# Econ 702

# Macroeconomics I

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Spring 2020

## Lecture 1: Introductory Material and Macroeconomic Variables

We examine the behavior of the macroeconomy (output, prices) in the short-run, medium run and long-run.

Main textbook:

Garín, Julio; Robert Lester; and, Eric Sims. 2018. Intermediate Macroeconomics. https://www3.nd.edu/~esims1/gls_textbook.html

There are also additional readings on the syllabus.

The readings are required. They are not a perfect substitute for attending lectures. We expect you to read and learn from the readings.

The lectures are required. The lectures are aimed at putting the readings into context and illuminating difficult parts of the models, and introducing new ideas.

**Topic/Reading**

1/22 Introduction and Macro Data

Garín, Lester and Sims, Chapters 1, 2 and 3

Engel, Charles. 2017. "Econ 666 Notes. Chapter 1: Balance of Payments Accounting and National Income Accounting." Pages 28-37.

Furman, Jason. 2016. "Extracting the Signal from the Noise: Seven Tips for Interpreting Macroeconomic Data." Milken Institute Review http://www.milkenreview.org/articles/extracting-the-signal-from-the-noise-7-tips-for-interpreting-macroeconomic-data

1/27 International Comparisons

Garín, Lester and Sims, Chapter 4.

Central Intelligence Agency, The World Factbook. "Economy" section for China, Colombia, Czechia, India, South Korea, United States.

1/29 Solow Growth Model

Garín, Lester and Sims, Chapter 5, section 5.1

2/3 Solow Growth Model

Garín, Lester and Sims, Chapter 5, sections 5.2-5.3

2/5 Solow Growth Model

Garín, Lester and Sims, Chapter 5, sections 5.4-5.6

Lucas, Robert E. Jr. 1988. "On the Mechanics of Economic Development." Journal of Monetary Economics 22. Pages 3-17.

2/10 Augmented Solow Growth Model

Garín, Lester and Sims, Chapter 6

2/12 Cross-Country Income Differences

Garín, Lester and Sims, Chapter 7

Acemoglu, Daron; Simon Johnson; and, James A. Robinson. 2005. "Institutions as a Fundamental Cause of Long-Run Growth," in Philippe Aghion and Steven Durlauf, eds., Handbook of Economic Growth, vol. 1, part A, 385-472.

Zillibotti, Fabrizio. 2017. "Growing and Slowing Down Like China." Journal of the European Economic Association 15, 943-947, 952-988.

2/17 Consumption-Saving Model

Garín, Lester and Sims, Chapter 9, sections 9.1-9.3

2/19 Consumption-Saving Model

Garín, Lester and Sims, Chapter 9, section 9.4

2/24 Overlapping Generations

Garín, Lester and Sims, Chapter 8

2/26 Neoclassical Model

Garín, Lester and Sims, Chapter 17

3/2 Shocks in Neoclassical Model

Garín, Lester and Sims, Chapter 18

3/4 Taking the Neolcassical Model to the Data

Garín, Lester and Sims, Chapter 19

Rebelo, Sergio. 2005. "Real Business Cycle Models: Past, Present and Future." Scandinavian Journal of Economics 107, 217-238.

3/9 Wrap-up on Neolcassical Model

Garín, Lester and Sims, Chapters 20 and 21

3/11 New Keynesian IS-LM-AD

Garín, Lester and Sims, Chapter 23

Gali, Jordi, "The State of New Keynesian Economics: A Partial Assessment," JEP 2018. https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.32.3.87

3/23 New Keynesian Supply Side

Garín, Lester and Sims, Chapter 24

Nakamura, Emi, and Jón Steinsson. "Price rigidity: Microeconomic evidence and macroeconomic implications." Annu. Rev. Econ. 5.1 (2013): 133-163. NBER WP

3/25 New Keynesian Supply Side

Garín, Lester and Sims, Chapter 24

Coibion, Olivier, Yuriy Gorodnichenko, and Rupal Kamdar. "The formation of expectations, inflation, and the phillips curve." Journal of Economic Literature 56.4 (2018): 1447-91.

3/30 Shocks in the New Keynesian Model

Garín, Lester and Sims, Chapter 25

4/1 Shocks in the New Keynesian Model

Garín, Lester and Sims, Chapter 25

4/6 Dynamics in the New Keynesian Model

Garín, Lester and Sims, Chapter 26

Ahmed, Shaghil, Andrew Levin, and Beth Anne Wilson. "Recent US macroeconomic stability: good policies, good practices, or good luck?." *Review of economics and statistics* 86.3 (2004): 824-832. https://www.federalreserve.gov/pubs/ifdp/2002/730/ifdp730.pdf

4/8 Dynamics in the New Keynesian Model

Garín, Lester and Sims, Chapter 26

4/13 Monetary Policy

Garín, Lester and Sims, Chapter 27

Orphanides, Athanasios, and Simon van Norden. "The unreliability of output-gap estimates in real time." *Review of economics and statistics* 84.4 (2002): 569-583. https://www.federalreserve.gov/Pubs/FEDS/1999/199938/199938pap.pdf

4/15 Monetary Policy

Garín, Lester and Sims, Chapter 27

Hamilton, James D., et al. "The equilibrium real funds rate: Past, present, and future." *IMF Economic Review* 64.4 (2016): 660-707. https://econweb.ucsd.edu/~jhamilto/USMPF_2015.pdf

4/20 Zero Lower Bound

Garín, Lester and Sims, Chapter 28

Kuttner, "Outside the Box: Unconventional Monetary Policy in the Great Recession and Beyond," Journal of Economic Perspectives 32(4) (Fall 2018). https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.32.4.121

4/22 Bond Pricing and the Term Structure

Garín, Lester and Sims, Chapter 33

Chinn, Menzie and Kavan Kucko, "The Predictive Power of the Yield Curve across Countries and Time," International Finance (March 2015) http://www.ssc.wisc.edu/~mchinn/Chinn_Kucko_IF2015.pdf

4/27 Financial Frictions

Garín, Lester and Sims, Chapter 35

Bernanke, Gertler and Gilchrist, "The Financial Accelerator and the Flight to Quality," The Review of Economics and Statistics 78(1). (Feb., 1996): 1-15. http://www.ssc.wisc.edu/~mchinn/bernanke_etal_restat96.pdf

4/29 Review

Course website (for my half of the class):

https://ssc.wisc.edu/~cengel/Econ702/Econ702

Office hours: TTh 1:30-3:00, and by appointment
7460 Sewell Social Sciences Building

Email: cengel@ssc.wisc.edu
Cell (please text only, no phone calls): 608-335-6986
WeChat ID: cengel1111

Mid-Term Exam after my last lecture on March 9th.

## Thinking Like a Macroeconomist

We need to think about the general equilibrium effects of shocks or policy changes. For example:

Effects of income tax on labor supply

**Endogenous** and **exogenous** variables.

- Endogenous variables are economic variables that are determined within our model
- Exogenous variables are ones that are outside the scope of our theory.
- Which variables should be treated as endogenous and which as exogenous is often a matter of judgment by the economist. It depends on which set of assumptions works best for understanding the economic problem at hand.

The measure of general economic activity that we use most often is Gross Domestic Product (GDP)

- GDP measures the value of final output of goods and services produced in a country over a given time period.

Begin by thinking about a closed economy. These three ways to think about GDP are equivalent:

- The value of goods and services produced in the economy

- The value of expenditure on goods and services
  Note the "trick" played with goods added to inventories

- The value of income earned

Nominal GDP is the "dollar" value of output:

$$\text{GDP}_t = p_{1,t}y_{1,t} + p_{2,t}y_{2,t} + \cdots + p_{n,t}y_{n,t} = \sum_{i=1}^{n} p_{i,t}y_{i,t}$$

Nominal GDP could increase either because output increased or prices increased. Real GDP measures change due to increases in output. We can measure value of GDP at some "base" year prices:

$$Y_t = p_{1,t}y_{1,t} + p_{2,t}y_{2,t} + \cdots + p_{n,t}y_{n,t}$$

$$Y_{t+1} = p_{1,t}y_{1,t+1} + p_{2,t}y_{2,t+1} + \cdots + p_{n,t}y_{n,t+1}$$

$$Y_{t+2} = p_{1,t}y_{1,t+2} + p_{2,t}y_{2,t+2} + \cdots + p_{n,t}y_{n,t+2}.$$

Since $Y_{t+j} / Y_t$ measures the growth in output from increased production, we ought to then be able to also back out the rate of increase of prices – that is, inflation.

