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How CBO Projects Inflation

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Abstract

The Congressional Budget Office projects consumer price inflation by making projections for individual types of goods and services and then aggregating them into forecasts for economywide consumer price inflation. Each projection accounts for variation across economic sectors in price sensitivity to cyclicality, persistence, and global and supply-side factors. For instance, many services are more sensitive to cyclical fluctuations than many goods, and many goods are more sensitive to supply-side factors than many services. The approach aims to flexibly incorporate shocks to prices of specific goods and services into CBO's macroeconomic forecast and to produce disaggregated forecasts of prices for use in the agency's budgetary analyses.

Keywords: inflation, projections

JEL Classification: E01, E17, E31, E37

Contents

Introduction

To project consumer price inflation, the Congressional Budget Office uses a disaggregated method that relies on nine personal consumption expenditure (PCE) price indexes and 10 price series from the consumer price index for all urban consumers (CPI-U). Several of those indexes are used in the agency's budgetary analyses. After each price series is projected, the forecasts are aggregated into the agency's projections for overall and core measures of the PCE price index and the CPI-U. Inflation projections for each price series depend mainly on three mechanisms:

- Cyclicality—how inflation reacts to changes in economic slack, which over the short run is driven mainly by fluctuations in aggregate demand;
- Persistence—how inflation evolves based on past price growth; and
- Global and supply-side factors—the relative prices of imported goods and supply-chain stress, for example.[1]

Those mechanisms capture fluctuations in demand and supply conditions across types of goods and services, the interactions of which ultimately set prices. The disaggregated approach to forecasting inflation thus allows for different responses to the factors driving inflation.

Cyclicality

Sensitivity to economic fluctuations varies across individual price indexes (Stock and Watson 2020). Inflation in some prices is highly sensitive to fluctuations in economic slack. Yet inflation in other price indexes is noncyclical, meaning inflation in those categories does not exhibit statistically significant positive correlation with economic slack.

Persistence

The persistence of price growth also varies across types of goods and services. For prices of some goods and services, past inflation is a strong indicator of future price growth. However, certain prices adjust faster than others (Bryan and Meyer 2010). For instance, gasoline prices lack persistence and are often updated daily, whereas rental contracts are typically updated annually. CBO's disaggregated approach accounts for differences in the persistence of price changes across categories of goods and services.

Global and Supply-Side Factors

Global and supply-side factors play a larger role in determining prices today than in the 1970s and 1980s, partly because of the large amount of international trade that takes place today. The

[1] In the short run, supply is relatively fixed in comparison with demand. In certain circumstances, such as the coronavirus pandemic, supply conditions fluctuate quickly and therefore factor into cyclicality and the extent of economic slack.

flow of tradable goods and the prices of imported goods heavily influence domestic goods prices in the United States. To capture how those factors affect domestic prices, many inflation models feature measures of supply-chain stress or relative import prices (Yellen 2017).[2] By contrast, many in-person services, such as restaurant meals, are much less sensitive than goods to global factors because the main costs for restaurants and other in-person services such as wages are determined mainly on the basis of local rather than global economies. Supply-chain disruptions likewise have a weaker impact on inflation for many services prices because the supply of services depends heavily on labor inputs which, unlike goods prices, are not directly affected by supply chains. Other supply factors, such as labor supply, have stronger influences on prices of services through their effects on aggregate demand and wages.

Related Literature

Research about inflation over the past 20 years has emphasized the importance of considering measures beyond economic slack (Atkeson and Ohanian 2001; Stock and Watson 2007, 2009; Dotsey, Fujita, and Stark 2018; Cecchetti and colleagues 2017; Hazell and colleagues 2022). That research advanced specifications from earlier work in which the unemployment rate was the main predictor of inflation (Phillips 1958). Those specifications, often referred to as Phillips curves, largely failed to accurately forecast inflation starting around 1990 (Arnold 2008). CBO has documented how sector-specific factors can affect demand and supply for individual goods and services (Chen 2019).

A related issue is that the relationship between economic slack and overall inflation can vary over time (Forbes, Gagnon, and Collins 2021; Benigno and Eggertsson 2023). That relationship may also shift because of changes in aggregate supply. In Demirel and Wilson (2023), the authors found evidence that the sensitivity of inflation to changes in demand varies with supply conditions and the amount of slack in the economy.

Organization of This Paper

In this paper, I will describe CBO's method for projecting inflation through several steps:

1. Define and examine measures of inflation in the United States.
2. Review aggregate information about core inflation that CBO examines and then explore individual price series.
3. Summarize the role of cyclicality, persistence, and global and supply-side factors in individual price series.
4. Describe CBO's disaggregated approach.
5. Briefly review CBO's most recent set of inflation projections from February 2024.

[2] CBO's approach to projecting inflation relies mainly on the relative price of core imported goods to capture widespread supply-side disruptions and relies on industry-level effects for sector-specific factors.

The CPI-U and PCE Price Indexes

CBO's approach to projecting inflation focuses on the two most commonly used measures: the CPI-U, from the Bureau of Labor Statistics (BLS), and the PCE price index, from the Bureau of Economic Analysis (BEA). CBO also generates projections of the CPI-W (the consumer price index for all urban wage earners) and the chained CPI-U. Appendix A summarizes how the agency projects those measures and discusses other price indexes.

The CPI-U and PCE price index have three main differences: weighting schemes, scope, and aggregation formulas. The measures also have methodological differences for calculating seasonal effects and sourcing data (McCully and colleagues 2007; Johnson 2017).

