MACROECONOMICS FOR DEVELOPING ECONOMIES

Data Exploration: Income Across Countries

Class 2 · Week 1, Wednesday

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Where we left off — and where we go today

YESTERDAY

We asked: why are our countries still "developing"?

We sorted answers into four broad families:

- Technology and human capital
- Trade and openness
- Firms and coordination
- Institutions and the state

TODAY

Before we explain anything, we look at the data.

Two questions:

(a) What does "developing" mean, versus "developed"?

(b) Are more countries becoming "developed" over time?

Understanding Kernel Density plots

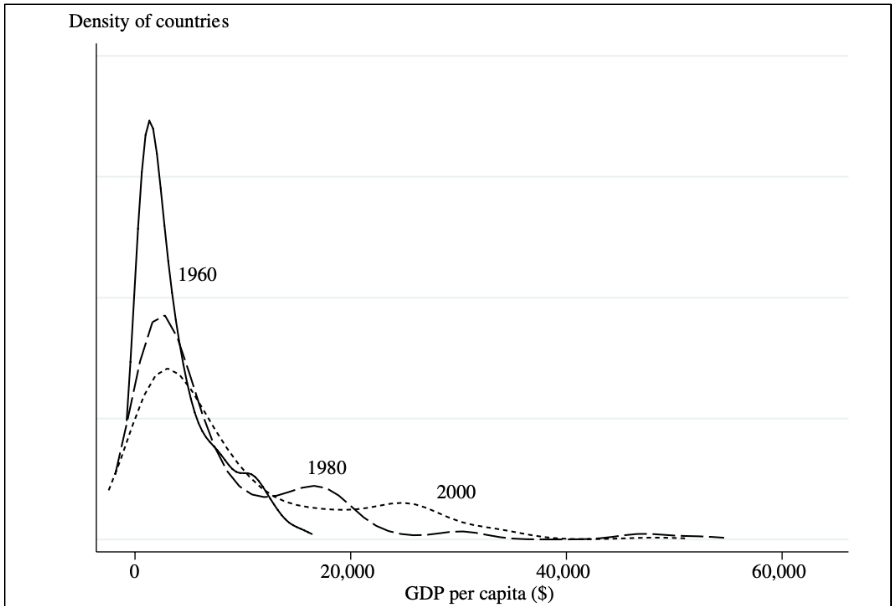


FIGURE 1.1 Estimates of the distribution of countries according to PPP-adjusted GDP per capita in 1960, 1980, and 2000.

What does this figure actually mean? What is on each axis, and what is each curve?

Acemoglu (2009), Introduction to Modern Economic Growth, Figure 1.1.

Start with the raw data

GDP per capita, PPP-adjusted, one row per country. About 180 rows.

Country	GDP per capita (PPP)
Burundi	$800
India	$6,700
Mexico	$19,700
United States	$62,800
⋮	⋮

Illustrative figures, 2019 international dollars.

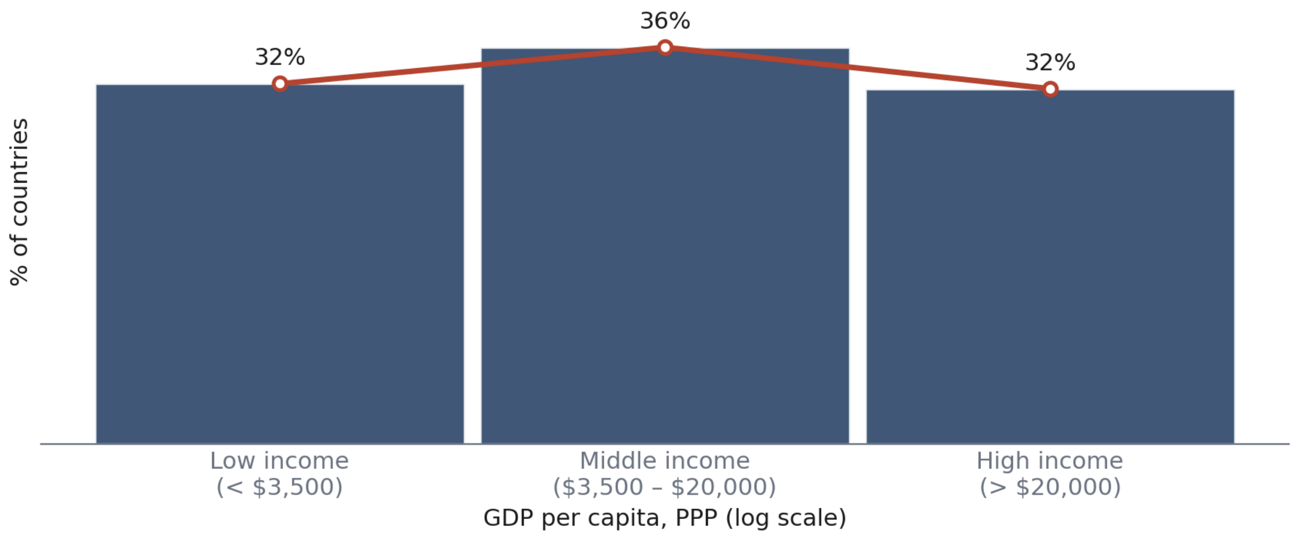
A first, crude summary: sort every country into three buckets.

