Lecture 9: The Facts of Growth
Intermediate Macroeconomics, Econ 102

François Geerolf

UCLA

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"It's true, Caesar. Rome is declining, but I expect it to pick up in the next quarter."

Short run or long run?

- We have focused at the **short run determinants of output**:
  - more saving was detrimental to investment.
  - redistributive taxation from low MPC to high MPC was desirable.

- However, in the medium and long run :
  - saving also feeds capital accumulation, and investment.
  - high taxation of low MPC discourages entrepreneurship, etc.

- In the keynesian theory we studied, output was <u>demand-determined</u>. However, in the long run, what determines output is also the <u>supply side</u>. At some point, increases in demand face a constraint on supply.

- In particular, one question that obsesses economists is how can we increase **long run growth of output**. According to Robert E. Lucas, a Chicago economist: "The consequences for human welfare involved in questions like these are simply staggering: once one starts to think about them, it is hard to think about anything else."
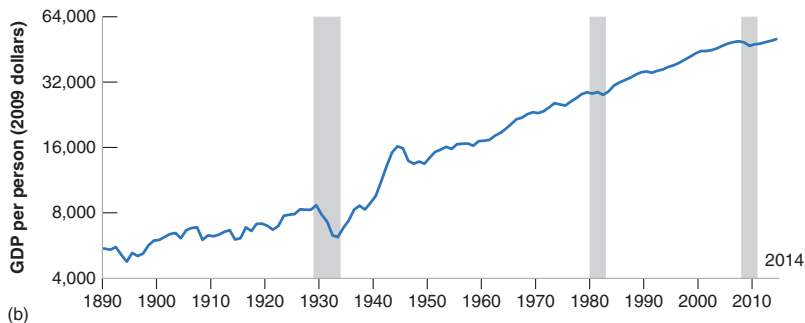
U.S. GDP since 1890.

- US output, since 1980, and until 2014, has increased by a **factor of 46.**

(a)
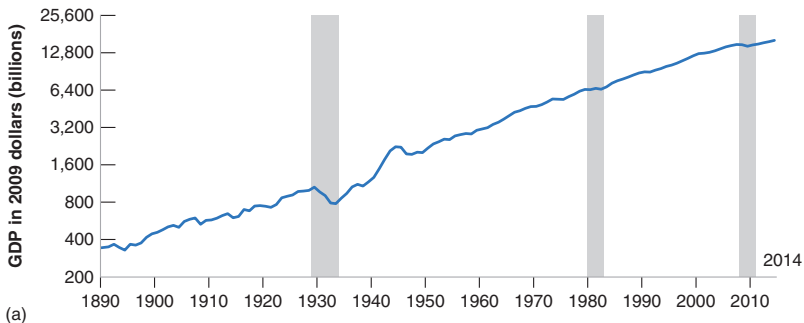
U.S. GDP per capita since 1890

- However, US output per capita, since 1980, and until 2014, has increased only by a **factor of 9.**

- U.S. population has increased from **63 million to more than 300 million** during this period.

Measurement issues

- We care about growth because we ultimately care about <u>standards of living</u>. **Output per person** if better than output itself, is the variable we compare over time or across countries.

- **Output per worker** = compare the productivity of a labor force (labor force participation, age structure, etc.)

- **Output per hour worked** = even better: for example, Germany VS U.S.

- Finally, this is not enough. We also need to correct for **variations** in exchange rates and **systematic differences** in prices across countries. For this reason, we use **purchasing power parity (PPP) numbers**
  - ▶ The $ increased and then decreased in the 1980s by roughly 50% vis-à-vis other currencies. Surely the standard of living did not change by that much!
  - ▶ GDP per person is $1529 in India, in 2011, using the exchange rate then. Cmpared to $47880 in the US, this is $31.3\times$ more. But prices of basic goods are much lower in India.

The construction of PPP numbers

- Consider this example. Exchange rate is 1 USD = 30 RUB.
  - ▶ United States: Each year, people buy a new car for 10,000 USD, and spend another 10,000 USD on food. (Total = 20,000 USD)
  - ▶ Russia: People spend 20,000 RUB on cars (each lasts for 15 years) a year, and 40,000 RUB on food (same quantity).

