The Power of Macroeconomics

Lecture Seven:

Economic Growth & Productivity

•Presented By:
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•University of California-Irvine

The Daily Financial Press News

- Stock prices
- Job numbers
- Trade statistics

A Perennial Wall Street Worry
Will the Federal Reserve hike interest rates?

In The Long Run, Economies Grow

- Productivity rises with the amount of capital and technological change.

Key Definition

1. **Living standards, measured by output per capita or consumption per household, are primarily determined by the level of productivity and growth of a country.**

In This Lecture

- Examine the process of economic growth.
- Understand the critical role productivity plays.
- Gain insights into how and why government policies play a critical role in the growth process.

The Process of Economic Growth

A Key Definition

1. **Economic growth represents the expansion of a country's potential GDP or national output.**
2. **The growth rate of output per person determines the rate at which the country's standard of living is rising.**

What's the Recipe for Economic Growth?

- Britain: A world leader in the 1800s by pioneering the Industrial Revolution.
- Japan: A powerhouse in the 1980s by imitating foreign technologies and protecting domestic industries.

All Nations Ride on the Four Wheels

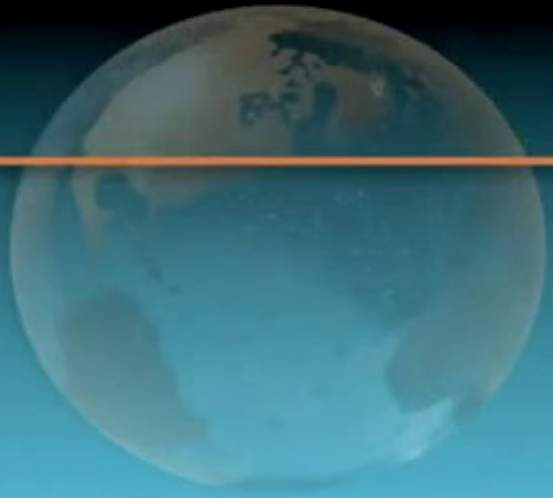
- All rapidly growing countries share common traits.

Key Point

The engine of economic growth must ride on the same four wheels, no matter how rich or poor the country.

The Four Wheels of Growth

- Human resources: labor, education, discipline, motivation.
- Natural resources: Land, minerals, fuels, environment.
- Capital formation: Machines, factories, roads.
- Technology: Science, engineering, management, entrepreneurship.



LECTURE SEVEN - PART TWO

Growth Wheel #1: The Labor Force

- The quantity of workers is important BUT:
- The quality of labor inputs may be the single most important element in economic growth.

Skilled Versus Unskilled Workers

- A country rich in capital goods may still fail.
- The capital goods must be effectively used and maintained by skilled and trained workers.

Key Point

Improvements in literacy, health, and discipline, and the ability to use computers, add greatly to the productivity of labor.

Growth Wheel #2: Natural Resources

- Resources: Arable land, oil and gas, forests, water, and mineral resources.
- Canada and Norway have grown primarily on their outputs in agriculture, fisheries, and forestry and not manufacturing.
- The U.S. is the world's largest producer and exporter of grains.

Natural Resources Not Necessary for Rapid Growth!

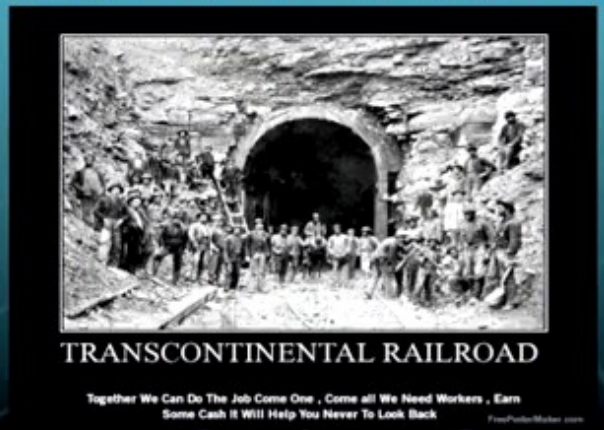
- Cities like New York and Singapore prosper on their high-density service industries.
- Countries such as Japan depend more on labor and capital than indigenous resources.

Growth Wheel #3: Capital Formation

- Capital includes:
  - Structures like roads and power plants.
  - Equipment like trucks and computers.
- The rapid accumulation of capital accounts for some astonishing growth stories.

A Study In Capital Formation

- The transcontinental railroads of North America brought commerce to the American heartland.
- Investment in automobiles, roads, and power plants increased productivity and provided the infrastructure which created new industries.



Capital Accumulation

- Requires a sacrifice of current consumption.
- Rapid growth means investing heavily in new capital goods.
- Rapidly growing countries may devote 10-20% of output to capital formation.

Key Concept: Social Overhead Capital

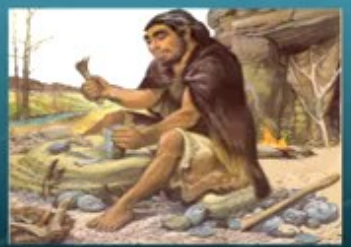
- It's not just about private sector investment!
- Government projects are also a key to growth.
- Roads and irrigation & water projects, for example, involve large "indivisible" investments with "increasing returns to scale."

Key Point

Government projects involve external benefits that private firms cannot capture so government is necessary to provide them.

Growth Wheel #4: Technological Change & Innovation

- A key to the rapid growth of living standards.
- Growth is NOT a process of simple replication.
- Growth IS a never-ending stream of inventions and technological advances.



Technological Change Defined

- Changes in production processes.
- Introduction of new products or services.