- **Low income** — below $3,500
- **Middle income** — $3,500 – $20,000
- **High income** — above $20,000

Thresholds are just conventions — the World Bank redraws them every year.

Three buckets

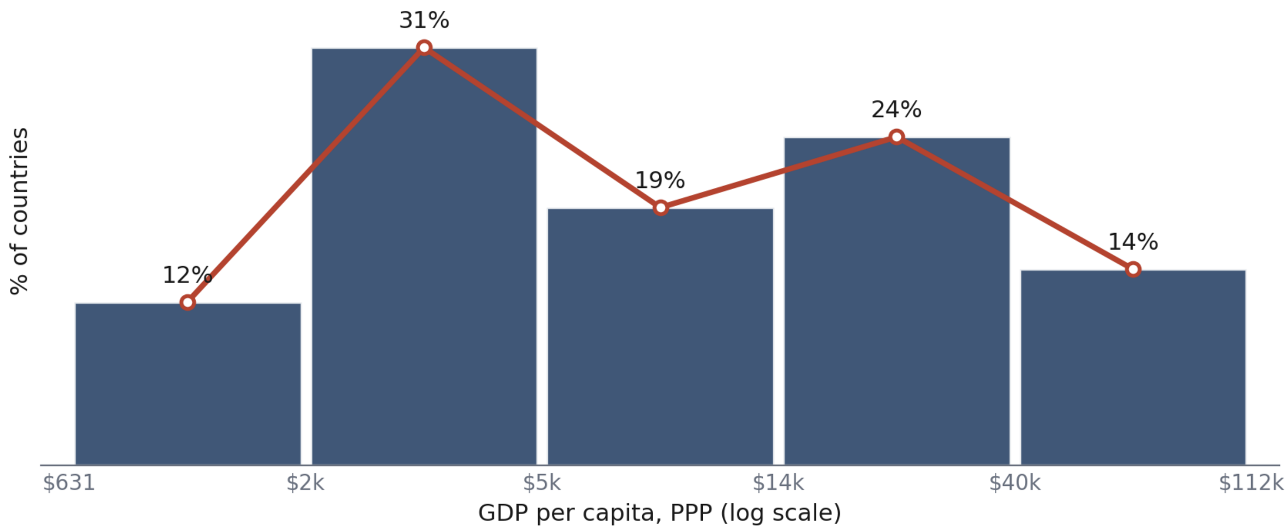
Share of countries in each bucket, with a line traced over the tops.



? **Useful — but three categories put Burundi and Bolivia in the same box. Why not five?**

Five buckets

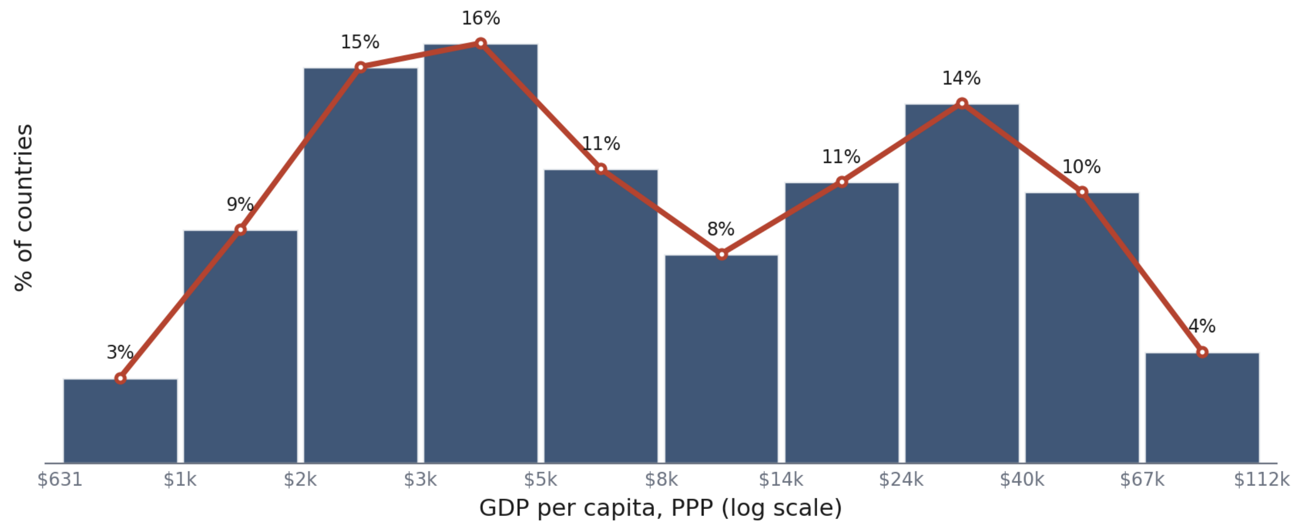
Same countries, same data — only the buckets have changed.



? **Better — a shape is appearing. Why stop here? Why not ten?**

Ten buckets

The traced line is now doing real work: two humps, and a thin middle.



