Economic Growth

Lecture 1: Introduction and course overview

Chris Edmond

MIT 14.452

Fall 2021

This Course

- *An 'advanced introduction' to economic growth*

- Primary goal is to introduce the fundamental concepts and issues in long run economic growth that every economist should know.

- Secondary goal is to strengthen your understanding of the key tools of dynamic economics, tools which are useful in macro and in other fields.

- Along the way, we will also encounter some of the key open empirical questions in economic growth.

  Never too early to start thinking about research.

Course Logistics

- **Lecturer:** Chris Edmond
  - lectures: Tuesdays and Thursdays 4:00-5:30pm (Zoom link) (**note new time**)
  - office hours: Fridays 4:00-5:00 or by appointment
  - email: `cedmond@mit.edu`
- **TA:** Shinnosuke Kikuchi
  - recitations Fridays 2:30–4:00 (E51-151)
  - office hours Fridays 5:30–7:00 (E52-448)
  - email: `skikuchi@mit.edu`
- **Course Website:** https://canvas.mit.edu/courses/10215

Readings

- **Textbook:**
  - Acemoglu (2009) *Introduction to Modern Economic Growth.*
  - a useful supplement at about the same level

    Barro and Sala-i-Martin (2004) *Economic Growth* (2nd edition).
  - further background at an advanced undergraduate level

    Jones and Vollrath (2013) *Introduction to Economic Growth* (3rd edition).
- Lecture notes build on these texts and on versions of this course taught by Acemoglu and previous generations of teachers over the years.
- Articles discussed in class will be posted on Canvas.

Assessment and Prerequisites

Assessment:

- Three problem sets
  - 30% of final mark
  - 1-2 questions per problem set for grading
  - remainder discussed in recitation, but not graded
  - collaboration encouraged!
- Final exam: Thursday December 16 (last lecture Thursday December 9)
  - 70% of final mark

Prerequisites:

- 14.451 Dynamic Optimization Methods with Applications (or equivalent)
- In particular, I assume you are comfortable with simple difference and differential equations, stability concepts in discrete and continuous time, and have some exposure to the neoclassical growth model.

Outline

Course Outline

- Will broadly follow intellectual development of the field in postwar era.
- Follows the intellectual development of economics more generally
  - earlier literature relatively more theoretical
  - recent literature relatively more quantitative

    (more micro data, fewer cross-country growth regressions)
- Focus is on key contributions with most staying-power.
- I will consider the course a success if by the end of it you
  - can quickly understand setup and key results in research papers
  - are *impatient to read the latest papers in the field*
    (check out the NBER summer institute EFG working group on growth)

Course Outline

- **Solow Model:** Lectures 2–4.

  Review of the Solow model. Different types of technological progress. Using the Solow model to interpret the stylized facts of economic growth. Implications for cross-country growth. Growth accounting and development accounting.

  (presumably much of this is familiar to you, but we'll add detail and context)

- **Neoclassical Growth Model:** Lectures 5–7.

  Optimal saving in dynamic models. Implications for capital accumulation and growth. Solving a planning problem to find the efficient allocation. Decentralizing the planning problem. Welfare theorems and aggregation.

  (you will have seen some of this in 14.451, but we'll add detail and spell out the connection to dynamic general equilibrium theory)

- **Overlapping Generations:** Lecture 8.

  Beyond the representative household. Implications for dynamic efficiency. Applications to public debt, 'r vs g' etc.

Course Outline

- **Endogenous Growth:** Lectures 9–10.

  Externalities in the neoclassical growth model. Human capital. Asymptotically 'AK' economies and their limitations. Endogenous growth due to investment in R&D.

- **Directed Technical Change:** Lectures 11–12.

  Implications of factor-biased technical change. Endogenously biased technical change. Trends in factor shares. Shape of the production function. Automation. Micro vs. macro production functions.

- **Firm Dynamics and Growth:** Lecture 13.

  Beyond the representative firm. Creative destruction and growth. Competition and innovation. Reallocation. Misallocation. Market power.

Economic Growth Facts

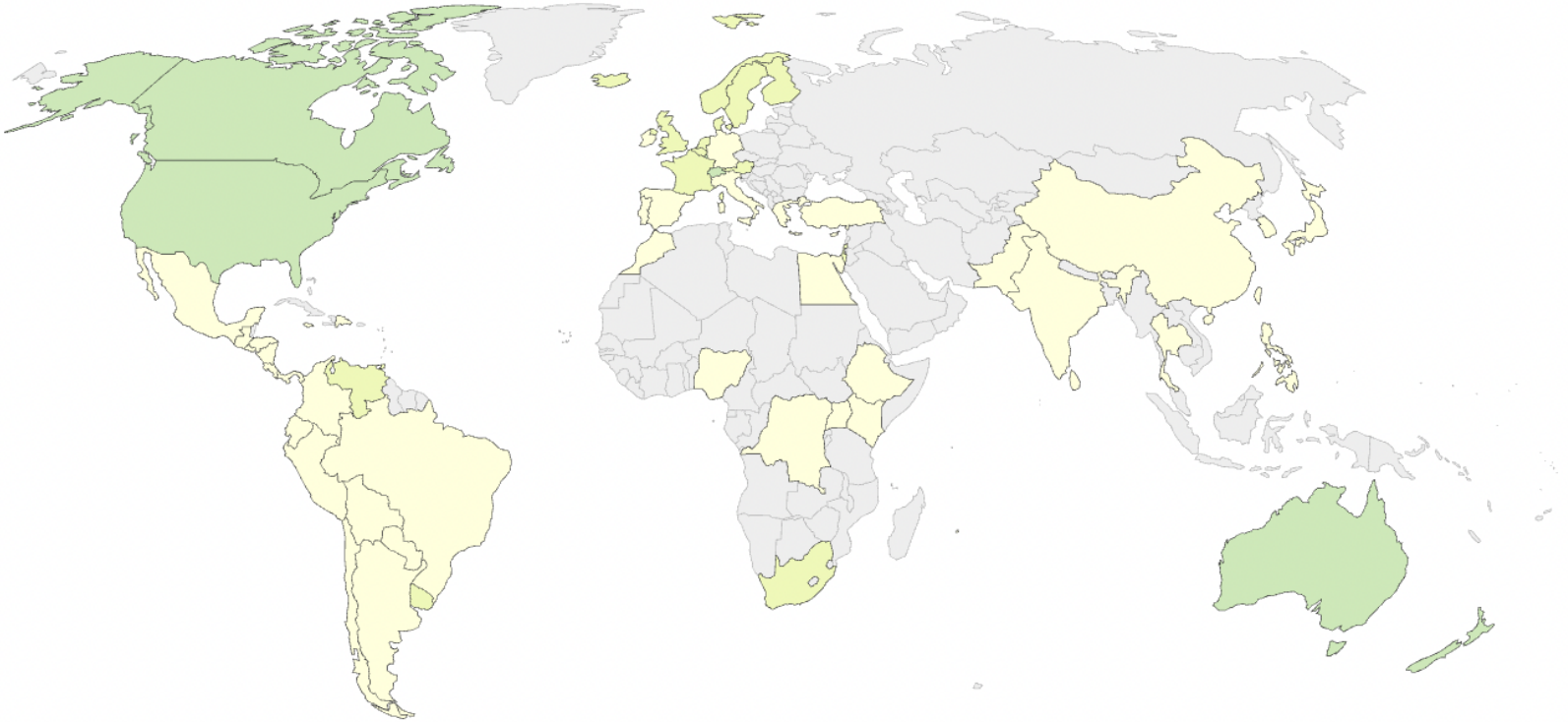
Economic Growth Facts

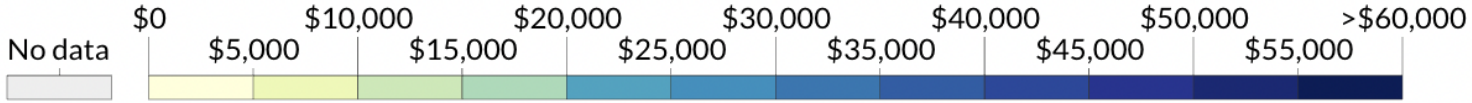
Real GDP per capita, 1950

GDP per capita is adjusted for price changes over time and between countries. It is expressed in 2011 international dollars.

Our World in Data

World





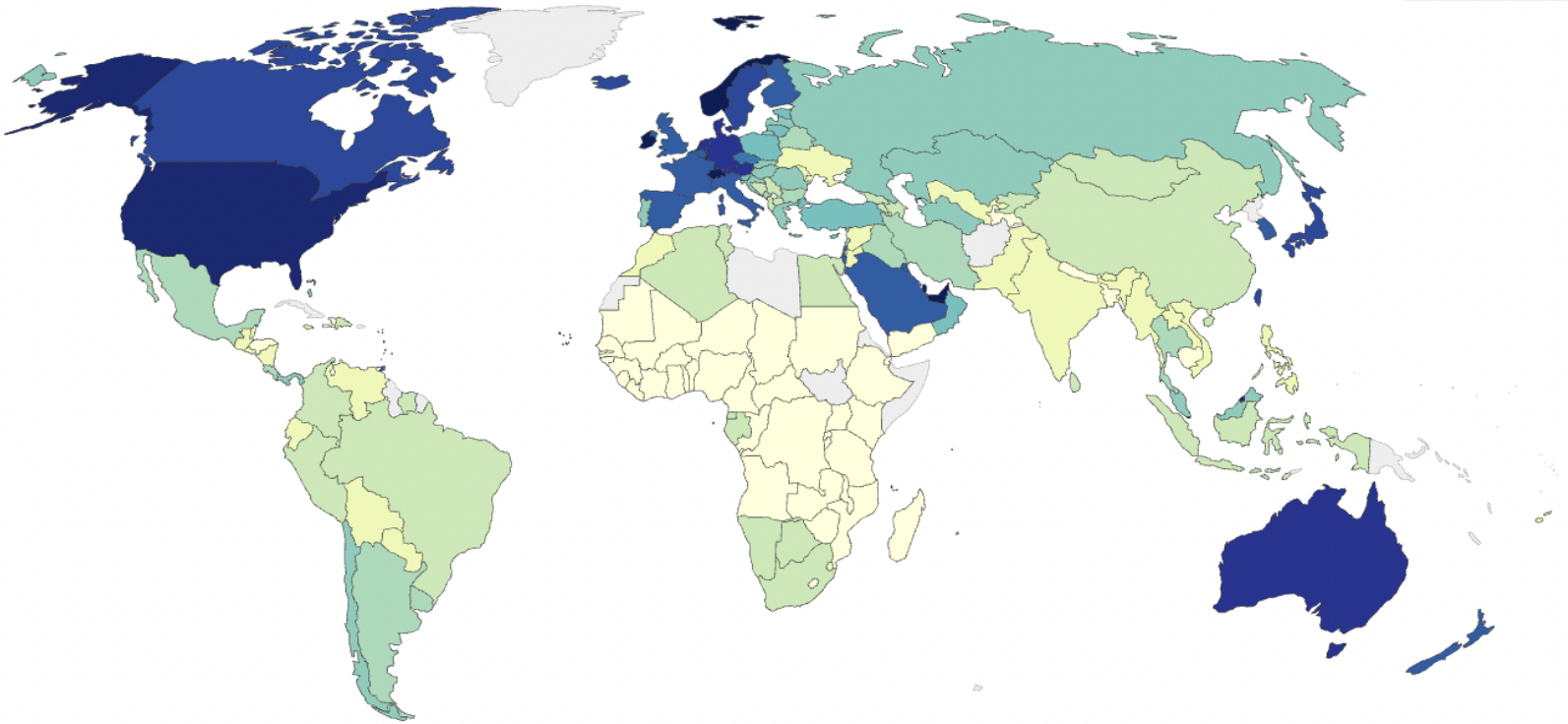
Economic Growth Facts

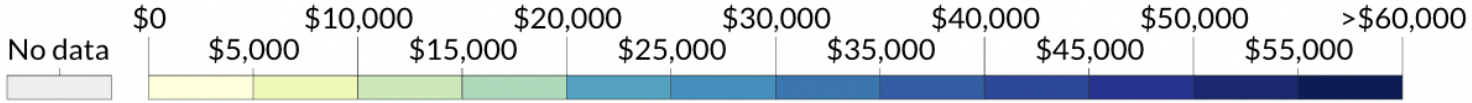
Real GDP per capita, 2017

GDP per capita is adjusted for price changes over time and between countries. It is expressed in 2011 international dollars.

