

# Macroeconomics in One Equation

## Lecture 4: Price Level and Inflation

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## Basic Concepts

### Inflation and Inflation Rate

A sustained rise in the overall price level of the economy. Percentage change.

### Consumer Price Index (CPI)

An index of the overall cost of the goods and services bought by a typical consumer. The core CPI excludes items of food and energy.

### Producer Price Index (PPI)

An index of prices of domestically produced goods in manufacturing, mining, agriculture, fishing, forestry, and electronic utility industries.

### Personal Consumption Expenditure (PCE) Price Index

An index of prices of goods and services purchased by consumers in the US. The core PCE price index excludes food and energy prices that are volatile.

# Introduction

- In  $MV=PY$ , P is the aggregate price level for all the goods and services in market transactions. Inflation can be defined as the overall general upward price movement of goods and services in an economy (BLS).
- Where are the official data and statistics on the price level and inflation?
- How do economists measure the price level in the economy where there are billions of goods and services? Among the various measures of price levels, which one is more reliable and useful?
- What are the macroeconomic effects of a change in the price levels?
- In high inflation (deflation) periods, who are the "winners" and "losers"? What are the specific costs (and benefits) of inflation facing individuals, households, businesses, and the society?
- Why do price levels change over time? More specifically, what are the causes of inflation and deflation? What are the implications for decision making and public policy debates?

# BLS: U.S. Economy at a Glance

## United States - Monthly Data

Data Series	Back Data	July 2021	Aug 2021	Sept 2021	Oct 2021	Nov 2021	Dec 2021
Unemployment Rate <sup>(1)</sup>		5.4	5.2	4.7	4.6	4.2	3.9
Change in Payroll Employment <sup>(2)</sup>		1,091	483	379	648	(P) 249	(P) 199
Average Hourly Earnings <sup>(3)</sup>		30.55	30.67	30.84	31.01	(P) 31.12	(P) 31.31
Consumer Price Index <sup>(4)</sup>		0.5	0.3	0.4	0.9	0.8	0.5
Producer Price Index <sup>(5)</sup>		0.9	0.9	(P) 0.4	(P) 0.6	(P) 1.0	(P) 0.2
U.S. Import Price Index <sup>(6)</sup>		0.3	-0.2	0.4	1.5	0.7	-0.2

### Footnotes

(1). In percent, seasonally adjusted. Annual averages are available for [Not Seasonally Adjusted data](#).

(2). Number of jobs, in thousands, seasonally adjusted.

(3). Average Hourly Earnings for all employees on private nonfarm payrolls.

(4). All items, U.S. city average, all urban consumers, 1982-84=100, 1-month percent change, seasonally adjusted.

(5). Final Demand, 1-month percent change, seasonally adjusted.

(6). All imports, 1-month percent change, not seasonally adjusted.

(P). Preliminary

## United States - Quarterly Data

Data Series	Back Data	4th Qtr 2020	1st Qtr 2021	2nd Qtr 2021	3rd Qtr 2021	4th Qtr 2021
Employment Cost Index <sup>(1)</sup>		0.7	0.9	0.7	1.3	1.0
Productivity <sup>(2)</sup>		-3.4	4.3	2.4	(R) -5.2	

### Footnotes

(1). Compensation, all civilian workers, quarterly data, 3-month percent change, seasonally adjusted.

(2). Output per hour, nonfarm business, quarterly data, percent change from previous quarter at annual rate, seasonally adjusted.

(R). Revised

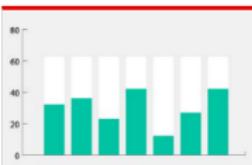
<https://www.bls.gov/eag/eag.us.htm>

# BLS: Graphics for Economic News Releases



## **EMPLOYMENT & UNEMPLOYMENT**

- Business Employment Dynamics
- County Employment and Wages
- Employment Situation
- Job Openings and Labor Turnover Survey
- Metro Area Employment and Unemployment
- State Employment and Unemployment
- State Job Openings and Labor Turnover



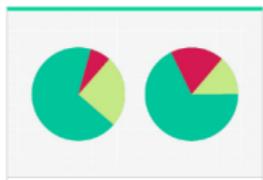
INFLATION & PRICES

- Consumer Price Index
- Producer Price Index
- Import/Export Price Index



PAY & BENEFITS

- Employee Benefits
- Employment Cost Index
- Employer Costs for Employee Compensation
- Usual Weekly Earnings



## PRODUCTIVITY

- Productivity and Costs
- Productivity, Wholesale and Retail
- Productivity, Mining and Manufacturing
- Productivity, Selected Service-Providing Industries
- Productivity by State



## SPENDING & TIME USE

American Time Use Survey



## WORKPLACE INJURIES

## **Employer-reported Workplace Injuries and Illnesses**

### **Fatal Occupational Injuries**

Charts Related to the latest BLS news releases: This section features charts to complement the written analysis and data tables in the news releases.

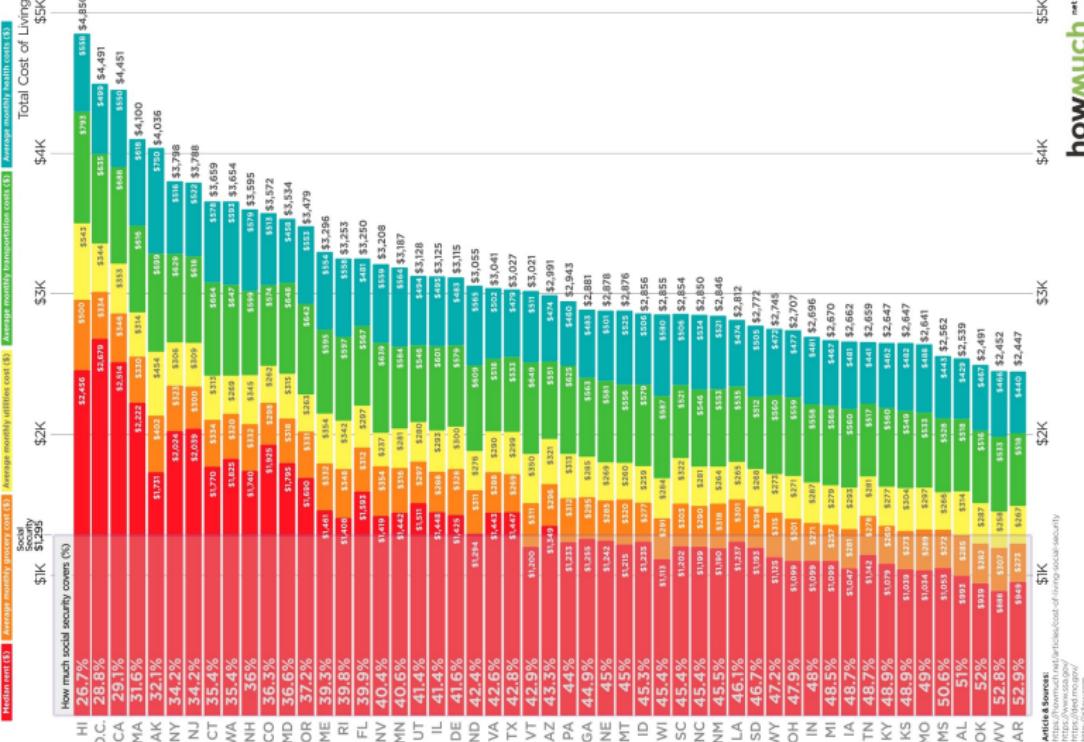
BLS hopes these data visualizations will help you see important trends in the labor market and economy more clearly. BLS will continue to add data visualizations like these for more BLS news releases.



# The Cost of Living vs Social Security Benefits

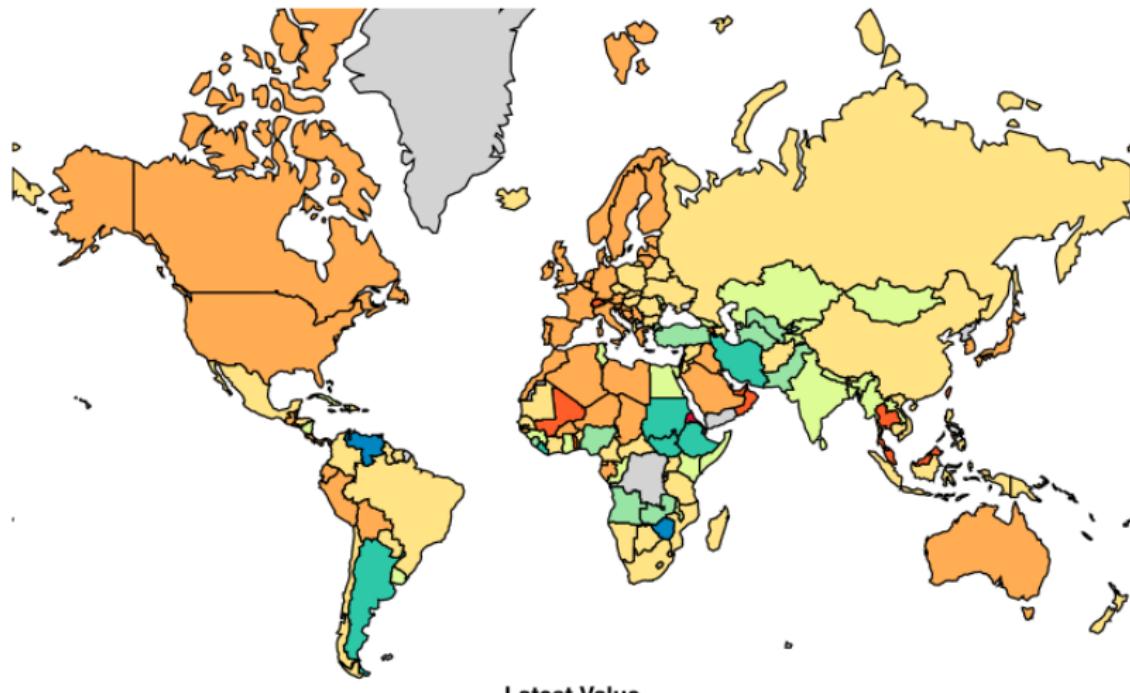
## The Cost of Living vs. Social Security Benefits

### How Much Does Social Security Actually Cover?



Article & Source  
<https://www.howmuch.net/articles/cost-of-living-social-security>  
<https://www.howmuch.net>

# Inflation Rate in the World, 2022



<https://worldpopulationreview.com/country-rankings/inflation-rate-by-country>



# Outline

- ① Data and Statistics
- ② Measurement Methods
- ③ Inflation: Costs & Effects
- ④ Inflation: Theory & Models



Chart 1. One-month percent change in CPI for All Urban Consumers (CPI-U), seasonally adjusted, Dec. 2020 - Dec. 2021

Percent change

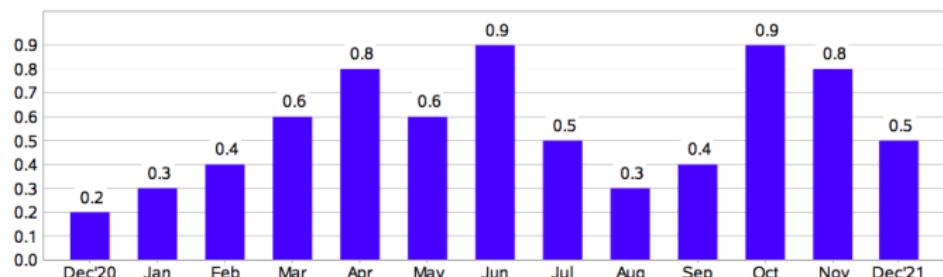
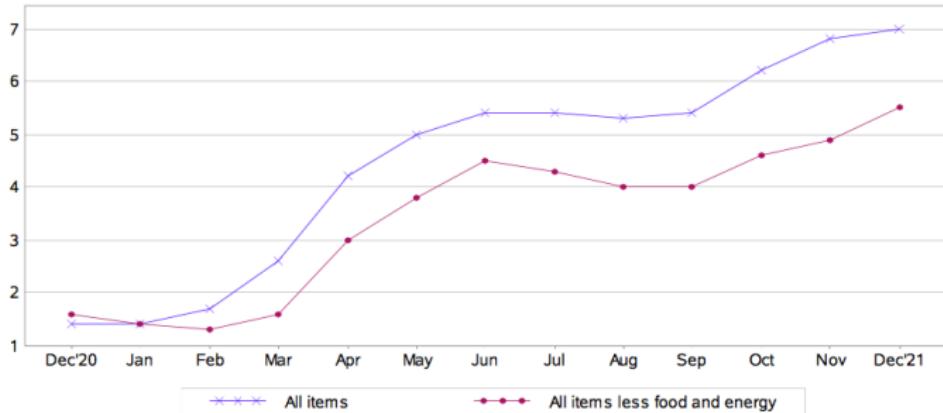
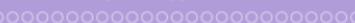


Chart 2. 12-month percent change in CPI for All Urban Consumers (CPI-U), not seasonally adjusted, Dec. 2020 - Dec. 2021

Percent change



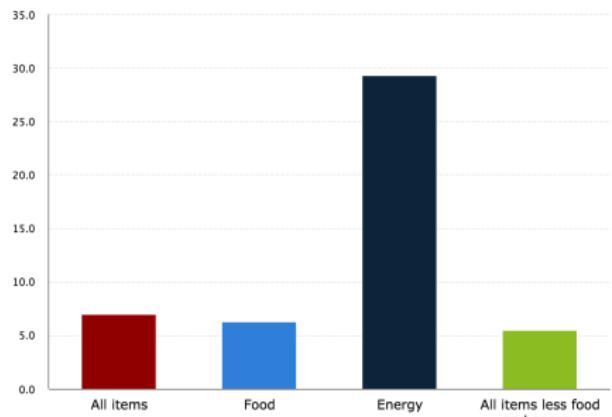
Bureau of Labor Statistics - News Release Consumer Price Index. <https://www.bls.gov/bls/newsrels.htm>



12-month percentage change, Consumer Price Index, selected categories, December 2021, not seasonally adjusted

Click on columns to drill down

**Percent**      **Major categories**



Source: U.S. Bureau of Labor Statistics.

<https://www.bls.gov/charts/consumer-price-index/consumer-price-index-by-category.htm>

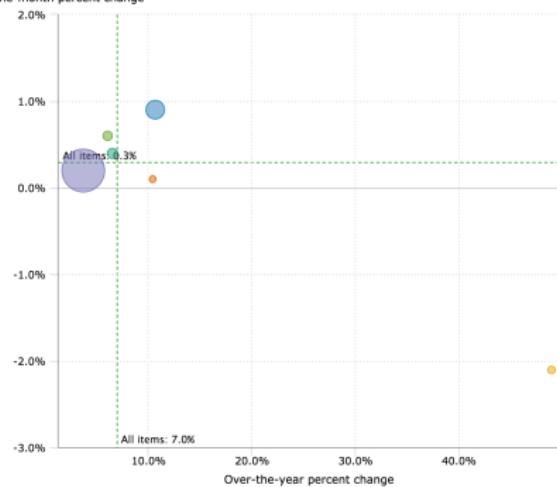
<https://www.bls.gov/charts/consumer-price-index/consumer-price-index-relative-importance.htm>

Relative importance, and over-the-year and over-the-month percent change, selected Consumer Price Index components, December 2021, not seasonally adjusted

Bubble size represents relative importance (All items = 100.0)

- Food at home
- Food away from home
- Energy commodities
- Energy services
- Commodities less food and energy com...
- Services less energy services

the-month percent change



Hover over chart to view data.  
Source: U.S. Bureau of Labor Statistics.





**12-month percent change in the Consumer Price Index for All Urban Consumers, selected items, not seasonally adjusted**

Dec 2020 to Dec 2021  
Dec 2019 to Dec 2020  
Dec 2018 to Dec 2019  
Dec 2017 to Dec 2018

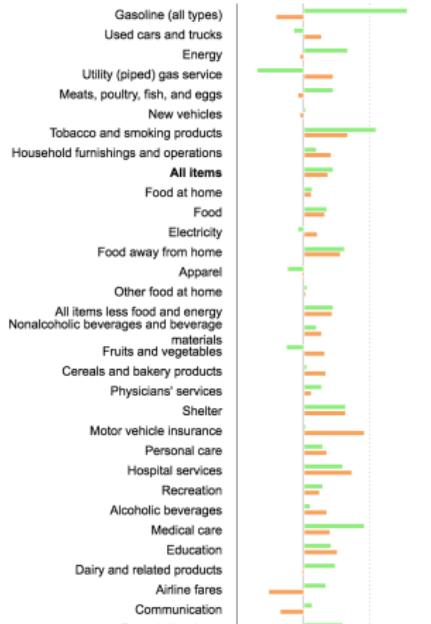


Click legend items to change data display. Hover over chart to view data.

Source: U.S. Bureau of Labor Statistics.

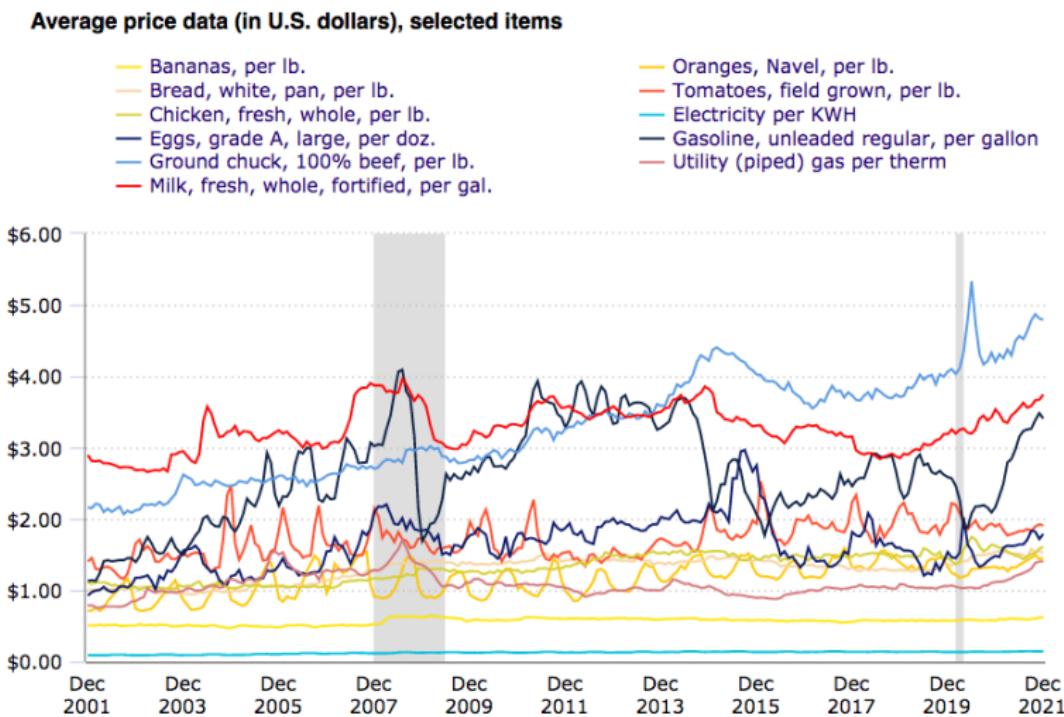
**12-month percent change in the Consumer Price Index for All Urban Consumers, selected items, not seasonally adjusted**

Dec 2020 to Dec 2021  
Dec 2019 to Dec 2020  
Dec 2018 to Dec 2019  
Dec 2017 to Dec 2018



Click legend items to change data display. Hover over chart to view data.

Source: U.S. Bureau of Labor Statistics.