Fundamental Product Inventions

- The telephone, radio, airplane, phonograph, TV, radio, VCR, DVR, PDAs etc.
- Today's tiny notebooks are faster than computers in the 1960s.

The Technology Beat Goes On

- A continuous process of improvements.
- Over 100,000 new U.S. patents annually.
- Millions of small refinements.

Demand and Efficiency Factors

- The four supply factors of growth relate to the physical ability of the economy to expand.
- Two other factors are equally important.

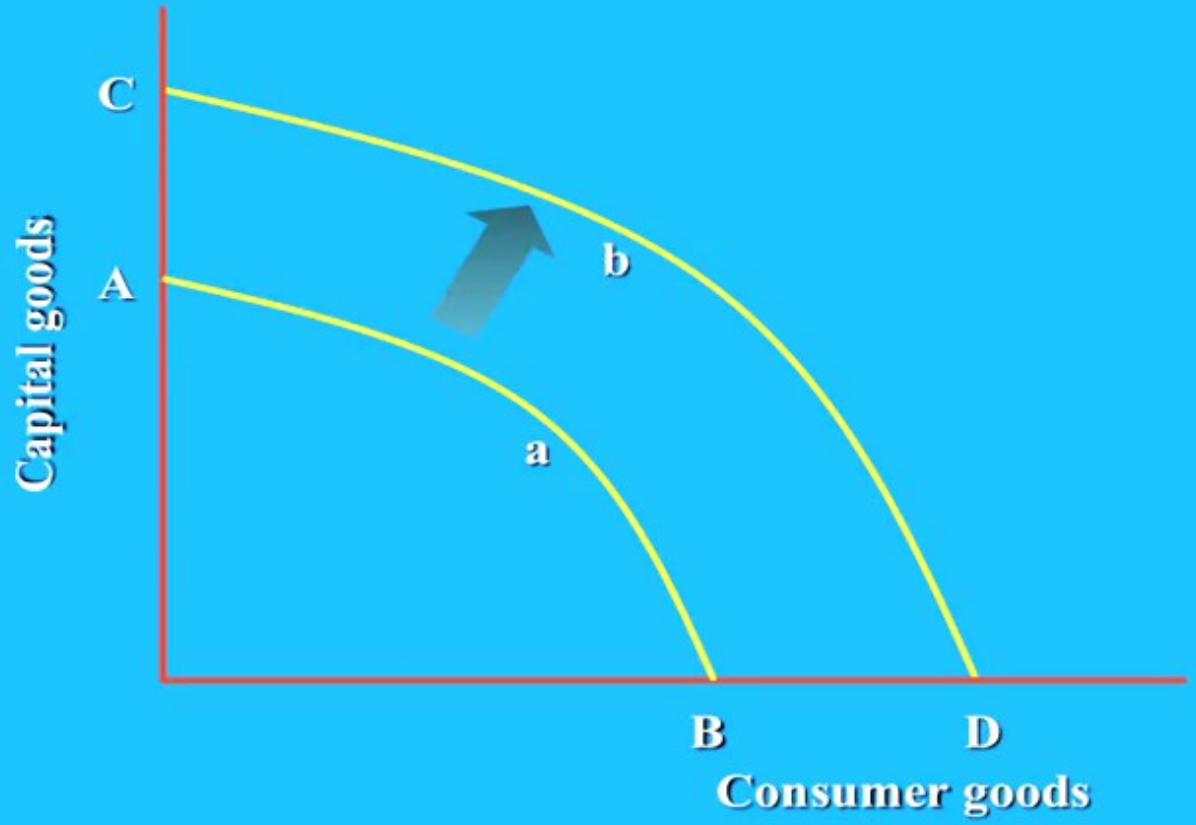
The Demand Factor

A nation must fully employ its expanding supply of resources to reach its potential so aggregate demand must grow!

The Efficiency Factor

- It's not just about reaching full employment!
- A country must achieve *productive efficiency* by using resources in the least costly way.
- A country must also achieve *allocative efficiency:* The specific mix of goods and services must maximize society's well-being.

A Production Possibilities Frontier Analysis!



Sources of growth		Percentage of total growth
1. Increase in quantity of labor		33
2. Increase in labor productivity		67
3. Technological advance	28	
4. Quantity of capital	20	
5. Education and training	12	
6. Economies of scale	8	
7. Improved resource allocation	8	
8. Legal-human environment and other	−9	
		100

Source: Edward F. Denison, *Trends in American Economic Growth, 1929–1982* (Washington: Brookings Institution, 1985), p. 30; *Economic Report of the President*, various years; authors' estimates.

Question

Which factors of growth have been most instrumental in increasing labor productivity?

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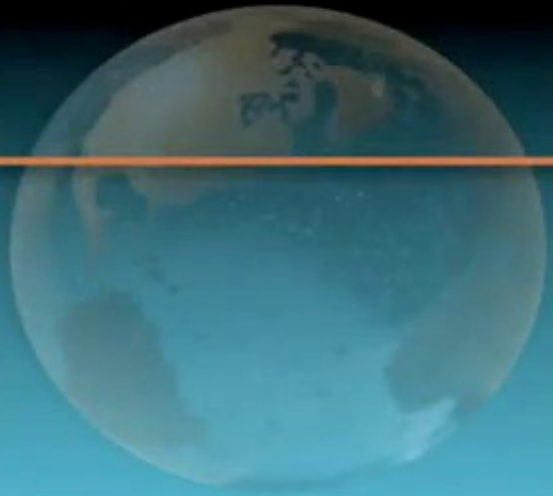


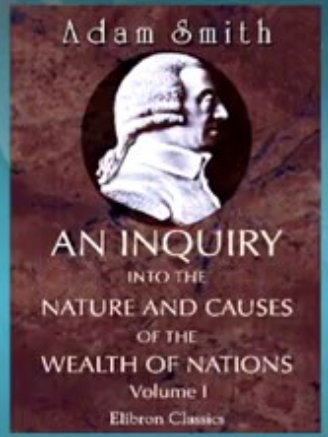
LECTURE SEVEN - PART THREE

Which Wheel To Ride On?

