Macroeconomics: Economic Growth (Licence 3) Lesson 1: Introduction

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Economic Growth

Lesson 1

- Presentation

- Main Stylized Facts

- Main Questions of Economic Growth

Economic Growth

Lesson 1

- How do we measure Economic Growth?

Economic Growth

Measures of Economic Growth

- GDP per capita vs measures of quality of life
  - GDP per capita highly correlated with other measures

- GDP per capita vs GDP per worker
  - Consumer Welfare (Demand) vs. Firm Productivity (Supply)

Economic Growth

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- **Fact 1: There are huge differences in per capita income across economies.**

Economic Growth

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- **Fact 1: There is enormous variation in per capita income across economies.**

- The poorest countries have per capita incomes that are less than 5 percent of per capita income in the richest countries.

- Income per capita (or GDP per capita) is not the sole measure of what is good: but it's a useful summary statistic.

- Income per capita ignores distribution of income within a country

- Comparing income per capita across countries is not trivial

Economic Growth

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- **Fact 1: There is enormous variation in per capita income across economies.**

    - You have to convert between currencies (Base currency as a unit of measurement)

    - Countries have different relative prices for goods (take into account inflation)

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- **Useful sources to collect indicators of economic growth: National accounts**

- IMF (GDP, RER, Price indexes)

- World Bank (WB)

- OECD (Stan dataset, production data at sectoral level for OECD countries)

- Eurostat

- Groningen Growth and Development Centre:

- Penn World Tables (useful for PPP-purchasing power parity comparisons)

Economic Growth

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- **Developed Countries: GDP per capita in high income countries**

Country	GDP per capita 2008	GDP per worker 2008	Labor Force Part. Rate 2008	Avg. Growth 1960-2008	Years to Double
United States	$43,326	$84,771	0.51	1.6	43
Japan	33,735	64,778	0.52	3.4	21
France	31,980	69,910	0.46	2.2	30
United Kingdom	35,345	70,008	0.51	1.9	36
Spain	28,958	57,786	0.50	2.7	26

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- **Less developed Countries: GDP per capita in low ncome countries**

Country	GDP per capita 2008	GDP per worker 2008	Labor Force Part. Rate 2008	Avg. Growth 1960-2008	Years to Double
China	6,415	10,938	0.59	5.6	13
India	3,078	7,801	0.39	3.0	24
Nigeria	1,963	6,106	0.32	0.6	114
Uganda	1,122	2,604	0.43	1.3	52

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- **Growth Miracles: South East Asian countries**

Country	GDP per capita 2008	GDP per worker 2008	Labor Force Part. Rate 2008	Avg. Growth 1960-2008	Years to Double
Hong Kong	37,834	70,940	0.53	4.3	16
Singapore	49,987	92,634	0.54	4.1	17
Taiwan	29,645	62,610	0.47	5.1	14
South Korea	25,539	50,988	0.50	4.5	16

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- **Growth Disasters**

Country	GDP per capita 2008	GDP per worker 2008	Labor Force Part. Rate 2008	Avg. Growth 1960-2008	Years to Double
Venezuela	9,762	21,439	0.46	-0.1	-627
Haiti	1,403	3,164	0.44	-0.4	-168
Madagascar	810	1,656	0.49	-0.1	-488
Zimbabwe	135	343	0.40	-1.5	-47

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Distribution of Population by GDP per Worker, 2008
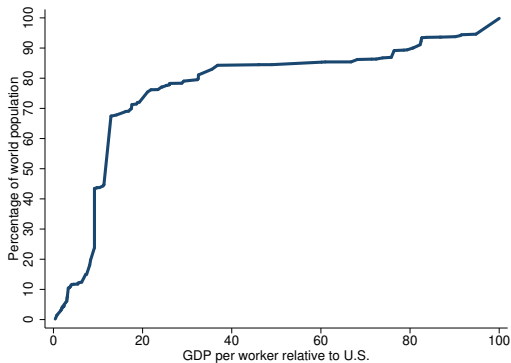
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GDP per capita in 2005
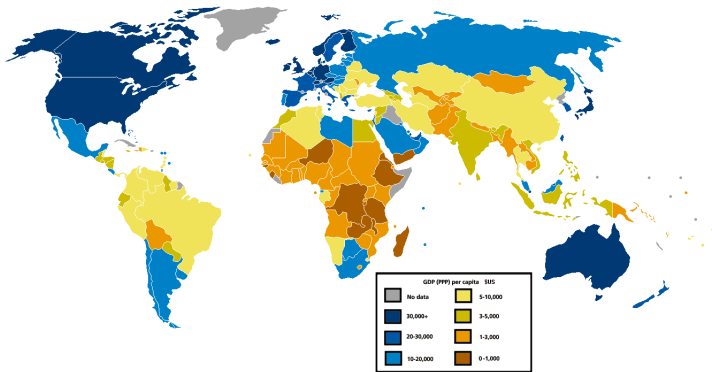
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GDP Density

