Week 12: Economic Growth

ECON 1101 Principles of Economics

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Economic Growth: Context & Agenda

Context: Measuring Living Standards

- **Recall:** We use inflation adjustments to convert nominal variables to **real** variables
- Real GDP per capita is our best proxy for living standards
- Income differences across countries reflect vast differences in nutrition, safety, healthcare, and quality of life

Today's Goal: Understand what explains these huge variations.

1. **Empirics:** The power of compounding growth
2. **Theory:** The Production Function and Productivity
3. **Policy:** Role of institutions, economic, and social policy in promoting growth

Context and Empirics

Cross Country Comparison of Historical Growth Rates

	Real GDP per Person (in 2020 Dollars)			
Country	**Period**	**Start**	**End**	**Growth Rate (per year)**
China	1900–2020	$834	$17,312	2.56%
Japan	1890–2020	$1,751	$42,197	2.48%
Brazil	1900–2020	$907	$14,836	2.36%
Mexico	1900–2020	$1,350	$18,833	2.22%
Indonesia	1900–2020	$1,038	$12,074	2.07%
Germany	1870–2020	$2,544	$53,694	1.05%
Canada	1870–2020	$2,766	$48,073	1.92%
India	1900–2020	$786	$6,454	1.77%
United States	1870–2020	$4,668	$63,544	1.76%
Argentina	1900–2020	$2,671	$20,768	1.72%
Bangladesh	1900–2020	$726	$5,083	1.64%
Pakistan	1900–2020	$859	$4,877	1.46%
United Kingdom	1870–2020	$5,601	$44,916	1.40%

Effects of Compounding

- Compounding is the "8th Wonder of the World"
- **Rule of 70:** Years to double $\approx$ 70/Growth Rate
- U.S. (approx 2% growth) doubles income every 35 years
- Distinction: **Level** (how rich you are now) vs. **Growth Rate** (how fast you are getting richer)
- Small policy changes that boost *sustained* growth by even 0.5% have huge long-run effects

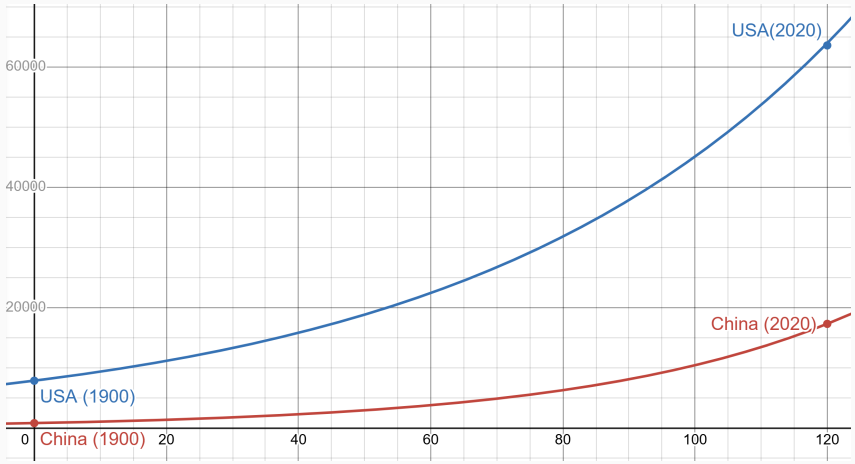

Figure 1: USA vs. China Growth Paths

Productivity and its Determinants

Live Poll #1: Intuition Check

Poll Question

Imagine two countries with the same population.

- **Country A** has very few Laptops (capital)
- **Country B** has many Laptops

If we give **one additional Laptop** to each country, which country will see the biggest increase in productivity?

How to Respond:

- Scan the QR Code
- Or, go to the URL below:

  PollEv.com/apisharam

To respond by text: Send **APISHARAM** to **22333** once to join.

Live Poll #1: The Answer

The Correct Answer Is...

(A) Country A (The poor country)

Why?

