ECONOMIC GROWTH: CONCEPTS AND PATTERNS

EE 462 Development Macroeconomics

Semester 1/2015

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

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*?

  ➔ $X_t = X_0 \times (1+r)^t$

- Example: GDP per capita (2005 PPP) in Thailand was 7,794 in 2009. If the average growth rate is 5% per year, what would be Thailand's GDP per capita GDP in 2019?

  ➔ $GDP_{2019} = 7,794 \times (1.05)^{10} = 12,695$

  ➔ $GDP_{2019}/GDP_{2009} = 1.63$

- If r = 7%, X_{10} =? Ans. $GDP_{2019} = 15,332$ $(GDP_{2019}/GDP_{2009} = 1.97)$

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: $X_t = X_0 \times (1+r)^t$)

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

➔ $r = (X_t / X_0)^{1/t} - 1$

Ex. X_0=7,794 and X_t =12,695 ➔ *r = (1.63)^(0.1)-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 $b = ln(1+r)$

➔ $r = e^b - 1$

Factor Accumulation, Productivity Growth, Economic Growth

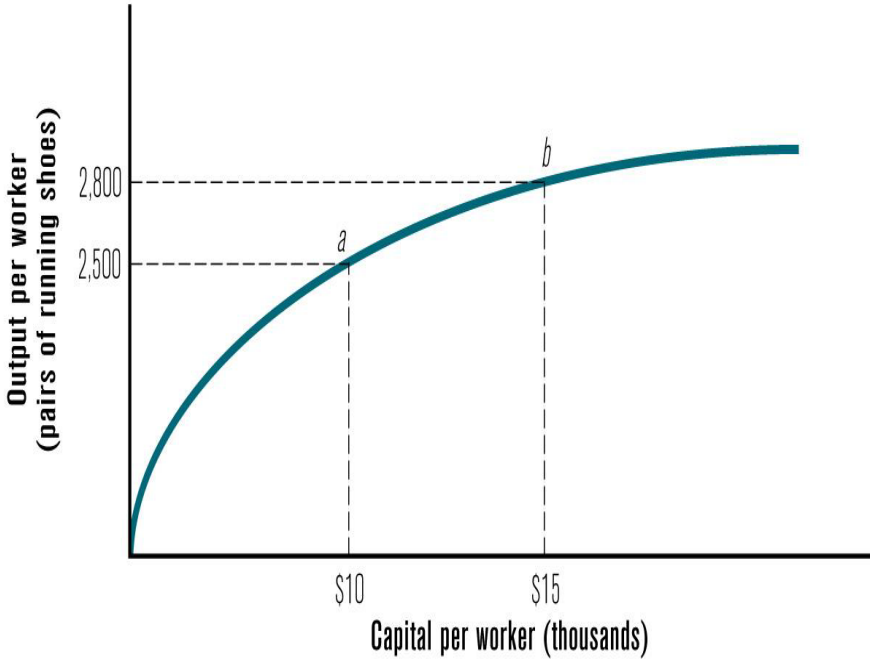
- Economic growth depends on two processes:

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.