The largest portion of the difference between the CPI-U and the PCE price index is caused by their different weighting schemes. Weights in the PCE price index are determined monthly by surveys of businesses measuring what they sell to consumers. Weights in the CPI-U are determined annually by surveys of households measuring what they bought from businesses in the calendar year two years before the current year.[3] Components receive different amounts of weight in each index. For example, the index for other services receives a weight of 49 percent in the PCE price index and a weight of 27 percent in the CPI-U (see Table 1).[4]

[3] Before January 2023, CPI-U weights had been determined biennially using two years of expenditure data.

[4] Weights in the PCE price index are measured as the average nominal consumption shares of each category over the 1999–2019 period. Weights in the CPI-U are measured as the average relative importance of each category over that same period. Because of rounding, weights in this paper might not sum to one.

Table 1.

Percentage Weights Assigned to Components of the PCE Price Index and CPI-U

Individual price index	Percentage weight in PCE price index	Percentage weight in CPI-U
	Durable goods	
Total durable goods[a]	12	10
	Nondurable goods	
Energy nondurable goods	3	5
Food and beverages for at-home consumption	8	8
Food away from home	Part of other services	6
Alcoholic beverages	Part of food at home	1
Other nondurable goods	11	10
	Services	
Energy services	2	4
Shelter services	15	29
Other services	49	27

Data sources: Bureau of Economic Analysis and Bureau of Labor Statistics.

CPI-U = consumer price index for all urban consumers; PCE = price index for personal consumption expenditures.

a. The index for new and used motor vehicles and parts has a weight of 4 percent in the PCE price index and a weight of 6 percent in the CPI-U.

The second-largest contributing factor to the difference between the CPI-U and the PCE price index is their scope. Unlike the CPI-U, the PCE price index is meant to capture expenditures not only by consumers but also by other organizations such as employers and the government on behalf of households, such as for employer-sponsored health insurance and health care paid for by Medicare and Medicaid. That difference is particularly salient for the medical care subcomponent of the PCE price index for other services. Medical care and insurance premium costs in the PCE price index include portions of insurance premiums paid by employers as well as Medicare and Medicaid payments, whereas the medical care index in the CPI-U includes only out-of-pocket costs to consumers.[5] The PCE price index also contains several items excluded from the CPI-U, such as financial services, foreign travel by U.S. citizens, and consumption expenditures of services from nonprofit institutions.

The third-largest driver of the difference between the CPI-U and the PCE price index is their aggregation formulas. The PCE price index uses a method that involves chain-weighting, a

[5] In October 2023, to reduce volatility and the lag involved in incorporating health insurance financial data, the CPI-U began using a smoothed semiannual index rather than an unsmoothed annual index (Bureau of Labor Statistics 2023a).

technique that captures changes in consumption patterns. In effect, the PCE price index allows for substitutions between goods during the year as people move to buy different items when prices change (if the price of chicken increases, for example, people might buy pork instead). The CPI-U, by contrast, is constructed using a basket of goods that remains fixed during the year.

Finally, the PCE price index and the CPI-U differ for other, smaller reasons, such as seasonal adjustments, price measurement differences, and residual differences. Taken together, those other effects generally account for a smaller portion of the difference between the indexes than the reasons outlined above.

As a result of the weighting, scope, formula, and other effects, the CPI-U has grown faster than the PCE price index over the long run. CPI-U inflation has averaged 2.3 percent annually, whereas inflation in the PCE price index has averaged 2.0 percent annually. As a result, a "wedge" or "gap" exists between inflation in the CPI-U and PCE price index that averaged roughly 0.3 percent over the 1999–2019 period.

In addition to the overall PCE price index and the overall CPI-U, BEA and BLS both release core measures of consumer inflation. Core inflation measures are meant to capture the underlying trend in inflation by stripping out volatile components. Core measures of the PCE price index and the CPI-U exclude food and energy prices and are released alongside overall measures. Over time, core prices indexes grow at roughly the same rate as overall price indexes.

Using Analysis of Core Inflation as a First Step

To understand recent developments with economywide inflation, CBO starts by analyzing core inflation. That approach yields information about how factors such as cyclicality, persistence, and global and supply-side shocks are affecting total inflation and how those mechanisms might be affecting certain individual price series. The analysis uses the following equation:

$$\pi_t^{core\ PCE} = \alpha_0 \pi_t^e + \alpha_1 \pi_{t-1}^{adjusted\ core\ imported\ goods} + \beta(L)\pi_t^{core\ PCE} + \gamma(L) slack_t + \varepsilon_t \quad (1)$$

The term π_t^e is the inflation "anchor," which CBO now estimates to be 2 percent. The anchor represents the Federal Reserve's goal of 2 percent long-run inflation and is a proxy for long-run inflation expectations. In principle, the anchor could vary over time but in practice is held constant for historical periods and in CBO's projections. The term $\pi_{t-1}^{adjusted\ core\ imported\ goods}$ denotes a relative measure of price inflation in nonenergy goods imported into the United States at time $(t-1)$ that captures global factors. The term $\pi_t^{core\ PCE}$ denotes the annualized growth rate of the core PCE price index from quarter $(t-1)$ to quarter

t.[6] The term $slack_t$ denotes the unemployment gap at time t and represents economic slack.[7] Both $\beta(L)$ and $\gamma(L)$ are lag polynomials that account for the potential inclusion of multiple quarterly lags of core inflation and economic slack. For that equation, CBO uses a sample period that extends from the early 1990s to present. The sample's start date is selected based on when inflation began settling toward 2 percent in the 1990s.

