Overview[1]

Graham Lewis

University of Minnesota

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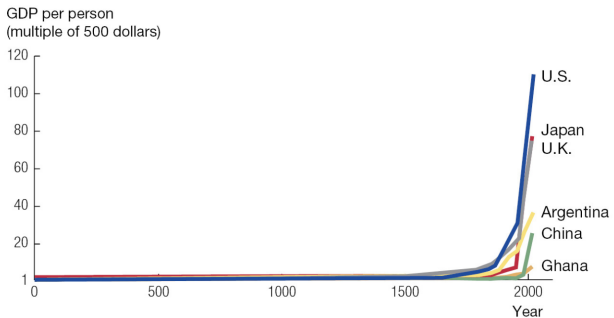
[1] All graphs are from our Jones textbook unless said otherwise

Overview

FIGURE 3.1

Economic Growth over the Very Long Run in Six Countries

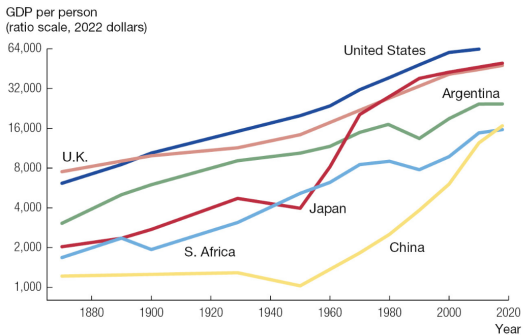


Source: The Maddison-Project, ggdc.net/maddison/.

Overview: Recent Picture

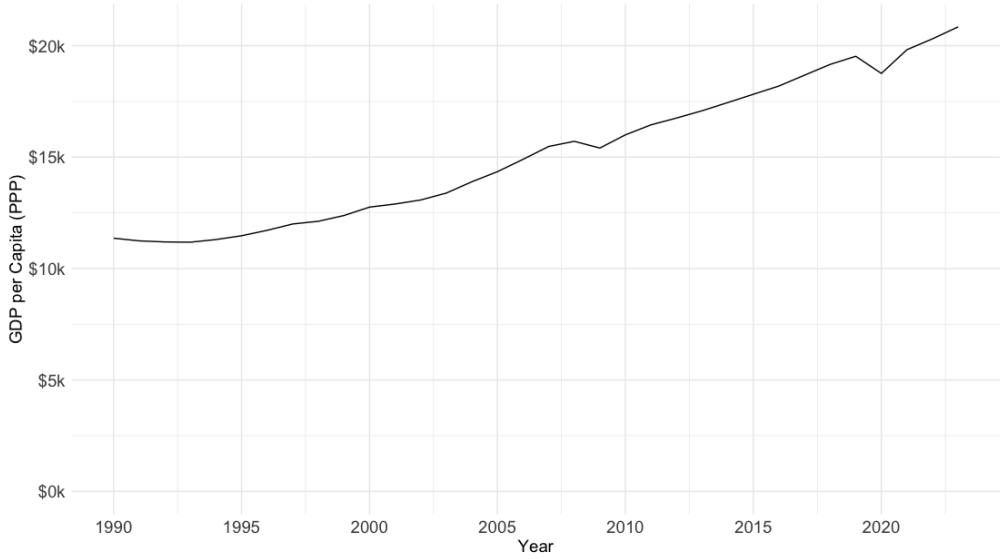
FIGURE 3.6

Per Capita GDP since 1870



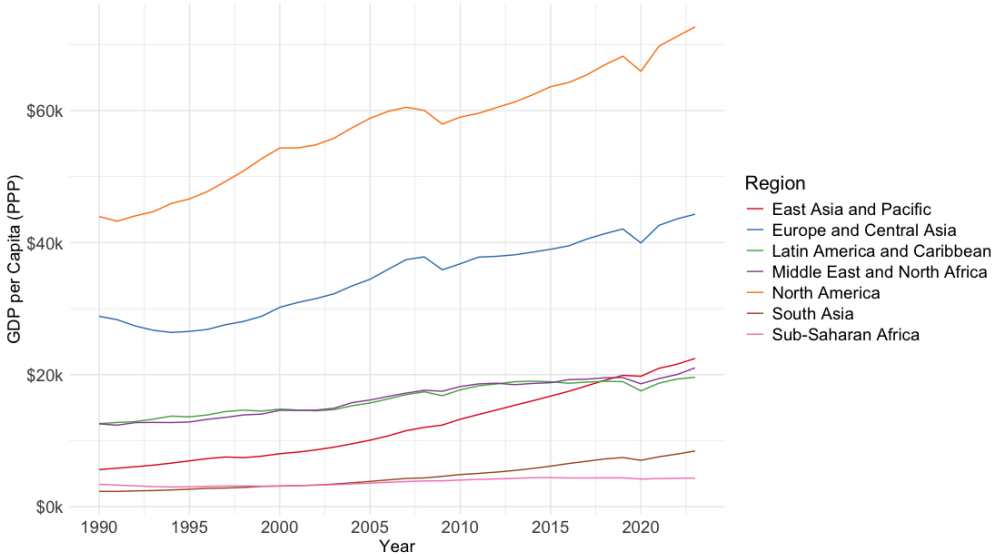
Source: The Maddison-Project, ggdc.net/maddison/. Observations are presented every decade after 1950 and less frequently before that as a way of smoothing the series.

