LECTURE 14

Macroeconomic measurement

I. MACROECONOMICS VERSUS MICROECONOMICS

Macroeconomics

- Definition:

  - The study of the aggregate economy.

- Concerned with:

  - Total output.

  - Aggregate price level and inflation.

  - The unemployment rate.

  - The overall level of interest rates; the exchange rate; overall exports and imports.

II. REAL GDP

Real Gross Domestic Product (Real GDP)

- The market value of the final goods and services newly produced in a country during some period of time, adjusted for price changes.

Economists' Definition of "Real"

- Adjusted for changes in prices or equivalently, keeping prices constant

- Another way to say it: Measured in terms of goods and services, rather than dollars.

- In contrast, "nominal" means measured in terms of dollars.

Nominal GDP

- Nominal GDP: The market value of the final goods and services newly produced in a country during some period of time, **_not_** adjusted for price changes.

- Thus, for the United States, it is measured in dollars.

- Example: Nominal GDP in 2022 = $\sum_i P_{i,2022} \bullet Q_{i,2022}$,

where i represents each possible good in the economy (and ∑ is the symbol for a sum).

- Note that we use 2022 prices in computing 2022 nominal GDP, 2021 prices in computing 2021 nominal GDP, ….

Calculating *Real* GDP

- Problem is that prices for same goods change from year to year.

- Need to use the same prices to control for price changes. We typically use the prices for a base year.

- Example: If 2022 is the base year:

$$2023 \text{ real GDP} = \sum_i P_{i,2022} \bullet Q_{i,2023}.$$

- If 2022 is the base year, 2023 real GDP is value of the final goods and services newly produced in the United States in 2023 using 2022 prices

- 2023 real GDP is comparable to 2022 GDP

Growth Rate of Real GDP

- The percentage change in real GDP from one year to the next.

- Note on percentage changes:

  - Let X be some variable, and let subscripts denote time periods.

  - Then the percentage change in X from period t − 1 to period t is defined as:

$$\frac{X_t - X_{t-1}}{X_{t-1}} \bullet 100.$$

Measuring GDP

- GDP = market value of the final goods and services newly produced in a country during some period of time

- Key points:

  - ***Final*** goods and services.

  - ***Newly produced***.

  - ***Within the country***.

  - ***In some period of time***.

Three Approaches to Measuring GDP

- **Expenditure:** Use market prices and the quantities of final goods: Y=C+I+G+NX

  – Can divide into private consumption (C), investment (I), government purchases (G), and net exports (NX).

- **Production (value added):** follow goods/service through each stage of production and count value added at each stage:

  – Timber $500 → Lumber $1000 → Furniture $2000

- **Income:** Income from producing goods and services within the country:

  – Can divide into labor income and capital income

GDP vs. National Income

- GDP is Gross Domestic Product

- Capital assets (buildings, machines, etc.) wear off over time: this is called depreciation of capital

- NDP is Net Domestic product = GDP – Depreciation of capital = about 90% of GDP.

- National income = NDP + net foreign income

  - Net foreign income = foreign income earned by residents – domestic income paid to foreigners

  - For most rich countries, net foreign income is small but can be large in developing countries where companies are owned mostly by foreigners who get the profits

  - National income makes more sense than GDP for inequality

What's NOT in GDP

- Unpaid labor that produces services

  - caring for family, housework, volunteer work not in GDP

- Illegal trade

  - Drug trafficking, bootlegging

- Used goods that are resold

  - Counted when first produced. Resold goods count only as value added if it's a business (e.g. used car business)

- Environmental damage

  - It is a form of "environmental capital" damage that does not get counted nor depreciated even in NDP

- Imputed rent of homeowners is in GDP however

Quiz A

Suppose I mine a new bitcoin using $50K of electricity and computer power and sell it on the market for $65K and make a profit of $15K. What does that add to GDP?

- A. The full $65K amount. Bitcoin is not different from mining for gold.

- B. Only the $50K of electricity and computer power because those are the only real goods

- C. Only the $15K profit I made because electricity and computer power are intermediary goods in the process of production

- D. $0K because bitcoins don't have inherent value

- E. None of the above

Quiz B

Suppose I have a bitcoin that I bought last year for $30K. This year, I am selling it for $65K and hence I make a gain of $35K. What does this add to GDP this year?
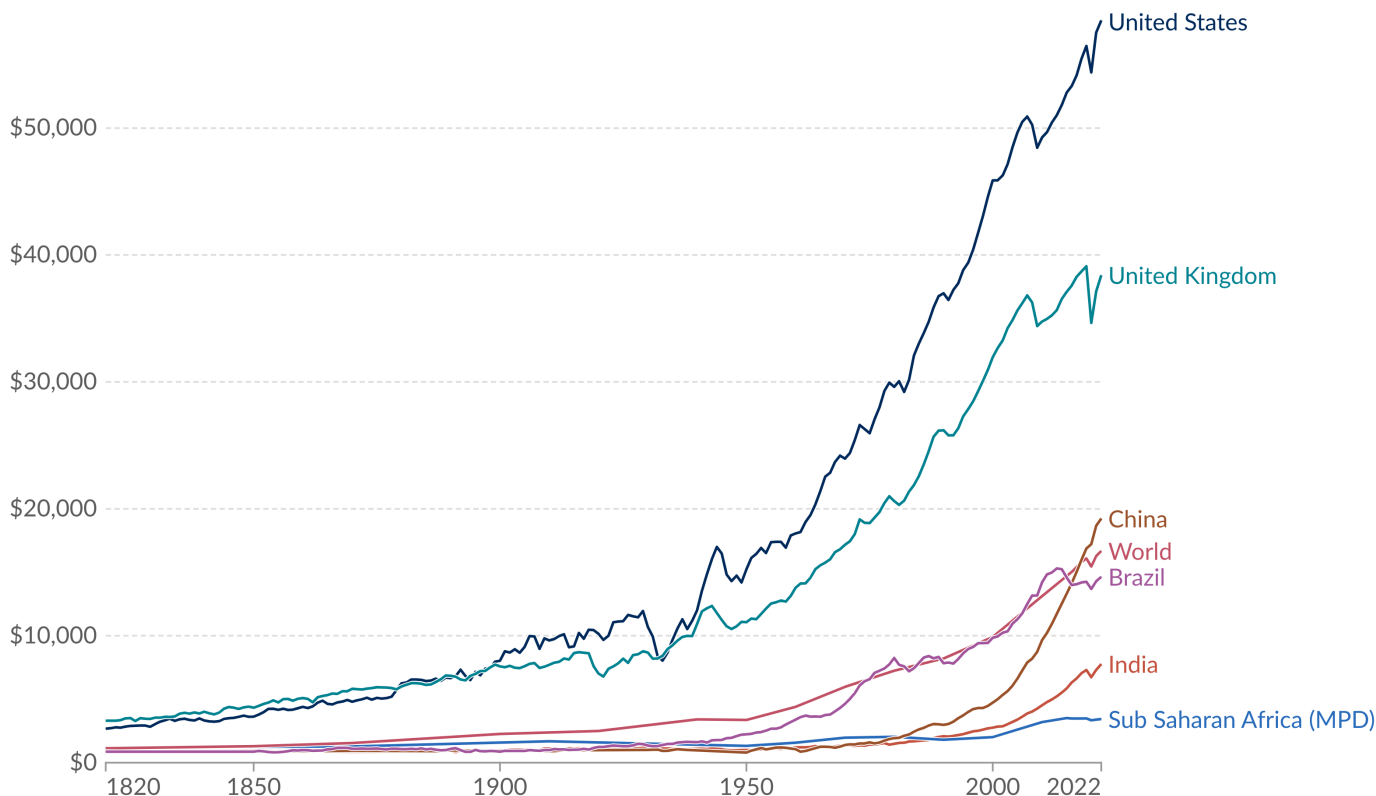
- A. The full $65K amount.

- B. Only the $30K that was the value of bitcoin last year.

- C. Only the $35K profit I made because that's the value added

- D. $0K because nothing new was produced

- E. None of the above

Real GDP per Person over Time and Regions

GDP per capita, 1820 to 2022

This data is adjusted for inflation and for differences in the cost of living between countries.

$50,000

$40,000

$30,000

$20,000

$10,000

$0

United States

United Kingdom

China
World
Brazil

India

Sub Saharan Africa (MPD)

1820   1850   1900   1950   2000   2022

Data source: Bolt and van Zanden - Maddison Project Database 2023   OurWorldInData.org/economic-growth | CC BY
Note: This data is expressed in international-$[1] at 2011 prices.

