EC132.02
Principles of Macroeconomics

Boston College

Thursday, February 14

Announcements and Reminders

Aplia homework on the CPI due tomorrow, Friday, February 15, at 9am.

Aplia homework on Production and Growth due Friday, March 1, at 9am.

First midterm exam: next Thursday, February 21, 10:30 – 11:45am.

Announcements and Reminders

First midterm exam: next Thursday, February 21, 10:30 – 11:45am.

Closed book exam, between 6 and 12 questions (short-answer, with multiple parts) covering:

Ch 4 – The Market Forces of Supply and Demand

Ch 23 – Measuring a Nation's Income

Ch 24 – Measuring the Cost of Living

Ch 25 – Production and Growth

Ch 25 Production and Growth

1. Economic Growth Around the World ✔

2. Productivity
   A. Why Productivity is So Important ✔
   B. How Productivity is Determined ✔
   C. The Aggregate Production Function ←

3. Economic Growth and Public Policy

Next: Ch 26 Saving, Investment and the Financial System (not on next week's exam).

How Productivity is Determined

What determines Crusoe's living standard?	What determines the US living standard?
His productivity (output per worker).	Our productivity (output per worker).

What determines Crusoe's productivity?	What determines US productivity?
Number of fishing poles.	Amount of physical capital per worker.
Amount of training in fishing.	Amount of human capital per worker.
Supply of fish.	Amount of natural resources per worker.
Invention of new fishing techniques.	Amount of technological knowledge.

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Technological knowledge is reflected in the number of books in the library.

Human capital depends on how many of those books people have actually read.

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Physical capital, human capital, and natural resources are "embodied" and "rivalrous."

Technological knowledge is "disembodied" and "non-rivalrous."

The Aggregate Production Function

L = quantity of labor

K = quantity of physical capital

N = quantity of land

Y = quantity of output

For an individual firm, microeconomists relate inputs to outputs via a production function

$$Y = F(L,K,N)$$

The Aggregate Production Function

Y = quantity of output (real GDP)

L = quantity of labor (# of workers)

K = stock of physical capital

H = stock of human capital

N = stock of natural resources

A = stock of technological knowledge

Likewise, for the economy as a whole, macroeconomists relate inputs to outputs via the aggregate production function

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

The Aggregate Production Function

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

The aggregate production function assumes that an increase in technological knowledge leads directly to an increase in output.

Of course, the aggregate production function could always be written with *A* inside:

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

The Aggregate Production Function

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

But macroeconomists often assume that holding technological knowledge fixed, the aggregate production function exhibits constant returns to scale: doubling *L*, *K*, *H*, and *N* all at once leads to a doubling of output.

The Aggregate Production Function

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

With constant returns to scale:

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

$$3Y = A\mathrm{F}(3L,3K,3H,3N)$$

Or for any number x:

$$xY = A\mathrm{F}(\mathrm{x}L,xK,xH,xN)$$

The Aggregate Production Function

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

$$xY = A\mathrm{F}(\mathrm{x}L,xK,xH,xN)$$

Choose $x = 1/L$:

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

The Aggregate Production Function

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

Y/L = output per worker (productivity)

K/L = physical capital per worker

H/L = human capital per worker

N/L = natural resources per worker

A = stock of technological knowledge

The Aggregate Production Function

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

Robert Solow, "Technical Change and the Aggregate Production Function," *Review of Economics and Statistics* (August 1957), was one of the first to use this framework empirically. He found that most of the productivity growth in the US from 1909-1949 was due to technological change.