The agency's current estimates suggest that although core inflation is not highly cyclical (core inflation does not respond much to measures of slack), it displays considerable persistence and sensitivity to global factors. The lack of significant cyclicality is consistent with other research findings discussed in the introduction. That effect could occur because, at the aggregate level, cyclicality can be hard to parse out because not all prices in the economy react the same way to changes in domestic production, labor markets, and other economic factors. In other words, cyclically sensitive components of overall inflation might respond to slack in ways that lead to findings of a muted response to slack in an aggregate analysis.

According to CBO's estimates using data from the 1990s to present, core price inflation is persistent—meaning that inflation is backward looking, in a sense, and that elevated inflation typically continues for a while. At the same time, inflation also appears to be partially anchored, meaning that inflation tends to return to the Federal Reserve's long-run goal of 2 percent.

Core prices also are sensitive to global factors, by CBO's estimation. However, not all components of core inflation are closely tied to global factors and international markets. For instance, the costs of restaurant meals and rents do not increase by much when imported goods prices increase.

Overview of CBO's Disaggregated Analysis

Motivated by cyclical sensitivity's variation across various price indexes, CBO uses a disaggregated inflation forecasting approach (Chen 2019) to projecting inflation with CBO's macroeconomic forecasting model (CMAC). Forecasting equations for individual price series offers two benefits. First, the technique allows incorporating sector-specific shocks and trends that affect particular goods and services. Second, it generates certain sectoral price series used for budgetary analysis. For example, CBO's projections of outlays for health care programs are based in part on projections of medical prices. The disaggregated approach creates projections

[6] Unless otherwise specified, inflation measures are in terms of quarterly percentage change at an annual rate.

[7] The unemployment gap measures how far away the unemployment rate is from the noncyclical rate of unemployment. CBO defines the noncyclical rate of unemployment as the rate of unemployment arising from all sources except fluctuations in aggregate demand.

for each of those price indexes, ensuring that individual price series align with the agency's projections of overall and core inflation.

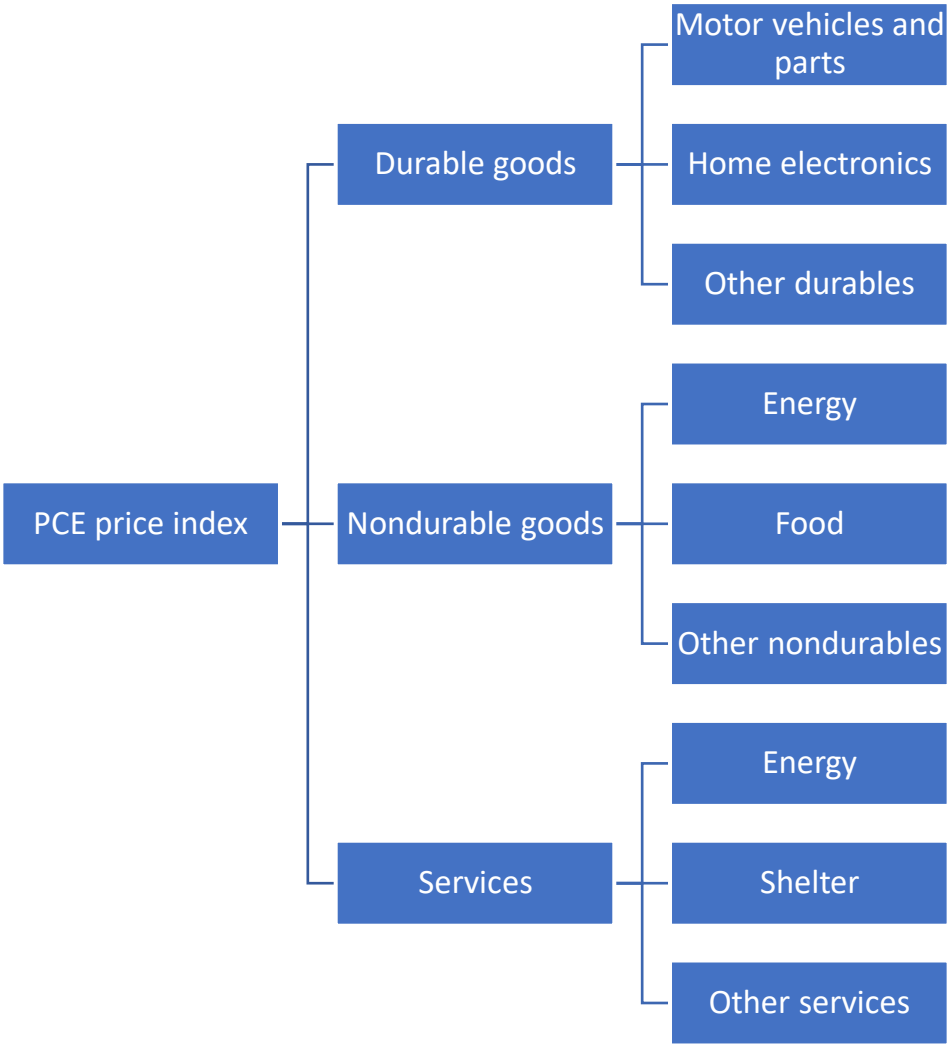
CBO projects individual price series in the three broad categories of durable goods, nondurable goods, and services. Both the PCE price index and the CPI-U include similar items in each category. For example, durable goods include items such as motor vehicles, furniture, and home electronics. Similarly, nondurable goods include items such as gasoline, grocery store items, and cosmetics. Services include items such as shelter services, utilities, medical care, and transportation services.[8]

For the PCE price index, CBO's forecasting approach involves generating separate projections for prices of home electronics, motor vehicles, other durable goods, food, energy goods, other nondurable goods, energy services, shelter services, and other services (see Figure 1). Identities in BEA's national income and product accounts are then used to calculate the durable goods, nondurable goods, and services subaggregates of the PCE price index.