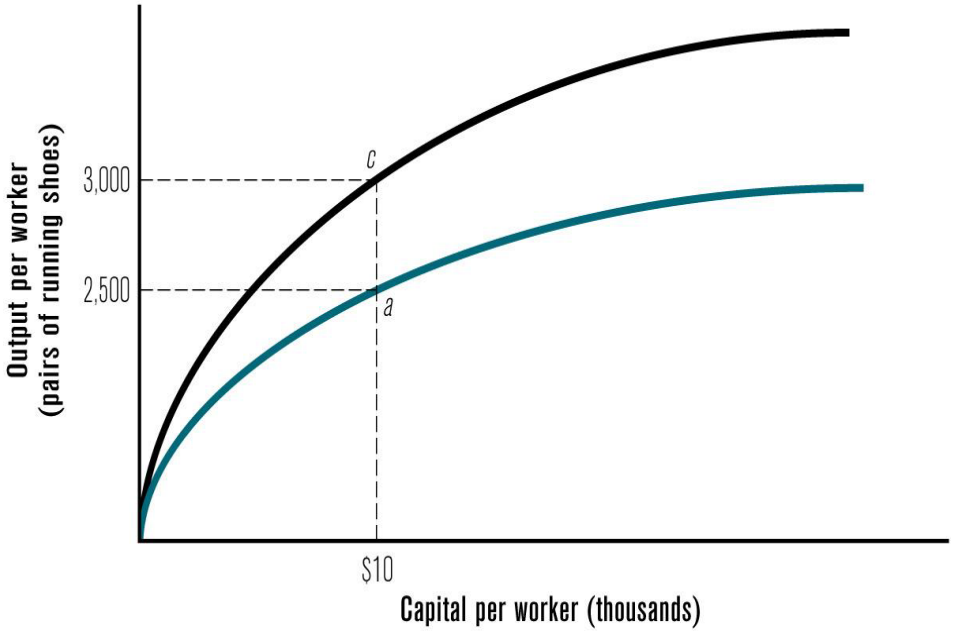
- This can be explained using production function

  Q= f(Labor, Capital, etc…)

Basic Sources of Economic Growth



Factor Accumulation



Productivity Gains

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 = 0.05 – 0.028 – 0.012 = 0.01
      (i.e. 20% of GDP growth)
    - 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: Empirical Evidence

General findings:

- Economic growth in industrialized countries are attributed vastly by TFP, and less by capital accumulation.
- Data problems and price distortions are major concerns in developing countries.
