

Economic Growth (continued...)

Monday, September 26, 2005

Announcements

- Questions, Comments, or Concerns
 - Outline for Today: Productivity
 - Motivations
 - What is it
 - Q's OH are M 4-5; Robinson Hall
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So Far

- Investment Rates (γ), Population Growth Rates (n) and Depreciation Rates (δ) have determined:
 1. How the economy's capital stock (as measured in per worker terms) evolves over time
 2. How the income *will* evolve over time
 - So then, where is economic growth coming from?
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Possible Answers

- All economies are currently converging to the steady state and very few are actually in it?
 - Economies are growing just at the rate of population implying GDP is growing but not GDP per capita?
 - Economics is just a load of !&\$# ?
 - We're leaving out something?
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Let's Use A Simple Model

1. Use the equation of motion for k
 2. Take out any deleterious effect on capital accumulation; namely consider that capital never depreciates and that population does not grow ($n + \delta = 0$)
 3. Investment is a constant fraction of income
 4. What will happen to capital and output over time?
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Solving the Simple Model

□ Equations

$$\dot{k} = \gamma f(k)$$

$$\dot{k} = \gamma A k^\alpha$$

$$\frac{\dot{k}}{k} = \gamma A \frac{k^\alpha}{k} = \gamma A k^{(\alpha-1)} = \hat{k}$$

$$\lim_{k \rightarrow \infty} \hat{k} = 0$$

- Capital grows but because the MPK falls over time, income stops growing
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The point

- ❑ Even without any deleterious effect on capital accumulation, the MPK will make certain that output will not grow indefinitely
 - ❑ (this effect was one point in Marx's criticism of capitalism)
 - ❑ However, if A continues to grow, then growth can be sustained.
 - ❑ Simply put, differences between physical capital and population differences are not enough to explain the large disparities in incomes throughout the world
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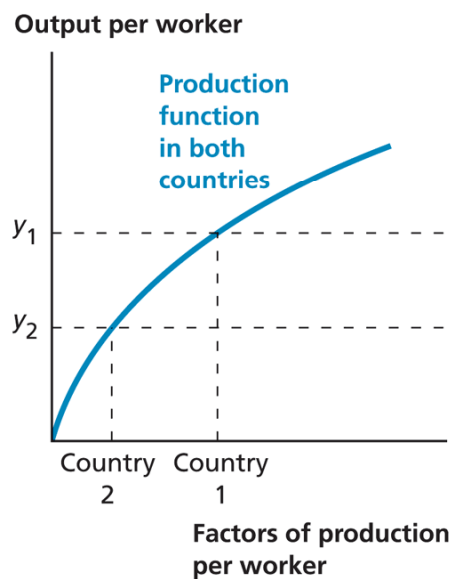
Productivity

- A is a measure of productivity: the effectiveness with which total factors of production are used
 - Decomposing Productivity: $A = T \times E$
 - T is technology
 - Represents the knowledge about how factors of production can be combined to produce output
 - E is efficiency
 - Measures how effectively given technology and factors of production are actually used
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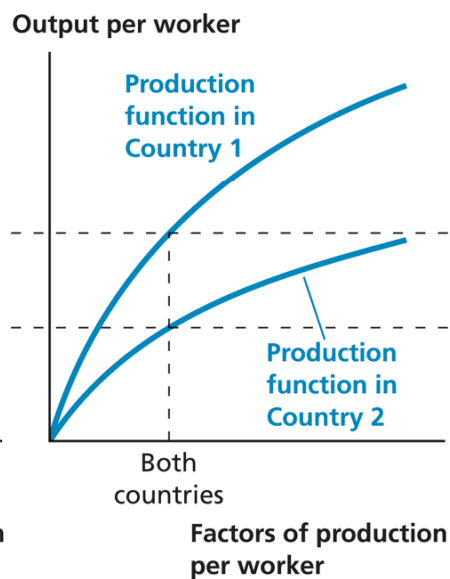
Differences in Productivity

FIGURE 7.1
Possible Sources of Differences in Output per Worker

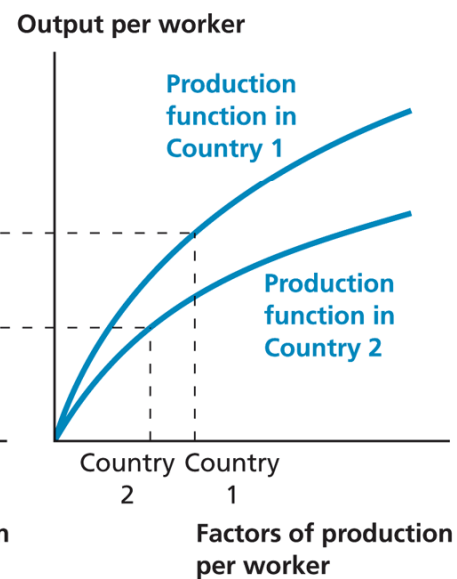
(a) Differences in output due to factor accumulation