[8] Shelter costs, or shelter services, are defined by BLS to capture the flow of housing services that housing units offer to their occupants. Shelter costs are a component of CPI-U and PCE inflation, whereas sales prices and valuation of housing units are not included in those measures.

Figure 1.

CBO's Breakdown of the PCE Price Index



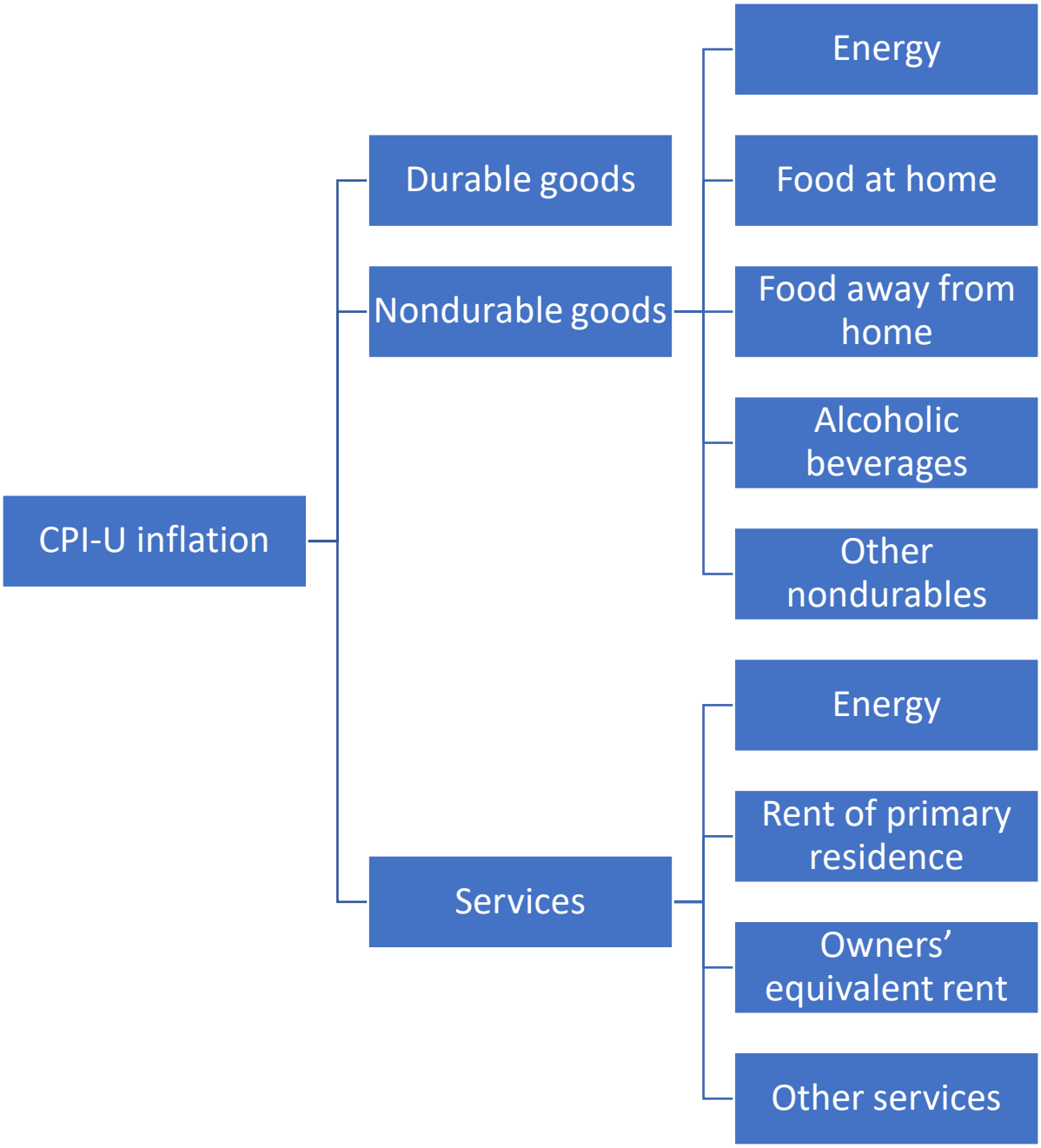
Data source: Congressional Budget Office.

PCE = price index for personal consumption expenditures.

The CPI-U receives a similar treatment. In CMAC, the CPI-U consists of 10 individual price indexes: durable goods, other nondurable goods, food at home, food away from home, alcoholic beverages, energy goods, energy services, rent of primary residence, owners' equivalent rent, and other services. CBO creates projections for each series, which are then aggregated into the forecast for the overall CPI-U. The disaggregation of the CPI-U differs from the disaggregation of the PCE price index, as shown in Figure 2.

Figure 2.

CBO's Breakdown of the CPI-U



Data source: Congressional Budget Office.

CPI-U = consumer price index for all urban consumers.

Each of the 9 PCE price series and 10 CPI-U price series is estimated separately with its own econometric specification. CBO's projections of core inflation are calculated by totaling a subset of the individual price indexes outlined above. Core PCE inflation excludes food, energy nondurable goods, and energy services. Core CPI-U inflation excludes food at home, food away from home, energy nondurable goods, and energy services. The first step for modeling each price series is to conduct regression analysis to examine the explanatory power of economic slack, past inflation, and global and supply-side factors (see Appendix B for details).[9]

Prices for services are generally more cyclically sensitive than goods prices, which implies that measures of economic slack such as the unemployment gap are a useful foundation with which to project inflation in service categories (see Table 2).