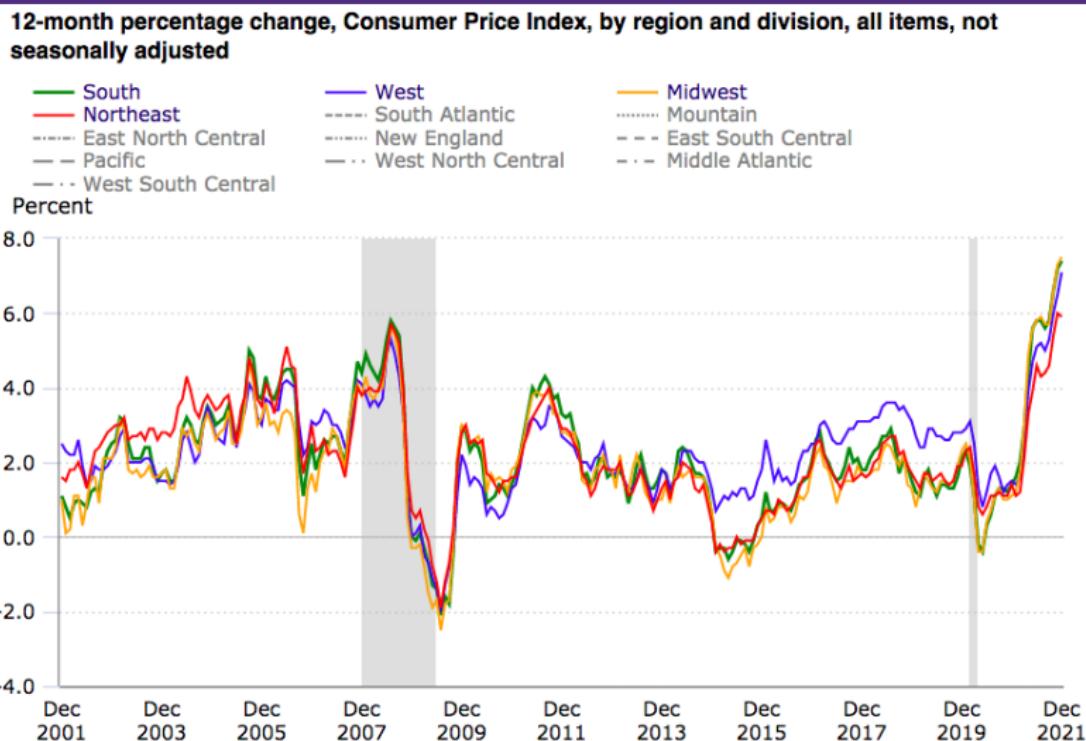
Hover over chart to view data.

Note: Shaded area represents recession, as determined by the National Bureau of Economic Research.

Source: U.S. Bureau of Labor Statistics.



<https://www.bls.gov/charts/consumer-price-index/consumer-price-index-average-price-data.htm>



Data for some metropolitan areas are bimonthly.

Hover over chart to view data.

Note: Shaded area represents recession, as determined by the National Bureau of Economic Research.

Source: U.S. Bureau of Labor Statistics.

<https://www.bls.gov/charts/consumer-price-index/consumer-price-index-by-region.htm>

# U.S. PPI News Release

Chart 1. One-month percent changes in selected PPI final demand price indexes, seasonally adjusted

Percent change

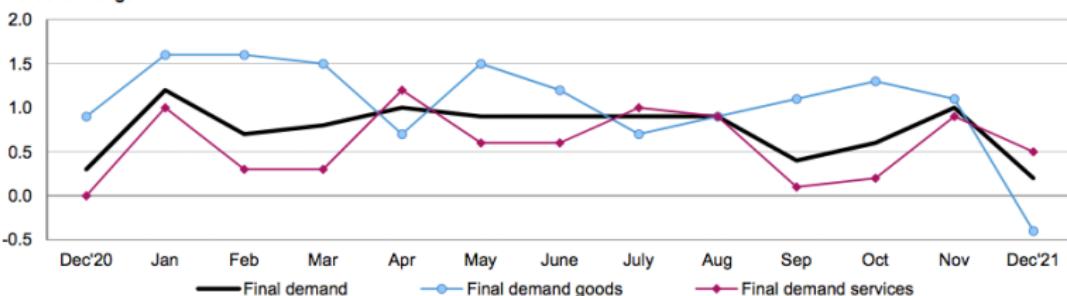
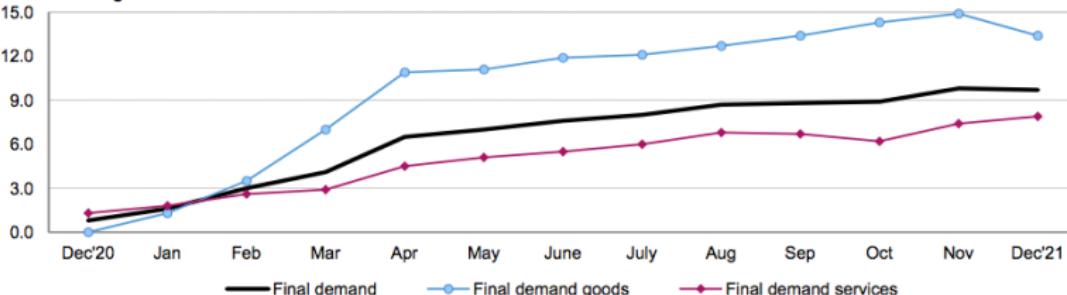


Chart 2. Twelve-month percent changes in selected PPI final demand price indexes, not seasonally adjusted

Percent change

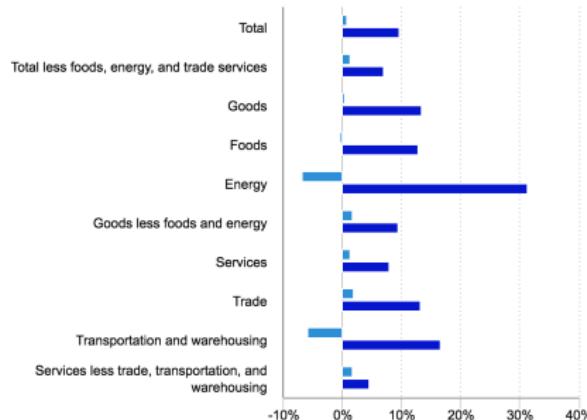


Bureau of Labor Statistics - News Release Producer Price Index. <https://www.bls.gov/bls/newsrels.htm>

# U.S. PPI Annual Comparisons

Producer Price Indexes for final demand, 12-month percent changes for the year ended in December, 2017 to 2021

Dec 2017  
Dec 2018  
Dec 2019  
Dec 2020  
Dec 2021

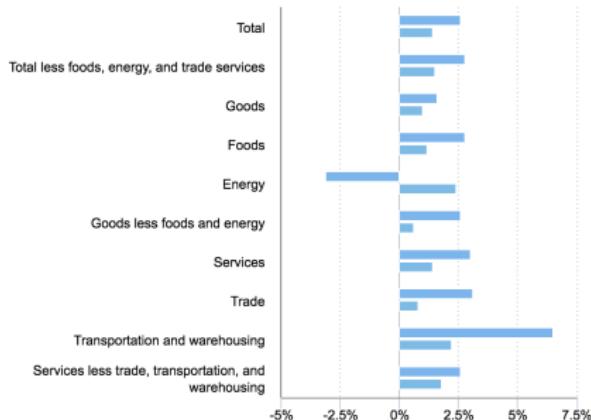


Click legend items to change data display. Hover over chart to view data.  
Source: U.S. Bureau of Labor Statistics.

<https://www.bls.gov/opub/ted/prices.htm>

Producer Price Indexes for final demand, 12-month percent changes for the year ended in December, 2017 to 2021

Dec 2017  
Dec 2018  
Dec 2019  
Dec 2020  
Dec 2021



Click legend items to change data display. Hover over chart to view data.  
Source: U.S. Bureau of Labor Statistics.



Chart 1. One-month and 12-month percent changes in the Import Price Index: December 2020 – December 2021

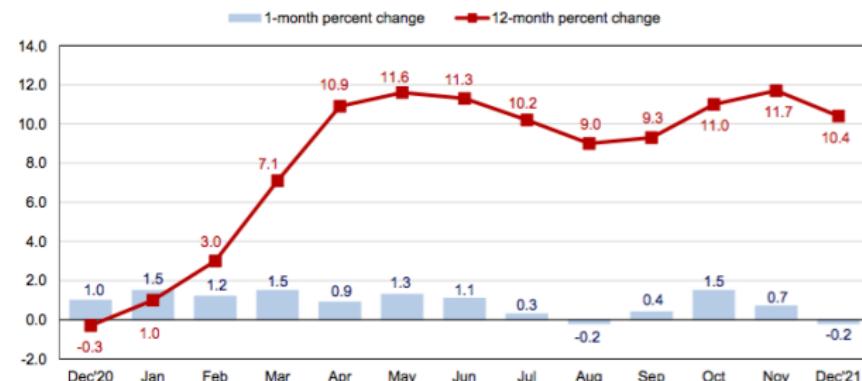
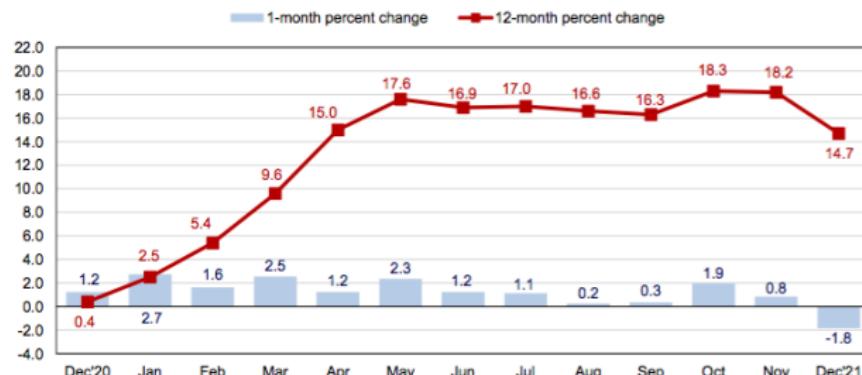


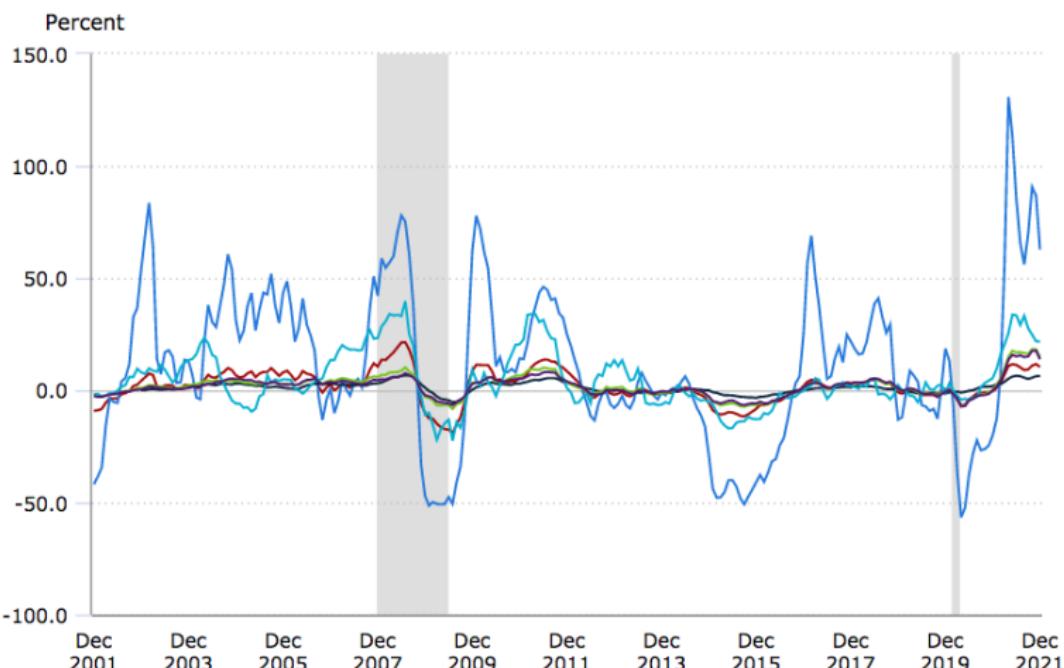
Chart 2. One-month and 12-month percent changes in the Export Price Index: December 2020 – December 2021



BLS News Release - U.S. Import and Export Price Indexes. <https://www.bls.gov/bls/newsrels.htm>

**U.S. import and export price indexes, 12-month percent change**

— All imports    — Fuel imports    — Nonfuel imports    — All exports  
— Agricultural exports    — Nonagricultural exports



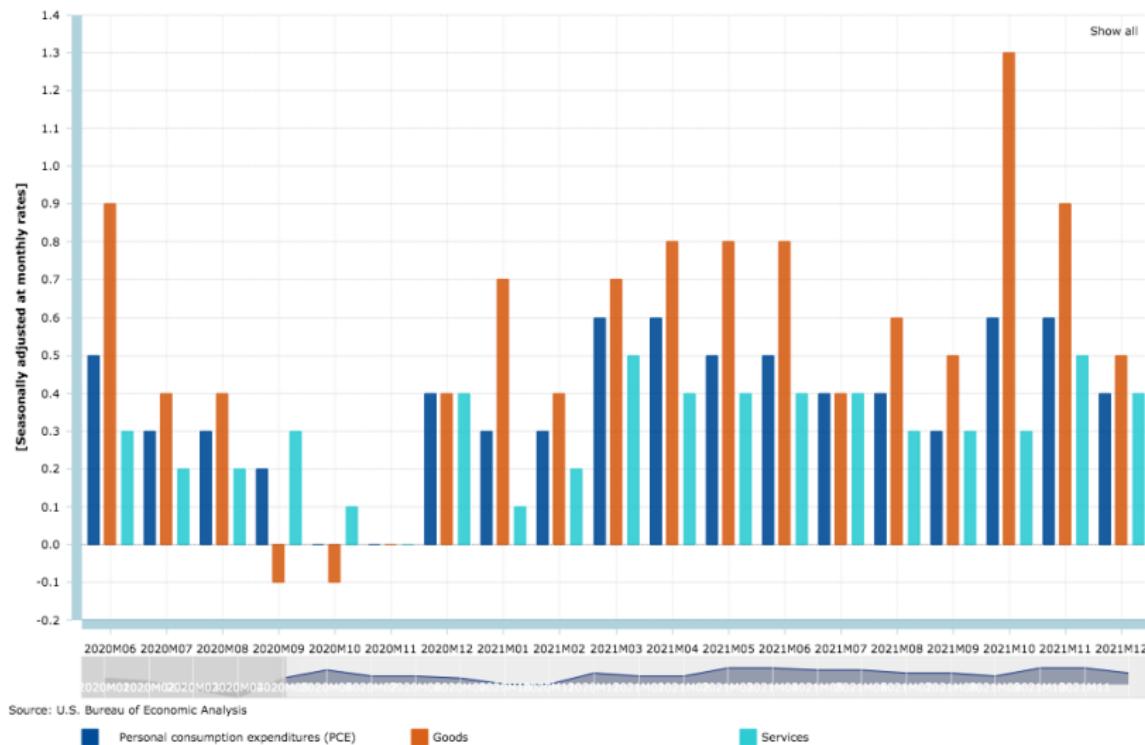
Hover over chart to view data.

Note: Shaded area represents recession, as determined by the National Bureau of Economic Research.

Source: U.S. Bureau of Labor Statistics.

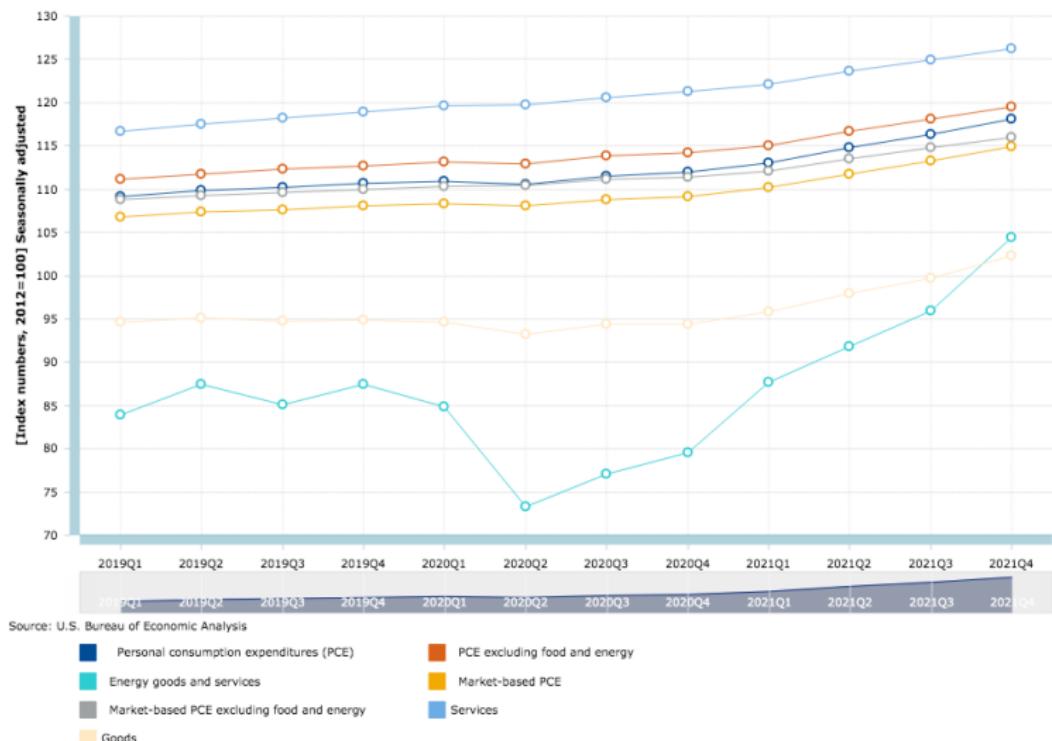


Table 2.8.7. Percent Change From Preceding Period in Prices for Personal Consumption Expenditures by Major Type of Product, Monthly



<https://www.bea.gov/resources/learning-center/quick-guide-some-popular-bea-price-indexes>

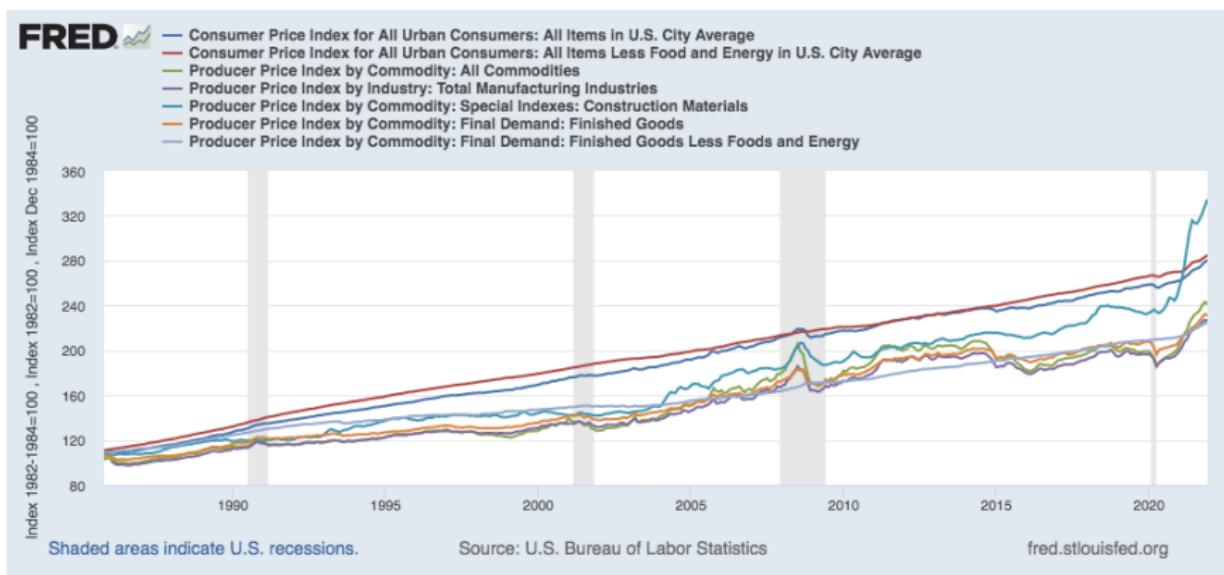
Table 2.3.4. Price Indexes for Personal Consumption Expenditures by Major Type of Product