GDP per square kilometer
- $ 0 - 499
- $ 500 - 1,099
- $ 1,100 - 2,999
- $ 3,000 - 8,099
- $ 8,100 - 21,199
- $ 22,000 - 59,999
- $ 60,000 - 162,999
- $ 163,000 - 441,999
- $ 442,000 - 546,000,000
- No Data
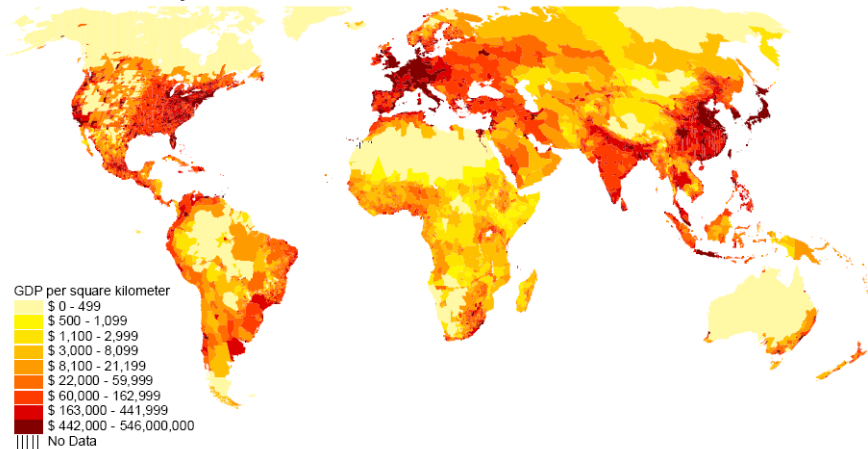
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Light intensity: World
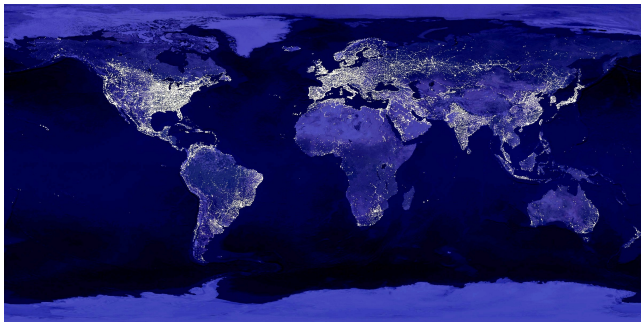
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Light intensity: Europe

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- **Fact 2: Countries grow at different rates.**

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- **Fact 2: Rates of economic growth vary substantially across countries.**

- We will try to distinguish whether these are long-term differences or just transitional differences.

- If they are long-term, then eventually some countries will be infinitely rich compared to others

- We think most differences are transitional.

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Computing growth rates

- Growth rate, g, of a continuous variable, y (income per capita), from period $t = 0$ to period $t = 1$:

$$\frac{y_1 - y_0}{y_0} = \frac{y_1}{y_0} - 1 = g \tag{1}$$

- Rearranging terms we have:

$$y_1 = (1 + g)y_0 \tag{2}$$

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Computing growth rates

- For a constant g:

$$y_2 = (1+g)y_1 = (1+g)y_0(1+g) = (1+g)^2 y_0 \qquad (3)$$

- At any future time t for a constant g between 0 and t:

$$y_t = (1+g)(1+g).....(1+g)y_0 = y_0(1+g)^t \qquad (4)$$

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Computing growth rates

- The growth rate can also be approximate using the natural log, ln:

$$ln y_1 - ln y_0 \approx g \qquad (5)$$

- Taking the log of equation (4) $y_t = y_0(1+g)^t$:

$$ln y_t = ln y_0 + t ln(1+g)$$

$$\frac{ln y_t - ln y_0}{t} = ln(1+g)$$

- For small values of g, $ln(1+g) \approx g$, thereby:

$$\frac{ln y_t - ln y_0}{t} \approx g$$

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A country growing at growth rate g per year will double its income per capita every $0.7/g$ years

