Economic growth: Introduction

EC 235 | Fall 2023

Materials

Required readings:

- Blanchard, ch. 10.

Prologue

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So far, our lectures focued on the *short-* and *medium-run* features of the macroeconomy.

In both time frames, economic *fluctuations* dominate the picture.

However, when looking at the behavior of aggregate *output/income* over time, fluctuations become less apparent and *economic growth* dominates.

Thus, we now turn our attention to the *long-run*, with the purpose of understanding *what determines economic growth*.

The standard of living

The standard of living

Thinking about growth

Thinking about growth

The *conventional* approach to economic growth is due to the work of Robert M. Solow.

The starting point of such approach is through an *aggregate production function*:

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

where Y is aggregate output; K is the capital stock; and N, the number of employed workers.

What are some of the *limitations* of such modeling approach?

Thinking about growth

Given an aggregate production function, *how much* output (Y) can be produced for given quantities of the capital and labor inputs, K and N, respectively?

The answer lies on *technology*.

- Countries with more advanced technology will produce more output from the same quantities of K and N than will an economy with less advanced production methods.

Thinking about growth

Now, time to think about some *restrictions* we may impose on the aggregate production function.

The first is thinking about what happens to *F(K, N)* when we, for instance, *double* both the number of workers and the amount of capital in the economy.

We'll assume *constant returns to scale* (CRS):

$$F(2K, 2N) = 2Y$$

More generally:

$$F(xK, xN) = xY$$

Thinking about growth

What if we assume that *only one* factor of production increases?

Even under constant returns to scale, there are *decreasing returns to each factor*.

There are *decreasing returns to capital*:

- Given labor, increases in capital lead to *smaller and smaller increases* in output.

There are *decreasing returns to labor*:

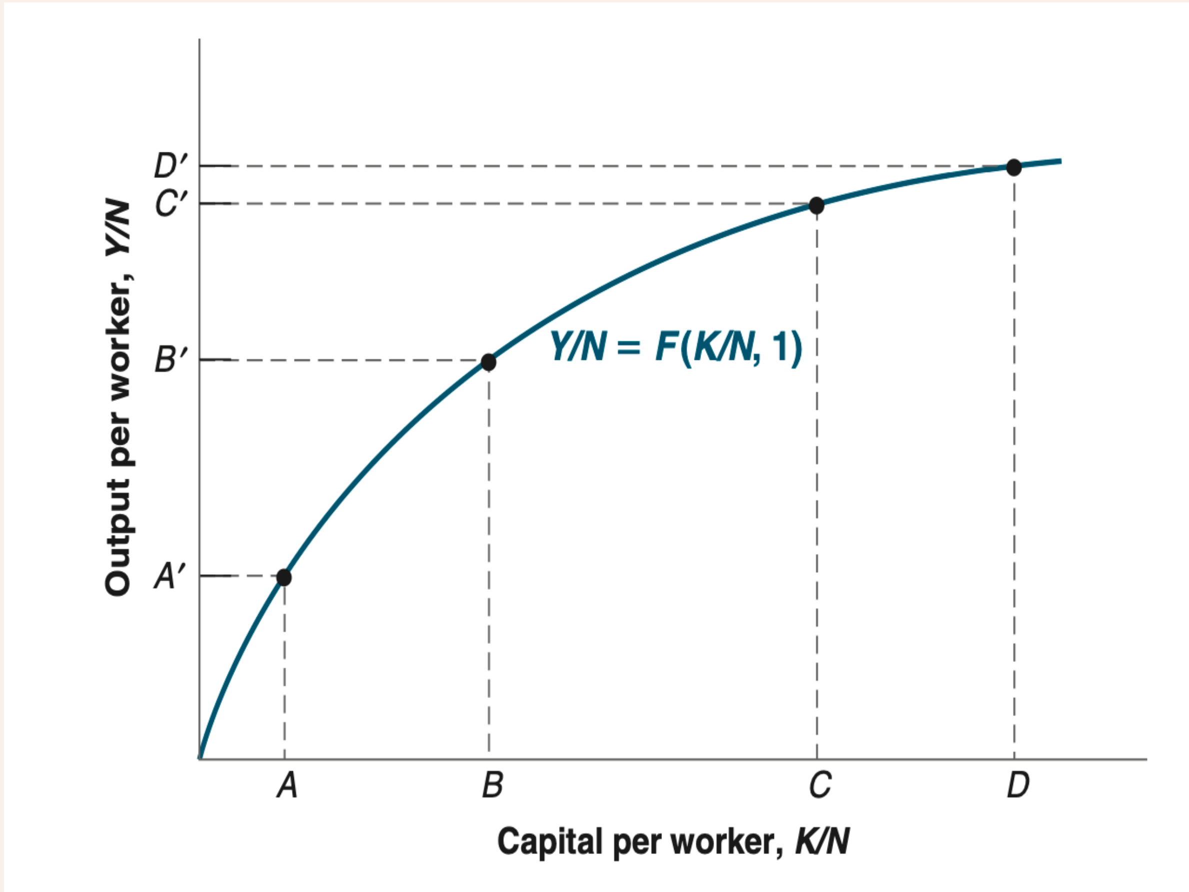
- Given capital, increases in labor lead to *smaller and smaller increases* in output.