1. International dollars: International dollars are a hypothetical currency that is used to make meaningful comparisons of monetary indicators of living standards. Figures expressed in international dollars are adjusted for inflation within countries over time, and for differences in the cost of living between countries. The goal of such adjustments is to provide a unit whose purchasing power is held fixed over time and across countries, such that one international dollar can buy the same quantity and quality of goods and services no matter where or when it is spent. Read more in our article: What are Purchasing Power Parity adjustments and why do we need them?
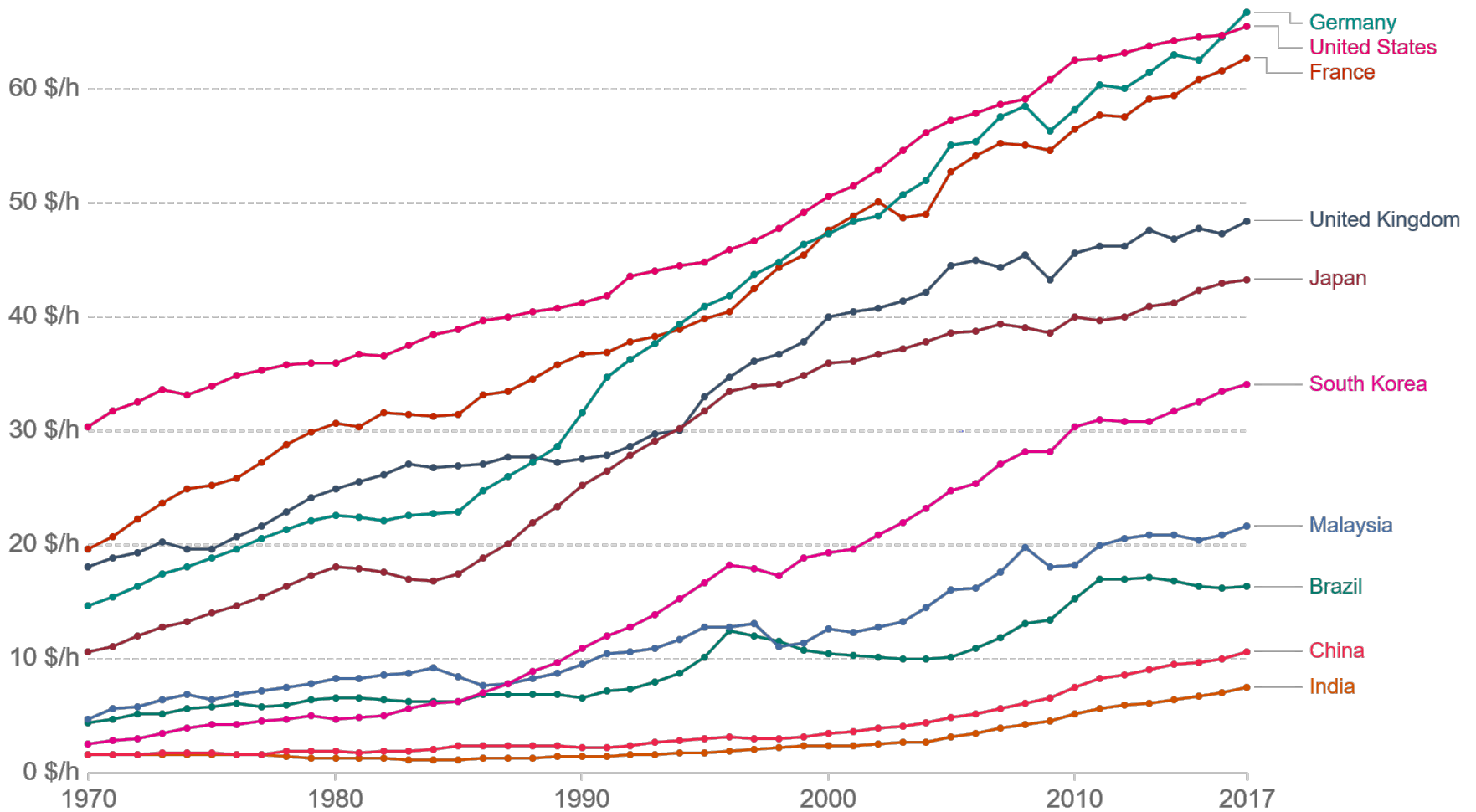
Source: Our World in Data; data from the Maddison Project.
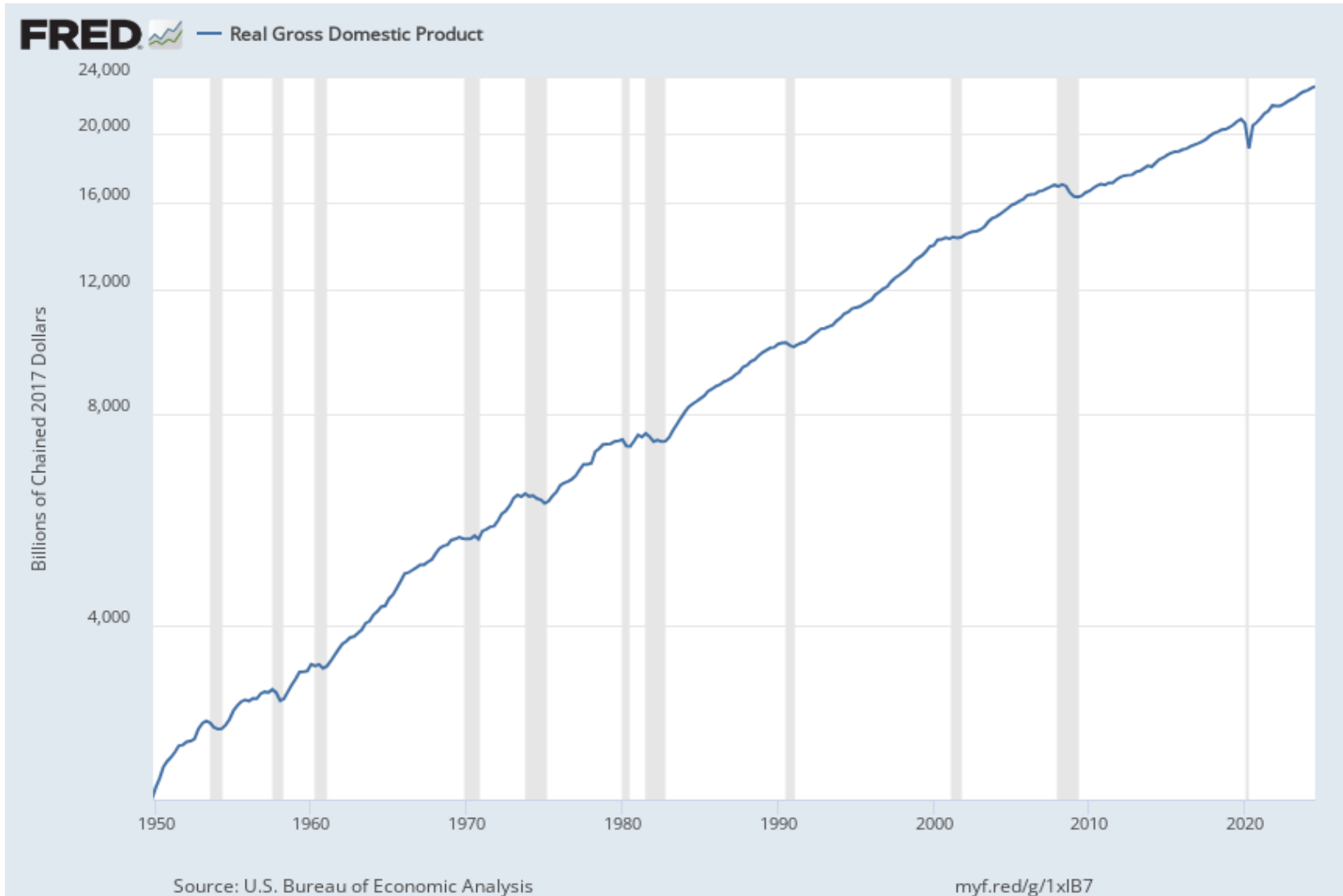
Labor Productivity

