

Macroeconomics

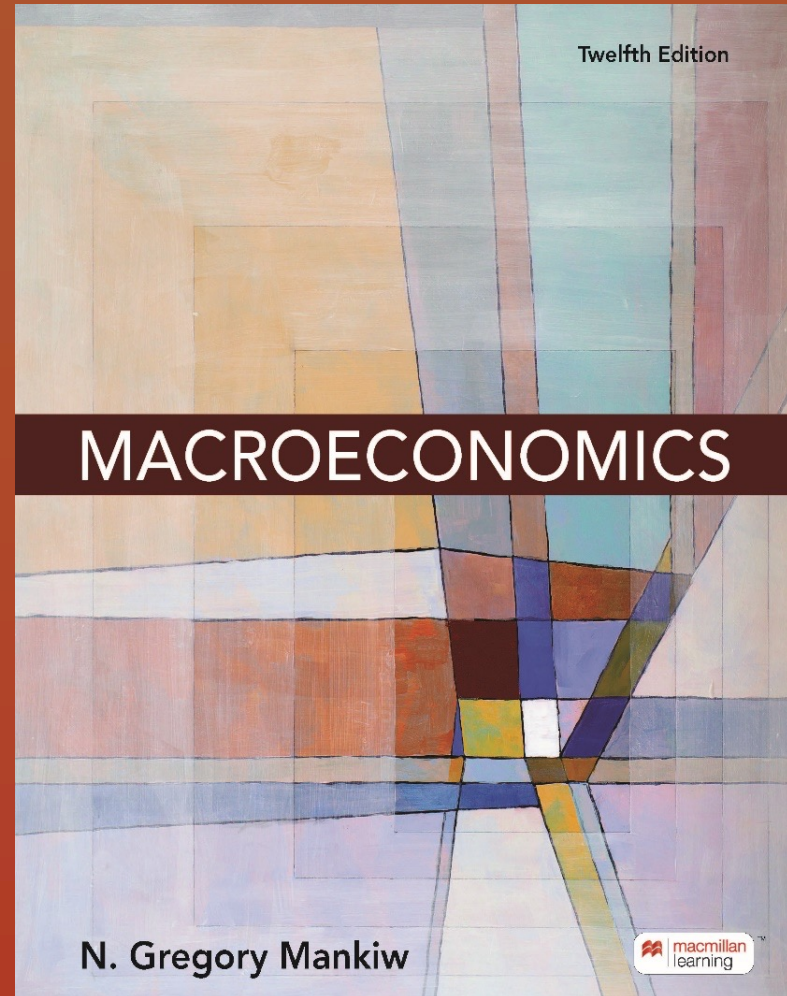
N. Gregory Mankiw



The Data of Macroeconomics

Presentation Slides

Modified for ECON 2204
by Bob Murphy



IN THIS CHAPTER, YOU WILL LEARN:

. . . the meaning and measurement of the most important macroeconomic statistics:

- gross domestic product (GDP)
- the consumer price index (CPI)
- the unemployment rate

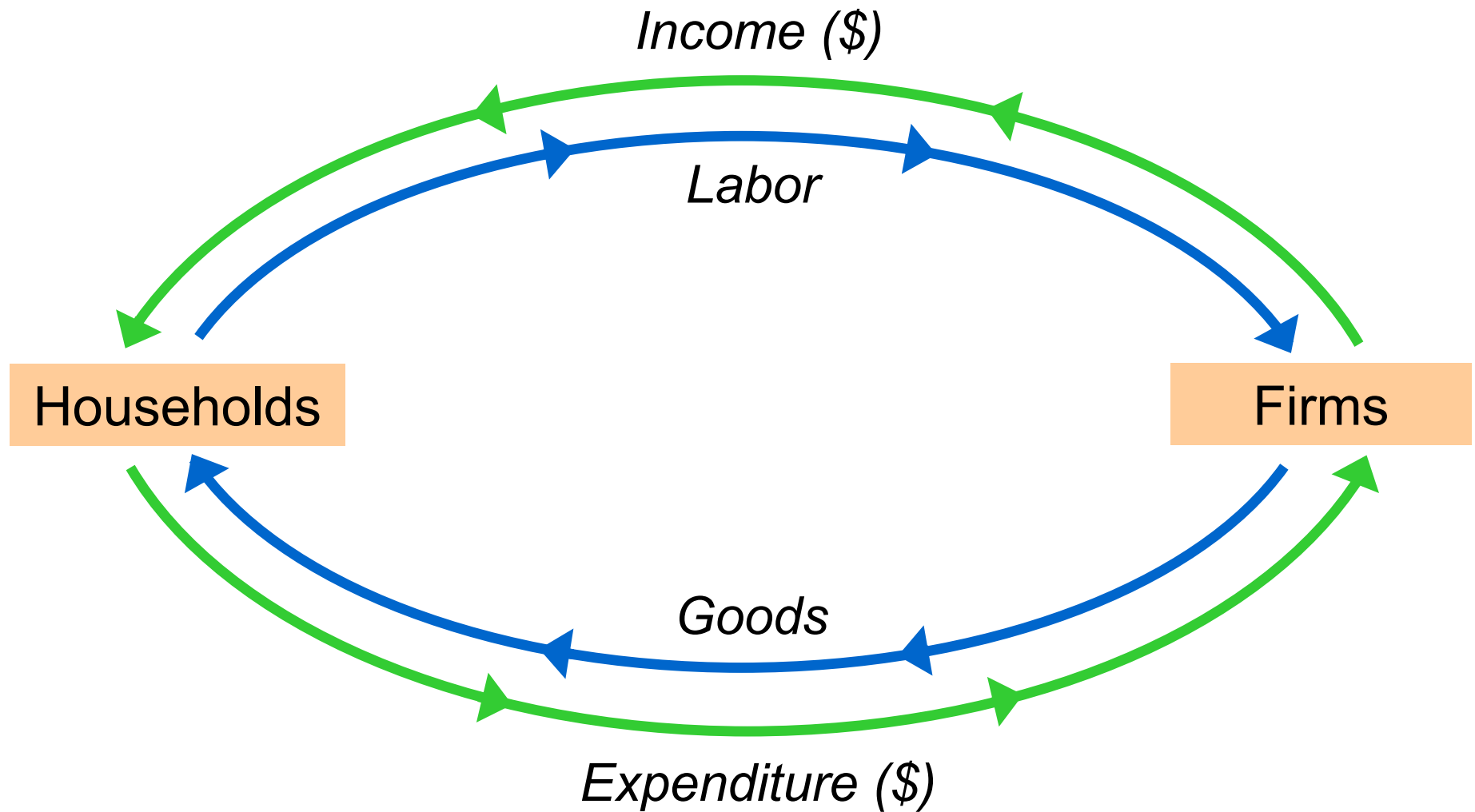
Gross Domestic Product: Expenditure and Income

Two definitions:

- Total expenditure on domestically produced final goods and services.
- Total income earned by domestically located factors of production.

Expenditure equals income because every dollar a buyer spends becomes income to the seller.

The Circular Flow



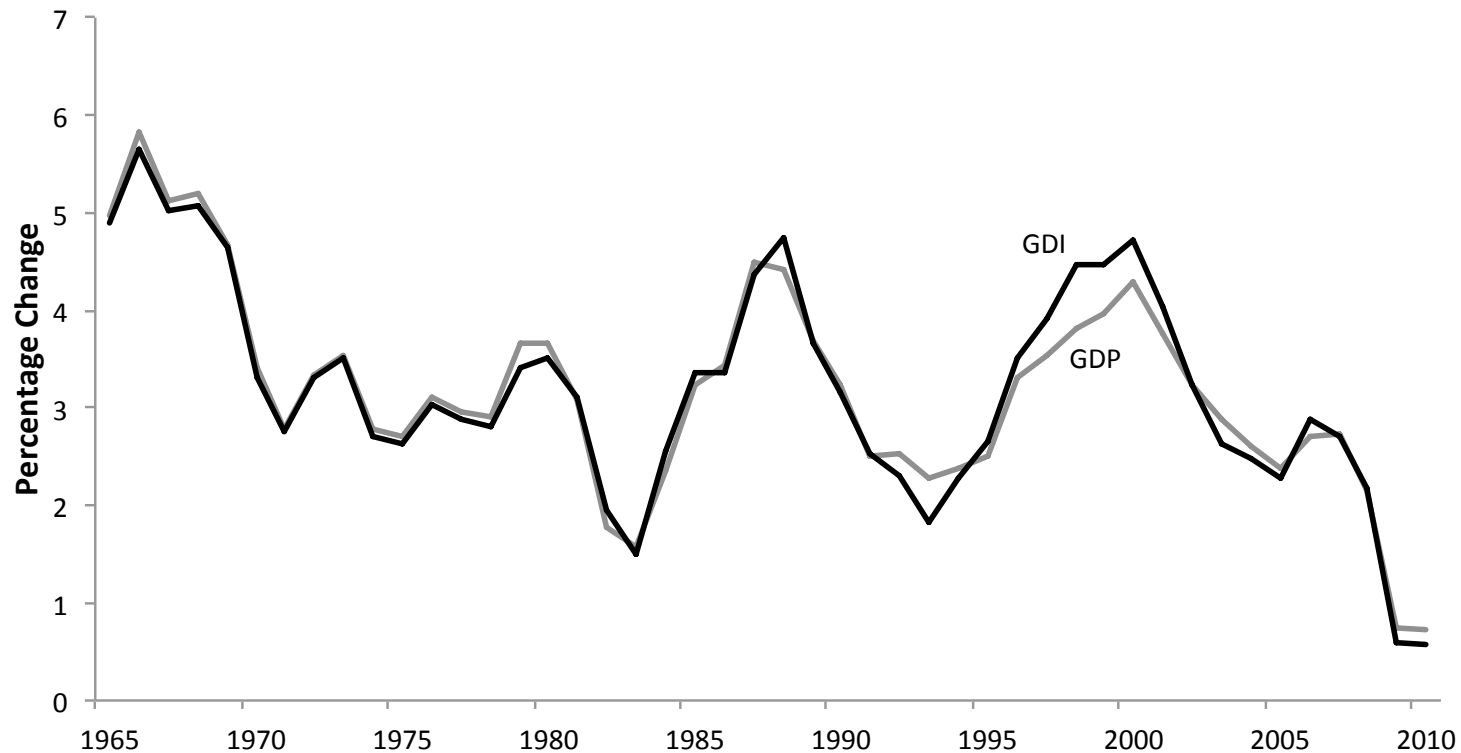
Gross Domestic Product: Expenditure and Income

- One caveat:
- Measurement of income and expenditure is imperfect.
- Difference in GDP and Gross Domestic Income (GDI) is called the “Statistical Discrepancy.”

See Supplement 2-1

Gross Domestic Product: Expenditure and Income

Figure 1 Comparing Measures of Economic Growth



Source: U.S. Department of Commerce, Bureau of Economic Analysis.

Note: Data are average annual percentage change over previous five years.

Value added

Value added: The value of output minus the value of the intermediate goods used to produce that output

Final goods, value added, and GDP

- GDP = value of final goods produced
= sum of value added at all stages
of production.
- The value of the final goods already includes the value of the intermediate goods, so including intermediate *and* final goods in GDP would be double counting.

The expenditure components of GDP

- consumption, ***C***
- investment, ***I***
- government spending, ***G***
- net exports, ***NX***

An important identity:

$$\mathbf{Y} = \mathbf{C} + \mathbf{I} + \mathbf{G} + \mathbf{NX}$$

*value of
total output*

*aggregate
expenditure*

Consumption (C)

Definition: The value of all goods and services bought by households. Includes:



- **Durable goods** last a long time.
E.g., cars, home appliances
- **Nondurable goods** last a short time.
E.g., food, clothing
- **Services** are intangible items purchased by consumers.
E.g., dry cleaning, air travel

Consumption (C)

Definition: The value of all goods and services bought by households, including:

- ***Durable goods***
last a long time.
Examples: cars, home appliances
- ***Nondurable goods***
last a short time.
Examples: food, clothing
- ***Services***
are intangible/non-physical items or activities,
purchased by consumers.
Examples: dry cleaning, air travel, concerts

U.S. consumption, 2022

	Total (billions of dollars)	Per Person (dollars)
Gross Domestic Product	25,461	76,324
Consumption	17,363	52,047
Nondurable goods	3,757	11,261
Durable goods	2,186	6,552
Services	11,420	34,234

Investment (I)

- Spending on capital, a physical asset used in future production
- Includes:
 - ***Business fixed investment***
Spending on plant and equipment
 - ***Residential fixed investment***
Spending by consumers and landlords on housing units
 - ***Inventory investment***
The change in the value of all firms' inventories

U.S. investment, 2022

	Total (billions of dollars)	Per Person (dollars)
Gross Domestic Product	25,461	76,324
Investment	4,625	13,864
Nonresidential fixed investment	3,340	10,012
Residential fixed investment	1,127	3,377
Inventory investment	159	475

Investment vs. capital

Note: Investment is spending on new capital.

Example (*assumes no depreciation*):

- 1/1/2016:
Economy has \$10 trillion worth of capital
- During 2016:
Investment = \$2 trillion
- 1/1/2017:
Economy will have \$12 trillion worth of capital

Stocks vs. Flows

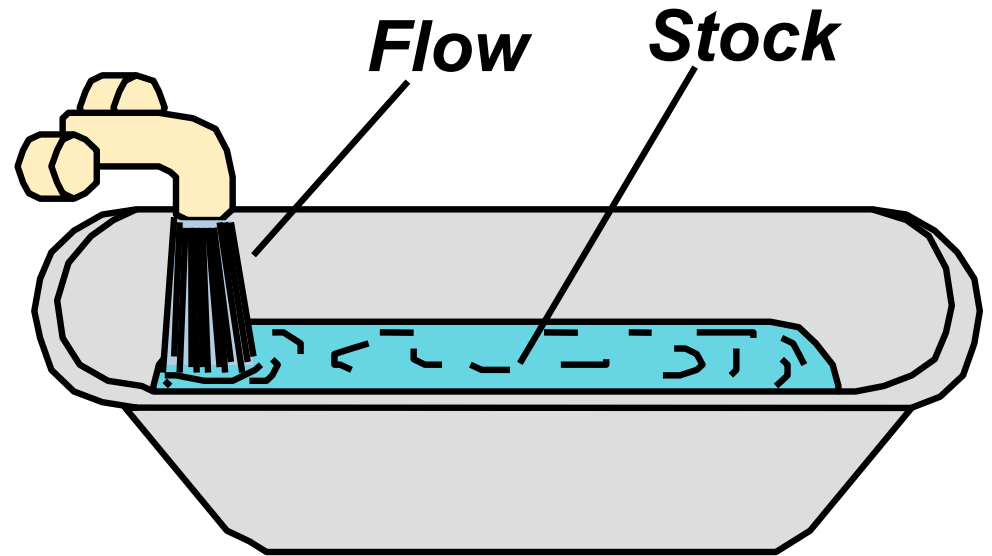
A **stock** is a quantity measured at a point in time.

