The Wealth of Nations: Growth and Inequality

An introduction to economic growth

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ECON 1102/7074

File: 03growth_intro.tex
Read: HGLO Ch.4 and Ch.5 (pp.110-119)

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Outline of Talk

Objectives: The Long Run

- This week we learn:
  - Some facts related to economic growth that later chapters will seek to explain.
  - How economic growth has dramatically improved welfare around the world.
  - Growth as a recent phenomenon.
  - Some tools used to study economic growth, including how to calculate growth rates.

Motivation

Why do some nations grow and become wealthier? ...

Motivation

... Meanwhile, some others lag behind and remain in poverty?

Motivation

What is this country?

- Life expectancy at birth: < 50 years
- Infant mortality: 10%
- Percentage of households without electricity, refrigerator, telephone, car: 90%
- Percentage of adults with high school diplomas: $< 10\%$
- Some countries have seen rapid economic growth and improvements to health quality, but many others have not.

Motivation

What is this country?

A. Kenya

B. The United States of America (in some recent history)

C. All of the above

Motivation

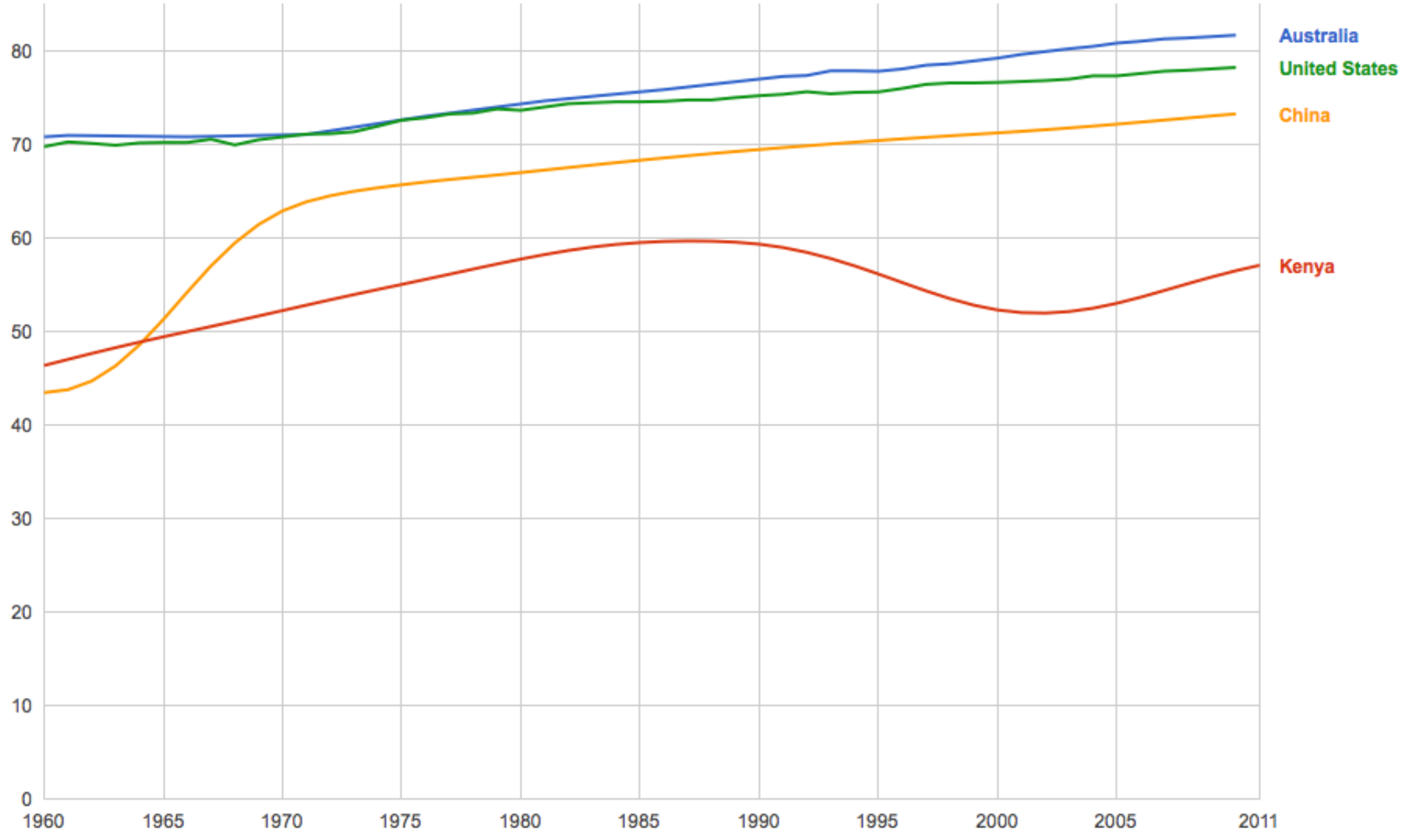
Fact

Some countries have seen rapid economic growth in terms of per capita income ...

... improvements to health quality, and other indicators of quality of life ...

but many others have not.

Motivation: some development indicators



Life expectancy at birth.

