ECONOMIC GROWTH: CONCEPTS AND PATTERNS

EE 462 Development Macroeconomics

Topics

- Divergent Patterns of Economic Growth since 1960
- Factor Accumulation, Productivity Growth, Econ. Growth
- Saving, Investment, & Capital Accumulation
- Sources of Growth Analysis
- Characteristics of Rapidly Growing Countries

TFP
"total factor productivity"

"Growth Accounting"

Divergent Patterns of Economic Growth since 1960

Group	Ratios of 2009 to 1960 GDP/capita	Avg. Annual Growth Rates (%)	Examples of Countries
Negative growth	0.89 0.98	- 0.23 - 0.24	Madagascar Zambia
Slow growth	1.05 – 2.16	0.01 – 1.58	Senegal, Kenya, Peru, Chad, S.Africa, Philippines
Moderate growth	3.06 – 4.29	2.31 – 3.01	Turkey, Brazil, Chile, Lesotho, Mauritius
Rapid growth	4.55 – 18.94	3.14 – 6.18	India, Egypt, Malaysia, Thailand, Botswana, China
Industrialized	2.6 – 5.13	1.97 – 3.4	UK, US, Canada, Japan

Calculating Future Values

- *Question: why small differences in growth rates can make a big difference in income levels over time?*
- Suppose a country's current income/capita is X_0, and the growth rate is r% per year. What will be the income level in year t?

  ➔ $X_t = X_0 \times (1+r)^t$ $\quad FV = PV(1+r)^t$

- Example: GDP per capita (2005 PPP) in Thailand was 7,794 in 2012. If the average growth rate is 5% per year, what would be Thailand's GDP per capita GDP in 2022?

  ➔ $GDP_{2022} = 7,794 \times (1+0.05)^{10} = 12,695$

  ➔ $GDP_{2022}/GDP_{2012} = \frac{12,695}{7,794} \approx 1.63$

- If r = 7%, X_{10} =? Ans. $GDP_{2022} = (GDP_{2022}/GDP_{2012} = \frac{15,332}{7,794}) = 1.97$

  ↳ $7794 \times (1.07)^{10} = 15,332$

Calculating Growth Rates

- Suppose a country's current income/capita is X_0, and the income level in year X_0.?. What's the annual average growth rate? (Recall: $X_t = X_0 \times (1+r)^t$)

$$\rightarrow \frac{X_t}{X_0} = (1+r)^t \rightarrow \left(\frac{X_t}{X_0}\right)^{1/t} = 1+r$$

1. Calculate growth rate using the *endpoint data*.

$$\therefore r = \left(\frac{X_t}{X_0}\right)^{1/t} - 1$$

➔ $r = (X_t / X_0)^{1/t} - 1$

Ex. X_0=7,794 and X_t =12,695 ➔ $r = \left(\frac{12,695}{7,794}\right)^{1/10} - 1 = 0.05$

2. Estimate average growth rate by *least-square regression*.

- $lnX_t = lnX_0 + ln(1+r) \times t$
- Regression: $lnX_t = a + bt$ where $a = lnX_0$ and $b = ln(1+r)$

➔ $r =$

$$x_t = x_0 \cdot (1+r)^t$$

$$\ln(x_t) = \ln[x_0 \cdot (1+r)^t] = \ln x_0 + \ln[(1+r)^t]$$

$$\underbrace{\ln(x_t)}_{Y} = \ln(x_0) + t \cdot \ln(1+r)$$

Y (dependent var)

t ← independent var.

OLS : $Y = a + bX + e$, where $Y = \ln(x_t)$

$a = \ln(x_0) =$ constant

$X = t$

$b = \ln(1+r)$

→ $\hat{b}$ = estimated coeff.

$\hat{b} = \ln(1+r)$

$e^{\hat{b}} = 1+r$

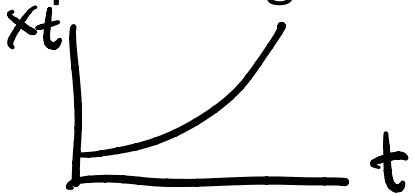
$r = e^{\hat{b}} - 1$

Ex. $\hat{b} = 1.5$

Calculating Growth Rates (Cont'd)

- "The rule of 70" – based on continuous compounding
- Given the exponential function:

$$X_t = X_0 \times e^{rt}$$



- How many years does it take for income to double?