E.g.,

“The U.S. capital stock was \$10 trillion on January 1, 2016.”

A **flow** is a quantity measured per unit of time.

E.g., “U.S. investment was \$2 trillion during 2016.”



Stocks vs. Flows: Examples

<i>Stock</i>	<i>Flow</i>
a person's wealth	a person's annual savings
# of people with college degrees	# of new college graduates this year
the govt debt	the govt budget deficit

Government spending (G)

- **G** includes all government spending on goods and services.
- **G** excludes transfer payments (e.g., unemployment insurance payments) because they do not represent spending on goods and services.

U.S. government spending, 2022

	Total (billions of dollars)	Per Person (dollars)
Gross Domestic Product	25,461	76,324
Government Purchases	4,446	13,328
Federal	1,647	4,936
Defense	925	2,773
Nondefense	722	2,163
State and local	2,800	8,392

Net exports (NX)

- **NX** = exports – imports
 - **Exports**: the value of goods and services sold to other countries
 - **Imports**: the value of goods and services purchased from other countries
- Hence, NX equals net spending from abroad on our goods and services

U.S. net exports, 2022

	Total (billions of dollars)	Per Person (dollars)
Gross Domestic Product	25,461	76,324
Net Exports	−973	−2,916
Exports	2,981	8,935
Imports	3,953	11,851

Table 2.1, GDP and the Components of Expenditure: 2019, Page 25

	Total (billions of dollars)	Per Person (dollars)
Gross Domestic Product	\$21,729	\$66,199
Consumption	14,795	45,074
Nondurable goods	3,011	9,173
Durable goods	1,548	4,715
Services	10,237	31,186
Investment	3,698	11,267
Nonresidential fixed investment	2,863	8,721
Residential fixed investment	818	2,491
Inventory investment	18	55
Government Purchases	3,814	11,619
Federal	1,450	4,417
Defense	862	2,626
Nondefense	588	1,790
State and local	2,364	7,202
Net Exports	-578	-1,761
Exports	2,498	7,609
Imports	3,076	9,370

NOW YOU TRY

An expenditure-output puzzle?

Suppose a firm:

- produces \$10 million worth of final goods
- only sells \$9 million worth
- Does this violate the ***expenditure = output*** identity?

Why output = expenditure

- Unsold output goes into inventory, and is counted as “inventory investment” . . . whether or not the inventory buildup was intentional.
- In effect, we are assuming that firms purchase their unsold output.

GDP:

An important and versatile concept

We have now seen that GDP measures:

- total income
- total output
- total expenditure
- the sum of value added at all stages in the production of final goods and services

GNP vs. GDP

- **Gross national product (GNP):**
Total income earned by the nation's factors of production, regardless of where located.
- **Gross domestic product (GDP):**
Total income earned by domestically-located factors of production, regardless of nationality.

$$\text{GNP} - \text{GDP} = \text{factor payments from abroad} \\ \text{minus factor payments to abroad}$$
- Examples of factor payments: wages, profits, rent, interest & dividends on assets

NOW YOU TRY

Discussion Question

*In your country,
which would you
want to be bigger,
GDP or GNP?*

Why?

GNP vs. GDP in Select Countries, 2012

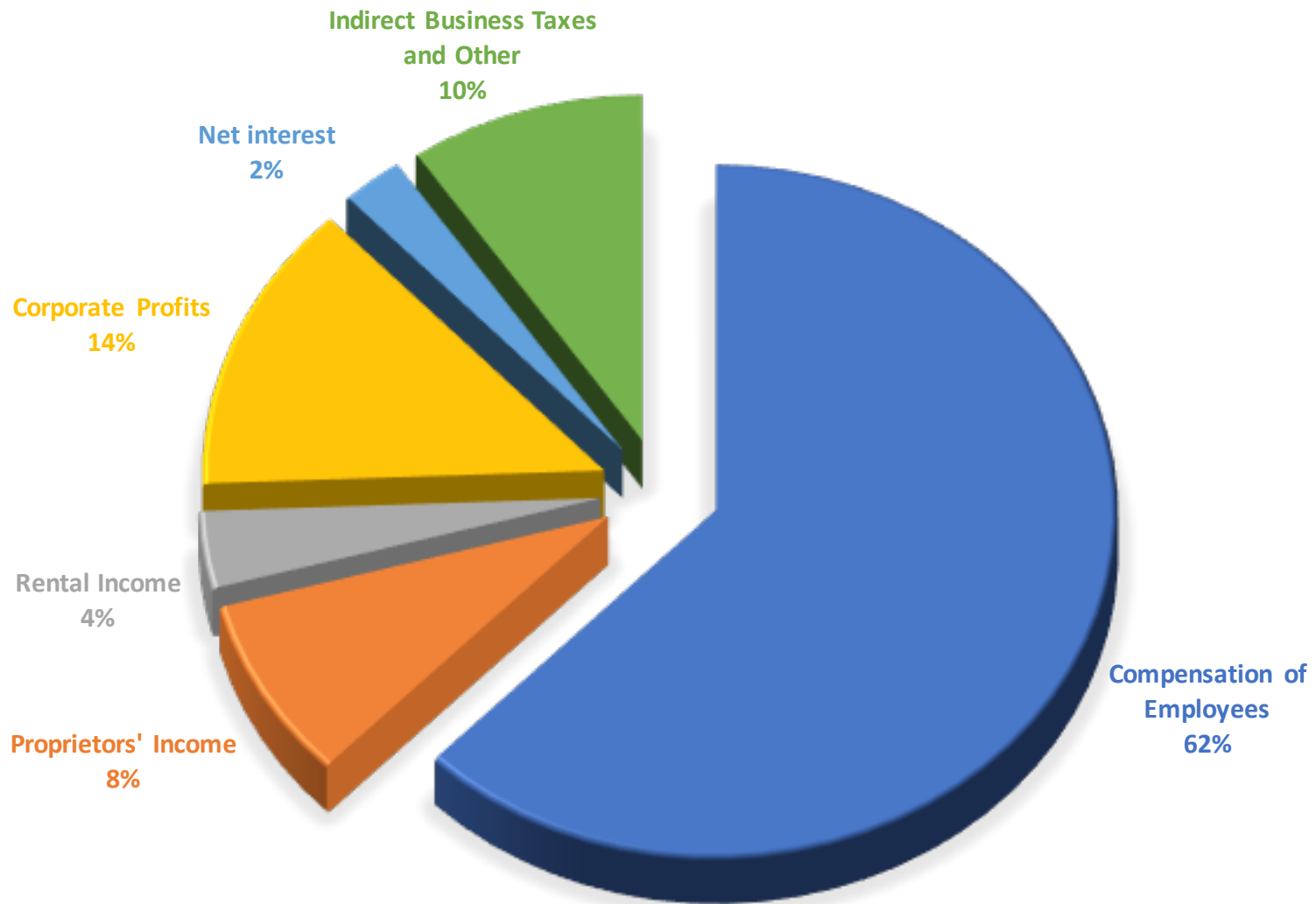
Country	GNP	GDP	<i>GNP – GDP (% of GDP)</i>
Bangladesh	127,672	116,355	9.7
Japan	6,150,132	5,961,066	3.2
China	8,184,963	8,227,103	-0.5
United States	16,514,500	16,244,600	1.7
India	1,837,279	1,858,740	-1.2
Canada	1,821,424	1,779,635	2.3
Greece	250,167	248,939	0.5
Iraq	216,453	215,838	0.3
Ireland	171,996	210,636	-18.3

GNP and GDP in millions of current U.S. dollars.

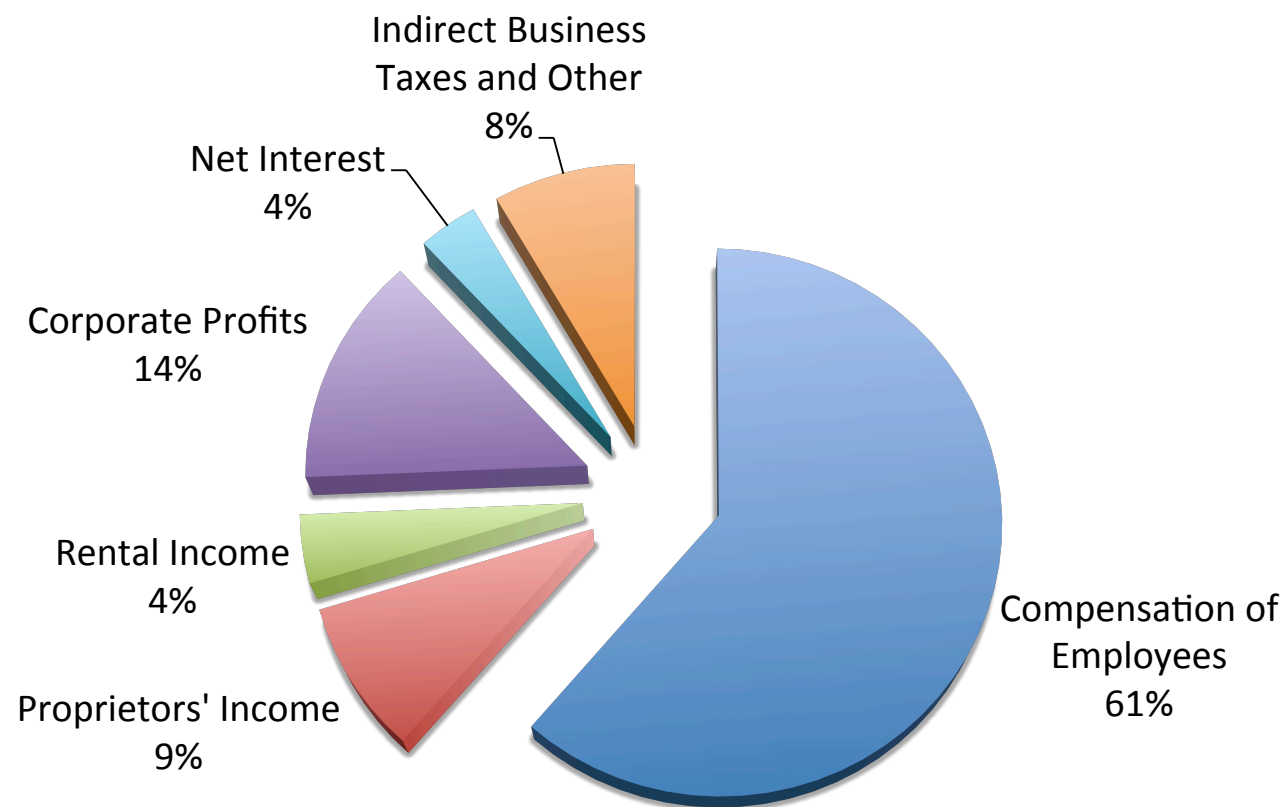
Other Measures of Income

- *Net National Product* = GNP – Depreciation
- *National Income* = NNP – Statistical Discrepancy
- *National Income* = Compensation of Employees + Proprietors' Income + Rental Income + Corporate Profits + Net Interest + Indirect Business Taxes
- Note: *Supplement 2-5* describes a change in definition of National Income to include Indirect Business Taxes.

COMPONENTS OF NATIONAL INCOME, 2022



Components of National Income, 2014



Other Measures of Income

- *Personal Income* = National Income - Indirect Business Taxes - Corporate Profits - Social Insurance Contributions - Net Interest + Dividends + Government Transfers to Individuals + Personal Interest Income
- *Disposable Personal Income* = Personal Income - Personal Tax and Nontax Payments
- *Disposable Personal Income* is what households and noncorporate businesses have to spend (or save).

Real vs. nominal GDP

- GDP is the *value* of all final goods and services produced.
- **Nominal GDP** measures these values using current prices.
- **Real GDP** measures these values using the prices of a base year.

Real vs. Nominal GDP: Fixed Base-Year Prices

$$\text{GDP}_t = \sum_{i=1}^n P_{it} Q_{it}$$

$$\text{RGDP}_t = \sum_{i=1}^n P_{iB} Q_{it}$$

Real GDP controls for inflation

- Changes in nominal GDP can be due to:
 - changes in prices
 - changes in quantities of output produced
- Changes in real GDP can only be due to changes in quantities.
- **One way to calculate changes in real GDP is by using fixed base-year prices.

Measuring Economic Growth: Fixed Base-Year Prices

$$\begin{aligned} \text{RGDP}_t / \text{RGDP}_{t-1} &= \frac{\sum_{i=1}^n P_{iB} Q_{it}}{\sum_{i=1}^n P_{iB} Q_{it-1}} \\ &= \frac{\sum_{i=1}^n P_{iB} Q_{it-1} \left[Q_{it} / Q_{it-1} \right]}{\sum_{i=1}^n P_{iB} Q_{it-1}} \end{aligned}$$

Measuring Economic Growth: Fixed Base-Year Prices

$$\text{RGDP}_t / \text{RGDP}_{t-1} = \frac{\sum_{i=1}^n P_{iB} Q_{it-1} \left[Q_{it} / Q_{it-1} \right]}{\sum_{i=1}^n P_{iB} Q_{it-1}}$$

$$\left[1 + g_t \right] = \sum_{i=1}^n \omega_{iB} \left[Q_{it} / Q_{it-1} \right]$$

Measuring Economic Growth: Fixed Base-Year Prices

$$\left[1 + g_t\right] = \sum_{i=1}^n \omega_{iB} \left[Q_{it} / Q_{it-1}\right]$$

where $\omega_{iB} = \frac{P_{iB} Q_{it-1}}{\sum_{i=1}^n P_{iB} Q_{it-1}}$

Measuring Economic Growth

A problem arises when using fixed base-year weights: *Growth will vary depending on base year chosen.*

Rapidly growing sectors with declining relative prices will be weighted “*too much*” as base year becomes further and further in the past. Opposite for slowly growing sectors.