Source: World Bank Development Indicators; Google Public Data

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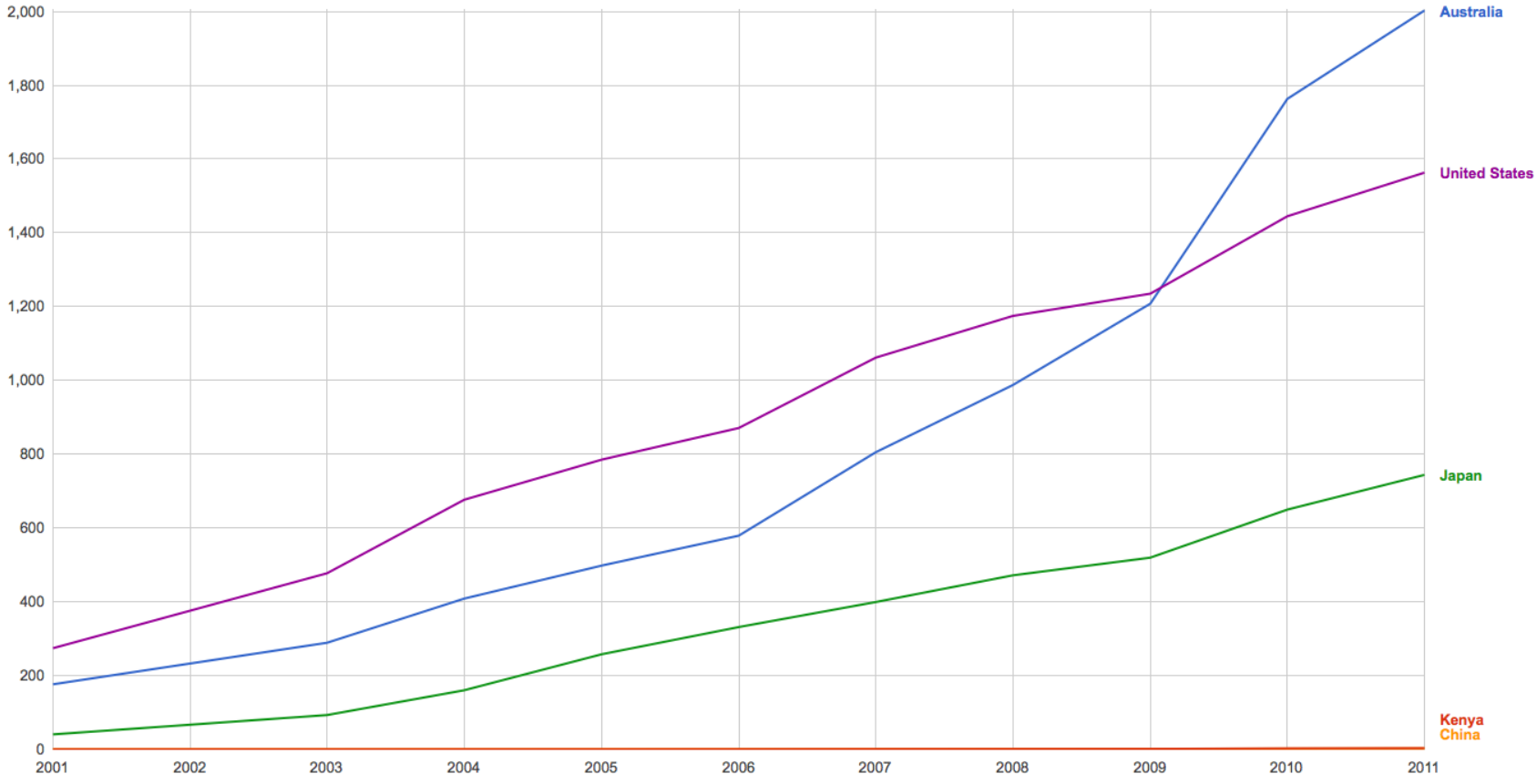
Motivation: some development indicators



Secure internet servers (per 1 million people).

Source: World Bank Development Indicators; Google Public Data

Living Standard: a development measure

For starters (this course), let's focus on this measure:

Living Standard $\equiv$ Per capita (real) GDP

Living Standard: a development measure

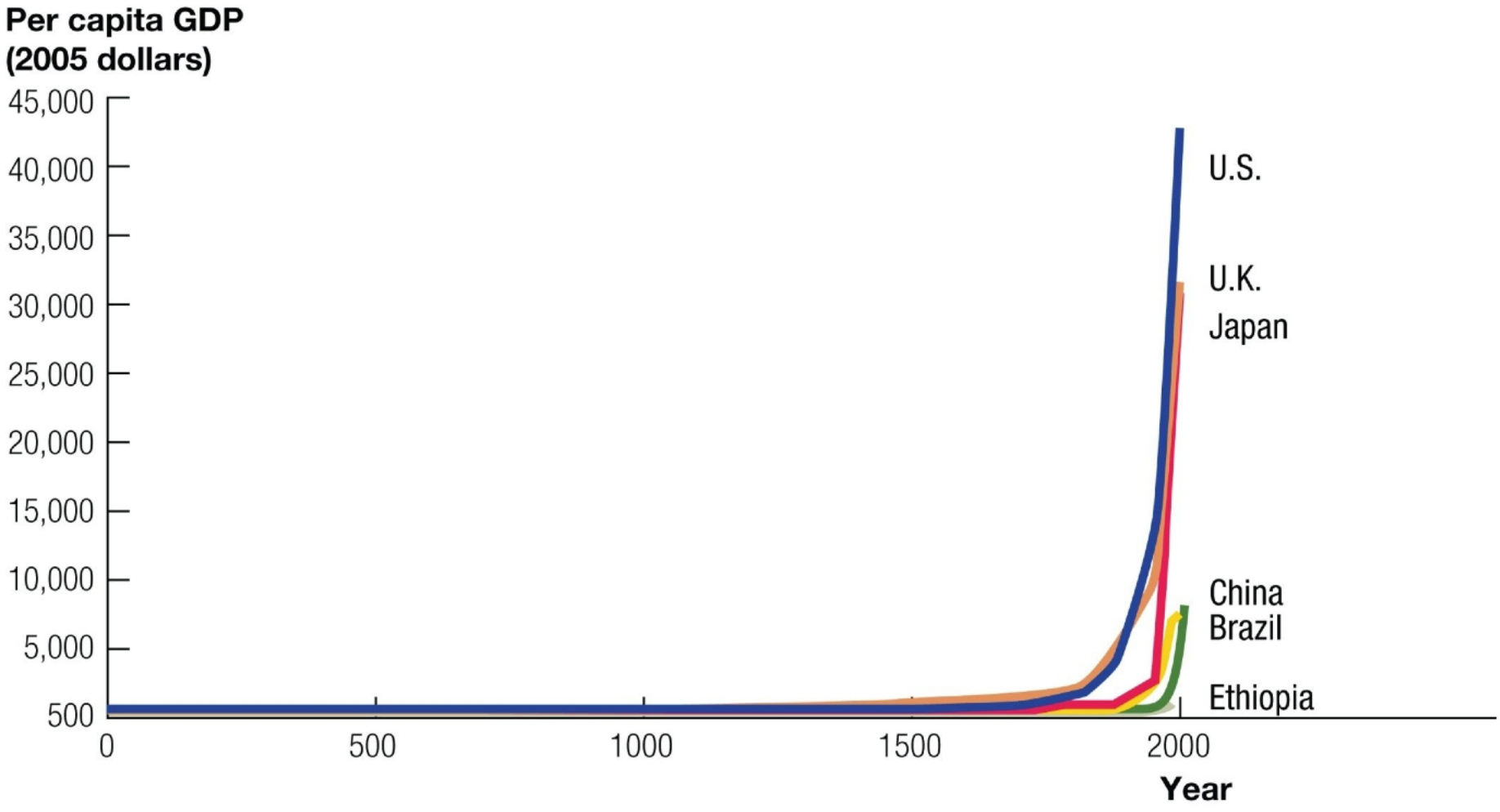
Facts about "living standard":

- Sustained increases:
  - a recent phenomenon: last 2-3 centuries
    - ⋆ a.k.a. "Modern Economic Growth"
  - emerges in different places at different times.