$$P_t = \frac{p_{1,t}y_{1,t} + p_{2,t}y_{2,t} + \cdots + p_{n,t}y_{n,t}}{p_{1,t}y_{1,t} + p_{2,t}y_{2,t} + \cdots + p_{n,t}y_{n,t}} = 1$$

$$P_{t+1} = \frac{p_{1,t+1}y_{1,t+1} + p_{2,t+1}y_{2,t+1} + \cdots + p_{n,t+1}y_{n,t+1}}{p_{1,t}y_{1,t+1} + p_{2,t}y_{2,t+1} + \cdots + p_{n,t}y_{n,t+1}}$$

$$P_{t+2} = \frac{p_{1,t+2}y_{1,t+2} + p_{2,t+2}y_{2,t+2} + \cdots + p_{n,t+2}y_{n,t+2}}{p_{1,t}y_{1,t+2} + p_{2,t}y_{2,t+2} + \cdots + p_{n,t}y_{n,t+2}}.$$

The gross rate of inflation between $t$ and $t+1$ is given by $P_{t+1} / P_t$

Notice we can write $P_{t+1}$ as a weighted average of prices. The denominator in the expression is

$$Y_{t+1} = p_{1,t}y_{1,t+1} + p_{2,t}y_{2,t+1} + \cdots + p_{n,t}y_{n,t+1}$$

We can write

$$P_{t+1} = \frac{p_{1,t}y_{1,t+1}}{Y_{t+1}} \cdot \frac{p_{1,t+1}}{p_{1,t}} + \frac{p_{2,t}y_{2,t+1}}{Y_{t+1}} \cdot \frac{p_{2,t+1}}{p_{2,t}} + \ldots + \frac{p_{n,t}y_{n,t+1}}{Y_{t+1}} \cdot \frac{p_{n,t+1}}{p_{n,t}}$$

The overall price level in period $t+1$ relative to period $t$ is a weighted average of the gross inflation rates for each good. The weights are the share of good $i$ in real GDP.

In these examples, we used the *base* year prices to weight output when we calculate real output growth:

$$\frac{Y_{t+1}}{Y_t} = \frac{p_{1,t}y_{1,t+1} + p_{2,t}y_{2,t+1} + \ldots + p_{n,t}y_{n,t+1}}{p_{1,t}y_{1,t} + p_{2,t}y_{2,t} + \ldots + p_{n,t}y_{n,t}}.$$

You could alternatively use *current* year prices:

$$\frac{\tilde{Y}_{t+1}}{\tilde{Y}_t} = \frac{p_{1,t+1}y_{1,t+1} + p_{2,t+1}y_{2,t+1} + \ldots + p_{n,t+1}y_{n,t+1}}{p_{1,t+1}y_{1,t} + p_{2,t+1}y_{2,t} + \ldots + p_{n,t+1}y_{n,t}}$$

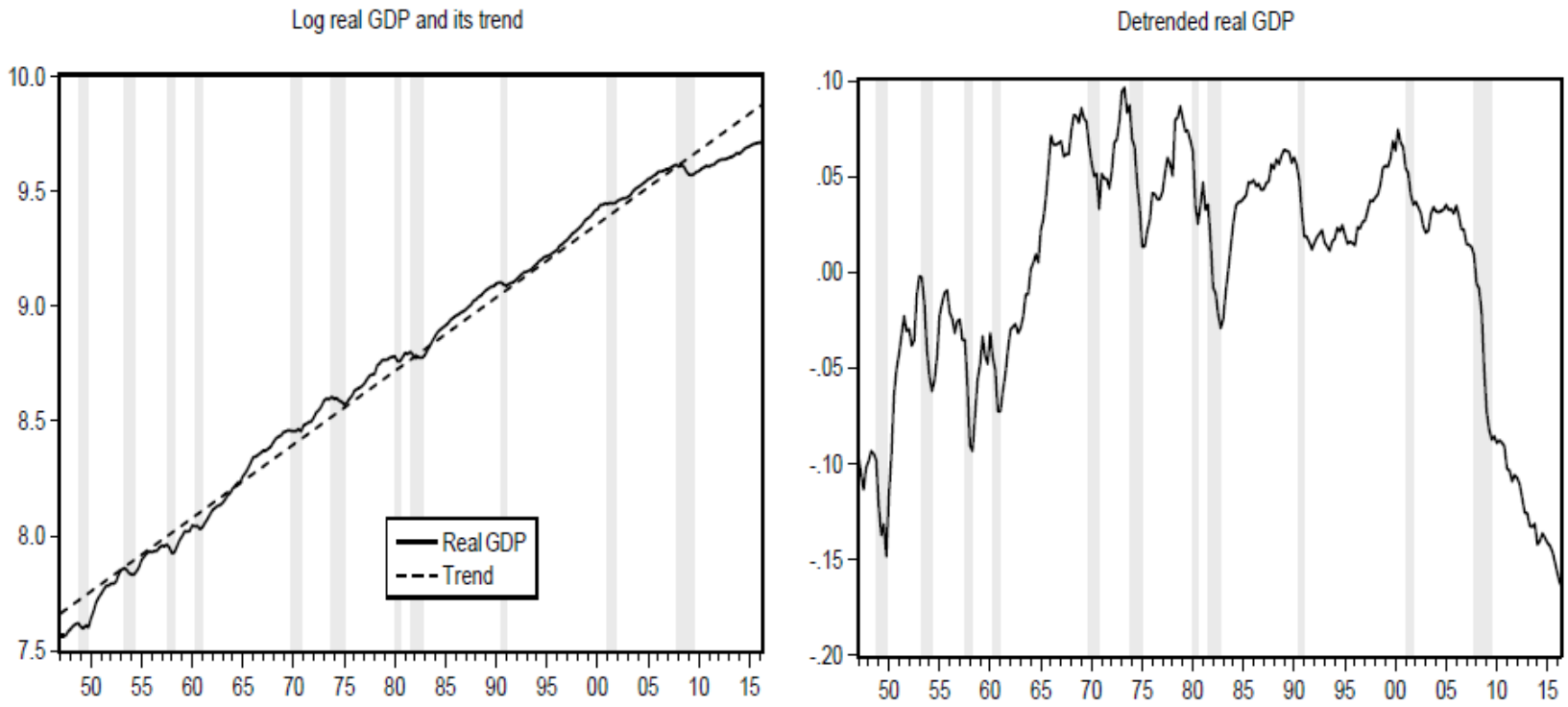
The U.S. calculates GDP growth as a geometric average of $\frac{Y_{t+1}}{Y_t}$ and $\frac{\tilde{Y}_{t+1}}{\tilde{Y}_t}$

The inflation rate we were just discussing is the inflation based on the GDP deflator. It measures the rate of inflation of prices of our output.

The Consumer Price Index (CPI) measures the rate of inflation of goods and services that consumers purchase.

It is also a weighted average of inflation of prices of individual goods. The weights are based on consumer expenditure shares (which are calculated periodically.)

Figure 1.3: Real GDP




Please read the paper on the reading list by Jason Furman.

One thing the paper discusses is data revisions.