- Sources of econ growth in LDCs attribute a larger role to capital accumulation than in industrialized countries. Why?
- Among developing countries, TFP growth in East Asia was faster than that in other regions.
- TFP growth tends to become more important as income rises.

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

Country/ Region	Growth of Output per worker	Capital per worker	Education per worker	TFP
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

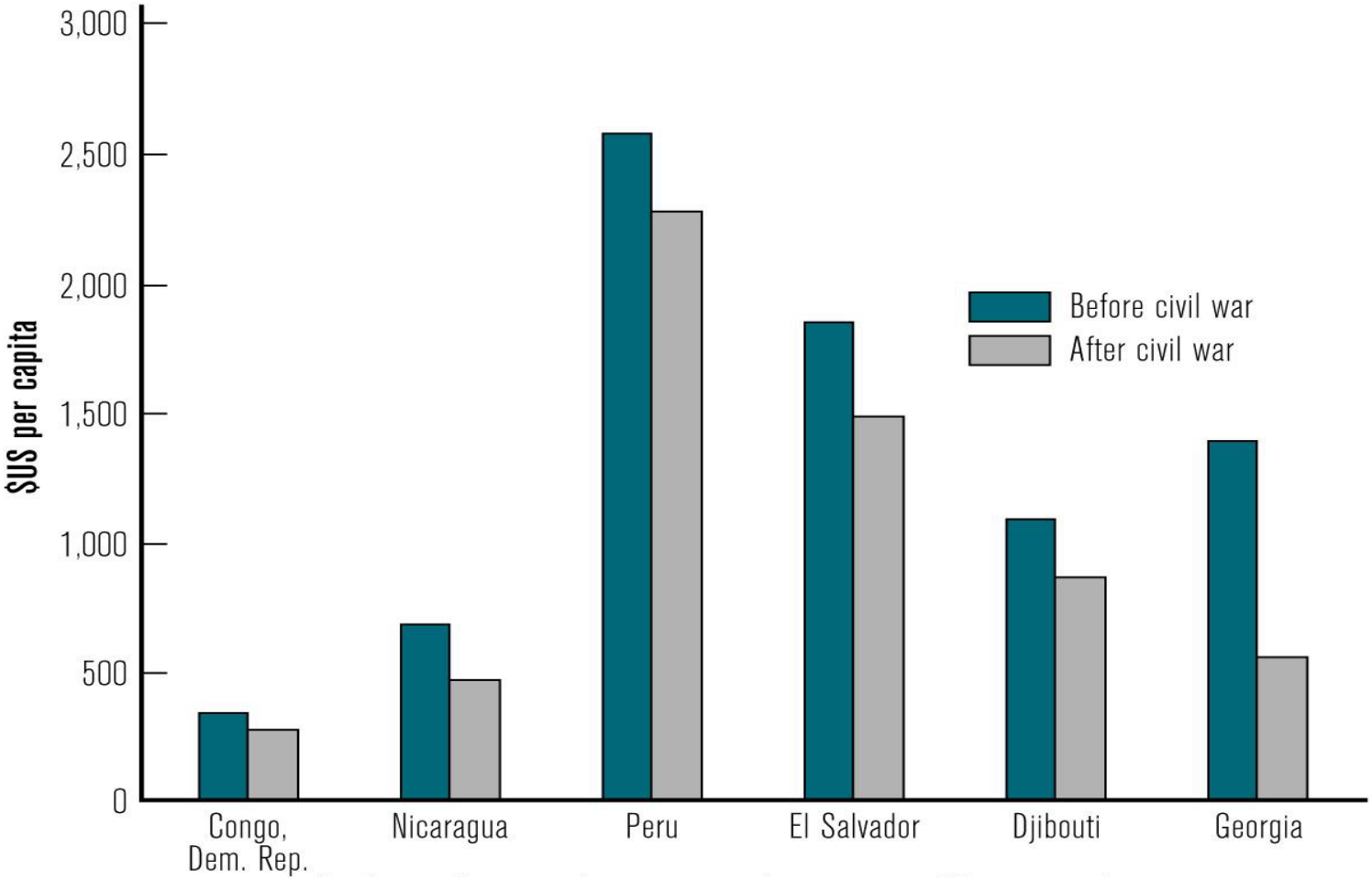
Source: Collins & Bosworth (2003). "The Empirics of Growth: An Update."