➔ Let $X_t = 2$ and $X_0 = 1$.

Then, $2 = 1 \times e^{rt}$ and $ln2 = ln1 + rt$ → $rt = ln(2) = 0.7$

$t = \frac{0.7}{r}$

So, doubling time (t)= $\frac{0.7}{r}$.

Example: If a country's GDP grows at 2% per year, how many years would its economy double in size? $t = \frac{0.7}{0.02} = 35$

Factor Accumulation, Productivity Growth, Economic Growth

- Economic growth depends on two processes:

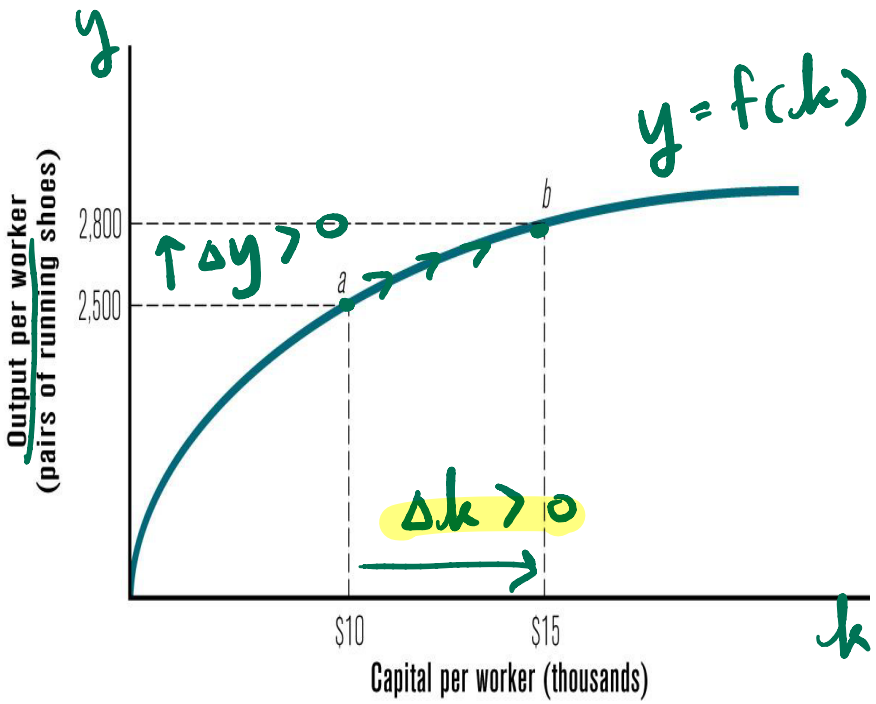
1. *Factor Accumulation*
   - Increasing in the size of capital stock and labor force.
2. *Productivity Growth*
   - Increasing the amount of output per unit of machine or worker
   - productivity can be increased by greater efficiency (e.g. specialization), and technological change.

- This can be explained using production function

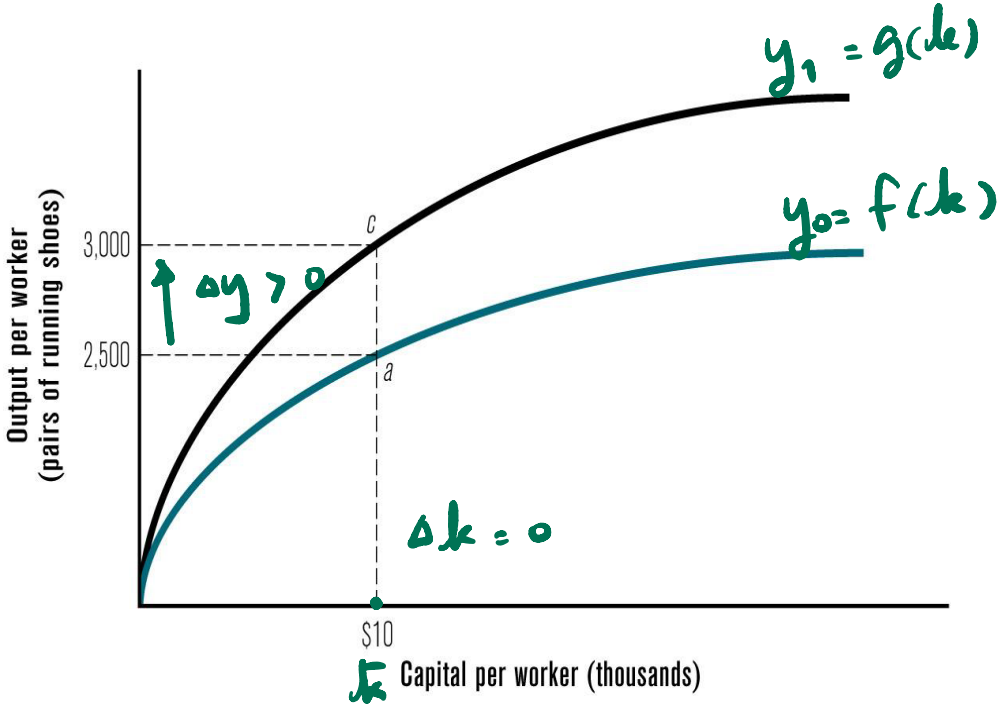
  Q= f(Labor, Capital, etc…)