- Thus, consumption per person in Russia is only 10% of U.S. consumption per person.

- If we use **U.S. prices** for both countries and assume people spend all money on food, then consumption per person is 20,000 USD (10,000 USD + 10,000 USD) in the U.S., but 10,700 USD [(1/15) x 10,000 USD)+(1 x 10,000 USD)] in Russia, so Russian consumption per person is **53.5% of U.S. consumption per person**.

- Penn World Tables attempt to construct **PPP estimates**, using a common set of prices across countries.

Measurement issues

	Annual Growth Rate Output per Person (%)	Real Output per Person (2005 dollars)		
	1950–2011	1950	2011	2011/1950
France	2.5	6,499	29,586	4.6
Japan	4.1	2,832	31,867	11.3
United Kingdom	2.0	9,673	32,093	3.3
United States	2.0	12,725	42,244	3.3
Average	2.4	7,933	33,947	4.3

Table 10-1 The Evolution of Output per Person in Four Rich Countries since 1950

Notes: The data stop in 2011, the latest year (at this point) available in the Penn tables.
The average in the last line is a simple unweighted average.

Source: Penn Tables. http://cid.econ.ucdavis.edu/pwt.html

- Small differences in growth rates (4.1% for Japan, versus 2.0% in the US) lead to large differences in output per person growth over 61 years: this is due to the **force of compounding**.
- There has been a **convergence** of output per person across countries.
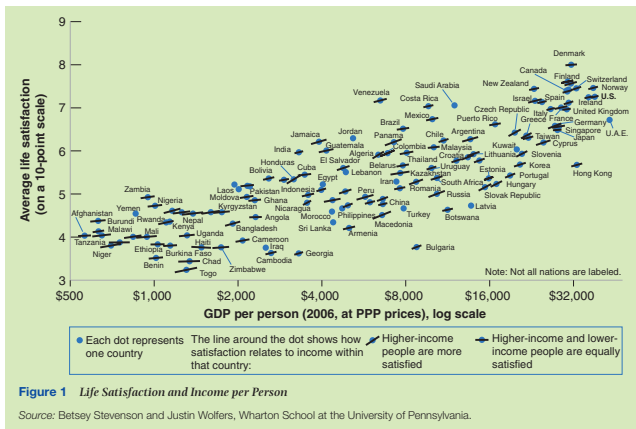
Does money lead to happiness?

Figure 1 *Life Satisfaction and Income per Person*

Source: Betsey Stevenson and Justin Wolfers, Wharton School at the University of Pennsylvania.

- The relationship is not that tight.
- **Easterlin paradox**: Once basic needs are satisfied, higher income per person does not increase happiness, and the level of income relative to others, rather than the absolute level of income, matters.

Convergence in OECD Countries
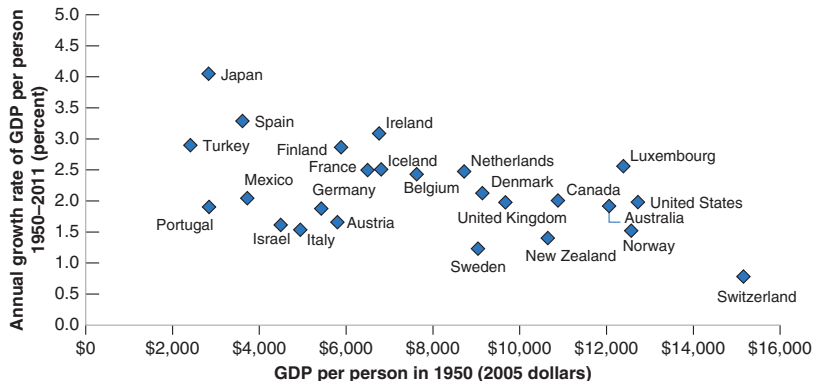
- Convergence again: Countries with lower levels of output per person in 1950 have typically grown faster.

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Measurement issues

- From the end of the Roman Empire to roughly year 1500, Europe was in a **Malthusian trap** or **Malthusian era**:
  - stagnation of output per person.
  - most workers were in agriculture with little technological progress.