Chain-Weighted Real GDP

- Over time, relative prices change, so the base year should be updated periodically--which BEA used to do.
- In essence, chain-weighted real GDP updates the base year every year, using an average of last year's and this year's prices, so it is more accurate than fixed base-year GDP.
- Official measure of GDP now produced by BEA.
- *See Supplement 2-3.*

Chain-Weighted Real GDP

Step 1:

$$[1 + g_t]_{t-1} = \frac{\sum_{i=1}^n P_{it-1} Q_{it-1} \left[Q_{it} / Q_{it-1} \right]}{\sum_{i=1}^n P_{it-1} Q_{it-1}}$$

Rewrite as:

$$\left[1 + g_t \right]_{t-1} = \sum_{i=1}^n \omega_{it-1} \left[Q_{it} / Q_{it-1} \right]$$

Chain-Weighted Real GDP

Step 2:

$$[1 + g_t]_t = \frac{\sum_{i=1}^n P_{it} Q_{it-1} \left[Q_{it} / Q_{it-1} \right]}{\sum_{i=1}^n P_{it} Q_{it-1}}$$

Rewrite as:

$$\left[1 + g_t \right]_t = \sum_{i=1}^n \omega_{it} \left[Q_{it} / Q_{it-1} \right]$$

Chain-Weighted Real GDP

Step 3:

$$[1 + g_t] = \{[1 + g_t]_t \times [1 + g_t]_{t-1}\}^{0.5}$$

To get level of real GDP, use nominal GDP for a given year and apply growth rate:

$$RGDP_t = [1 + g_t][1 + g_{t-1}][1 + g_{t-2}][1 + g_{t-3}]GDP_{t-4}$$

Real GDP is measured here in year t-4 dollars.

GDP deflator

- **Inflation rate**: the percentage increase in the overall level of prices.
- One measure of the price level: **GDP deflator**

Definition:

$$\text{GDP deflator} = 100 \times \frac{\text{Nominal GDP}}{\text{Real GDP}}$$

Deflator: Fixed-Weight Growth Measures

$$\begin{aligned}\text{GDP Deflator}_t &= \text{GDP}_t / \text{RGDP}_t \\ &= \sum_{i=1}^n P_{it} Q_{it} / \sum_{i=1}^n P_{iB} Q_{it} \\ &= \frac{\sum_{i=1}^n P_{iB} Q_{it} \left[P_{it} / P_{iB} \right]}{\sum_{i=1}^n P_{iB} Q_{it}}\end{aligned}$$

GDP deflator

- GDP Deflator is a Paasche (current-weighted) index when real GDP is computed as a Laspeyres (fixed-weighted) index:

$$\text{GDP Deflator}_t = \frac{\sum_{i=1}^n P_{iB} Q_{it} \left[P_{it} / P_{iB} \right]}{\sum_{i=1}^n P_{iB} Q_{it}}$$

GDP deflator

- Rewriting this expression gives:

$$\text{GDP Deflator}_t = \sum_{i=1}^n \gamma_i \left[P_{it} / P_{iB} \right]$$

$$\text{where } \gamma_i = \frac{P_{iB} Q_{it}}{\sum_{i=1}^n P_{iB} Q_{it}}$$

Chain-Weighted Real GDP

- We can compute a deflator for chain-weighted GDP in same manner used for the fixed-weight measure.
- This price measure is a chain-weighted index with quantity weights updated each year, but using an average of this year's and last year's quantities.
- As with the real GDP measure, the price measure updates the base year every year, ensuring the measure is never too far out of date.
- *See Supplement 2-3.*

Two arithmetic tricks for working with percentage changes

1. For any variables X and Y ,
percentage change in $(X \times Y)$
 $\approx$ percentage change in X
 $+ \text{percentage change in } Y$

Ex.: If your hourly wage rises 5%
and you work 7% more hours,
then your wage income rises
approximately 12%.

Two arithmetic tricks for working with percentage changes

2. Percentage change in (X/Y)
 $\approx$ percentage change in X
 $-$ percentage change in Y

Ex.: GDP deflator = $100 \times \text{NGDP}/\text{RGDP}$.

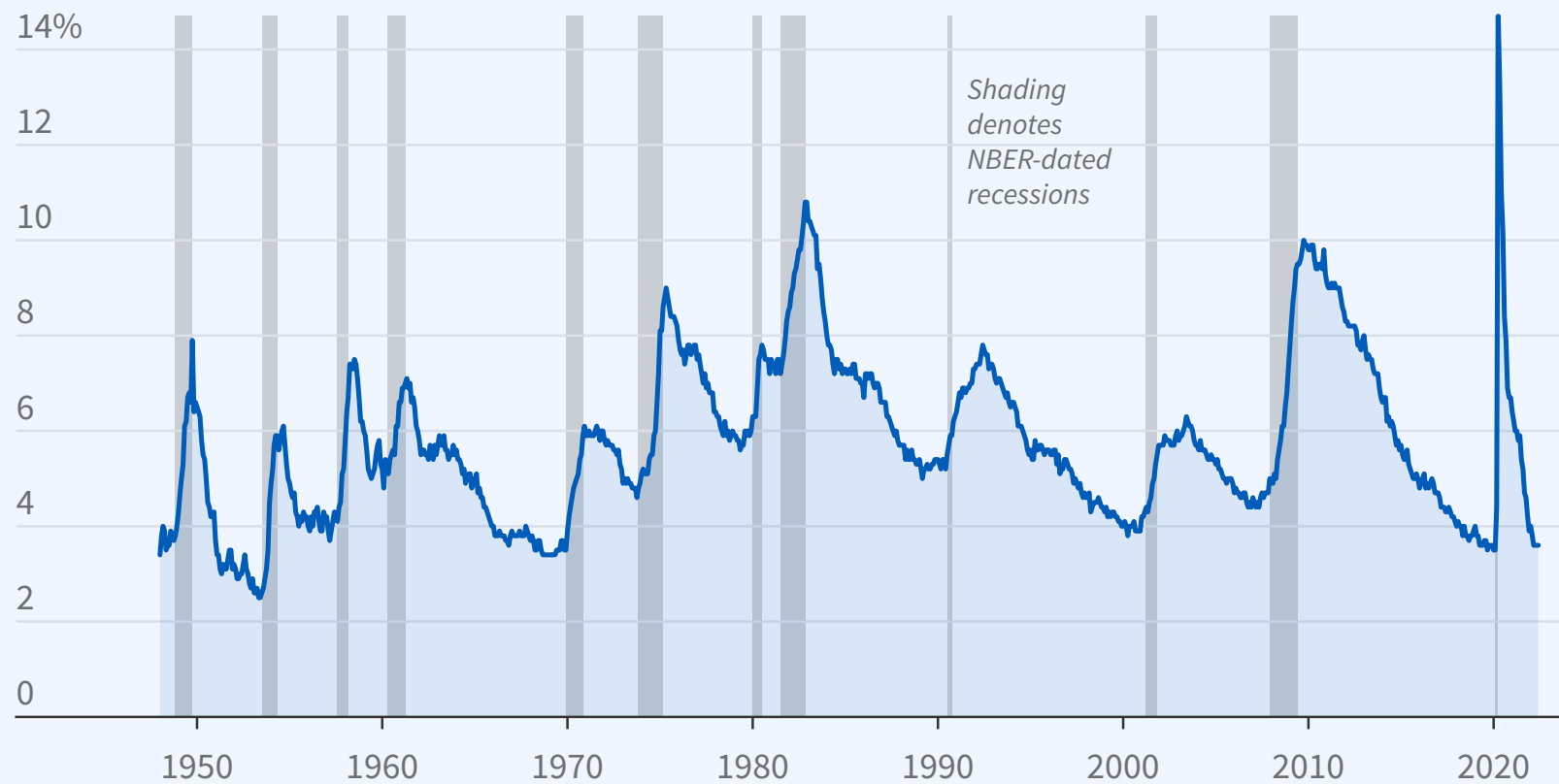
If NGDP rises 9% and RGDP rises 4%,
then the inflation rate is approximately 5%.

When is the Economy in a Recession?

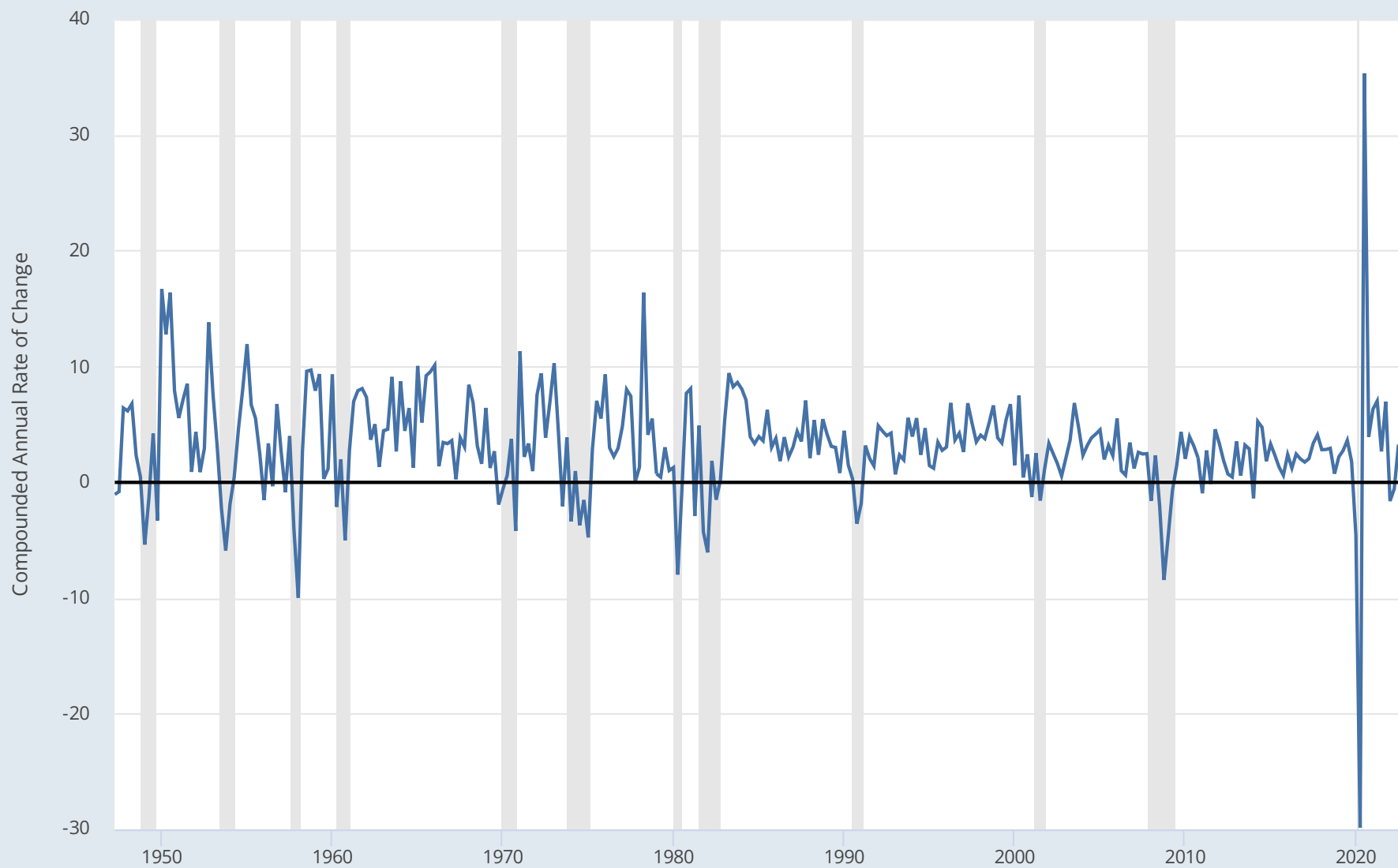
- Rule of Thumb: Two quarters of decline in Real GDP
- National Bureau of Economic Research uses more nuanced approach (see **Supplement 1-3**):
 - Monthly Indicators rather than Quarterly.
 - “A significant decline in activity spread across the economy, lasting more than a few months, visible in industrial production, employment, real income, and wholesale-retail trade.”

****For details on the latest decision by the NBER that a recession began in February 2020, see <https://www.nber.org/news/business-cycle-dating-committee-announcement-june-8-2020>**

