


# Lecture 4: Economic Growth Model

**Instructor:** Fei Tan

 @econdojo    @BusinessSchool101    Saint Louis University

**Course:** Macroeconomics 201

**Date:** September 13, 2025

## The Road Ahead

1. Measuring Standard of Living
2. Economic Growth Model

## Standard of Living Revisited

- Cross-country comparison of standard of living
  - purchasing power parity (PPP) numbers
  - GDP/GDP per capita constructed with common set of prices for all countries
  - downloadable from Penn World Tables
- Why using PPP numbers
  - exchange rate vary a lot
  - systematic differences in prices across countries
- We measure long-run economic growth by percentage increase in PPP numbers over long periods

$$\text{growth rate} = \frac{Y_t - Y_{t-n}}{Y_{t-n}} \times 100\%, \quad n \sim \text{decades}$$

## Growth in Rich Countries

	Annual Growth Rate Output per Person (%)	Real Output per Person (2005 dollars)		
	1950–2009	1950	2009	2009/1950
<b>France</b>	<b>2.5</b>	<b>7,112</b>	<b>30,821</b>	<b>4.3</b>
<b>Japan</b>	<b>3.9</b>	<b>3,118</b>	<b>31,958</b>	<b>10.2</b>
<b>United Kingdom</b>	<b>2.0</b>	<b>10,400</b>	<b>33,386</b>	<b>3.2</b>
<b>United States</b>	<b>1.9</b>	<b>13,183</b>	<b>41,102</b>	<b>3.1</b>
<b>Average</b>	<b>2.6</b>	<b>8,453</b>	<b>34,317</b>	<b>5.2</b>

*Notes:* The data stop in 2009, the latest year (at this point) available in the Penn tables. The average in the last line is a simple unweighted average. *Source:* Alan Heston, Robert Summers, and Bettina Aten, Penn World Table Version 7.0, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, May 2011

- Large increase in output per capita
- Convergence of output per capita across countries

## Economic Growth Model

### Aggregate production function

$$Y = F(K, N) \quad (\text{e.g. } Y = AN)$$

- Notations
  - $Y$  = aggregate output
  - $K$  = aggregate capital
  - $N$  = aggregate employment
- Three assumptions
  - constant returns to scale

$$xY = F(xK, xN) \quad \text{for any } x$$

- decreasing returns to capital & labor

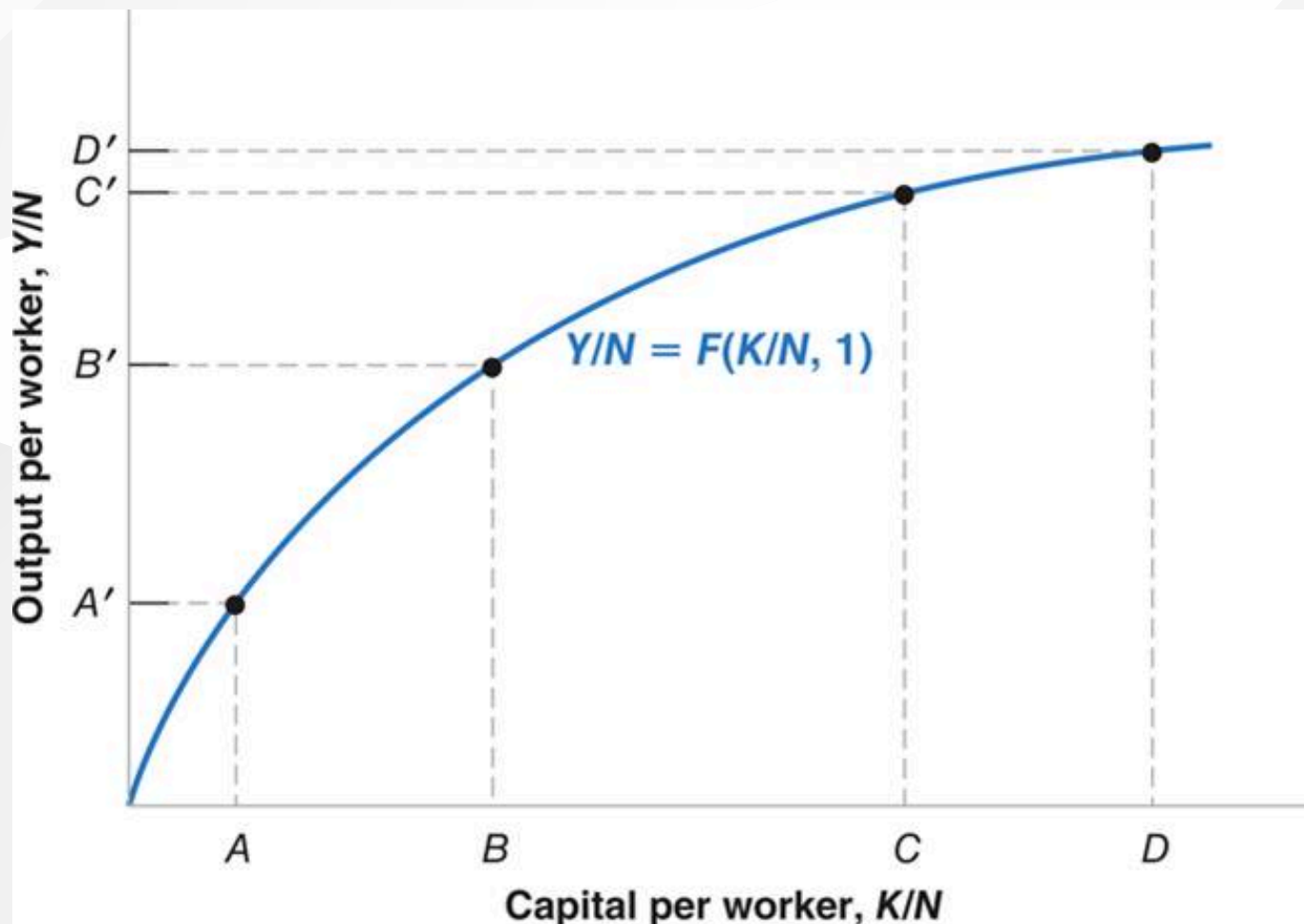
## Economic Growth Model (Cont'd)