The Aggregate Production Function

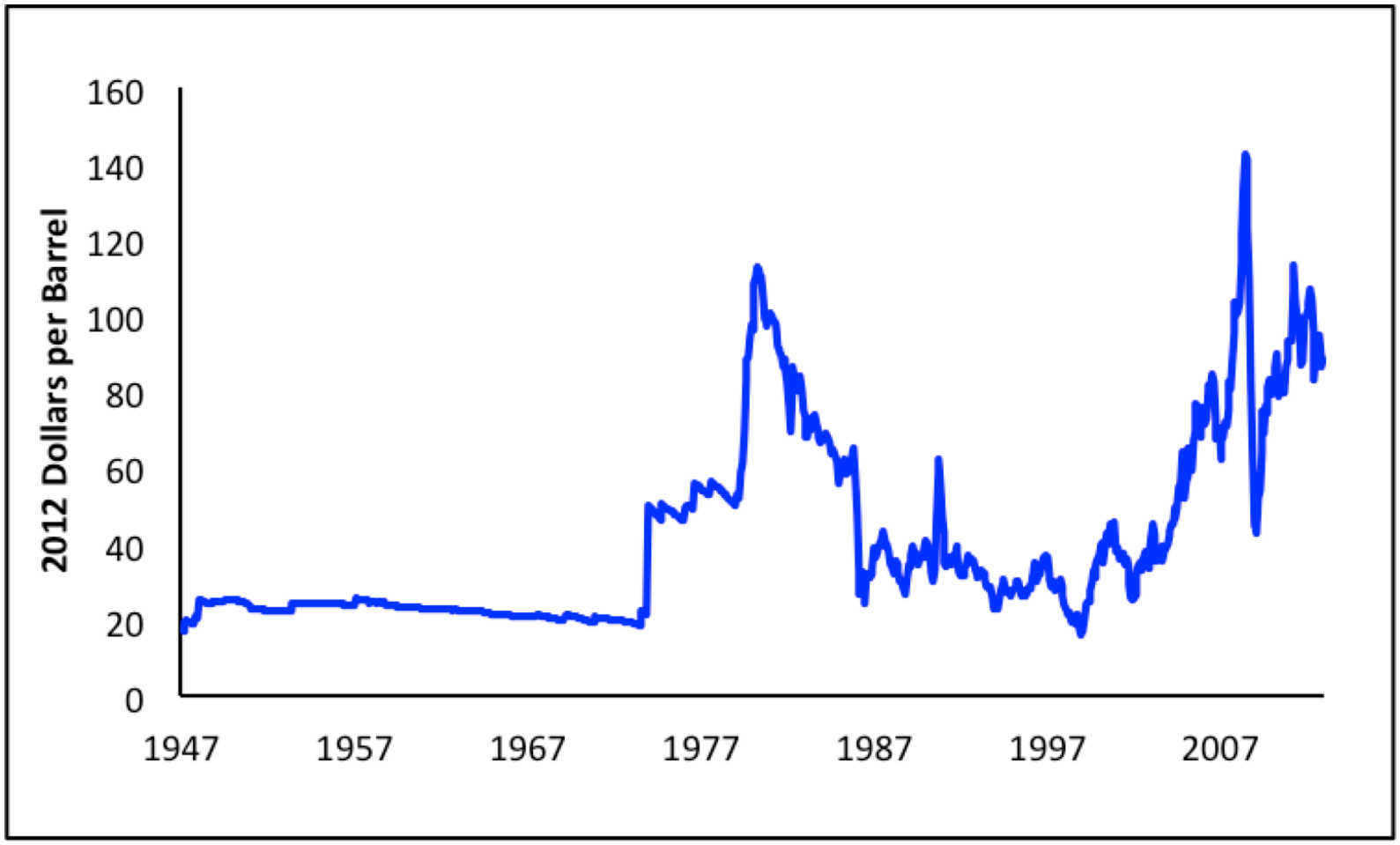
$$Y/L = A\mathrm{F}(1, K/L, H/L, N/L)$$

Over time, nonrenewable resources get depleted, reducing productivity.

But technological knowledge grows, increasing productivity.

Who wins this race?

Real Price of Oil, 1947-2012



Real Price of Oil, 1861-2011