Unemployment Rate and Recessions since 1948



Source: Unemployment data is from the Federal Reserve Bank of St. Louis

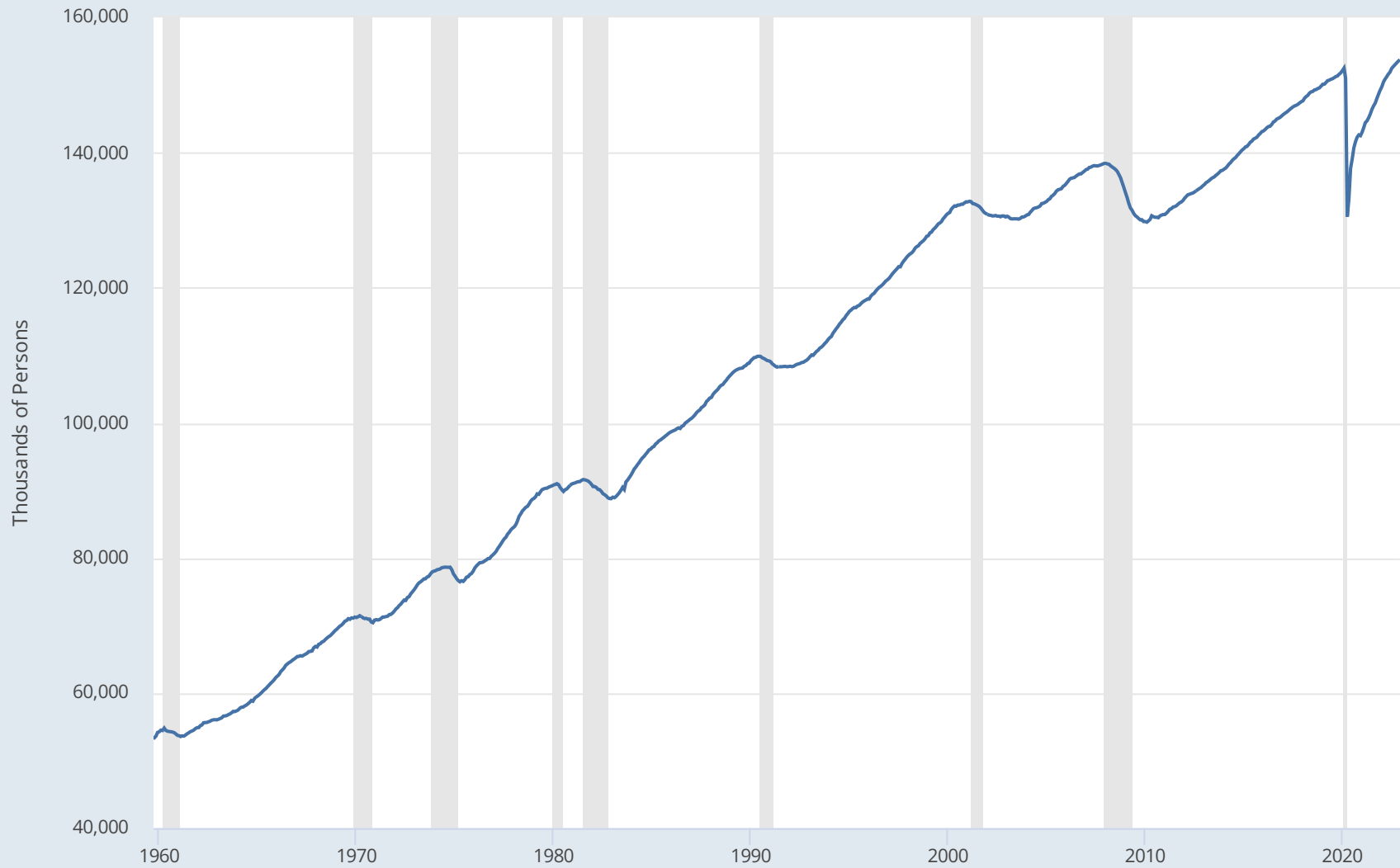


Source: U.S. Bureau of Economic Analysis

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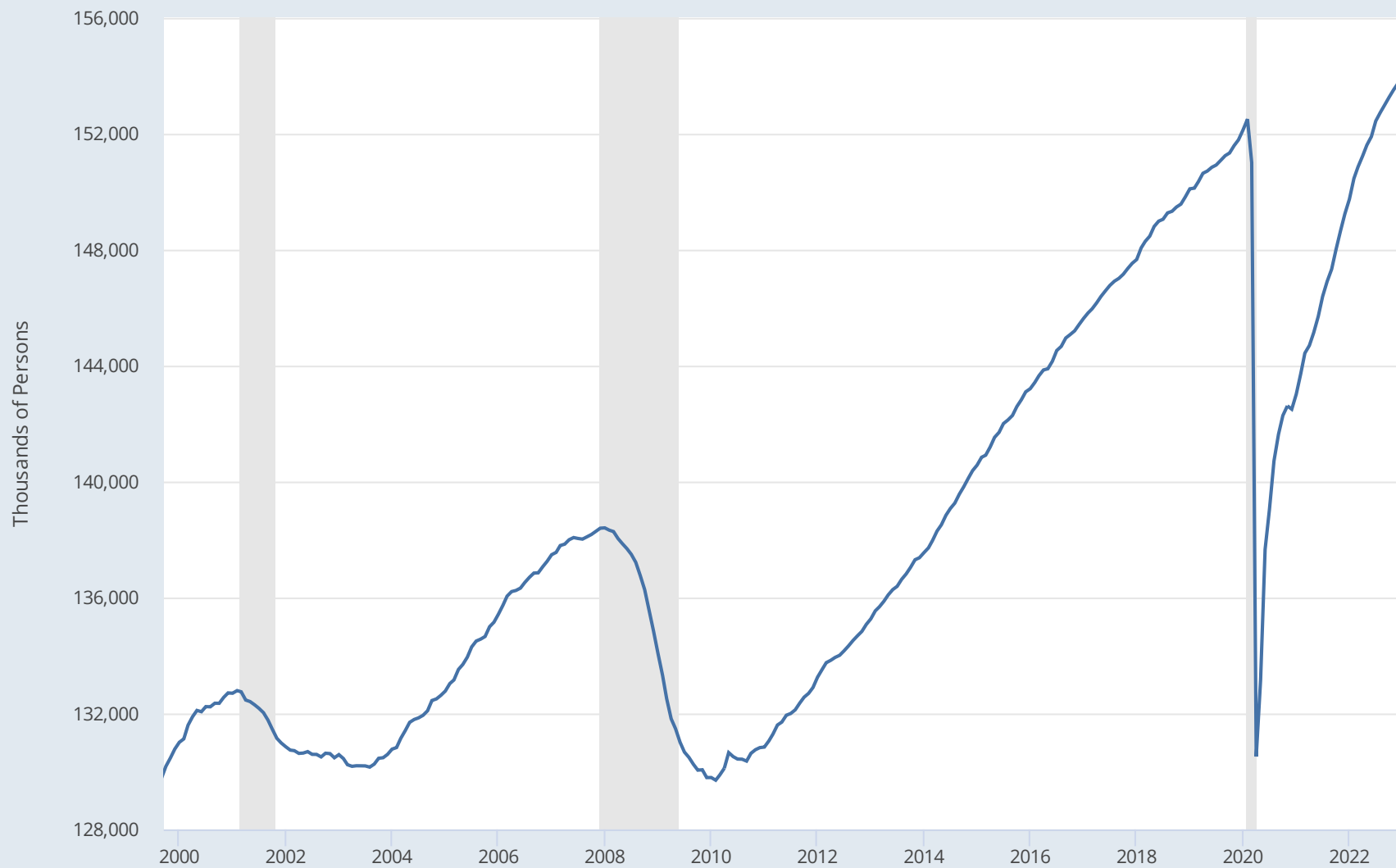


— All Employees, Total Nonfarm



Source: U.S. Bureau of Labor Statistics

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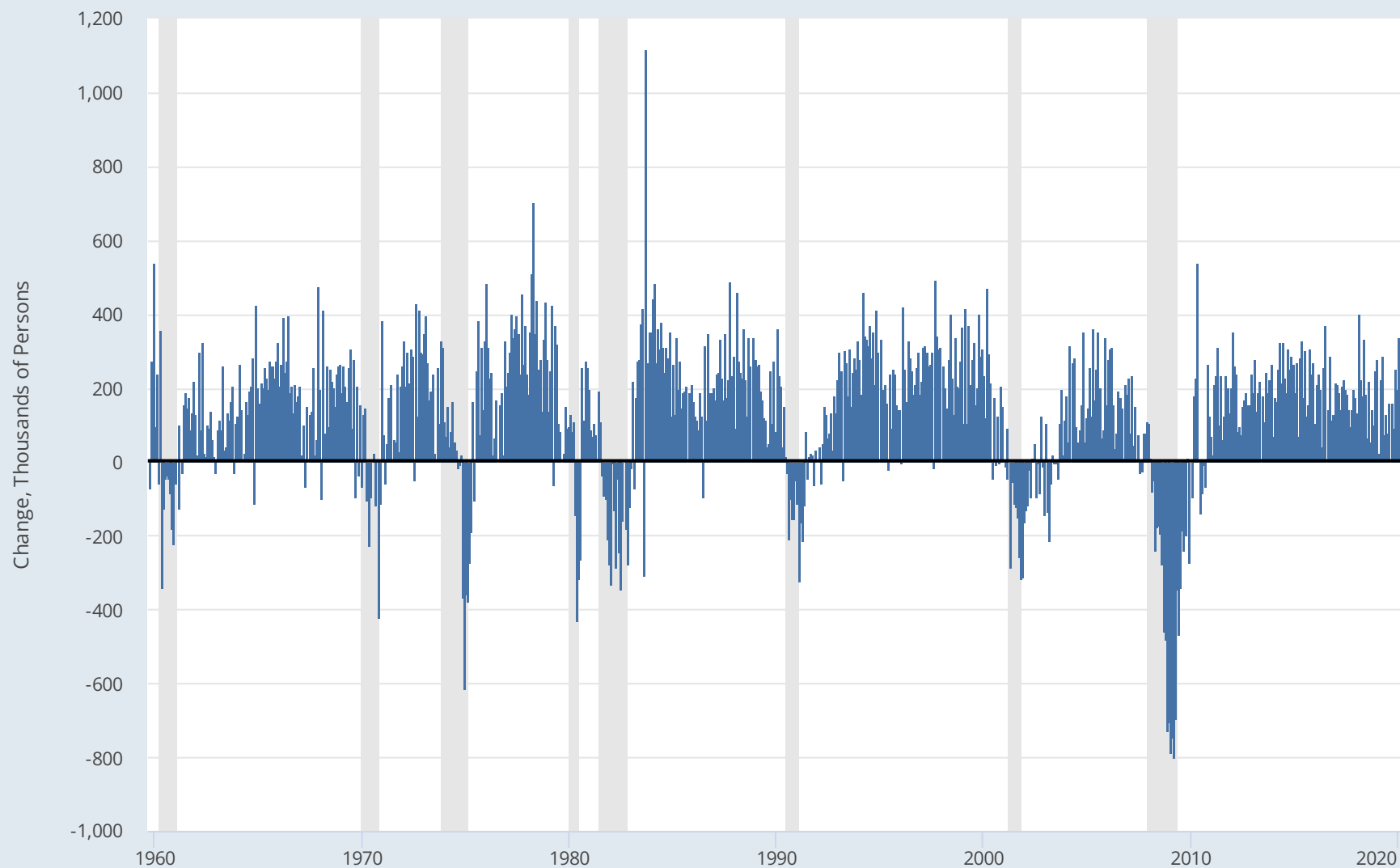


Source: U.S. Bureau of Labor Statistics

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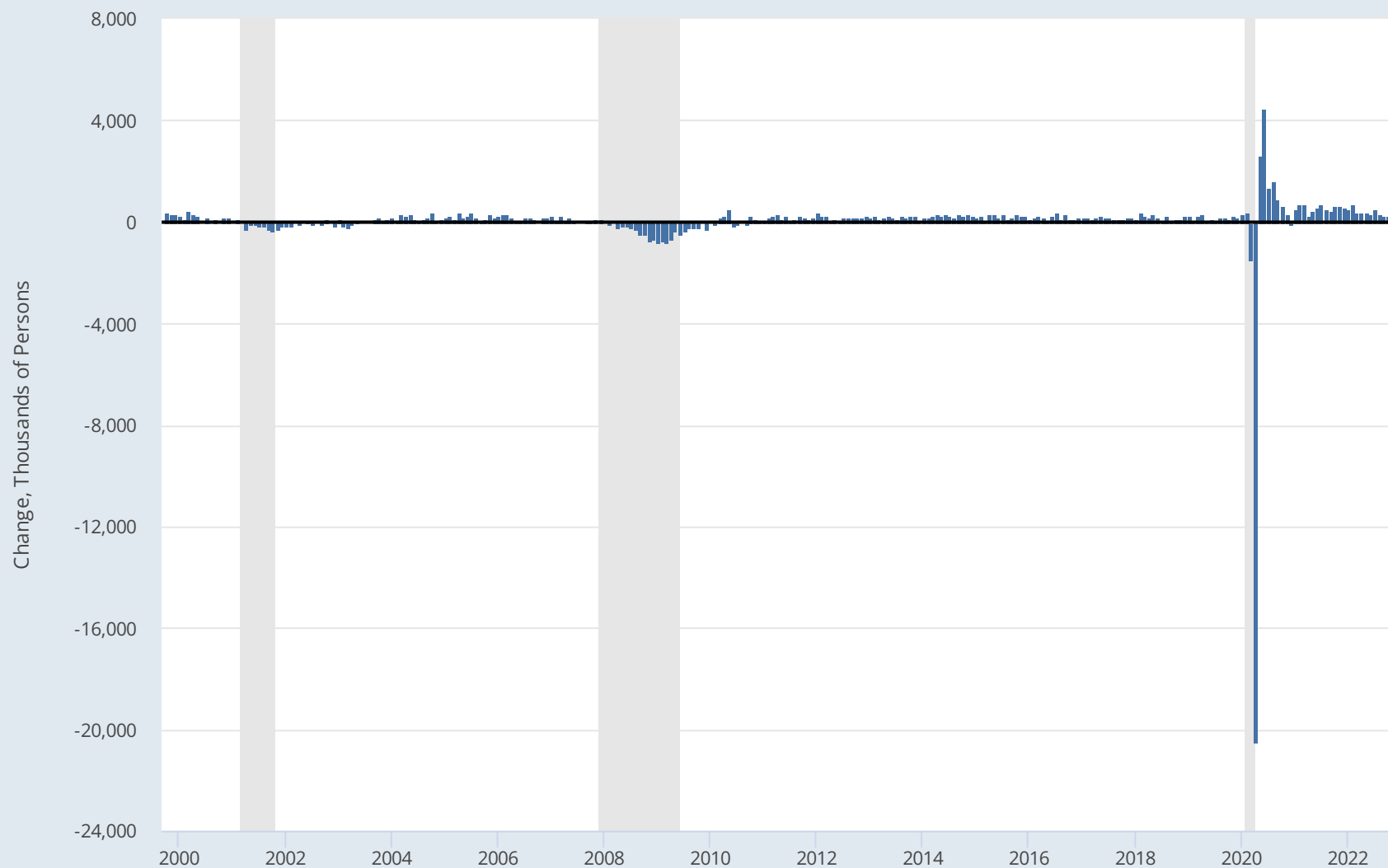


● All Employees, Total Nonfarm



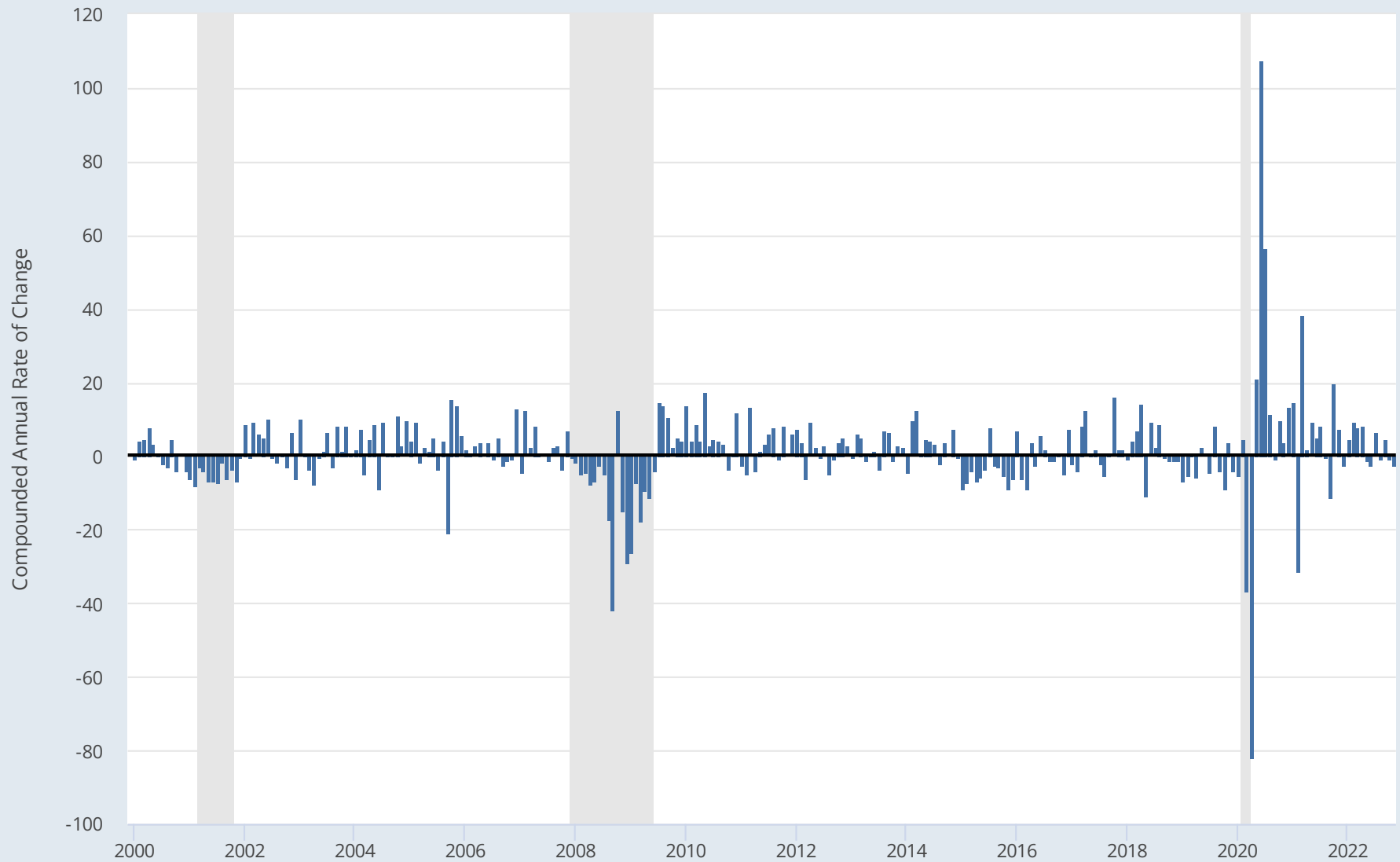
Source: U.S. Bureau of Labor Statistics

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Source: U.S. Bureau of Labor Statistics