Productivity per hour worked

Labor productivity per hour is measured as gross domestic product (GDP) per hour of work.
GDP is measured in constant 2011 international-$, which means it is adjusted for price differences between countries (PPP adjustment) and for inflation to allow comparisons between countries and over time.
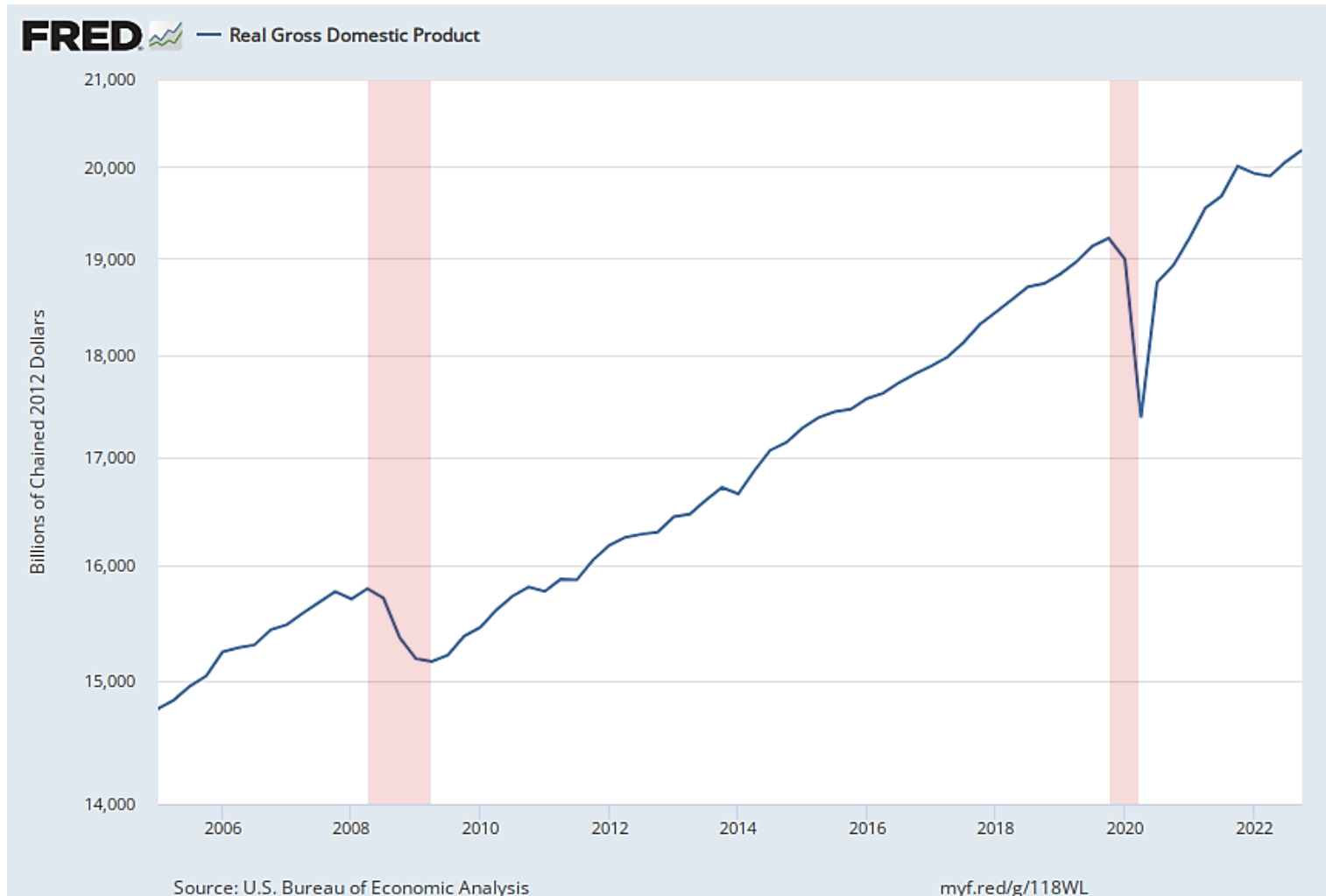
Real GDP in the U.S., 1950–2024 (in 2017 $)

FRED ⟋ — Real Gross Domestic Product

Billions of Chained 2017 Dollars

Source: U.S. Bureau of Economic Analysis
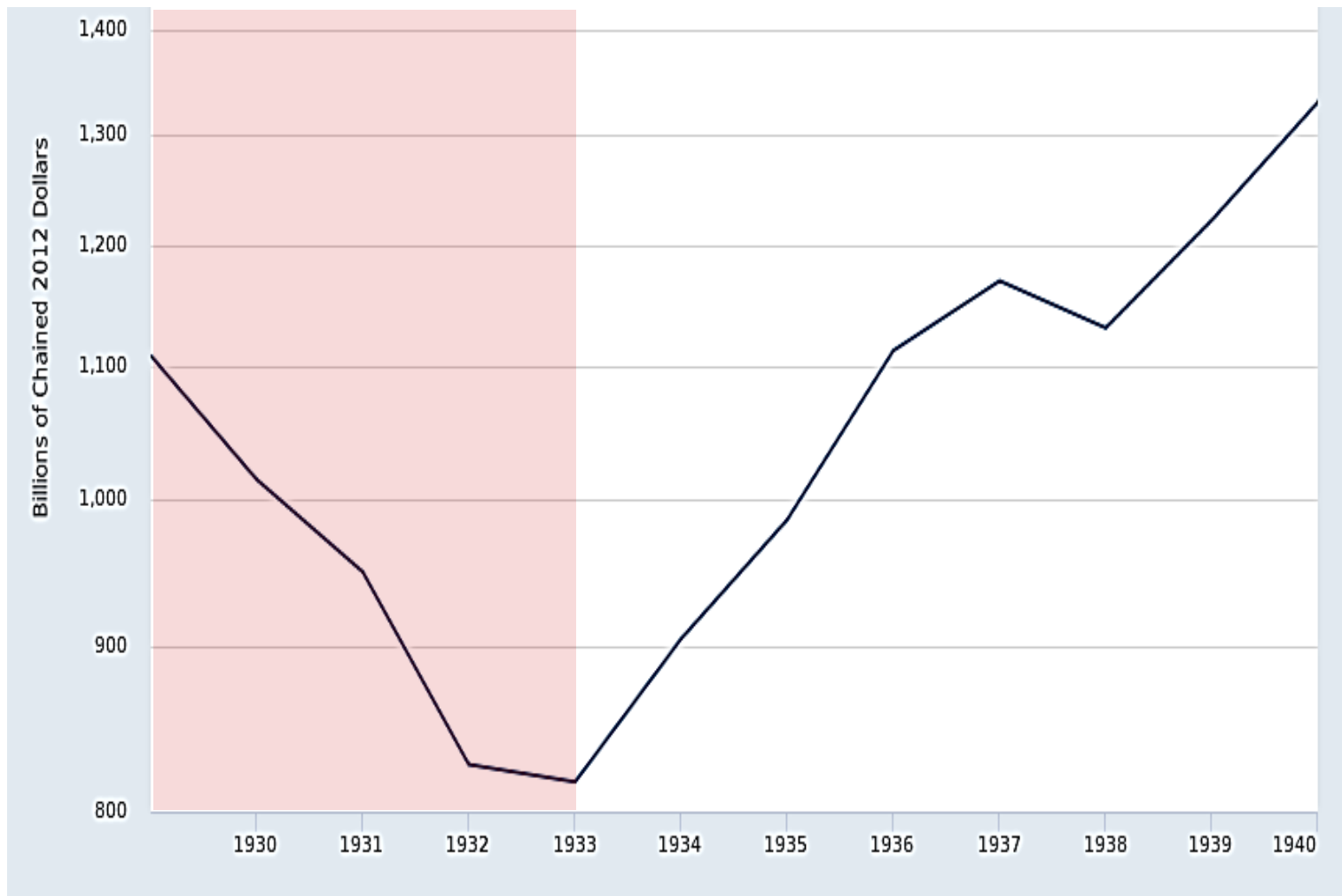
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Source: FRED (Federal Reserve Economic Data); data from Bureau of Economic Analysis.
Note the log scale for Real GDP. Straight line would mean same growth rate year to year
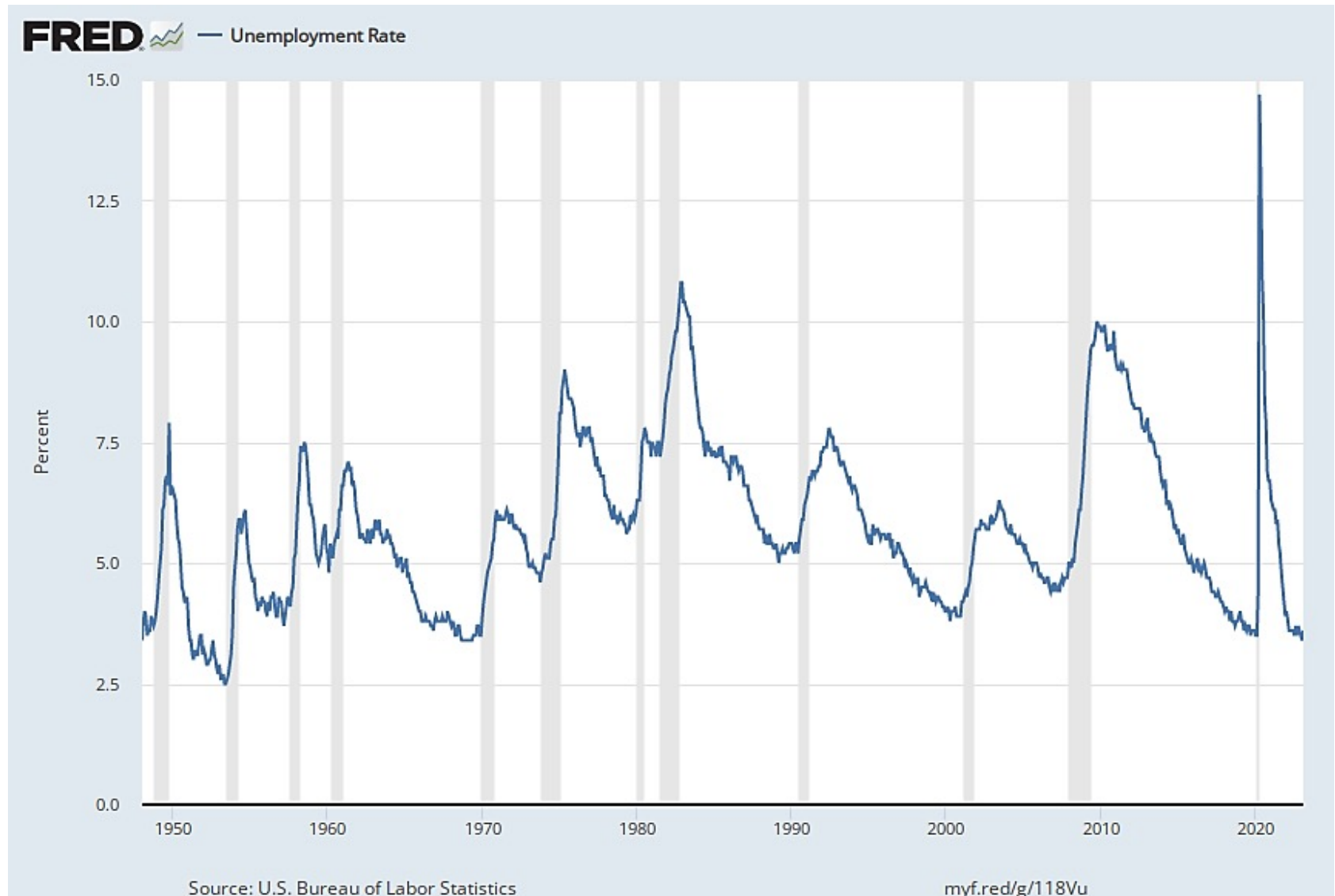
U.S. Real GDP, 2005–2022