Source: U.S. Bureau of Economic Analysis

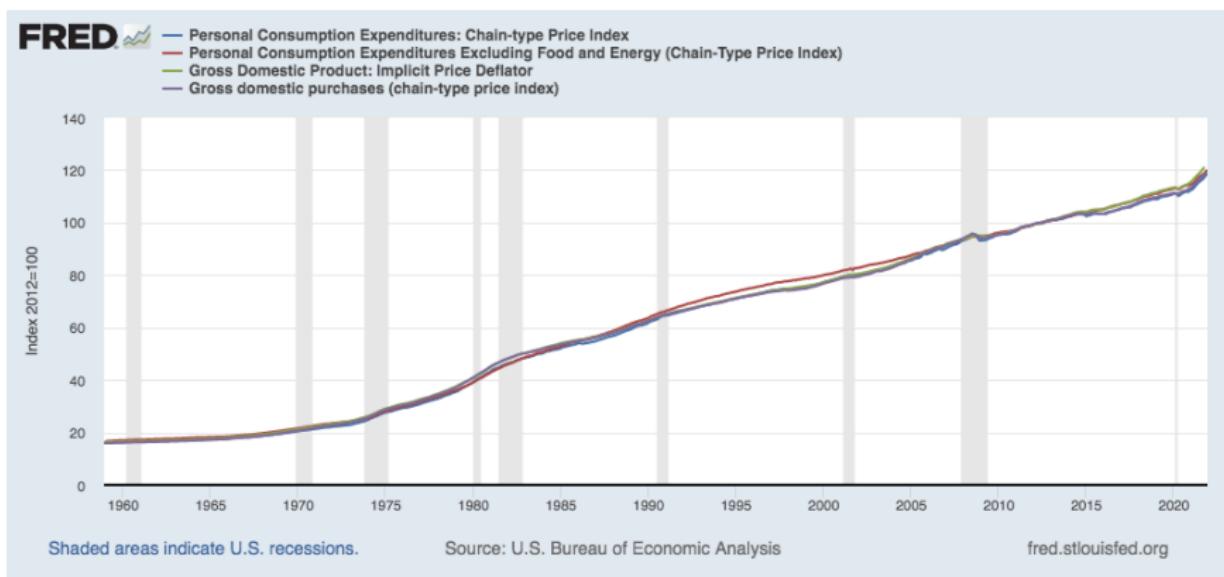
- Personal consumption expenditures (PCE)
- PCE excluding food and energy
- Energy goods and services
- Market-based PCE
- Market-based PCE excluding food and energy
- Goods

# U.S. CPI and PPI



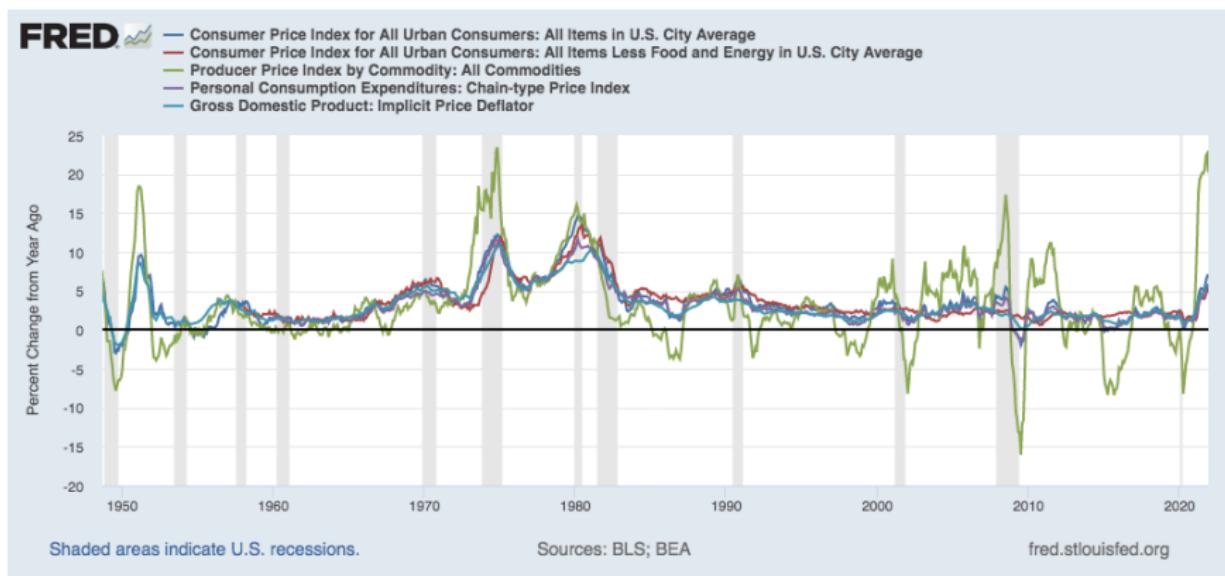
<https://fred.stlouisfed.org/series/CPIAUCSL>

# U.S. PCE and GDP Price Deflator

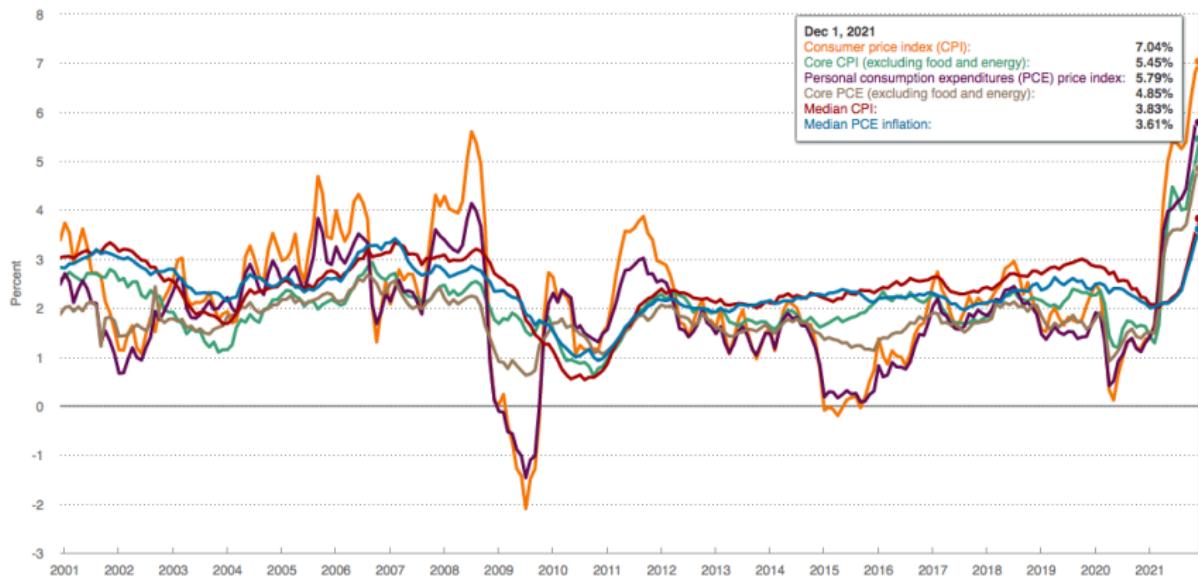


<https://fred.stlouisfed.org/series/PCEPI>

# U.S. Inflation Rates by Indexes



# U.S. Inflation Rates: CPI vs PCE



Source: Federal Reserve Bank of Cleveland calculations based on data from the BLS, BEA, Federal Reserve Bank of Cleveland, Federal Reserve Bank of Dallas, and Haver Analytics. Notes: Quarterly data only display for quarters in which all of the monthly data are available. Data for the monthly level of the median CPI, trimmed-mean CPI, and trimmed-mean PCE are not available.

<https://www.clevelandfed.org/our-research/center-for-inflation-research/inflation-charts.aspx>



# Outline

- ① Data and Statistics
- ② Measurement Methods
- ③ Inflation: Costs & Effects
- ④ Inflation: Theory & Models

# Bureau of Labor Statistics on Inflation and Prices

BLS has various indexes that measure different aspects of inflation.

- ① The Consumer Price Index (CPI) program produces monthly data on changes in the prices paid by urban consumers for a representative basket of goods and services.  
<https://www.bls.gov/cpi/>
- ② Producer Price Index (PPI). The Producer Price Indexes measure changes in the selling prices received by domestic producers of goods, services, and construction. The news media most often reports the percent change in the PPI for Final Demand.  
<https://www.bls.gov/ppi/>
- ③ Import and Export Prices. The International Price Program measured change in the prices of imports and exports of nonmilitary goods between the United States and the rest of the world.  
<https://www.bls.gov/mxp/>
- ④ Employment Cost Trends. Quarterly statistics that measure change in labor costs (also called employment costs or compensation costs) over time and the level of costs per hour worked.  
<https://www.bls.gov/ncs/ect/>

<https://www.bls.gov/bls/inflation.htm>

## Bureau of Labor Statistics: Endorsement

The Federal Reserve uses the following information from the Bureau of Labor Statistics every day:

- Price statistics help us monitor inflation in the prices that consumers pay and producers receive for goods and services.
- Employment and unemployment statistics help us examine trends in job growth for the nation and for different geographic areas, industries, and occupations.
- Pay and benefit statistics provide us with insights about the well-being of American workers and their families.
- Productivity statistics help us understand trends in the efficiency of workers, which ultimately affect the nation's standard of living

At the Federal Reserve, one of our main roles is to promote maximum employment, stable prices, and moderate long-term interest rates. This task requires accurate and timely information about the U.S. economy. Much of the vital economic information we use at the Federal Reserve comes from the U.S. Bureau of Labor Statistics.

Source: Jerome H Powell (2018) Federal Reserve's Endorsement of BLS  
<https://www.bls.gov/respondents/fed-reserve-endorsement-2018.pdf>

# BLS: CPI Overview

Quick Facts: Consumer Price Index	
Subject areas	Prices
Key measures	Average prices Consumer price indexes Consumer prices
How the data are obtained	Survey of businesses, Survey of households
Classification system	Commodity
Periodicity of data availability	Bimonthly, Monthly
Geographic detail	Census region, Metro area, U.S. City average
Scope	Urban consumers
Key products	<ul style="list-style-type: none"><li>• <a href="#">Consumer Price Index news release</a></li><li>• <a href="#">Consumer Price Index factsheets</a></li><li>• <a href="#">Databases</a></li><li>• <a href="#">Tables</a></li><li>• <a href="#">Interactive charts</a></li></ul>
Program webpage	<a href="https://www.bls.gov/cpi">www.bls.gov/cpi</a>

<https://www.bls.gov/opub/hom/cpi/home.htm>

<https://www.bls.gov/cpi/factsheets/>

<https://www.bls.gov/cpi/>

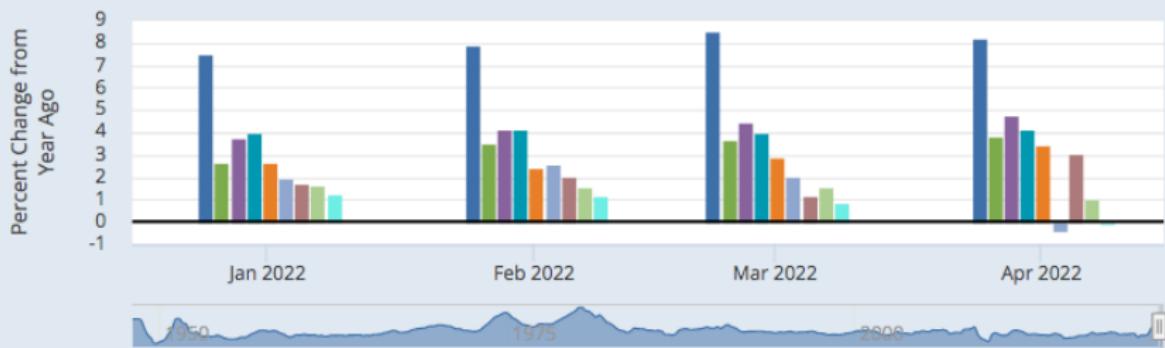
The Bureau of Labor Statistics publishes four consumer price series each month:

- The CPI for All Urban Consumers (CPI-U) is the index most often reported by the national media.
- The CPI for Urban Wage Earners and Clerical Workers (CPI-W) is the index most often used for wage escalation agreements.
- The Chained CPI (C-CPI-U) is designed as a closer approximation to a "cost-of-living" index than the CPI-U or CPI-W.
- Average prices for select utility, food, beverage, and energy items.

# CPI Inflation Rates by Select Category



- Consumer Price Index for All Urban Consumers: All Items in U.S. City Average
- Consumer Price Index for All Urban Consumers: Alcoholic Beverages in U.S. City Average
- Consumer Price Index for All Urban Consumers: Rent of Primary Residence in U.S. City Average
- Consumer Price Index for All Urban Consumers: Water and Sewer and Trash Collection Services in U.S. City Average
- Consumer Price Index for All Urban Consumers: Medical Care Services in U.S. City Average
- Consumer Price Index for All Urban Consumers: Toys in U.S. City Average
- Consumer Price Index for All Urban Consumers: Fees for Lessons or Instructions in U.S. City Average
- Consumer Price Index for All Urban Consumers: Education and Communication in U.S. City Average
- Consumer Price Index for All Urban Consumers: Communication in U.S. City Average



Source: U.S. Bureau of Labor Statistics

The blue bar shows overall CPI inflation. The other bars display specific categories with lower-than-average inflation. For example, both education and health services, which have had noteworthy price increases in the past, are showing much more restraint now. There are also puzzles, like alcoholic beverages, toys, and communications (for example, computers). Prices that are administratively set, such as water and trash collection, are fairly stable. <https://fredblog.stlouisfed.org/2022/05/where-cpi-inflation-isnt-so-high/>



## CPI and Inflation: Calculations

- ① Fix the basket  $Q_B^i (i = 1, 2, \dots, n)$ . BLS surveys consumers to determine what's in the typical consumer's "shopping basket."<sup>1</sup>
- ② Find the prices  $P_t^i$ . The BLS collects data on the prices of all the goods and services in the basket over time.
- ③ Compute the basket's cost. For year  $t$ , the total cost of the basket  $TC_t = \sum_i^n P_t^i Q_B^i$  summing over all the goods and services in the basket.
- ④ In the base year, the total cost of the basket  $TC_B = \sum_i^n P_B^i Q_B^i$
- ⑤ Compute CPI in year  $t$ :  $CPI_t = TC_t / TC_B$  and  $CPI_B = TC_B / TC_B = 100\%$   
 $CPI_t = (\text{Basket's cost in current year} \div \text{Basket's cost in base year}) \times 100\%$
- ⑥ Compute the inflation rate. Percentage change in the CPI.  
 $\pi_t = [(CPI_t - CPI_{t-1}) / CPI_{t-1}] \times 100\%$

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<sup>1</sup>The BLS uses a survey of 7,000 American families called the Consumer Expenditures Survey to determine which items go in the basket and how much weight to assign to each item. The CPI is constructed each month using 80,000 items in a fixed basket of goods and services representing what Americans buy in their everyday lives.

## EXAMPLE 1: Market basket: 10 pizzas, 5 shirts

year	Price of pizza	Price of shirts	Cost of basket
2017	\$12	\$18	$\$12 \times 10 + \$18 \times 5 = \$210$
2018	\$14	\$20	$\$14 \times 10 + \$20 \times 5 = \$240$
2019	\$16	\$22	$\$16 \times 10 + \$22 \times 5 = \$270$

Compute **CPI** in each year (2017 base year)

Inflation rate

$$2017: 100 \times (\$210/\$210) = 100$$

$$2018: 100 \times (\$240/\$210) = 114.3$$

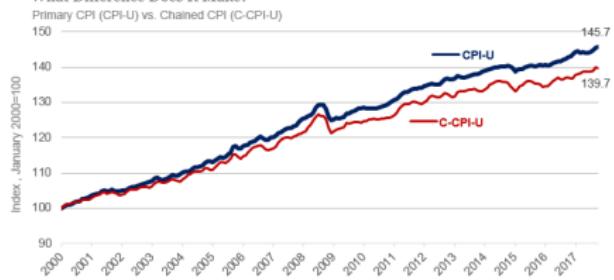
$$2019: 100 \times (\$270/\$210) = 128.6$$

$$\left. \begin{array}{l} 14.3\% = \frac{114.3 - 100}{100} \times 100 \\ 12.5\% = \frac{128.6 - 114.3}{114.3} \times 100 \end{array} \right\}$$

Source: Mankiw (2021) CH24 Measuring the cost of living

# CPI vs Chained CPI

What Difference Does It Make?



Source: FRED, BLS.



What difference does chaining the CPI make?



Source: FRED, BLS



A provision in the tax bill signed into law in 2017 focuses attention on the measure the government uses to adjust tax brackets and other elements of the tax code for inflation. The bill substitutes a measure called "the chained consumer price index" (C-CPI-U) for the one previously mandated by law, the consumer price index (CPI-U). The chained CPI takes into account the substitutions between similar items by updating its basket according to what people buy from one period to the next.

<https://www.brookings.edu/blog/up-front/2017/12/07/the-hutchins-center-explains-the-chained-cpi/>

<https://www.brookings.edu/blog/up-front/2021/06/28/how-does-the-government-measure-inflation/>

## BLS: CPI Interpretation

- Each month's index value displays the average change in the prices of consumer goods and services since a base period, which is currently 1982-84 for most indexes. The base year index is 100.
- For example, the CPI-U for April 2017 was 244.524. You can interpret this as a representative set of consumer goods and services that cost \$100 in 1982-84 would have cost \$244.52 in April 2017.
- Rather than emphasizing the level of the index in comparison to the base period, the monthly CPI release stresses the CPI's percent change from the previous month and from the previous year.
- The most commonly reported monthly percent changes are the 1-month seasonally adjusted percent change, and the 12-month not seasonally adjusted percent change.

Source: BLS Handbook of Methods (2020) Consumer Price Index. <https://www.bls.gov/opub/hom/cpi/home.htm>

## BLS: CPI Applications

The CPI affects all virtually Americans because of the ways in which it is used.

- ① As the most widely used measure of retail inflation, the CPI is a major indicator of the effectiveness of government economic policy (fiscal and monetary). Business executives, labor leaders, and other private citizens also use the index as a guide in making economic decisions.
- ② As a means of adjusting income payments. Social Security benefits as well as military and Federal Civil Service pension payments are indexed to the CPI. In the private sector, many collective bargaining agreements tie automatic wage increases to the CPI and some firms and households use the index to adjust rents, alimony, and child support payments.
- ③ To adjust tax bracket thresholds. Federal (and some state) income tax bracket thresholds and other parameters are adjusted to the CPI.
- ④ As a deflator of other economic series. Other statistical programs use the CPI or its components to adjust for price changes and produce deflated versions of their series.

Source: BLS Handbook of Methods (2020) Consumer Price Index.<https://www.bls.gov/opub/hom/cpi/home.htm>

## BLS: Producer Price Index Overview

The Producer Price Index (PPI) measures average changes in prices received by domestic producers for their output. Most of the information used in calculating producer price indexes is obtained through the systematic sampling of industries. As of January 2014, the PPI program included:

- ① Price indexes for approximately 535 mining, forestry, utility, construction, manufacturing, and services industries; over 500 indexes for groupings of industries; and more than 4,000 indexes for specific within-industry product and service categories;
- ② More than 3,700 commodity price indexes for goods and about 800 for services (seasonally adjusted and not seasonally adjusted), organized by product, service, and end use;
- ③ Over 600 indexes for aggregate measures of price change, including the aggregation system for final demand–intermediate demand

Source: BLS Handbook of Methods (2020) Producer Price Index.