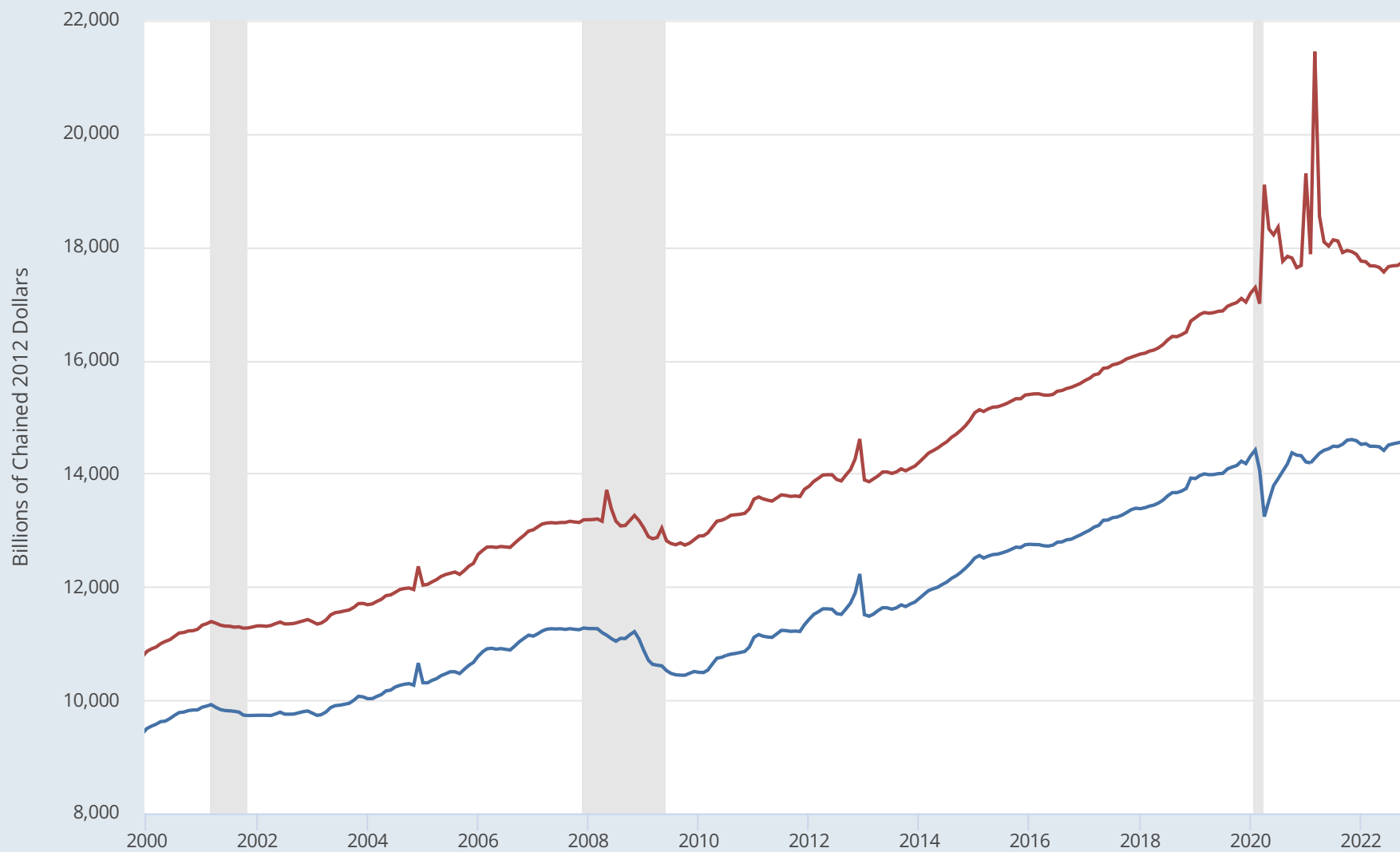
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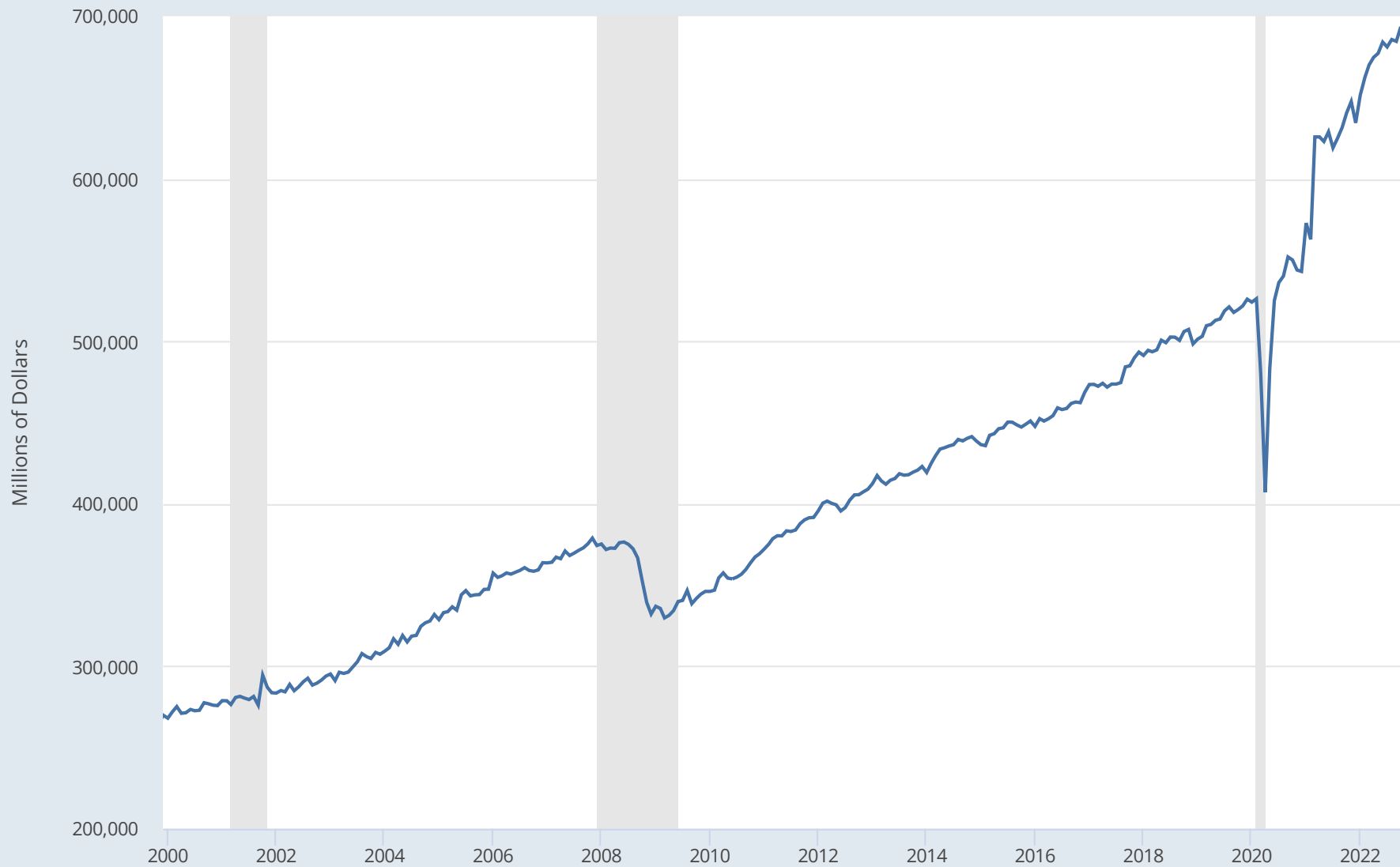


— Real personal income excluding current transfer receipts
— Real Personal Income



Source: U.S. Bureau of Economic Analysis

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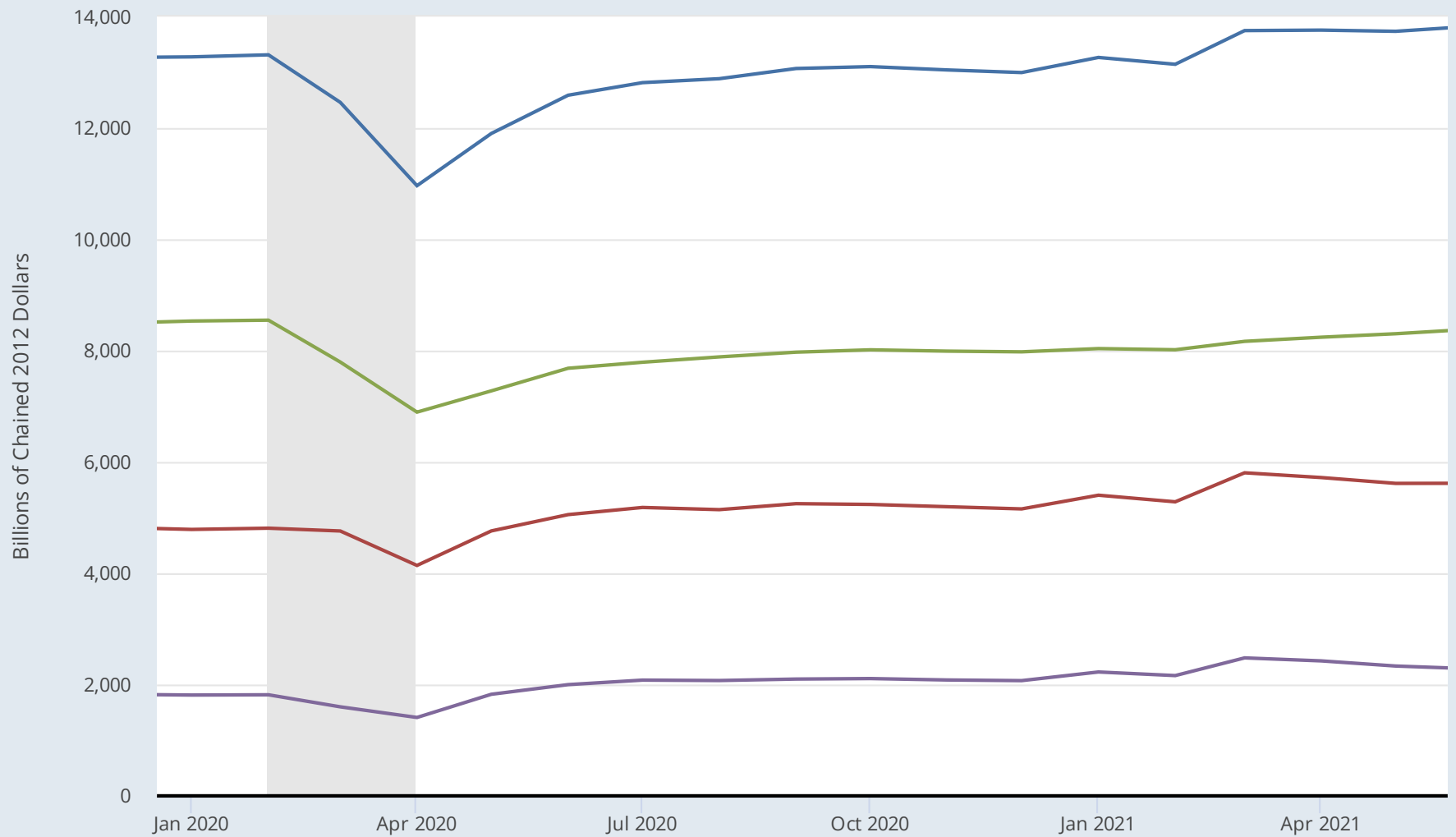


Source: U.S. Census Bureau

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- Real Personal Consumption Expenditures
- Real Personal Consumption Expenditures: Goods
- Real Personal Consumption Expenditures: Services
- Real Personal Consumption Expenditures: Durable Goods