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?"

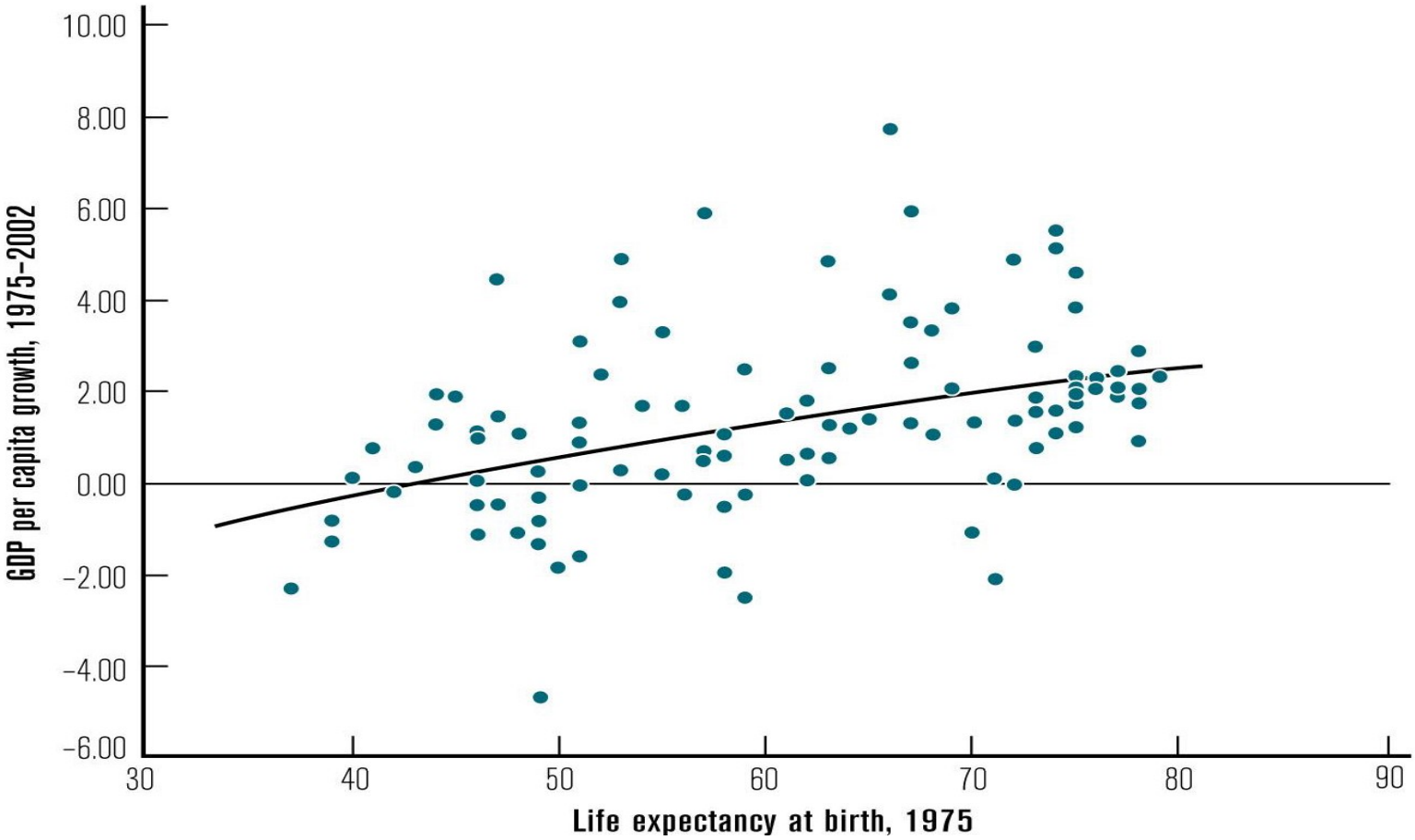
- Six broad characteristics that fast-growing countries share:
  1. Macroeconomic stability
  2. Investment in health and education*
  3. Effective governance and institutions
  4. Favorable environment to private enterprise
  5. Trade, openness, and growth*
  6. Favorable geography or location?