- This is the principle of **Diminishing Marginal Returns**
- The first laptop you get makes you much more productive. The 5th laptop adds very little value
- This helps explain the "Catch-Up Effect"

The Production Function & Constant Returns

- Recall the production function from Micro. In Macro, we use an "aggregate" version:

$$Y = A \times F(L, K, H, N)$$

- **Crucial Assumption: Constant Returns to Scale (CRS)**
  - If we double all inputs, output doubles
  - Mathematically, for any multiplier x: $xY = AF(xL, xK, xH, xN)$
- Setting $x = 1/L$, we convert this to **per-worker** terms:

$$\frac{Y}{L} = AF\left(1, \frac{K}{L}, \frac{H}{L}, \frac{N}{L}\right)$$

$$y = Af(k, h, n)$$

- This transforms our focus from total GDP (Y) to **Productivity (y)**

Productivity and Diminishing Returns

- **Productivity ($y = Y/L$):** The quantity of goods produced from each unit of labor
- **Diminishing Marginal Product:**
  - As physical capital per worker (k) rises, the extra output from an additional unit of capital falls
  - This curvature drives the "Catch-Up Effect"

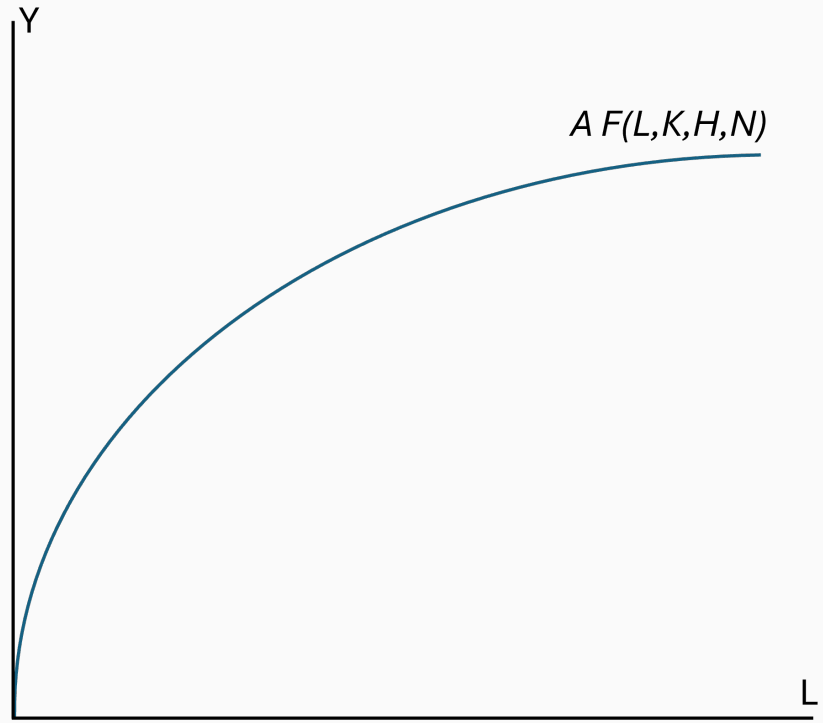

Figure 2: The function becomes flatter as capital per worker increases

Determinants of Productivity

Productivity (Y/L) depends on four key factors:

1. **Physical Capital per Worker (K/L):** The stock of equipment and structures used to produce goods and services
2. **Human Capital per Worker (H/L):** The knowledge and skills workers acquire through education, training, and experience
3. **Natural Resources per Worker (N/L):** Inputs provided by nature (land, rivers, mineral deposits)
4. **Technological Knowledge (A):** Society's understanding of the best ways to produce goods and services

Live Poll #2: Distinguishing Factors of Production

Poll Question

A new scientific discovery reveals a faster way to manufacture vaccines. Once this method is published in a journal, it represents an increase in:

- Technology (A)
- Human Capital (H)
- Physical Capital (K)
- Natural Resources (N)

How to Respond:

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Live Poll #2: The Answer

The Correct Answer Is...

Technology (A)

The Distinction:

- **Technology (A)** is the recipe or blueprint. It is society's shared understanding of how to produce goods (the "discovery" itself)
- **Human Capital (H)** is the time and effort it takes for a specific worker to *read and learn* that recipe (the education/training)

Exercise 1: GDP per Capita vs Productivity

Suppose

- Country A has a population of 240 million, and one quarter of its population is in the labor force. Its GDP is $12 trillion
- Country B has a population of 60 million, and one fifth of its population is in the labor force. Its GDP is $2.4 trillion

Question:

1. Which country has the higher GDP per capita?
2. Which has the higher productivity of labor?

Exercise 1: Solution

1. **Country A:**

$$\frac{Y_A}{\text{Pop}_A} = \frac{12 \times 10^{12}}{240 \times 10^6} = 50,000 > 40,000 = \frac{2.4 \times 10^{12}}{60 \times 10^6} = \frac{Y_B}{\text{Pop}_B}$$

2. **They are equal!**

$$\frac{Y_A}{L_A} = \frac{12 \times 10^{12}}{60 \times 10^6} = 200,000 = \frac{2.4 \times 10^{12}}{12 \times 10^6} = \frac{Y_B}{L_B}$$

Exercise 2: Comparing Capital and Productivity

Suppose technology is identical in both countries:

- **Country A:** Labor = 50 million, Capital = \$10 billion
- **Country B:** Labor = 25 million, Capital = \$20 billion

Questions:

1. Which country has the higher capital-to-labor ratio (K/L)?
2. Which country has higher labor productivity (Y/L)?
3. Which country would benefit *more* from an additional unit of capital?