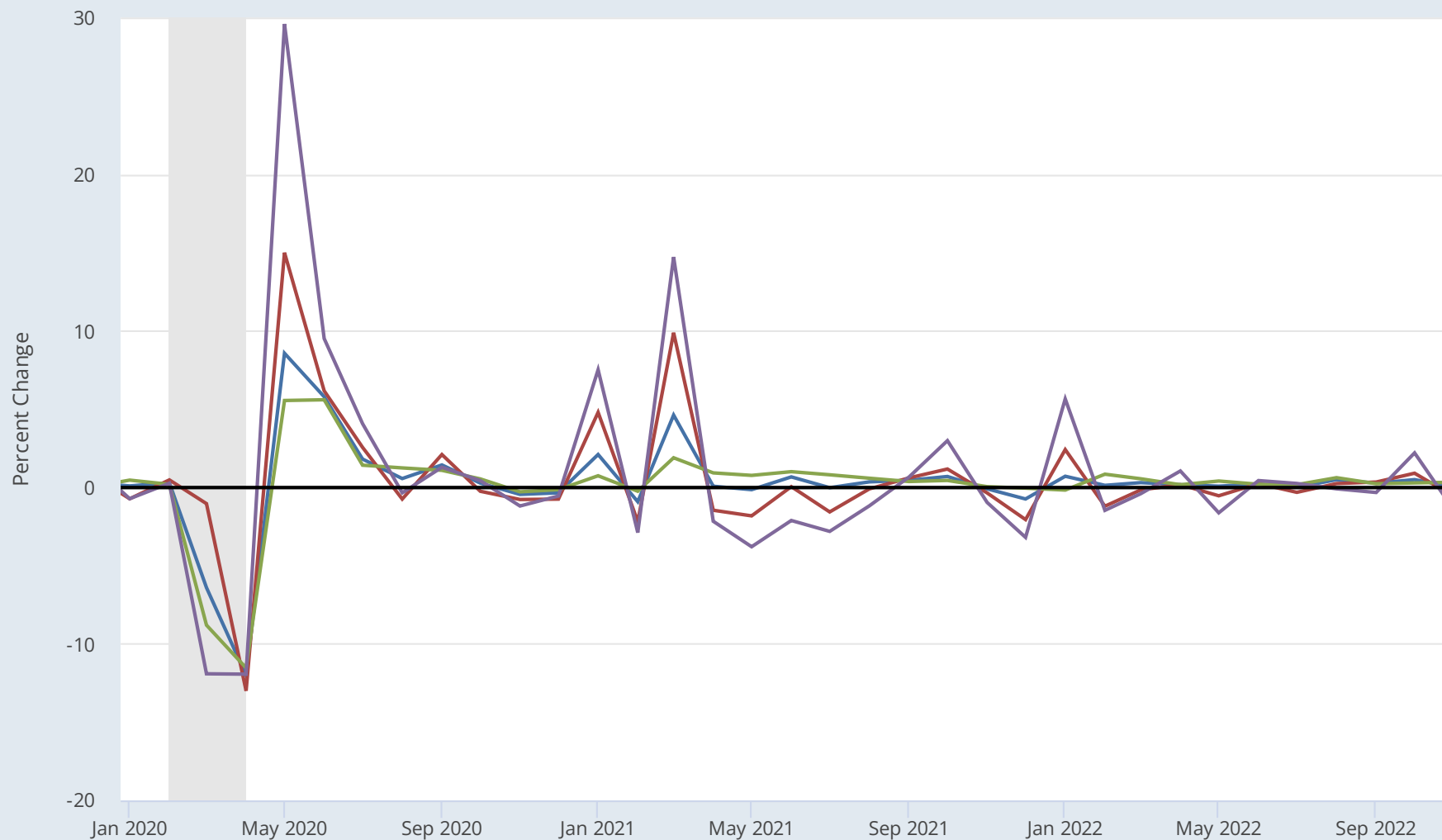


Source: U.S. Bureau of Economic Analysis

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- Real Personal Consumption Expenditures
- Real Personal Consumption Expenditures: Goods
- Real Personal Consumption Expenditures: Services
- Real Personal Consumption Expenditures: Durable Goods



Source: U.S. Bureau of Economic Analysis

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Consumer price index (CPI)

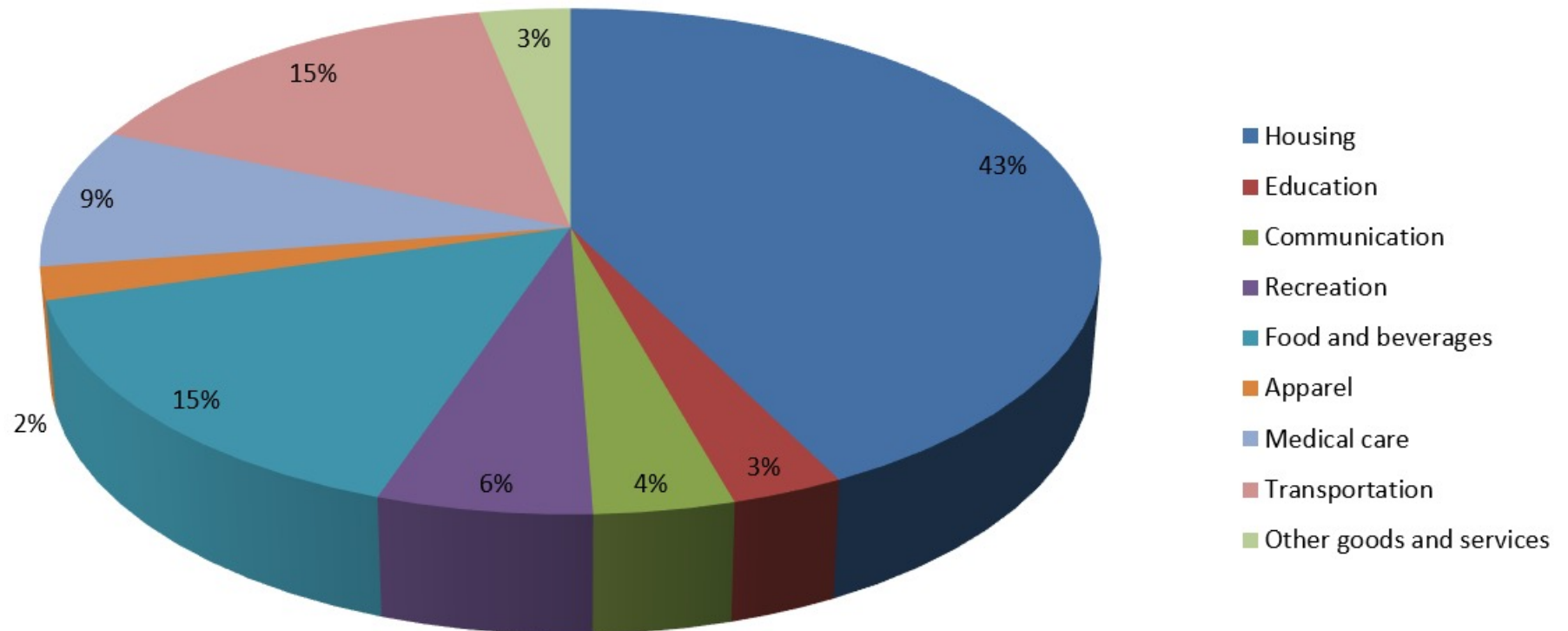
- A measure of the overall level of prices
- Published by the Bureau of Labor Statistics (BLS)
- Uses:
 - tracks changes in the typical household's cost of living
 - adjusts many contracts for inflation ("COLAs")
 - allows comparisons of dollar amounts over time

How the BLS constructs the CPI

1. Survey consumers to determine composition of the typical consumer's "basket" of goods
2. Every month, collect data on prices of all items in the basket; compute cost of basket
3. CPI in any month equals

$$100 \times \frac{\text{Cost of basket in that month}}{\text{Cost of basket in base period}}$$

The composition of the CPI's "basket"



Understanding the CPI

For good $i = 1, \dots, n$

C_i = amount of good i in the CPI's basket

P_{it} = price of good i in month t

E_t = cost of the CPI basket in month t

E_B = cost of the basket in the base period

Understanding the CPI

$$\begin{aligned} \text{CPI} &= \frac{E_t}{E_B} = \frac{\sum_{i=1}^n Q_{iB} P_{it}}{\sum_{i=1}^n Q_{iB} P_{iB}} \\ &= \frac{\sum_{i=1}^n Q_{iB} P_{iB} \left[P_{it} / P_{iB} \right]}{\sum_{i=1}^n Q_{iB} P_{iB}} \end{aligned}$$

Understanding the CPI

$$\text{CPI} = \frac{E_t}{E_B} = \sum_{i=1}^n \gamma_{iB} \left[P_{it} / P_{iB} \right]$$

where the weights are given by:

$$\gamma_{iB} = \frac{Q_{iB} P_{iB}}{\sum_{i=1}^n Q_{iB} P_{iB}}$$

Understanding the CPI

The CPI is a weighted average of prices relative to their value in the base period.

The weight on each “price relative” reflects that good’s relative importance in the CPI’s basket.

Note that the weights remain fixed over time—the CPI is a Laspeyres Index.

Why the CPI may overstate inflation

- **Substitution bias:**

The CPI uses fixed weights, so it cannot reflect consumers' ability to substitute toward goods whose relative prices have fallen.

- **Introduction of new goods:**

The introduction of new goods makes consumers better off and, in effect, increases the real value of the dollar. But it does not reduce the CPI, because the CPI uses fixed weights.

- **Unmeasured changes in quality:**

Quality improvements increase the value of the dollar but are often not fully measured.

The size of the CPI's bias

- In 1995, a Senate-appointed panel of experts estimated that the CPI overstates inflation by about 1.1% per year.
- So the BLS made adjustments to reduce the bias.
- Now, the CPI's bias is probably under 1% per year.
- *See Supplements 2-8 and 2-9.*

CPI vs. GDP deflator

Prices of capital goods:

- included in GDP deflator (if produced domestically)
- excluded from CPI

Prices of imported consumer goods:

- included in CPI
- excluded from GDP deflator

The basket of goods:

- CPI: fixed
- GDP deflator: changes every year

The PCE deflator

- Another measure of the price level:
Personal Consumption Expenditures Price Index,
the ratio of nominal to real consumer spending
- How the PCE is like the CPI:
 - only includes consumer spending
 - includes imported consumer goods
- How the PCE is like the GDP deflator:
 - the “basket” changes over time
- The Federal Reserve prefers PCE.

Core Measures of Inflation

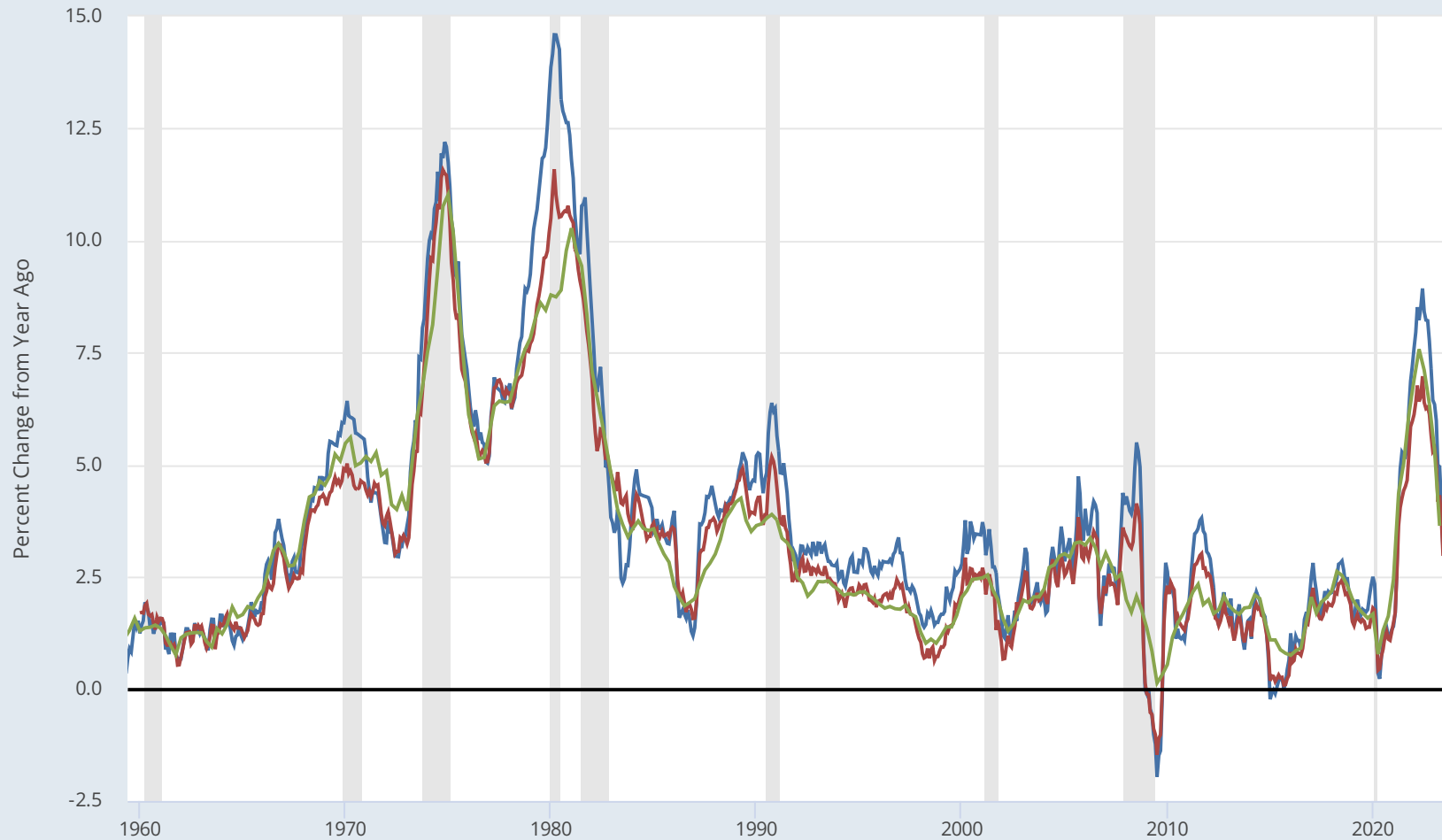
- BLS and BEA produce measures of inflation that exclude food and energy sectors.
- These are known as “Core” inflation measures.
- Produced for both the CPI and the PCE Price Index.
- Federal Reserve often focuses on core inflation as a better measure of underlying trends in prices.