Our World in Data

World





Economic Growth Facts

- High level overview of key facts, following Jones (2016).
- *Frontier growth*: the US and similar countries, driven by
  - physical capital accumulation
  - human capital accumulation
  - innovation
  - improvements in allocative efficiency
- *Growth relative to frontier*: everywhere else, especially developing world.
  - what are the relative importance of these factors across countries?
- We want to understand the (low frequency) time-series for individual countries and the cross-section of countries at points in time. More ambitiously, we want to understand the dynamics of the cross-section itself (or cross-section of dynamics), i.e., the panel structure.

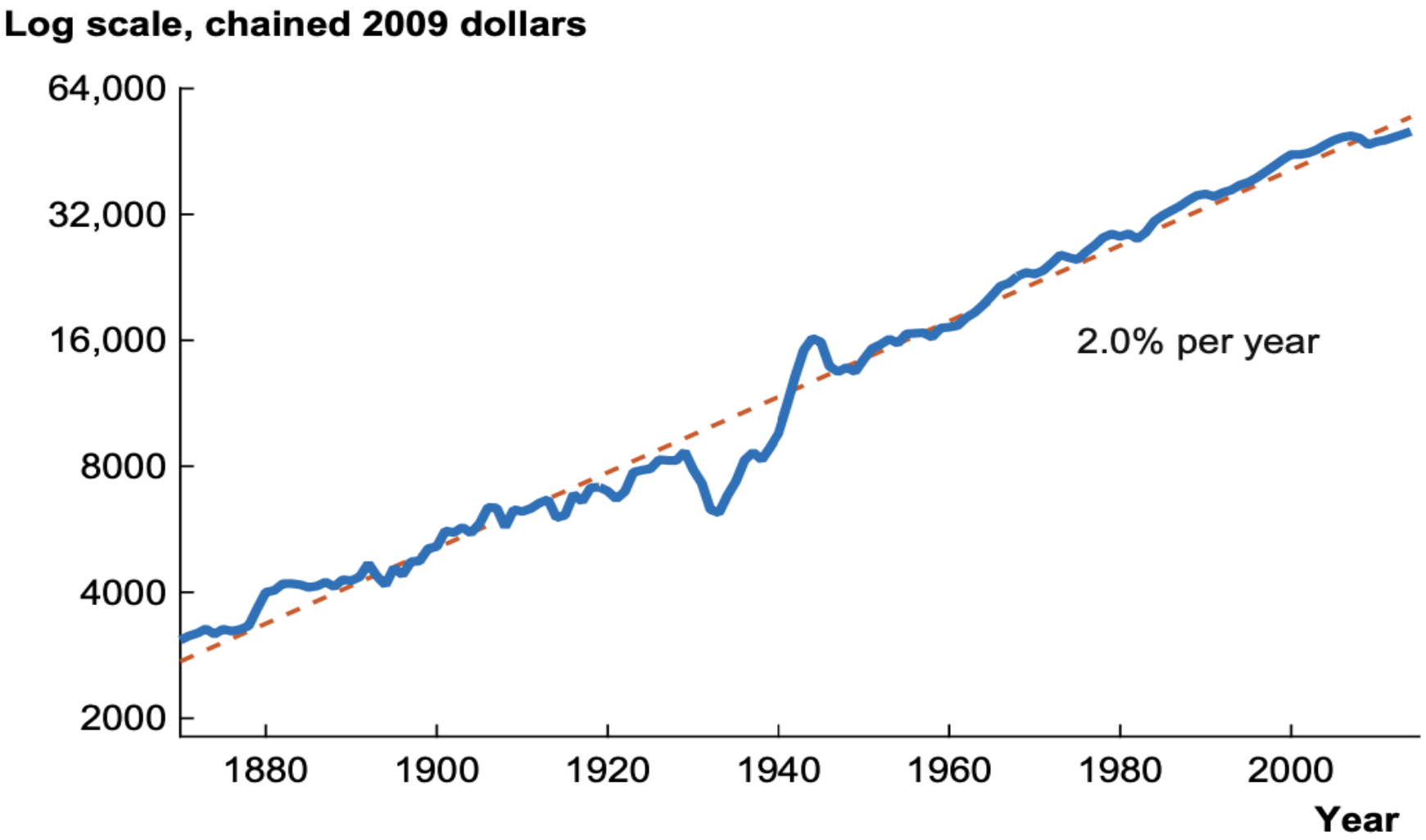
Disclaimer

- For this overview, focus on statistics like output per person.
- It should go without saying that there's more to life than GDP.

Outline

Outline

US Real Output Per Person

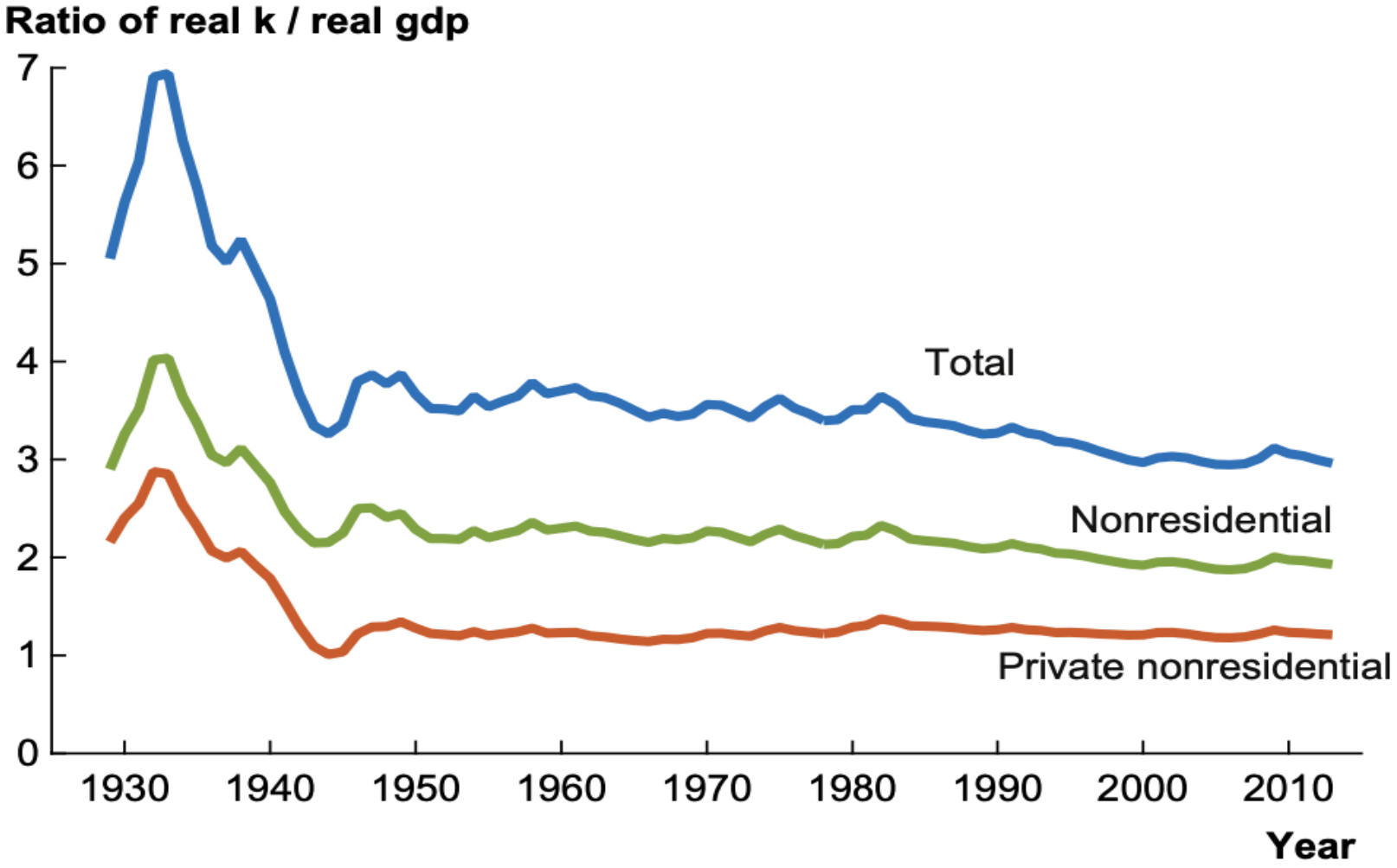


Relative stability of growth in real GDP per person. Source: Jones (2016).

Relative Stability of Frontier Growth

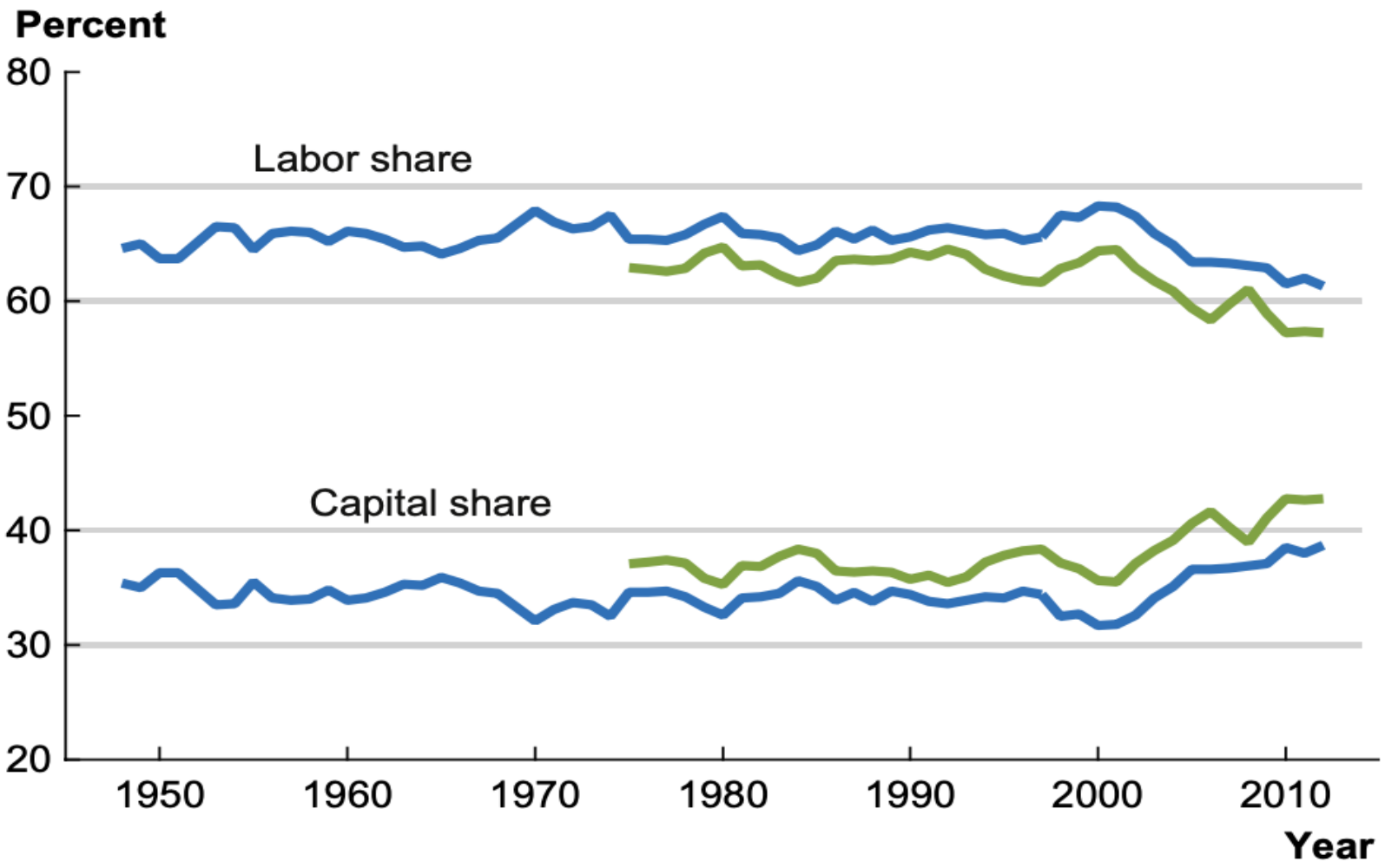
- Benchmark growth models are organised around *balanced growth paths.*
- These growth paths set up to capture certain 'stylized facts' (Kaldor 1963)
  - trend growth in output per person and real wages
  - no trend in capital/output ratio, real interest rates, or factor shares
- How well do these 'stylized facts' hold up?