Exercise 2: Solution

1. **Capital-to-Labor Ratio:**
   - Country A: $10B/50M = 200$
   - Country B: $20B/25M = 800$
   - **Country B** has higher K/L

2. **Productivity:** Since Y/L depends on K/L, **Country B** is more productive

3. **Marginal Gain:** Due to diminishing returns, the country with *less* capital will see a bigger boost. **Country A** benefits more from investment

Exercise 3: Very Fun Algebra Problems

1. If labor productivity in the United States increases by 5% and the labor force grows by 4%, what is its GDP growth rate?

2. If the labor force falls by 8%, by how much must labor productivity increase for GDP growth to be positive?

Exercise 3: Solution

1. Labor productivity increase by 5% $\implies \frac{Y_2}{L_2} = 1.05\,\frac{Y_1}{L_1}$

   Labor force increase by 4% $\implies L_2 = 1.04\,L_1$

   Substitute $1.04\,L_1$ in for L_2:

   $$\frac{Y_2}{1.04L_1} = 1.05\frac{Y_1}{L_1} \implies Y_2 = (1.05)(1.04)\,Y_1 = 1.092\,Y_1$$

   $\implies$ GDP grows by **9.2%**

2. Labor force falls by 8% $\implies L_2 = 0.92\,L_1$

   Let g be productivity growth: $\frac{Y_2}{0.92L_1} = (1+g)\frac{Y_1}{L_1}$
   For $Y_2 > Y_1$, we need $0.92(1+g) > 1$
   $\implies 1+g > 1.087 \implies g > \mathbf{8.7}\%$

Policies and Institutions

Role of Policies and Institutions

- Understanding the determinants (K, H, N, A) helps us design policies to boost them
- Policies can accelerate productivity through targeted incentives
- Institutions help sustain and protect productivity gains

Savings and Investment (K)

- To boost Capital (K), society must consume less today to save and invest for tomorrow
- **Trade-off:** Lower consumption now for higher consumption later
- **Diminishing Returns:** As capital stock rises, the extra output from an extra unit of capital falls
- **Catch-up effect:** Poor countries tend to grow faster than rich countries because they start with less capital

International Trade and Capital Flows

- **Foreign Direct Investment (FDI):** Capital investment owned and operated by a foreign entity
- **Foreign Portfolio Investment (FPI):** Investment financed with foreign money but operated by domestic residents
- Both increase the capital stock (K) in a country, leading to higher productivity and wages
- **Trade Policies:** Outward-oriented policies (e.g., South Korea) generally lead to faster growth than inward-oriented policies (e.g., import substitution)

Human Capital Investment (H)

- Education is investment in human capital
- **Opportunity Cost:** Wages foregone while in school
- **Positive Externalities:** An educated workforce generates new ideas (A) that benefit everyone
- **Health:** Healthier workers are more productive. Fogel (1990) estimated that 30% of Britain's growth (1790-1980) was due to better nutrition

Research and Development (A)

- Technological knowledge is the main driver of long-run growth in living standards
- Knowledge is a **public good**: Ideas can be shared freely (non-rival)
- **Policy Support:**
  - Patent laws (turn ideas into private goods temporarily)
  - Tax incentives and direct grants (NSF, NIH) for basic research

Institutions and Property Rights

- Markets require **property rights** and stability to function
- **Political Instability:** If a dictator might seize your factory, you won't invest
- **Corruption:** Acts like a tax on investment
- Acemoglu, Johnson, and Robinson (2001): *Inclusive* institutions that enforce property rights and rule of law are critical for long-run growth

Population Growth

- **Stretching Natural Resources (Malthus):** More people = less land per person
- **Diluting Capital Stock:** More people (L) means lower K/L if capital doesn't grow fast enough
- **Promoting Tech Progress (Kremer):** More people = more scientists, inventors, and engineers = faster technological growth (A)

Conclusion

- Economic growth driven by *compounding* effects of productivity gains
- Productivity depends on Physical Capital (K), Human Capital (H), Natural Resources (N), and Technology (A)
- Growth is not automatic, and requires sound policies and strong institutions to encourage saving, investment, and innovation!
- There is no "silver bullet"! Balanced growth strategies usually work best