- Some experts stress capital investment.
- Others advocate more R&D and technological change.
- A third group emphasizes education.

The Critical Role of Land in Early Growth Theory

- An Idyllic Age.
- Land freely available to all.
- Capital accumulation did not yet matter.



Adam Smith's Growth Model

- People spread out onto more acres as population increases.
- With no capital, national output doubles as population doubles.
- Wages represent the entire national income.

Key Result

Output expands with population so real wage per worker stays constant!!

The Golden Age Ends!

- With population growth, all land occupied.
- Balanced growth of land, labor, and output no longer possible.
- As land becomes scarce, rents rise to ration it among different uses.

Output Grows Slower Than Population

- Population still grows along with output.
- But output grows more slowly than does population.
- Why?

Key Concept

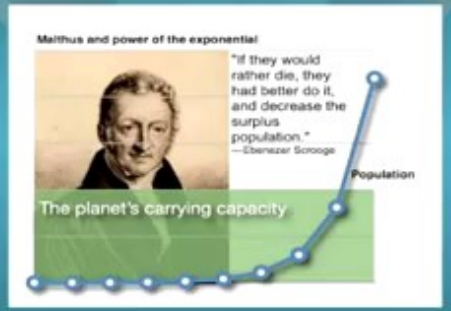
The Law of Diminishing Returns.

The Law of Diminishing Returns

- New laborers added to a fixed supply of land means each worker has less land to work with.
- The “marginal product” of each additional worker must decrease.
- Wages must fall with falling productivity!

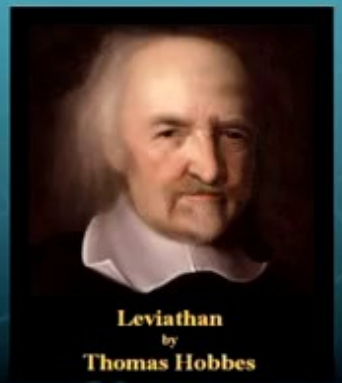
Malthusian Growth Theory

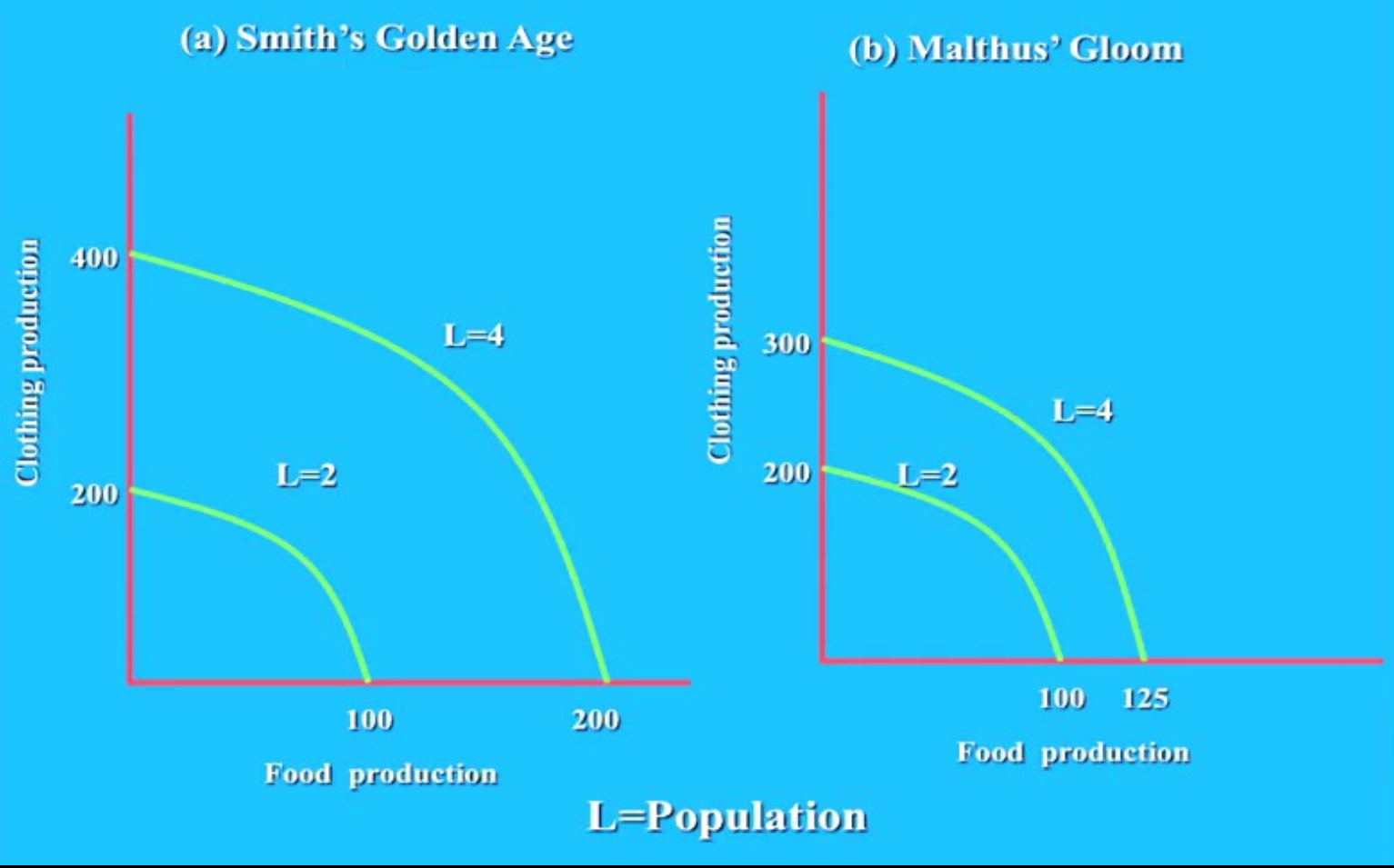
- Population pressures will drive wages and workers to subsistence levels.
- If subsistence wages go up, population will expand.
- This drives productivity and wages back to subsistence levels.
- Mortality rates rise and population declines.