US Capital/Output Ratio



Relative stability of the physical capital/output ratio. Total includes both public and private, residential and nonresidential capital. Source: Jones (2016).

US Factor Shares



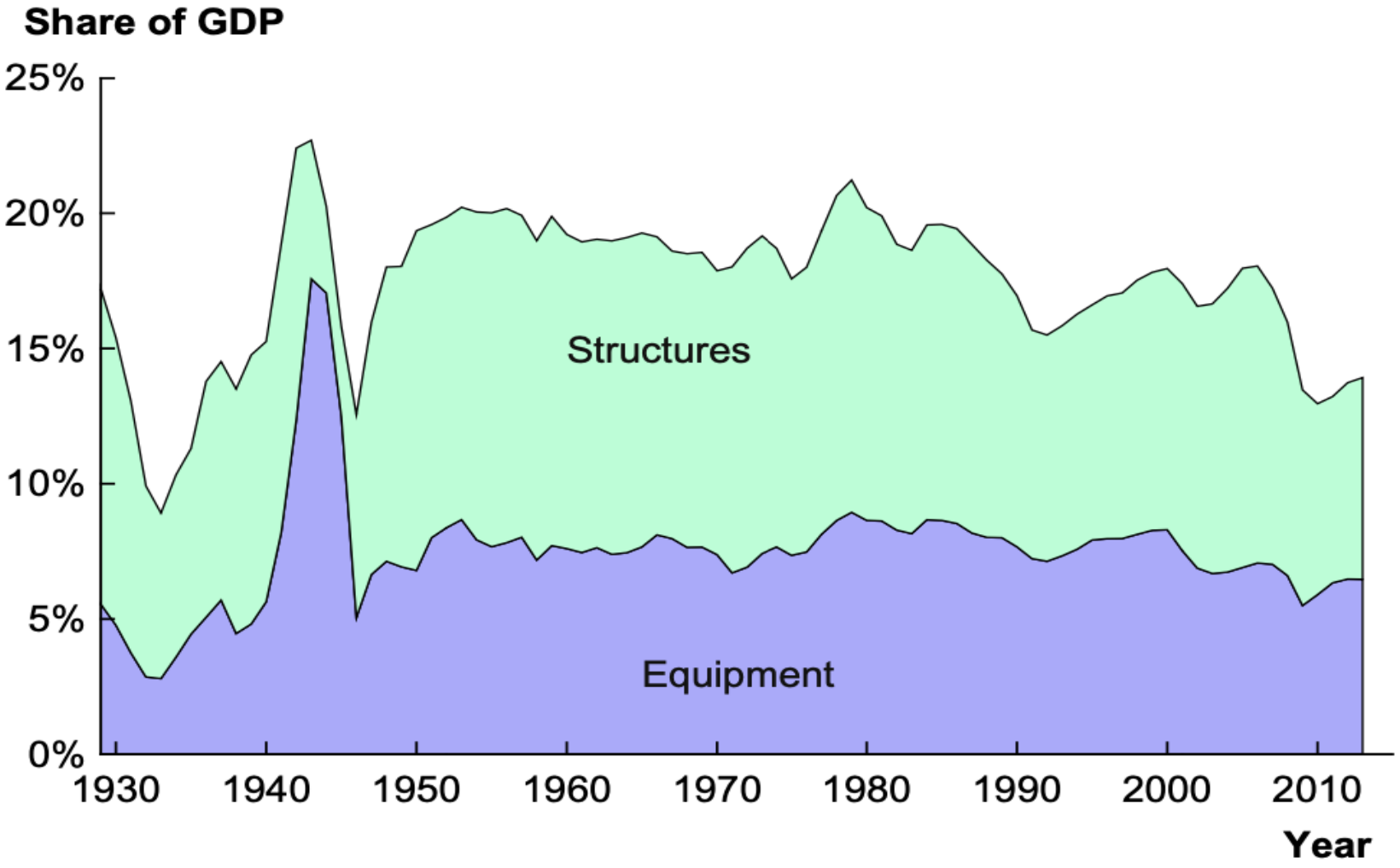
Shares of income paid to physical capital and labor. Source: Jones (2016). Green lines are the factor shares for the corporate sector from Karabarbounis and Neiman (2014).

Sources of Growth

- We will see many different models of frontier growth.
- Different models emphasize different proximate *sources of growth*, such as
  - physical capital accumulation
  - human capital accumulation
  - innovation, knowledge accumulation
  - improvements in allocative efficiency
- Moreover all of this also depends on a country's political and legal *institutions* — which in turn depend on economic outcomes.
  - a pervasive endogeneity problem.

Outline

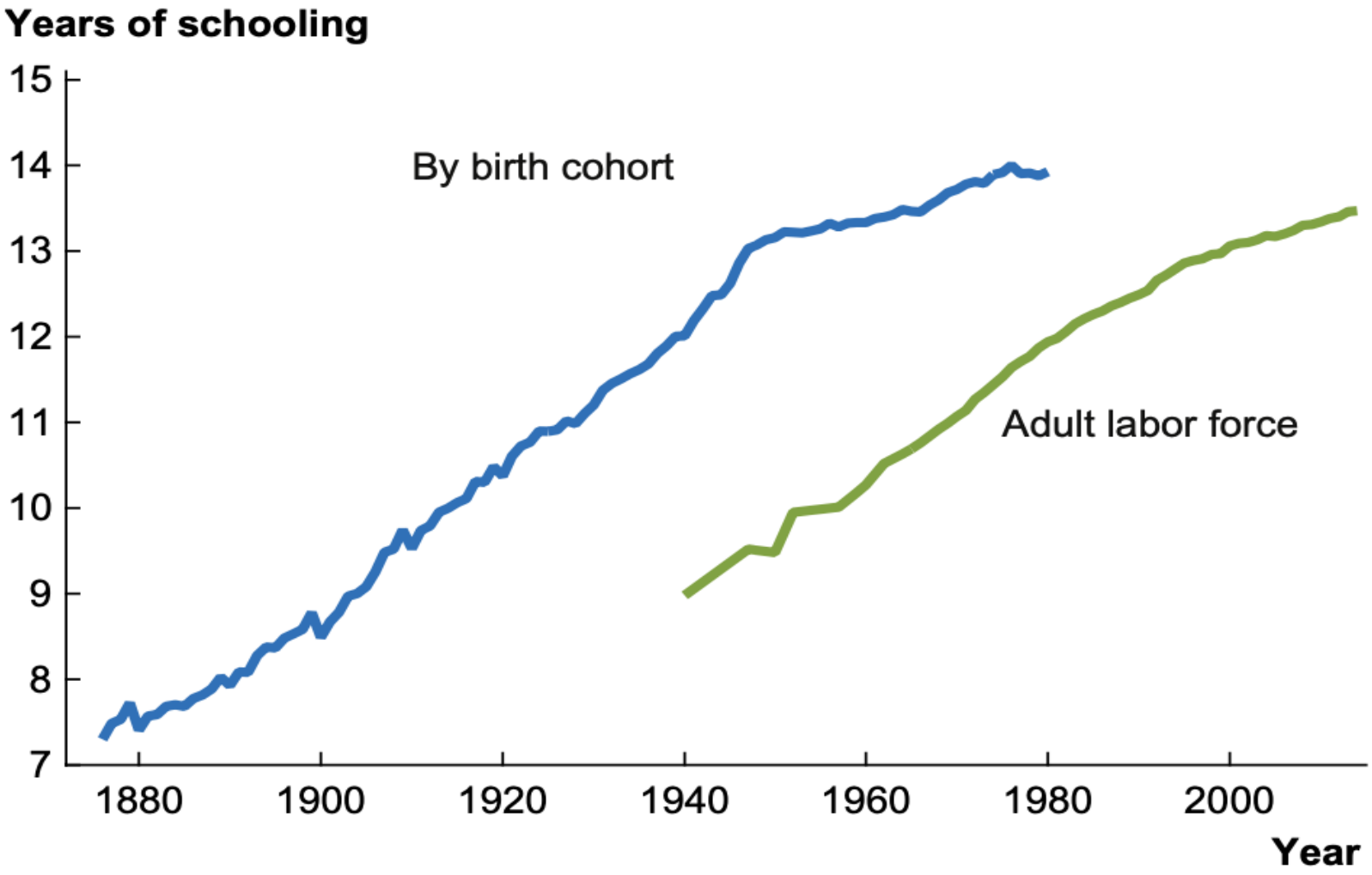
Investment in Physical Capital



Recent decline in investment share. Structures includes both residential and nonresidential investment. Excludes intellectual property products and inventories. Source: Jones (2016).

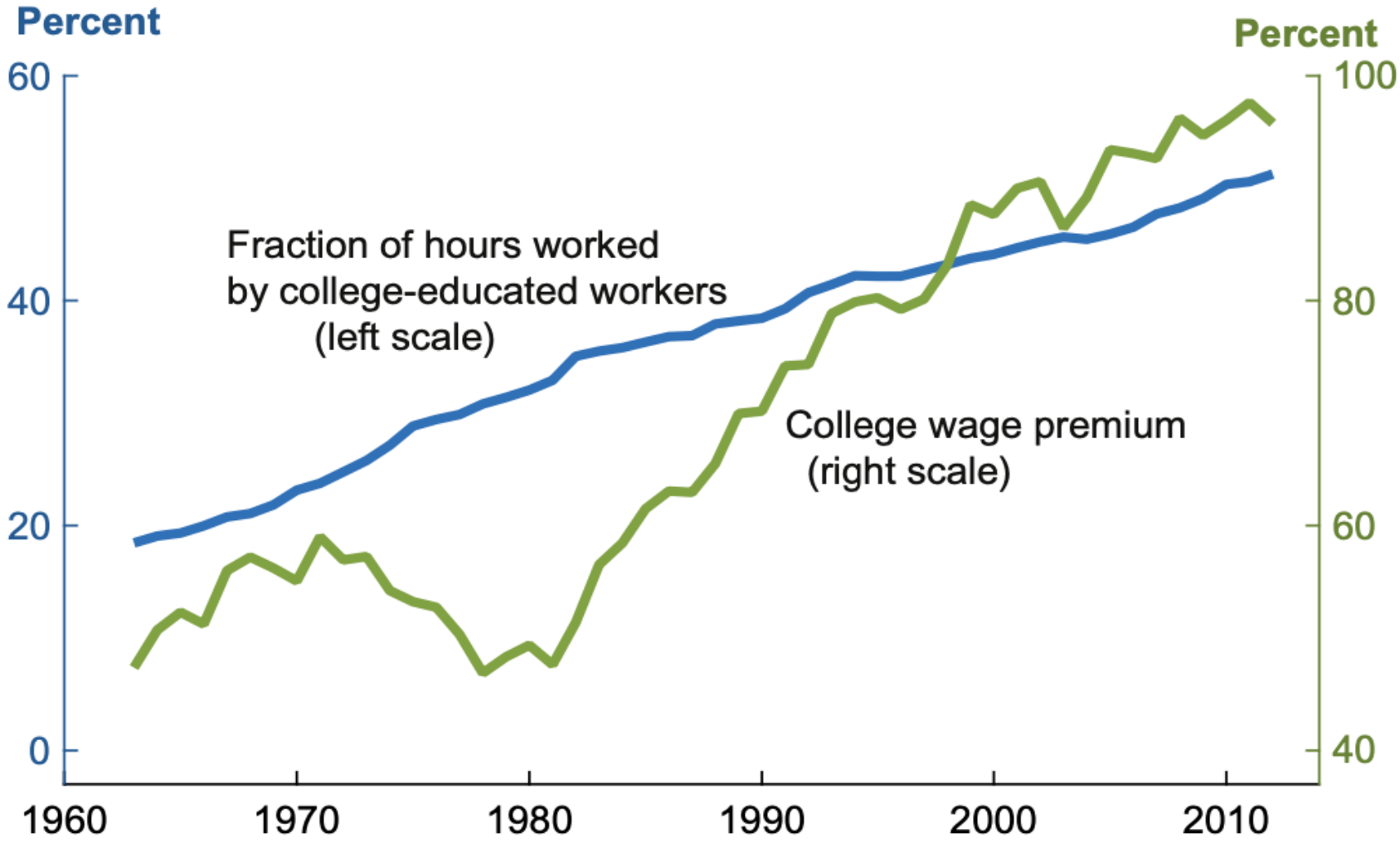
Outline

Investment in Human Capital



Educational attainment by birth cohort and for the adult labor force. Source: Jones (2016), using data from Goldin and Katz (2007).