GDP per capita before and after a Civil War



➔ Average income was 28% lower after the civil war than before.

Growth and Life Expectancy

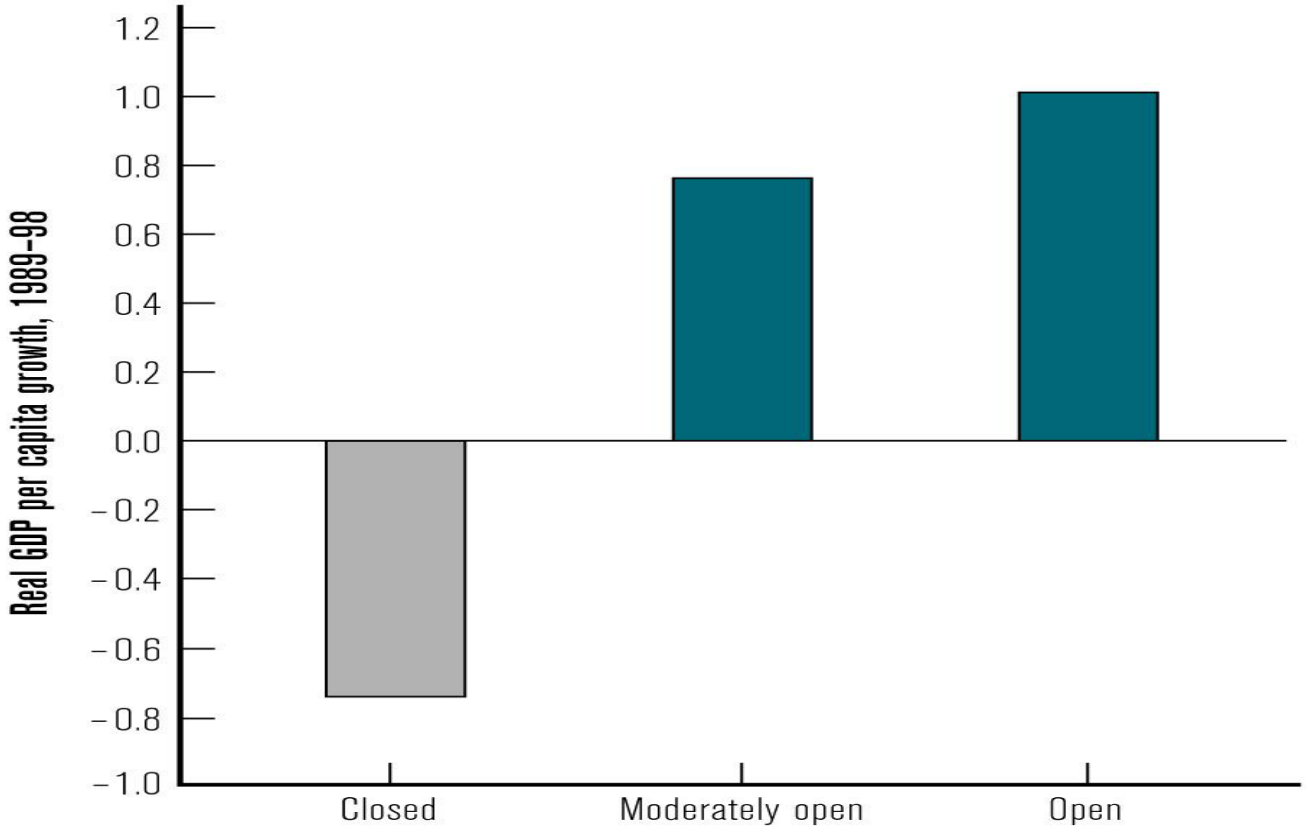


Better health → faster growth OR faster growth (higher income) → improve LE?