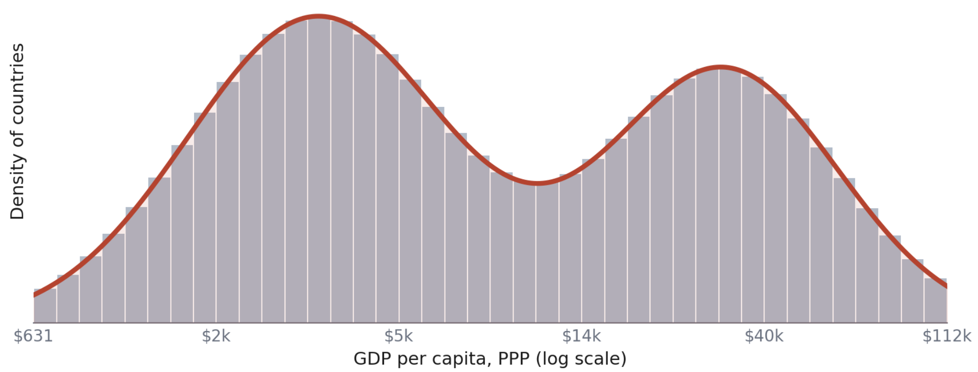
? **As the buckets get narrower, the traced line gets smoother. How many buckets can we have?**

The limit: a kernel density

- Imagine buckets that are **infinitely narrow**.
- And imagine **infinitely many countries**, drawn with the same distribution of income per capita.
- The traced line stops being jagged and becomes a **smooth curve**.

That curve is a kernel density.

The height is no longer a count. The total area under the curve is 1, and the area between any two income levels is the share of countries lying between them.



So: what Figure 1.1 shows

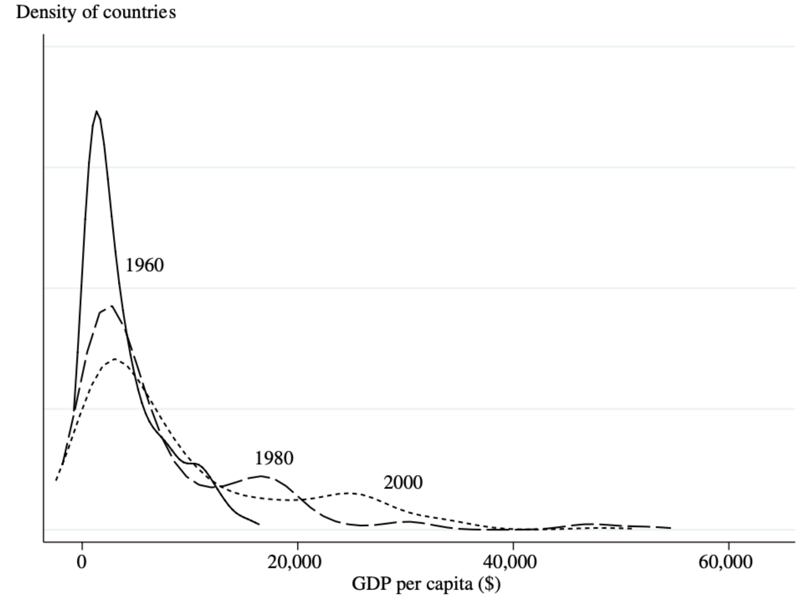


FIGURE 1.1 Estimates of the distribution of countries according to PPP-adjusted GDP per capita in 1960, 1980, and 2000.

Acemoglu (2009), Figure 1.1.

- One curve per year; each curve is the distribution of **countries**, not of people.
- The curve **spreads out** between 1960 and 2000 — the gap between rich and poor countries widens.
- Next week we plot this ourselves and extend it to **2019**, to see what has changed since the textbook was written.

One more note: we measure in PPP terms

Purchasing Power Parity. Why not just use the exchange rate?

A concrete case — one standard haircut.

$1 ≈ 17 MXN

The market exchange rate

$50

A standard haircut in Washington, D.C.

≈ 525 MXN

The same haircut in Mexico City — about $31 at the market rate

? **The haircut is the same haircut. So is a Mexican with 525 pesos really poorer than an American with $50?**

What PPP actually does

- Take a **standard basket** of goods and services — food, rent, transport, a haircut.
- Price that same basket in **each country, in local currency**.
- The ratio of the two prices is the **PPP conversion rate**. It is a price index, not a market rate.

10.5

Implied PPP rate: pesos per international dollar
(against a market rate of about 17)

What follows from 10.5 < 17

- A peso buys **more inside Mexico** than the same peso converted to dollars buys in the United States.
- So Mexicans are **richer than the market-rate figure implies** — by roughly $17/10.5 \approx 1.6$ times.

Underlying data: International Comparison Program (World Bank) — the source behind PPP-adjusted GDP in the Penn World Table.

Plotting in logs

Why take the logarithm of income per capita?

- It is more natural to look at the log of a variable that **grows over time**, when growth is approximately proportional.
- If $x(t)$ grows at a **constant proportional rate**, then $\log x(t)$ grows **linearly** — a straight line on the page.

Same proportional growth

$\log x_1(t) - \log x_2(t)$ stays constant

The proportional gap — “twice as rich” — is preserved.

But in levels

$x_1(t) - x_2(t)$ keeps growing

The absolute gap widens even when nothing has changed relatively.

A practical bonus: a difference in logs of 0.1 is about a 10% difference in income — you can understand gaps more intuitively.

Argument follows Acemoglu (2009), §1.1.