Source: FRED; data from Bureau of Economic Analysis. Shaded red denotes recession when real GDP is falling.

U.S. Real GDP, 1929–1940

Source: FRED; data from Bureau of Economic Analysis. Great Depression for 1929-1933 is the largest recession the US ever experienced since 1900

U.S. Unemployment Rate, Jan. 1948–Feb. 2023

Source: FRED; data from Bureau of Labor Statistics. Shaded areas show recessions: Unemployment rate rises sharply during each recession: labor becomes under-utilized

III. INFLATION

Overview

- Inflation refers to growth in the average or overall level of prices.

- Thus to describe how we measure inflation, we need to start by describing how we measure the overall (or aggregate) price level.

- The most common measure is the Consumer Price Index (or CPI).

Calculating the Consumer Price Index

- Choose a base year (for example, 1983), and always use **quantities** for each good from the base year to multiply the prices.

- Then the CPI in (for example) 2022 is:

$$\text{CPI}_{2022} = \frac{\sum_i P_{i,2022} \bullet Q_{i,1983}}{\sum_i P_{i,1983} \bullet Q_{i,1983}} \bullet 100.$$

New goods/services and Chained Index

- Problem of a fixed base year is that some goods (smart phones, electric cars, etc.) did not exist in 1983

- Solution is to use a chained index where the base year is the preceding year

- This is how the US now computes the CPI

- The chained CPI for 2023 is based on 2022 quantities:

$$\text{CPI}^{\text{chained}}{}_{2023} = \frac{\sum_i P_{i,2023} \bullet Q_{i,2022}}{\sum_i P_{i,2022} \bullet Q_{i,2022}} \bullet 100.$$

- Similarly, CPI for 2022 is based on 2021 quantities, etc.
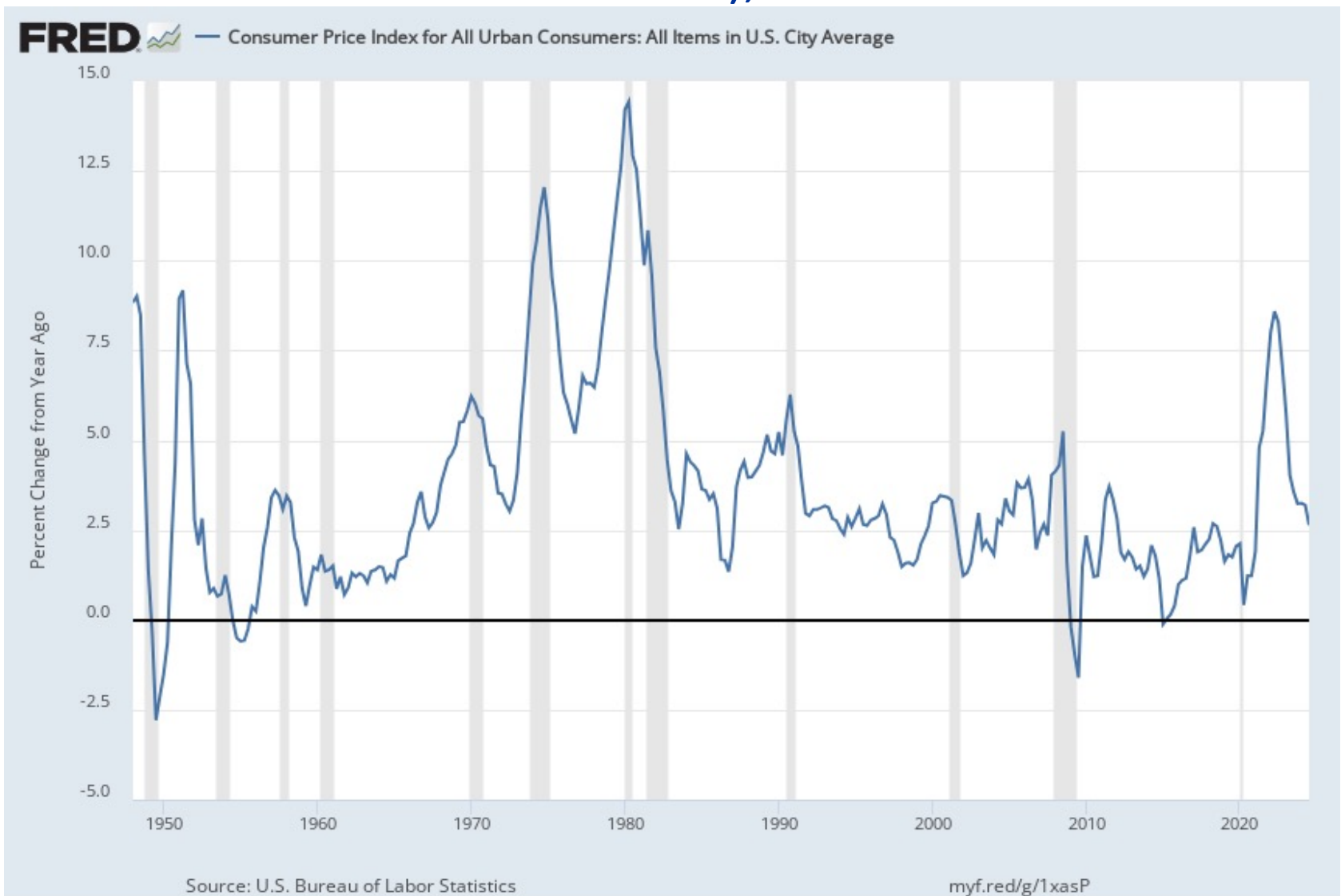
Inflation

- The percent change in a price index.

- Example: the inflation rate from 2022 to 2023 as measured by the CPI) is:

$$\pi_{2023} = \frac{\text{CPI}_{2023} - \text{CPI}_{2022}}{\text{CPI}_{2023}} \bullet 100.$$

- Notes:

  - Economists use "π" (Greek letter Pi) to denote inflation.

  - If inflation is negative, we say there is "deflation."

U.S. Inflation (Percent Change from 1 year ago in the Consumer Price Index), 1948–2024Q3

Source: U.S. Bureau of Labor Statistics

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Source: FRED; data from Bureau of Economic Analysis.