Overview: Recent Picture[2]



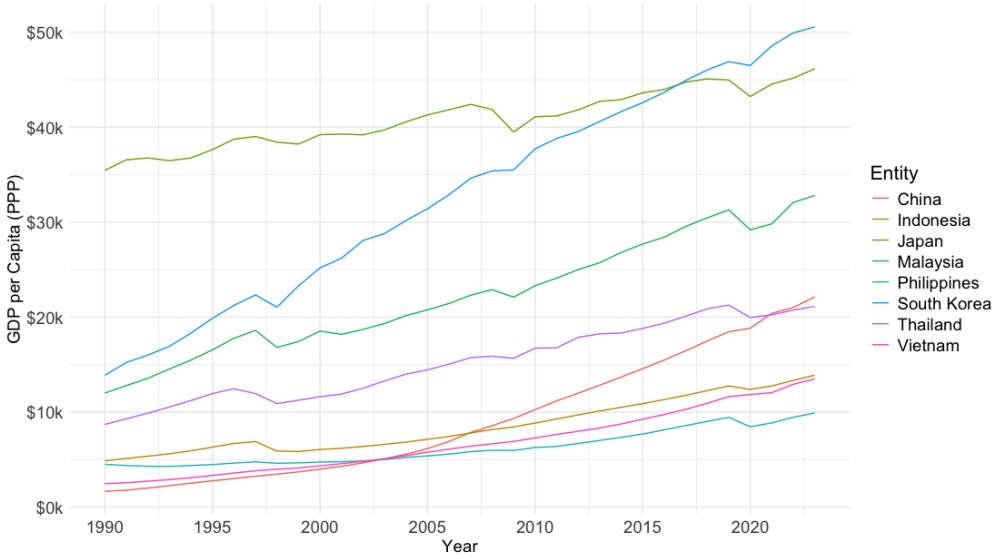
[2]Bolt and van Zanden - Maddison Project Database 2023 – with minor processing by Our World in Data

Global Differences: By Region [3]



[3] Bolt and van Zanden - Maddison Project Database 2023 – with minor processing by Our World in Data

Global Differences: Within Regions[4]

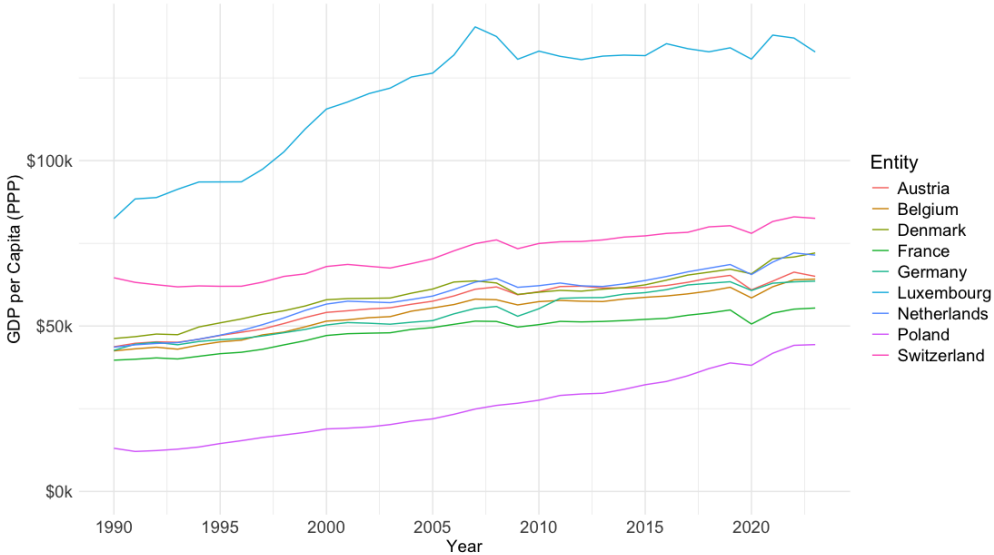


[4] Bolt and van Zanden - Maddison Project Database 2023 – with minor processing by Our World in Data

Global Differences: Within a Peninsula [5]