- At a future time t, the country has double income than at time 0:

$$y_t = 2y_0$$

- We know from equation (4) $y_t = y_0(1 + g)^t$:

- Where g is the annual average growth rate during the period (t years)

- Thereby: $2y_0 = y_0(1 + g)^t$

- $2 = (1 + g)^t$
- Taking the log: $ln(2) = t ln(1 + g)$

$$t = ln(2)/ln(1 + g) \approx .0.7/g$$

- For small values of g, since $ln(1 + g) \approx g$

Economic Growth

A country growing at growth rate g per year will double its income per capita every 0.7/g years

- For instance, if t is measured in years and the country grows at 2% per year ($g = 0.02$)

- it will take 35 years to double the country's income
  ($0.7/g = 0.7/0.02 = 35$)

Economic Growth

The simple model of economic growth with constant g

$$y_t = y_0(1 + g)^t$$

- We can plot graphically this exponential function with t on the x-axis and y_t on the y-axis
- We plot the values of y_t of a variable growing at a constant and positive g
- Where a line is used to plot the values of $\ln y_t$
- Log linearizing $y_t = y_0(1 + g)^t$, we get:

$$lny_t = lny_0 + t ln(1 + g)$$

- Or (since $ln(1 + g) \approx g$)

$$lny_t \approx lny_0 + gt$$

- Where lny_0 is the **intercept** on the y-axis
- and $ln(1 + g)$ (or just g for small values of g) is the **slope** of the line

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Plotting logs
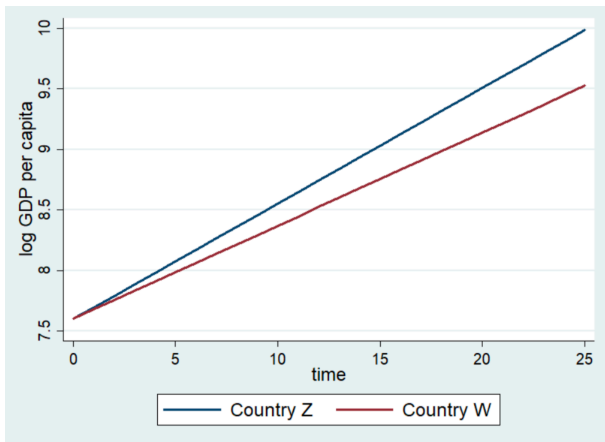
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- **Fact 3: Growth rates vary over time.**

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- **Fact 3: Growth rates are not generally constant over time.**

- For the world as a whole, since growth rates were close to zero over most of history but have increased sharply in the twentieth century.

- For individual countries, growth rates also change over time.

- The big changes in growth rates over history are from **pre-Industrial Revolution (close to 0% growth) to modern times (roughly 1.85% growth per year for developed countries)**

- The big changes in growth rates within countries tend to be as they transition from poor to rich (e.g. Japan or China), after which growth slows down.
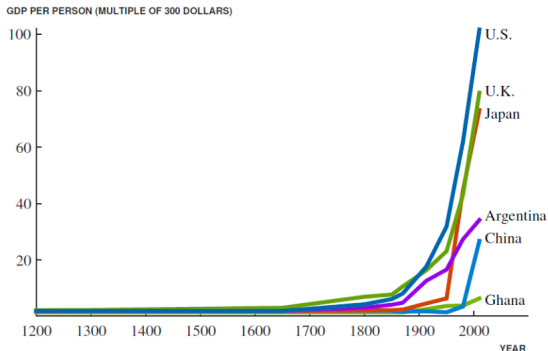
World GDP per Capita Growth Rates over time (not constant)
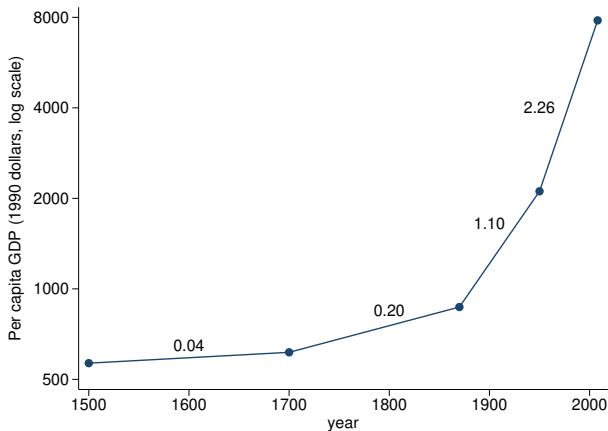
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Growth rates over time across countries