Inflation is persistent in most of the price series; however, energy prices and nondurable goods prices lack that property. For persistent inflation, CBO's modeling includes measures of past inflation in the category or sometimes uses past inflation in other categories.

Global and supply-side factors have become more important in projections of inflation when forecasting equations are estimated using data that include the 2020–2022 period. As a result, CBO more broadly incorporates measures related to global and supply-side conditions, including economic variables related to import price growth and sector-specific dummy variables that capture prices' sensitivity to supply-side disruptions during the pandemic. Each price index's relationship with cyclicality, persistence, and global supply-side factors plays a role in how CBO estimates an econometric equation for the series.

[9] Supply-side factors included in those exercises are the global supply-chain pressures index created by the Federal Reserve Bank of New York and CBO's own measure of the relative price of core imported goods. Both measures capture the effects of global trade on supply and thus prices.

Table 2.

Properties of Individual Price Indexes

Individual price index	Cyclical	Persistent	Sensitive to global and supply factors
PCE price index	X	✓	✓
Core PCE price index	X	✓	✓
Durable goods	X	✓	✓*
New and used motor vehicles and parts	X	✓	✓*
Home electronics	X	✓	Mixed evidence
Other durable goods	X	✓	✓*
Nondurable goods	X	X	✓
Energy nondurable goods	X	X	✓*
Food at home	✓*	✓	✓
Other nondurable goods	X	X	X
Services	✓	✓	✓
Energy services	✓*	X	✓
Food away from home (CPI-U measure)	✓**	✓	X
Shelter services	✓	✓	Mixed evidence
Medical services	X	✓	✓**
Other services (includes medical services)	X	✓	✓

Data sources: Bureau of Economic Analysis, Bureau of Labor Statistics, and Congressional Budget Office.

*Relationship has become significant since the 2020 pandemic. **Relationship has become less significant since the 2020 pandemic.

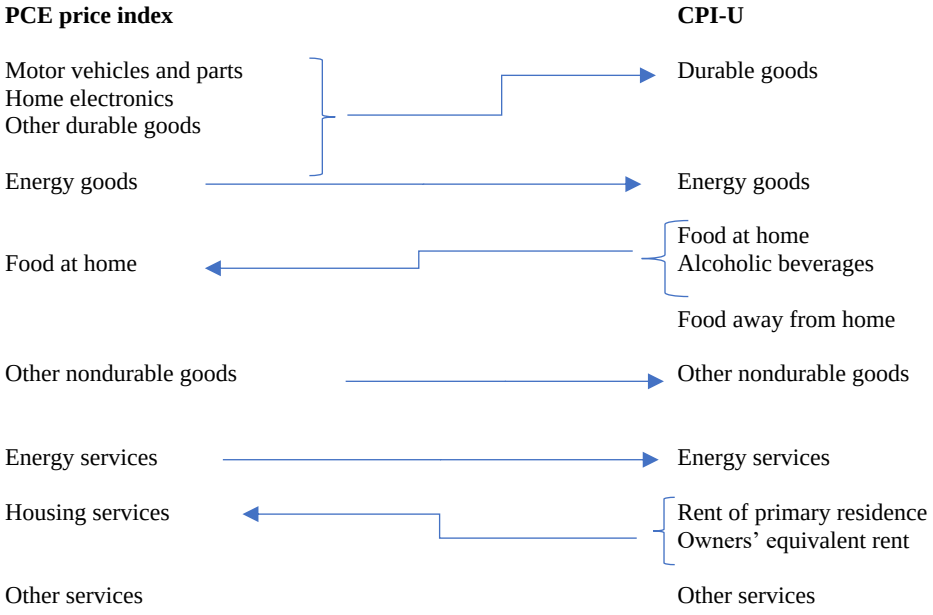
How CBO Conducts Disaggregated Analysis

CBO projects inflation in individual prices by creating a series of econometric equations that capture cyclicality, persistence, sensitivity to global and supply-side factors, and long-run trends across prices of goods and services. Each equation is tailored to the properties of the specific series, though many share a common foundation, such as the relationship with the output gap or persistence. Most equations are estimated over a period starting in the 1990s to present.

For consistency in inflation projections, and to align with BLS and BEA's own analytic method, components of the CPI-U and the PCE price index are linked throughout the forecast. Doing so ensures that the forecasts for CPI-U inflation and PCE inflation move in sync with each other because projections in one index have downstream effects on the other. Also, some measures calculated by BEA depend on data collected by BLS. Thus, forecasting the CPI-U components and then aggregating them into projections of PCE inflation is consistent with how the original series are constructed. For example, BEA's calculation of shelter services relies on BLS's calculations of rent and owners' equivalent rent inflation, and CBO's method similarly uses the two BLS measures of shelter costs to project the BEA measure. Figure 3 highlights the flow between projections of PCE price indexes and the CPI-U in CMAC.

Figure 3.

Linkage Between Price Indexes in CMAC



Data source: Congressional Budget Office.

CMAC = CBO's macroeconomic forecasting model; CPI-U = consumer price index for all urban consumers; PCE = price index for personal consumption expenditures.

The estimation order is based on the downstream effects of each price series on other prices in the economy. Energy nondurable goods, such as gasoline, come first because they are not strongly influenced by other consumer prices. However, because they influence transportation and shipping costs, gasoline prices do have large downstream effects on other prices. Conversely, other service prices come last because consumer prices in other categories are not highly influenced by non–housing services costs. (For details about the order, see Appendix C.) In updating its forecast, CBO estimates the econometric equations for each price series by using refreshed data, updated inputs from other sectors in CMAC, and judgmental adjustments based on historical residuals and high-frequency information.