Thinking about growth

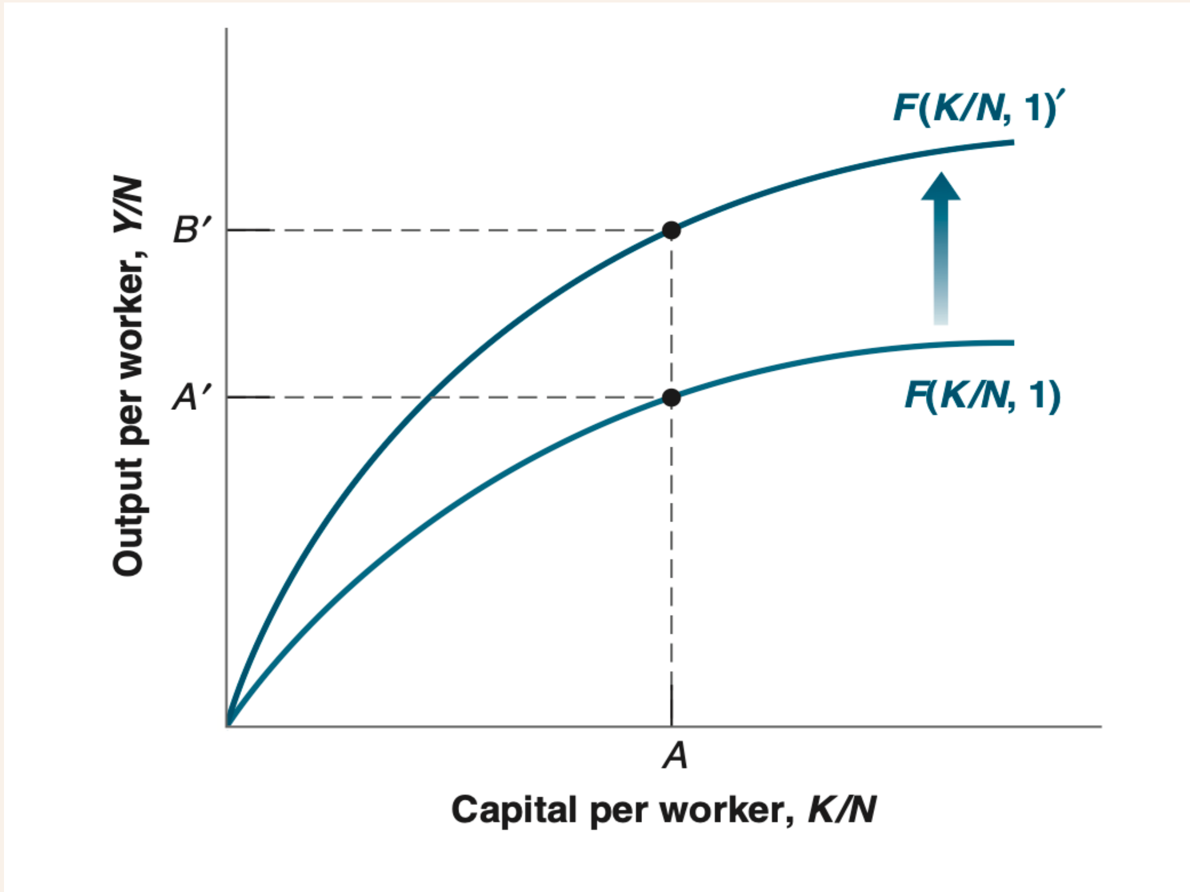
From the aggregate production function, we can specify it in terms of the labor input, N:

$$\frac{Y}{N} = F(\frac{K}{N}, \frac{N}{N}) = F(\frac{K}{N}, 1)$$

Thinking about growth



Thinking about growth



Thinking about growth

Two key things from the previous charts:

1. Capital accumulation *by itself* cannot sustain growth;

2. *Sustained* growth requires *sustained technological progress*.

Interactions between output and capital

Interactions between output and capital

The determination of output over the long-run depends on two relations between output (*Y*) and capital (*K*):

- The amount of capital determines the amount of output being produced;
- The amount of output being produced determines the amount of saving and, in turn, the amount of capital being accumulated over time.

From the aggregate production function normalized by labor, we may *simplify* things by writing:

$$\frac{Y}{N} = F\left(\frac{K}{N}, 1\right) = f\left(\frac{K}{N}\right)$$

Interactions between output and capital

Again:

$$\frac{Y}{N} = F\left(\frac{K}{N}, 1\right) = f\left(\frac{K}{N}\right)$$

This relation implies that we assume employment *N* to be *constant* over the *long-run*.

This way, we are able to *focus* on the process of *capital accumulation* over time and its *effects* on growth.

Interactions between output and capital

If we introduce *time indexes*, we may write:

$$\frac{Y_t}{N} = f\left(\frac{K_t}{N}\right)$$

Interactions between output and capital

Next, we move on to how output and capital accumulation are related over time.

We will keep assuming a closed economy, with *investment* being equal as the sum of *private* and *public* savings in equilibrium:

$$I = S + (T - G)$$

For simplicity, we will assume a balanced budget (i.e., public savings are equal to zero), so investment equals private savings:

$$I = S$$

Interactions between output and capital

Private savings are *proportional* to aggregate income:

$$S = sY$$

where the parameter s is the *saving rate* $(0 < s < 1)$.

Combining what we have so far, we can write:

$$I_t = sY_t$$

The above relation states that investment is *proportional* to aggregate income/output.

Interactions between output and capital

Turning to the capital stock, K, we will assume that it depreciates at a rate δ per year.

Equivalently, a proportion $(1 - \delta)$ remains intact from one year to the next.

The evolution of the capital stock is then given by:

$$K_{t+1} = (1 - \delta)K_t + I_t$$

Interactions between output and capital

Normalizing the previous relation by the number of employed workers, *N*:

$$\frac{K_{t+1}}{N} = (1 - \delta)\frac{K_t}{N} + \frac{I_t}{N}$$

Rearranging...

$$\frac{K_{t+1}}{N} - \frac{K_t}{N} = s\frac{Y_t}{N} - \delta\frac{K_t}{N}$$

Interactions between output and capital

Again:

$$\frac{K_{t+1}}{N} - \frac{K_t}{N} = s\frac{Y_t}{N} - \delta\frac{K_t}{N}$$

This relation implies that the *change in the capital stock per worker*, represented by the *difference* between the two terms on the *left*, is equal to *savings per worker*, represented by the first term on the right, minus *depreciation*, represented by the second term on the right.