The distribution in logs

Unweighted: every country counts once, China the same as Uruguay.

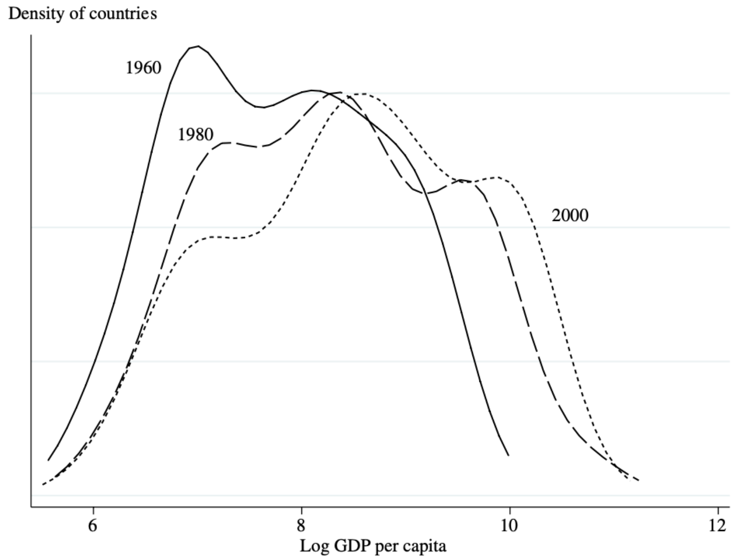


FIGURE 1.2 Estimates of the distribution of countries according to log GDP per capita (PPP adjusted) in 1960, 1980, and 2000.

? **Between 1960 and 2000, did inequality between countries rise or fall?**

Acemoglu (2009), Figure 1.2.

The same picture, weighted by population

Now every person counts once, instead of every country.

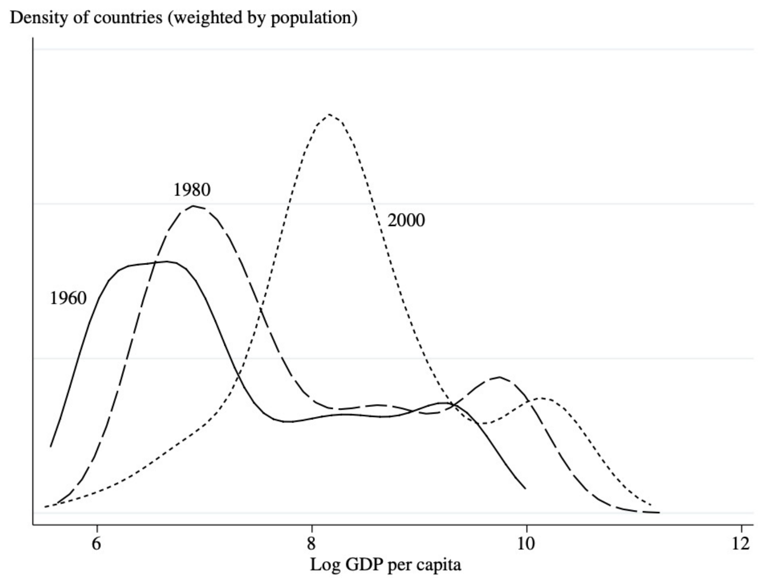


FIGURE 1.3 Estimates of the population-weighted distribution of countries according to log GDP per capita (PPP adjusted) in 1960, 1980, and 2000.

? **Given the last slide, has income inequality among people risen or fallen?**

Acemoglu (2009), Figure 1.3.

Per capita, or per worker?

- **GDP per capita** divides by everyone. It is the right measure for **welfare** — for how well off people are.
- **GDP per worker** divides by the economically active population. It is the right measure for **productivity** — for how much output a person at work produces.
- They differ where participation, age structure or unemployment differ.

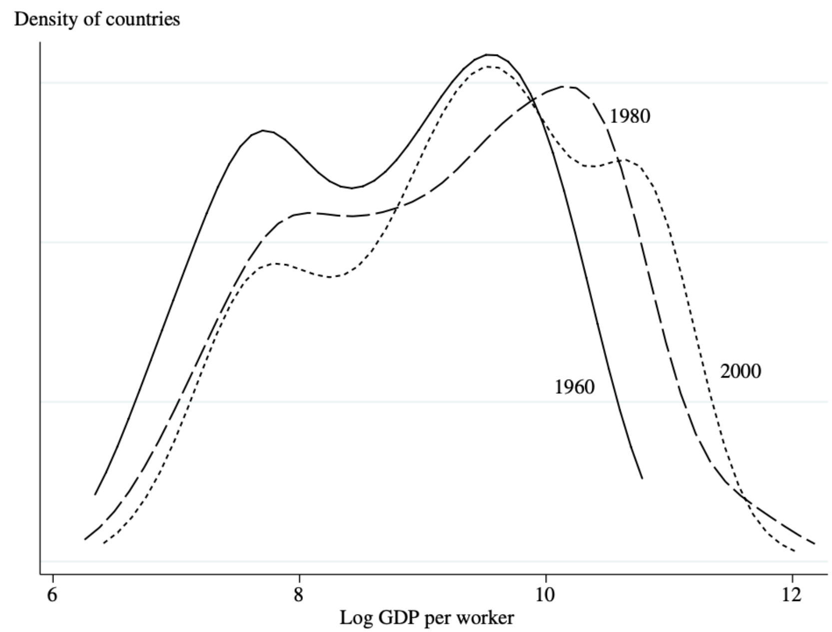


FIGURE 1.4 Estimates of the distribution of countries according to log GDP per worker (PPP adjusted) in 1960, 1980, and 2000.