<https://www.bls.gov/charts/producer-price-index> <https://www.bls.gov/opub/hom/pdf/ppi-20111028.pdf>

**Table A. Monthly and 12-month percent changes in selected final demand price indexes, seasonally adjusted**

Month	Total final demand	Final demand less foods, energy, and trade	Final demand goods				Final demand services				Change in final demand from 12 months ago (unadj.)	Change in final demand less foods, energy, and trade from 12 mo. ago (unadj.)	
			Total	Foods	Energy	Less foods and energy	Total	Trade	Transportation and warehousing	Other			
<b>2020</b>													
Dec.	0.3	0.4	0.9	-1.4	4.9	0.5	0.0	-0.7		-0.2	0.4	0.8	1.3
<b>2021</b>													
Jan.	1.2	1.0	1.6	1.6	5.1	0.8	1.0	0.8		0.7	1.2	1.6	1.9
Feb.	0.7	0.4	1.6	1.4	6.2	0.5	0.3	0.2		0.8	0.2	3.0	2.3
Mar.	0.8	0.6	1.5	0.6	5.0	0.8	0.3	0.2		1.4	0.4	4.1	3.1
Apr.	1.0	0.8	0.7	1.8	-1.2	1.0	1.2	2.3		3.6	0.4	6.5	4.8
May	0.9	0.5	1.5	2.7	1.2	1.1	0.6	1.7		0.2	0.2	7.0	5.3
June	0.9	0.6	1.2	0.8	2.9	1.0	0.6	0.9		1.6	0.3	7.6	5.6
July	0.9	0.8	0.7	-1.3	2.4	0.8	1.0	1.7		2.5	0.5	8.0	6.0
Aug.(1)	0.9	0.4	0.9	2.3	0.6	0.6	0.9	2.2		0.9	0.2	8.7	6.2
Sept.(1)	0.4	0.3	1.1	2.1	2.1	0.5	0.1	0.1		-1.2	0.3	8.8	6.0
Oct.(1)	0.6	0.3	1.3	-0.3	5.5	0.6	0.2	0.7		0.9	-0.2	8.9	6.2
Nov.(1)	1.0	0.8	1.1	1.3	2.0	0.8	0.9	1.2		2.7	0.6	9.8	6.9
Dec.	0.2	0.4	-0.4	-0.6	-3.3	0.5	0.5	0.8		1.7	0.2	9.7	6.9

**Footnotes**

(1) Some of the figures shown above and elsewhere in this release may differ from those previously reported because data for August 2021 through November 2021 have been revised to reflect the availability of late reports and corrections by respondents.

# BLS: International Price Program Overview

Quick Facts: International Price Program	
Subject areas	Prices
Key measures	Import price indexes Export price indexes
How the data are obtained	Survey of businesses
Classification system	Geography, Industry, Commodity
Periodicity of data availability	Monthly
Geographic detail	International, National
Scope	Private sector
Key products	<ul style="list-style-type: none"><li>• <a href="#">U.S. Import and Export Price Indexes Monthly News Release</a></li><li>• <a href="#">Detailed Tables</a></li><li>• <a href="#">Industry Pamphlets, Pamphlets by U.S. export region, Pamphlets for Trade with Selected Countries, Fact Sheets, and supplemental publications</a></li></ul>
Program webpage	<a href="http://www.bls.gov/mxp">www.bls.gov/mxp</a>

The U.S. Import and Export Price Indexes are derived from a monthly business survey of U.S. companies that import and export goods and two services: air freight and air passenger fares. The survey records the price changes of the same item over time; each item in the market basket is used to calculate price indexes that measure the average change in prices of imports and exports of industries and products.

<https://www.bls.gov/opub/hom/ipp/home.htm>

# U.S. Import and Export Price Indexes in Percent Change

Month	IMPORTS			EXPORTS		
	All imports	Fuel imports	Nonfuel imports	All exports	Agri-cultural exports	Non-agricultural exports
<b>2020</b>						
December	1.0	7.3	0.4	1.2	1.0	1.3
<b>2021</b>						
January	1.5	9.0	0.9	2.7	6.0	2.3
February	1.2	10.9	0.4	1.6	2.7	1.5
March	1.5	8.0	0.9	2.5	2.4	2.5
April	0.9	1.9	0.8	1.2	0.7	1.2
May	1.3	5.2	0.9	2.3	6.1	1.8
June	1.1	4.9	0.7	1.2	1.4	1.1
July	0.3	2.9	0.0	1.1	-1.7	1.3
August	-0.2	-2.2	0.0	0.2	0.9	0.1
September	0.4	3.6	0.1	0.3	-1.5	0.5
October	1.5	11.1	0.5	(B) 1.9	(B) 1.2	(B) 2.0
November	0.7	(B) 2.3	0.5	(B) 0.8	(B) 1.1	(B) 0.6
December	-0.2	-6.5	0.5	-1.8	0.8	-2.1
Dec. 2019 to 2020	-0.3	-20.1	1.9	0.4	5.4	-0.1
Dec. 2020 to 2021	10.4	62.7	6.4	14.7	21.7	13.8
Footnotes (B) Revised						

<https://www.bls.gov/news.release/ximpim.nr0.htm>

# BLS: Employment Cost Trends

## What is the Employment Cost Index?



From each of the thousands of employers in our sample, professional BLS economists and statisticians collect information about jobs that are reflective of the U.S. labor market as a whole. Data on employers' compensation costs are compiled each quarter to produce the Employment Cost Index.

### ECI

#### The Employment Cost Index

The ECI tracks changes in the costs of labor including wages and benefits provided by the employer.



#### WAGES



Many people think wages are all it costs a company to employ a worker. Yet, a paycheck is typically only around two-thirds of the total cost of compensation. The remainder is employer-provided benefits such as paid time off and workers' compensation.

## Who relies on the Employment Cost Index?



To learn more please visit: [bls.gov/eci](http://bls.gov/eci) or follow [@BLS\\_gov](https://twitter.com/BLS_gov)

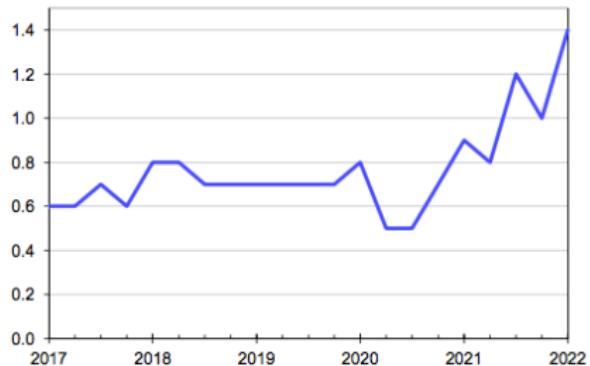


The National Compensation Survey produces quarterly indexes measuring change over time in labor costs, Employment Cost Index (ECI), and quarterly data measuring level of average costs per hour worked, Employer Costs for Employee Compensation (ECEC).

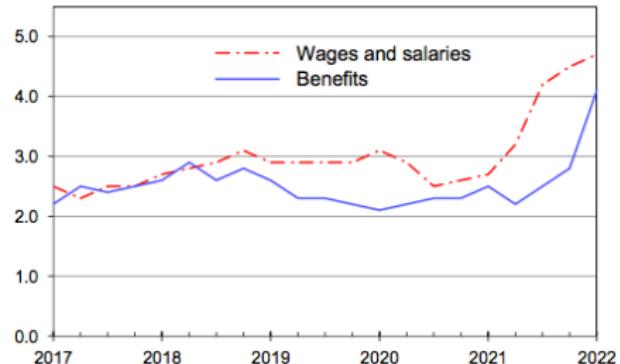
To learn more please visit: [bls.gov/eci](http://bls.gov/eci) or follow [@BLS\\_gov](https://twitter.com/BLS_gov)



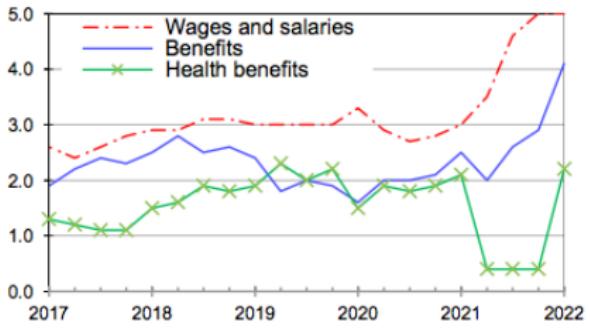
**Chart 1. Three-month percent change, seasonally adjusted, civilian workers, total compensation**



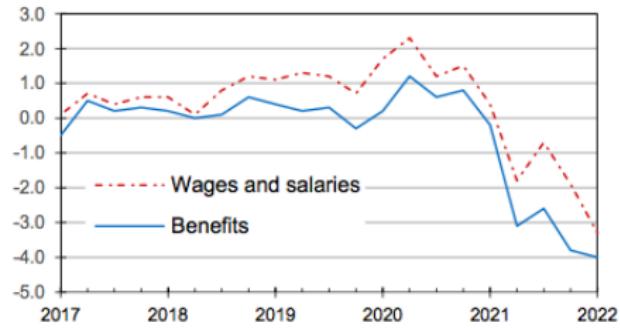
**Chart 2. Twelve-month percent change, not seasonally adjusted, civilian workers**



**Chart 3. Twelve-month percent change, current dollar, private industry workers**



**Chart 4. Twelve-month percent change, constant dollar, private industry workers**





# BEA Data: Prices and Inflation

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## Prices & Inflation

### GDP Price Index

Measures changes in prices paid for goods and services produced in the United States

### GDP Price Deflator

A price measure very similar to the GDP price index

### Gross Domestic Purchases Price Index

BEA's featured measure of price changes in the U.S. economy overall

### Personal Consumption Expenditures Price Index

Measures inflation in the prices paid by people living in the United States

### Personal Consumption Expenditures Price Index, Excluding Food and Energy

The core PCE price index excludes two volatile categories to reveal underlying inflation

### Regional Price Parities by State and Metro Area

Measure price levels that can be compared across states or metro areas

### Health Care

Measures spending to treat diseases and provides price indexes of treatments

[Learn about Prices & Inflation](#)<https://www.bea.gov/data/prices-inflation>

## Quick Guide: Some Popular BEA Price Indexes

[Print/Download](#)

Measures prices for final goods and services that are:

	Bought by consumers	Bought by businesses & governments	Produced in U.S.	Imported to U.S.	Exported from U.S.	
PCE Price Index Personal Consumption Expenditures Price Index						<ul style="list-style-type: none"> <li>Closely watched by the Federal Reserve</li> <li>Similar to the BLS Consumer Price Index; the formulas and uses differ</li> <li>Captures consumers' changing behavior and a wide range of expenses</li> </ul>
Core PCE Price Index PCE Price Index, Excluding Food and Energy						<ul style="list-style-type: none"> <li>Closely watched by the Federal Reserve</li> <li>Excludes two categories prone to volatile prices that may distort overall trends</li> </ul>
Gross Domestic Purchases Price Index						<ul style="list-style-type: none"> <li>BEA's featured measure of inflation in the U.S. economy overall</li> </ul>
GDP Price Index Gross Domestic Product Price Index						<ul style="list-style-type: none"> <li>Measures only U.S.-produced goods and services</li> </ul>
GDP Price Deflator Gross Domestic Product Implicit Price Deflator						<ul style="list-style-type: none"> <li>Closely mirrors the GDP price index, although calculated differently</li> <li>Used by some firms to adjust payments in contracts</li> </ul>

[bea.gov/data/prices-inflation](https://bea.gov/data/prices-inflation) • [CustomerService@bea.gov](mailto:CustomerService@bea.gov) • (301) 278-9004

<https://www.bea.gov/resources/learning-center/quick-guide-some-popular-bea-price-indexes>

## BEA: Personal Consumption Expenditures Price Indexes

- The PCE price index is known for capturing inflation (or deflation) across a wide range of consumer expenses and for reflecting changes in consumer behavior. For example, if the price of beef rises, shoppers may buy less beef and more chicken.
- BEA revises previously published PCE data to reflect updated information or new methodology, providing consistency across decades of data that's valuable for researchers. The PCE price index is used primarily for macroeconomic analysis and forecasting.
- A variation is the personal consumption expenditures price index, excluding food and energy, also known as the core PCE price index.
- The core index makes it easier to see the underlying inflation trend by excluding two categories—food and energy—where prices tend to swing up and down more dramatically and more often than other prices. The Federal Reserve closely watched the index as it conducts monetary policy.

<https://www.bea.gov/resources/learning-center/what-to-know-prices-inflation>

# PCE Price Indexes by Major Type of Product

Line		2019 Q1	2019 Q2	2019 Q3	2019 Q4	2020 Q1	2020 Q2	2020 Q3	2020 Q4
1	Personal consumption expenditures (PCE)	109.100	109.835	110.141	110.612	110.958	110.505	111.507	111.928
2	Goods	94.647	95.120	94.697	94.863	94.597	93.243	94.361	94.437
3	Durable goods	86.978	86.846	86.360	85.770	85.450	84.830	86.404	86.452
4	Motor vehicles and parts	97.704	98.205	98.200	98.014	97.876	97.531	101.752	102.332
5	Furnishings and durable household equipment	87.563	87.401	87.298	86.435	86.978	87.024	88.450	88.928
6	Recreational goods and vehicles	74.943	73.706	72.707	71.884	70.988	69.830	70.072	69.875
7	Other durable goods	84.908	85.969	85.075	84.691	83.996	83.152	82.622	81.483
8	Nondurable goods	98.672	99.492	99.109	99.723	99.491	97.720	98.553	98.646
9	Food and beverages purchased for off-premises consumption	104.418	104.288	104.358	104.703	105.466	109.051	108.688	108.701
10	Clothing and footwear	98.637	98.068	98.382	96.596	97.009	90.957	91.983	91.621
11	Gasoline and other energy goods	72.071	77.602	74.297	77.712	74.011	55.499	61.630	64.352
12	Other nondurable goods	105.534	105.811	106.024	106.816	106.984	107.089	107.429	106.965
13	Services	116.656	117.536	118.253	118.900	119.604	119.713	120.624	121.267
14	Household consumption expenditures (for services)	116.418	117.252	117.906	118.582	119.285	119.473	120.338	120.943
15	Housing and utilities	120.938	121.903	122.772	123.679	124.598	125.310	125.901	126.604
16	Health care	108.923	109.417	109.900	110.653	111.146	112.218	113.121	113.538
17	Transportation services	108.144	108.956	109.080	109.865	108.988	107.026	106.768	108.453
18	Recreation services	114.492	115.126	115.342	116.424	116.990	117.662	117.762	118.817
19	Food services and accommodations	117.450	118.663	119.191	119.360	120.023	119.945	121.283	122.211
20	Financial services and insurance	135.609	137.778	138.990	139.443	140.920	138.805	140.840	141.333
21	Other services	109.220	109.243	109.882	110.232	110.994	111.059	111.720	111.875
22	Final consumption expenditures of nonprofit institutions serving households (NPISHs) <sup>1</sup>	121.769	123.691	125.806	125.755	126.394	125.153	126.786	128.162
23	Gross output of nonprofit institutions <sup>2</sup>	115.621	116.559	117.457	118.145	118.913	119.458	120.666	121.429
24	Less: Receipts from sales of goods and services by nonprofit institutions <sup>3</sup>	113.390	113.988	114.460	115.368	116.143	117.492	118.483	118.996
	Addenda:								
25	PCE excluding food and energy <sup>4</sup>	111.136	111.783	112.269	112.647	113.135	112.919	113.904	114.255
26	Energy goods and services <sup>5</sup>	83.898	87.410	85.053	87.452	84.844	73.294	77.052	79.498
27	Market-based PCE <sup>6</sup>	106.790	107.390	107.576	108.025	108.308	108.045	108.793	109.155
28	Market-based PCE excluding food and energy <sup>6</sup>	108.738	109.213	109.585	109.924	110.359	110.405	111.087	111.356

[https://apps.bea.gov/iTable/index\\_nipa.cfm](https://apps.bea.gov/iTable/index_nipa.cfm)

## CPI and PCE: A Comparison

The Bureau of Labor Statistics (BLS) prepares the Consumer Price Index for All Urban Consumers (CPI-U), and the Bureau of Economic Analysis (BEA) prepares the Personal Consumption Expenditures (PCE) chain-type price index.

- ① "Formula effect." The CPI is based on a modified Laspeyres formula, while the PCE price index is based on a Fisher-Ideal formula.
- ② "Weight effect." The relative weights used in the CPI are based primarily on household surveys, while the relative weights used in the PCE price index are based primarily on business surveys.
- ③ "Scope effect." The CPI measures the out-of-pocket expenditures of all urban households, while the PCE price index measures the goods and services purchased by households and nonprofit institutions serving households within the framework of the NIPAs.
- ④ "Other effects." Seasonal adjustment differences, price differences, and residual differences.

Source: McCully et. al. (2007) Comparing the CPI and the PCE Price Index. Survey of Current Business. BLS.

# CPI and PCE: A Reconciliation

## Chart 1. The CPI and the PCE Price Index

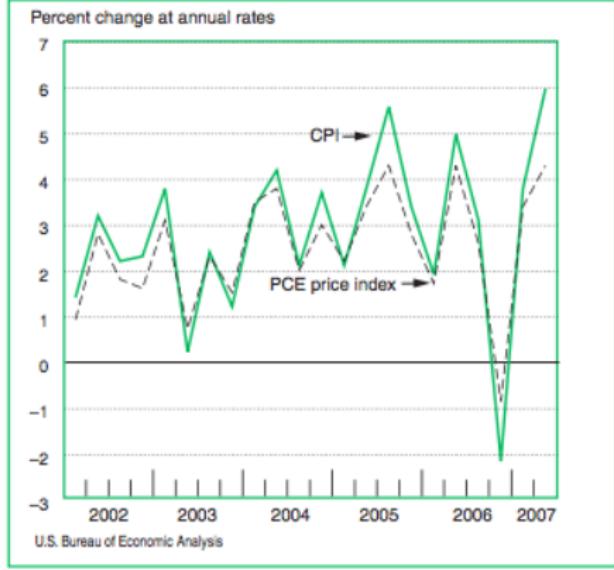


Table 2. Reconciliation of Quarterly Percent Changes  
Between the CPI and the PCE Price Index

[2002 to Second Quarter of 2007]

Line	
PCE chain-type price index (average annual percent change).....	1 2.5
Less: Formula effect (percentage points).....	2 -0.17
Gasoline and oil.....	3 -0.03
Computers peripherals and software.....	4 -0.04
Video and audio goods.....	5 -0.02
Tobacco products.....	6 -0.01
Medical care services.....	7 0.01
Electricity, gas, fuel oil, and other household fuels.....	8 -0.01
Housing.....	9 -0.01
Food.....	10 -0.01
Other.....	11 -0.05
Equals: PCE fixed-weight price index (average annual percent change).....	12 2.7
Less: Weight effect (percentage points).....	13 -0.67
Rent of shelter.....	14 -0.43
Gasoline and oil.....	15 -0.15
Electricity, gas, fuel oil, and other household fuels.....	16 -0.09
Other.....	17 0.00
Less: Scope effect—PCE items out-of-scope of the CPI (percentage points).....	18 0.76
Physicians.....	19 0.06
Hospitals and nursing homes.....	20 0.31
Services furnished without payment by financial intermediaries except life insurance and pension plans.....	21 0.02
Foreign travel by U.S. residents.....	22 0.06
Other.....	23 0.31
Plus: Scope effect—CPI items out-of-scope of the PCE price index (percentage points).....	24 0.24
Physicians.....	25 0.05
Hospitals and related services.....	26 0.10
Other.....	27 0.09
Less: Other effects .....	28 -0.04
Seasonal adjustment.....	29 -0.03
Price .....	30 -0.01
All other .....	31 0.00
Equals: CPI (average annual percent change).....	32 2.9

Source: McCully et. al. (2007) Comparing the CPI and the PCE Price Index. Survey of Current Business. BLS.