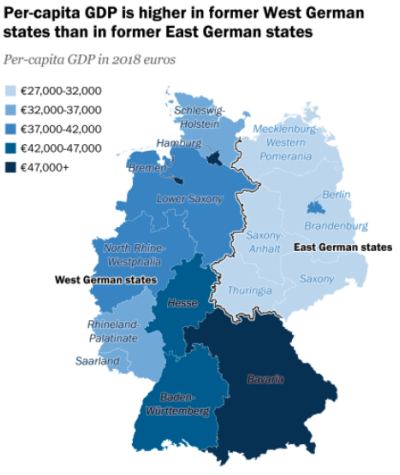
[5] Source: NASA 2024

Global Differences: Around Germany[6]



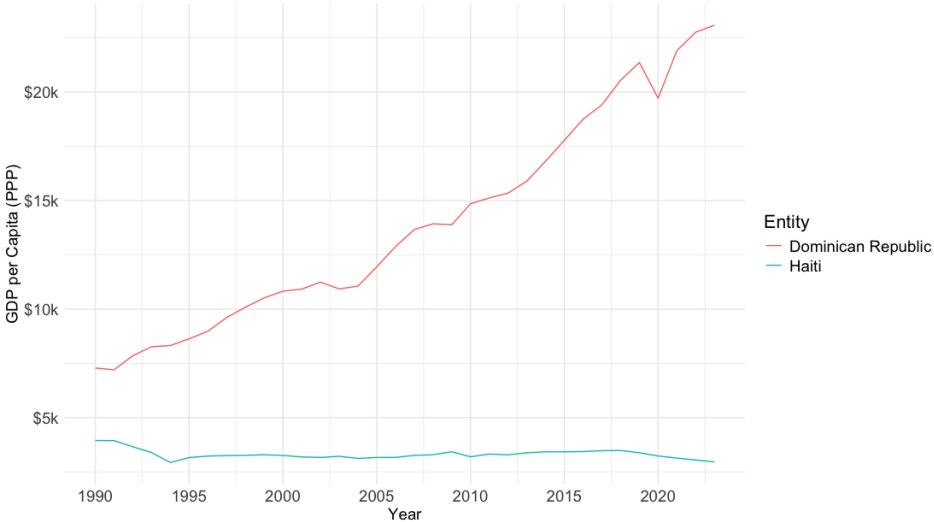
[6] Bolt and van Zanden - Maddison Project Database 2023 – with minor processing by Our World in Data

Global Differences: Within Germany[7]



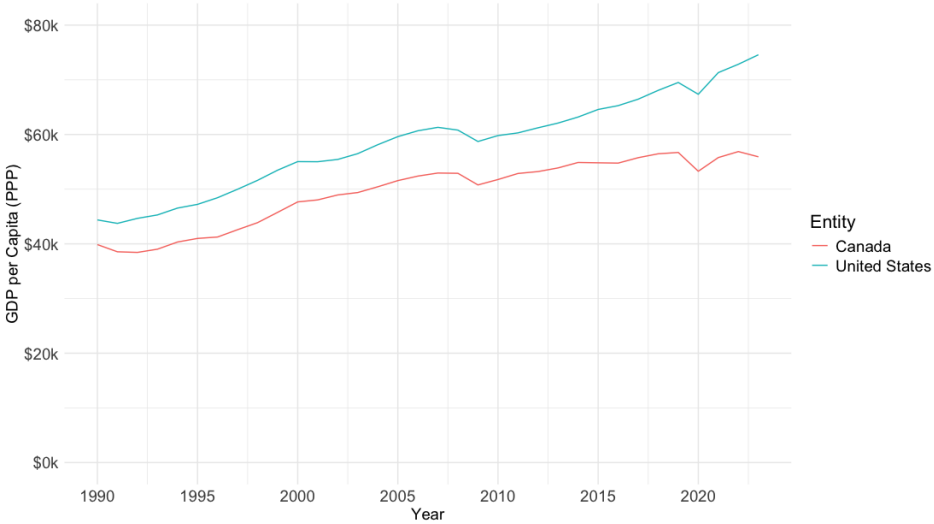
[7]Source: Pew Research Center

Global Differences: Within an Island[8]



[8] Bolt and van Zanden - Maddison Project Database 2023 – with minor processing by Our World in Data

Global Differences: Two Developed Neighbors[9]



[9] Bolt and van Zanden - Maddison Project Database 2023 – with minor processing by Our World in Data

Global Differences

"I do not see how one can look at figures like these without seeing them representing possibilities. Is there some action a government of India could take that would lead the Indian economy to grow like Indonesia's or Egypt's? If so, what exactly? If not, what is it about the "nature of India" that makes it so? 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" - Robert Lucas (1988)