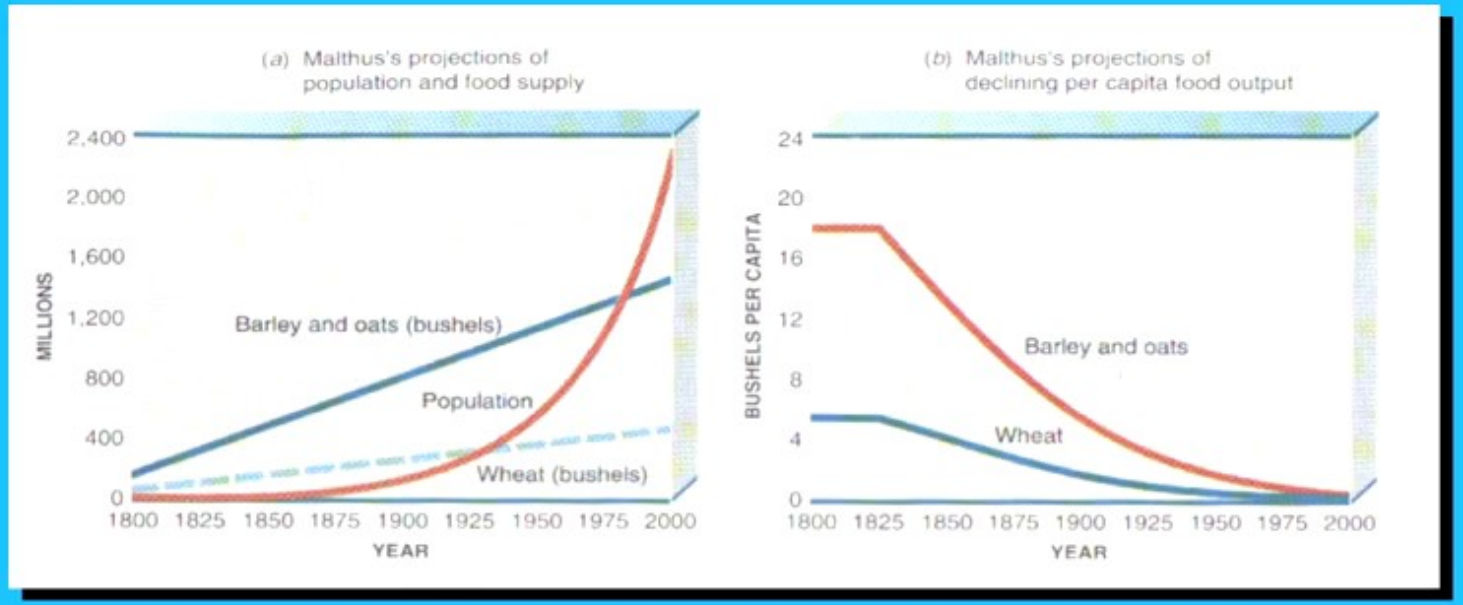


When Malthus Met Hobbes

- Only at subsistence wages is population stable.
- Working class doomed to a life “nasty, brutish, and short.”
- Malthusian growth theory is the origin of the term “the dismal science.”




(a) Smith's Golden Age
Clothing production
400
200
L=4
L=2
100
200
Food production
(b) Malthus' Gloom
Clothing production
300
200
L=4
L=2
100
125
Food production
L=Population


(a) Malthus's projections of population and food supply
MILLIONS
2,400
2,000
1,600
1,200
800
400
0
Barley and oats (bushels)
Population
Wheat (bushels)
1800 1825 1850 1875 1900 1925 1950 1975 2000
YEAR
(b) Malthus's projections of declining per capita food output
BUSHELS PER CAPITA
24
20
16
12
8
4
0
Barley and oats
Wheat
1800 1825 1850 1875 1900 1925 1950 1975 2000
YEAR

Overcoming Malthusian Doom

Key Points

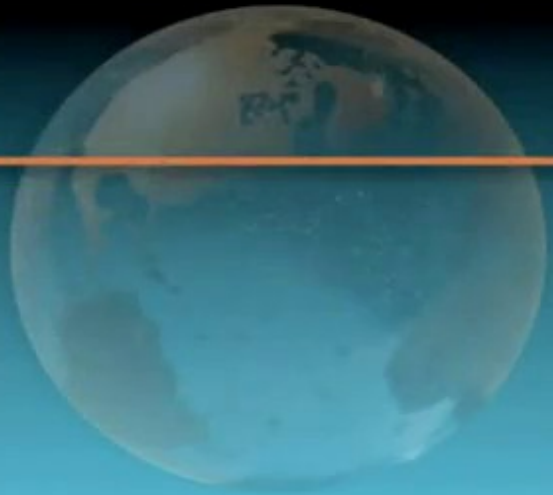
1. Technological innovation & capital investment can overcome the law of diminishing returns.
2. Land need not become the limiting factor in production!

Lessons From the Industrial Revolution

- Power-driven machinery increased production.
- Teams of workers gathered into giant firms.
- Railroads and steamships linked the globe.
- Iron and steel made possible stronger and faster machines.