Figure 1.4: GDP Deflator

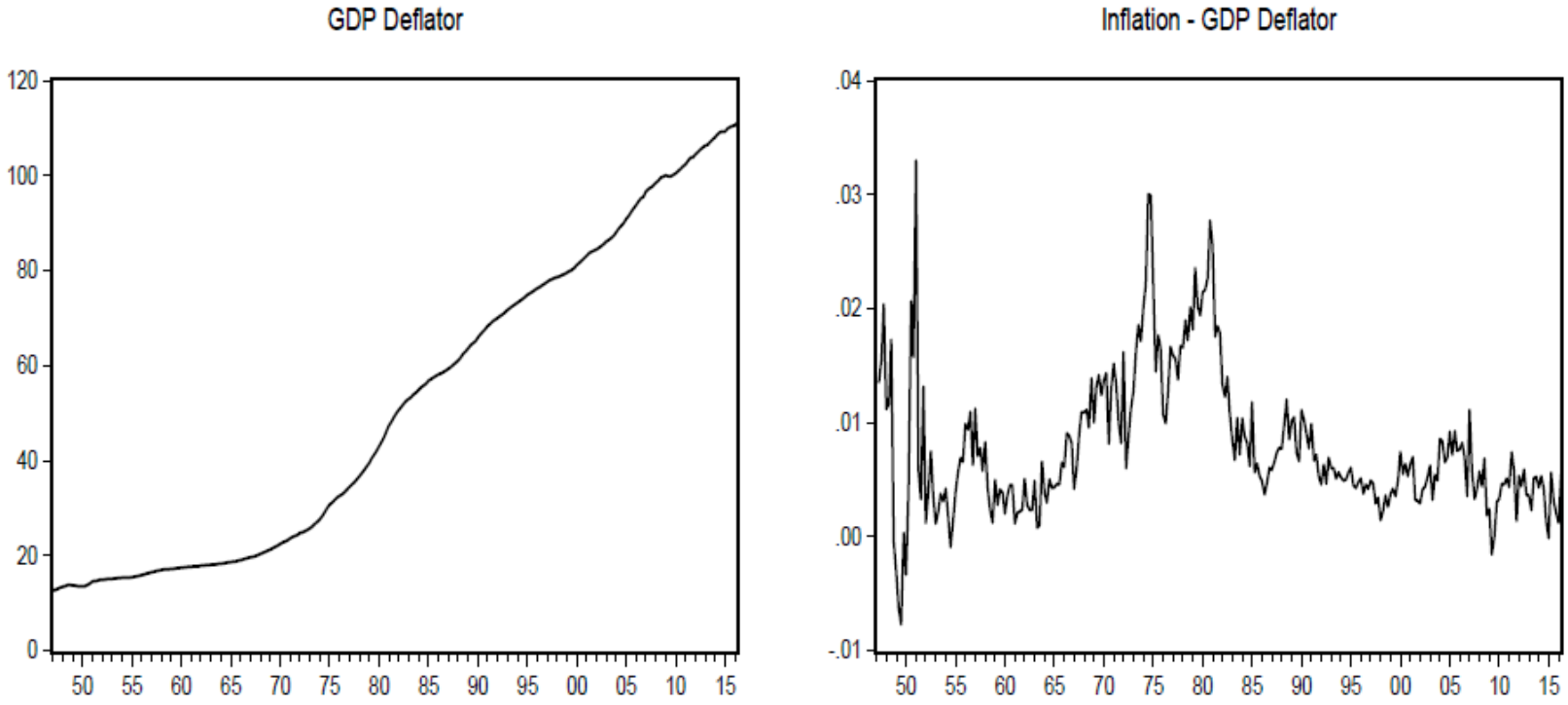
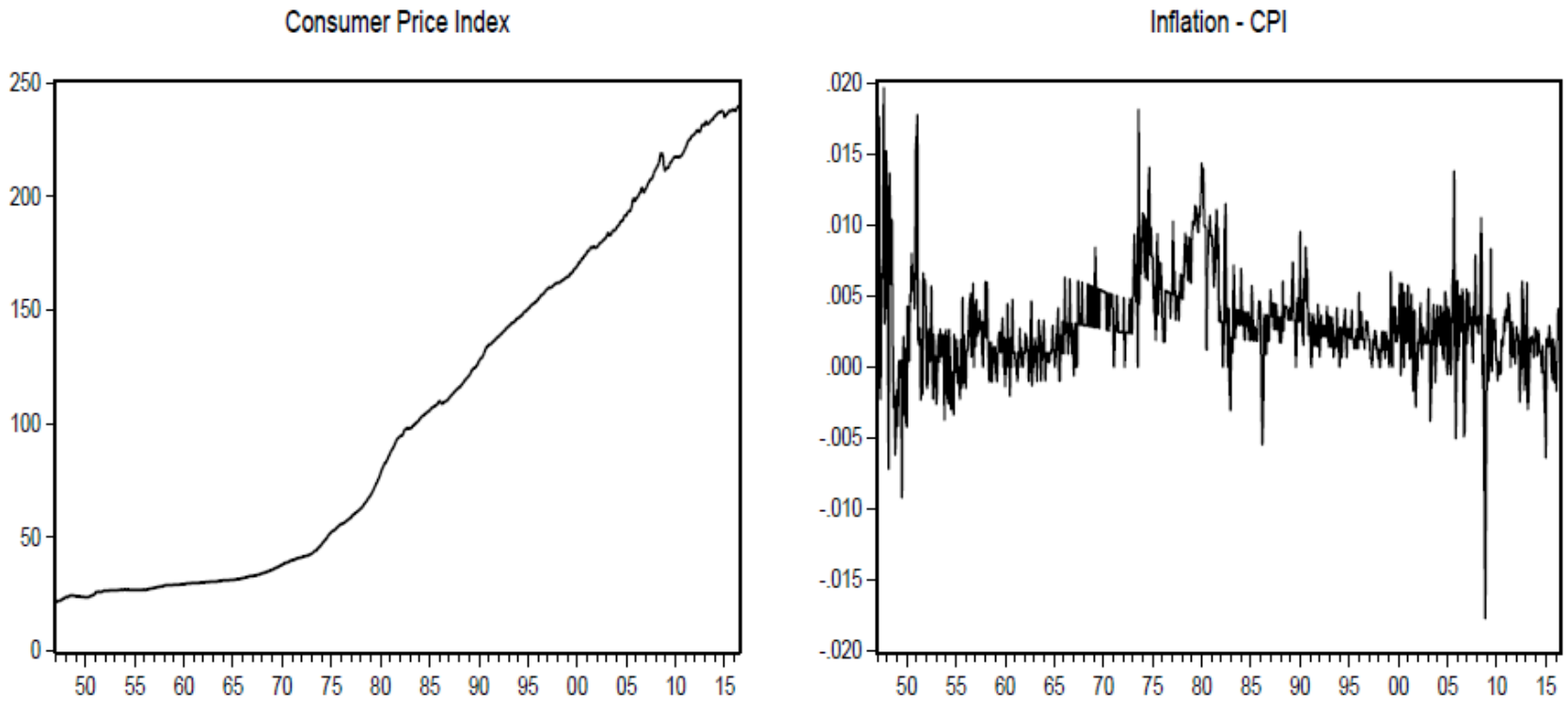


Figure 1.5: CPI




Notice how volatile CPI inflation is. Should we base our measurement of current inflation on the change in the CPI over the past month?

Again, please read the Furman paper.

GDP from the expenditure side:

$$GDP = C + I + G$$

*C* – expenditure by households on newly produced consumption goods and services.

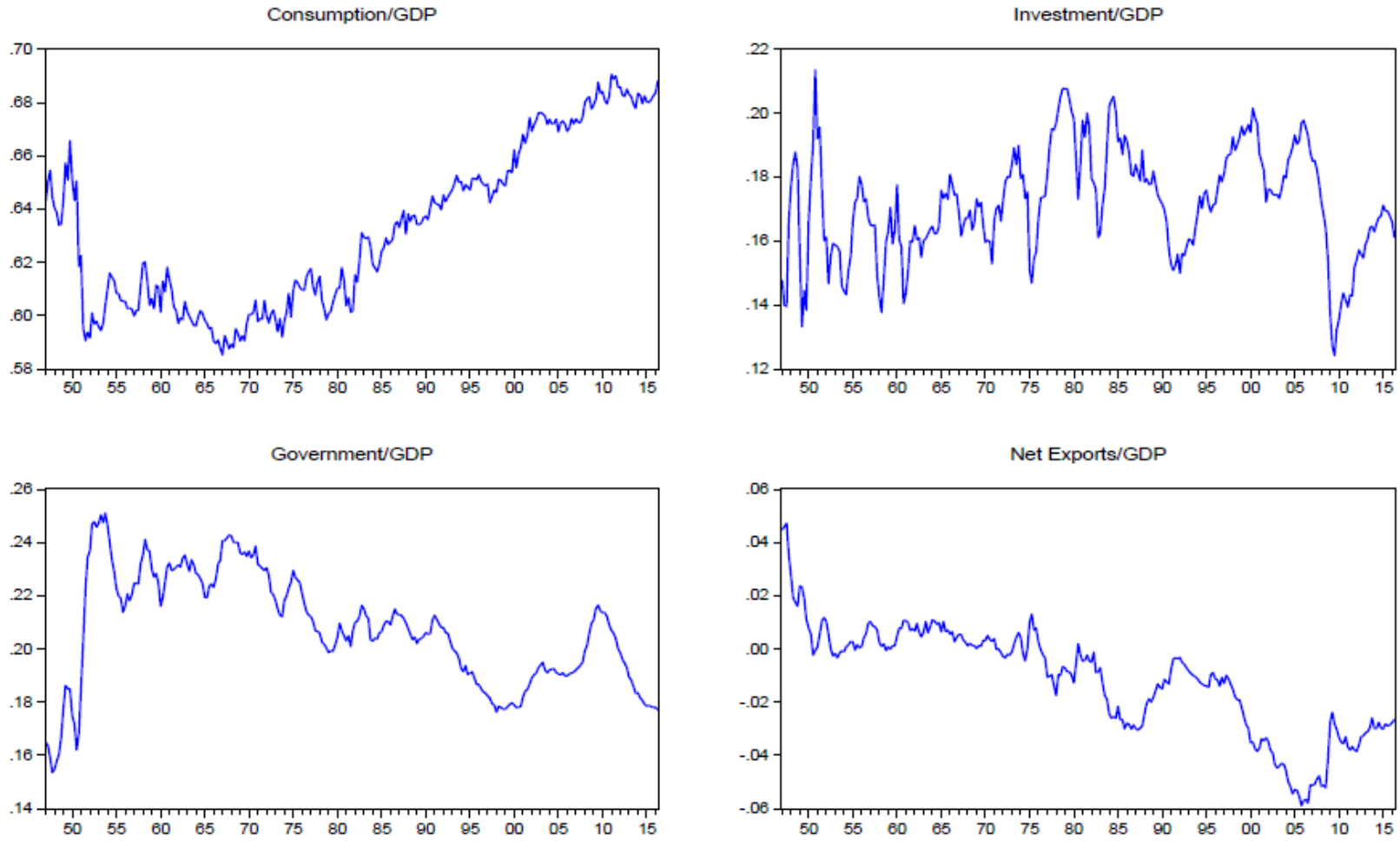
*I* – expenditure, mostly by businesses, on capital goods (machinery, factories, office buildings, computers, etc.) Includes new homes that are built. Includes inventory investment. This is spending on final goods – not on intermediate goods.