$Q = Y = f(K, L) \Rightarrow y \equiv \frac{Y}{L} = f(k)$ where $k = \frac{K}{L}$

Basic Sources of Economic Growth



Factor Accumulation



Productivity Gains → TFP

Saving, Investment & Capital Accumulation

- Solow growth model:
  - Explores the contribution of each factor to increase to output: Q(K, L, Productivity gains)
- Key elements of economic growth:
  - New investment increases the capital stock
  - Investment (I) is financed through savings (S)
  - Savings comes from current income of GDP: S= f(Y)
- *Sustaining Growth requires both generating new investment and making sure it is productive*.

Sources of Growth Analysis

- Growth accounting (or source of growth analysis) measures the relationship between productivity change and economic growth
- Total factor productivity (TFP): contribution to production of efficiency, technology, and other influences on productivity
- The growth equation can be written as:

$$g_Y = (W_k \times g_K) + (W_n \times g_L) + a$$

where

- g_Y = growth of total income (or GDP)
- g_K, g_L = growth of capital and labor
- W_k, W_n = share of capital and labor
- a= rate of productivity of inputs = "Solow residual"

Growth Accounting (Cont'd)

- Example: Assume the following: g_Y =0.05, g_K=0.07, g_L= 0.02, W_L=0.6, and W_K= 0.4. a = ?
  - Recall $g_Y = (W_k \times g_K) + (W_n \times g_L) + a$
  - Substitute: 0.05 = (0.4 x 0.07) + (0.6 x 0.02) + a
    - TFP growth: a = 0.01
      (i.e. 20 % of GDP growth) = 0.01/0.05
    - Growth in K accounts for 0.028/0.05 = 56 % of g_Y
    - Growth in L accounts for 0.012/0.05 = 24 % of g_Y
- Problems with Solow residual:
  - could represent influences other than productivity gains.
  - "a" captures the measurement errors and omitted variables because it is the residual in the equation.

Sources of Growth Across Countries 1960-2000 (1980s)

$y = f(k)$ where $k = K/L$

Country/ Region	Growth of Output per worker (g_Y)		Capital per worker (g_k)		Education per worker (g_h)		TFP ("a")
		α_k		α_h			
Brazil	-1.63	=	0.16	+	0.68	+	-2.47
Ethiopia	-1.74	=	1.11	+	0.27	+	-3.12
Ghana	-1.14		-1.23		0.15		0.07
Africa	-1.06		-0.07		0.42		-1.41
East Asia	4.36		2.45		0.66		1.25
Latin America	-1.77		0.04		0.47		-2.28
Middle East	1.15		0.55		0.53		0.07
South Asia	0.68		1.02		0.42		2.25
Industrialized	1.82		0.69		0.24		0.9