New Industries Grow Up

- Key Innovations: Telephone, automobile, electric power.
- Capital accumulation & new technologies became the dominant force affecting economic development.



LECTURE SEVEN - PART FOUR

The Neoclassical Growth Model

- Explains how capital accumulation and technological change affect the economy.
- Pioneered by Nobel Laureate Robert Solow of MIT.

Neoclassical Growth Model Approach

- **Major Model Components:** Capital and technological change.
- **Primary Tool:** Aggregate Production Function.

Key Point

The Aggregate Production Function Model relates technology and factor inputs to total potential GDP.

Key Concept!!!!

- Capital Deepening: The process of increasing the amount of capital per worker.

Examples

- More farm machinery and irrigation systems in farming.
- More railroads and highways in transportation.
- More computers and communication systems in banking.

First Major Insight of Solow Model

- In the absence of technological change, capital deepening does *not* lead to a proportional increase in output.

Question

Why does capital deepening not lead to a proportional increase in output in the absence of technological change?

The Law of Diminishing Returns

- Answer: Capital deepening does not lead to a proportional increase in output because of the law of diminishing returns.
- The Law of Diminishing Returns Applied: As you add more capital to a fixed supply of labor, the marginal product of capital must fall.

Second Major Insight of Solow Model

- Capital deepening leads to economic stagnation in the absence of technological change!

Question

What happens to worker wages and the return on capital as a result of capital deepening?

Who Wins, Who Loses

- Workers Win: They have more capital so their marginal product rises along with wages.
- Capital Owners Lose: They see lower rates of return and falling real interest rates because of diminishing returns to capital!!!

Remember: This is in the ABSENCE of technological change!

The Long Run Without Tech Change

- Economy enters a *steady state* in which capital deepening ceases as the capital-labor ratio stops rising.
- As real wages rise and returns to capital fall, further investments become unprofitable.
- Without technological change, both capital incomes and wages stagnate!!!!

Replication Without Innovation Leads to Stagnation

Key Point

If economic growth consists *only* of accumulating capital through replicating factories with existing methods of production, then peoples' standard of living will eventually stop rising.

Third Major Insight of the Neoclassical Growth Model

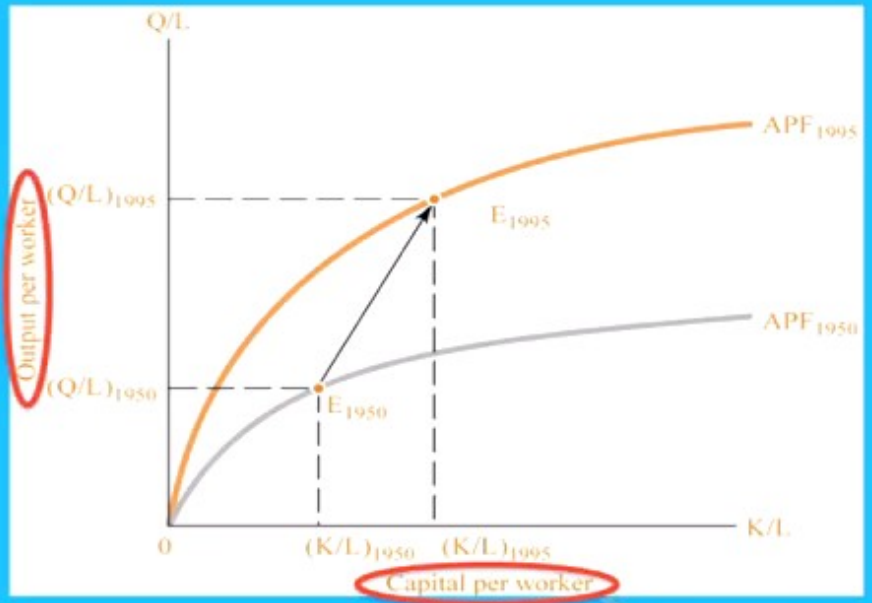
- It is only through technological change that modern economies can avoid the trap of economic stagnation.

What isTechnological Change?

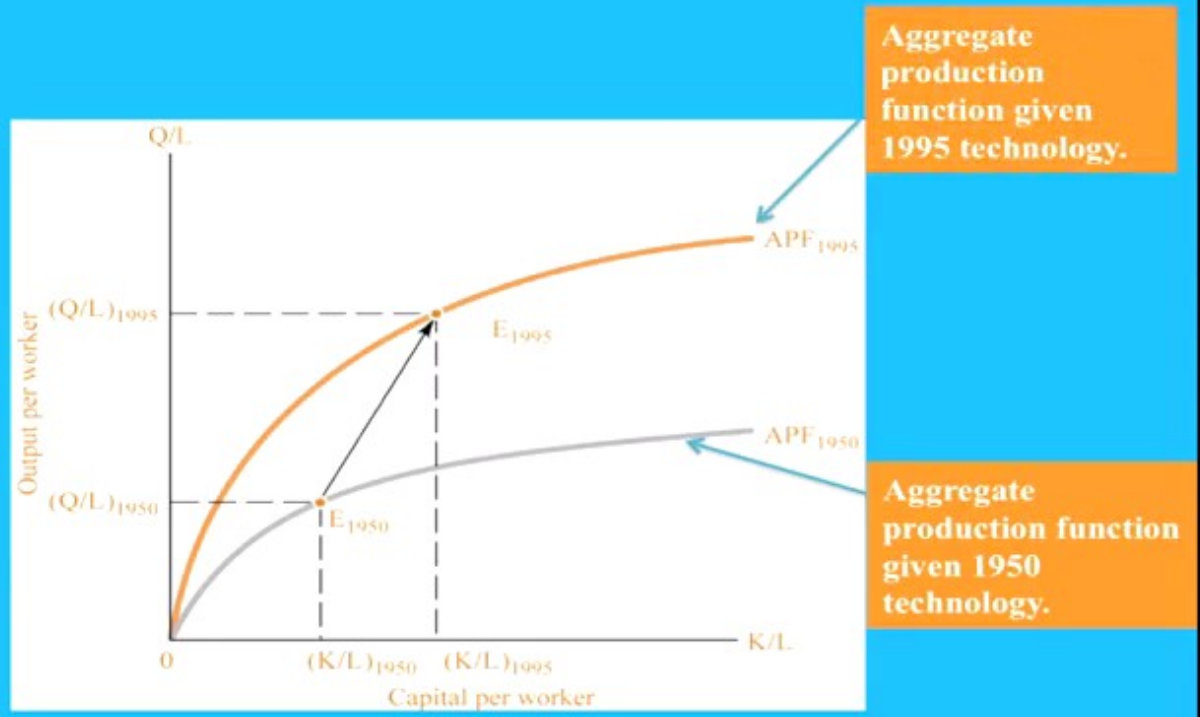
- Advances in production processes.
- The introduction of new and improved goods and services.
- New managerial techniques.
- New forms of business organization.