U.S. Inflation (Percent Change in the Price Index for Personal Consumption Expenditures), 1930–1933

Source: U.S. Bureau of Economic Analysis   myf.red/g/qjB8
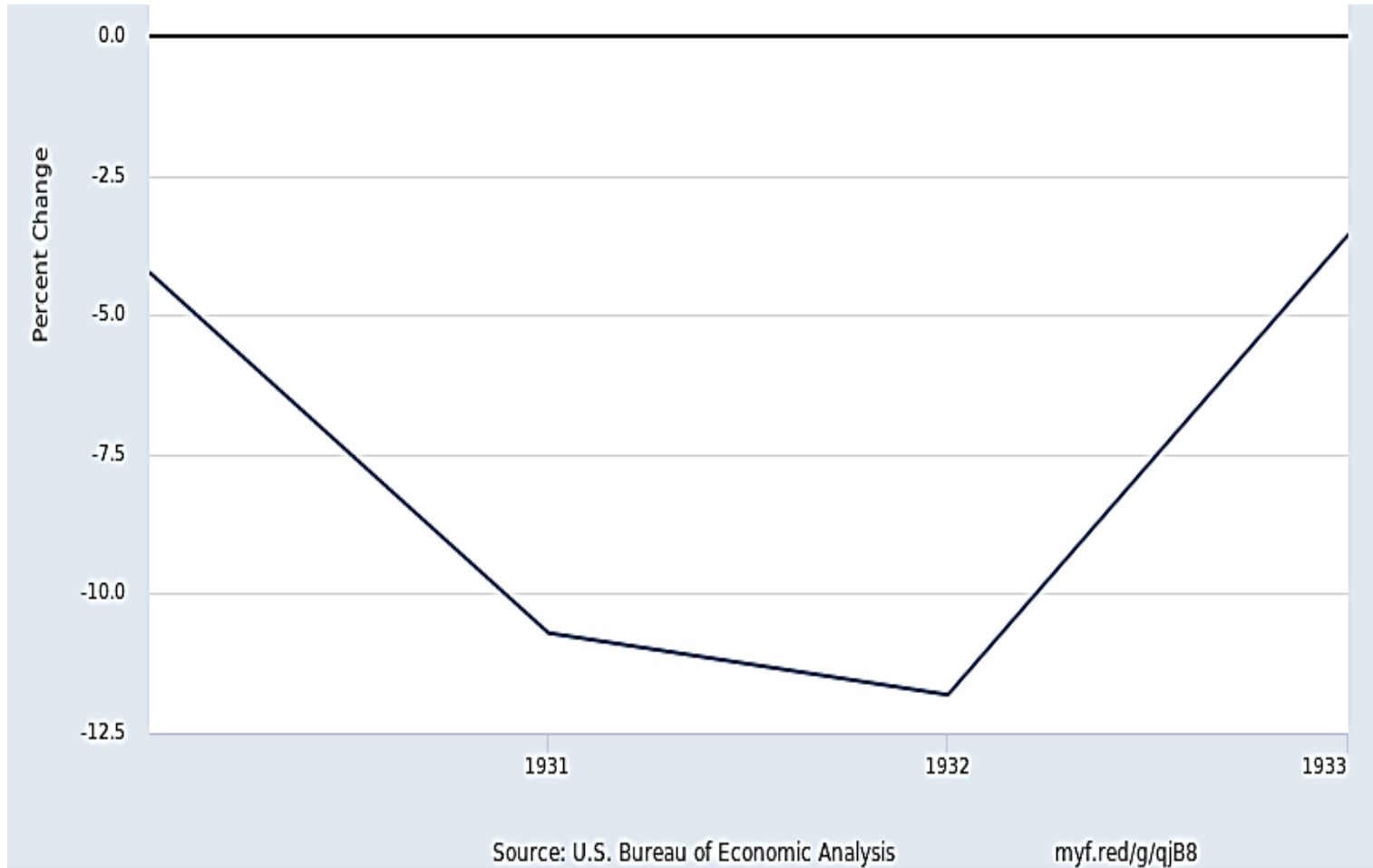
Source: FRED; data from Bureau of Economic Analysis.

Poll on Inflation

How do you feel about the recent inflation episode in 2022-23 when prices increased by about 10% more than normal

- A. I don't care because if prices increases, incomes also increase so nothing real changes

- B. I get upset because my expenses increase but my disposable income doesn't

- C. I like it because my disposable income has actually increased faster than my expenses

- D. I get disoriented not knowing anymore how much things cost, and whether sellers are taking advantage of us.

- E. I did not even know that there had been excess inflation.

Why Do We Care about Inflation?

- An argument for not caring

  - In aggregate: expenditure = income (your expenditure is somebody's income) so inflation means that both expenditures and incomes are higher

- Arguments for caring:

  - Redistribution

  - Psychology

  - Efficiency
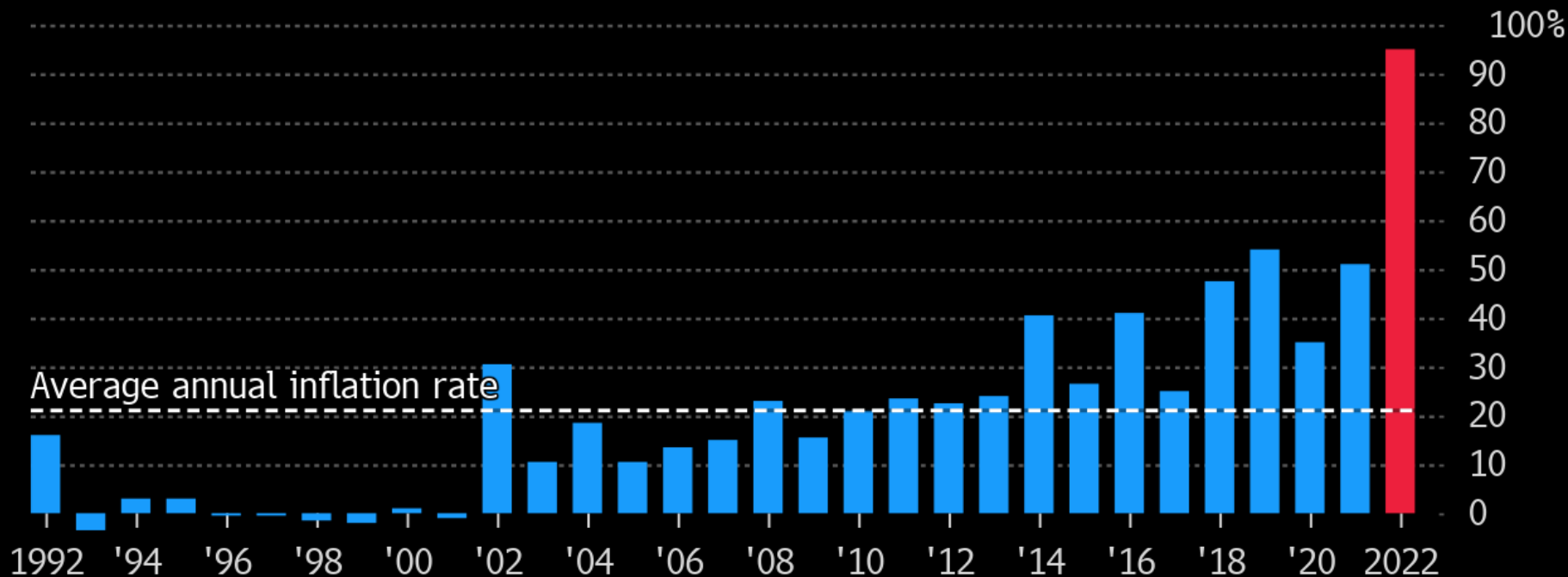
Inflation can be chronically high in some cases
Example: Argentina since 2002

VENEZUELA'S ANNUAL INFLATION RATE

Annual Inflation (9/29/20): 1899%
Annual 30-Day Moving Average
PPP Inflation (9/29/20): 1,669%

Annual Inflation Rate

Implied Annual Inflation Rate — Implied Annual 30 Day Moving Average PPP Inflation

Sources: U.S Bureau of Labor Statistics, AirTM
Calculations by Prof. Steve H. Hanke, The Johns Hopkins University.
Note: These inflation rates are implied by the movements in the black-market VES/USD exchange rate; values under 25% should be considered unreliable.

And can sometimes devolve into hyperinflation (generally short)
Example: Venezuela 2018-2020

The Nominal vs. the Real Interest Rate

- The **nominal** interest rate is just the stated interest rate—the interest rate measured in terms of dollars, with no adjustment for changes in prices.

    - We denote it by i.

- The **real** interest rate is interest rate measured in terms of purchasing power—that is, adjusted for changes in prices.

    - We denote it by r.

Key Equation: r = i − π.