How do the CPI and PCE price indexes compare?



Source: FRED, BLS, BEA



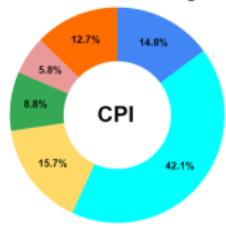
What difference does chaining the CPI make?



Source: FRED, BLS

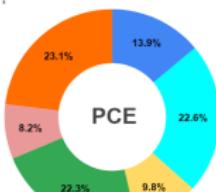


How does the PCE weigh items compared to the CPI?



Source: BLS, BEA

- Food and beverages
- Housing
- Transportation
- Medical care
- Recreation
- Other goods and services



How do the "underlying" inflation measures compare?



Source: BLS, Federal Reserve Bank of Cleveland, Haver Analytics



<https://www.brookings.edu/blog/up-front/2021/06/28/how-does-the-government-measure-inflation/>



# Outline

- ① Data and Statistics
- ② Measurement Methods
- ③ Inflation: Costs & Effects
- ④ Inflation: Theory & Models



*When prices are stable, people can hold money for transactions and other purposes without having to worry that inflation will eat away at the real value of their money balances.*

–Ben Bernanke

*I believe that the Federal Reserve's success in reducing and stabilizing inflation and inflation expectations is a major reason for this improved economic performance.*

–Ben Bernanke

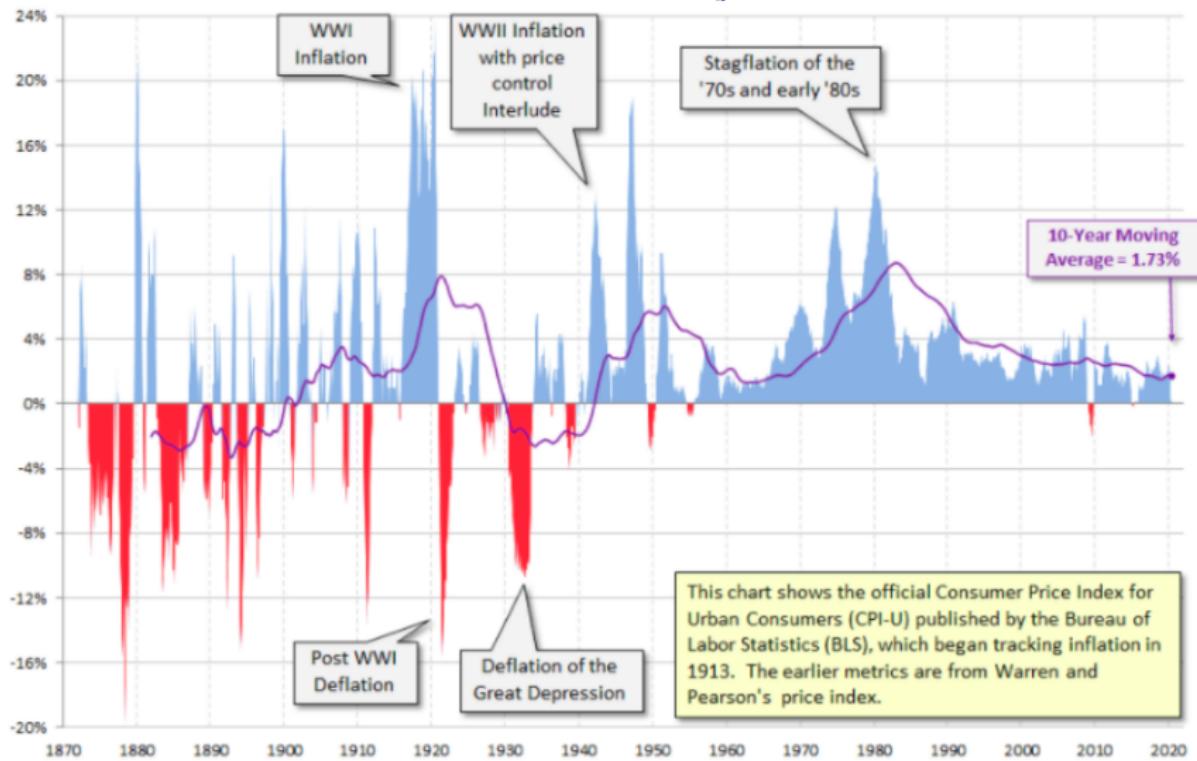
*The extent to which inflation expectations are anchored can change, depending on economic developments and (most important) the current and past conduct of monetary policy. In this context, I use the term 'anchored' to mean relatively insensitive to incoming data. So, for example, if the public experiences a spell of inflation higher than their long-run expectation, but their long-run expectation of inflation changes little as a result, then inflation expectations are well anchored. If, on the other hand, the public reacts to a short period of higher-than-expected inflation by marking up their long-run expectation considerably, then expectations are poorly anchored.*

–Ben Bernanke

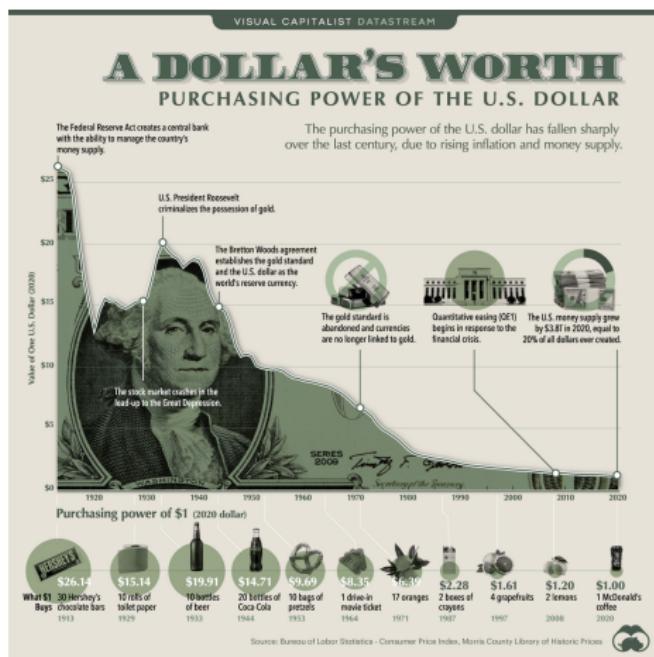
<https://www.famousquotes.com/author/ben-bernanke-quotes>

<https://www.federalreserve.gov/news-events/speech/bernanke20070710a.htm>

# U.S. Inflation and Deflation History, 1872-2020



<https://www.zytrade.com/this-chart-shows-the-historical-impact-of-inflation-in-the-us/>



The purchasing power of a currency is the amount of goods and services that can be bought with one unit of the currency.

<https://www.visualcapitalist.com/purchasing-power-of-the-u-s-dollar-over-time/>

- In 1913, the Federal Reserve Act granted Federal Reserve banks the ability to manage the money supply in order to ensure economic stability.
- Back then, a dollar could buy 30 Hershey's chocolate bars. As more dollars came into circulation, average prices of goods and services rose while the purchasing power of the dollar fell.
- By 1929, the Consumer Price Index (CPI) was 73% higher than in 1913, but a dollar was now enough only for 10 rolls of toilet paper.
- In 1933, one U.S. dollar could buy 10 bottles of beer. Today, it's the cost of a small McDonald's coffee.

## The Social Costs of Inflation

Economists have identified several costs and consequences of inflation. Facing inflation uncertainty, the market price system does not communicate information efficiently. Misinformation distorts economic and financial decisions.

- ① Shoeleather costs associated with reduced money holdings
- ② Menu costs associated with more frequent adjustment of prices
- ③ Arbitrary redistributions of wealth between debtors and creditors
- ④ Increased variability of relative prices and resources misallocation
- ⑤ Confusion and inconvenience resulting from a changing unit of account
- ⑥ Unintended changes in tax liabilities due to nonindexation of the tax code

Much of the problem with inflation is distributional, but there are real consequences as well. Time spent worrying about inflation, or profiting from inflation, is a diversion of resources away from productive activity. Many of these costs are particularly large during hyperinflation, but the size of these costs for moderate inflation is less clear. Most economists agree that inflation lowers economic welfare even when allowing for revenue from the inflation tax and the distortion that would be created by alternative taxes that raise the same revenue. <https://www.econlib.org/library/Enc/Inflation.html>

Source: Mankiw (2021) CH30, Principles of Economics. Cengage.

## Inflation: Expected vs Unexpected

- Inflation can do great harm. The harm is greater to the extent that the actual inflation rate differs from the anticipated inflation rate. When transactors correctly anticipate a faster decline in the purchasing power of the dollar (a higher inflation rate), the terms of contracts calling for future payments in dollars are adjusted accordingly.
- Borrowers and lenders who expect higher inflation agree to a higher nominal interest rate (dollars repaid over dollars lent) so as to preserve the real interest rate (purchasing power repaid over purchasing power lent) between them.
- Although lenders and borrowers do not suffer from a higher inflation rate when the rate is perfectly anticipated, holders of non-interest-bearing forms of money, such as currency, do. Higher anticipated inflation subjects them to the equivalent of a higher tax on their money holdings.
- When the inflation rate is incorrectly anticipated, financial trades are upset. If the inflation rate turns out to be higher than anticipated, a borrower gets to repay in less valuable dollars, at the expense of the lender who gets less back in purchasing power than expected. If it is lower than anticipated, the lender gains at the expense of the borrower (assuming the borrower is able to make the greater real payment).
- When the future inflation rate is highly uncertain, so that the risk of such gains and losses on new contracts is overwhelming, risk-averse parties shy away from making financial contracts (debt and equity).

## The Effect of Unexpected Inflation: Example

To illustrate how unexpected inflation (shock or surprise) redistribute between borrowers and lenders of nominal contracts, consider the following example.

- Suppose you are wanting to buy a car that costs \$10,000 today. You agree to borrow the \$10,000 from your bank today and pay it back, with 5% interest—for a total of \$10,500—one year from today.
- Suppose the bank and you both expect inflation to be zero percent. However, if after a year, realized inflation turns out to be 10%, then the \$10,500 you promised to pay is worth only \$9,450 in today's dollars  $\$10,500 - (\$10,500 \times 0.1)$ , and you are actually paying back less than the principle you borrowed.
- This example illustrates the redistributive effect of surprises in inflation. This phenomenon also holds for longer horizon shocks—the original value of contracts changes when agreements are made based on the expected cumulative inflation rate over the agreed horizon, and the market updates its expectation over time with the arrival of new information.

<https://www.stlouisfed.org/on-the-economy/2022/mar/how-much-are-we-taxed-surprise-inflation>

# The Effect of Inflation: Market Interest Rate



Consumer Price Index for All Urban Consumers: All Items in U.S. City Average  
Market Yield on U.S. Treasury Securities at 1-Year Constant Maturity



Inflation impairs the value of money in terms of its purchasing power. Given a fixed amount of money, rising inflation means higher overall price level and living cost. Hence, declining purchasing power of money. For depositors, savers, and investors, putting their money in banks and financial markets without accounting for ongoing and future inflation will result in a definite loss. To compensate for such inflationary loss, the market rate of investment return must at least factor in the rate of inflation agreed by market participants: the higher ongoing and expected future inflation, the higher the rate of interest in contract.

<https://fred.stlouisfed.org/series/CPIAUCSL>



## The Effect of Inflation: Asset Valuation

- In general, higher and more volatile inflation has negative effects on all financial assets, from stocks to corporate bonds to treasury bonds, and neutral to positive effects on gold, collectibles and real assets.
- That said, the impact of inflation on individual company values can vary widely, with a few companies benefiting, some affected only lightly, and other companies being affected more adversely, by higher than expected inflation.
- In an environment where finding inflation hedges has become the first priority for most investors, the search is on for companies that are less exposed to high and rising inflation. The conventional wisdom, based largely on investor experiences from the 1970s, is that commodity companies and firms with pricing power are the best ones to hold, if you fear inflation, but is that true, and even if it is true, why is it so?
- The nature of markets is that they are never quite settled, as investors recalibrate expectations constantly and reset prices. In most time periods, those recalibrations and resets tend to be small and in both directions, resulting in the ups and downs that pass for normal volatility. Clearly, we are not in one of those time periods, as markets approach bipolar territory, with big moves up and down. The good news is that the culprit behind the volatility is easy to identify, and it is inflation, but the bad news is that inflation remains the most unpredictable of all macroeconomic factors to factor into stock prices and value.

Source: Aswath Damodaran (2022) A Follow up on Inflation: The Disparate Effects on Company Values! (w)



## The Costs of Inflation: Winners and Losers

- To the extent that households' nominal income, which they receive in current money, does not increase as much as prices, they are worse off, because they can afford to purchase less. In other words, their purchasing power or real income (inflation-adjusted) falls. Real income is a proxy for the standard of living. When real incomes are rising, so is the standard of living, and vice versa.
- In reality, prices change at different paces. Some, such as the prices of traded commodities, change every day; others, such as wages established by contracts, take longer to adjust (or are "sticky," in economic parlance). In an inflationary environment, unevenly rising prices inevitably reduce the purchasing power of some consumers, and this erosion of real income is the single biggest cost of inflation.
- Inflation can also distort purchasing power over time for recipients and payers of fixed interest rates. Take pensioners who receive a fixed 5 percent yearly increase to their pension. If inflation is higher than 5 percent, a pensioner's purchasing power falls. On the other hand, a borrower who pays a fixed-rate mortgage of 5 percent would benefit from 5 percent inflation, because the real interest rate (the nominal rate minus the inflation rate) would be zero; servicing this debt would be even easier if inflation were higher, as long as the borrower's income keeps up with inflation. The lender's real income, of course, suffers. To the extent that inflation is not factored into nominal interest rates, some gain and some lose purchasing power.

## Inflation: Shoelather Cost and Menu Cost

- Although lenders and borrowers do not suffer from a higher inflation rate when the rate is perfectly anticipated, holders of non-interest-bearing forms of money, such as currency, do. Higher anticipated inflation subjects them to the equivalent of a higher tax on their money holdings. Inflation thereby drives transactors into costly strategies for getting by with smaller currency holdings, such as making more trips to the bank to take out smaller amounts each time.
- From the point of view of eliminating needless costs of economizing on cash, low inflation is clearly preferable to high inflation. Economizing on holding cash is an action that is optimal from the individual's viewpoint but costly from society's viewpoint.
- In addition to the tax on cash balances, at least one other harm stems from higher inflation even when perfectly anticipated. With higher inflation, published prices become obsolete more quickly, and so price setters must more frequently incur the costs of adjusting nominal prices. Economists sometimes call these "menu costs" because they include reprinting restaurant menus as well as changing price tags on supermarket shelves, revising catalogs, replacing numbers on gas station price signs, and so on.



## The Costs of Inflation: Tax Distortion

- Where the tax code is not fully indexed, higher inflation increases the distorting effects of taxes. Before the U.S. income tax brackets were indexed, inflation pushed income earners with unchanged real income into brackets where they faced higher marginal income tax rates. This discouraged people from making taxable income.
- With indexing of federal tax brackets in 1985, this distortion disappeared. However, the capital gains tax is still levied on nominal gains, not on real gains (inflation-adjusted). The portion of your asset's nominal price rise that merely corresponds to inflation is taxed along with any real profit.
- The higher the inflation rate, the higher the effective tax rate on your real capital gains, even with an unchanged nominal capital gains tax rate. Higher inflation thus discourages capital formation by discouraging people from accumulating taxable assets.
- Inflation reduces the value of corporate shares because the corporate income tax system in many countries is not fully indexed. Firms face higher real tax burdens as inflation rises.

## Inflation-induced Tax Distortion: Example

	Economy A (price stability)	Economy B (price stability)
Real interest rate	4%	4%
Inflation rate	0	8
Nominal interest rate (real interest rate + inflation rate)	4	12
Reduced interest due to 25 percent tax (0.25 times nominal interest rate)	1	3
After tax nominal interest rate (0.75 times nominal interest rate)	3	9
After tax real interest rate (after tax nominal interest rate minus inflation rate)	3	1

Most have not considered the fact that tax laws do not differentiate between nominal and real interest income and capital gains, and they soon realize that this can lead to effects on saving. The table provides an example of the after-tax real interest rate under different inflation scenarios: In the presence of zero inflation, a 25 percent tax on interest income reduces the real interest rate from 4 percent to 3 percent. In the presence of 8 percent inflation, the same tax reduces the real interest rate from 4 percent to 1 percent. This implies that higher inflation will tend to discourage saving. A possible solution to this problem would be to index the tax system.

Source: Mankiw (2021) CH30, Principles of Economics. Cengage



# Inflation Expectations: Significance and Measurement

Inflation expectations are the rate at which people—consumers, businesses, investors—expect prices to rise in the future. They matter because actual inflation depends, in part, on what we expect it to be. On the other hand, inflation expectation can also be self-fulfilling.

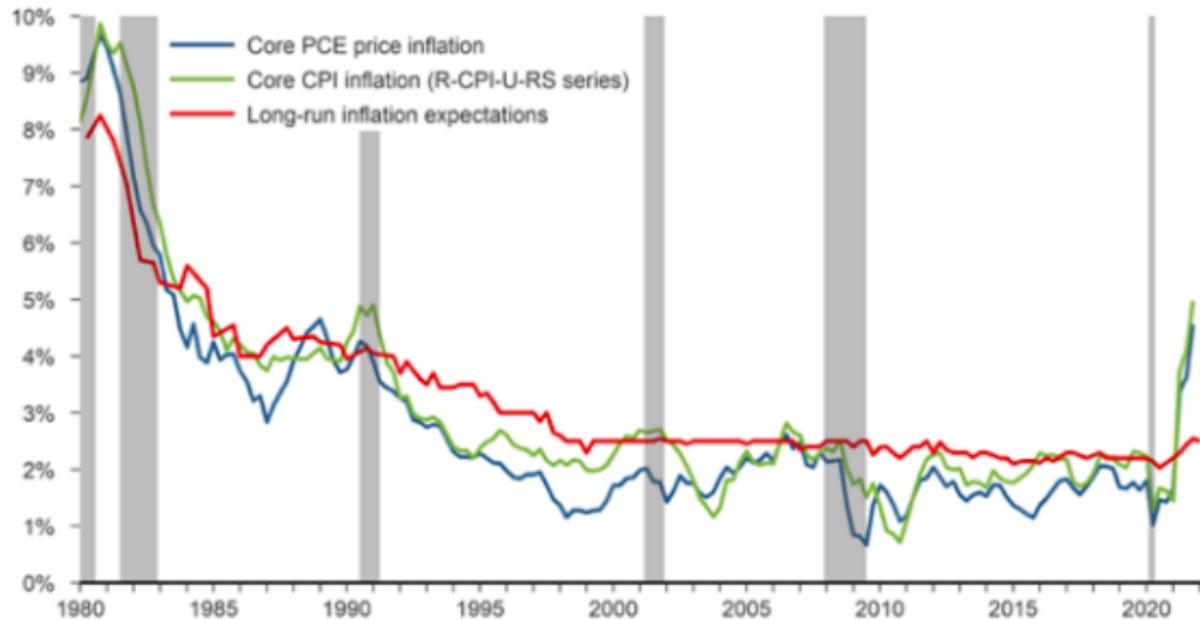
How should we measure inflation expectations, and how should we use that information for forecasting and controlling inflation? Three primary ways to track inflation expectations.