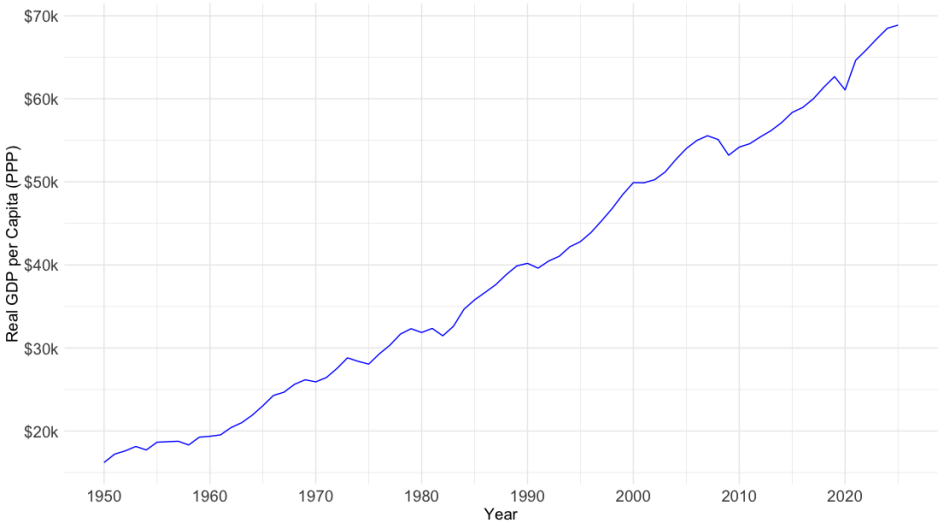
Central Questions In Our Course

- In this course we will seek to answer several key questions:
  1. What drives long-run economic growth?
  2. What explains fluctuations in growth trajectories?
  3. How do economic choices today impact outcomes tomorrow?

Course Overview: Key Topics

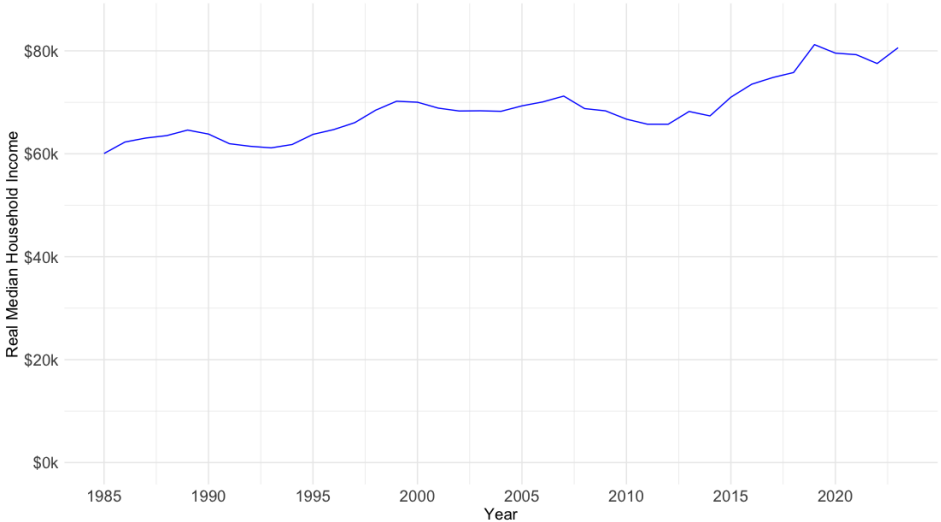
- Our course will adhere to the following roadmap:
  1. An Overview of Long-Run Growth (Jones ch. 3)
  2. Production (Jones ch. 4)
  3. The Solow Model (Jones ch. 5)
  4. Growth and Ideas (Jones ch. 6)
  5. Beyond physical capital: Human and intangible capital
  6. The labor supply
- You are expected to review Jones chapter 2 (material from ECON 1102) in your own time.

U.S.: Real GDP per Capita[10]



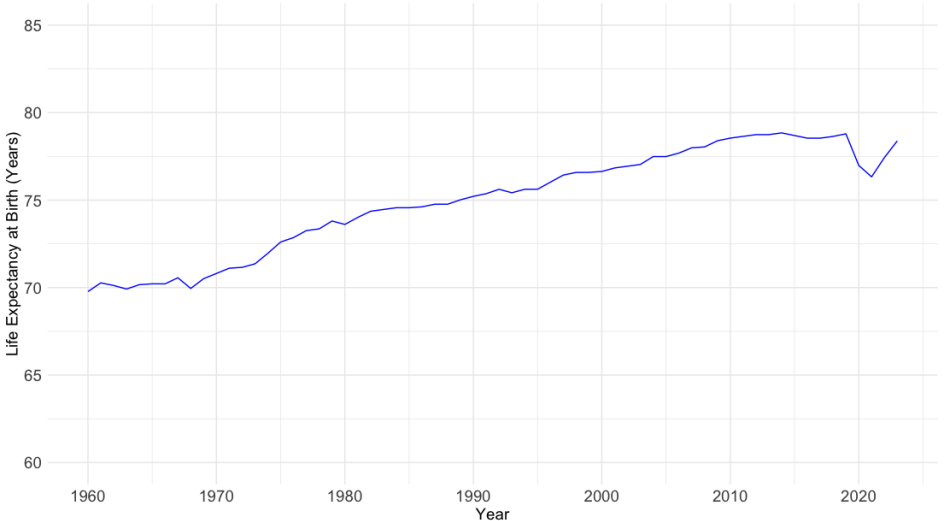
[10] FRED Database

U.S.: Median Household Income[11]