- Example: If i=5% but π=5%, then r=0%. Inflation eats up the full nominal return i so that real return r is zero

Nominal and Real Interest Rates (1-year nominal interest rate, and 1-year nominal rate minus 1-year inflation rate)

Source: FRED. This shows the nominal and real interest rate on 1 year Treasury bills (debt that the US federal government issues)
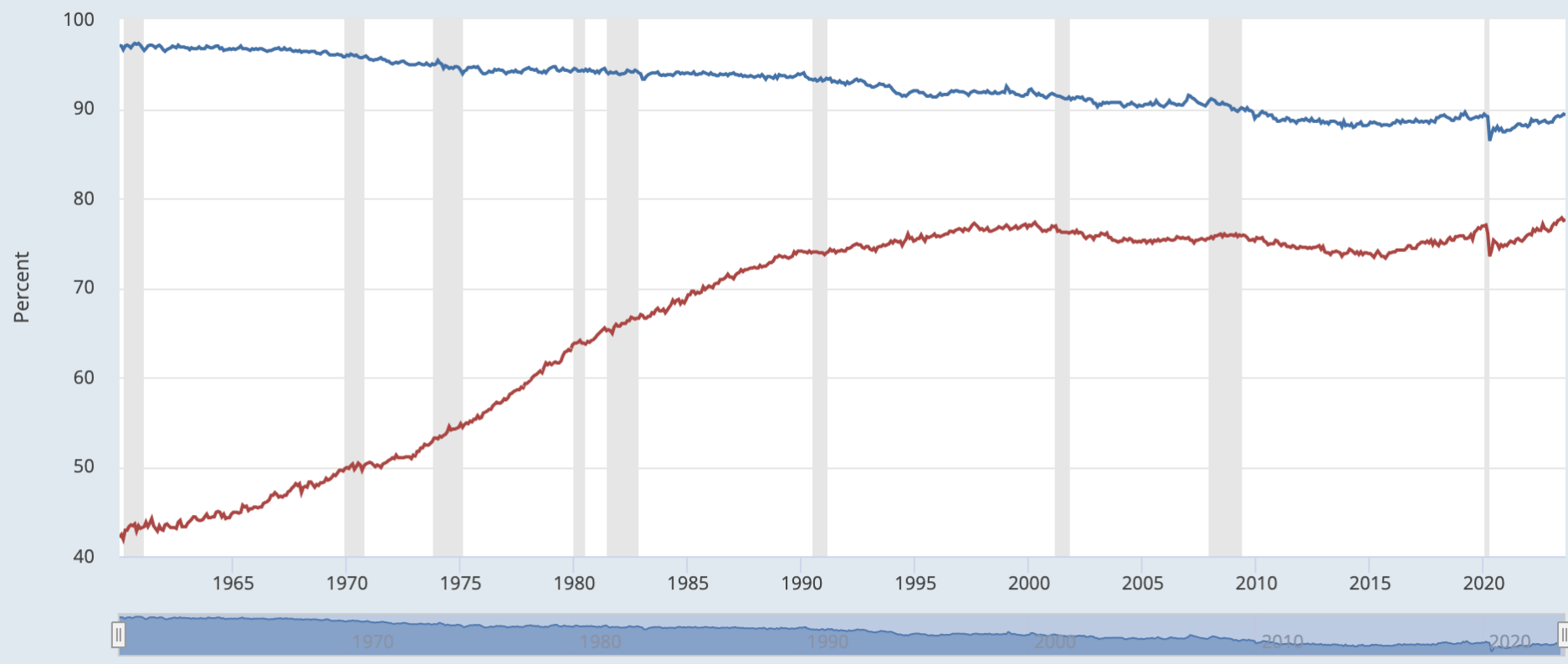
Why Consumption/Saving Choices and Investment Depend on the *Real* Interest Rate **r**

- Consumer: saving $1 now gives $1+i in nominal $ in one year but purchasing value is only $(1+i)/(1+\pi) \approx $1+i-\pi = $1+r in today's $.

- Firm: Investing $I for a capital asset (e.g. computer) today and getting MRP_K$ next year from computer use

  - Present Value PV = nominal MRP$_K$/(1+i)

  - But nominal MRP$_K$ = real MRP$_K$ $\times$ (1+π) as nominal MRP$_K$ grows with inflation as well

  - PV= real MRP$_K$ $\times$ (1+π)/(1+i)=real MRP$_K$/(1+r)

  - Firms' investment decision depends only on real values

V. Unemployment

Definitions

- Unemployed: The number of people who are not working and who are actively looking for work.

- Employed: The number of people who are working

- Vacancies: The number of job openings from firms

- Labor force: Employed + unemployed

- Activity rate = labor force / population

- Unemployment rate u = unemployed/labor force

- Vacancy rate v = job openings / labor force

FRED — Activity Rate: Aged 25-54: Males for United States
      — Activity Rate: Aged 25-54: Females for United States

Source: Organization for Economic Co-operation and Development

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Customize | Download Data

In the US, sharp increase in prime age female **activity rate** since 1960. Some decrease for men. Labor force includes employed plus unemployed looking for work which explains why activity rate does not fall during recessions.
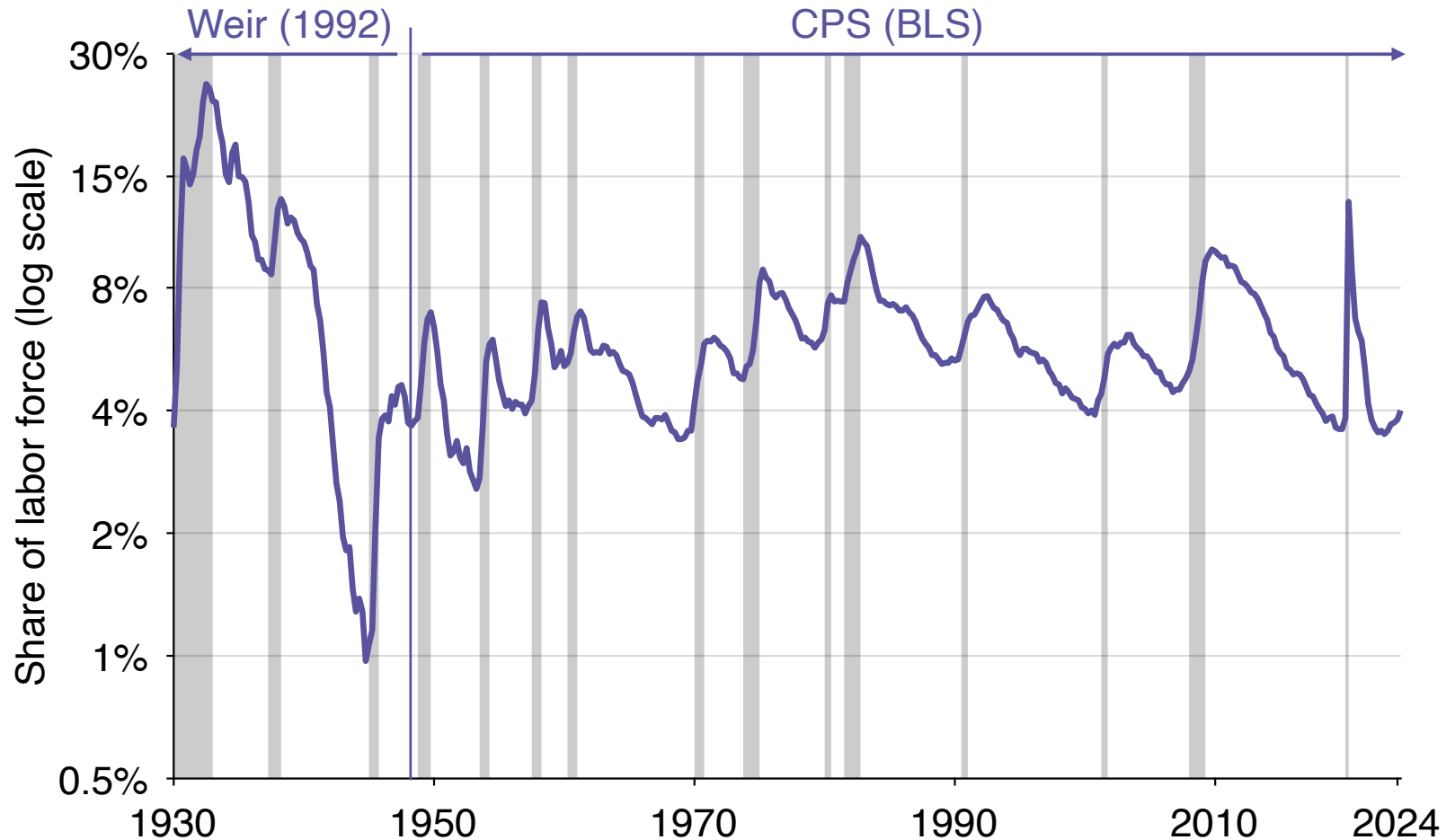Source: Fred stats, Fred Blog article