Acemoglu (2009), Figure 1.4. "Workers" = economically active population, ILO definition.

PART II

Why do we care about these numbers at all?

Does being richer mean being better off?

There is data and research on happiness — and I would not claim that richer countries are happier.

But people in richer countries are better off in two respects that are hard to argue with.

1 They consume more

More food, housing, transport, medicine, schooling — more of the things people buy.

2 They live longer

Life expectancy at birth runs from the low 40s to about 80 across the income range.

First: they consume more

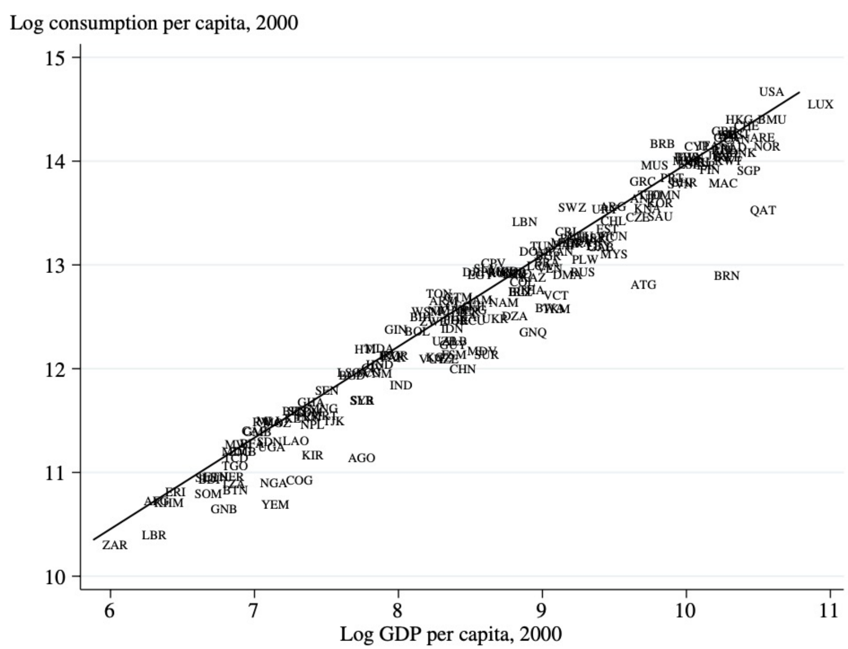


FIGURE 1.5 The association between income per capita and consumption per capita in 2000. For a definition of the abbreviations used in this and similar figures in the book, see http://unstats.un.org/unsd/methods/m49/m49alpha.htm.

Acemoglu (2009), Figure 1.5.

? **The points lie almost on a line. Is it actually telling us anything?**

Second: they live longer

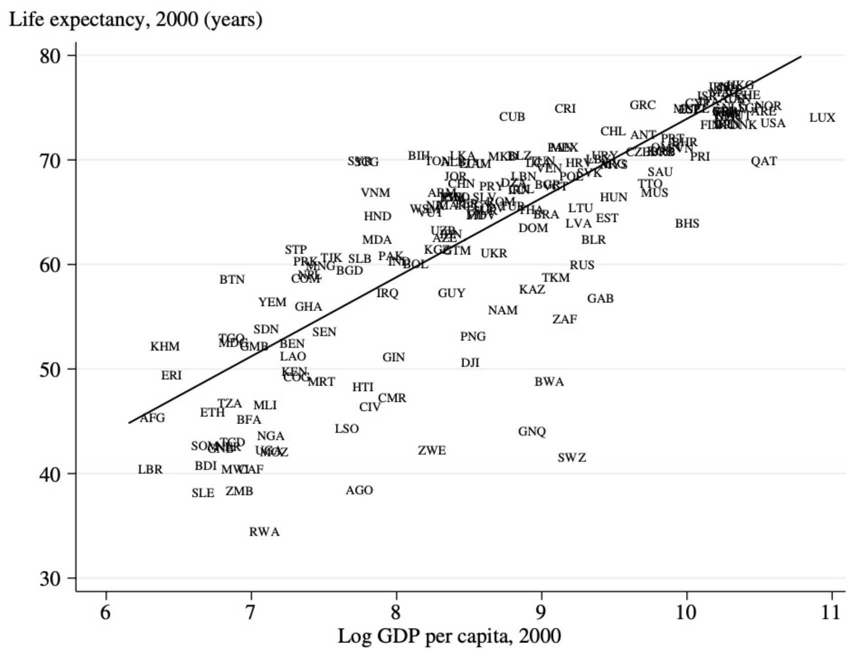


FIGURE 1.6 The association between income per capita and life expectancy at birth in 2000.

Why should income and life expectancy be related at all? And which way does the causation run?

Acemoglu (2009), Figure 1.6.

PART III

Economic growth and income differences

How can one country be 30 times richer than another?

The answer is in the growth rate, and the power of compounding.