*G* – government spending on goods and services. Does not include transfer payments. (We call it government *outlays* when we refer to all money in the government budget including transfers.)

## Table 1. Real Gross Domestic Product and Related Measures: Percent Change From Preceding Period

| Line | | 2016 | 2017 | 2018 | Seasonally adjusted at annual rates | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2015 | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | | |
| | | | | | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3[r] |
| 1 | **Gross domestic product (GDP)** | **1.6** | **2.4** | **2.9** | **0.1** | **2.0** | **1.9** | **2.2** | **2.0** | **2.3** | **2.2** | **3.2** | **3.5** | **2.5** | **3.5** | **2.9** | **1.1** | **3.1** | **2.0** | **2.1** |
| 2 | **Personal consumption expenditures** | **2.7** | **2.6** | **3.0** | **1.8** | **3.2** | **2.9** | **2.6** | **2.5** | **2.4** | **2.4** | **2.4** | **4.6** | **1.7** | **4.0** | **3.5** | **1.4** | **1.1** | **4.6** | **3.2** |
| 3 | Goods | 3.6 | 3.9 | 4.1 | 1.5 | 4.2 | 4.5 | 4.0 | 1.9 | 3.2 | 5.5 | 4.1 | 7.5 | 1.3 | 5.4 | 3.6 | 1.6 | 1.5 | 8.6 | 5.3 |
| 4 | Durable goods | 6.1 | 6.9 | 6.3 | 2.3 | 5.8 | 7.0 | 10.8 | 5.8 | 3.4 | 7.7 | 7.8 | 12.2 | 2.3 | 8.0 | 3.6 | 1.3 | 0.3 | 13.0 | 8.1 |
| 5 | Nondurable goods | 2.4 | 2.5 | 3.0 | 1.1 | 3.4 | 3.2 | 0.6 | 0.0 | 3.1 | 4.3 | 2.2 | 5.1 | 0.7 | 4.1 | 3.6 | 1.7 | 2.2 | 6.5 | 3.9 |
| 6 | Services | 2.3 | 2.0 | 2.5 | 2.0 | 2.7 | 2.2 | 1.9 | 2.8 | 2.0 | 1.0 | 1.6 | 3.4 | 1.9 | 3.4 | 3.4 | 1.4 | 1.0 | 2.8 | 2.2 |
| 7 | **Gross private domestic investment** | **-1.3** | **4.4** | **5.1** | **-6.0** | **-1.6** | **-1.7** | **0.5** | **9.3** | **3.4** | **3.6** | **7.4** | **4.7** | **6.2** | **-1.8** | **13.7** | **3.0** | **6.2** | **-6.3** | **-1.0** |
| 8 | Fixed investment | 1.9 | 4.2 | 4.6 | -2.2 | 2.6 | 2.7 | 3.8 | 2.0 | 7.7 | 2.8 | 1.4 | 8.7 | 5.5 | 5.2 | 0.7 | 2.7 | 3.2 | -1.4 | -0.8 |
| 9 | Nonresidential | 0.7 | 4.4 | 6.4 | -4.4 | -0.6 | 4.0 | 5.6 | 0.7 | 6.6 | 4.4 | 2.4 | 8.4 | 8.8 | 7.9 | 2.1 | 4.8 | 4.4 | -1.0 | -2.3 |
| 10 | Structures | -5.0 | 4.7 | 4.1 | -20.5 | -11.4 | 10.0 | 18.4 | 2.4 | 7.3 | 2.0 | -7.7 | 5.2 | 12.1 | 11.0 | -2.1 | -9.0 | 4.0 | -11.1 | -9.9 |
| 11 | Equipment | -1.3 | 4.7 | 6.8 | -4.8 | -3.9 | -2.3 | 0.3 | 0.4 | 6.3 | 8.9 | 6.2 | 12.9 | 6.6 | 3.4 | 2.9 | 7.4 | -0.1 | 0.8 | -3.8 |
| 12 | Intellectual property products | 7.9 | 3.7 | 7.4 | 9.8 | 12.9 | 9.3 | 4.7 | 0.0 | 6.3 | 0.3 | 4.9 | 4.7 | 9.7 | 11.9 | 4.1 | 11.7 | 10.8 | 3.6 | 4.7 |
| 13 | Residential | 6.5 | 3.5 | -1.5 | 6.6 | 14.7 | -2.0 | -2.6 | 6.4 | 11.9 | -2.2 | -2.0 | 9.9 | -5.3 | -3.7 | -4.0 | -4.7 | -1.0 | -3.0 | 4.6 |
| 14 | Change in private inventories | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 15 | **Net exports of goods and services** | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 16 | Exports | 0.0 | 3.5 | 3.0 | -1.6 | -3.0 | 4.0 | 6.1 | -2.5 | 6.1 | 1.6 | 4.4 | 10.1 | 0.8 | 5.8 | -6.2 | 1.5 | 4.1 | -5.7 | 1.0 |
| 17 | Goods | 0.6 | 3.9 | 4.3 | -4.1 | 0.9 | 2.7 | 7.2 | -0.8 | 5.9 | 2.2 | 2.2 | 13.6 | 1.2 | 12.0 | -9.1 | 2.6 | 4.6 | -5.9 | 2.1 |
| 18 | Services | -1.1 | 2.7 | 0.7 | 3.4 | -10.0 | 6.2 | 4.1 | -5.7 | 6.3 | 0.4 | 8.8 | 3.8 | -0.1 | -5.3 | -0.1 | -0.7 | 3.3 | -5.1 | -1.3 |
| 19 | Imports | 2.0 | 4.7 | 4.4 | 0.0 | 0.9 | 0.8 | 4.7 | 7.5 | 4.1 | 3.5 | 1.3 | 14.0 | 0.6 | 0.3 | 8.6 | 3.5 | -1.5 | 0.0 | 1.8 |
| 20 | Goods | 1.5 | 4.8 | 5.0 | -0.8 | -0.1 | 1.1 | 3.7 | 8.1 | 4.1 | 3.4 | 0.9 | 16.4 | 1.4 | 0.8 | 9.2 | 2.3 | -2.8 | 0.1 | 1.1 |
| 21 | Services | 4.4 | 4.4 | 1.6 | 3.5 | 5.4 | -0.4 | 9.1 | 5.2 | 3.8 | 4.0 | 2.8 | 4.5 | -2.8 | -2.0 | 6.1 | 8.9 | 4.5 | -0.7 | 4.8 |
| 22 | **Government consumption expenditures and gross investment** | **1.8** | **0.7** | **1.7** | **1.1** | **3.8** | **-0.7** | **1.7** | **1.1** | **-0.2** | **1.4** | **-0.1** | **2.4** | **1.9** | **2.6** | **2.1** | **-0.4** | **2.9** | **4.8** | **1.7** |
| 23 | Federal | 0.4 | 0.8 | 2.9 | 2.5 | 0.7 | -2.7 | 2.0 | 0.6 | -1.2 | 3.3 | 0.1 | 4.6 | 2.8 | 3.9 | 2.9 | 1.1 | 2.2 | 8.3 | 3.3 |
| 24 | National defense | -0.6 | 0.7 | 3.3 | 2.8 | -0.4 | -5.2 | 3.4 | -1.0 | -1.9 | 6.8 | -1.6 | 4.5 | 0.6 | 7.5 | 3.0 | 5.2 | 7.7 | 3.3 | 2.2 |
| 25 | Nondefense | 2.0 | 0.8 | 2.4 | 2.1 | 2.2 | 1.0 | -0.1 | 2.8 | -0.2 | -1.6 | 2.6 | 4.8 | 6.0 | -1.0 | 2.8 | -4.5 | -5.4 | 16.1 | 5.0 |
| 26 | State and local | 2.6 | 0.6 | 1.0 | 0.2 | 5.8 | 0.5 | 1.6 | 1.4 | 0.3 | 0.3 | -0.2 | 1.1 | 1.4 | 1.8 | 1.6 | -1.2 | 3.3 | 2.7 | 0.7 |

Figure 1.2: GDP Components as a Share of Total GDP



When output is sold, the proceeds go as income to somebody – as wages to workers, or profits to firm owners, or rents to owners of factories and land.

If we sell $10 of bread, maybe $5 goes toward paying workers who made the bread. Maybe $2 goes to the business owner.

$3 goes to pay for the ingredients – the flour, etc. to make the dough. But that $3 is income for somebody in the flour mill – the worker, the firm owner, etc.

So GDP measures not only the value of our output, but also the value of income earned.