- After 1500, growth of output per person turned positive:
  - 1500-1700: around 0.1% per year in Europe.
  - 1700-1820: around 0.2% per year in Europe.
  - Starting with the industrial revolution, growth rates increased. But between 1820 and 1950, U.S. growth was still 1.5% per year.

- High sustained growth has been known only since 1950.

Convergence in 85 Countries

- In a larger panel of 85, countries, there is no clear relation between the growth rate of output since 1960 and the level of output per person in 1960.

Convergence in 85 Countries

- For the OECD countries, there is clear evidence of convergence, just as we saw in a previous scatterplot.

- Convergence is also visible for many Asian countries:
  - **Japan** was the first country to take off in Asia.
  - In the 1960s, four countries (Singapore, Taiwan, Hong Kong, and South Korea) – sometimes called the **four tigers** – started growing as well.

- We see a different picture, however, for African countries:
  - Most African countries were very poor in 1960, and most of them have not done well over the period.
  - Some of them had negative growth of output per person between 1960 and 2011 due in part to internal or external conflicts.
  - Countries with favorable natural resources, such as Botswana and Equatorial Guinea are exceptions.

The Aggregate Production Function

- We introduced an aggregate production function F previously, which was very simple with:

$$Y = F(N) = N$$

- We know introduce capital and write the production function as follows:

$$Y = F(K, N)$$

where Y is output, N is labor, and K **is capital**.

- The function F tells us how much output is produced for given quantities of capital and labor, and should be throught of as a **recipe**. It depends on the state of technology.

The Aggregate Production Function

- Imagine that we double the number of workers and the amount of capital in the economy. What would happen to output? A reasonable answer would be that output is doubled as well. In this case, there are constant returns to scale:

$$2Y = F(2K, 2N)$$

- More generally, for any x, we have that:

$$xY = F(xK, xN)$$

- There are **decreasing returns to capital**. (cf Econ 101) Each new machines is less and less efficient at allowing you to produce more output (capital and labor are complementary)

- There are **decreasing returns to labor**. Similarly, if workers do not have computers, or if a plant building cars does not increase the number of machines, then output will eventually increase less for each additional unit of labor.
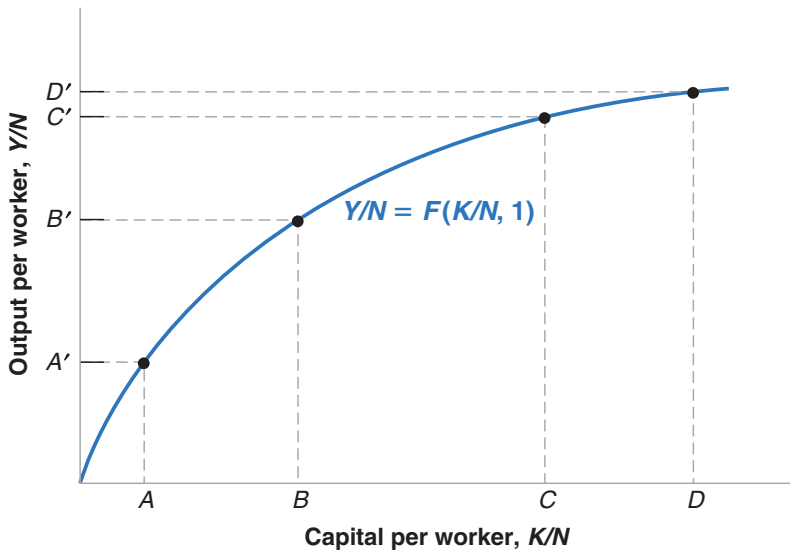
The Aggregate Production Function

- The production function and constant returns to scale imply a simple relation between output per worker (Y/N) and capital per worker (K/N):

$$\frac{Y}{N} = F\left(\frac{K}{N}, \frac{N}{N}\right) = F\left(\frac{K}{N}, 1\right)$$

- Increases in capital per worker lead to movements along the production function.

- In contrast, an improvement in the state of technology leads to a shift in the production function.

- Overall, growth in GDP per capita may come from both:
  - **capital accumulation** (resulting from a higher saving rate)
  - **technological progress.** (resulting from an improvement in the state of technology)

Capital accumulation

Improvement in Technology