Overview of How CBO Projects PCE Inflation

The PCE price index is estimated using a system of nine equations. The overall PCE price index is the weighted average of the following components:

1. Energy goods
2. Energy services
3. Food and beverages at home
4. New and used motor vehicles and parts
5. Home electronics
6. Other durable goods
7. Other nondurable goods
8. Shelter services
9. Other services

To merge the nine forecast components into projections of overall and core PCE, CBO uses a Fisher aggregation formula, similar to the one used by BEA. For the overall PCE price index, the aggregation scheme uses the following equation:

$$\pi_t^{PCE} = \alpha_{1,t}\pi_t^{energy\ goods} + \alpha_{2,t}\pi_t^{energy\ services} + \alpha_{3,t}\pi_t^{food} + \alpha_{4,t}\pi_t^{motor\ vehicles} + \alpha_{5,t}\pi_t^{electronics} + \alpha_{6,t}\pi_t^{other\ durables} + \alpha_{7,t}\pi_t^{other\ nondurables} + \alpha_{8,t}\pi_t^{shelter\ services} + \alpha_{9,t}\pi_t^{other\ services} + \varepsilon_t \quad (2)$$

where the α coefficients represent time-varying consumption shares for each component of inflation. The error term, ε_t, accounts for the fact that the equation is an approximation.

The core PCE aggregation scheme follows a similar pattern but excludes food and energy prices and includes only the six core inflation components from the CBO forecast. The core PCE price index is a weighted average of the following components:

1. New and used motor vehicles and parts
2. Home electronics
3. Other durable goods
4. Other nondurable goods
5. Shelter services
6. Other services

CBO uses a Fisher aggregation formula to merge that set of six projections into the forecast for core PCE inflation. The aggregation scheme is represented by the following equation:

$$\pi_t^{core\ PCE} = \delta_{1,t}\pi_t^{motor\ vehicles} + \delta_{2,t}\pi_t^{electronics} + \delta_{3,t}\pi_t^{other\ durables} + \delta_{4,t}\pi_t^{other\ nondurables} + \delta_{5,t}\pi_t^{shelter\ services} + \delta_{6,t}\pi_t^{other\ services} + \varepsilon_t \quad (3)$$

where the δ coefficients represent time-varying core consumption shares for each component of core inflation. Table 3 details the nine econometric equations used to estimate each of the nine price indexes and each component's average PCE share from 1999 to 2019. Each equation is discussed in the following sections.

Table 3.

Equations for Components of the PCE Price Index

Individual price index (percentage of PCE)	Equation
	Durable goods
New and used motor vehicles and parts (4)	$\pi_t^{motor\ vehicles} = \alpha_0 + \alpha_1\pi_{t-1}^{motor\ vehicles} + \alpha_2 NAFTA_t + \alpha_3 growth\ in\ imported\ goods\ prices_t + \alpha_4\pi_{t-1}^{energy\ goods} + \alpha_5 great\ recesssion_t + \alpha_6(slack_t \times covid_t) + \varepsilon_t$
Home electronics (2)	$\pi_t^{electronics} = \alpha_0 + \alpha_1\pi_{t-1}^{electronics} + \alpha_2\pi_{t-2}^{electronics} + \alpha_3 Growth\ of\ PPI_{t-1}^{computers} + \alpha_4 exchange\ rate\ growth_t + \varepsilon_t$
Other durable goods (6)	$\pi_t^{other\ durables} = \alpha_1 exchange\ rate\ growth_t + \alpha_2 House\ Price\ Growth_{t-5} + \gamma_1\pi_{t-1}^{other\ durables} + \gamma_2\pi_{t-3}^{other\ durables} + \delta_2(slack_t \times fiscal\ relief_t) + \varepsilon_t$
	Nondurable goods
Energy goods (3)	$\pi_t^{energy\ goods} = \alpha_1\pi_t^{oil} + \alpha_2\pi_t^{petroleum\ imports} + \varepsilon_t$
Food and beverages at home (8)	$\pi_t^{PCE\ food} = \alpha_1\pi_{t-1}^{PCE\ food} + \alpha_2\pi_t^{CPIU\ food\ at\ home} + \alpha_3\pi_t^{CPIU\ beverages} + \varepsilon_t$
Other nondurable goods (11)	$\pi_t^{other\ nondurables} = \alpha_0 + \alpha_1\pi_{t-1}^{other\ nondurables} + \alpha_2\pi_{t-4}^{other\ nondurables} + \alpha_4 tobacco\ tax_t + \varepsilon_t$
	Services
Energy services (2)	$\pi_t^{energy\ services} = \alpha_0 + \alpha_1\pi_t^{core} + \alpha_2\pi_t^{natural\ gas} + \sum_{j=1}^{4}\pi_{t-j}^{energy\ goods} + \varepsilon_t$
Shelter services (15)	$\pi_t^{PCE\ shelter\ services} = \alpha_1\pi_t^{CPIU\ resrent} + \alpha_2\pi_t^{CPIU\ OER} + \varepsilon_t$
Other services (49)	$\pi_t^{other\ services} = \alpha_0 + \alpha_1\pi_t^{medical\ services} + \alpha_2\pi_t^{other\ services\ less\ medical\ services} + \varepsilon_t$

Data sources: Bureau of Economic Analysis and Congressional Budget Office.

"NAFTA," "fiscal stimulus," and "tobacco tax" are dummy variables that indicate when certain policies were enacted. "Great recession" is a dummy variable meant to capture changes in consumer demand during the great recession. "Covid" is a dummy variable that reflects structural changes in demand and supply-side factors that began at the onset of the Covid-19 pandemic. Other variables such as "PPI computers," "petroleum imports," and "House Price Growth" are nonconsumer prices from CMAC. "Exchange rate growth" is a nominal measure of import-weighted exchange rate growth.