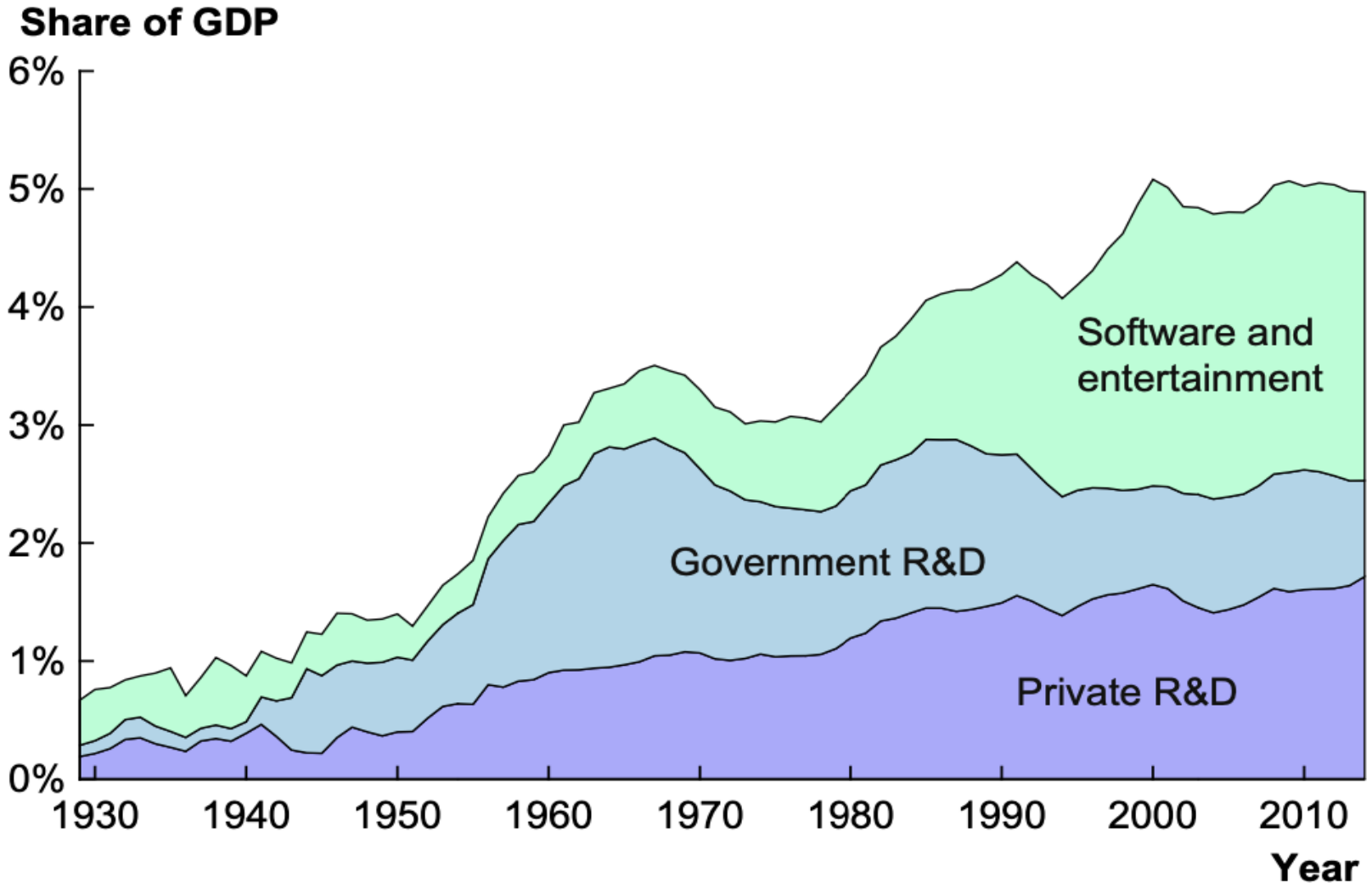
Skill-Biased Technical Change?



Fraction of hours worked by college graduates and average excess amount earned by college graduates relative to non-college graduates, controlling for experience and gender. Source: Jones (2016), following Katz and Murphy (1992) updated by Autor (2014).

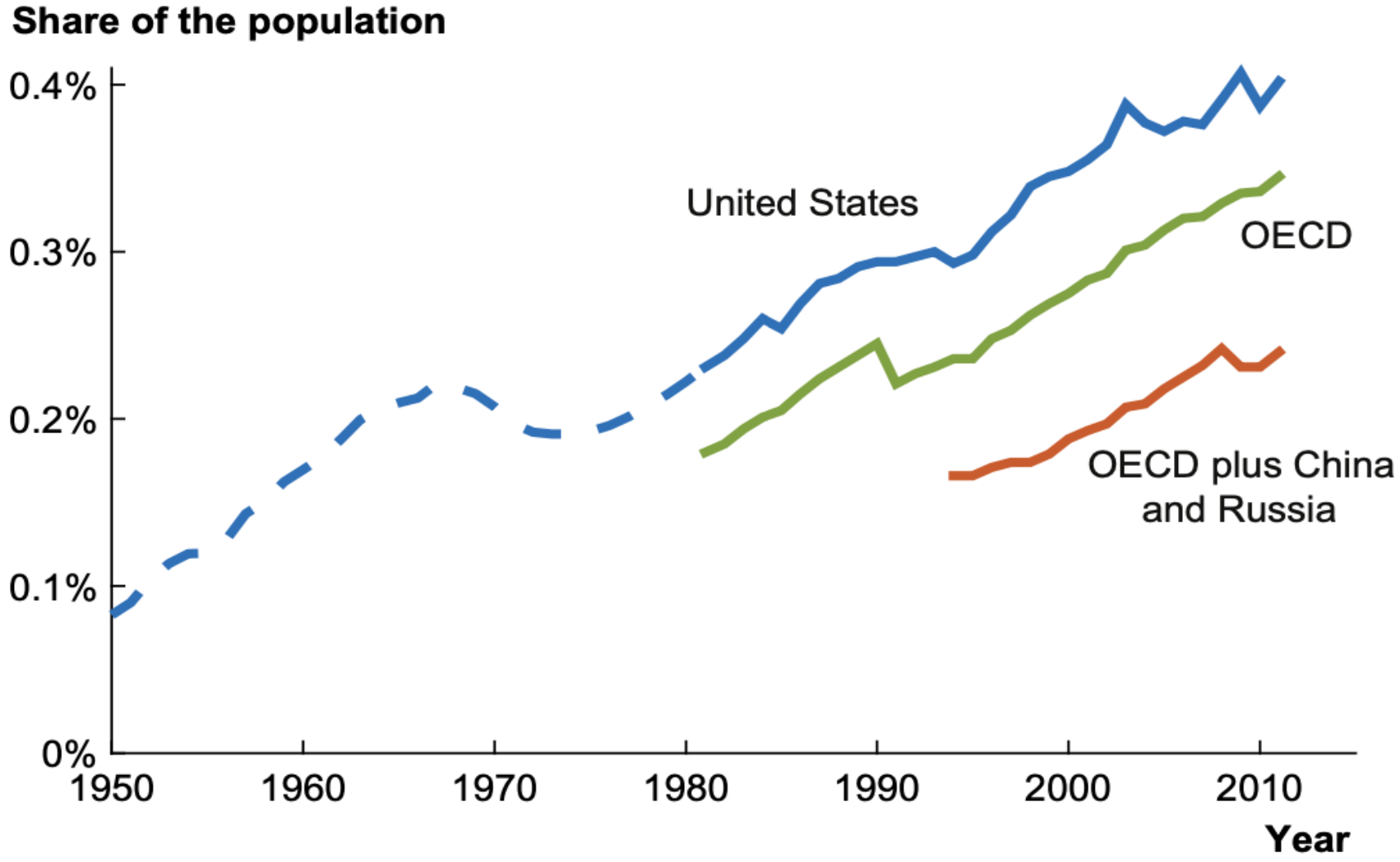
Outline

Investment in R&D [expenditure]



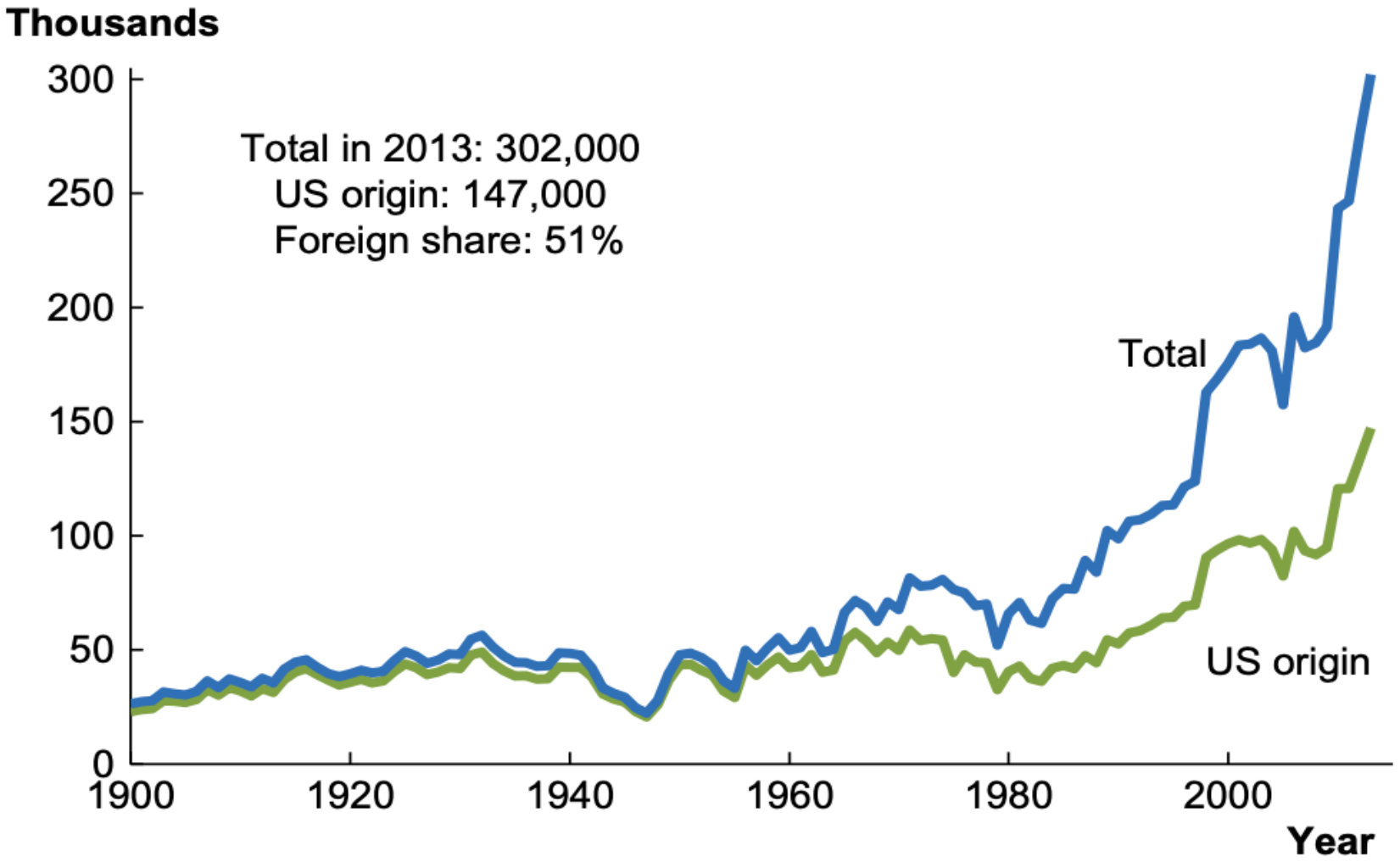
US research and development expenditure as share of GDP. Source: Jones (2016).

Investment in R&D [employment]



Research and development employment as share of population. Source: Jones (2016).