[Billions of dollars]

| Line | | 2016 | 2017 | 2018 | Seasonally adjusted at annual rates | | | | | Line |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2018 | | 2019 | | | |
| | | | | | Q3 | Q4 | Q1 | Q2 | Q3[r] | |
| 1 | **Personal income** [1] | **16,121.2** | **16,878.8** | **17,819.2** | **17,928.5** | **18,082.8** | **18,355.4** | **18,555.9** | **18,718.4** | 1 |
| 2 | Compensation of employees | 9,960.3 | 10,411.6 | 10,928.5 | 10,994.3 | 11,057.4 | 11,306.6 | 11,386.9 | 11,489.0 | 2 |
| 3 | Wages and salaries | 8,083.5 | 8,462.1 | 8,888.5 | 8,942.2 | 8,990.0 | 9,211.5 | 9,273.6 | 9,354.0 | 3 |
| 4 | Supplements to wages and salaries | 1,876.8 | 1,949.5 | 2,040.0 | 2,052.0 | 2,067.4 | 2,095.1 | 2,113.3 | 2,135.1 | 4 |
| 5 | Proprietors' income with inventory valuation and capital consumption adjustments | 1,423.7 | 1,518.2 | 1,588.8 | 1,590.0 | 1,624.4 | 1,621.2 | 1,632.9 | 1,683.4 | 5 |
| 6 | Farm | 35.6 | 38.1 | 27.2 | 17.4 | 35.9 | 24.8 | 19.2 | 41.8 | 6 |
| 7 | Nonfarm | 1,388.1 | 1,480.1 | 1,561.6 | 1,572.6 | 1,588.4 | 1,596.3 | 1,613.7 | 1,641.5 | 7 |
| 8 | Rental income of persons with capital consumption adjustment | 681.4 | 718.8 | 756.8 | 765.2 | 764.1 | 767.0 | 777.2 | 779.7 | 8 |
| 9 | Personal income receipts on assets | 2,521.4 | 2,681.6 | 2,930.1 | 2,957.7 | 3,002.0 | 2,955.1 | 3,016.5 | 2,997.7 | 9 |
| 10 | Personal interest income | 1,457.4 | 1,551.6 | 1,702.7 | 1,719.3 | 1,727.2 | 1,699.3 | 1,750.5 | 1,716.8 | 10 |
| 11 | Personal dividend income | 1,064.0 | 1,130.0 | 1,227.5 | 1,238.4 | 1,274.8 | 1,255.8 | 1,266.0 | 1,280.9 | 11 |
| 12 | Personal current transfer receipts | 2,774.2 | 2,848.1 | 2,971.5 | 2,983.8 | 3,003.7 | 3,113.1 | 3,158.6 | 3,195.8 | 12 |
| 13 | Less: Contributions for government social insurance, domestic | 1,239.9 | 1,299.6 | 1,356.5 | 1,362.4 | 1,368.7 | 1,407.6 | 1,416.3 | 1,427.1 | 13 |
| 14 | Less: Personal current taxes | 1,956.1 | 2,045.8 | 2,077.6 | 2,086.5 | 2,077.4 | 2,156.9 | 2,200.1 | 2,183.2 | 14 |
| 15 | **Equals: Disposable personal income** | **14,165.1** | **14,833.0** | **15,741.5** | **15,842.0** | **16,005.4** | **16,198.5** | **16,355.7** | **16,535.3** | 15 |

See the chapter by Engel in our readings, which makes note of the adjustments to measure personal income versus GDP

Open Economy – unfortunately, we have little time to spend on that this semester.

In the open economy, goods and services are bought by households, governments in the rest of the world. We lump those together and call those our exports, $X$.

But when we measured $C$, $I$, and $G$, we included all spending by domestic residents, including spending on foreign goods and services. To get spending by domestic residents on domestic goods, we need to subtract off imports of goods and services: $C + I + G - IM$

Add spending by foreign residents to spending by domestic residents to get total spending on domestic goods:

$$GDP = C + I + G + X - IM$$

## Comparing Output across Countries

China's GDP in 2017 was approximately RMB 81 trillion.

How do we compare that with other economies?

We can convert each economy's GDP into dollars using the exchange rate. The average exchange rate in 2017 was approximately 6.75 RMB per dollar.

So RMB 81 trillion ≈ USD 12 trillion

That is, the exchange rate is $S_{RMB/USD} = 6.75$

China's GDP in dollars is $\frac{GDP_{CHINA}}{S_{RMB/USD}} = \frac{81}{6.75} = 12$ trillion

A different question is to ask how much could China's income (GDP) buy in China, compared to how much the U.S. income could buy in the U.S.

This is the PPP (purchasing power parity) measure of GDP. We start by measuring the cost of a basket of consumer goods in each country, in that country's currency. (The basket is common to the countries – the expenditure shares are for a typical "world" consumer".)

$$\text{Real Chinese GDP} = \frac{GDP_{CHINA}}{P_{CHINA}^{RMB}}$$

That measures how many "baskets" of goods the Chinese GDP could buy. Then we ask what the cost of those baskets would be in USD:

$$\text{PPP Chinese GDP} = \frac{GDP_{CHINA}}{P_{CHINA}^{RMB}} \times P_{U.S.}^{USD}$$

In 2017, China's PPP GDP was USD 25.4 trillion

Recall when we used the exchange rate to convert it was USD 12 trillion.

$$\frac{GDP_{CHINA}}{P_{CHINA}^{RMB}} \times P_{U.S.}^{USD} = 25.4 \qquad \frac{GDP_{CHINA}}{S_{RMB/USD}} = 12$$

Using simple math, we get $\frac{S_{RMB/USD} P_{U.S.}^{USD}}{P_{CHINA}^{RMB}} = \frac{25.4}{12} = 2.12$

The numerator is the RMB price of the basket when it is bought in the U.S. In other words, the basket costs 2.12 times as much in the U.S. as in China, when you convert prices into a common currency.

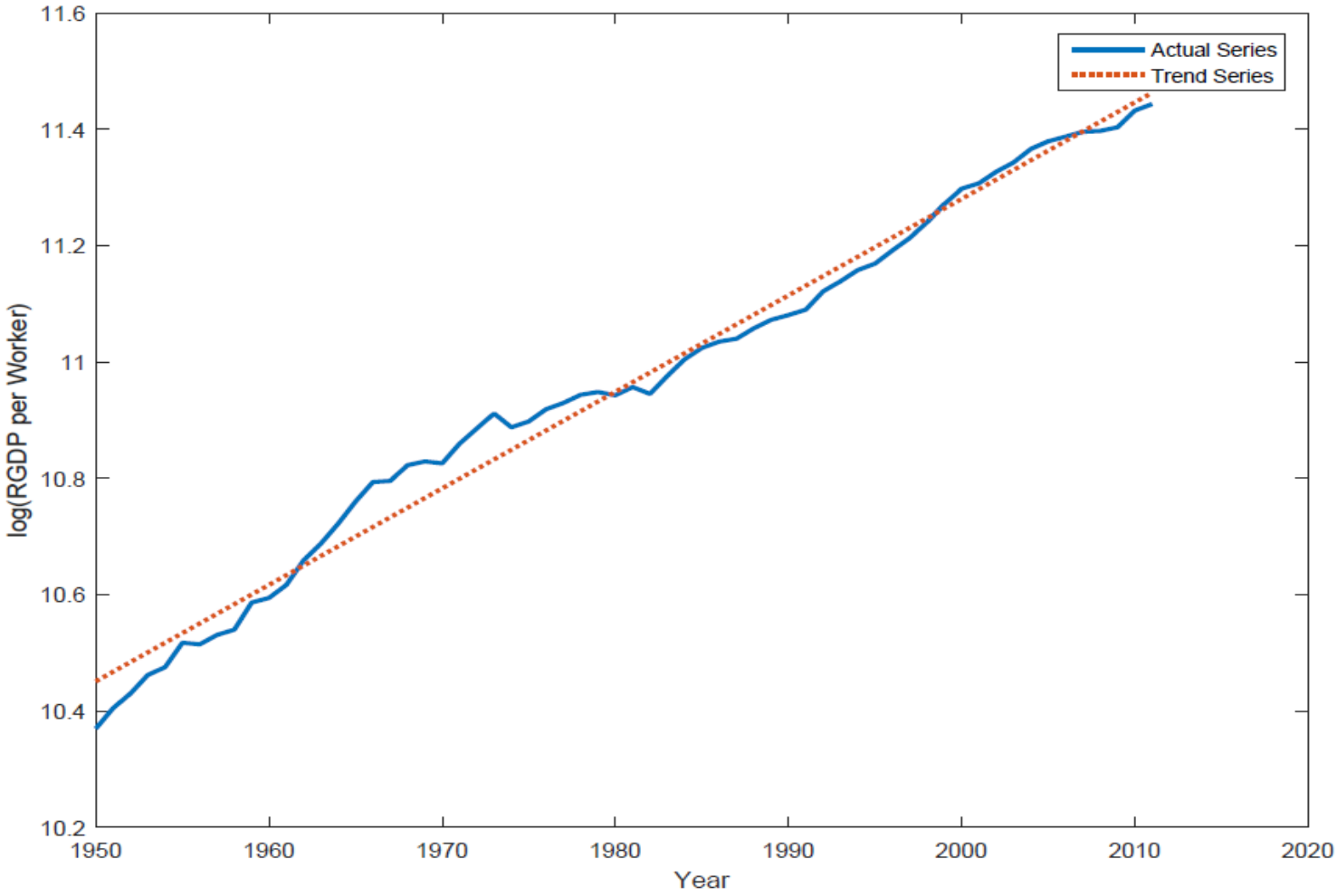
C.I.A. World Fact Book

Let's look at these variables for the U.S., China, Colombia, Czechia, India and South Korea:

GDP per capita (PPP)
Gross national saving
Labor force by occupation
Distribution of family income (Gini Index)
Inflation rate
Median age
Urbanization

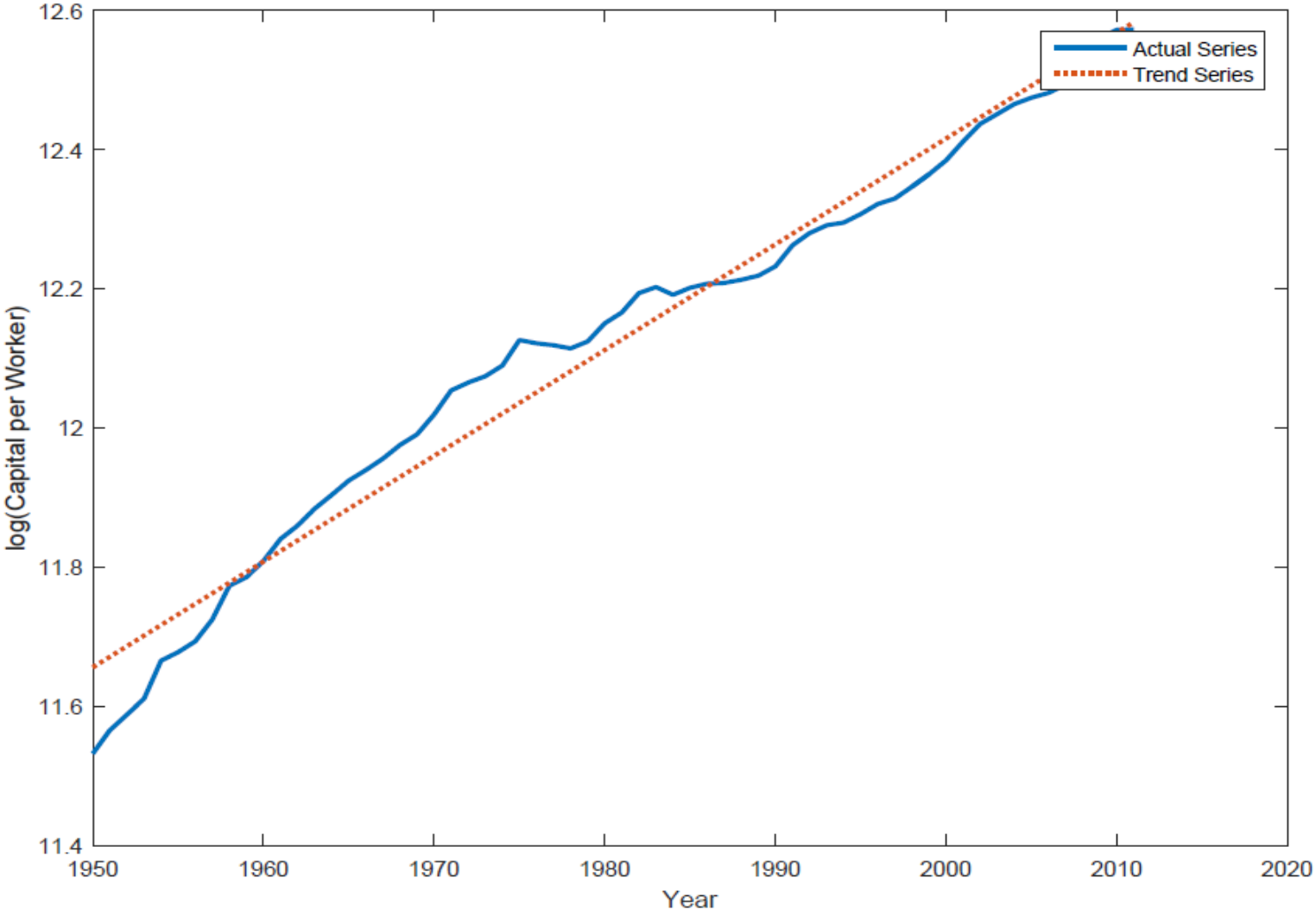
1. Output per worker grows at a roughly constant rate over long periods

Figure 4.1: Real GDP per Worker in the US 1950-2011



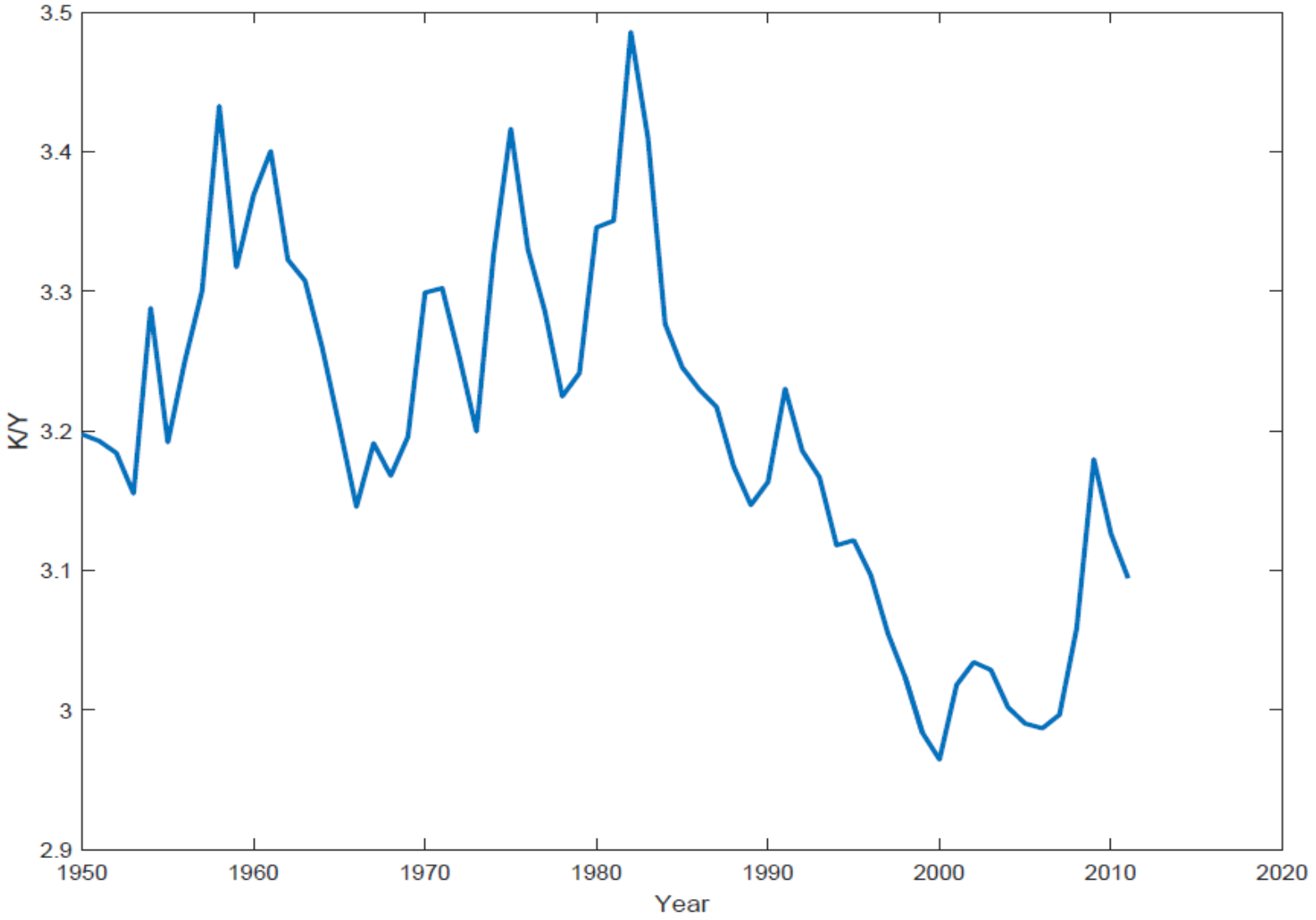
2. Capital per worker grows at a roughly constant rate over long periods

Figure 4.2: Capital per worker in the US 1950-2011.