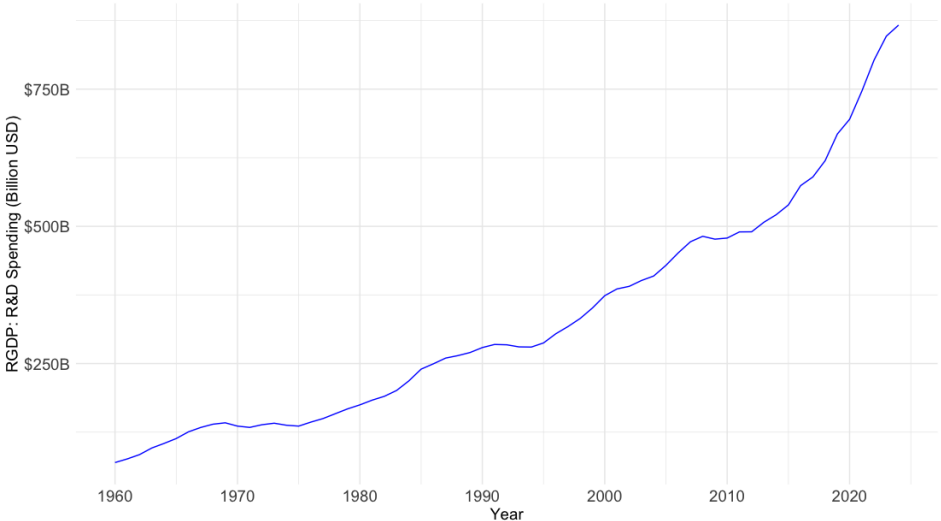
[11] U.S. Census Bureau via FRED

U.S.: Health[12]



[12]World Bank via FRED

U.S.: R&D Spending[13]



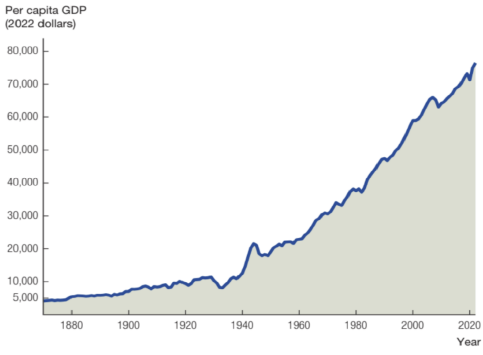
[13] U.S. Bureau of Economic Analysis via FRED

Defining Growth

- So far we have seen many plots detailing growth.
- Recall from math that the growth rate between periods t and $t+1$ of variable y is given by
$$\frac{y_{t+1} - y_t}{y_t}.$$
- A useful rule of thumb is that if y_t grows at rate g, then the time it takes to double is given by $\frac{70}{g}$.
- For example, if the U.S. Real GDP per capita grows at 2%, then it should take 35 years to double.

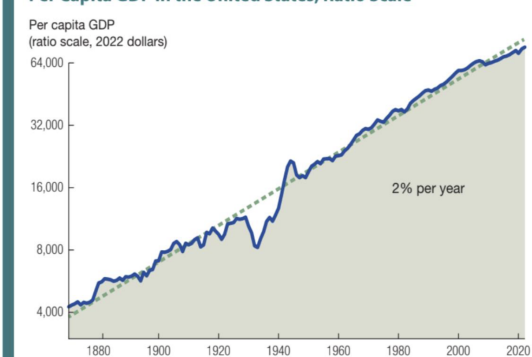
Growth Rates: U.S.

FIGURE 3.2
Per Capita GDP in the United States



Source: Data from 1870 to 1928 from Barro-Ursua Macroeconomic Data, 2010. Data since 1929 from U.S. Department of Commerce, Bureau of Economic Analysis.

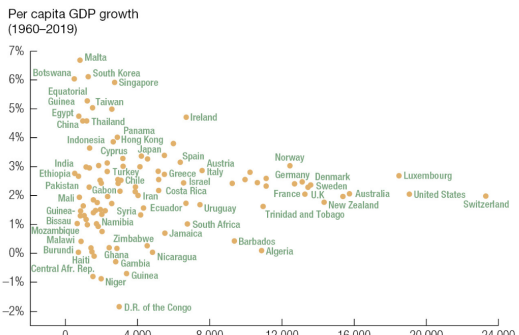
FIGURE 3.5
Per Capita GDP in the United States, Ratio Scale



Growth Rates: Around The World

FIGURE 5.9

Growth Rates around the World, 1960–2019



Source: Penn World Table, Version 10.0.