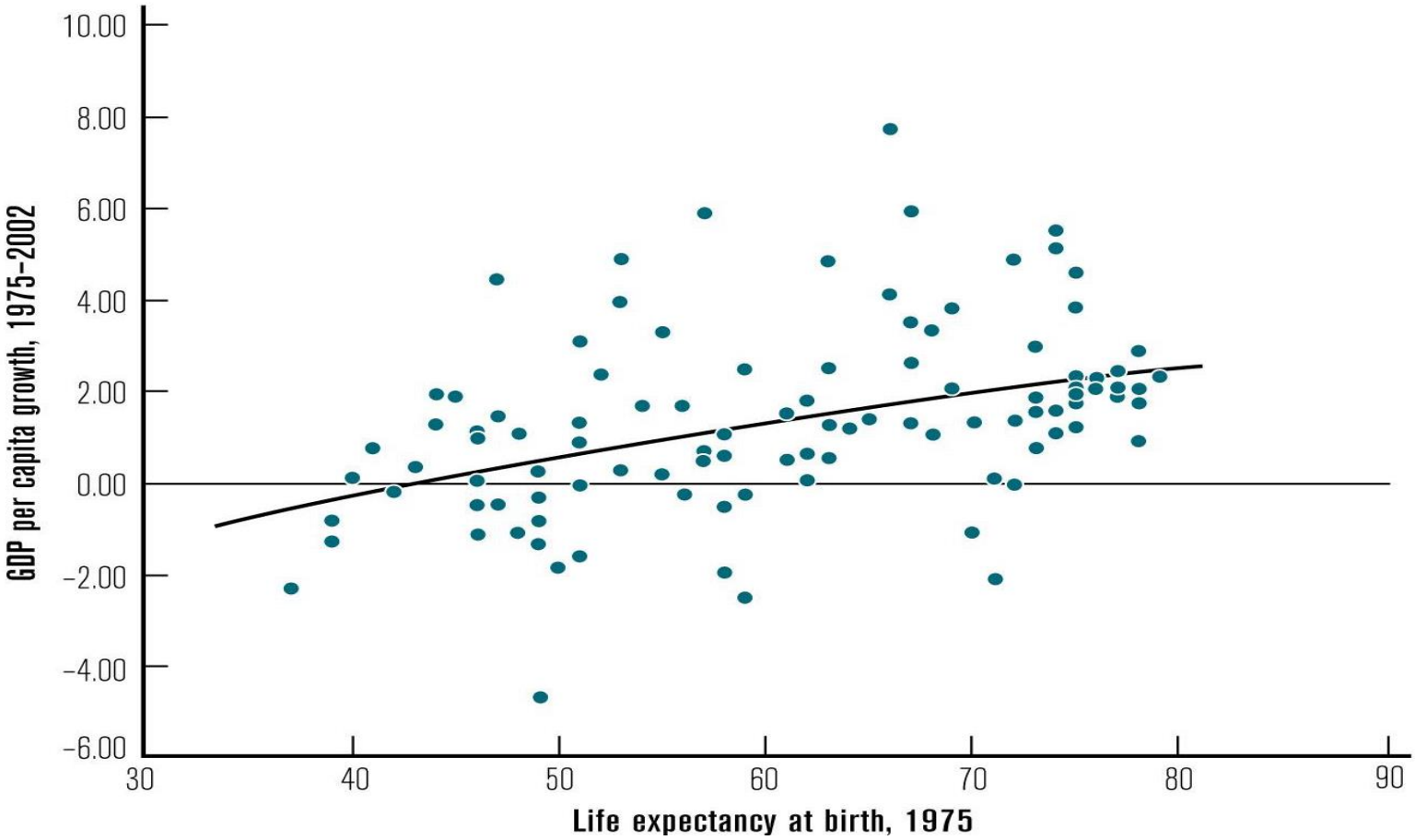
Source: Collins & Bosworth (2003). "The Empirics of Growth: An Update."

Characteristics of Rapidly Growing Countries

- Why some economies growth faster than others?
  - Need to look at empirical evidence; there's no consensus
  - Important to ask "which causes which?"

- Six broad characteristics that fast-growing countries share:
  1. Macroeconomic stability
  2. Investment in health and education*
  3. Effective governance and institutions
  4. Favorable environment to private enterprise
  5. Trade, openness, and growth*
  6. Favorable geography or location?