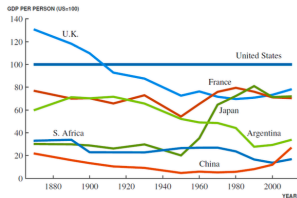GDP PER PERSON (MULTIPLE OF 300 DOLLARS)

Note: The graph shows GDP per person for various countries. The units are in multiples of 300 dollars and therefore correspond roughly to the ratio between a country's per capita income and the income in the poorest country in the world. Source: The Maddison Project, Bolt and van Zanden (2014).
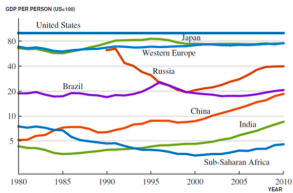
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- **Fact 4: Comparing a country to others reveals that its relative per capita income can change over time.**

Growth rates over time across countries

From C. Jones, 2015, Facts of economic growth, available at http://web.stanford.edu/~chadj/papers.html

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- **Fact 4: A country's relative position in the world distribution of per capita incomes is not immutable.**

- Countries can go from being "poor" to being "rich", and vice versa.

- The "growth disasters" in the table were all very well off in 1960 compared to East Asia. Now they are well behind.

- The "growth miracles" in the table were though, in 1960, to be on the path to starvation and destitution.

- **What are the sources of these movements in rankings?**

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- **Do countries converge in the long-run to the same level of income?**

- If so, between the initial year and year t in the future,

- we should observe smaller growth rates for countries that are originally richer than for originally poorer countries

- **There is no empirical evidence of absolute convergence**

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Lack of evidence of absolute convergence

- . If we look at the income dynamics of all countries in the world,

- we do not systematically observe that initially poorer countries grow at higher rates than initially richer countries over time

- There is no evidence that, disregarding countries' characteristics,

- **the levels of income of initially poorer countries converge towards the levels of income of initially richer countries.**

# Economic Growth

Lack of evidence of absolute convergence
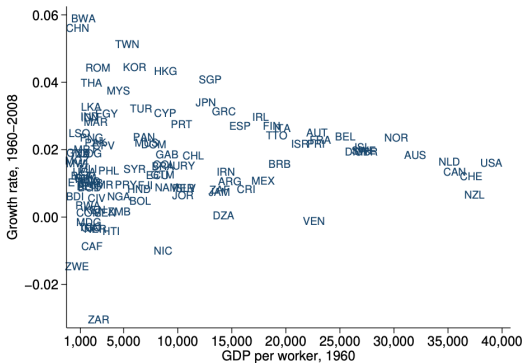
Evidence of conditional convergence

- Income dynamics of countries with similar characteristics (e.g. education levels, investment shares, institutional quality, etc.-OECD countries),

- show that we observe that initially poorer countries grow at higher rates than initially richer countries over time

- there is evidence that, once we take into account countries' structural characteristics,

- the levels of income of initially poorer countries converge towards the levels of income of initially richer countries.

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Evidence of conditional convergence OECD countries (conditional on similar characteristics)

Economic Growth
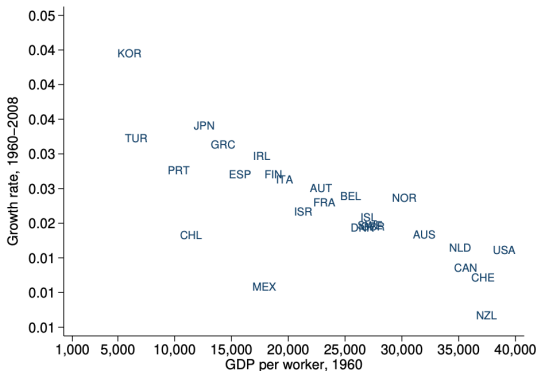
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- **Fact 5: In the U.S. over the last century,**
  - The real rate of return on capital, r, shows no trend upward or downward

  - The shares of income devoted to capital, rK/Y, and labor, wL/Y, show no trend; and

  - The **average growth rate of output per person has been positive and relatively constant** over time - that is, the United States exhibits steady, sustained per capita income growth.