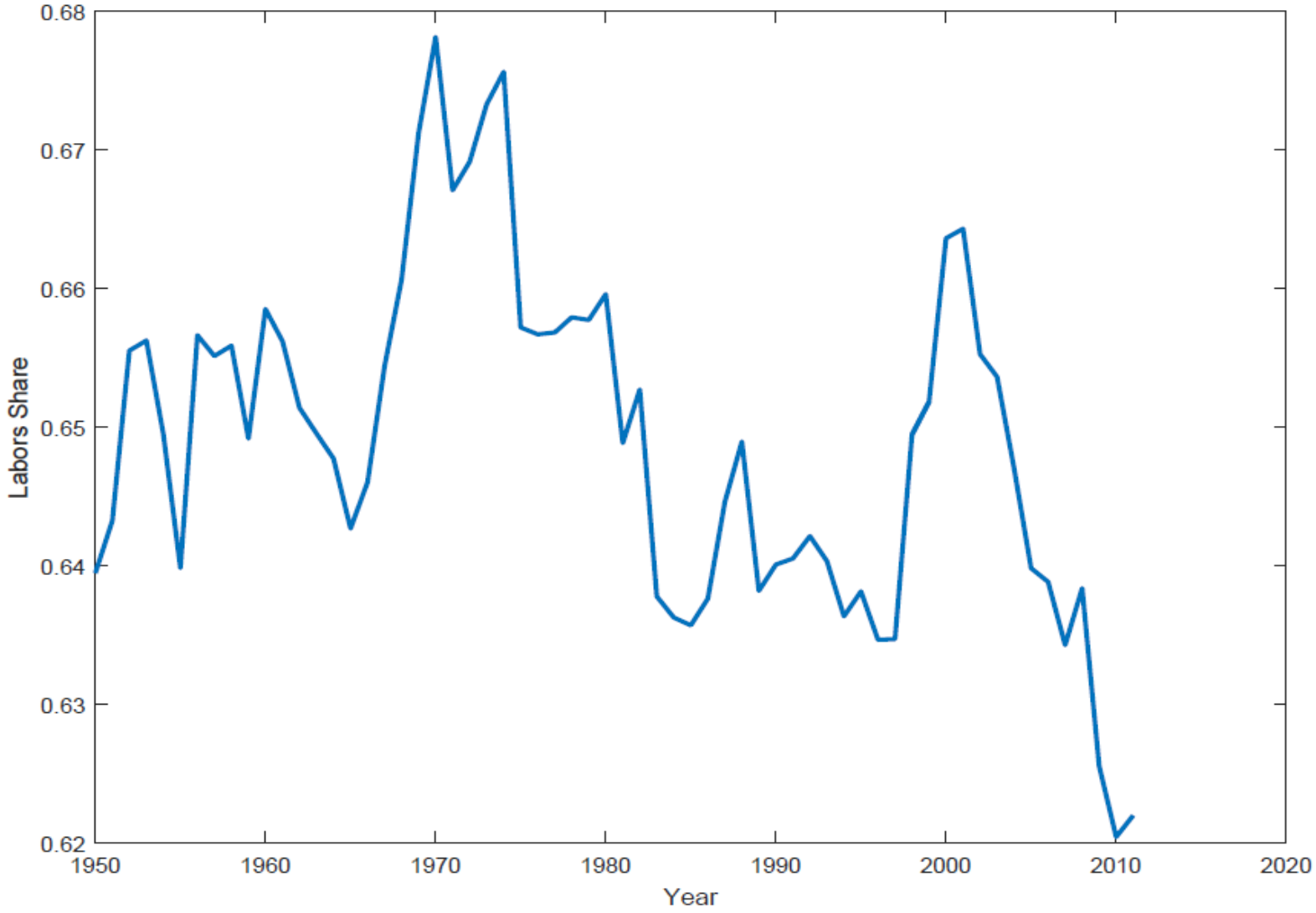
3. Capital/output ratio is roughly constant over long periods

Figure 4.3: Capital to Output Ratio in the U.S. 1950–2011



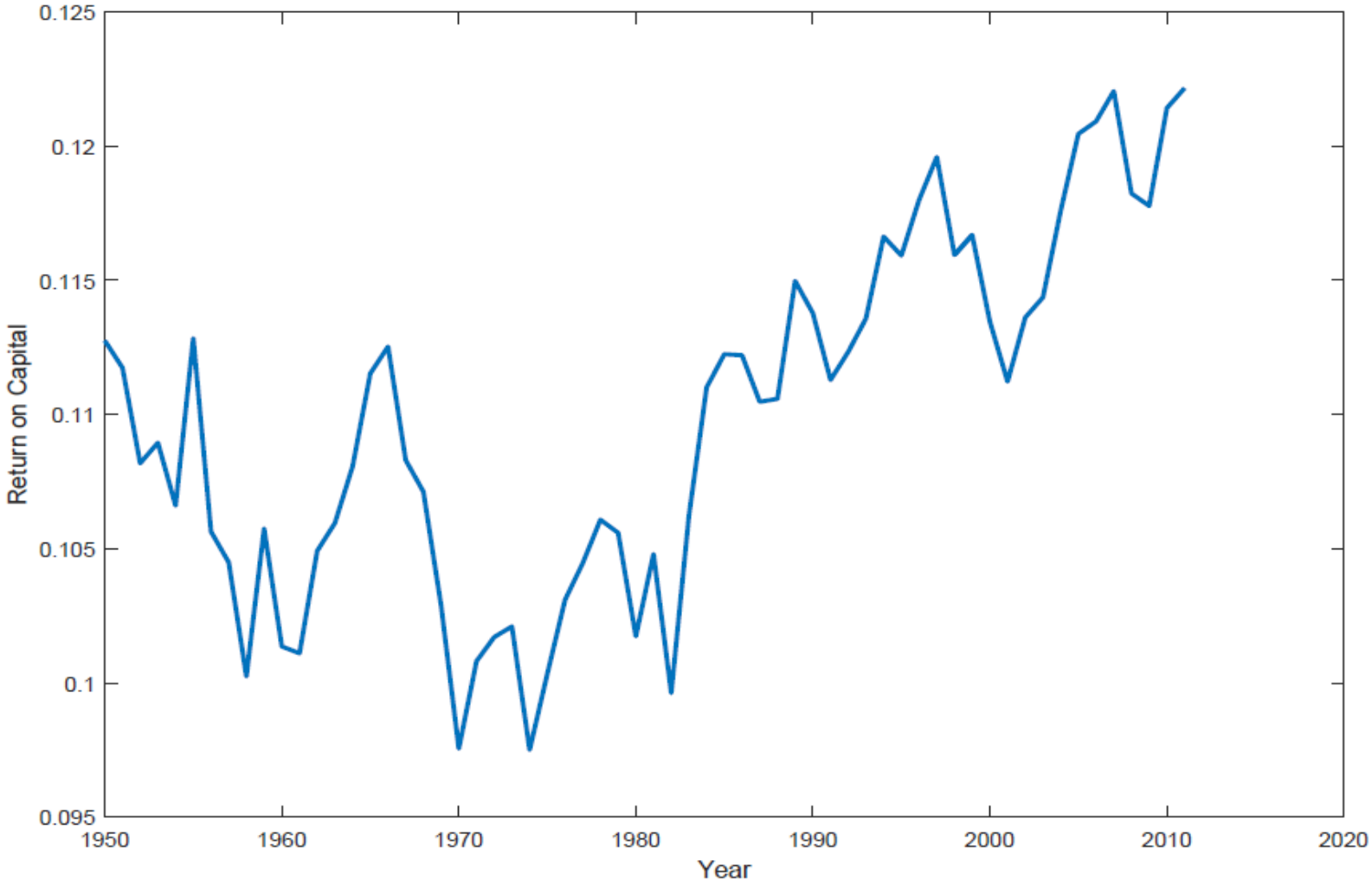
4. Labor's share ($wN/Y$) is roughly constant over time

Figure 4.4: Labor Share in the US 1950-2011.



5. Rate of return to capital is roughly constant $R=(Y-wN)/K$

Figure 4.5: Return on capital in the US 1950-2011.