Living Standard: a development measure

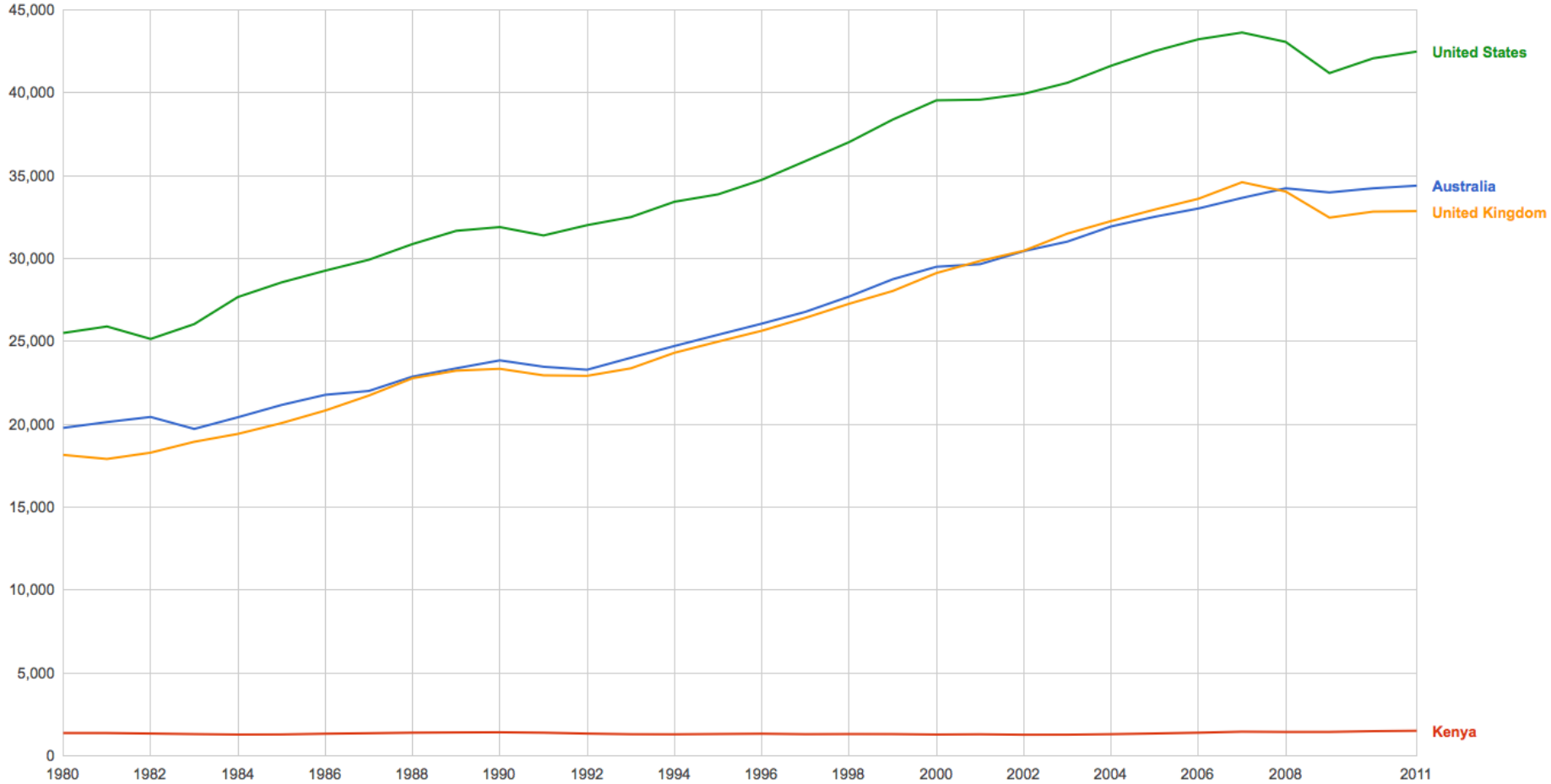
(Continued) Facts about "living standard":

- Per capita GDP differ remarkably around the world.
  - "The Great Divergence": era of increased difference in living standards across countries.
  - Pre-1700, nations differed only by a factor of two or three; ...
  - Today it is over a factor of 50 for several countries.



Living standard over the very long run: six countries.

Source: Angus Maddison dataset.



GDP per capita (2005, PPP adjusted dollars): recent history for four countries.

Source: World Bank Development Indicators; Google Public Data

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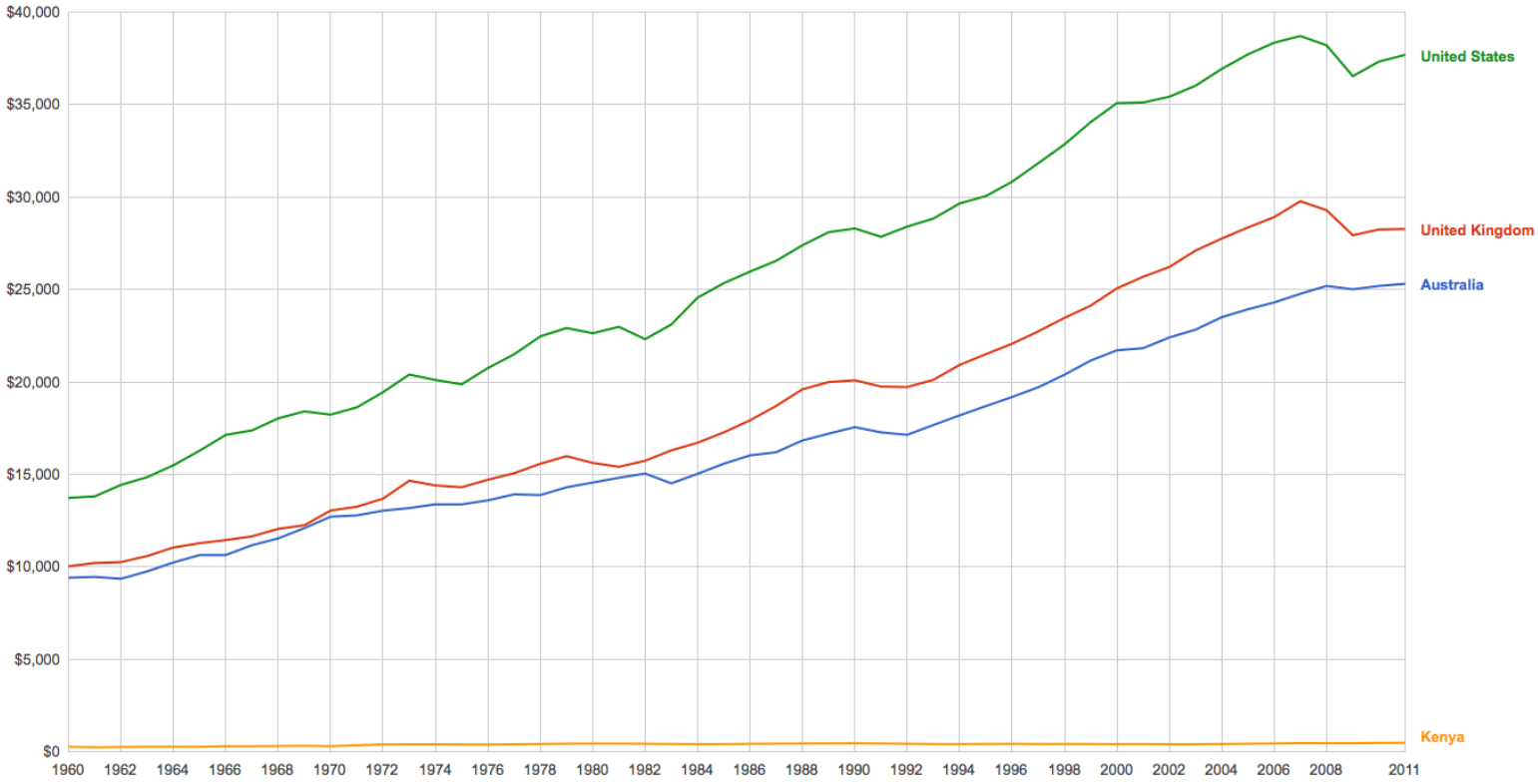
"Modern" Economic Growth