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

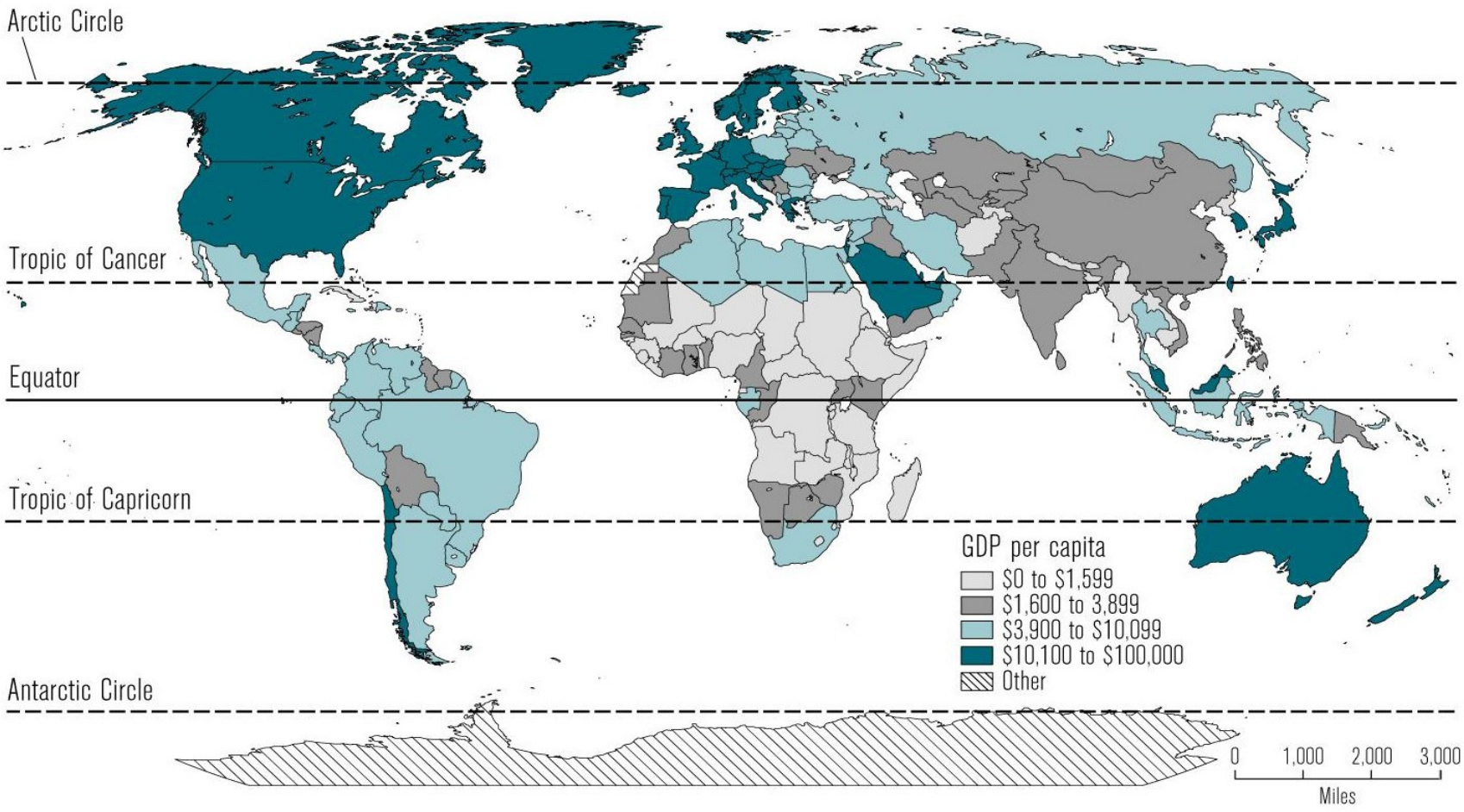
Openness and Growth



Inconclusive evidences:

1. How to construct measure of trade policy orientation
2. Pro-trade policies → growth?

Does geography matter?



More recent data:
http://data.worldbank.org/indicator/NY.GNP.PCAP.PP.CD/countries?display=map

Bosworth & Collins' (2008) - Accounting for Growth: Comparing China and India

- This paper examines sources of economic growth in India and China during 1978-2004.
- The authors compare the sources of growth analysis between the two countries and across three sectors (agriculture, industry, services).
- The equation used to analyze sources of growth is:

$$\Delta \ln(Y/L) = \alpha[\Delta \ln(K/L)] + (1-\alpha)\Delta \ln H + \Delta \ln A$$

  - Employment growth: growth in pop of labor force age
  - Data on capita: national account
  - Data on education: constructed indices of educational attainment

Table 1

Sources of Growth: China, India, and East Asia, 1978–2004

(annual percentage rate of change)

Period/country		*Output*	*Employment*	*Output per worker*	*Contribution to output per worker of*		
					Physical capital	*Education*	*Total factor productivity*
1978–2004	China	9.3	2.0	7.3	3.2	0.3	3.6
	India	**5.4**	**2.0**	**3.3**	**1.3**	**0.4**	**1.6**
1978–1993	China	8.9	2.5	6.4	2.4	0.4	3.5
	India	**4.5**	**2.1**	**2.4**	**0.9**	**0.3**	**1.1**
1993–2004	China	9.7	1.2	8.5	4.2	0.3	3.9
	India	**6.5**	**1.9**	**4.6**	**1.8**	**0.4**	**2.3**
East Asia excluding China							
1960–1980		7.0	3.0	4.0	2.2	0.5	1.2
1980–2003		6.1	2.4	3.7	2.2	0.5	0.9
1980–1993		7.3	2.7	4.6	2.6	0.6	1.4
1993–2003		4.5	2.0	2.5	1.8	0.5	0.3

Table 3

Sources of Growth by Major Sector, 1978–2004

(*annual percentage rate of change*)

