing returns to scale.
Describing Production Functions

- **Constant returns to scale** means that output will rise by the same proportionate increase in all inputs.

- **Increasing returns to scale** occurs when output rises by a greater proportionate increase as all inputs.

- **Decreasing returns to scale** occurs when output rises by a smaller proportionate increase as all inputs.

- **Diminishing marginal productivity** describes what happens when more of one input is added without increasing any other inputs.
Describing Production Functions

• The *law of diminishing marginal productivity* states that increasing one output, keeping all others constant, will lead to smaller and smaller gains in output.

The Classical Growth Model

• The Classical growth model focuses on capital accumulation in the growth process.
• The more capital an economy has, the faster it will grow.
• Because of this emphasis on capital, market economies are called *capitalist economies*.

The Production Function

• Production function shows the relationship between inputs and outputs.
• Growth is shown by a shift in the production function.
• Output = A\*F(labor, capital, land)

The Classical Growth Model

• According to the Classical growth model, the more capital an economy has, the faster it will grow.
• Classical economists focused their analysis and their policy advice on how to increase investment:
  
  savings  ➔ investment  ➔
  increase in capital  ➔ growth
**Diminishing Marginal Productivity of Labor**

- The Classical growth model focused on how diminishing marginal productivity of labor would limit growth.
- Since the amount of farm land is fixed, diminishing marginal productivity would set in as population grew.
- The iron law of wages - as output per person declines, at some point available output is no longer sufficient to feed the population.
- This long-run outcome was called the stationary state.

**Diminishing Returns and Population Growth**

![Graph showing Diminishing Returns and Population Growth]

**Diminishing Marginal Productivity of Capital**

- The predictions for the long term were incorrect because increases in technology and capital overwhelmed diminishing marginal productivity.
- The focus became the diminishing marginal productivity of capital, not labor.

- Capital grows faster than labor
- Capital is less productive
- Slower growth of output
- Per capita growth stagnates

**Diminishing Marginal Productivity of Capital**

- The predictions of the stationary state turned out to be wrong.
- Increases in technology and capital overwhelmed the law of diminishing marginal productivity.
Diminishing Marginal Productivity of Capital

- The predictions for the long term were incorrect because increases in technology and capital overwhelmed diminishing marginal productivity.
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The Convergence Hypothesis

- The diminishing marginal productivity of capital leads to the convergence hypothesis – per capita income in countries with similar institutional structures will converge to the higher level.
- The U.S. will grow slower because the marginal product of capital is higher in developing countries, hence costs of production are lower.
- This difference causes capital investment flows and production to move from the U.S. to developing countries.

The Convergence Hypothesis

- As of the early 2000s the predictions of convergence have not come true.
- Economists have several explanations of why convergence has not taken place:
  - Lack of factor mobility
  - Differing institutional structure
  - Incomparable factors of production
  - Technological agglomeration effects

Lack of Factor Mobility and Differing Institutional Structure

- The transfer of capital and technology causes convergence.
- If there are barriers to factor mobility, convergence is slowed down or reduced.
- The more similar the institutional structures, the more likely convergence will occur because firms are more likely to move production to countries that are well-suited to business.
Incomparable Factors of Production

• Labor in various countries differ in skills, education, experience, and effort.
• When a society’s workers become more educated, that country’s human capital increases even though labor hours may not change.
• Increases in human capital allow labor to keep pace with capital and avoid the diminishing marginal productivity of capital.

Technological Agglomeration

• Technological agglomeration – the tendency of technological advance to spawn further technological advances, creating a concentration of new technologies in a specific location.
• As long as new technological advances occur faster in developed countries than older technologies diffuse into less developed countries, convergence need not take place.

New Growth Theory

• Unlike Classical growth theory, which left technology outside of economic analysis, new growth theory emphasizes the role of technology rather than capital in the growth process.

Technological advance → Investment → Further technological advance → Growth

New Growth Theory

• New growth theory emphasizes the role of technology rather than capital in the growth process.
Technology

- Technology is the result of investment in creating technology (research and development).
- Investment in technology increases the technological stock of an economy.

Technology

- Growth theory separates investment in capital and investment in technology.
- Increases in technology are not as directly linked to investment as is capital.

Technology

- Increases in technology often have enormous positive spillover effects.
- Technological advances in one sector of the economy lead to advances in completely different sectors.

Technology

- Technological advances have positive externalities.
  - *Positive externalities* – positive effects on others not taken into account by the decision maker.
Learning by Doing

• New growth theory also highlights learning by doing.
• *Learning by doing* – improving the methods of production through experience.

Learning by Doing

• By increasing the productivity of workers, learning by doing overcomes the law of diminishing marginal productivity.

Increasing Returns to Scale

Technological Lock-In

• Technological lock-in is an example of how sometimes the economy does not use the best technology available.
Technological Lock-In

- *Technological lock-in* occurs when old technologies become entrenched in the market.
- They become locked into new products despite the fact that more efficient technologies are available.

Technological Lock-In

- One reason for technological lock-in is network externalities.
- *Network externalities* – an externality in which the use of a good by one individual makes that technology more valuable to other people.

Technological Lock-In

- Switching from a technology exhibiting network externalities to a superior technology is expensive and sometimes nearly impossible.

Economic Policies to Encourage Per Capita Growth*

- Encourage saving and investment.
- Control population growth.
- Increase the level of education.
- Create institutions that encourage technological innovation.
- Provide funding for basic research.
- Increase the economy’s openness to trade.
Review Question 8-1  Explain the difference between the Classical growth theory and new growth theory.

Classical growth theory is a model of growth that focuses on the role of capital accumulation in growth. According to the Classical theory, the more capital an economy has, the faster it will grow. New growth theory emphasizes the role of technology rather than capital in the growth process. Increases in technology can shift the production possibilities curve out and allow the society to produce more output without new resources.

Review Question 8-2  List six government policies that can promote growth.

Government policies to promote growth include: encourage saving and investment, control population growth, increase the level of education, create institutions that encourage technological innovation, fund basic research, and increase openness to trade.