### Per capita production function

$$\frac{Y}{N} = F\left(\frac{K}{N}, \frac{N}{N}\right) = F\left(\frac{K}{N}, 1\right) \quad (\text{set } x = 1/N)$$

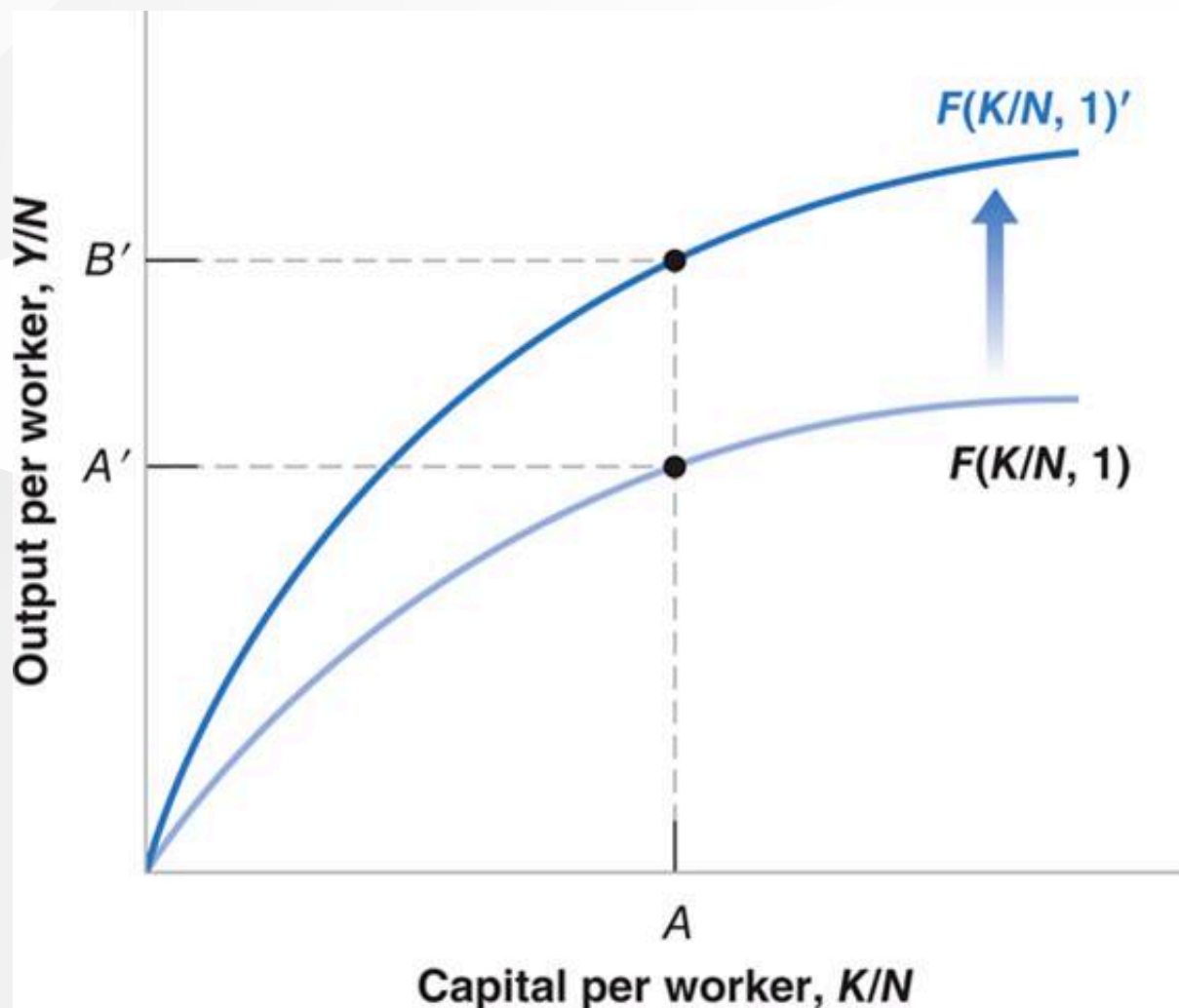
- Notations
  - $Y/N$  = output per capita
  - $K/N$  = capital per capita
- Sources of economic growth
  - capital accumulation
  - technological progress

## Capital Accumulation



- Capital accumulation cannot sustain growth (why?)

## Technological Progress



- Sustained growth requires sustained technological progress



## Readings & Exercises

- Readings
  - HO: chapter 11
  - BJ: lecture 8 (supplementary)
- Exercises
  - HO: problem 2.8, 2.9
  - Let production function be  $Y = \sqrt{K}\sqrt{N}$ . Compute output when  $K = 49$  and  $N = 81$ . If capital and labor double, what is output? It is constant returns to scale? Compute  $Y/N$  when  $K/N = 4$ .