- ① Consumer and business surveys. The University of Michigan's Survey Research Center, for instance, asks a sample of households how much they expect prices to change over the next year, and five to ten years into the future. The Federal Reserve Bank of New York and the Conference Board field similar surveys.
- ② Professional economic forecasts. The Survey of Professional Forecasters (SPF) surveys professional economic forecasters on their outlook for two major government measures of inflation—the CPI and the PCE price index.
- ③ Market-based financial instruments. By comparing 10-year nominal Treasury yields with yields on 10-year Treasury Inflation Protection Securities (TIPS), whose yield is tied to changes in the CPI, economists can derive the breakeven rate that approximates the market's inflation expectations because it shows the inflation rate at which investors would earn the same real return on the two types of securities.

Federal Reserve economists recently created the Index of Common Inflation Expectations (CIE), which combines 21 indicators of inflation expectations, including readings from consumer surveys, markets, and economists' forecasts (w).

<https://www.brookings.edu/blog/up-front/2020/11/30/what-are-inflation-expectations-why-do-they-matter/>

## Actual Inflation vs Expected Inflation, 1980-2020 <sup>(w)</sup>



Notes: Gray bars denote NBER recessions. Long-run inflation expectations from Blue Chip (1980-1991) and SPF (1991-present), median expected inflation over the next 10 years.

Sources: FRBSF Economic Letter 2006-27; BEA, BLS, Philadelphia Fed, Blue Chip.

The more inflation rose, the more consumers and businesses expected it to rise. As inflation moved up, so did inflation expectations. Future inflation expectations were then built into wage and price contracts. Before long, inflation dynamics and future inflation were deeply intertwined with inflation psychology (Daly, 2022).

# Inflation Expectations: Survey Measure



In the graph, inflation expectation is measured and calculated by the median expected price change next 12 months. Source: Surveys of Consumers. University of Michigan: Inflation Expectation.

<https://fred.stlouisfed.org/series/MICH>

<https://data.sca.isr.umich.edu>

## Inflation Expectations: Market-based Measures



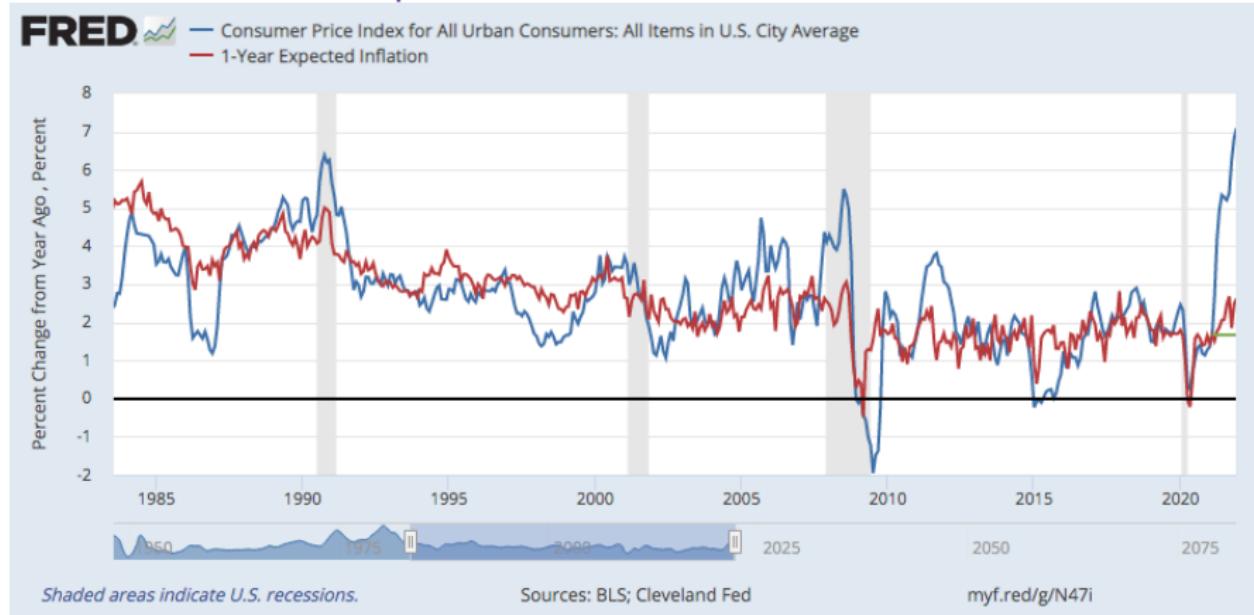
The breakeven inflation rate is an approximation of expected inflation implied from the U.S. Treasury securities. The latest value implies what market participants expect inflation to be in the next N years, on average. <https://fred.stlouisfed.org/series/T5YIE>

## Inflation Shock: Measure and Calculation

- The Cleveland Fed provides estimates of inflation expectations each month over different horizons.<sup>1</sup> For each year, we calculate how much the initial expectation has changed over the course of one year because of new information about the economy. For example, if last year you expected inflation to be 2%, but actual inflation over the year turns out to be 4%, then that is an inflation shock of 2 percentage points.
- Similar logic can be applied to longer horizons. For example, if last year (say, 2021.1) you expected inflation to be 2% per year on average for the next five years (2021.1 to 2026.1), but with new information that arrived over the previous year, now today, in January 2022, you update your inflation expectations for the same period (2021.1 to 2026.1) to average 4% instead: an inflation shock of 2% annually for the five-year horizon.
- The inflation shock people experienced in 2021 was the largest over the last four decades in terms of one-year, two-year, five-year and 10-year horizons, while the shock to 30-year horizons is the largest since 2000.

Source: Chiang and LaBelle (2022) How Much Are We "Taxed" by Surprise Inflation? FRBSL Blog (w)

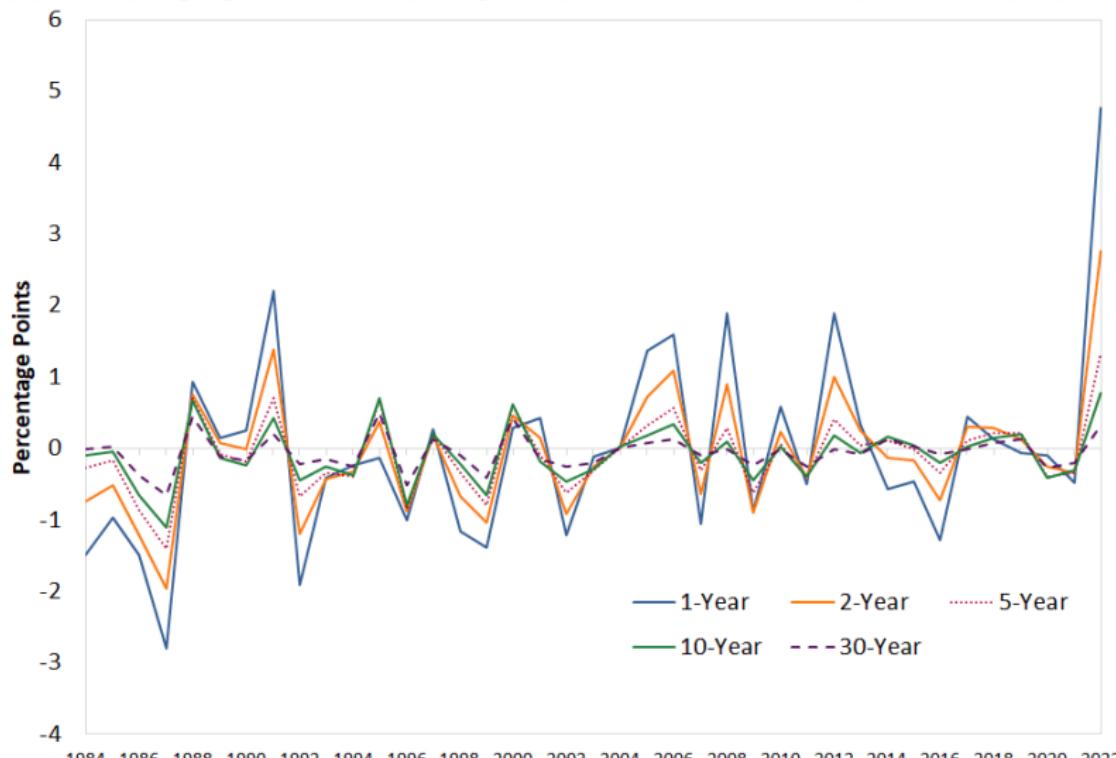
# Inflation Shock: Expected v.s. Actual Inflation



The graph shows one measure of realized inflation from the Bureau of Labor Statistics and measures of expected inflation from the Federal Reserve Bank of Cleveland. The blue line shows the monthly year-over-year change in the consumer price index. The red line shows one-year-ahead inflation expectations recorded over the course of the year. The distance between the blue line's realized inflation as of February 2022 (7.91%) and the red line's expected inflation for February 2022 (1.67%) represents an "inflation shock."

<https://fredblog.stlouisfed.org/2022/03/the-meaning-and-mechanics-of-inflation-shocks/>

# Annualized U.S. Inflation Shocks for Various Horizons



<https://fredblog.stlouisfed.org/2022/03/the-meaning-and-mechanics-of-inflation-shocks/>

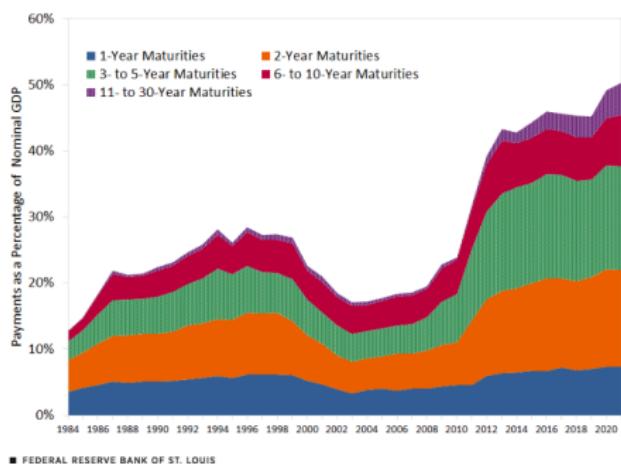
## Inflation "Tax" on U.S. Treasury Debt-holders

- The U.S. government is one of the largest borrowers in the world. This means redistribution happens between the U.S. government and its debtholders when the U.S. government borrows money in nominal terms today and pays it back at agreed-upon dates in the future.
- Rather than a single lump-sum payment, Treasury securities mature in a wide range of horizons. To understand how Treasury debts of different maturities are exposed to inflation shocks, we calculate, for each year, the year-end nominal value of Treasury debt that is outstanding and priced at the beginning of each year.
- Consider an example: If in Jan 2021, the U.S. government needs to make a payment of \$10,500 in one year, in Jan 2022, and \$10,500 in two years, in Jan 2023, and the market nominal interest rate (the forward rate) is expected to be 5% between Jan 2022 and Jan 2023; then in Jan 2021, the year-end value for the one-year horizon is \$10,500, and the year-end value for the two-year horizon is \$10,000 ( $\$10,500 \div 1.05$ ).
- These values represent the year-end amounts the U.S. government agrees to pay in January 2021 that are exposed to inflation shocks, and they allow us to understand how changes in the real value of nominal amounts from over the year affect the real value of outstanding debt of different horizons that the U.S. government had promised to pay—that is, how inflation shocks of different horizons affect the total real value of the U.S. government debt.

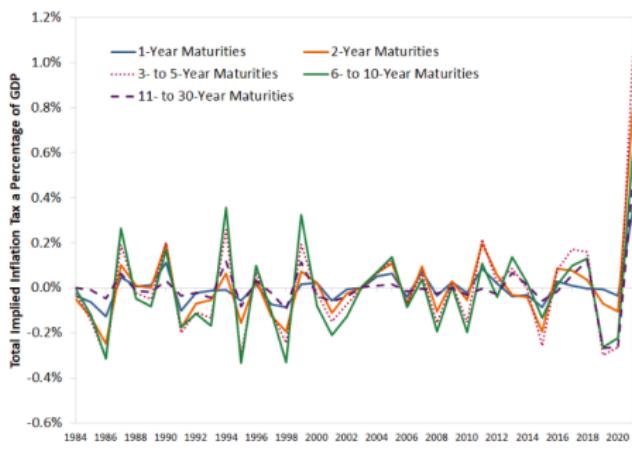
Source: Chiang and LaBelle (2022) How Much Are We "Taxed" by Surprise Inflation? FRBSL Blog (w)

# Inflation "Tax" on Treasury Debt-holders

Breakdown in the Nominal Value of U.S. Treasury Debt at Year-End



Size of the Annual Inflation Tax on U.S. Treasury Debtholders



■ FEDERAL RESERVE BANK OF ST. LOUIS

SOURCES: Center for Research in Security Prices and authors' calculations.

NOTE: The stacked areas represent the composition of payments of different maturities.

■ FEDERAL RESERVE BANK OF ST. LOUIS

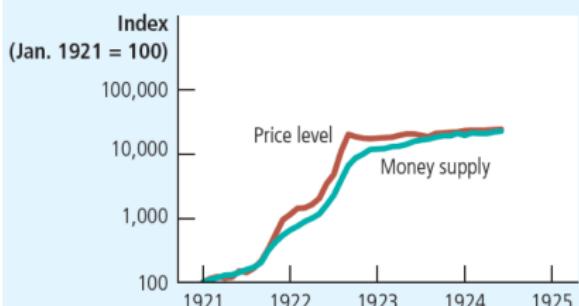
SOURCES: Center for Research in Security Prices, Federal Reserve Bank of Cleveland and authors' calculations.

As shown in the left figure, the largest share of current outstanding Treasury debt is debt maturing in three to five years, followed closely by two-year maturities. This means that the two-year and five-year inflation expectation shocks will have the largest redistributive impact on the government budget. Inflation surprises have decreased the real value of U.S. government debt as a percentage of U.S. GDP each year over the previous four decades. In the right figure, a positive number means a redistribution from debtholders to the U.S. government, an inflation tax on the debt holders. Source: Chiang and LaBelle (2022) (w)

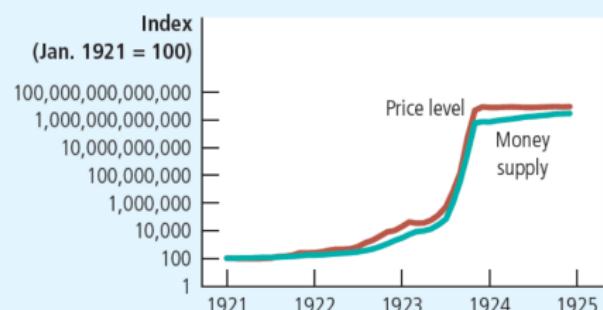
# Hyperinflation: A Little History

- Inflation is a sustained increase in the aggregate price level. Hyperinflation is very high inflation. Although the threshold is arbitrary, economists generally reserve the term "hyperinflation" to describe episodes when the monthly inflation rate is greater than 50 percent. At a monthly rate of 50 percent, an item that cost \$1 on January 1 would cost \$130 on January 1 of the following year.
- Hyperinflation is largely a twentieth-century phenomenon. The most widely studied hyperinflation occurred in Germany after World War I. The ratio of the German price index in November 1923 to the price index in August 1922—just fifteen months earlier—was  $1.02 \times 10^{10}$ . This huge number amounts to a monthly inflation rate of 322 percent. On average, prices quadrupled each month during the sixteen months of hyperinflation.
- While the German hyperinflation is better known, a much larger hyperinflation occurred in Hungary after World War II. Between August 1945 and July 1946 the general level of prices rose at the astounding rate of more than 19,000 percent per month, or 19 percent per day.
- Even these very large numbers understate the rates of inflation experienced during the worst days of the hyperinflations. In October 1923, German prices rose at the rate of 41 percent per day. And in July 1946, Hungarian prices more than tripled each day.

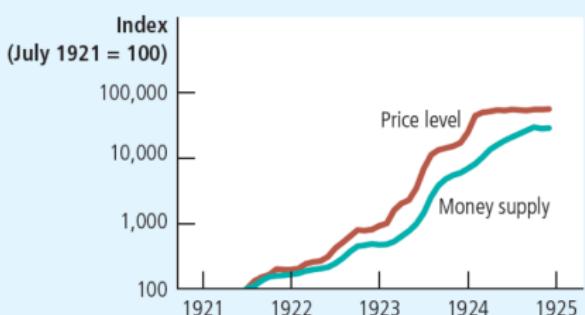
## Hyperinflation in Austria, 1920s



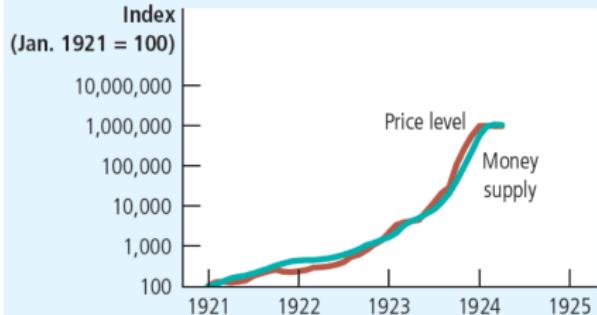
## Hyperinflation in Germany, 1920s



## Hyperinflation in Hungary, 1920s



## Hyperinflation in Poland, 1920s



Source: Mankiw (2021) CH30, Principles of Economics. Cengage



## Hyperinflation: Consequences and Effects (w)

- One effect with serious consequences is the reallocation of wealth. Hyperinflations transfer wealth from the general public, which holds money, to the government, which issues money. Hyperinflations also cause borrowers to gain at the expense of lenders when loan contracts are signed prior to the worst inflation. Businesses that hold stores of raw materials and commodities gain at the expense of the general public. In Germany, renters gained at the expense of property owners because rent ceilings did not keep pace with the general level of prices.
- Hyperinflation reduces an economy's efficiency by driving people away from monetary transactions and toward barter. In a normal economy, using money in exchange is highly efficient. During hyperinflations people prefer to be paid in commodities in order to avoid the inflation tax. If they are paid in money, they spend that money as quickly as possible. In Germany, workers were paid twice per day and would shop at midday to avoid further depreciation of their earnings. Hyperinflation is a wasteful game of "hot potato" in which people use up valuable resources trying to avoid holding on to paper money.
- The Latin American countries with high inflation experienced a phenomenon called "dollarization," the use of U.S. dollars in place of the domestic currency. As inflation rises, people come to believe that their own currency is not a good way to store value and they attempt to exchange their domestic money for dollars. In 1973, 90% of time deposits in Bolivia were denominated in Bolivian pesos. By the year of 1985 hyperinflation, more than 60% were denominated in dollars.

## Are there any Benefits from Inflation?

- Does inflation have any benefits? Some Keynesian macroeconomists once believed that higher inflation could "buy" a permanent reduction in the unemployment rate, a belief that was encapsulated in early versions of the "Phillips curve." Economists now agree that no such exploitable trade-off exists; it seemed to exist in the 1960s only when higher inflation was a surprise.
- Surprise inflation can reduce layoffs (by making dollar sales unexpectedly high) and shorten job search (by making dollar wage offers unexpectedly high), lowering the unemployment rate below its "natural rate." When workers come to expect a high inflation rate, as they did in the 1970s, unemployment returns to its "natural rate." By the same logic, a surprise reduction in inflation can raise unemployment above its natural rate, making disinflation costly.
- Although the consensus against high inflation is widespread, opinions vary over whether an inflation rate of 0 percent is better than a rate of +3 percent or -3 percent. In favor of a positive inflation rate, some argue that a little bit of inflation provides "grease" to the economic system. Others argues that positive inflation—by keeping nominal interest rates well above their zero lower bound—preserves the central bank's ability to cut rates if looser monetary policy is needed.
- Some favor zero inflation as the policy that minimizes uncertainty about future inflation, thereby best facilitating financial contracts; and that minimizes the distortions associated with unindexed taxes.