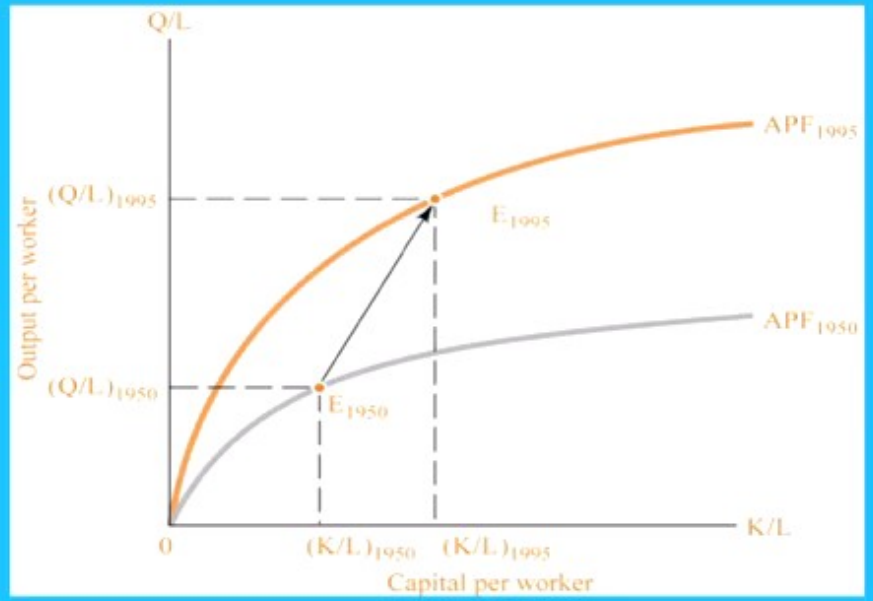
Examples Old and New

- Gas and diesel engines.
- Conveyor belts, assembly lines.
- Fuel-efficient aircraft, drones.
- Integrated microcircuits, computers.
- Xerography, MRIs.
- Containerized shipping.
- The Internet, 3D printing.
- Biotechnology, lasers, superconductivity.