Two countries, A and B, with the same income per capita today.

Country A

0%

growth per capita, every year

Country B

2%

growth per capita, every year

After 200 years

52×

B is more than 52 times richer than A

Nothing dramatic ever happens in country B. Two per cent a year is invisible in any single year — and huge over a lifetime.

So how different are growth rates?

Densities of growth rates, not of income levels — note what has changed on the axes.

“1960” is the geometric average growth rate 1950–1969;
“1980” is 1970–1989;
“2000” is 1990–2000.

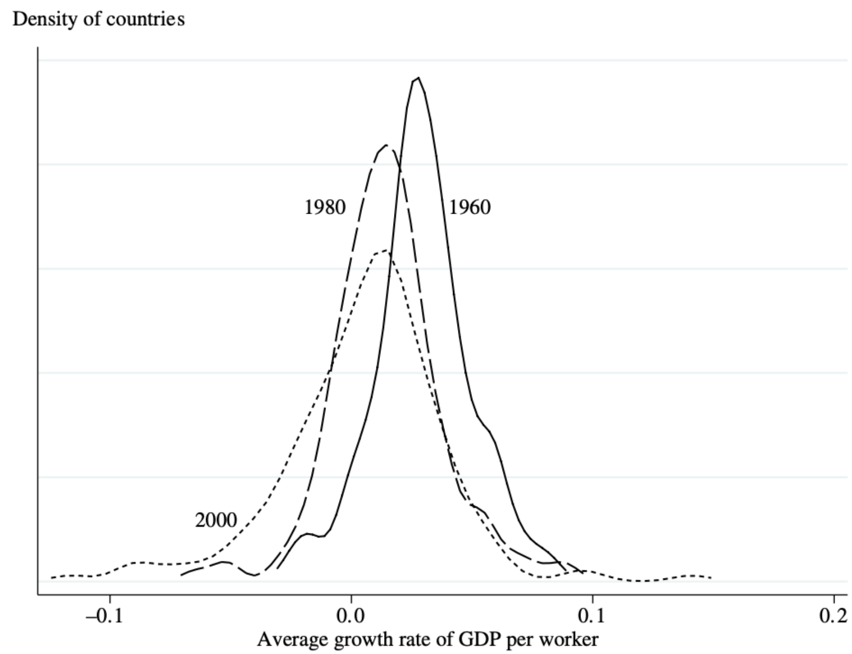


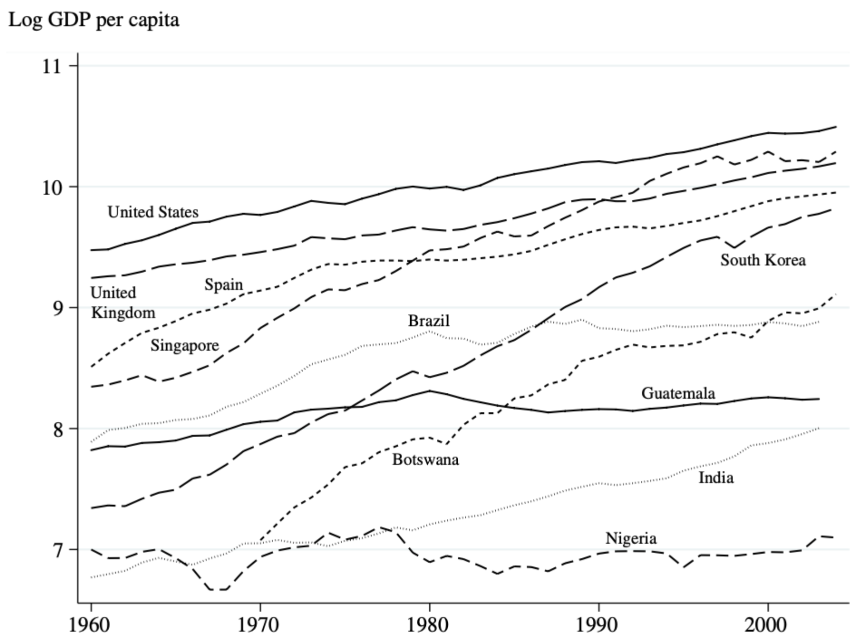
FIGURE 1.7 Estimates of the distribution of countries according to the growth rate of GDP per worker (PPP adjusted) in 1960, 1980, and 2000.

Acemoglu (2009), Figure 1.7.

? **How do you read this? What does the spread of each curve tell you, as against its centre?**

The same thing, country by country

Ten countries, 1960–2000, log income per capita.



Acemoglu (2009), Figure 1.8.

FIGURE 1.8 The evolution of income per capita in the United States, the United Kingdom, Spain, Singapore, Brazil, Guatemala, South Korea, Botswana, Nigeria, and India, 1960–2000.

- Singapore and South Korea start poor and end rich. Botswana, the “African success story”, does the same from further behind.
- Nigeria ends the period roughly where it began. Brazil and Guatemala stall through the 1980s.

PART IV

Convergence: unconditional and conditional

Convergence

Do poorer economies close the gap with richer ones?

UNCONDITIONAL CONVERGENCE

Poorer economies grow faster than richer ones — full stop, with no qualifications.

The gap closes on its own. Being poor is, by itself, an advantage.