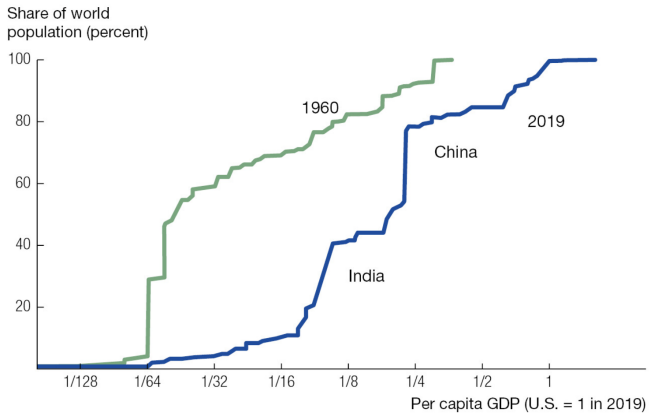
Growth Rates: Around The World

- The graph showed a wide-range of growth rates around the world.
- Countries like Botswana, China, Egypt, Japan, South Korea, and Thailand all experienced the fastest growth rates.
- Countries such as Democratic Republic of the Congo, Niger, and Guinea averaged negative growth rates.
- In a country like Singapore, a near 6% growth rate implies young adults are around 16 times richer than their grandparents,
- The flat growth rates of Madagascar and Nicaragua imply young adults are no richer than their grandparents.

Growth: Income Distribution

FIGURE 3.8

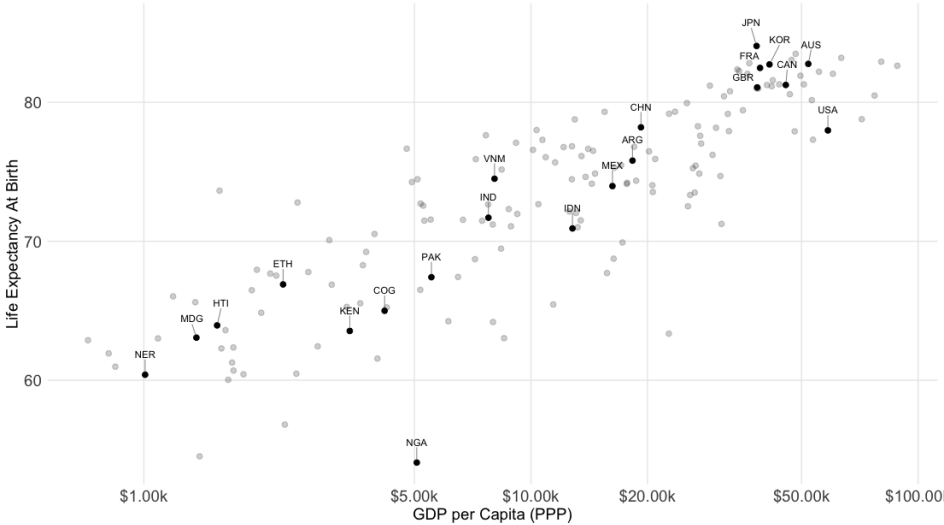
The Distribution of World Population by Per Capita GDP, 1960 and 2019



Growth: Alternative Metrics

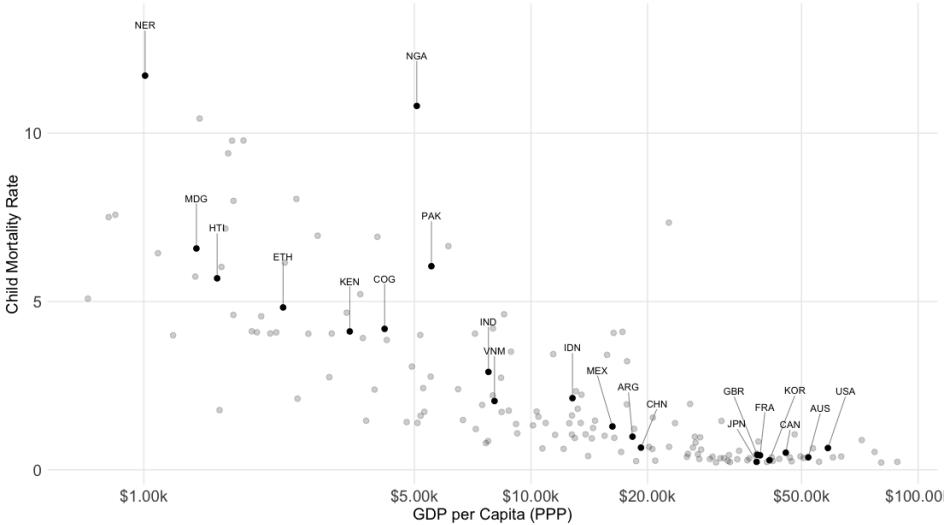
- Often times people argue for the use of alternative metrics to real GDP per capita that better captures general welfare.
- A natural question to ask is how related are these metrics to real GDP per capita.
  - If the metric is heavily correlated with real GDP per capita, then it need not alter our analysis.
  - A well-measured metric of an important summary of welfare not correlated with real GDP per capita could be an argument for using an alternative benchmark in gauging which countries are better off versus worse off.