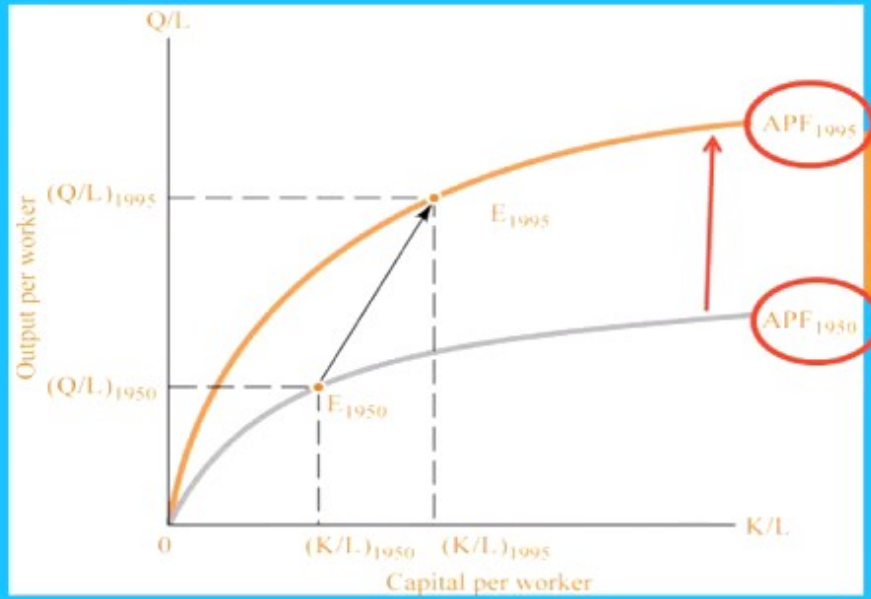


Capital Deepening

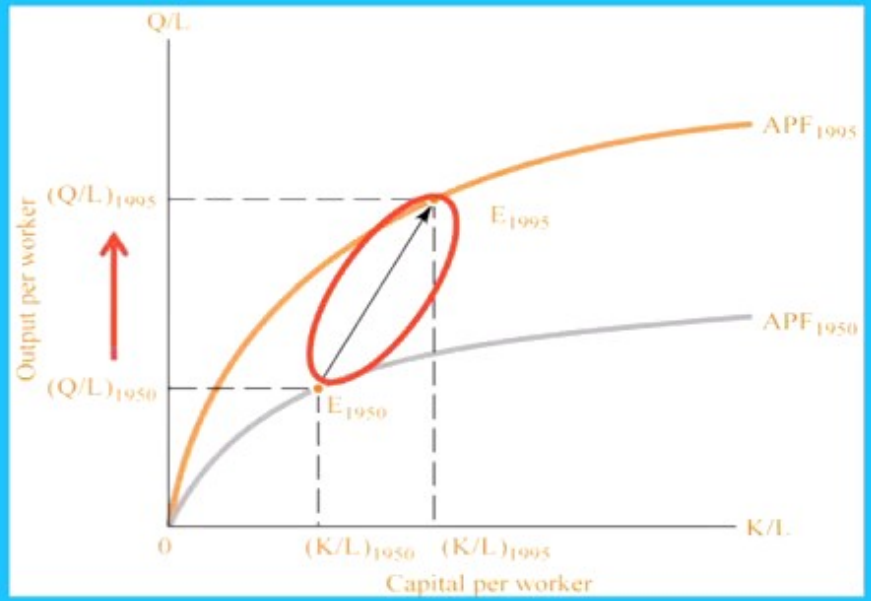

Q/L
APF1995
(Q/L)1995
E1995
APF1950
(Q/L)1950
E1950
Output per worker
K/L
0
(K/L)1950
(K/L)1995
Capital per worker
Aggregate production function given 1995 technology.
Aggregate production function given 1950 technology.

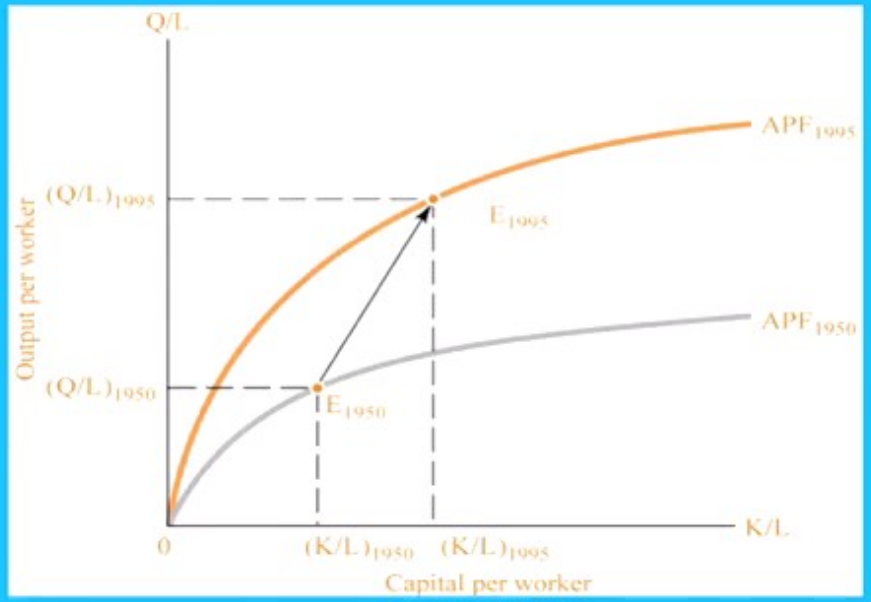


1. **How is technological change represented?**
2. **How is the effect of capital deepening & technological change on growth measured?**



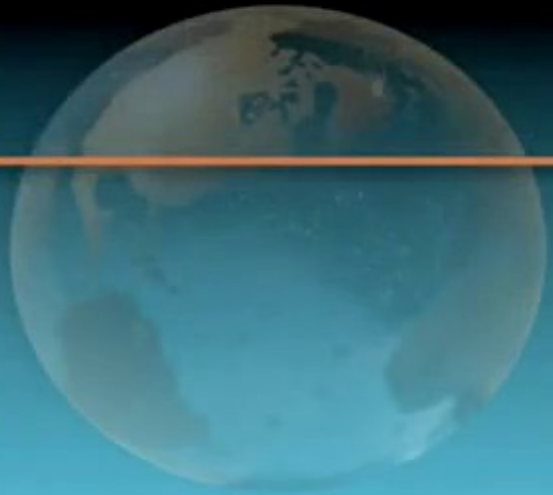
Tech change represented by an upward shift of the APF curve


Q/L
APF1995
(Q/L)1995
E1995
APF1950
Output per worker
(Q/L)1950
E1950
K/L
0
(K/L)1950
(K/L)1995
Capital per worker



Key Point

With technological change, both wages and returns to capital rise along with the standard of living!!!!



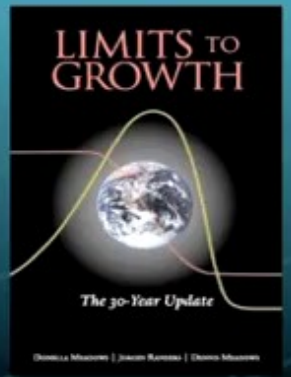
LECTURE SEVEN - PART FIVE

Two Important Questions

1. Is more growth always good?
2. What demand and supply side government policies might be used to improve productivity and growth?

The Pros and Cons of Growth

- Growth increases wages and standard of living.
- Growth results in dirtier air, a dying ocean, global warming, ozone depletion, and other environmental problems.



More Disadvantages of Growth

- Growth permits us to “make a better living” but it not guarantee us the “good life.”
- Growth often means worker burnout and alienation and accompanying health problems.
- Both blue and white collars workers alike are affected.

Economic vs. Population Growth

- We must distinguish between economic growth versus population growth.
- Congested neighborhoods, crowded cities, and gridlocked freeways are often the consequence of over-population.

Growth and Public Policy

- GDP per capita: The essential measure of growth.