Defined by:

- Timeline: from 1870 to 2000.
- For example, United States per capita GDP rose nearly 15-fold.
- Implication: A typical American college student today will earn a lifetime income about twice his or her parents.
- Consider Australia (next slide):
  - Within a span of 30 years ...
  - The **real** income per person in 2011 is almost 1.7 times that of 1981.
- What about say, Kenya, in comparison?

Recent "Modern" Economic Growth



Modern economic growth: Australian history

Source: World Bank Development Indicators; Google Public Data

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Defining Economic Growth

We have used the phrase **Economic Growth** a few times.

What do we really mean by it?

Defining Economic Growth

Growth of per capita GDP, y:

- A percentage change in y.
- Percentage change in y between period t and and $t+1$:

$$g_t := \frac{y_{t+1} - y_t}{y_t}.$$

- *In words*: The change in value/level of y (between two periods), divided by value of y in the initial period.

Defining Economic Growth

Growth of per capita GDP, y:

- Equivalently, we get:

$$g_t := \frac{y_{t+1}}{y_t} - 1.$$

- Equivalently, we have the relation between y_t and y_{t+1} as

$$y_{t+1} = (1 + g_t)y_t.$$

Constant Growth

Constant growth special case

Suppose a variable x grows at a constant rate of $g_t = n$, for all $t = 0, 1, 2, ...$ Applying the one-period growth from $t = 0$ to $t = 1$:

$$x_1 = (1 + n)x_0.$$

Since we know n constant, then from $t = 1$ to $t = 2$:

$$x_2 = (1 + n)x_1 = (1 + n) \times (1 + n)x_0 = (1 + n)^2 x_0.$$

See a pattern? By induction, we can derive for all $t \geq 0$,

$$x_t = (1 + n)^t x_0.$$

Constant Growth

Example

From data, human population L over time can be approximately modelled by a recursive, constant growth rate (n) rule:

$$L_{t+1} = (1+n)L_t,$$

for $t \geq 0$.

Or, as before, we can write for all $t \geq 0$,

$$L_t = (1+n)^t L_0.$$

Ratio Scale

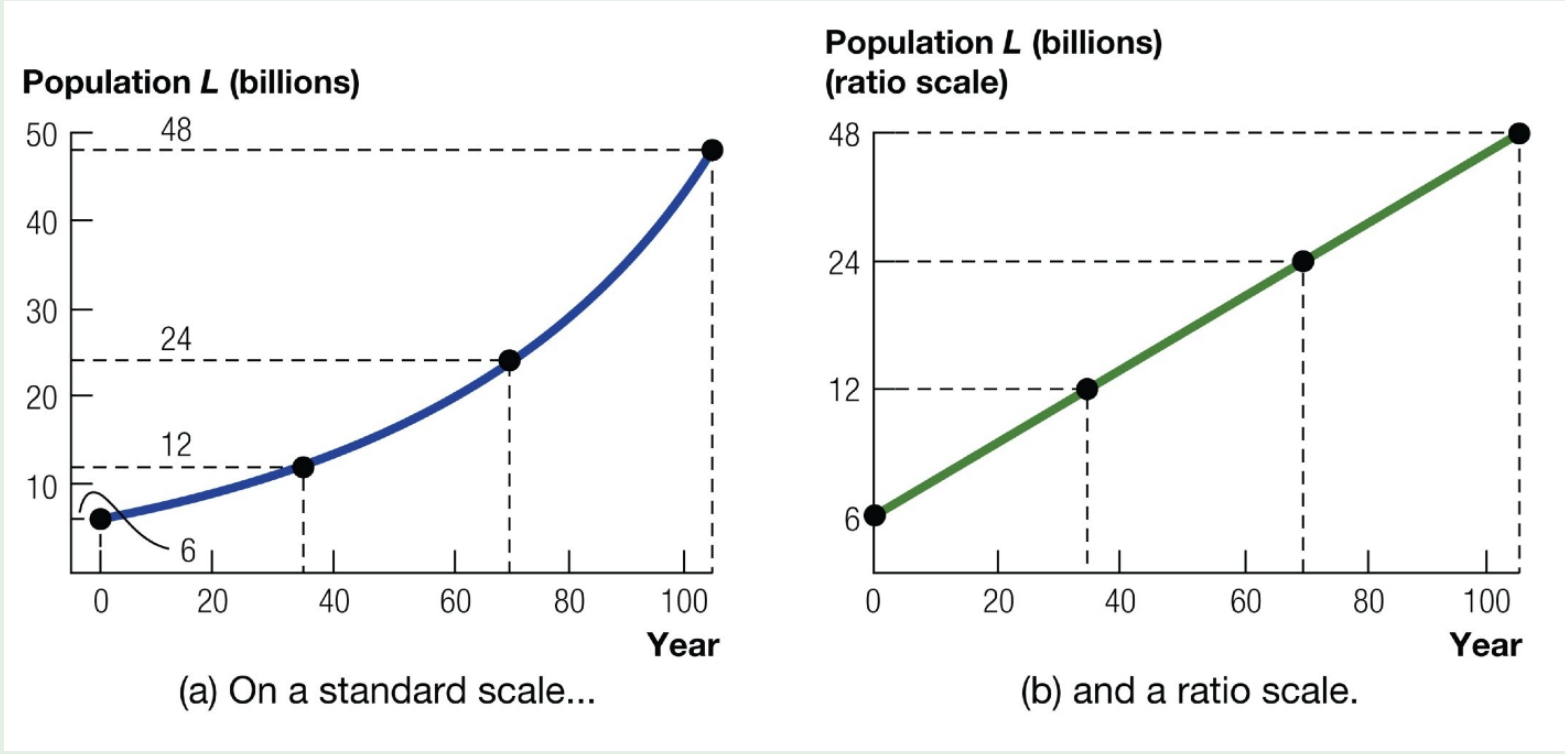
The Ratio Scale Plot:

- a plot where equally spaced tick marks on the vertical axis are labeled consecutively with numbers that exhibit a constant ratio
  - i.e., a ratio of 2 indicates that each tick mark doubles from the previous
- When plotted on a ratio scale, a variable that grows at a constant rate will be a straight line.

Ratio Scale

Example

Consider the constant population growth model again.



(a) On a standard scale...

(b) and a ratio scale.

Ratio Scale

Why is using the ratio scale informative?

- Suppose I observe GDP data for the country Fantasia up until today, $t = 0$.
- I'd like to project ahead Fantasia's prospect for the future, data I don't see yet!
- My economic advisers suggest to project ahead with a constant growth rate $g = 0.03$, or 3% per period.
- The President of Fantasia wants to know: *How long does it take for Fantasia's GDP, Y, to double from $t = 0$?*

Ratio Scale

We assume constant growth rate rule,

$$Y_t = (1+g)^t Y_{0.}$$

Given g, if $Y_t = 2 \times Y_0$, then

$$2Y_0 = (1+g)^t Y_0$$

and this implies

$$2 = (1+g)^t.$$

Remark:

- We have one equation, and one unknown, t.
- What is t?
  - the period at which Fantasia's income would have double from y_0.

Ratio Scale: Rule of 70

As a rule of thumb:

- If Y_t grows at constant rate $g \times 100$ percent per period, ...
- ... then the number of periods it takes for it to double is

$$\frac{70}{g \times 100}.$$

- This handy approximation rule is known as the **Rule of 70**.

Ratio Scale: Rule of 70

Example

If $g = 0.02$ every year, then Fantasia's GDP would have doubled every

$$\frac{70}{0.02 \times 100} = 35$$

years.

If $g = 0.03$ every year, then Fantasia's GDP would have doubled every

$$\frac{70}{0.03 \times 100} \approx 23$$

years.

Ratio Scale: Rule of 70

Where does this **Rule of 70** come from? We worked out

$$2 = (1+g)^t.$$

Taking natural logarithms on both sides

$$\ln(2) = \ln((1+g)^t) = \ln(1+g) \times t.$$

Since $\ln(2) \approx 0.7$ and $\ln(1+g) \approx g$ (for small g), then:

$$t \approx \frac{0.7}{g} = \frac{70}{g \times 100}.$$

Ratio Scale: Data Viewing

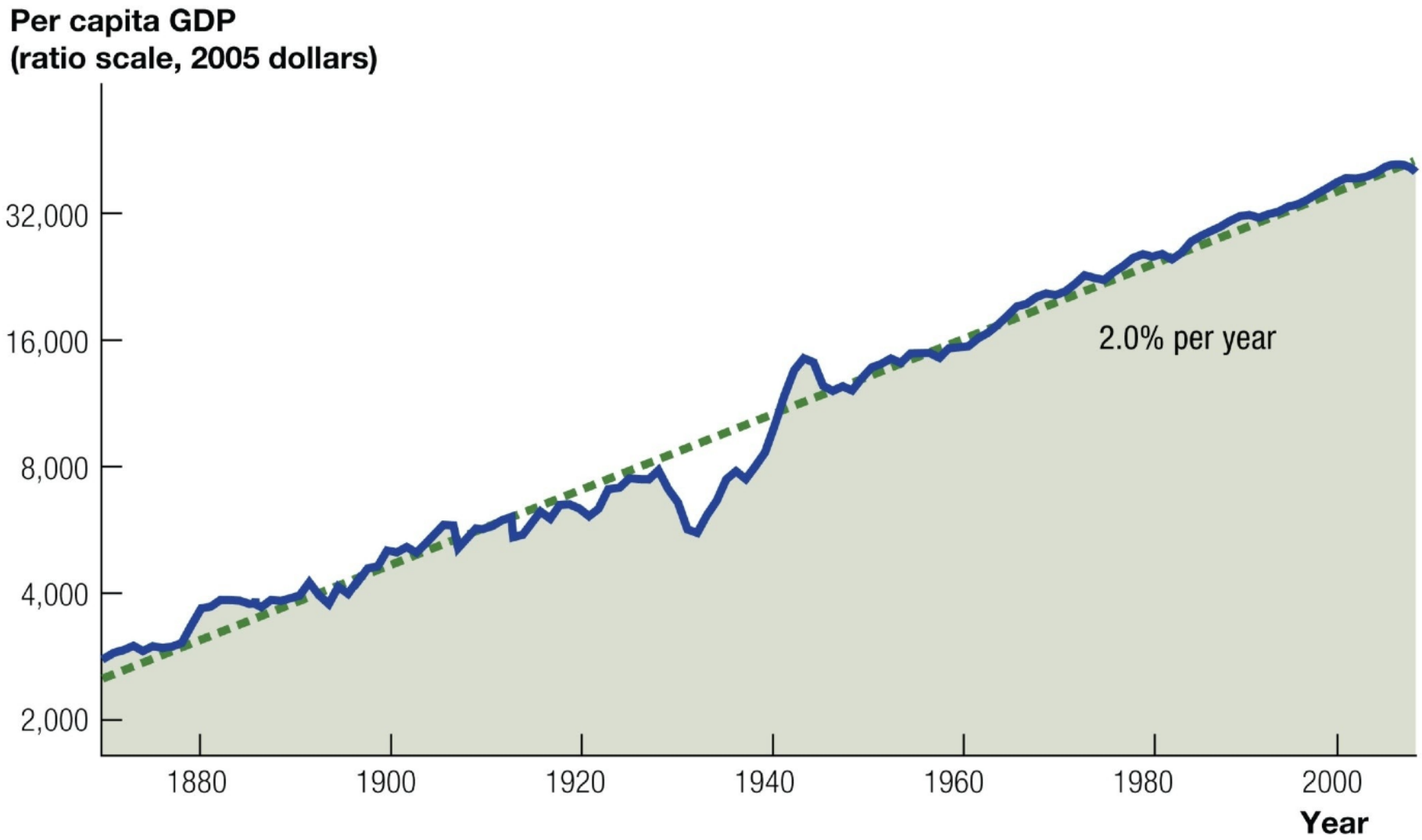
- If a variable is growing at a constant rate, it will be a straight line on a ratio scale.
- If growth rates are rising, the slope will be increasing.