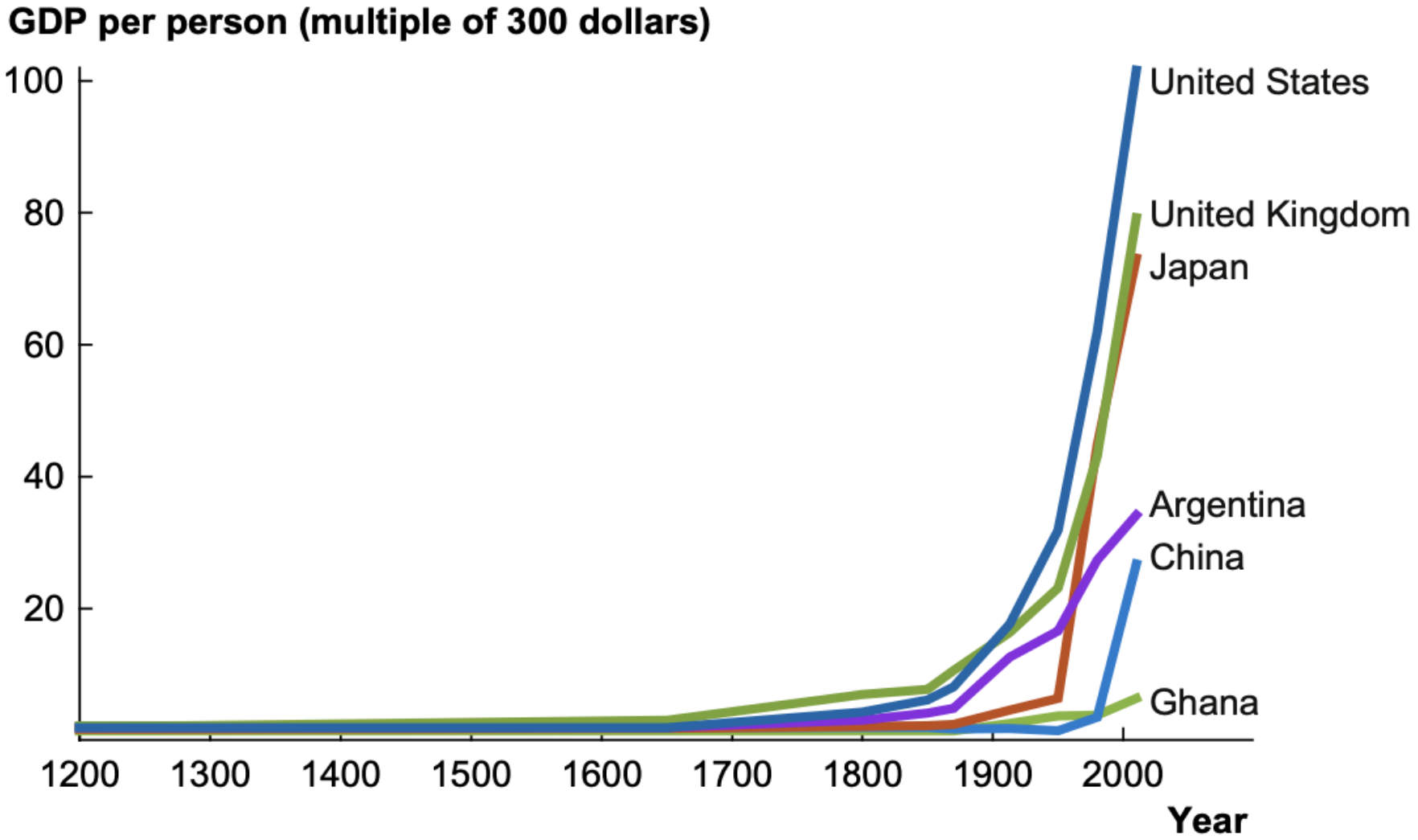
Patents Granted



Patents granted by US Patent and Trademark Office. Source: Jones (2016).

Outline

Great Divergence



Following Pritchett (1997), expressed as multiples of \$300 to measure relative to poorest countries. Source: Jones (2016).

Growth Relative to Frontier

- Given relatively stable growth at the frontier, how should we understand growth everywhere else, especially in developing countries?

- Why are there persistent differences in living standards across countries?

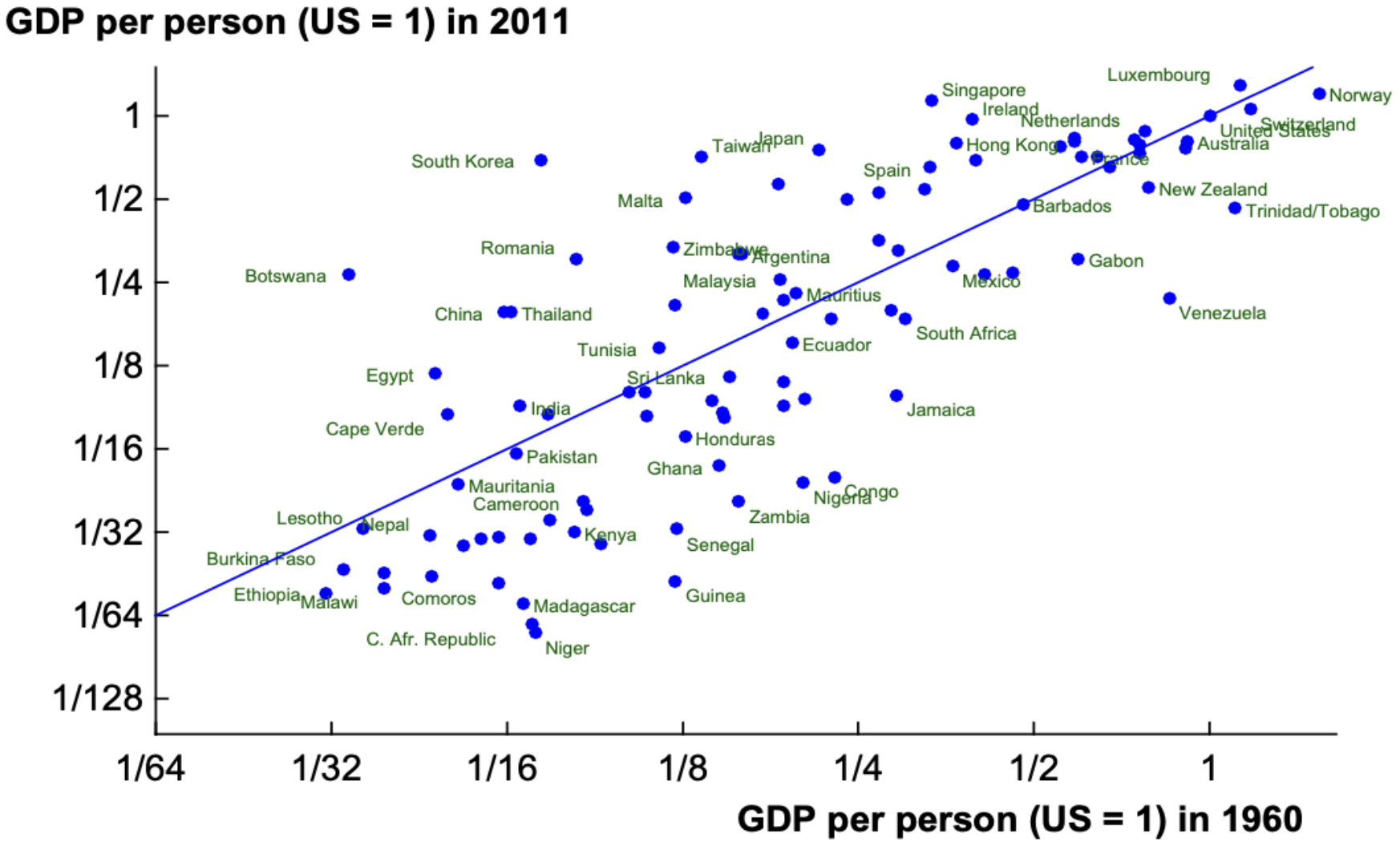
  - barriers to technology adoption?
  - barriers to physical or human capital accumulation?
  - allocative efficiency?
  - institutions?

- Are living standards becoming more or less dispersed across *countries*? Are poorer countries catching up to richer countries?

- Are living standards becoming more or less dispersed across *people*?

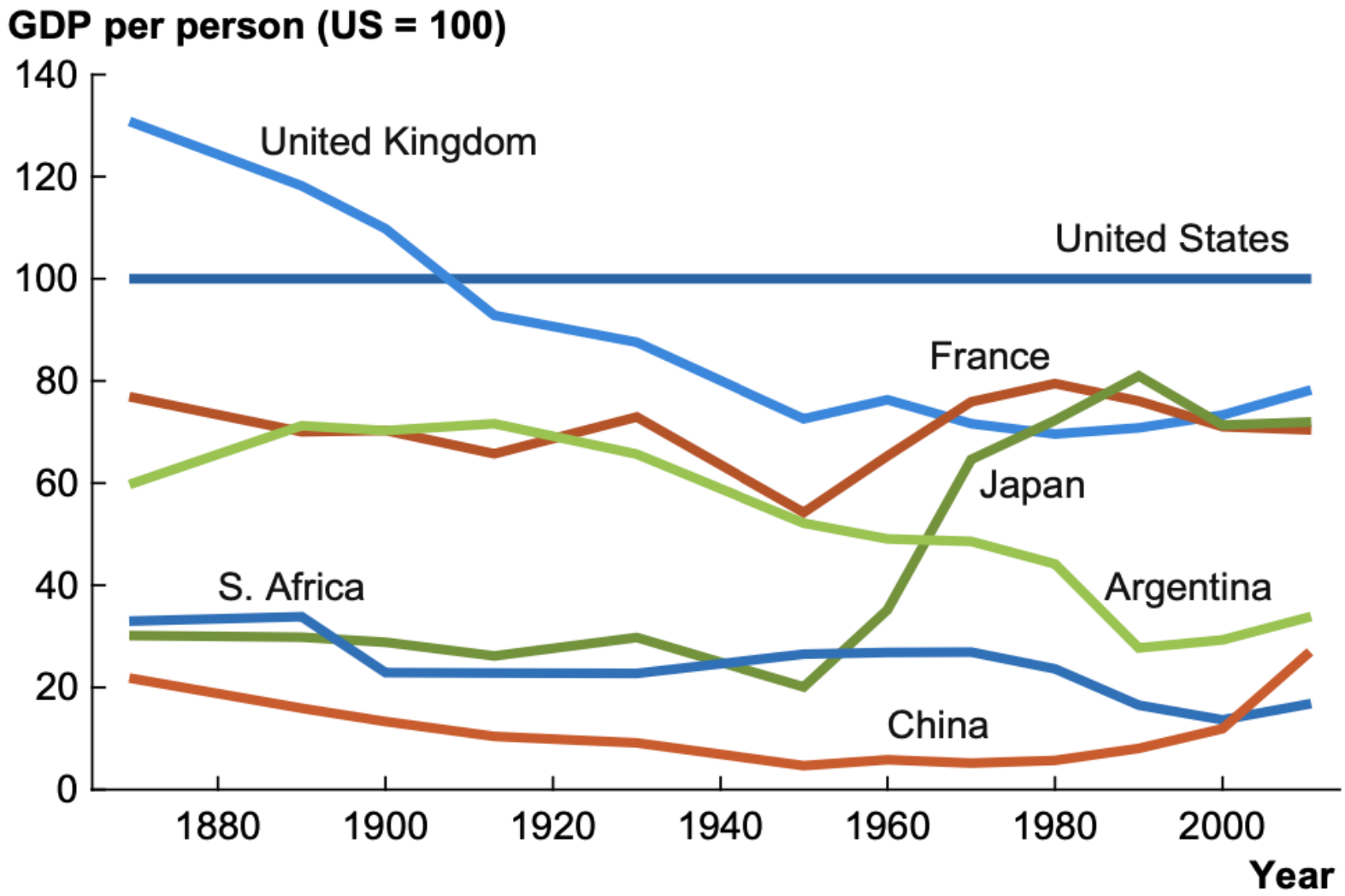
Outline

How Persistent Are Income Differences?