Key Questions

1. Are there reasons for desiring less GDP per person & a reduced standard of living?
2. How might the government use public policy to stimulate growth?

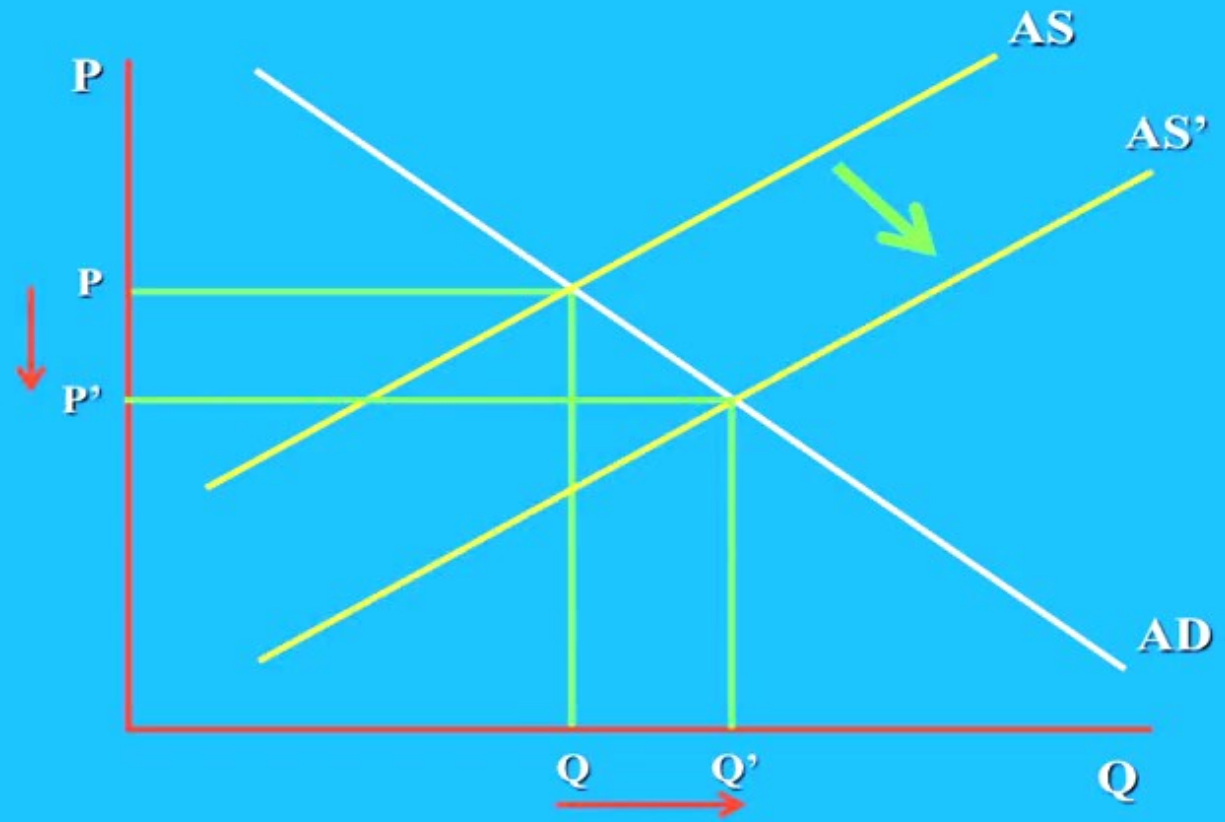
Demand-Side Policies

- Low growth is often the consequence of inadequate aggregate demand.
- Both Keynesian fiscal and monetary policies can be used to close a recessionary gap.

How Keynesian Policies Work

- If the Federal Reserve cuts interest rates, that stimulates investment.
- A fiscal policy which eliminates budget deficits can reinforce this “easy money” policy.

The Advantage of Supply Side Options



The Capital-Labor Ratio

- Productivity increases with the ratio of capital to labor.
- We must accelerate investment in new plant and equipment to boost the capital-labor ratio.
- The U.S. tax code offers a variety of incentives to stimulate investment.
- Examples: Accelerated depreciation, tax credits, lower business tax rates.

Human Capital

- To increase productivity, the quality of our our labor force and its managers.
- Policy options range from tuition tax credits and expanded student loans to job retraining programs and a focus on lifetime-learning.

Technological Change

- Accelerate the rate of technological change to increase productivity.
- This allows us to produce more goods and services from a given amount of resources.

Spurring Technological Change

- Policy options similar to those for increasing investment, namely, tax incentives.
- Increasing investment in new plant and equipment works hand in hand with increased R&D.
- Together, they speed the diffusion of new technology and accelerate the rate of productivity gains.

The Importance of Public Infrastructure

- Raise public infrastructure investment to spur productivity.
- Just as new plant and equipment help workers produce more, modern infrastructure helps businesses produce more.

Prudent Public Investment Essential

- Governments must not ignore appropriate investments in basic infrastructure.
- Critical needs: Bridges and airports to "smart roads" and the information superhighway.

"Deficit reduction at the expense of public investment has been and will continue to be self-defeating."

The Critical Savings Rate

- A higher savings rate will boost many of the factors determining productivity growth.
- Savings represent a key source of investment funds.
- They finance new plant and equipment, human capital, research and development, and public infrastructure.

How To Boost the Savings Rate

- The U.S. has one of the lowest savings rates of any of the industrialized nations.
- Policy options include expanded tax preferences for Individual Retirement Accounts and other pension funds.

Coming Up Next!

Lesson Eight:

Budget Deficits and the Public Debt

THE POWER OF MACROECONOMICS

Professor Peter Navarro
University of California-Irvine

END OF LESSON SEVEN