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- "Kaldor facts"

- Questions about the first two, are they really true over long periods of time?

- These facts will drive us to look at a specific pattern of growth - the *balanced growth path in the Solow model*

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Growth in U.S. GDP per capita
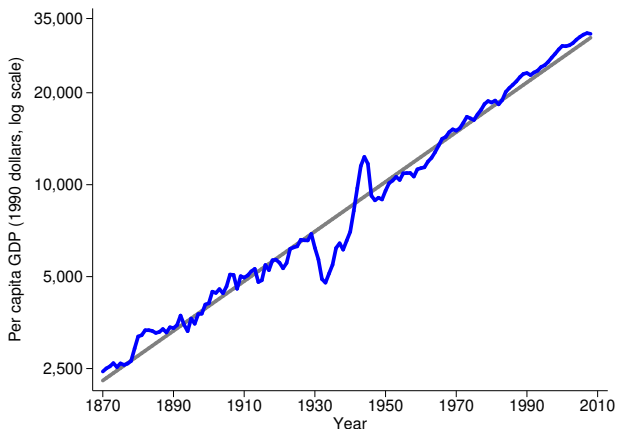
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- **Fact 6: Growth in output and growth in the volume of international trade are closely related.**

  - Growth in trade is associated with growth in output, but not necessarily level of trade (Japan does not actually trade much, but is rich)

  - Rapid growth in trade is no necessarily just growth in exports from East Asia (China and Korea also import a lot more than they used to)

  - **The role of export and import in fostering economic growth**

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Growth in Trade and Growth in Output
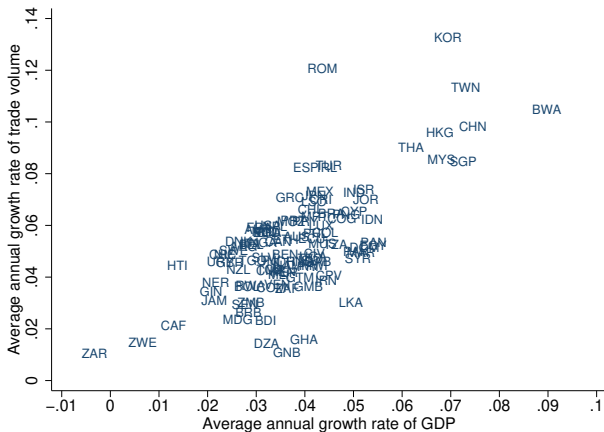
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- **Fact 6: Trade and Growth: determinant or cause?**
    - How does economic growth affect trade across countries?

    - Are countries able to increase economic growth thanks to international trade ?

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- **Fact 7: Both skilled and unskilled workers tend to migrate from poor to rich countries or regions.**

- Implies that return to both kinds of labor is higher in developed countries

- Shouldn't scarcity in poor countries imply a large premium to skilled workers?

Economic Growth

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- **Big Questions:**

- **Why are some countries so rich and others so poor?**

Economic Growth

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- **Answers to Big Questions**

- Level differences

- Different levels of human capital

- Different institutions supporting innovation/technology adoption/entrepreneurship

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- **Big Questions**

- Which are the determinants of economic growth?

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- **Answers to Big Questions**

- Technological progress: "efficiency gains" producing more goods with the same amount of inputs

- Not accumulation of more physical or human capital - those cannot sustain growth

Economic Growth

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- **Which are the determinants of technical progress?**

- Innovation:
  - **Product innovation:** new goods, or better versions (high quality) of old goods.

  - **Process innovation:** improving production processes.

- Ultimately technological progress will rely on population - **more people, more ideas, skills**

Economic Growth

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- **Big Questions**

- What creates growth miracles in some countries?

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- **Answers to Big Questions**

    - Reversing what made them poor

    - Changing institutions to foster technology adoption (role of international trade)

    - Changing institutions to create larger markets (trade, internal markets) to support innovation/adoption