(b) Differences in output due to productivity



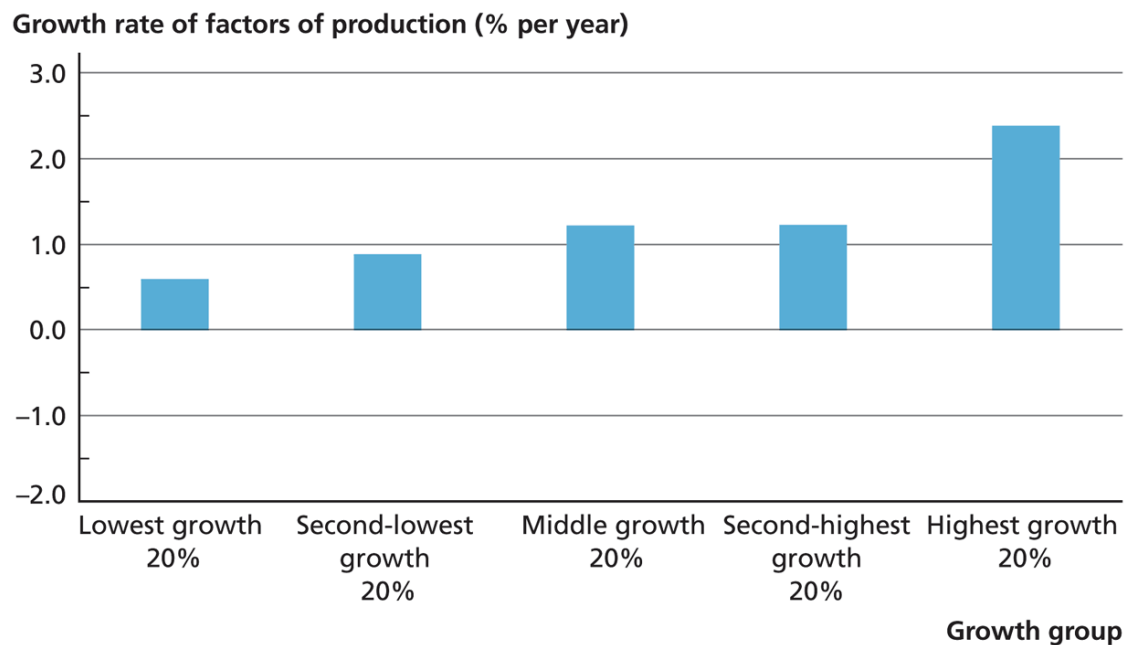
(c) Differences in output due to both productivity and factor accumulation



Differences in Factors of Production

FIGURE 7.5

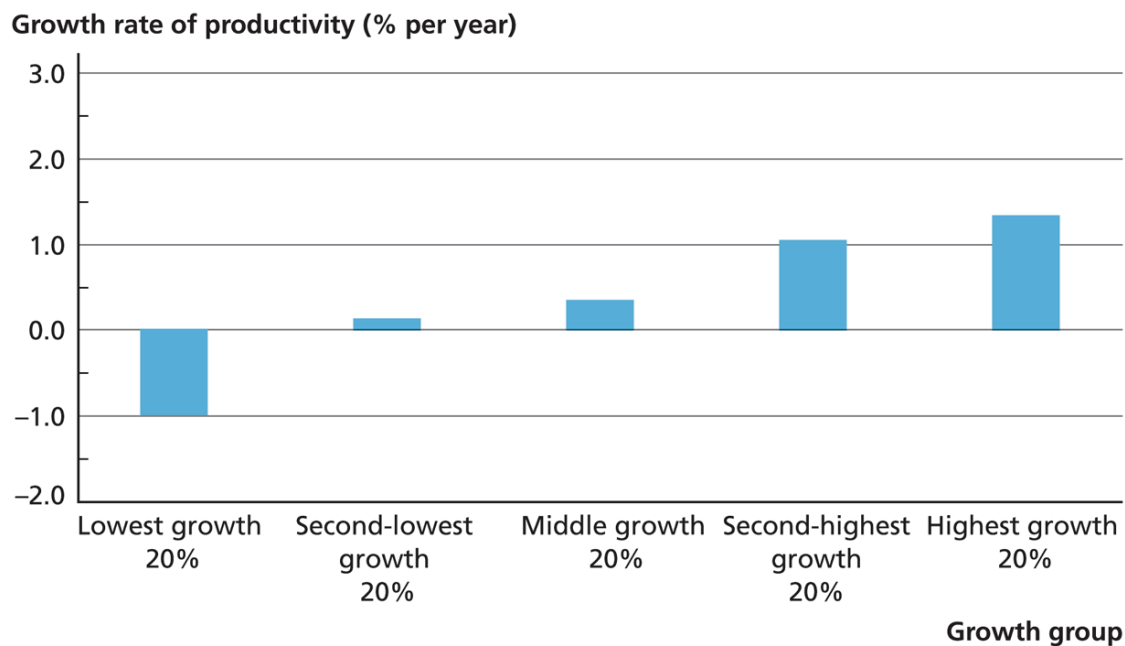
Role of Factors of Production in Determining Growth, 1960–1998