Example

Per capita GDP in the United States has grown at approximately 2 percent per year over the last 130 years.

Easy to see with a ratio scale. ...

... Approximately linear.



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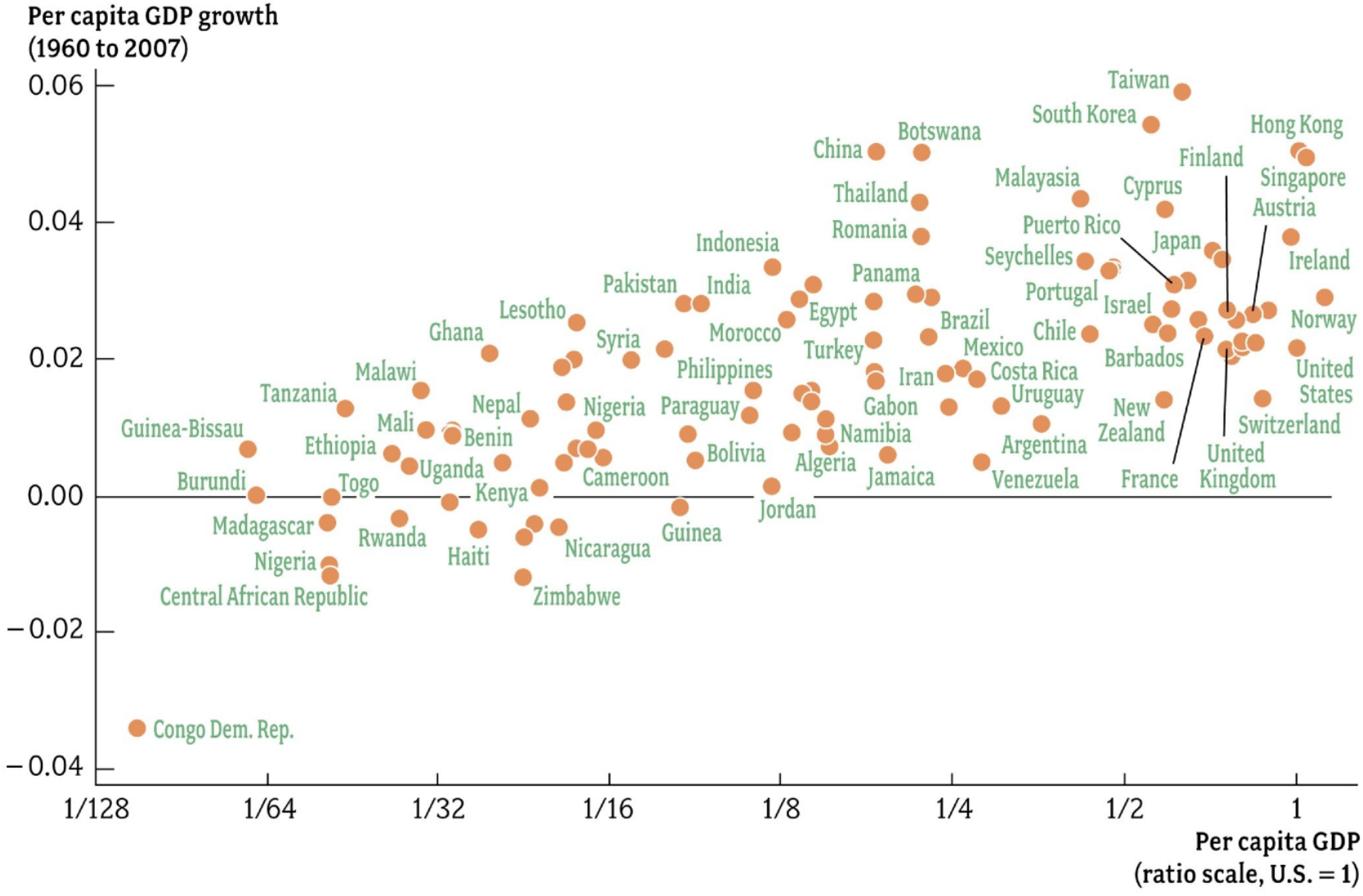
Modern Growth around the World

- Post WWII, growth in Germany and Japan accelerated.
- Convergence–Poorer countries will grow faster to "catch up" to the level of income in richer countries.
- Brazil had accelerated growth until 1980 and then stagnated.
- China and India have had the reverse pattern.

Modern Growth around the World

- Over the period 1960–2007
  - Some countries have exhibited a negative growth rate.
  - Other countries have sustained nearly 6 percent growth.
  - Most countries have sustained about 2 percent growth.
  - Small differences in growth rates result in large differences in standards of living.



Small differences in growth rates; large differences in living standards.