Period/country/sector		*Output*	*Employment*	*Output per worker*	*Contribution to output/worker of*		
					Physical capital	*Education*	*Factor productivity*
Agriculture							
1978–2004	China	4.6	0.3	4.3	2.3	0.3	1.7
	India	**2.5**	**1.1**	**1.4**	**0.3**	**0.3**	**0.8**
1978–1993	China	5.2	0.9	4.3	2.2	0.3	1.7
	India	**2.7**	**1.4**	**1.3**	**0.1**	**0.2**	**1.0**
1993–2004	China	3.7	−0.6	4.3	2.3	0.2	1.7
	India	**2.2**	**0.7**	**1.5**	**0.6**	**0.3**	**0.5**
Industry							
1978–2004	China	10.0	3.1	7.0	2.2	0.3	4.3
	India	**5.9**	**3.4**	**2.5**	**1.5**	**0.3**	**0.6**
1978–1993	China	9.3	4.4	4.9	1.5	0.4	3.0
	India	**5.4**	**3.3**	**2.1**	**1.4**	**0.4**	**0.3**
1993–2004	China	11.0	1.2	9.8	3.2	0.3	6.1
	India	**6.7**	**3.6**	**3.1**	**1.7**	**0.3**	**1.1**
Services							
1978–2004	China	10.7	5.8	4.9	2.7	0.3	1.8
	India	**7.2**	**3.8**	**3.5**	**0.6**	**0.4**	**2.4**
1978–1993	China	11.3	6.5	4.7	1.8	0.4	2.5
	India	**5.9**	**3.8**	**2.1**	**0.3**	**0.4**	**1.4**
1993–2004	China	9.8	4.7	5.1	3.9	0.3	0.9
	India	**9.1**	**3.7**	**5.4**	**1.1**	**0.4**	**3.9**

Table 4

Value-Added and Employment by Industry as Share of Total

(percent)

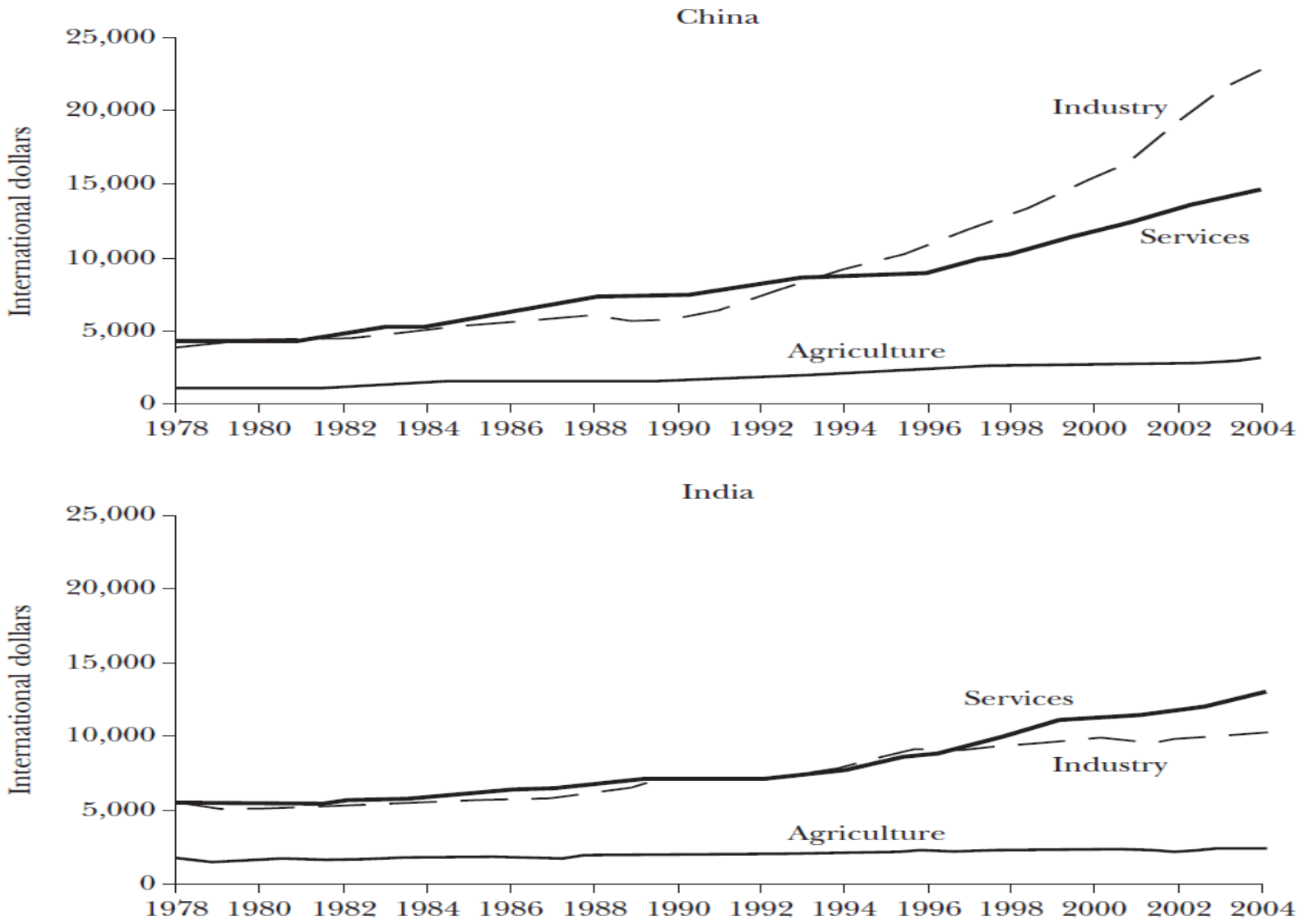
Year/country	*Agriculture*	*Industry*	*Services*	*Total*
		Value added		
1978				
China	28	48	24	100
India	**44**	**24**	**32**	**100**
1993				
China	17	51	33	100
India	**33**	**28**	**39**	**100**
2004				
China	9	58	33	100
India	**22**	**28**	**50**	**100**
		Employment		
1978				
China	71	17	12	100
India	**71**	**13**	**16**	**100**
1993				
China	56	22	21	100
India	**64**	**15**	**21**	**100**
2004				
China	47	23	31	100
India	**57**	**18**	**25**	**100**