U.S. Unemployment Rate, Jan. 1948–Feb. 2023
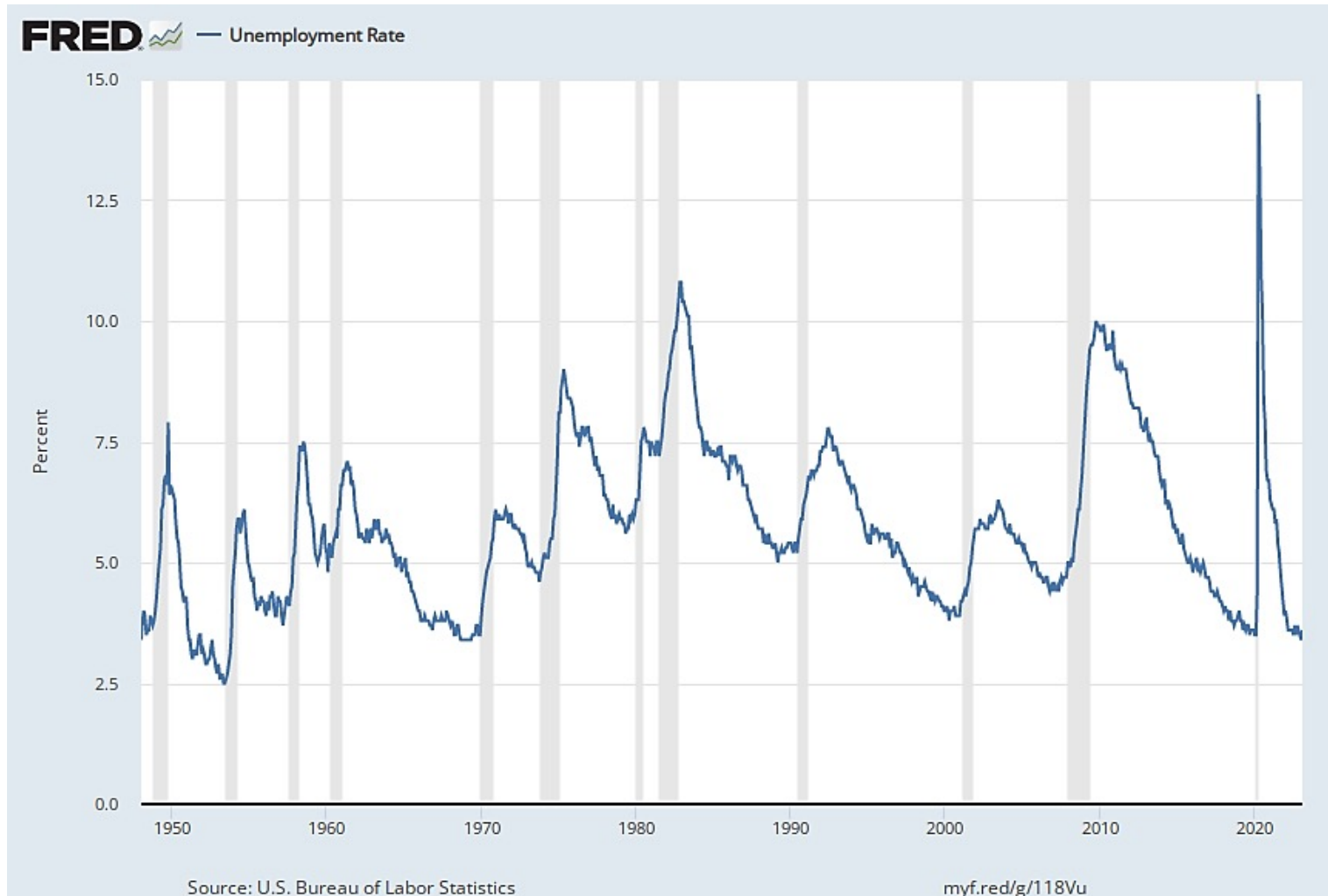
Source: FRED; data from Bureau of Labor Statistics. Shaded areas show recessions.

US UNEMPLOYMENT RATE (PETROSKY-NADEAU & ZHANG 2021)

Weir (1992)   CPS (BLS)

Share of labor force (log scale)

30%
15%
8%
4%
2%
1%
0.5%

1930   1950   1970   1990   2010   2024

Source: US unemployment rate in log-scale reached all time high of 25% during Great Depression and low of 1% in 1945
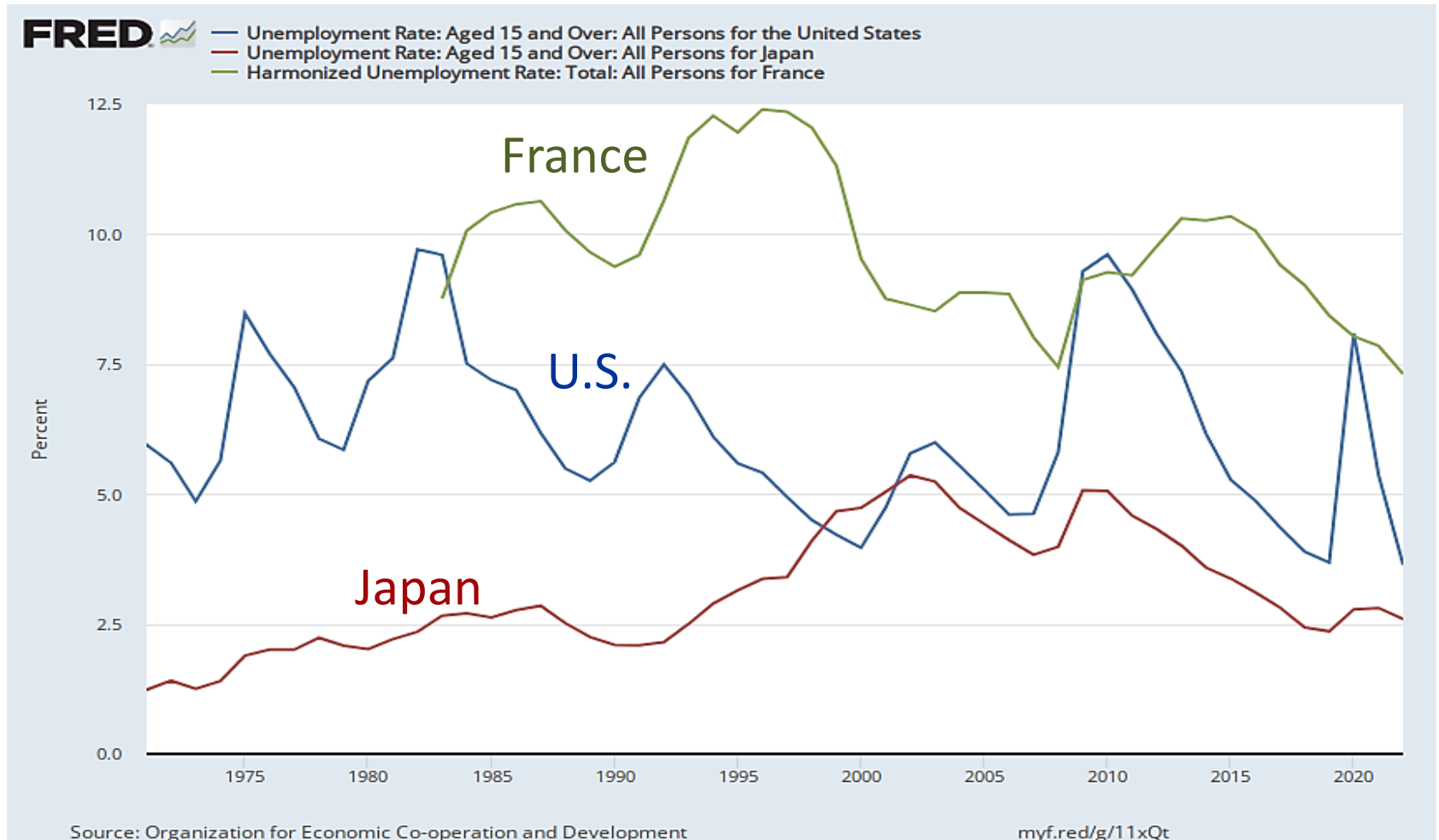
US VACANCY RATE (PETROSKY-NADEAU & ZHANG 2021)
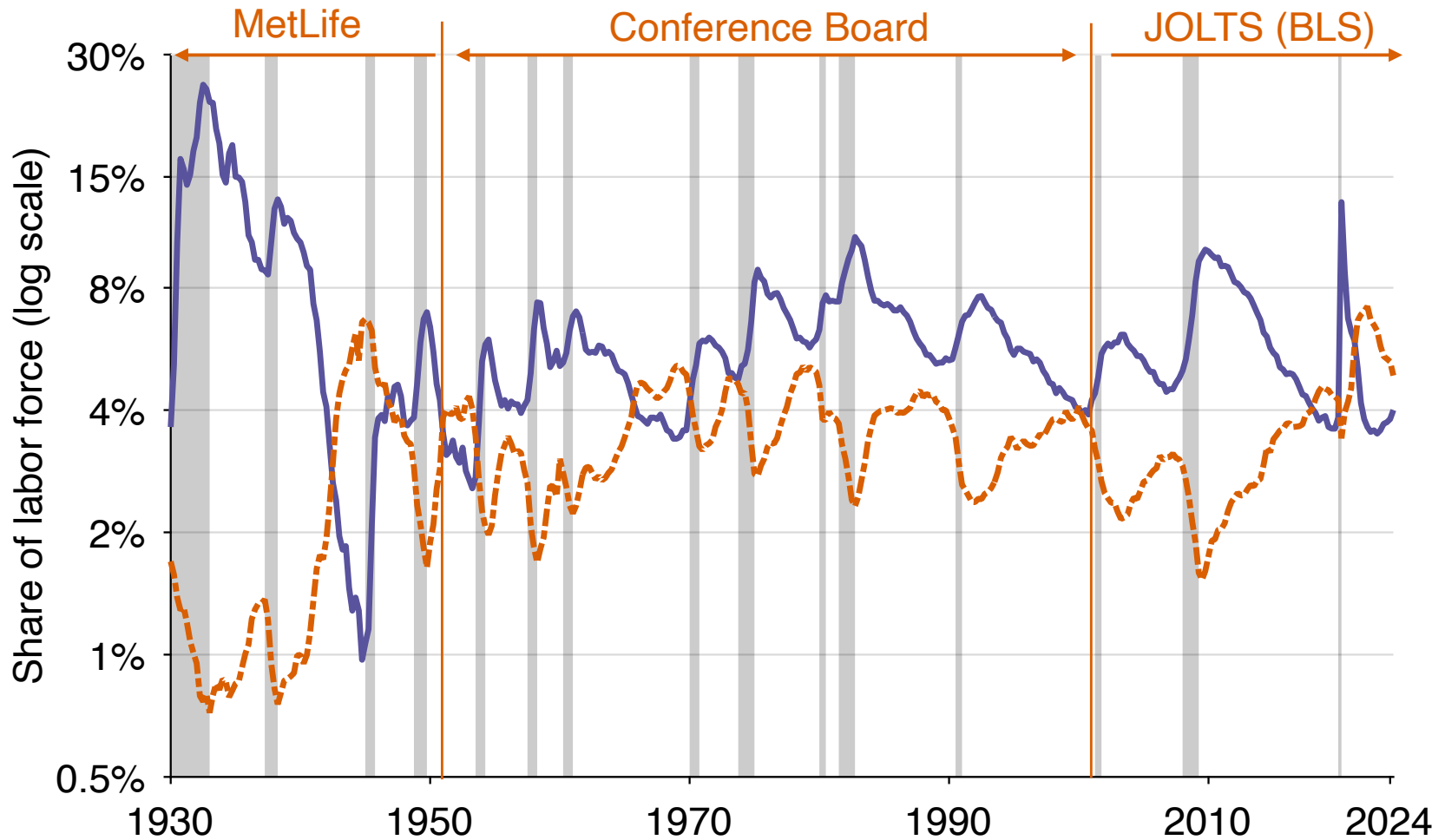
US vacancy rate (orange) and unemployment rate (blue) move in opposite directions (Beveridge Curve). Source is Michaillat and Saez '24