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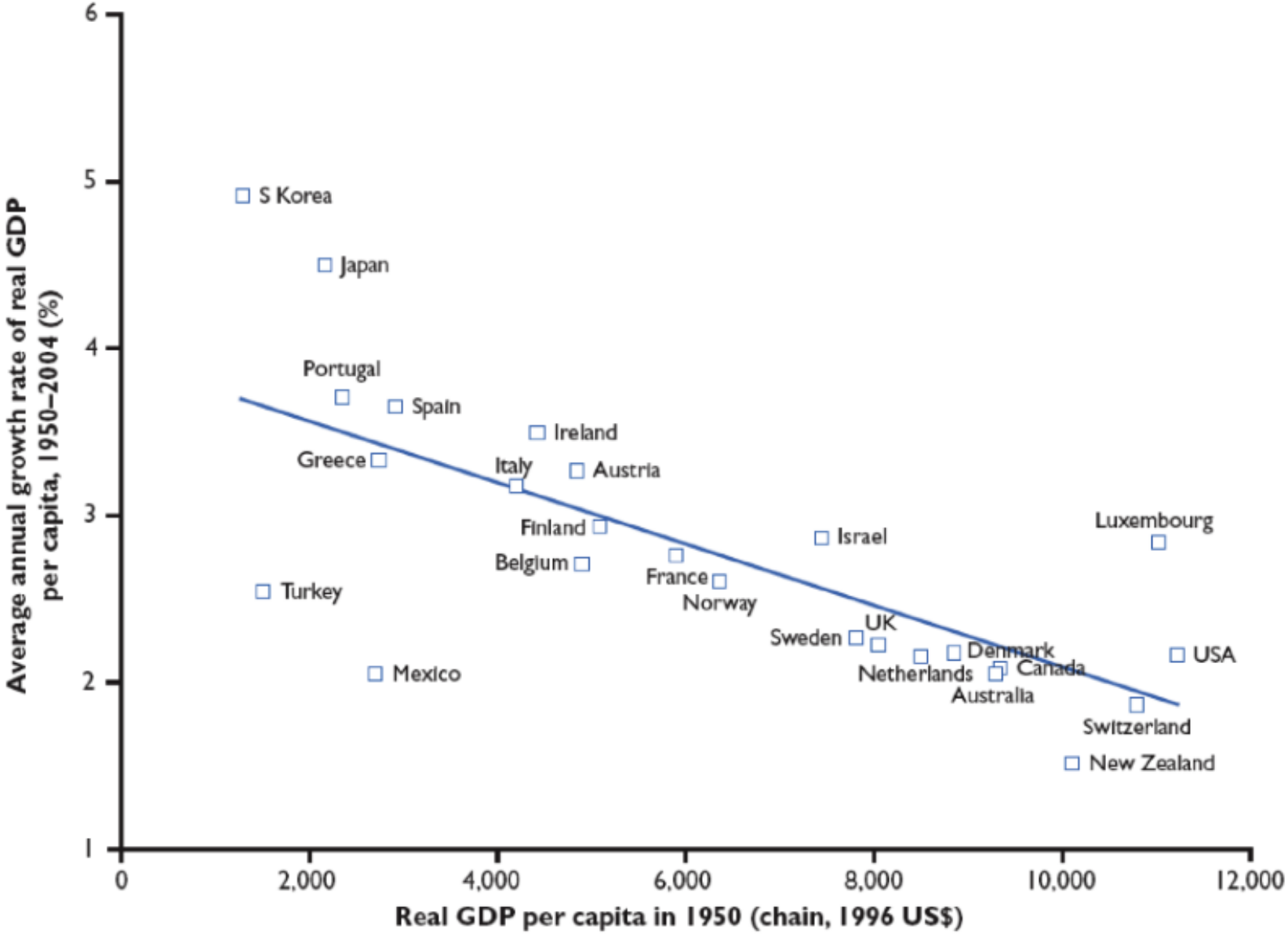
Modern Growth around the World

Convergence Fact 1

There is convergence or "catching up" among the richer nations (OECD members).



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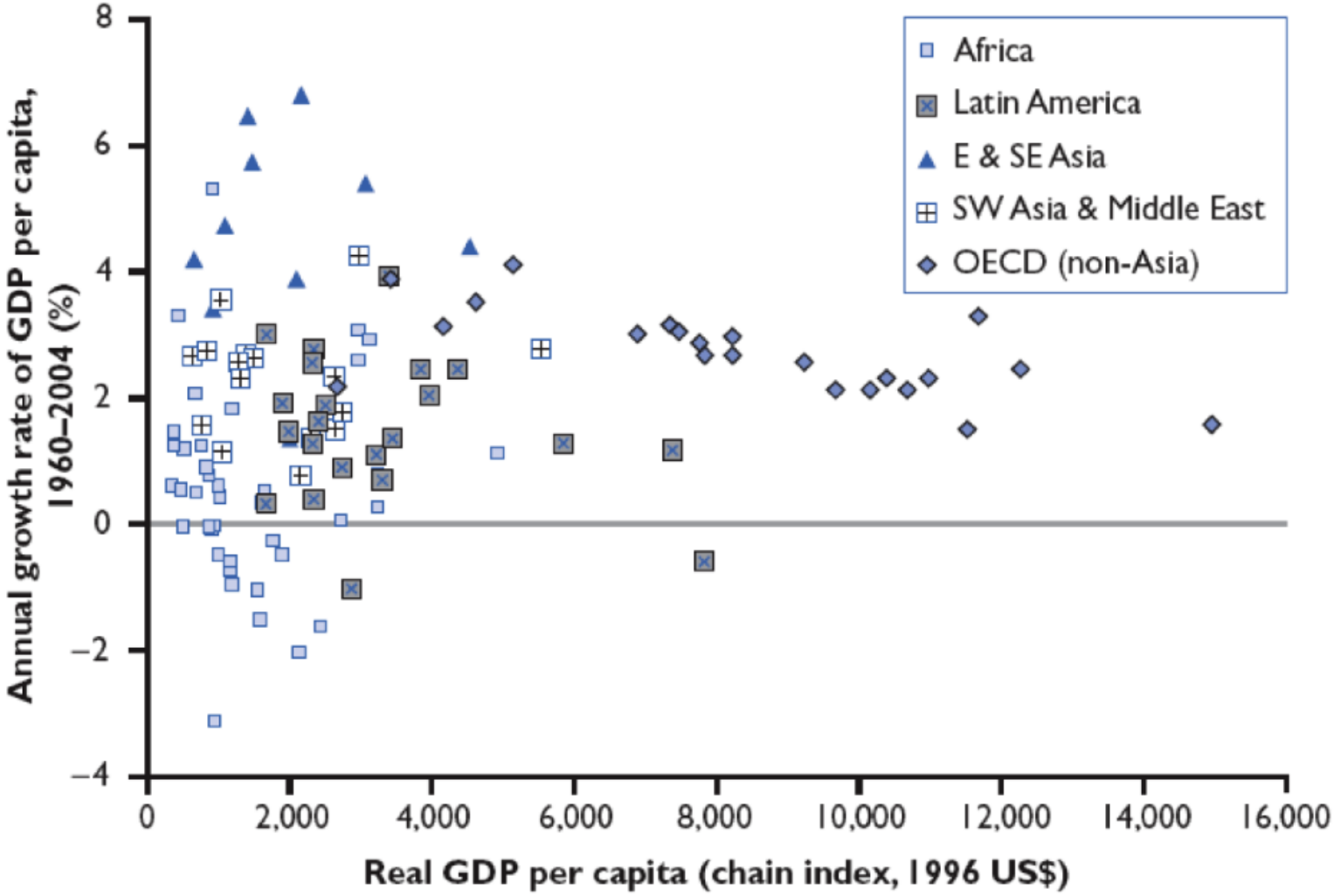
Modern Growth around the World

Convergence Fact 2

There is non-convergence or "no catching up" when we include African and other poorer nations.