GDP: Life Expectancy (2022)[14]



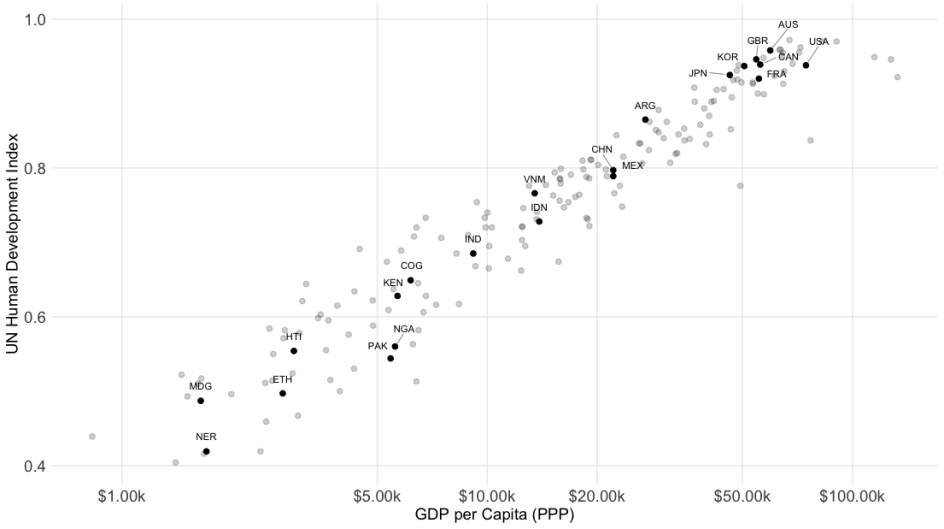
[14]Human Mortality Database (2024); UN, World Population Prospects (2024); Zijdeman et al. (2014); James C. Riley (2005); Bolt and van Zanden - Maddison Project Database 2023 HYDE (2023); Gapminder - Population v7 (2022); Gapminder - Systema Globalis (2022); Our World in Data – with major processing by Our World in Data

GDP: Child Mortality (2022)[15]



[15] United Nations Inter-agency Group for Child Mortality Estimation (2025); Gapminder (2015); Population based on various sources (2024); Bolt and van Zanden - Maddison Project Database 2023; HYDE (2023); Gapminder - Population v7 (2022); UN, World Population Prospects (2024); Gapminder - Systema Globalis (2022); Our World in Data – with major processing by Our World in Data

GDP: Human Development Index (2023)[16]



[16] UNDP, Human Development Report (2025); Data compiled from multiple sources by World Bank (2025); HYDE (2023); Gapminder - Population v7 (2022); UN, World Population Prospects (2024); Gapminder - Systema Globalis (2022); Our World in Data – with major processing by Our World in Data

Takeaways

- GDP growth has been near zero for most of human history.
- Economic growth has implications for many arenas of general welfare.
- Countries, even those close geographically, can differ greatly in both GDP levels and GDP growth.
- From 1900 until now, the U.S. consistently grew near 2%.

Growth

- What generates economic growth?
- We will approach this problem through creating models and comparing their output to data.
- A model simplifies the world through considering only relevant components to the outcome of interest.

Model: An Introduction

- Variables used in models fall into one of three categories

  1. Parameter: These variables are fixed over time. Modelers sometimes change them for experiments.
  2. Exogenous variable: These are inputs in the model that come from outside the model. These variables are determined by the modeler.
  3. Endogenous variable: These variables are explained by the model. The values these variables take are determined by the model.