For sources, see Table 7.2.

Differences in Productivity

FIGURE 7.6
Role of Productivity in Determining Growth, 1960–1998



For sources, see Table 7.2.

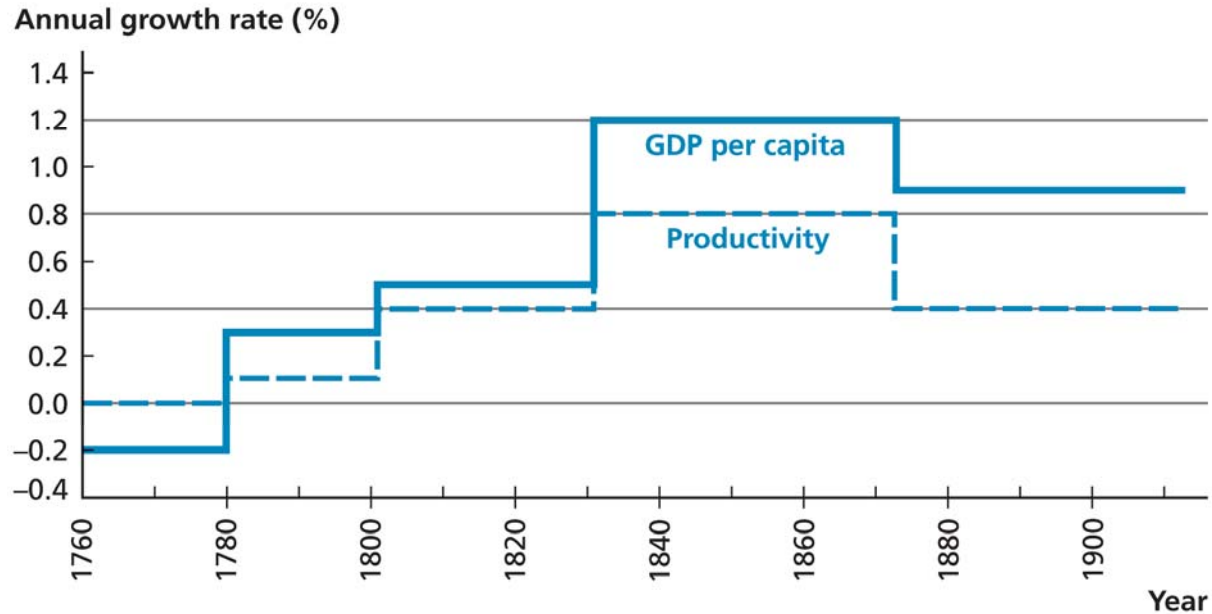
Productivity and Growth

- Currently, we believe the “idea” gap is as large as the “object” gap. That is, differences in productivity explain about as much as differences in factors of accumulation.
 - Math: $\hat{y} = \hat{A} + \hat{k}^\alpha$
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The UK Experience