# Outline

- ① Data and Statistics
- ② Measurement Methods
- ③ Inflation: Costs & Effects
- ④ Inflation: Theory & Models



## Ludwig von Mises (1995) CH4, Economic Policy—Thoughts for Today and Tomorrow.

*If the supply of caviar were as plentiful as the supply of potatoes, the price of caviar—that is, the exchange ratio between caviar and money or caviar and other commodities—would change considerably. In that case, one could obtain caviar at a much smaller sacrifice than is required today. Likewise, if the quantity of money is increased, the purchasing power of the monetary unit decreases, and the quantity of goods that can be obtained for one unit of this money decreases also.*

*When, in the sixteenth century, American resources of gold and silver were discovered and exploited, enormous quantities of the precious metals were transported to Europe. The result of this increase in the quantity of money was a general tendency toward an upward movement of prices in Europe. In the same way, today, when a government increases the quantity of paper money, the result is that the purchasing power of the monetary unit begins to drop, and so prices rise. This is called inflation. Unfortunately, in the United States, as well as in other countries, some people prefer to attribute the cause of inflation not to an increase in the quantity of money but, rather, to the rise in prices.*

*However, there has never been any serious argument against the economic interpretation of the relationship between prices and the quantity of money, or the exchange ratio between money and other goods, commodities, and services.*



*If the government wants to do something beneficial—for example, it wants to build a hospital—the way to find the needed money for this project is to tax the citizens and build the hospital out of tax revenues. Then no special "price revolution" will occur, because when the government collects money for the construction of the hospital, the citizens—having paid the taxes—are forced to reduce their spending. The individual taxpayer is forced to restrict either his consumption, his investments, or his savings. The government, appearing on the market as a buyer, replaces the individual citizen: the citizen buys less, but the government buys more. The government, of course, does not always buy the same goods which the citizens would have bought; but on the average there occurs no rise in prices due to the government's construction of a hospital.*

*For example, without inflating, the government could use the tax-collected money for hiring new employees or for raising the salaries of those who are already in government service. Then these people, whose salaries have been increased, are in a position to buy more. When the government taxes the citizens and uses this money to increase the salaries of government employees, the taxpayers have less to spend, but the government employees have more. Prices in general will not increase.*

Source: Ludwig von Mises (1995) CH4 Inflation, Economic Policy—Thoughts for Today and Tomorrow. Pages 41-42, Liberty Fund



*And more importantly, this tendency for prices to go up will develop step by step; it is not a general upward movement of what has been called the "price level." The metaphorical expression "price level" must never be used.*

*When people talk of a "price level," they have in mind the image of a level of a liquid which goes up or down according to the increase or decrease in its quantity, but which, like a liquid in a tank, always rises evenly. But with prices, there is no such thing as a "level." Prices do not change to the same extent at the same time. There are always prices that are changing more rapidly, rising or falling more rapidly than other prices. There is a reason for this.*

.....

*The situation is this: those people to whom the money comes first now have a higher income, and they can still buy many commodities and services at prices which correspond to the previous state of the market, to the condition that existed on the eve of inflation.*

*Therefore, they are in a very favorable position. And thus inflation continues step by step, from one group of the population to another. And all those to whom the additional money comes at the early stage of inflation are benefited because they are buying some things at prices still corresponding to the previous stage of the exchange ratio between money and commodities.*

*But there are other groups in the population to whom this additional money comes much, much later. These people are in an unfavorable position. Before the additional money comes to them they are forced to pay higher prices than they paid before for some—or for practically all—of the commodities they wanted to purchase, while their income has remained the same, or has not increased proportionately with prices.*

Source: Ludwig von Mises (1995) CH4 Inflation, Economic Policy—Thoughts for Today and Tomorrow. Pages 42-44, Liberty Fund



*The government may think that inflation—as a method of raising funds—is better than taxation, which is always unpopular and difficult. In many rich and great nations, legislators have often discussed, for months and months, the various forms of new taxes that were necessary because the parliament had decided to increase expenditures. Having discussed various methods of getting the money by taxation, they finally decided that perhaps it was better to do it by inflation.*

*But of course, the word "inflation" was not used. The politician in power who proceeds toward inflation does not announce: "I am proceeding toward inflation." The technical methods employed to achieve the inflation are so complicated that the average citizen does not realize inflation has begun.*

*One of the biggest inflations in history was in the German Reich after the First World War. The inflation was not so momentous during the war; it was the inflation after the war that brought about the catastrophe.*

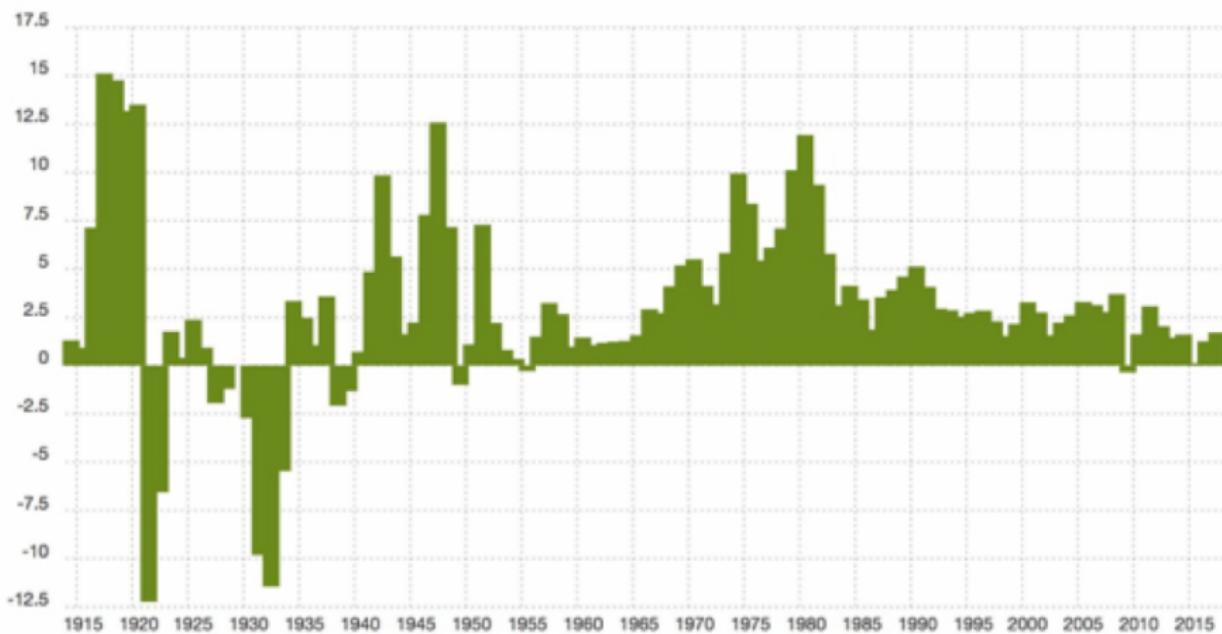
.....

*The government does not care, at first, that some people will be losers, it does not care that prices will go up. The legislators say: "This is a wonderful system!" But this wonderful system has one fundamental weakness: it cannot last. If inflation could go on forever, there would be no point in telling governments they should not inflate. But the certain fact about inflation is that, sooner or later, it must come to an end. It is a policy that cannot last.*

*In the long run, inflation comes to an end with the breakdown of the currency; it comes to a catastrophe, to a situation like the one in Germany in 1923.*

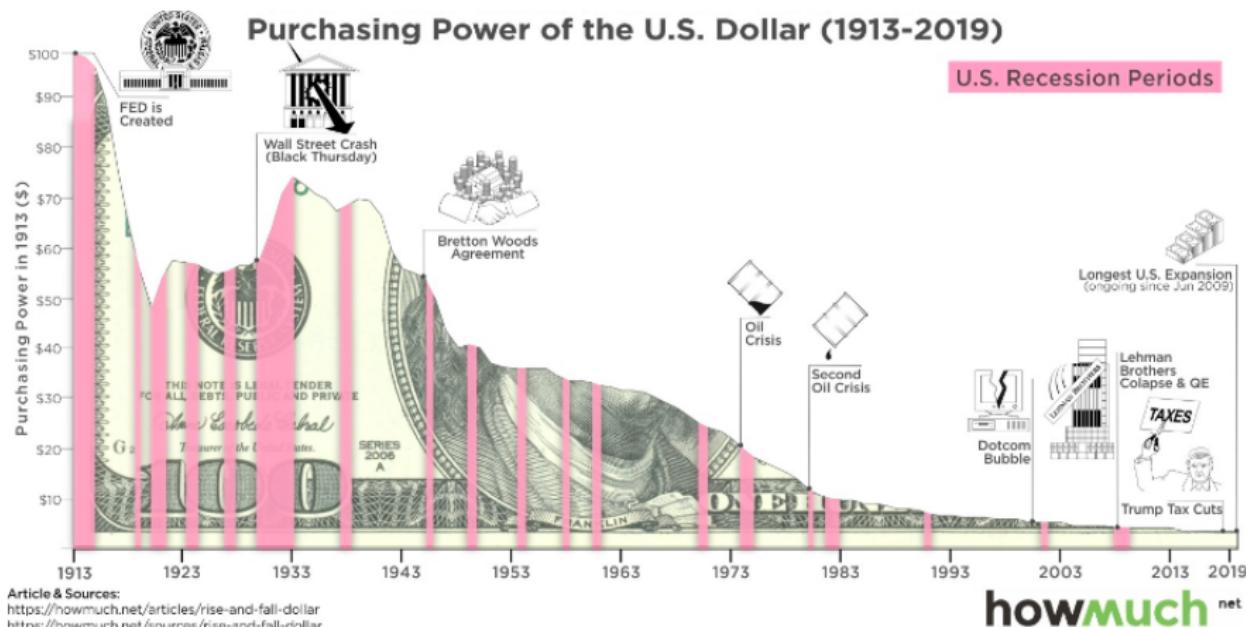
Source: Ludwig von Mises (1995) CH4 Inflation, Economic Policy—Thoughts for Today and Tomorrow. Pages 45–46, Liberty Fund

# U.S. Inflation Rate since 1913



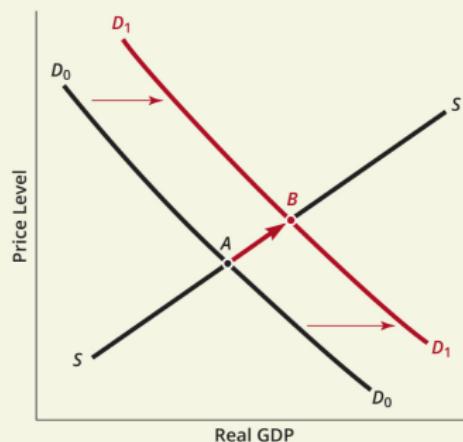
<https://www.in2013dollars.com/current-inflation-rate>

# U.S. Dollar Purchasing Power

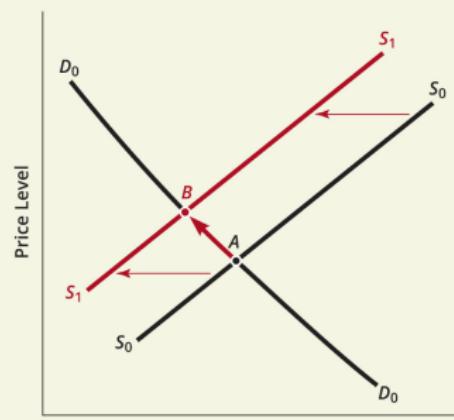


# Price Level and Inflation: Causes

## Demand-Pull Inflation



## Cost-Push Inflation



At one time economists classified inflation into two types: (1) demand-pull inflation, which is generated by excess demand for goods and services pulling up prices, and (2) cost-push inflation, which is generated by higher costs—such as energy price increases imposed by an oil cartel or wage increases demanded by powerful labor unions—being passed on in the form of higher prices by monopoly firms. Currently this classification is seldom used except in classifying short-run forces affecting prices. In the long run, neither type of inflation can be sustained without an accommodating growth in the money supply.

Source: Kennedy and Pray (2017) Macroeconomic Essentials, MIT. Appendix 12.1, page 298

Graphs: Baumol, Blinder, and Solow (2020) CH21, Economics: Principles and Policy, 14e, Cengage.

## Price Level and Monetary Value

- When the price level rises, people have to pay more for the goods and services they buy, vice versa.
- A rise in the price level also means that the value of money is now lower because each dollar now buys a smaller quantity of goods and services.
- If  $P$  is the price level, then the quantity of goods and services that can be purchased with \$1 is equal to  $1/P$ .
- Suppose you live in a country with one good (apples). When the price of an apple is \$2, the value of a dollar is  $1/2$  apple. When the price of an ice cream cone rises to \$3, the value of a dollar is  $1/3$  apple.
- Given the amount of money  $M$  and the price of goods and services, the quantity of goods and services it can purchase is  $M/P$ . Hence, the purchasing power of money.
- Therefore, there exists an inverse relationship between the price that money pays for and the purchase power of money per se.

Source: N. G. Mankiw (2021) CH30, Principles of Economics, 9e, Cengage.

## Classical Dichotomy and Monetary Neutrality

In the 18th century, David Hume and other economists wrote about the relationship between monetary changes and important macroeconomic variables such as production, employment, real wages, and real interest rates.

- According to classical economists that economic variables should be divided into two groups: nominal variables and real variables.
- Nominal variables are measured in monetary units. Real variables are measured in physical units. Classical dichotomy is the theoretical separation of nominal and real variables.
- Prices in the economy are nominal (because they are quoted in units of money), but relative prices are real (because they are not measured in money terms).
- Classical analysis suggested that different forces influence real and nominal variables. Changes in the money supply affect nominal variables but not real variables. Monetary neutrality refers to the proposition that changes in the money supply do not affect real variables.

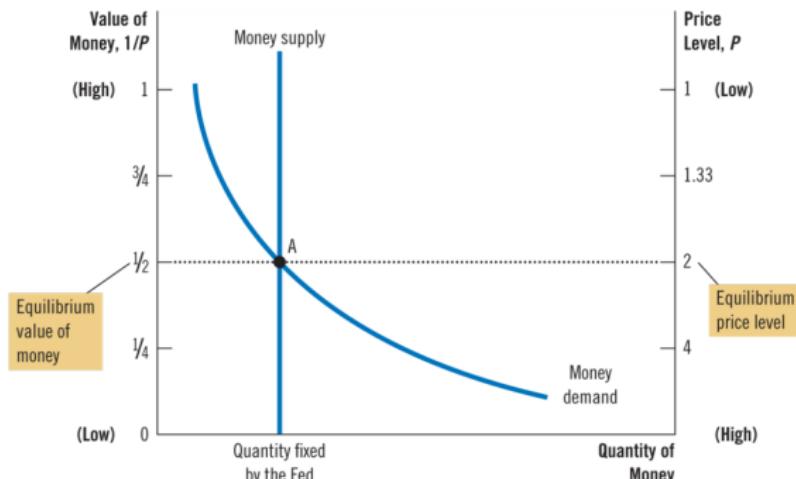
Source: N. G. Mankiw (2021) CH30, Principles of Economics, 9e, Cengage.

# Money and Price Equilibrium

The horizontal axis shows the quantity of money. The left vertical axis shows the value of money, and the right vertical axis shows the price level. The supply curve for money is vertical because the quantity of money supplied is fixed by the Fed. The demand curve for money slopes downward because people want to hold a larger quantity of money when each dollar buys less. At the equilibrium, point A, the value of money (on the left axis) and the price level (on the right axis) have adjusted to bring the quantity of money supplied and the quantity of money demanded into balance.

**FIGURE 1**

How the Supply and Demand for Money Determine the Equilibrium Price Level



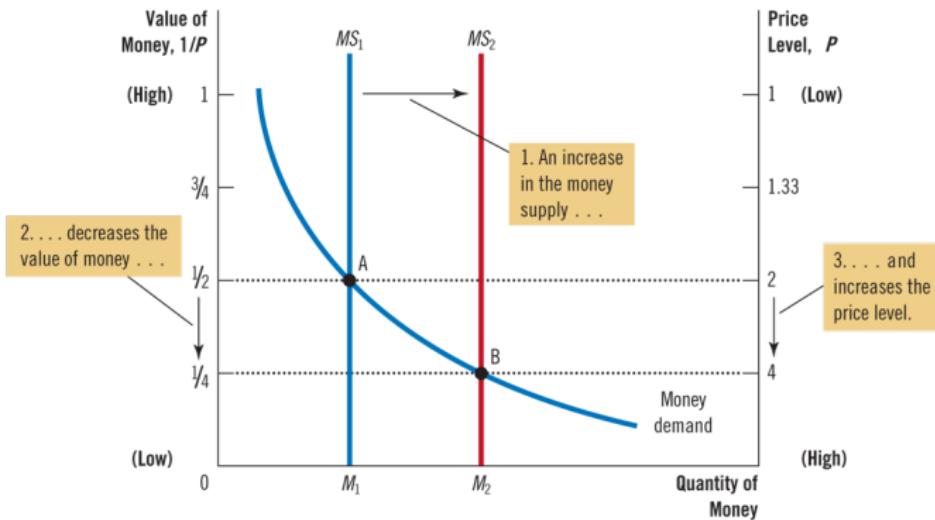
Source: N. G. Mankiw (2021) CH30, Principles of Economics, 9e, Cengage.

# Money Supply and Price Level Effect

**FIGURE 2**

## An Increase in the Money Supply

When the Fed increases the supply of money, the money supply curve shifts from  $MS_1$  to  $MS_2$ . The value of money (on the left axis) and the price level (on the right axis) adjust to bring supply and demand back into balance. The equilibrium moves from point A to point B. Thus, when an increase in the money supply makes dollars more plentiful, the price level increases, making each dollar less valuable.



Source: N. G. Mankiw (2021) CH30, Principles of Economics, 9e, Cengage.

## Price Adjustment Process in the Model

- The immediate effect of an increase in the money supply is to create an excess supply of money.
- People try to get rid of this excess supply in a variety of ways.
- They may buy goods and services with the excess funds.
- They may use these excess funds to make loans to others by buying bonds or depositing the money in a bank account. These loans will then be used by others to buy goods and services.
- In either case, the increase in the money supply leads to an increase in the demand for goods and services.
- Because the supply of goods and services has not changed, the result of an increase in the demand for goods and services will be higher prices.

Source: N. G. Mankiw (2021) CH30, Principles of Economics, 9e, Cengage.



## MV=PY: Aggregate Causes and Effects

In the quantity equation, holding other variables constant enables us, in turn, to explain the change in the price level.

- V, Y constant, M+  $\Rightarrow$  P+; M-  $\Rightarrow$  P-.
- M, V constant, Y+  $\Rightarrow$  P-; Y-  $\Rightarrow$  P+.
- M, Y constant, V+  $\Rightarrow$  P+; V-  $\Rightarrow$  P-.
- AD-AS model can explain these effects intuitively.
- As shown above, what are the causes of inflation in the long run?
- Money neutrality (money does not affect output) assumed, P is determined by changes in M, V and Y, but not vice versa.
- In practice, the causal effect can run in both directions. Otherwise, other variables than M and Y must be underlying the explanation.
- A deep question: What determine the change in M,V and Y?

## MV=PY: Money Growth and Inflation

Inflation occurs—that is, the purchasing power of the dollar shrinks—to the extent that the nominal supply of dollars grows faster than the real demand to hold dollars. A standard approach to analyzing the connection between the money stock (M) and the general price level (P) uses an accounting identity called the "equation of exchange": MV=PY.