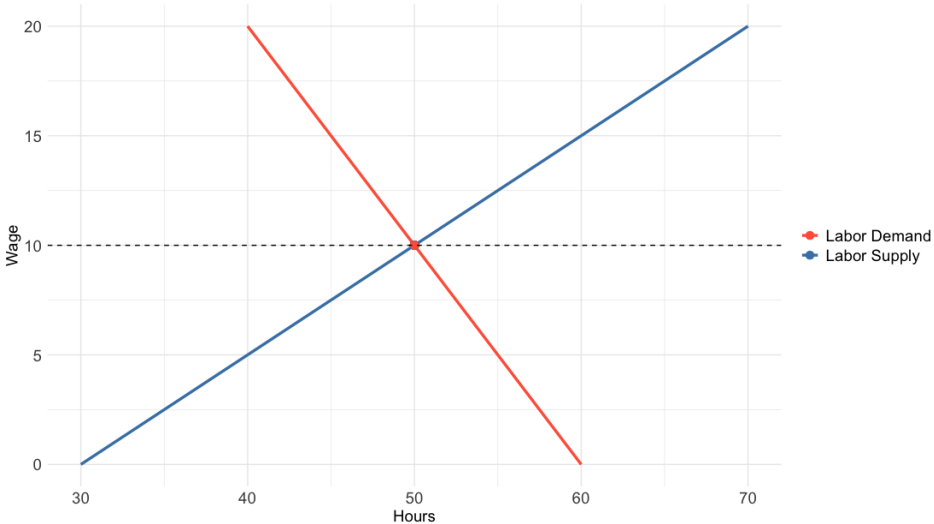
Model: Benefits

- Suppose we have a working model, what happens now?
- One of the benefits of a model is the ability to ask *counterfactuals* and hypotheticals.
- We can ask what would have changed if different decisions were made in the past or what will change if a new policy is implemented today.
- These allow us to assess impacts of previous policies or predict outcomes of new, untested policies.

Model: An Example

- We will end today with an example of a model.
- Let w be the wage.
- Let $L_s(w) = aw + b$ be the number of hours supplied by workers at wage w. (a and b are parameters).
- Let $L_d(w) = c - w$ be the number of hours demanded by firms at wage w.
- We will search for an equilibrium. That is, we will search for a $w^* \geq 0$ such that $L_s(w^*) = L_d(w^*)$.
- w is an endogenous variable determined by the model and a, b, c are parameters.

Model: Graph



Model: Algebra

- We had $L_s(w) = 2w + 30$ and $L_d(w) = 60 - w$.
- We can solve

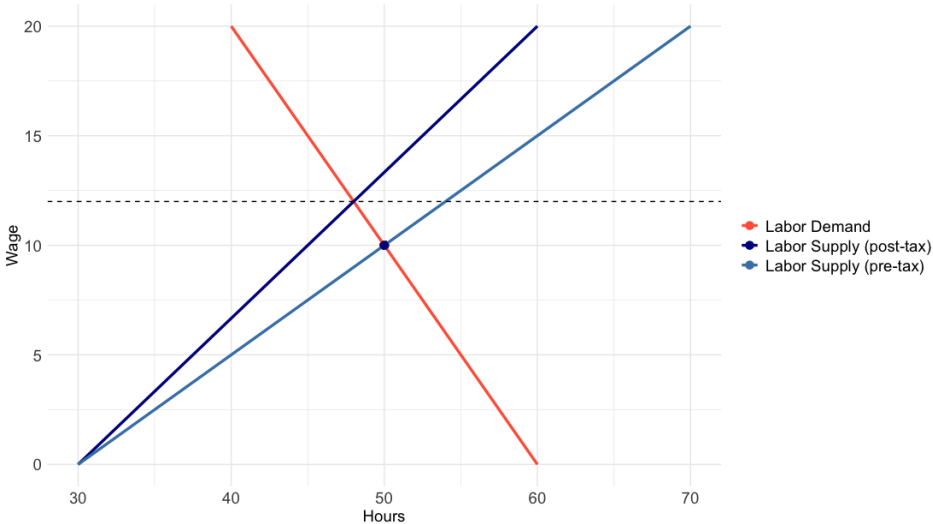
$$\begin{aligned} L_s(w) &= L_d(w) \\ 2w + 30 &= 60 - w \\ 3w &= 30 \\ w &= 10. \end{aligned}$$

- So at a wage of 10 units per hour, the labor supplied equals 50 which equals labor demand. (Note that once you knew parameters a, b, c, then you could solve the model for the endogenous variable w).

Model: Tax Experiment

- The advantage of a model is that we can run an experiment and compare our answer to our original solution.
- Suppose the government imposes a 25% income tax. How will this affect the equilibrium wage?

Model: Tax Experiment



Model: Tax Experiment

- The after tax wage of the worker will be $(1 - .25)w$. So our new equations will be $L_s(w) = 2(1 - .25)w + 30$ and $L_d(w) = 60 - w$. We can solve like last time,

$$\begin{aligned} L_s(w) &= L_d(w) \\ 2(1 - .25)w + 30 &= 60 - w \\ 1.50w + 30 &= 60 - w \\ 2.5w &= 30 \\ w &= 12. \end{aligned}$$

So at our new wage $w = 12$ we have 48 hours supplied, while at our old wage without the income tax we had 50 hours supplied. Equilibrium labor decreased with our income tax.

Next Time

- Next time we will model total output (GDP).
- Questions to think about:
  1. What factors are important for modeling total output?
  2. How would you combine these different factors to model output?
  3. Suppose you wanted to test your theory by plotting the output from your model versus GDP measured in the data, how would you measure the factors you listed?