CMAC = CBO's macroeconomic forecasting model; PCE = price index for personal consumption expenditures.

Overview of How CBO Projects CPI-U Inflation

The CPI-U is projected using a system of 10 equations. The overall CPI-U is a weighted average of the following price categories:

1. Energy goods
2. Energy services
3. Food at home
4. Food away from home
5. Durable goods
6. Alcoholic beverages
7. Other nondurable goods
8. Rent of primary residence
9. Owners' equivalent rent
10. Other services

To aggregate those indexes, CBO follows the Laspeyres formulation used by BLS. The equation for calculating overall CPI-U in terms of the price level P_t is[10]

$$P_t^{CPIU} = \gamma_1 P_t^{energy\ goods} + \gamma_2 P_t^{energy\ services} + \gamma_3 P_t^{food\ at\ home} + \gamma_4 P_t^{food\ away\ from\ home} + \gamma_5 P_t^{durable\ goods} + \gamma_6 P_t^{alc.beverages} + \gamma_7 P_t^{other\ nondurable\ goods} + \gamma_8 P_t^{rent\ of\ primary\ residence} + \gamma_9 P_t^{OER} + \gamma_{10} P_t^{other\ services} + \varepsilon_t \quad (4)$$

where the γ coefficients are time-constant, quantity-adjusted weights for each component of inflation. Unlike CBO's projections for PCE inflation, which rely on the forecasts of consumption shares from CMAC, the CPI-U forecast relies on the most recently available CPI-U weights from BLS. Those weights are extended and used in CBO's calculations of overall and core CPI-U.

The core CPI-U equation is similar but includes only six individual price series from the CBO forecast. Thus, core CPI-U is a weighted average of the following categories:

1. Durable goods
2. Alcoholic beverages
3. Other nondurable goods
4. Rent of primary residence
5. Owners' equivalent rent
6. Other services

[10] Price level P_t and inflation rate π_t have the following relationship: $\pi_t = \frac{P_t}{P_{t-1}} - 1$.

The Laspeyres aggregation method also is used for core CPI-U and takes the following form:

$$P_t^{core\ CPIU} = \omega_1 P_t^{durable\ goods} + \omega_2 P_t^{alc.beverages} + \omega_3 P_t^{other\ nondurable\ goods} + \omega_4 P_t^{rent\ of\ primary\ residence} + \omega_5 P_t^{OER} + \omega_6 P_t^{other\ services} + \varepsilon_t \quad (5)$$

In that equation, the ω coefficients represent time-constant, quantity-adjusted core weights for each core component of CPI-U inflation. Table 4 outlines the equations used to project each component of CPI-U inflation in CBO's analyses. The indexes for energy goods, energy services, and other nondurable goods are based on projections for those categories in the PCE price index.

Table 4.

Equations for Components of the CPI-U

Individual price index (percentage of CPI-U)	Equation
	Durable goods
Durable goods (10)	$\pi_t^{durable\ goods} = \alpha_1\pi_t^{PCE\ motor\ vehicles} + \alpha_2\pi_t^{PCE\ electronics} + \alpha_3\pi_t^{PCE\ other\ durables} + \varepsilon_t$
	Nondurable goods
Energy goods (5)	$\pi_t^{CPIU\ energy\ goods} = \alpha_1\pi_t^{PCE\ energy\ goods} + \varepsilon_t$
Food and beverages at home (8)	$\pi_t^{food\ at\ home} = \sum_{i=1}^{2}\alpha_i slack_{t-i} + \alpha_2\pi_{t-1}^{food\ at\ home} + \sum_{i=1}^{2}\beta_i\pi_{t-i}^{energy\ goods} + \varepsilon_t$
Food away from home (6)	$\pi_t^{food\ away\ from\ home} = \beta_0 + \sum_{i=0}^{2}\alpha_i slack_{t-i} + \alpha_3\pi_{t-1}^{food\ away\ from\ home} + \alpha_4\pi_{t-2}^{food\ away\ from\ home} + \alpha_5 wage\ growth_{t-1} + \varepsilon_t$
Alcoholic beverages (1)	$\pi_t^{alc.beverages} = \alpha_0\pi_t^{food\ at\ home} + \alpha_1\pi_t^{food\ away\ from\ home} + \sum_{i=2}^{3}\alpha_i slack_{t-i} + \varepsilon_t$
Other nondurable goods (10)	$\pi_t^{CPIU\ other\ nondurables} = \alpha_1\pi_t^{PCE\ other\ nondurables} + \varepsilon_t$
	Services
Energy services (4)	$\pi_t^{CPIU\ energy\ services} = \alpha_1\pi_t^{PCE\ energy\ services} + \varepsilon_t$
Rent of primary residence (7)	$\pi_t^{rent} = \alpha_0 + \alpha_1\pi_{t-1}^{rent} + \alpha_2\pi_{t-2}^{rent} + \alpha_3 slack_{t-1} + \alpha_4 House\ Price\ Growth_{t-5} + \varepsilon_t$
Owners' equivalent rent (23)	$\pi_t^{OER} = \alpha_1\pi_{t-1}^{OER} + \alpha_2\pi_t^{rent} + \alpha_3\pi_{t-1}^{rent} + \varepsilon_t$
Other services (27)	$\pi_t^{other\ services} = \alpha_0 + \sum_{i=1}^{3}\alpha_i slack_{t-i} + \sum_{j=1}^{2}\beta_j\pi_{t-j}^{other\ services} + \gamma\pi_t^{CPIU\ medical\ services} + \varepsilon_t$

Data sources: Bureau of Economic Analysis and Congressional Budget Office.