- A little mathematical trick is useful for understanding its relationship.
- Taking logs:  $\ln(MV) = \ln(PY) \Rightarrow \ln M + \ln V = \ln P + \ln Y$
- Total differentiation (or discrete change):  $\frac{dM}{M} + \frac{dV}{V} = \frac{dP}{P} + \frac{dY}{Y}$
- Suppose V is constant,  $\pi = \frac{dP}{P} \approx \frac{dM}{M} - \frac{dY}{Y}$  or  $P\% \approx M\% - Y\%$
- The dynamic equation of exchange indicates that, as a matter of accounting, inflation depends not only on the rate of monetary expansion, but also on the rate of velocity growth and (negatively) on the rate of real income growth.
- Which of these three factors contributes the most to inflation in practice?

## Inflation is a Monetary Phenomenon (w)

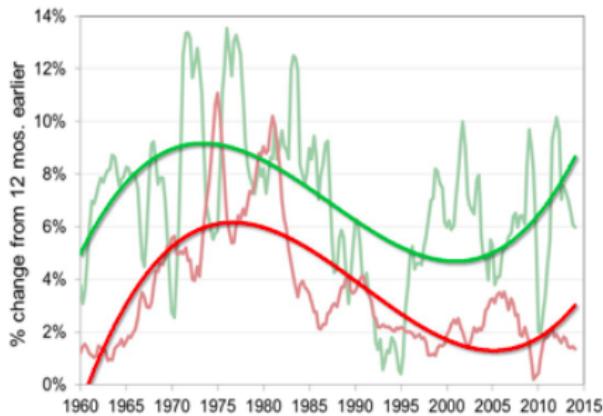
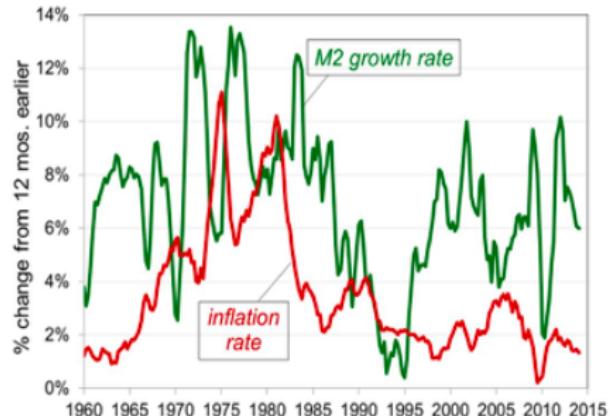
- Milton Friedman (1992, p. 262) famously proclaimed: "Inflation is always and everywhere a monetary phenomenon." What he meant was that sustained inflation has historically always been due to sustained money supply growth, not to sustained velocity growth or sustained negative growth in real income.
- The supporting evidence for Friedman's proposition is straightforward. For virtually any country one examines, even in a bad year real income seldom falls by more than two or three percentage points. Velocity has been known to rise over long periods, but seldom more than one percentage point year after year.
- When high-inflation and low-inflation countries are compared, differences in money growth are much greater than differences in either real output growth or velocity. As a result, the rate of monetary expansion is the dominant factor accounting for differences in inflation rates across countries.
- High-inflation countries are countries with rapid money growth. Likewise, the dominant factor accounting for different inflation rates over decades in the same country (e.g., the lower U.S. inflation rate in the 1990s compared with the 1970s) is different money growth rates. High-inflation decades are decades with rapid money growth. The dominance of money growth in accounting for inflation is especially pronounced in hyperinflation.

Source: Econlib

## The Cause of Inflation: Some Caveats

- The equation of exchange warns us that for a "supply shock" to account for a large rise in the general price level (not just a relative rise in some prices), the economy's output must shrink by a large percentage. In practice, "supply shock" cases are seldom large enough to account for much inflation and are typically short-lived.
- For example, of the 9.2 percent U.S. inflation rate in 1980 (as measured by the GDP deflator,  $P\% = 9.2\%$ ), the negative growth of real GDP (due, in part, to the OPEC oil price shock of 1979–1980) accounted for only 0.2 percentage points ( $Y\% = -0.2\%$ ). Meanwhile, growth in the money stock (M1 measure, December 1980 over December 1979) accounted for 7.0 percentage points ( $M\% = 7.0\%$ ). Growth of approximately 2% in the income-velocity of M1 accounted for the remainder ( $V\% = 2.0\%$ ). For the M2 measure of money and its velocity, the respective figures were 8.5% and 0.5%.
- The equation also tells us, contrary to what some pundits used to suggest, that "too much growth" cannot be a cause of inflation. The higher the rate of real income growth ( $Y\%$ ), the lower the inflation rate ( $P\%$ ), other things ( $M\%$  and  $V\%$ ) being equal. If an increase in inflation is associated with an "overheating" economy ( $Y\%$  above its sustainable long-run trend), the explanation is that both rising inflation and a temporary spurt in real growth are effects of a previous increase in money growth.
- What may look like "cost-push inflation" is often "demand-pull inflation" in disguise. ... At each level, the price increase appears to be pushed by input costs. But the rise in input costs is due, ultimately, to the demand pull of money growth.

## Money Growth and Inflation – U.S. Evidence, 1960-2014



The quantity theory of money is intended to explain the long-run relationship of inflation and money growth, not the short-run relationship. In the long run, inflation and money growth are positively related, as the theory predicts. In the short run, however, inflation and money growth appear highly negatively correlated! One possible reason is that the causality is reversed in the short run: When inflation rises—or is expected to rise—the Fed cuts back on money growth. If the economy slumps and inflation falls, the Fed increases money growth. It might be appropriate to discuss this when covering the chapters on short-run fluctuations.)

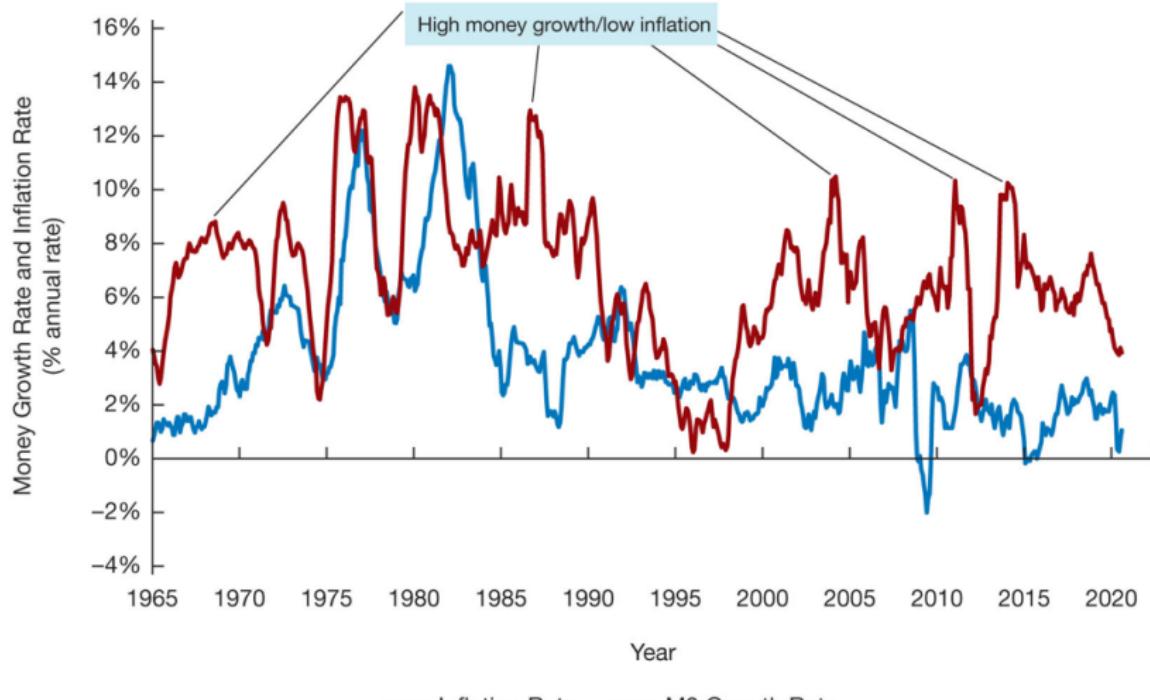
Data: Federal Reserve Bank of St. Louis <http://research.stlouisfed.org/fred2/>

M2SL – percentage change from a year ago, quarterly aggregation method average

GDPDEF – percentage change from a year ago

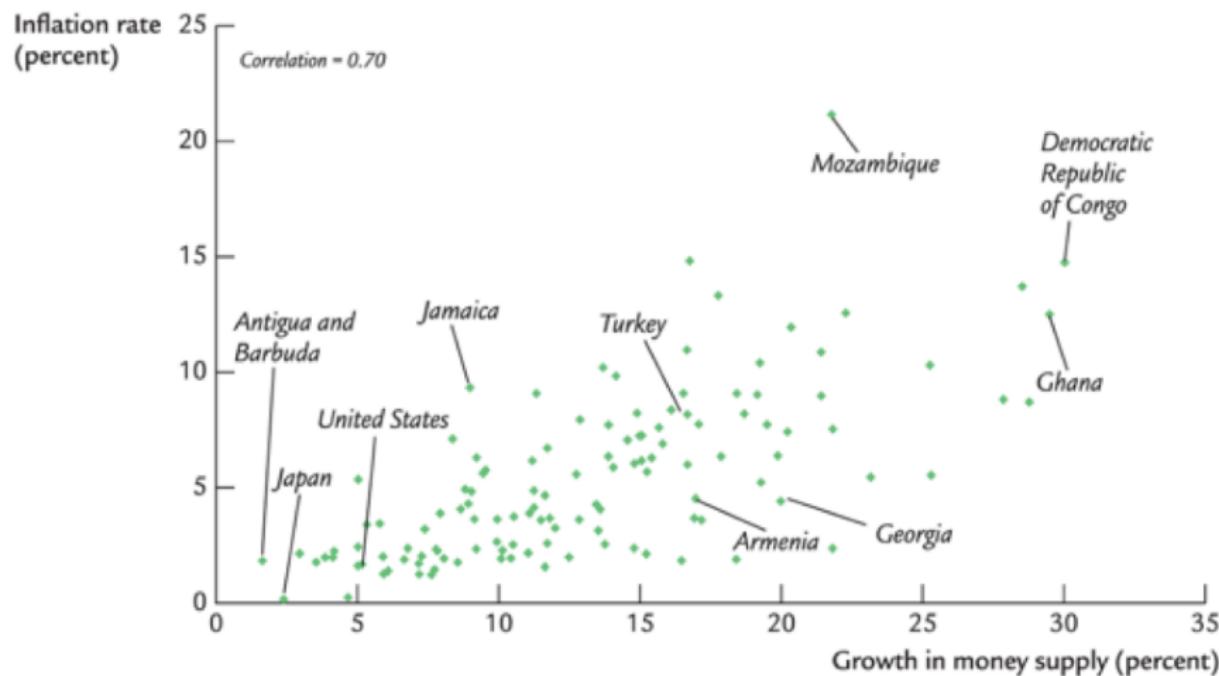
Source: Mankiw (2019) Macroeconomics. Worth

## Money Growth and Inflation – U.S. Evidence



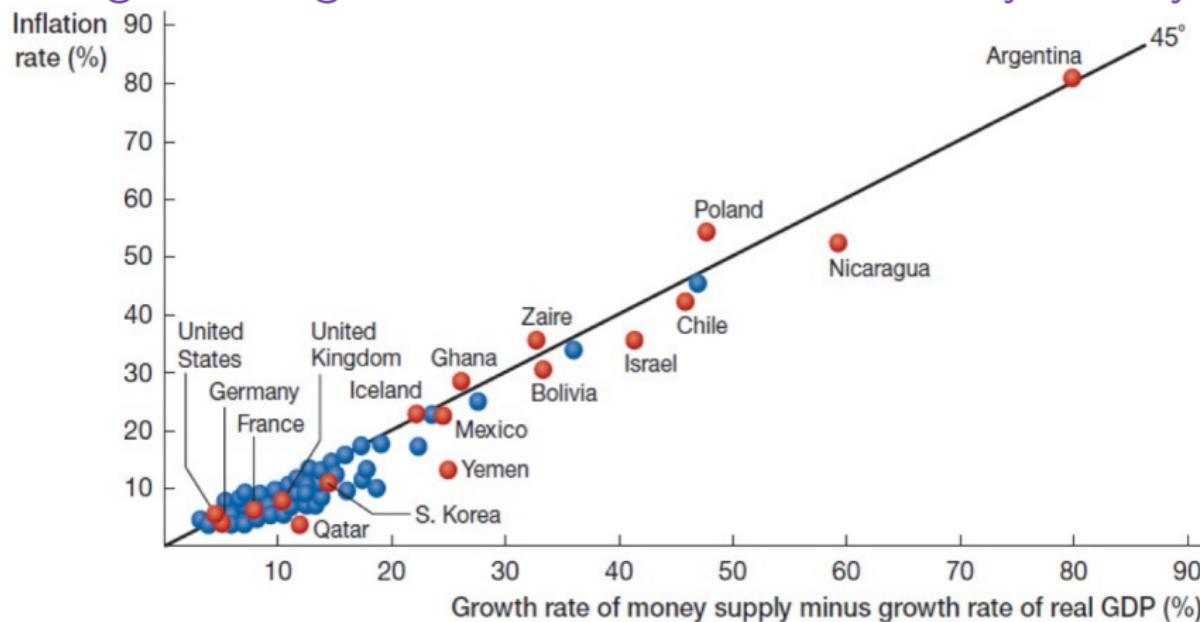
Source: Mishkin (2022).

## Money Growth and Inflation – International Evidence



Source: Mankiw (2019) Macroeconomics. Worth

# Testing the Long-Run Prediction of the Quantity Theory



What Causes Inflation? The quantity theory of money implies that inflation occurs when the growth rate of money supply exceeds the growth rate of real GDP. This relationship is illustrated by the inflation equation. The exhibit demonstrates the inflation equation by using data from 110 countries during the period 1960-1990.

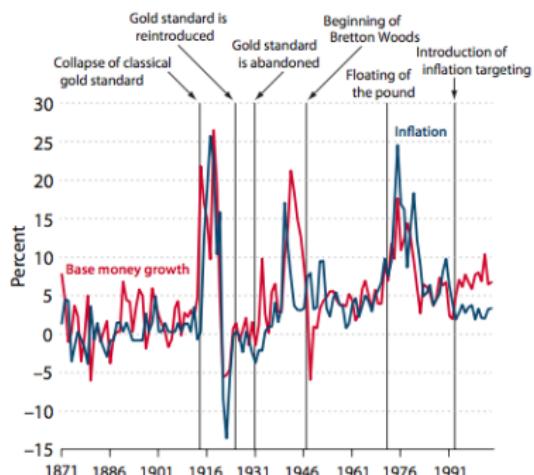
Source: Acemoglu, Laibson, and List (2022) CH11, Macroeconomics, 3e, Pearson

# Money Growth and Inflation – U.K. Evidence

## Inflation and Money Growth in the United Kingdom:

### Raw Data

Composite Index Price\* and M0 (annual rates of changes)



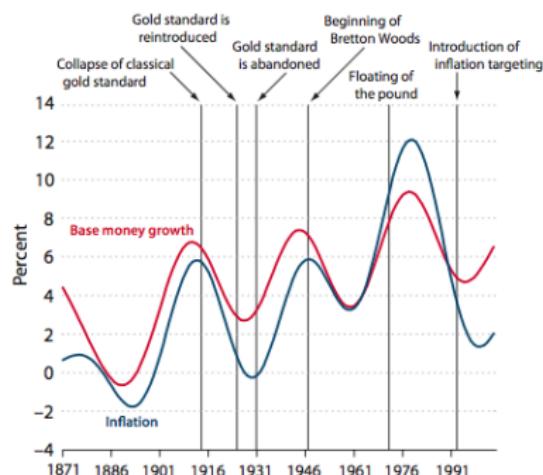
NOTE: \*See O'Donoghue, Goulding, and Allen (2004).

SOURCE: Reproduced from Benati (2005, Chart 1a) with permission from the Bank of England.

## Inflation and Money Growth in the United Kingdom:

### Components Beyond 30 Years

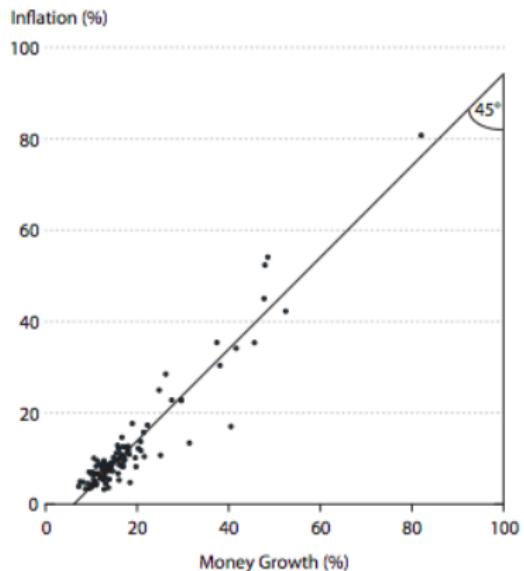
Composite Index Price and M0 (annual changes)



SOURCE: Reproduced from Benati (2005, Chart 2a) with permission from the Bank of England.

Source: Robert Lucas (2014)

# Money Growth and Inflation – International Evidence



NOTE: The figure shows average annual rates of growth in M2 and in consumer prices during 1960-90 in 110 countries.

SOURCE: Data source IMF. Reproduced with permission from McCandless and Weber (1995, Chart 1, p. 5).

Source: Robert Lucas (2014)

Sample	Coefficient for each definition of money		
	M0	M1	M2
All 110 countries	0.925	0.958	0.950
<i>Subsamples</i>			
21 OECD countries	0.894	0.940	0.958
14 Latin American countries	0.973	0.992	0.993

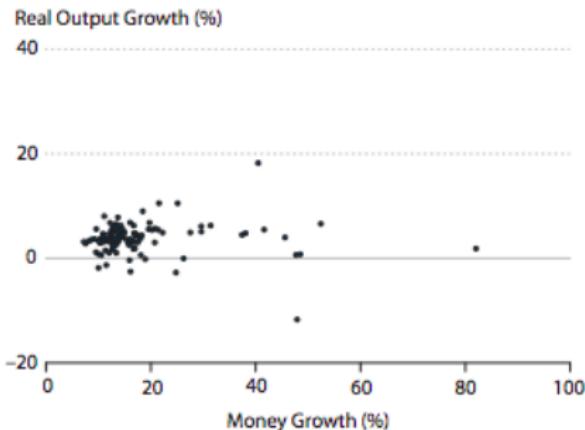
NOTE: Based on data from 1960-90. Inflation is defined as changes in a measure of consumer prices.

SOURCE: Data source IMF. Reproduced with permission from McCandless and Weber (1995, Table 1, p. 4).

# Money and Output Growth – International Evidence

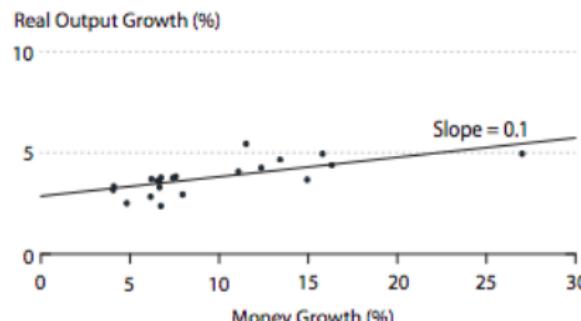
**Money and Real Output Growth: No Correlation in the Full Sample...**

**...But a Positive Correlation in the OECD Subsample**



NOTE: The figure shows average annual rates of growth in M2 and in nominal GDP, deflated by consumer prices during 1960-90 in 110 countries.

SOURCE: Data source IMF. Reproduced with permission from McCandless and Weber (1995, Chart 2, p. 7).



NOTE: The figure shows average annual rates of growth in M0 and in nominal GDP, deflated by consumer prices during 1960-90 in 21 countries.

SOURCE: Data source IMF. Reproduced with permission from McCandless and Weber (1995, Chart 3, p. 8).

Source: Robert Lucas (2014)

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