Measures of Inflation

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- Consumer Price Index for All Urban Consumers: All Items in U.S. City Average
- Personal Consumption Expenditures: Chain-type Price Index
- Gross Domestic Product: Chain-type Price Index



Sources: BLS; BEA

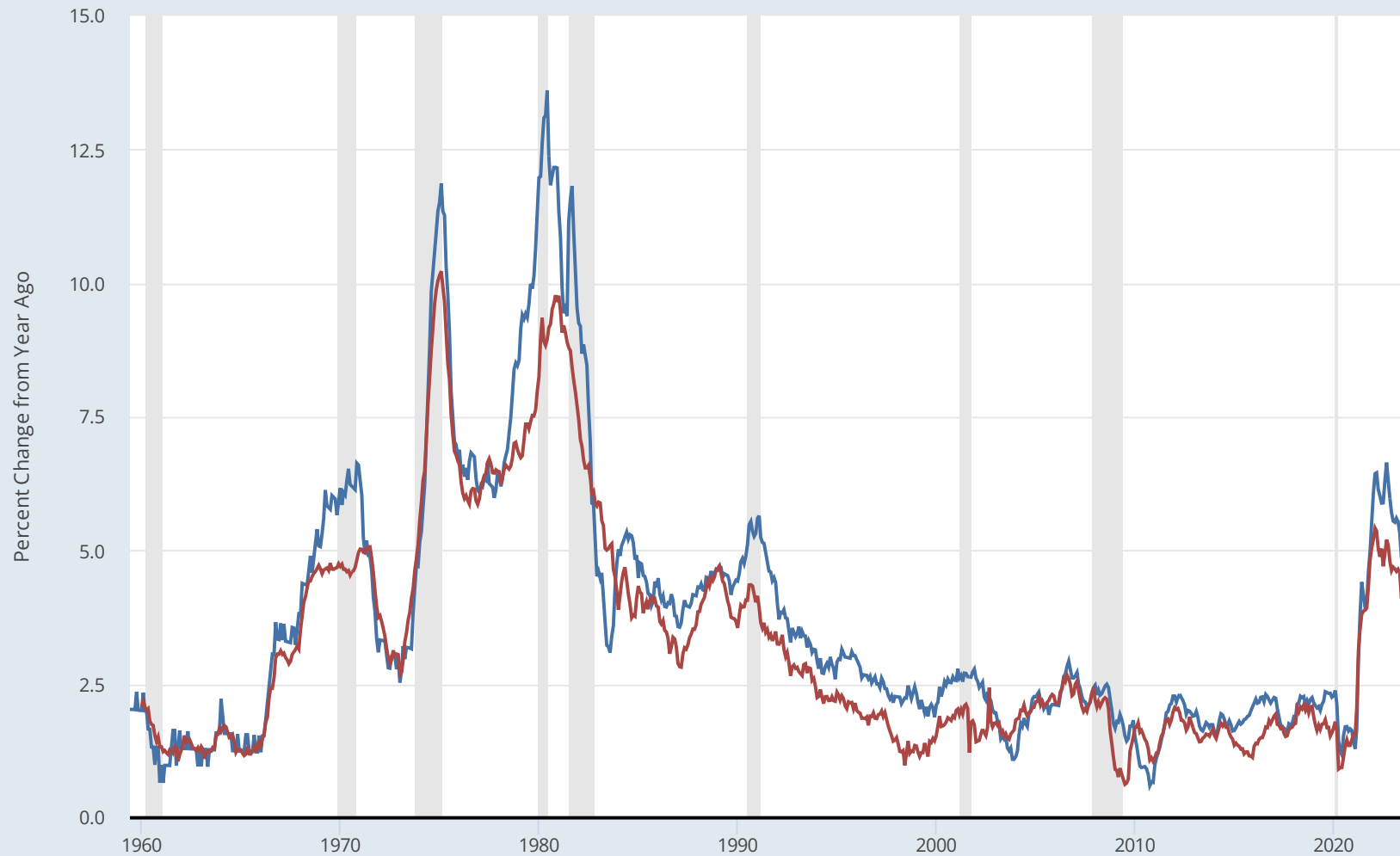
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Measures of Core Inflation

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— Consumer Price Index for All Urban Consumers: All Items Less Food and Energy in U.S. City Average
— Personal Consumption Expenditures Excluding Food and Energy (Chain-Type Price Index)



Sources: BLS; BEA

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Categories of the population

- **Employed**
working at a paid job
- **Unemployed**
not employed but looking for a job
- **Labor force**
the amount of labor available for producing goods and services; all employed plus unemployed persons
- **Not in the labor force**
not employed, not looking for work

Two important labor force concepts

- **Unemployment rate**
percentage of the labor force that is unemployed
- **Labor force participation rate**
the fraction of the adult population that “participates” in the labor force, *i.e.* is working or looking for work
- **Household (Current Population) Survey**
used to measure these concepts

NOW YOU TRY

Computing labor statistics

U.S. adult population by group, February 2021

Number employed = 150.24 million

Number unemployed = 9.72 million

Adult population = 260.66 million

Calculate

- the labor force
- the unemployment rate
- the labor force participation rate

NOW YOU TRY

Computing labor statistics, answers

Data: ***E*** = 150.24, ***U*** = 9.72, ***POP*** = 260.66

Labor force

$$***L*** = ***E*** + ***U*** = 150.24 + 9.72 = 159.96$$

Unemployment rate

$$***U/L*** \times 100\% = (9.72/159.96) \times 100\% = 6.1\%$$

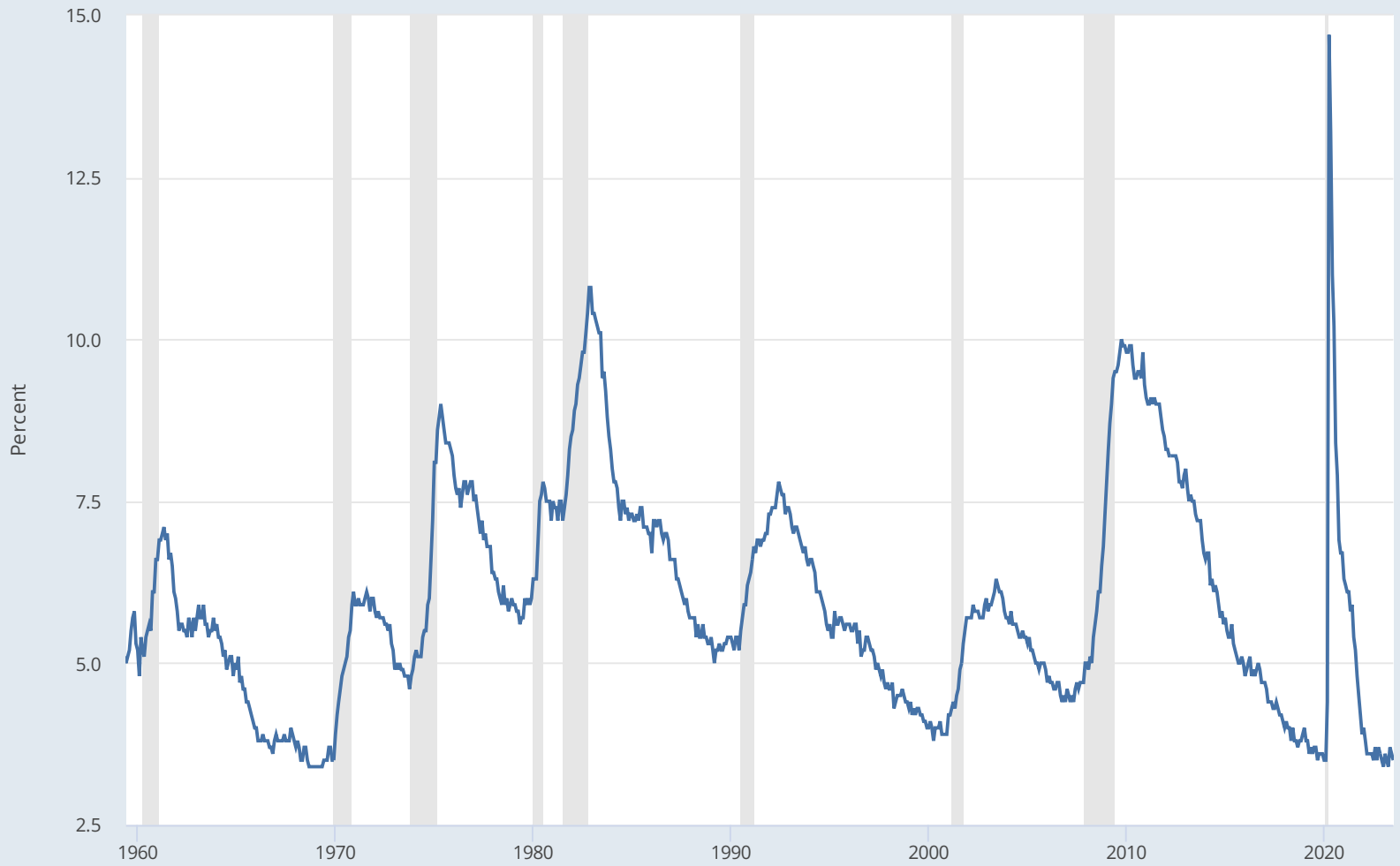
Labor-force participation rate

$$***L/POP*** \times 100\% = (159.96/260.66) \times 100\% = 61.37\%$$

Unemployment Rate

(Percentage of Labor Force)

FRED  — Unemployment Rate

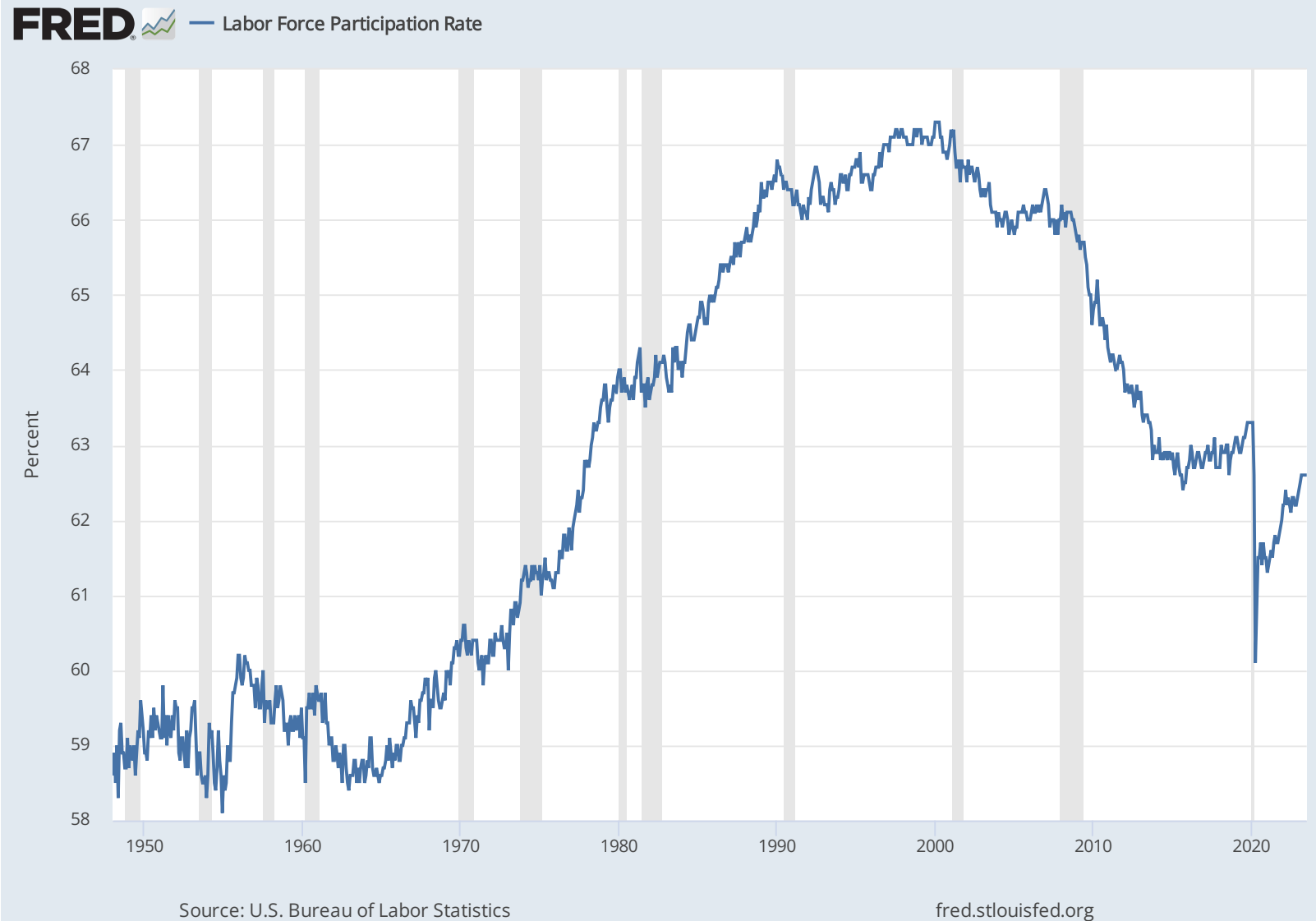


Source: U.S. Bureau of Labor Statistics

fred.stlouisfed.org

Labor Force Participation Rate

(Persons 16 Years of Age and Older)

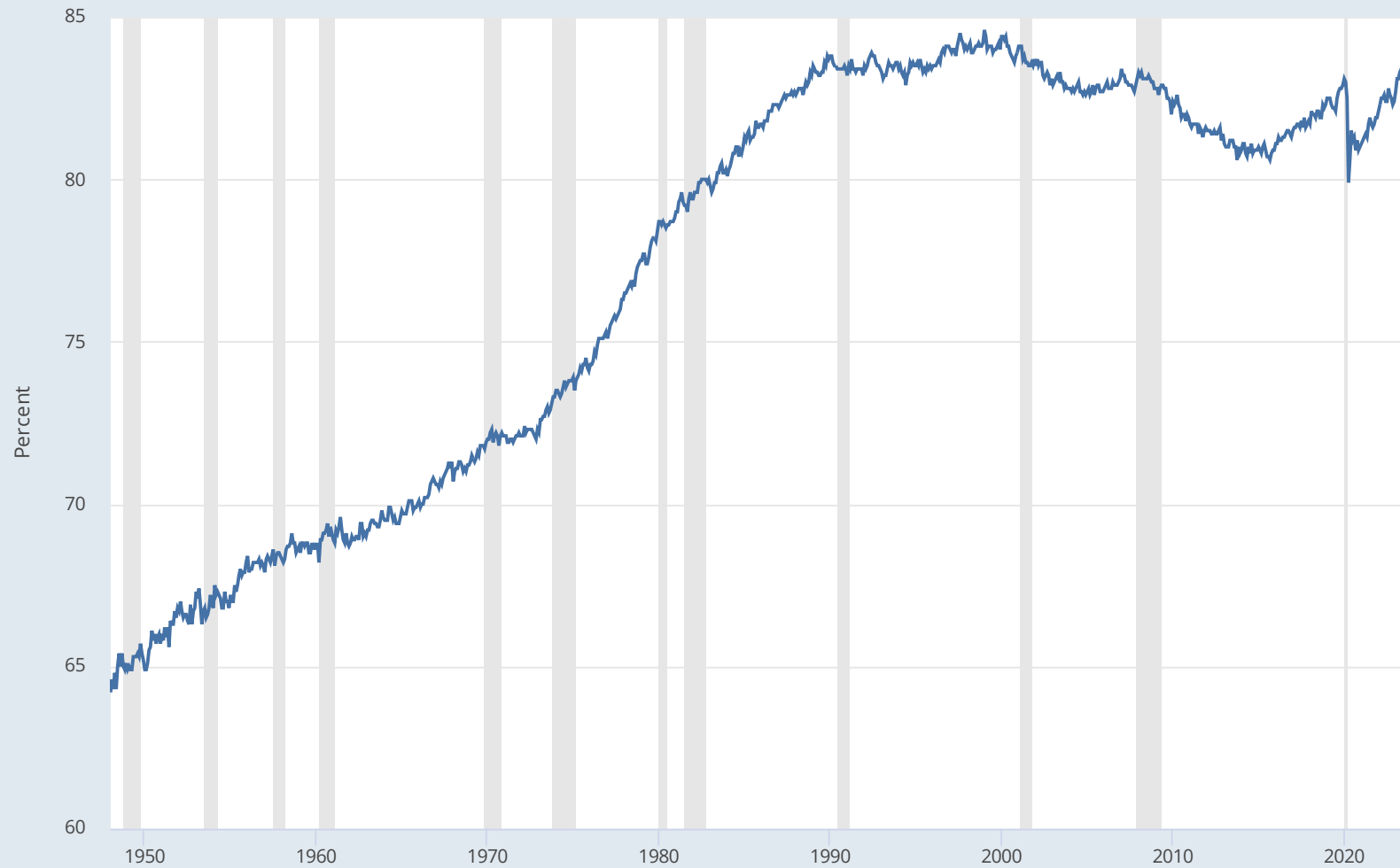


Labor Force Participation Rate

(Persons 25-54 Years of Age)



— Labor Force Participation Rate - 25-54 Yrs.