FIGURE 9.2

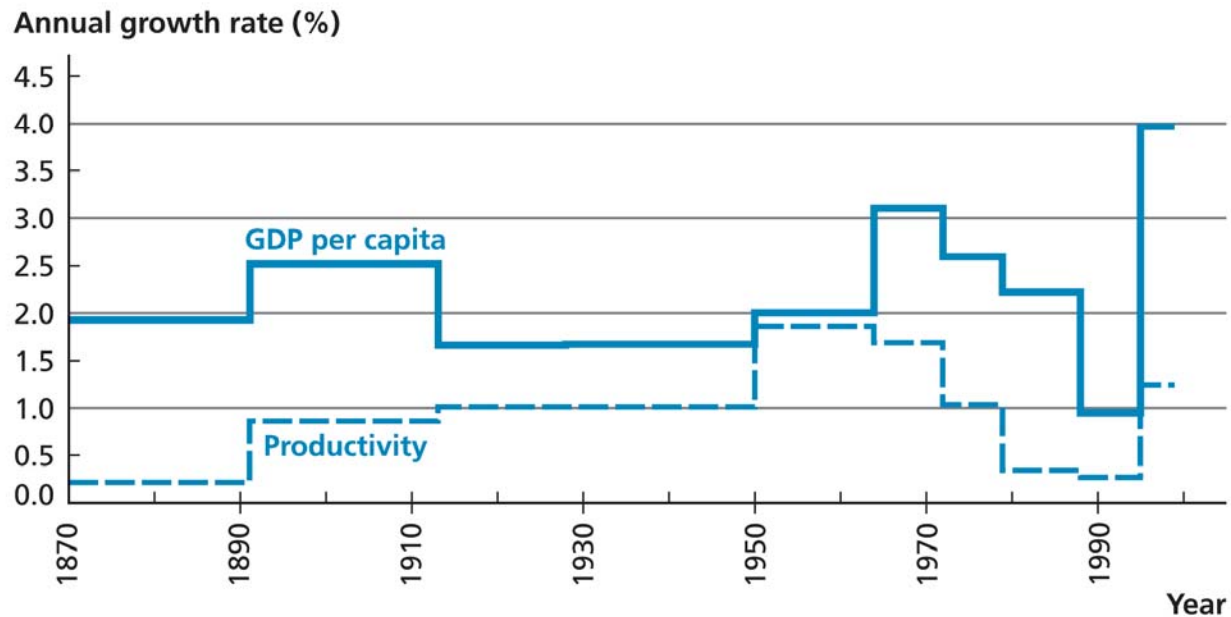
British Output and Productivity Growth, 1760–1913



Source: Crafts (1996).

The US Experience

FIGURE 9.3
U.S. Output and Productivity Growth, 1870–1999



Sources: Gordon (1999, 2000).

Technology

8500 BC: crop planting

3400 BC: the wheel

3000 BC: writing

250 BC: padded collar

1275 AD: mechanical clock

1453 AD: movable type

1768 AD: steam engine

18th cent: textile manufacturing

19th cent: network electricity

1908 AD: mass production of automobiles

1947 AD: transistor

1969 AD: primitive internet

Rate of Technological Progress (1)

- 500-1500 AD: 0.033% avg. ann. growth
 - If in 500 AD, $A=1$; in 1500 AD, $A=1.39$
 - 1500-1700 AD: 0.166% avg. ann. Growth
 - If in 1500 AD, $A=1.39$; in 1700 AD, $A=1.94$
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Rate of Technological Progress (2)

Industrial Revolution (~1760 - ~1830)

- Textiles: One lb. of cotton could be spun into thread in 3 hrs (~125X production)
 - Energy: Steam Engines => Steamboats => Railroads; advances in transportation
 - Metallurgy: Cost of Iron production fell; leading to increased output and uses in buildings, bridges, railroads, etc... (1760 -34K tons; 1830 -680K tons; 1870 -5,960K tons)
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Rate of Technological Progress (3)

- 1860-1900: 'second' industrial revolution
 - Mass production in factories (essentially moving from cottage to industry)
 - 1990-?: 'third' industrial revolution
 - Information technologies...
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Efficiency

- Similar in concept to health, we look for examples of inefficiencies to determine and describe efficiency
 - Thinking Points...
 - USSR: around the mid 80's, investment rates in both human and physical capital and certain technologies were comparable to most richer western countries, but output per capita was a third of the US (no role for prices, misaligned incentives, etc...)
 - Japan: *If we are going to attribute these productivity differences to differences in technology, it is hard to understand how Japanese businessmen can be so successful at learning and developing technologies for making automobile parts, and so inept at learning and developing technologies for freezing fish” -De Long*
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Five Sources of Inefficiency

- Unproductive Activities – when resources are devoted to activities without economic value [theft, smuggling, war, rent seeking]
 - Idle Resources – when resources are not used; Refers both to labor and capital [unstable economies, depression, Air Afrique, govt]
 - Technology Blocking – when no 'real' barriers exist to the usage of technology but it is nonetheless resisted (*a very rational response for the individual but not for society on the whole*) [stem cell research, Luddites, Margarine...late 19th cent. tax on yellow colored, 7 states banned, 2 required it to be pink in color...repealed by mid 1900's]
 - Misallocation among Firms – when resources are not optimally allocated to maximize output [monopolies]
 - Misallocation among sectors – " " among sectors
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Summary

- Productivity is responsible for about half of the growth in output among countries
 - Productivity can be decomposed into the part due to technological advances and the part due to efficiency
 - Wednesday: The fundamentals
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