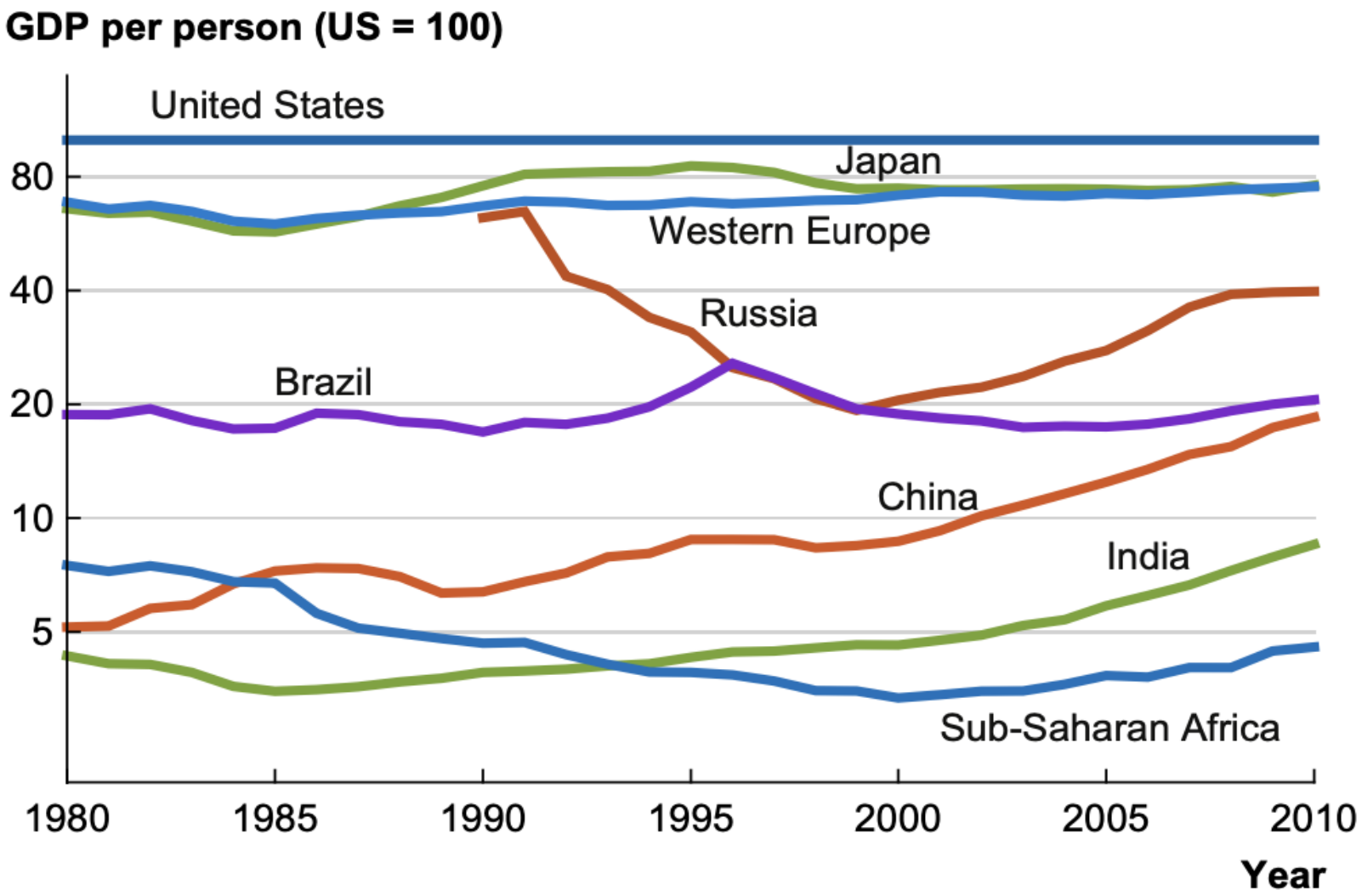
If income differences were perfectly persistent, data would lie on 45-degree line. Considerable persistence *and* considerable churn. Source: Jones (2016).

Growth Relative to Frontier (Since 1870)



Growth relative to the US since 1870. Source: Jones (2016), using data from the Maddison Project (Bolt and van Zanden 2014).

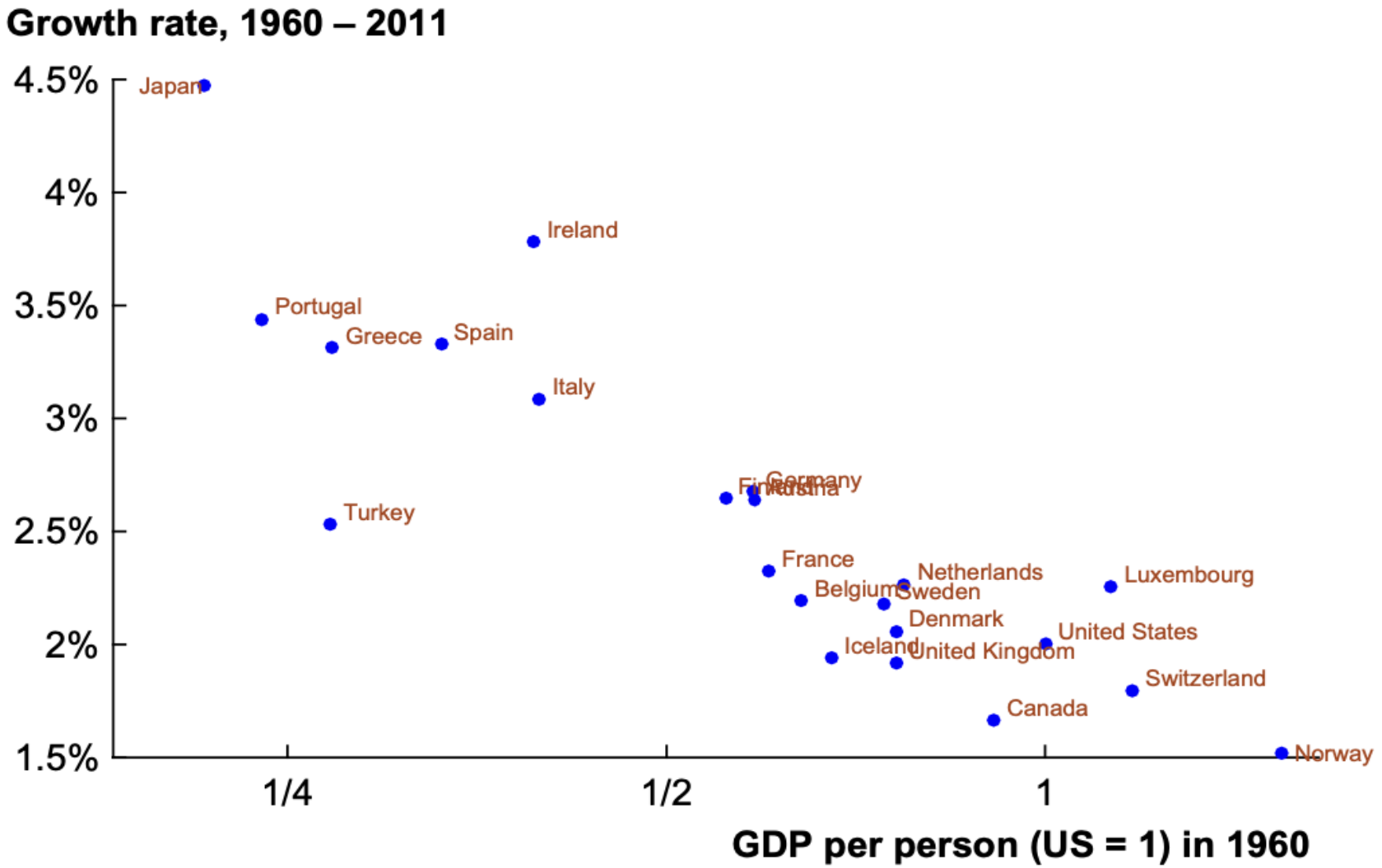
Growth Relative to Frontier (Since 1980)



Growth relative to the US since 1980. Source: Jones (2016), using data from the Penn World Tables (Feenstra et al 2015).

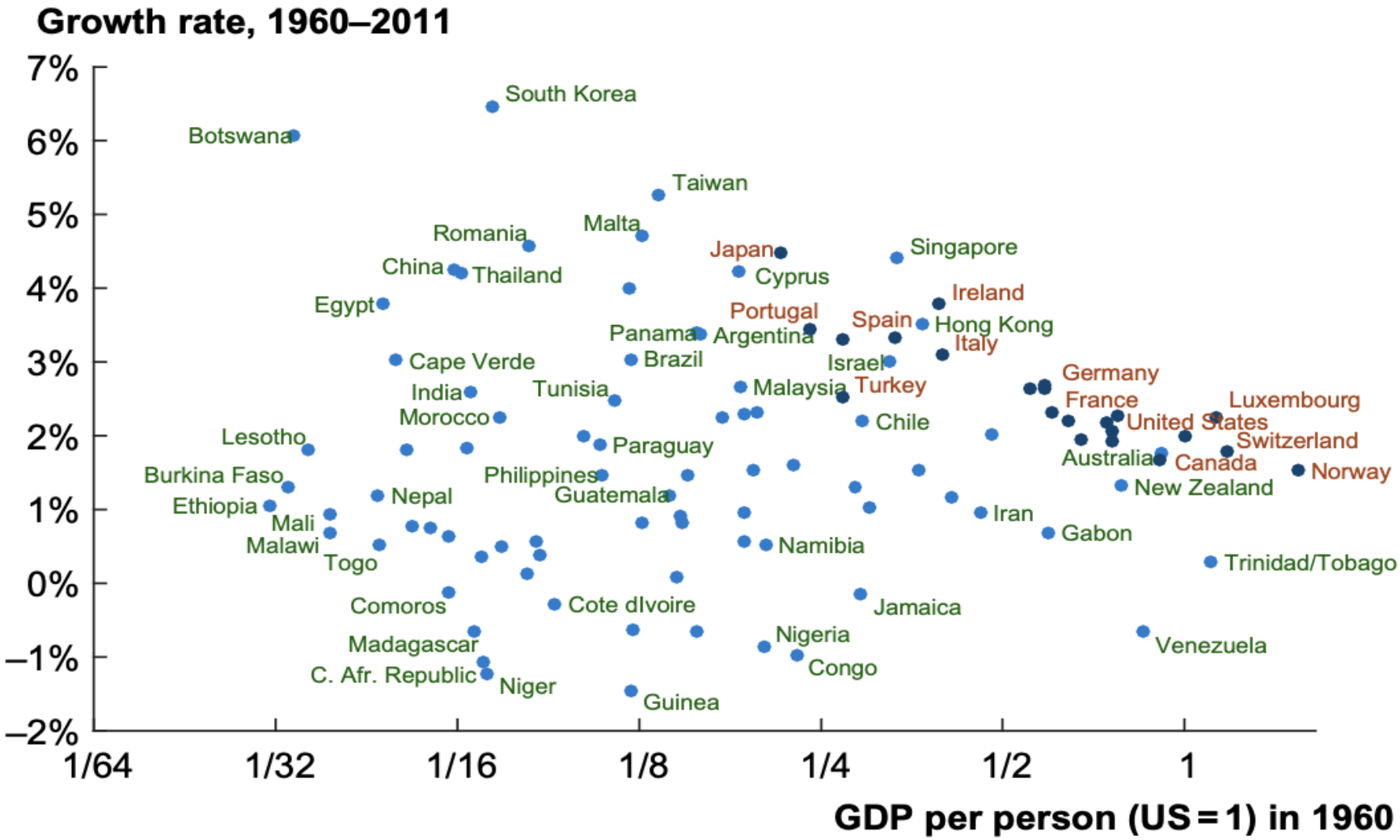
Outline

Do Poorer Countries Grow Faster?



Convergence amongst OECD countries. Source: Jones (2016).