CONDITIONAL CONVERGENCE

Poorer economies grow faster only once we control for structural differences.

Savings, human capital, institutions, population growth — countries converge to their own steady state, not to a common one.

? **Which of these do you believe, and why? Notice that the second is a weaker claim — and that the first, if true, would be very good news.**

Unconditional convergence — the whole world

Growth 1960–2000 against the starting point in 1960.

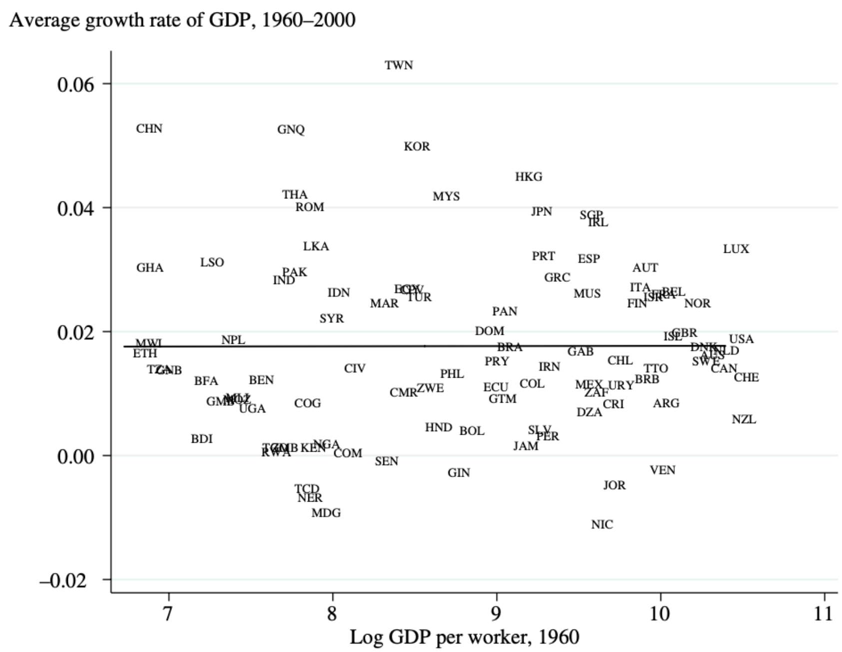


FIGURE 1.13 Annual growth rate of GDP per worker between 1960 and 2000 versus log GDP per worker in 1960 for the entire world.

Acemoglu (2009), Figure 1.13.

? **If poorer countries grew faster, this cloud would slope downwards. Does it?**

How do we test conditional convergence?

A typical Barro growth regression.

$$g_{\mathrm{i,t,t-1}} = \alpha \, log \, y_{\mathrm{i,t-1}} + X^{\mathrm{T}}_{\mathrm{i,t-1}} \beta + \varepsilon_{\mathrm{i,t}} \tag{1.1}$$

$g_{i,t,t-1}$	the annual growth rate in country i between dates t−1 and t
$y_{i,t-1}$	output per worker (or income per capita) at the start of the period
$X_{i,t-1}$	a vector of other controls — savings, schooling, population growth, institutions
β	the coefficients on those controls
$\epsilon_{i,t}$	an error term: everything omitted

Notice that if you drop the vector X entirely and this equation is a test of unconditional convergence.
The two ideas are the same regression with different controls.

Acemoglu (2009), equation (1.1).

The coefficient we care about is α

$\alpha < 0$

A country that starts poorer grows faster — the gap closes. This is what convergence means, in one sign.

-0.02

Barro's estimate, once controls are included: about 2% of the gap closed per year — roughly a 35-year half-life.

Two per cent a year is slow.

A country at a tenth of US income, converging at 2% a year with no other change, needs about a century to reach half. Conditional convergence is not a promise that the problem solves itself.

We run this regression ourselves next class.

Now look only at similar countries

The same axes as Figure 1.13, restricted to the core OECD.

Acemoglu (2009), Figure 1.14. "Core OECD" =

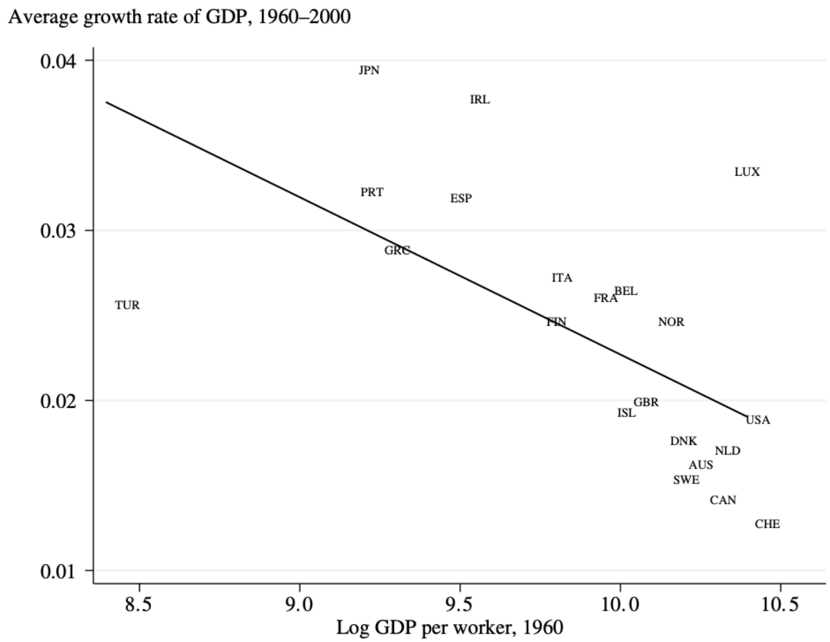


FIGURE 1.14 Annual growth rate of GDP per worker between 1960 and 2000 versus log GDP per worker in 1960 for core OECD countries.