6. Real wages grow at roughly a constant rate over long periods

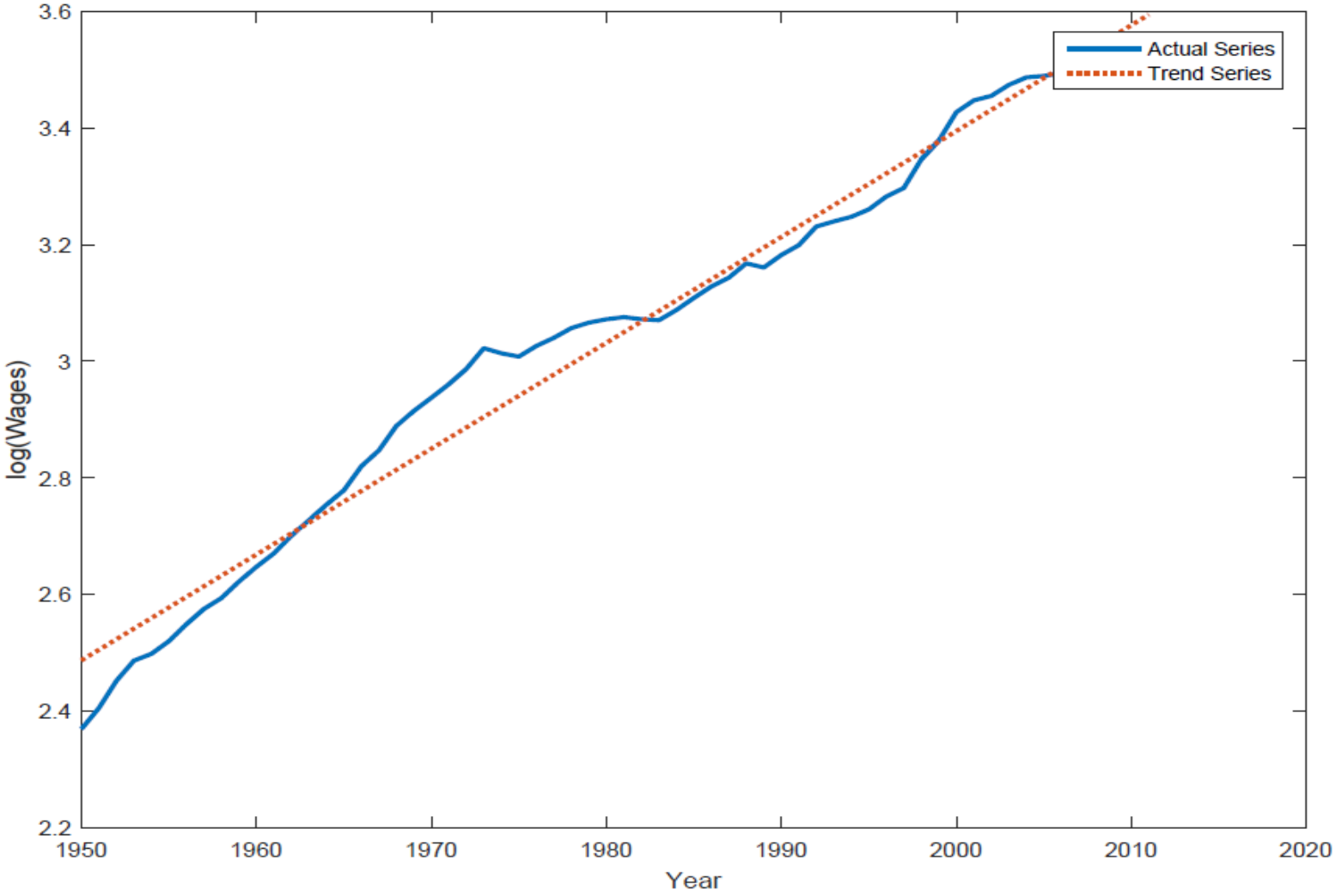



Figure 4.6: Wages in the US 1950-2011.

# Cross-country facts: 1. Enormous variation across countries

Table 4.1: GDP Per Capita for Selected Countries

| | | GDP per Person |
|---|---|---|
| High income countries | | |
| | Canada | $35,180 |
| | Germany | $34,383 |
| | Japan | $30,232 |
| | Singapore | $59,149 |
| | United Kingdom | $32,116 |
| | United States | $42,426 |
| Middle income countries | | |
| | China | $8,640 |
| | Dominican Republic | $8,694 |
| | Mexico | $12,648 |
| | South Africa | $10,831 |
| | Thailand | $9,567 |
| | Uruguay | $13,388 |
| Low income countries | | |
| | Cambodia | $2,607 |
| | Chad | $2,350 |
| | India | $3,719 |
| | Kenya | $1636 |
| | Mali | $1,157 |
| | Nepal | $1,281 |

2. There are growth miracles and growth disasters

Table 4.2: Growth Miracles and Growth Disasters

| Growth Miracles | | | |
|---|---|---|---|
| | 1970 Income | 2011 Income | % change |
| South Korea | $1918 | $27,870 | 1353 |
| Taiwan | $4,484 | $33,187 | 640 |
| China | $1,107 | $8,851 | 700 |
| Botswana | $721 | $14,787 | 1951 |

| Growth Disasters | | | |
|---|---|---|---|
| | 1970 Income | 2011 Income | % change |
| Madagascar | $1,321 | $937 | -29 |
| Niger | $1,304 | $651 | -50 |
| Burundi | $712 | $612 | -14 |
| Central African Republic | $1,148 | $762 | -34 |

3. Strong correlation between income per capita and human capital

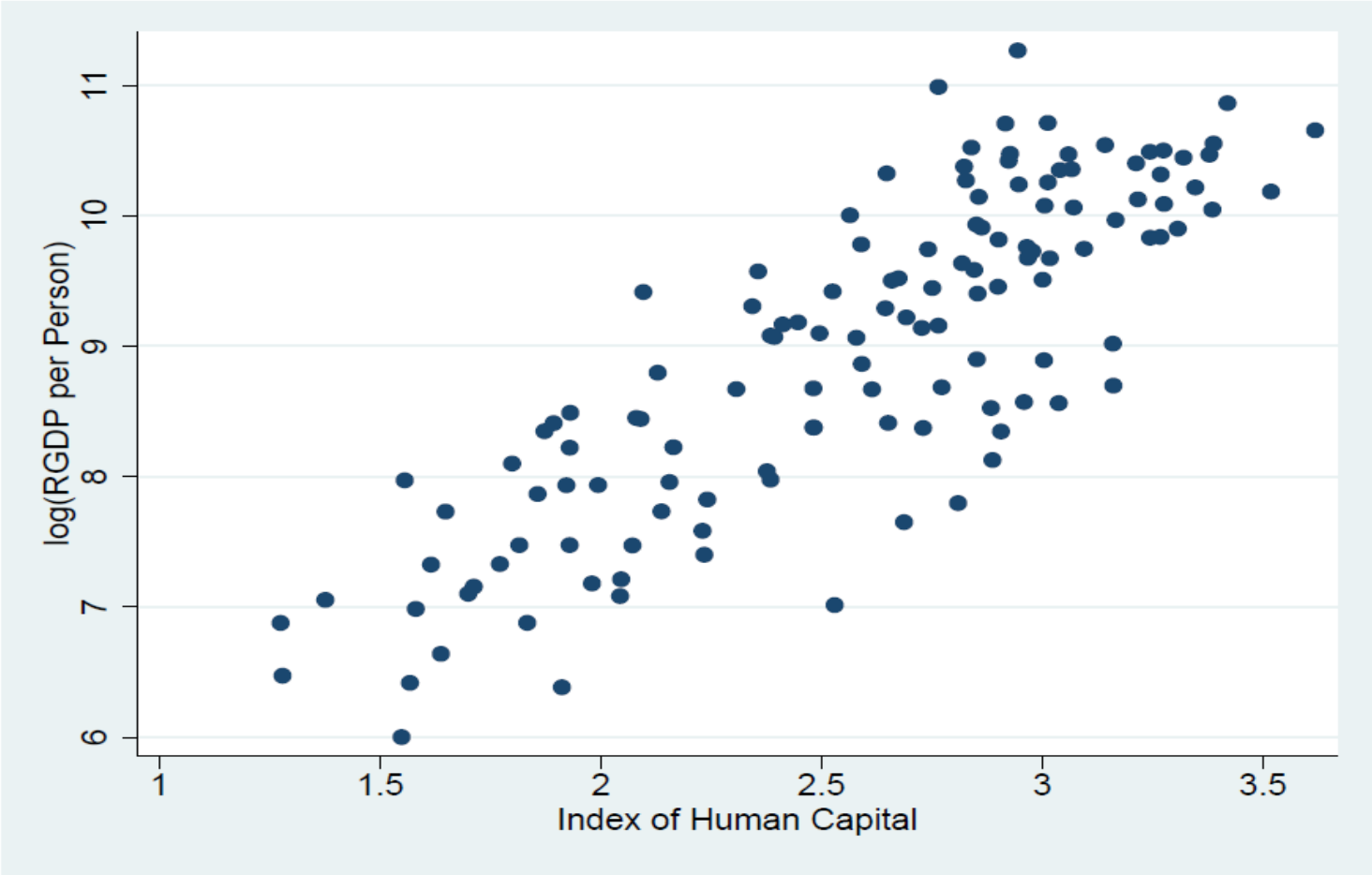



Figure 4.7: Relationship Between Human Capital and Income per Person

What to look for:

- Capital accumulation matters for income per person
- There is a sort of long run where capital/output is constant, but income keeps growing at a constant rate
- Something else matters: productivity growth? Human capital?
- But what makes those different? Institutions? Wars? Geography?