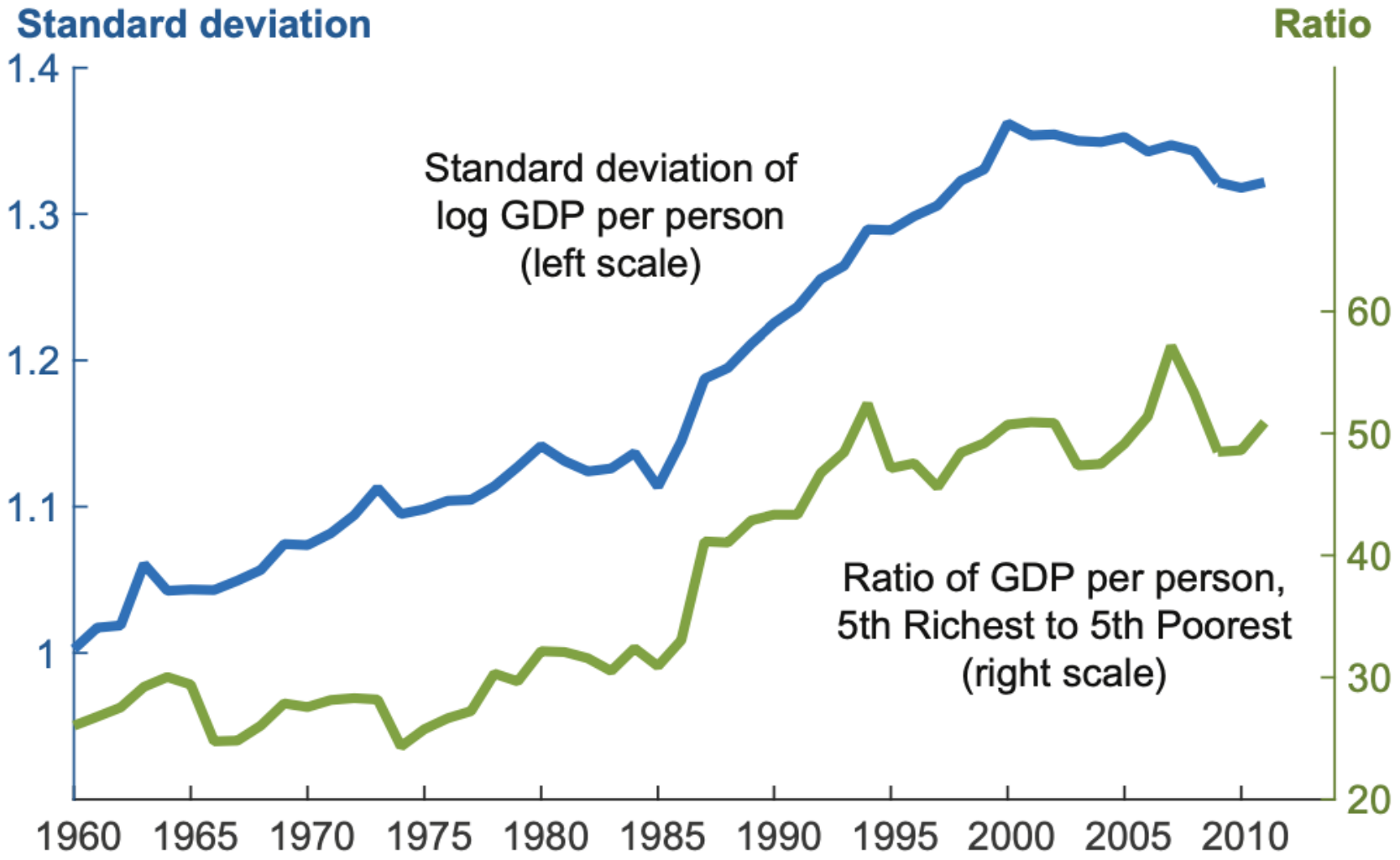
Do Poorer Countries Grow Faster?



But lack of convergence worldwide. Source: Jones (2016). Note: most growth models predict convergence only *conditional* on underlying parameters.

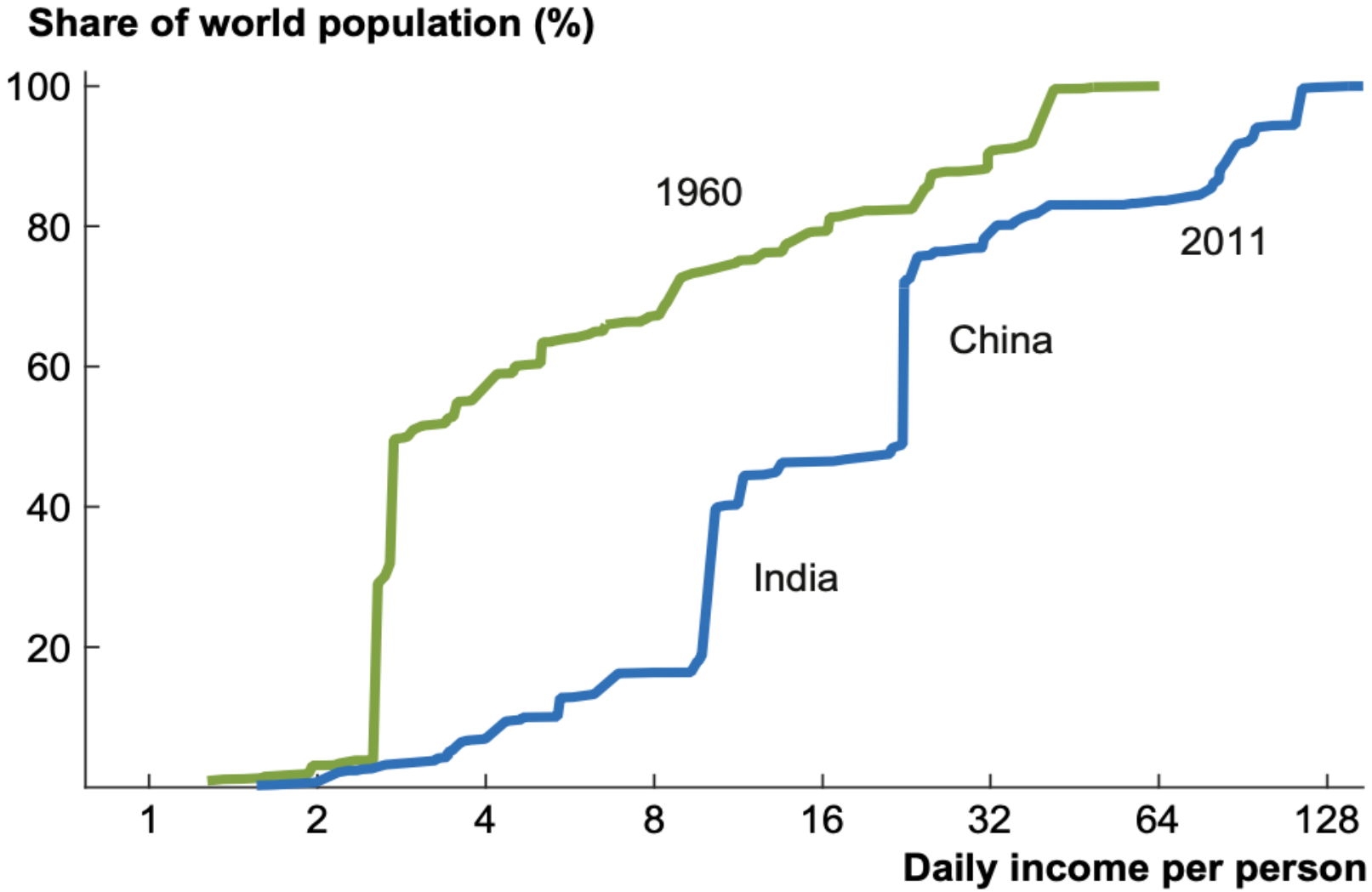
Outline

Increase in Cross-Country Dispersion



Increase in cross-country dispersion in real GDP per person since 1960. Source: Jones (2016), using data from the Penn World Tables. Each observation is a country.

Distribution of Income By Person



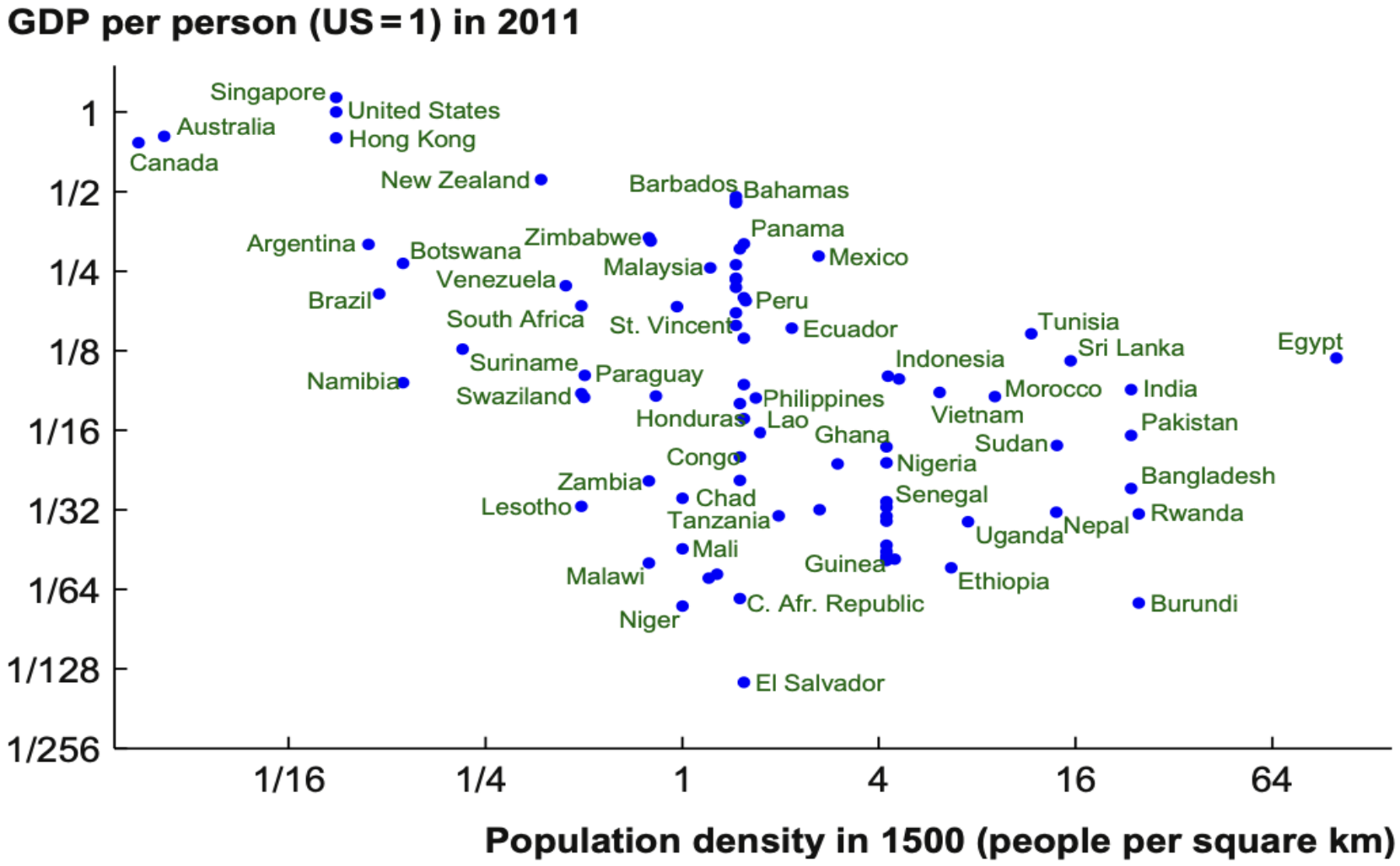
Each person in a country is assigned that country's real GDP per person, so abstracts from within-country income distribution. Source: Jones (2016).