? **Does this support the idea that poorer countries grow faster — once everything else is held equal?**

PART V

Correlates, and causes

From causes to correlates — and back

- Yesterday we were discussing **why** our countries are still developing. Those were claims about **causes**.
- Causes are hard to establish. **Correlates** are easy — and they are where every empirical literature begins.
- So: which observable characteristics of a country move together with its growth rate?

The trap, stated in advance

A correlate is not a lever. A variable can move with growth because it causes growth, because growth causes it, or because a third thing causes both. Almost every policy mistake in development has this shape.

Two correlates you raised yesterday

Investment and schooling, against growth 1960–2000.

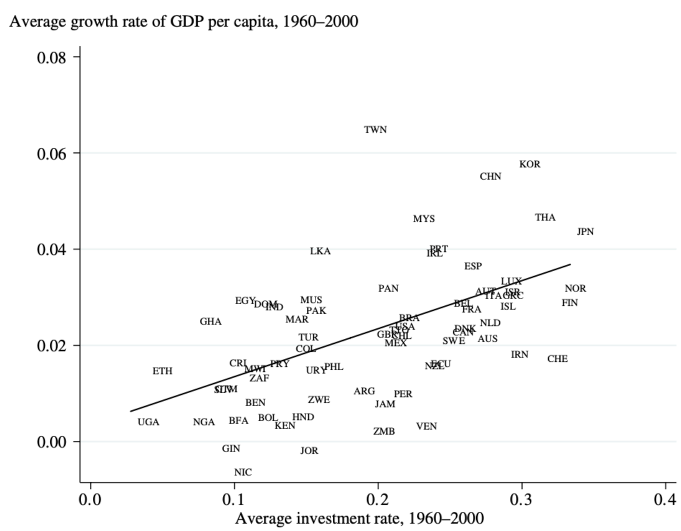


FIGURE 1.15 The relationship between average growth of GDP per capita and average growth of investments to GDP ratio, 1960–2000.

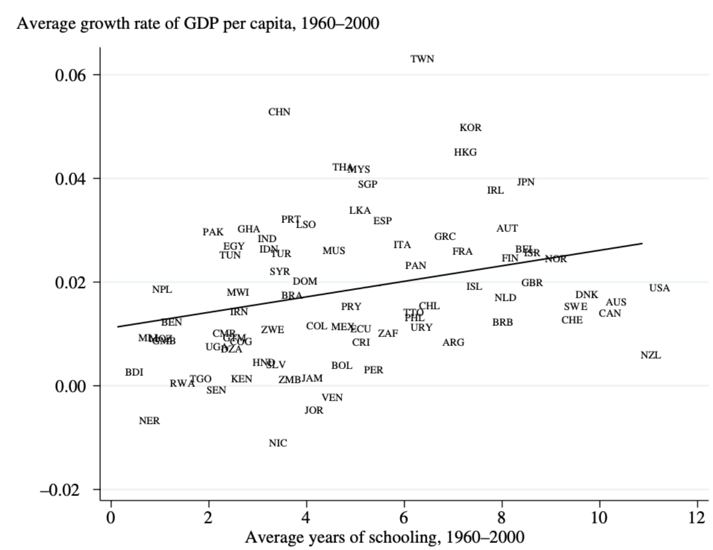


FIGURE 1.16 The relationship between average growth of GDP per capita and average years of schooling, 1960–2000.

Both associations are positive, and both are strong.

? **Which way is the causality running? Do countries grow because they invest and educate — or invest and educate because they grow?**

If it were this easy, everyone would have done it

How did South Korea and Singapore manage to grow, while Nigeria failed to take advantage of its growth opportunities?

If physical capital accumulation is so important, why did Nigeria not invest more in physical capital? If education is so important, why are education levels in Nigeria still so low — and why is the human capital that exists not used more effectively?

Investment and schooling are real policy levers. But they are also choices — and a theory of growth has to explain why different societies make different choices.

Argument and wording after Acemoglu (2009), §1.7.

Which points us at the fundamental causes

The factors behind why societies make different technology and accumulation choices.

Geography

Climate, disease burden, soils, distance from markets. Uncomfortable, contested, and unavoidable in the literature.

Institutions

Property rights, contract enforcement, state capacity, the rules of the game and who writes them.

Culture

Beliefs, norms and preferences — the hardest of the three to measure and the easiest to abuse.

These are the subject of Week 14 — and they are the reason this course does not end with a savings rate.

Three questions to take away

Everything in this course is an attempt at one of these.

1. Why are there such large differences in income per capita and worker productivity across countries?

2. Why do some countries grow rapidly while others stagnate?

3. How do we kick-start growth in stagnating economies?

Next class: we build these figures ourselves, in code, and carry them forward to 2019.