Source: China Data Center and *China Statistical Yearbook* (National Bureau of Statistics of China); India National Accounts; India National Sample Survey Organization.

Figure 2

Output per Worker by Sector, China and India, 1978–2004

(international dollars of 2004)



Source: China Data Center and *China Statistical Yearbook* (National Bureau of Statistics of China); India National Accounts; India National Sample Survey Organization.

Table 5

Sectoral Growth in Output per Worker, 1978–2004

(percentage contribution to growth)

	Total	*Agriculture*	*Industry*	*Services*	*Reallocation*
1978–93					
China	**6.4**	1.2	2.4	1.1	1.7
India	**2.4**	0.6	0.5	0.7	0.6
Difference	**4.0**	0.6	1.9	0.5	1.0
1993–04					
China	**8.5**	0.7	5.0	1.7	1.2
India	**4.6**	0.5	0.9	2.1	1.2
Difference	**3.9**	0.2	4.1	−0.4	0.0

Source: Authors calculations as explained in the text.

Key Findings (1)

- For the entire period, China's output growth rate (9.3%) was much higher than that of India (5.4%).
- Physical capital and TFP play contributed more to China's growth in output per worker.
- India's growth in output per worker improved after 1993, and it's comparable to that in East Asia (before financial crisis)
- In both countries, growth in output per worker is equally split between increases in K & H and gains in TFP.

Key Findings (2)

- Agriculture
  - Growth in agricultural Y/L in China after 1993 was impressive because the sector growths despite a drop in employment.
  - The gains in China were achieved through increases in K/L and TFP gain (more than double those for India.
- Industry
  - After 1993, China has achieved spectacular growth rate in industrial Y/L (9.8%) – This is attributed largely to TFP gain and increases in K/L (double of growth in previous period) .
  - Growth in Y/L in India is only 1/3 of that in China, and gains in TFP have been very modest (1%).

Key Findings (3)

- Services
  - Growth in Y/L in service sector in China has been ~5% steadily (mostly attributed to increases in K/L).
  - After 1993, growth in Y/L service sector in India exceeds 5% (closest match to China). This gain is reflected in a rapid improvement in TFP.