Outline

Institutions and Allocative Efficiency

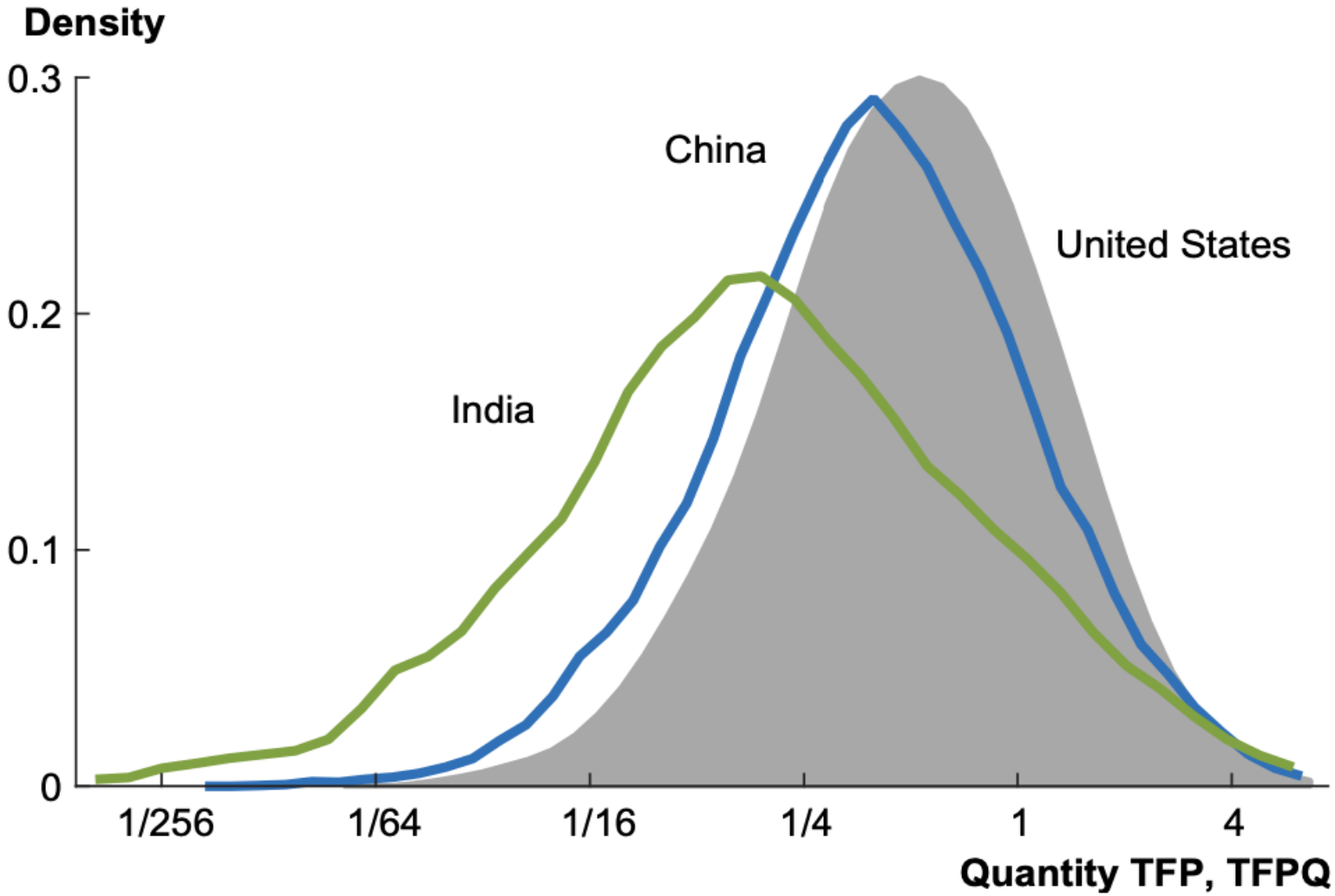
- Most decompositions of output per person across countries assign a large role to a productivity *residual* — 'total factor productivity'.
- Recent literature emphasizes this productivity residual may depend on
  - *institutions*, i.e., political and legal environment
  - *allocative efficiency*, i.e., distribution of economic activity across households and firms
- Moreover these may interact in important ways
  - institutions determine how economic rents are distributed
  - did economic rents from natural resources in European colonies encourage relatively 'extractive' institutions? (Engerman and Sokoloff 1997, Acemoglu et al 2002)
  - formal or informal race or sex etc discrimination affects allocative efficiency (Hsieh et al 2019)

Reversal of Fortune



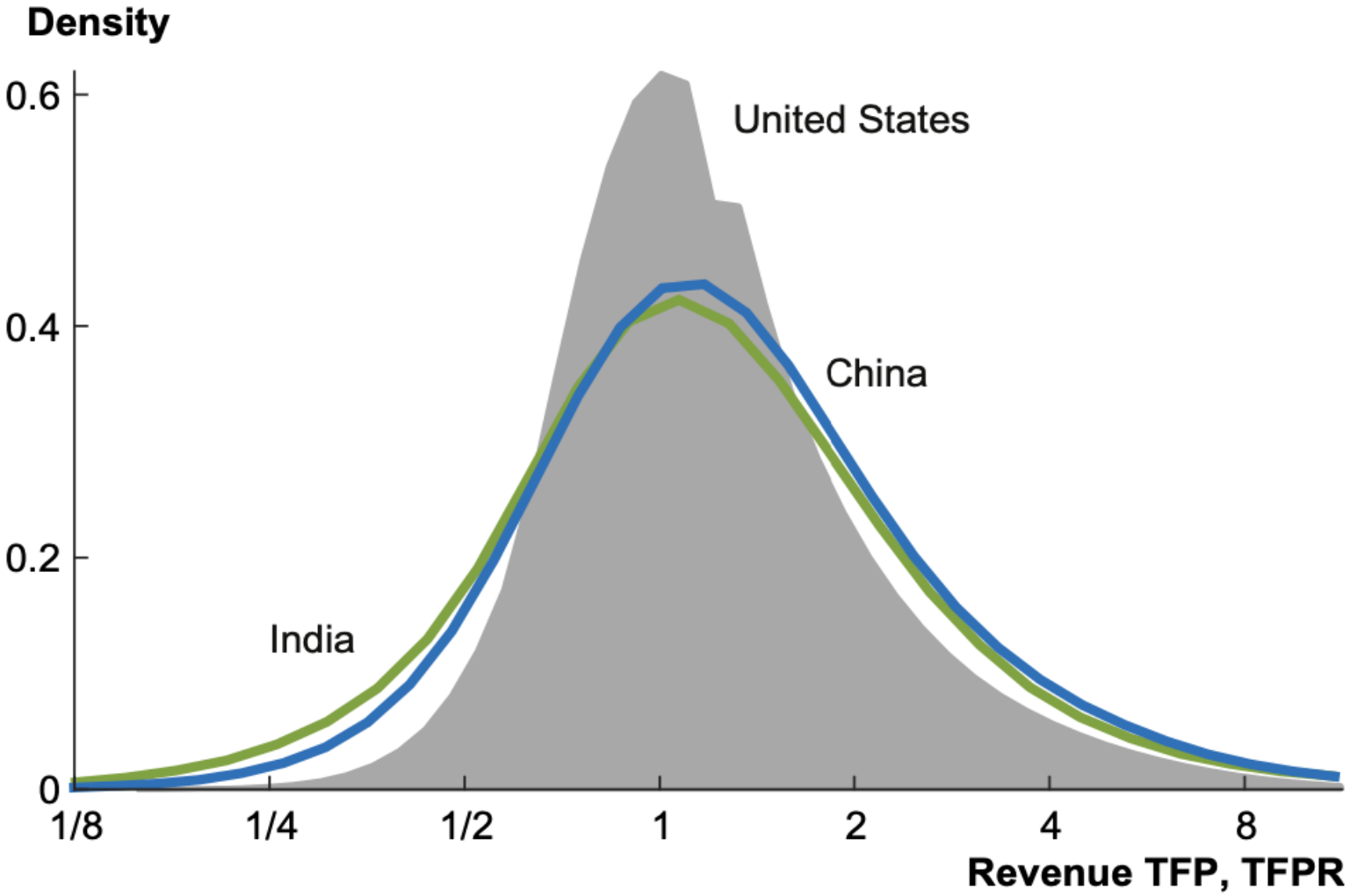
Past prosperity of former European colonies (measured by population density) negatively correlated with current prosperity. Source: Jones (2016), drawing on Acemoglu et al (2002).

Distribution of Physical Productivity



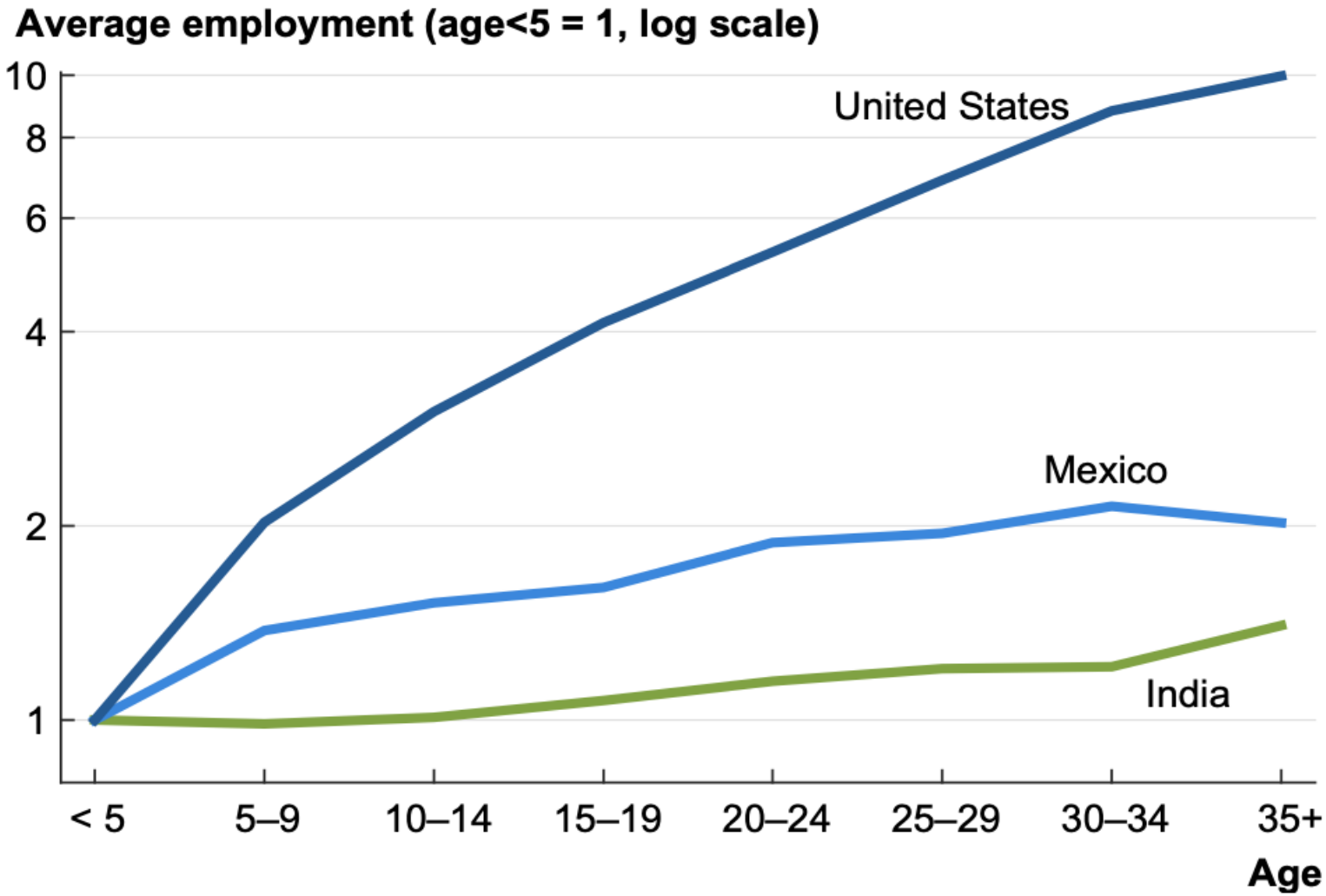
Physical productivity within 4-digit manufacturing industries. Source: Jones (2016), from Hsieh and Klenow (2009).

Distribution of Revenue Productivity



Revenue productivity within 4-digit manufacturing industries. Equals 1 if no distortions. Source: Jones (2016), from Hsieh and Klenow (2009).

Life-Cycle Employment of Manufacturing Plants



Average employment per surviving plant relative to young plants, within cohort. Source: Jones (2016), from Hsieh and Klenow (2014).

Looking Ahead

- Introduce workhorse models of economic growth.
  - build intuition, to understand possible mechanisms at work (i.e., causes of differences in growth over time and across countries)
  - find ways to quantitatively evaluate mechanisms
- Focus on *proximate* causes of economic growth — physical capital, human capital, and technology.
- But keep in mind, relative importance of proximate causes are themselves entwined with other structural factors and historical contingency.

Next Class

- Solow growth model.
- Capital-labor substitution.
- Diminishing returns to capital — why we might expect poorer countries to grow faster than richer ones 'other things equal'.

‘Homework’

- You can get the Penn World Tables here

  https://www.rug.nl/ggdc/productivity/pwt/

- Download the data and have some fun with it.