Why do some nations grow and become wealthier? ...

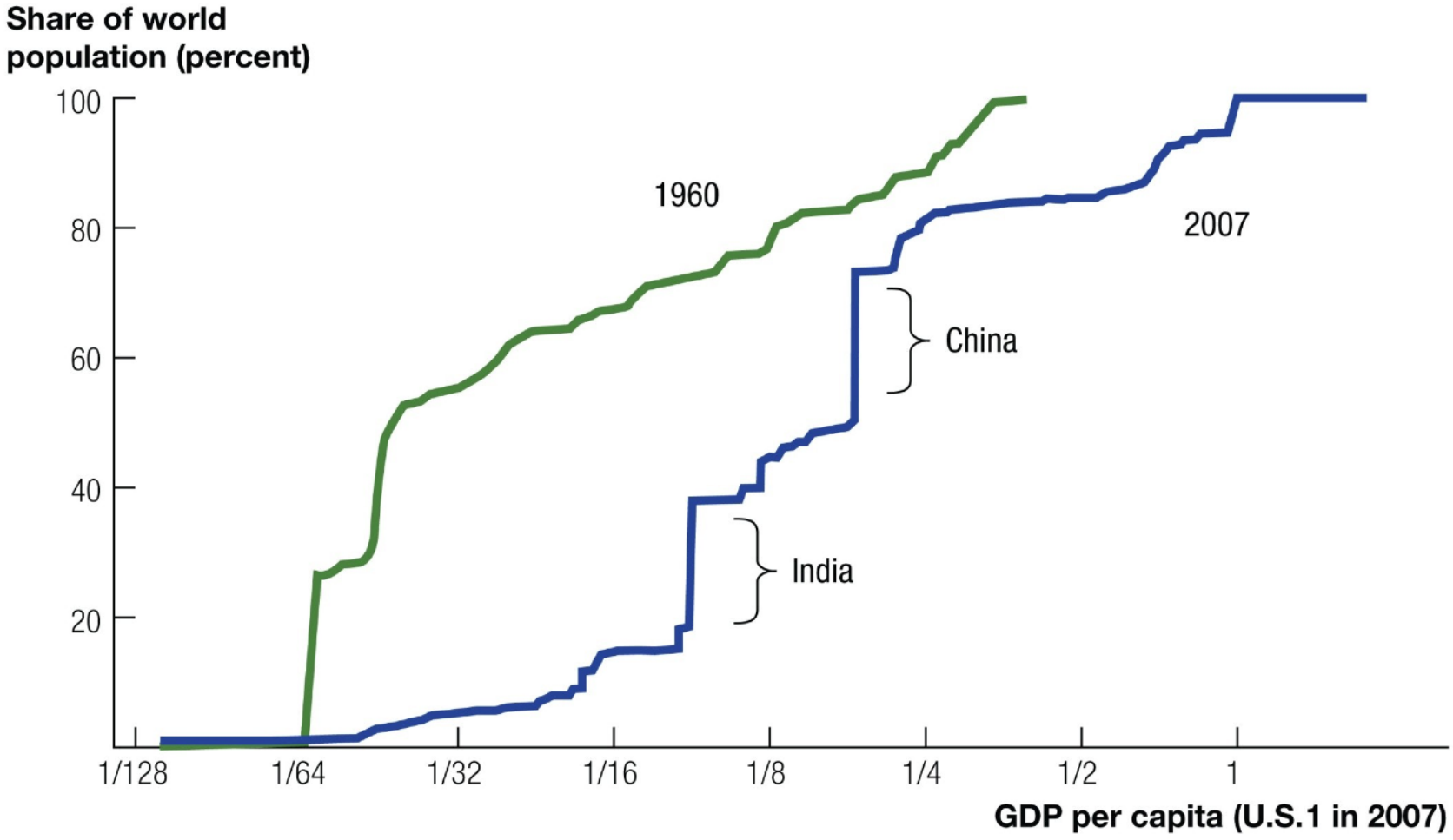
... Meanwhile, some others don't seem to catch up?

Case Study

People versus Countries

Since 1960:

- Bulk of the world's population is substantially richer.
- The fraction of people living in poverty has fallen.
- A major reason for changes
  - Economic growth in China and India
  - These are 40 percent of the world population!



Distribution of world population by living standard

Case Study

People versus Countries

- Figure showed proportion of world population who have living standards less than or equal to a given level of living standard.
  - Pick a point on the horizontal axis;
  - Read upwards towards the 1960, or, the 2007 graph.
  - Read leftwise on the vertical axis for the corresponding share number.
- Two snapshots: 1960 and 2007.
  - Mass of world population has shifted (right) over time to higher levels of living standard.

Economic Growth

Benefits and Costs

- The benefits of economic growth include: improvements in health, higher incomes, and an increase in the range of goods and services, among other things.
- Costs of economic growth include:
  - environmental problems, climate change,
  - income inequality across and within countries, and
  - a loss of certain types of jobs.
- Economists generally have a consensus that the benefits of economic growth outweigh the costs.

Economic Growth

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- improvements in health,
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Economic Growth

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Economic Growth

A Long-run Roadmap

- Are there certain policies that will allow a country to grow faster?
- If not, what is it about a country's "nature" that makes it grow at a slower rate?

Summary

- Sustained growth in standards of living is a very recent phenomenon.
- If the 130,000 years of human history were warped and collapsed into a single year, modern economic growth would have begun only atday of the year.

Summary

- Modern economic growth has taken hold in different places at different times.
- Since several hundred years ago, when standards of living across countries varied by no more than a factor of 2 or 3, there has been a "Great Divergence."
- Standards of living across countries today vary by more than a factor of 60.

Summary

- Since 1870:
  - Growth in per capita GDP has averaged about 2 percent per year in the United States
  - Per capita GDP has risen from about $2,500 to more than $37,000.
- Growth rates throughout the world since 1960 show substantial variation
  - Negative growth in many poor countries
  - Rates as high as 6 percent per year in several newly industrializing countries, most of which are in Asia

Summary

- Economic growth, especially in India and China, has dramatically reduced poverty in the world.
- In 1960
  - Two out of three people in the world lived on less than $5 per day (in today's prices).
  - By 2000 –This number had fallen to only 1 in 10.

Conversation Pieces

... with your loved ones over dinner tonight

The following is more fun than reading the telephone directory.

Key words:

- Modern Economic Growth
- Great Divergence
- Industrial Revolution
- Ratio Scale
- Rule of 70
- Convergence; Non-convergence
- Population
- Growth side effects: costs of growth