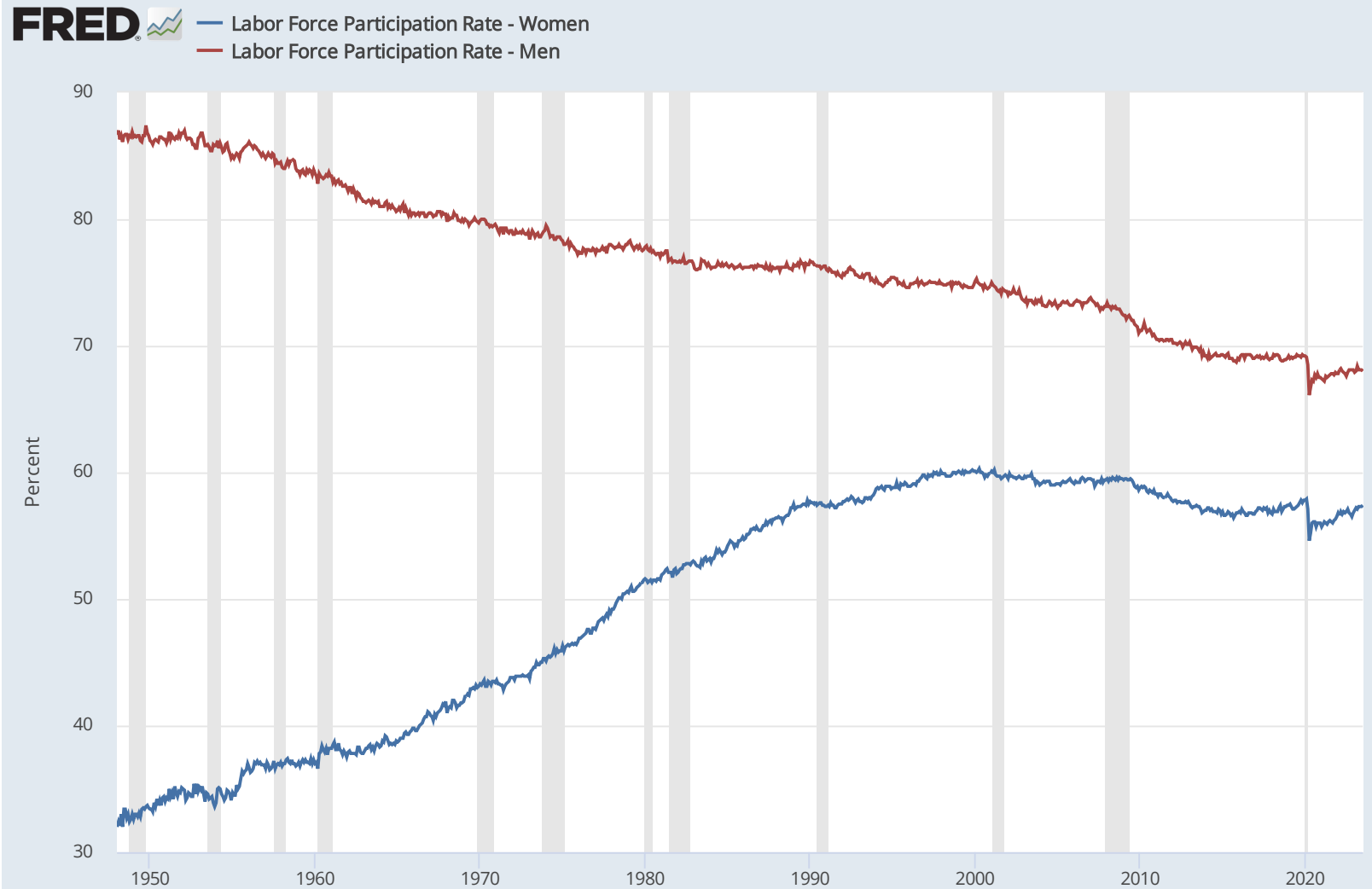


Source: U.S. Bureau of Labor Statistics

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Labor Force Participation Rate, Men and Women

(Persons 16 Years of Age and Older)



Source: U.S. Bureau of Labor Statistics

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NOW YOU TRY

Computing percentage changes

Suppose

- population increases by 1 percent
- labor force increases by 3 percent
- The number of unemployed persons increases by 2 percent

Compute the percentage changes in the labor-force participation and unemployment rates.

NOW YOU TRY

Computing percentage changes, answers

$$\text{LFPR} = L/\text{POP}$$

L increases 3%, POP increases 1%,
so LFPR increases $3\% - 1\% = 2\%$.

$$\text{U rate} = U/L$$

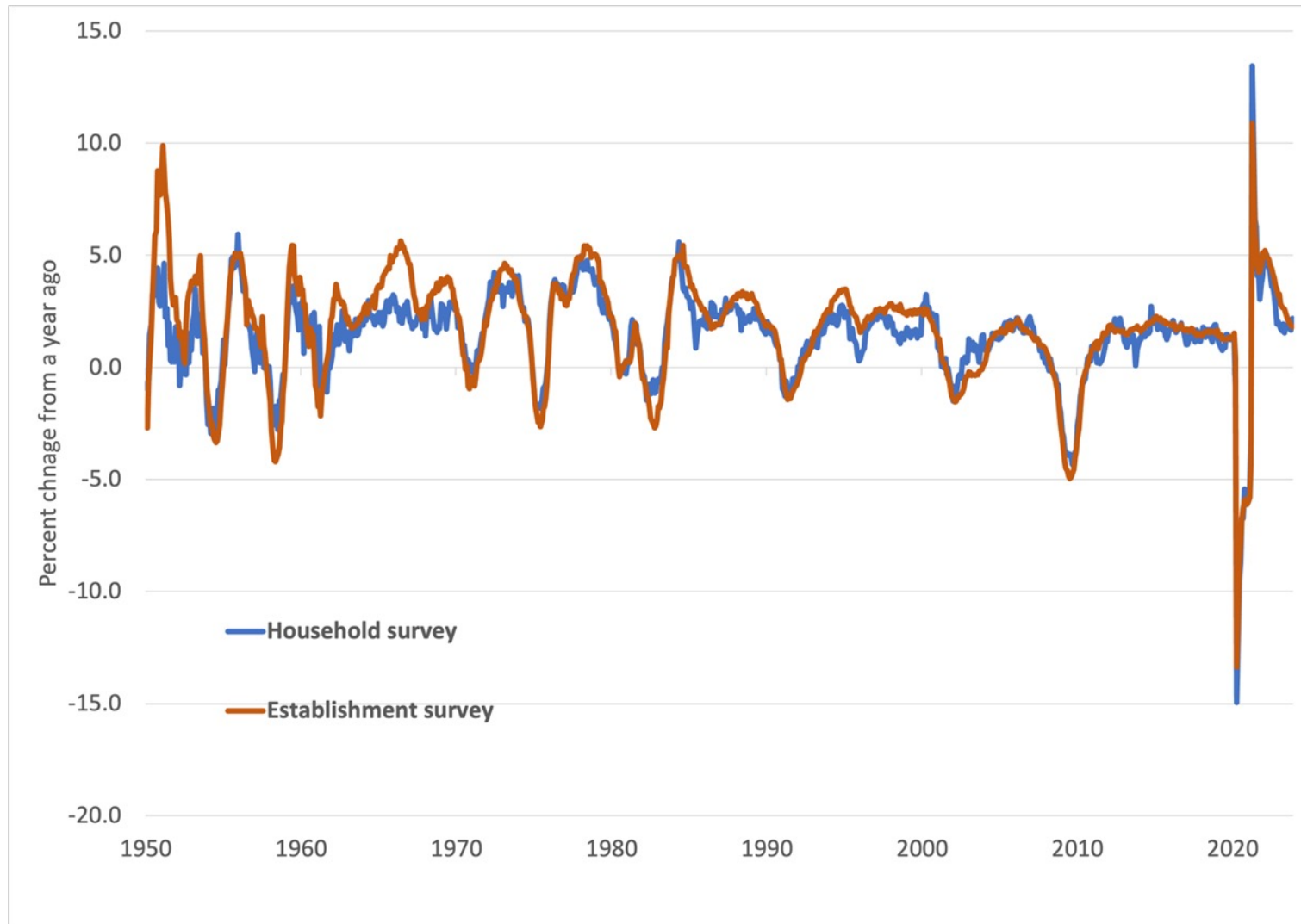
U increases 2%, L increases 3%,
so U-rate increases $2\% - 3\% = -1\%$.

*Note: The changes in LFPR and U-rate are shown as a percentage of their initial values, not in percentage points!
Example: If the initial value of LFPR is 60.0 percent, a 2 percent increase would bring it to 61.2 percent because 2 percent of 60 equals 1.2.*

The establishment survey

- The BLS obtains a second measure of employment by surveying businesses, asking how many workers are on their payrolls.
- Neither measure is perfect, and they occasionally diverge due to:
 - treatment of self-employed persons
 - new firms not counted in establishment survey
 - technical issues involving population inferences from sample data

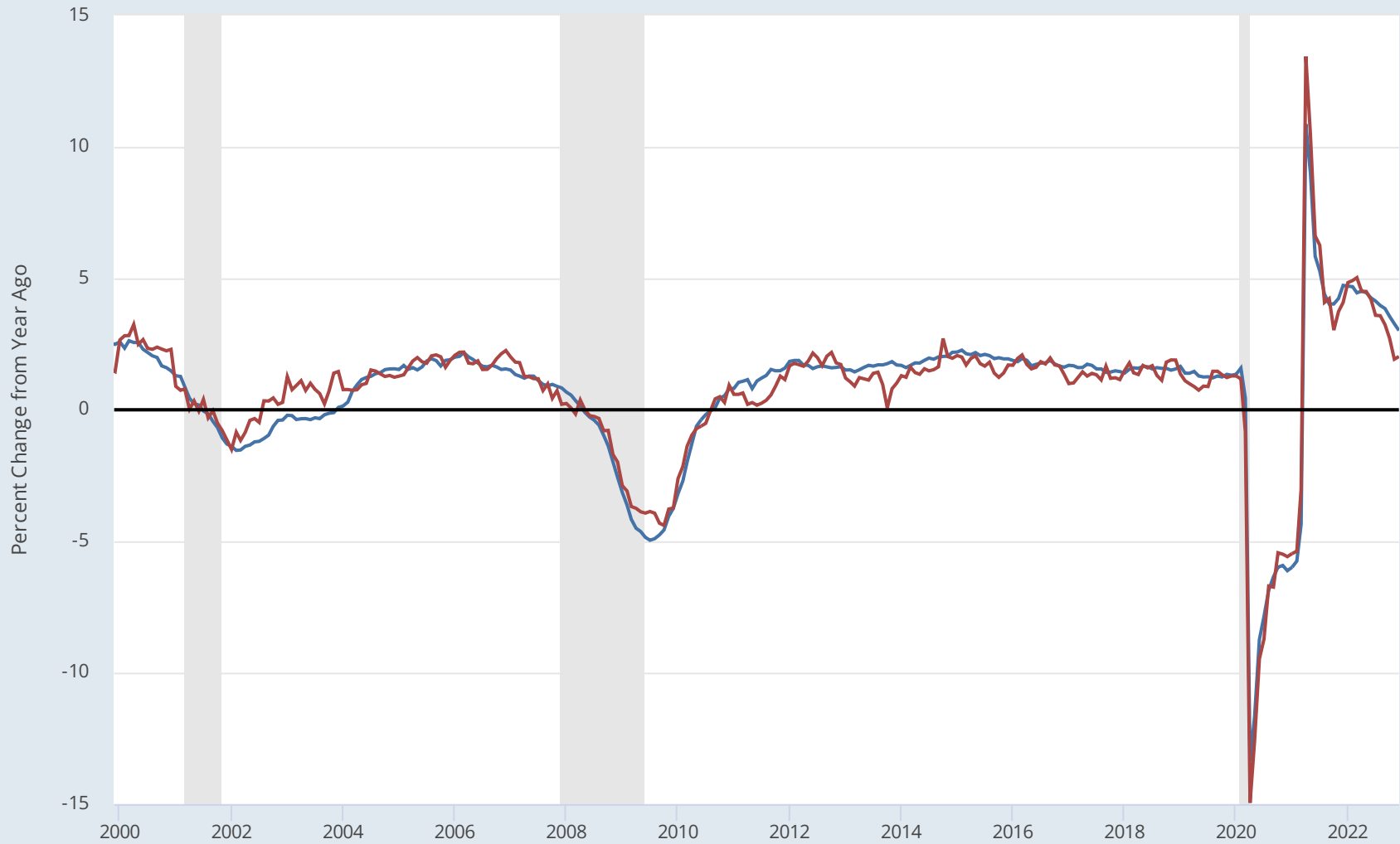
The measures of employment growth



Source: Federal Reserve Bank of St. Louis



— All Employees, Total Nonfarm
— Employment Level



Source: U.S. Bureau of Labor Statistics

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CHAPTER SUMMARY, PART 1

- Gross domestic product (GDP) measures both total income and total expenditure on the economy's output of goods and services.
- Nominal GDP values output at current prices; real GDP values output at constant prices. Changes in output affect both measures, but changes in prices affect only nominal GDP.
- GDP is the sum of consumption, investment, government purchases, and net exports.

CHAPTER SUMMARY

- The overall level of prices can be measured by either:
 - the consumer price index (CPI), the price of a fixed basket of goods purchased by the typical consumer, or
 - the GDP deflator, the ratio of nominal to real GDP.
 - the PCE deflator
- The unemployment rate is the fraction of the labor force that is not employed.