Growth and Life Expectancy

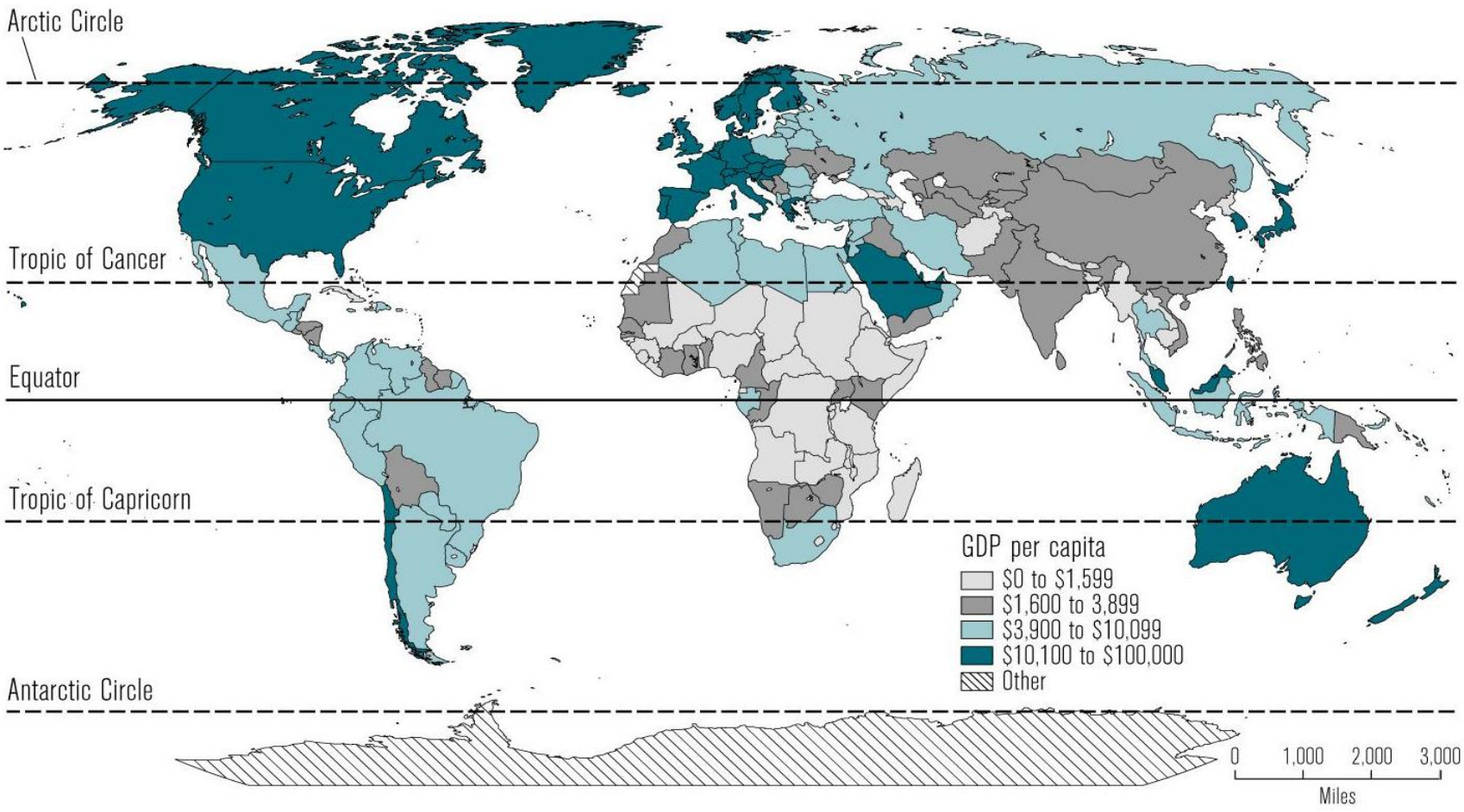


Better health → faster growth OR faster growth (higher income) → improve LE?

Institutions, Governance & Growth [Box 3.2]

- 5 institutions are necessary according to Rodrik and Subramanian (2003):
  1. *Market-creating institutions*: protect property rights
  2. *Market-regulating institutions*: deal with market failures
  3. *Market-stabilizing institutions*: control macroeconomic volatility
  4. *Market-legitimizing institutions*: provide social protection and insurance
  5. *Political institutions*: how a country is governed & extent of political participation

Does geography matter?



More recent data: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?view=map