Types and Sources of Unemployment

- Cyclical unemployment

  - Caused by output being below potential during recessions

- Structural unemployment

  - Caused by job rationing due to permanent causes (e.g., minimum wage or unions in perfect competitive model)

- Frictional unemployment

  - Caused by turnover and job search

Normal or natural unemployment consists of structural and frictional unemployment.

Unemployment 1971–2022, U.S., Japan, and France

FRED

- Unemployment Rate: Aged 15 and Over: All Persons for the United States
- Unemployment Rate: Aged 15 and Over: All Persons for Japan
- Harmonized Unemployment Rate: Total: All Persons for France

France

U.S.

Japan

Source: Organization for Economic Co-operation and Development

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Source: FRED; data from the OECD.

Frictional Unemployment

- It takes time to match workers and jobs.

- At the micro level, the economy is constantly changing with lots of jobs getting destroyed and new jobs created

- As a result, at any time there are both unemployed workers and job vacancies for employers are trying to fill.

- This process is sometimes described as "churn."

The Natural Rate of Unemployment

- The economy's normal or usual unemployment rate.

- The natural rate of unemployment is more than zero.

- Vacancies (jobs that firms try to fill) move in the opposite direction as unemployment (Beveridge curve).

  - In recessions: too few vacancies, too much unemployment

  - In booms: too many vacancies, too little unemployment

- Labor market is efficient when number of vacancies are the same as number of unemployed (unemployment wastes resources but so does trying to fill vacancies)

EFFICIENCY CRITERION FOR US LABOR MARKET
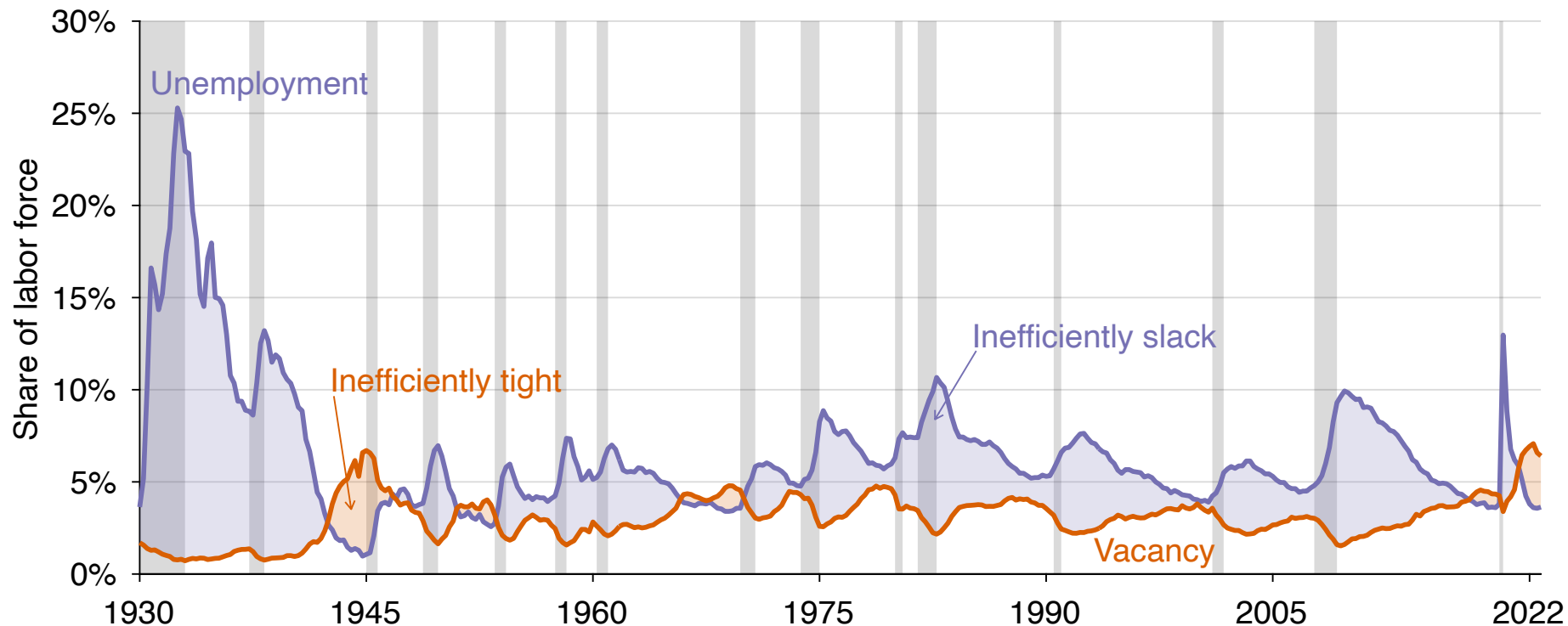
Source: Michaillat and Saez (2024): labor market too slack when unemployed exceed vacancies (common) and too tight when vacancies exceed unemployed (rare)

References

- [CORE-The Economy](#), Chapter 13.

- Principles of Economics, Chapters 17 and 18.