"Wage growth" is a measure of ECI wage growth included in CMAC. "House Price Growth" is a nonconsumer price present in CMAC.

CMAC = CBO's macroeconomic forecasting model; CPI-U = consumer price index for all urban consumers; ECI = employment cost index.

How CBO Projects PCE Inflation

CBO's forecasts for PCE inflation and core PCE inflation are derived from the individual price indexes (see Equations 2 and 3). The following sections outline the projections for each PCE price series used in the aggregate projections.

Energy Prices. CBO creates projections of two energy price series: nondurable energy goods (or simply energy goods) and energy services. The energy goods category consists mainly of gasoline along with other fuels, lubricants, and other fluids used mostly for motor vehicles. The energy services category includes household utilities such as electricity and piped natural gas. Prices of energy goods and energy services are volatile, reflecting changes in demand, trade conditions, private investment, and negotiations between suppliers.

The equation for each energy price series differs with respect to cyclicality, persistence, and sensitivity to global and supply-side factors. In general, energy prices exhibit noncyclical behavior, lack persistence owing to their high volatility, and are sensitive to global and supply-side factors (see Table 2). Specifically, energy goods prices are not sensitive to economic slack in the United States or recent inflation but do respond to changes in global and supply-side factors. As a result, CBO's forecast for the price of energy goods relies on domestic oil prices and imported petroleum prices rather than measures of economic slack:

$$\pi_t^{energy\ goods} = \alpha_1 \pi_t^{oil} + \alpha_2 \pi_t^{petroleum\ imports} + \varepsilon_t$$

For that equation, $R^2 = 0.71$; Durbin–Watson = 2.26.

Because gasoline is a large component of the energy goods category and crude oil is a key input in gasoline production, domestic oil prices and imported petroleum prices are important factors for forecasting energy goods prices. Given the rapidly evolving nature of conditions in the energy market, CBO's projections for domestic oil prices and imported petroleum prices rely on oil futures prices from financial markets to forecast near-term prices (Gecan 2020). Over the longer run, CBO's projections for those prices depend on expectations of future oil prices and overall consumer price inflation.

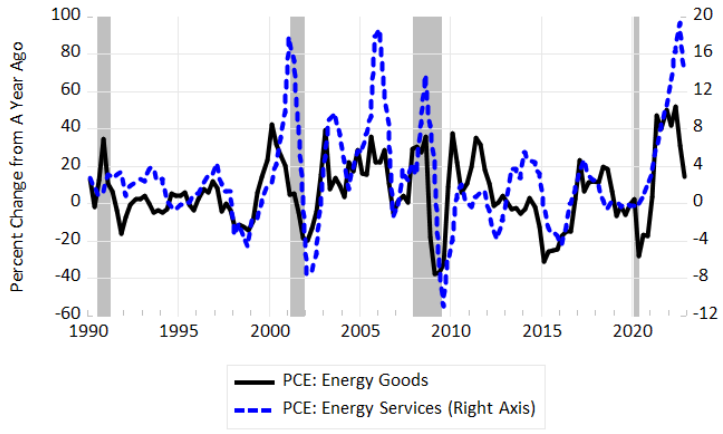
Unlike energy goods prices, energy services prices display some cyclicality—meaning they are sensitive to the degree of slack in the economy (see Table 2). CBO's projections for energy services prices thus depend on core inflation, which in turn accounts for the effects of economic slack.

In addition, CBO's projections for energy services prices depend on natural gas prices and energy goods prices. Energy goods prices serve as an input for energy services price projections for two main reasons: Transportation costs directly affect energy services prices, and oil supply

shocks often affect both markets simultaneously. Figure 4 shows that the two series tend to surge and decline over similar intervals.

Figure 4.

Inflation in Prices for Energy Goods and Services



Data source: Bureau of Economic Analysis.

PCE = price index for personal consumption expenditures.

In this equation, energy services inflation depends on core inflation, CBO's own forecast of natural gas prices, and energy goods prices:

$$\pi_t^{energy\ services} = \alpha_0 + \alpha_1 \pi_t^{core} + \alpha_2 \pi_t^{natural\ gas} + \sum_{j=1}^{4} \pi_{t-j}^{energy\ goods} + \varepsilon_t$$

For that equation, R^2 = 0.59; Durbin–Watson = 1.85.

The agency's analytic method for projecting natural gas prices mirrors that of its oil price projections. In the short run, CBO's projections for natural gas prices rely on regularly updated information on natural gas futures prices. Over the longer run, those projections are based on expectations of future natural gas prices and consumer price inflation. Energy goods prices also play a crucial role in shaping energy services price projections for two reasons. First, transportation costs directly affect energy services prices. Second, supply shocks, such as the 2022 invasion of Ukraine, often affect both the energy goods and energy services markets simultaneously. As a result, fluctuations in energy goods prices can have a cascading effect on energy services prices.

Food Prices. CBO projects one PCE price index for food—the price index for food and beverages for off-premises consumption (food at home). The PCE food at home category comprises various grocery store food items, including cereals, meats, fish and seafood, dairy products, sweets, fruits, and vegetables, as well as alcoholic and nonalcoholic beverages for off-premises consumption. CBO uses two CPI-U series—food at home and alcoholic beverages—to project the PCE price index for food at home.

The PCE food at home category exhibits cyclical behavior, displays persistence, and is sensitive to global and supply-side conditions—that is, grocery inflation is affected by the degree of slack, recent inflation, and global and supply factors such as energy prices, the exchange value of the dollar, and conditions for growing food. The equation for the PCE food at home category captures those characteristics through its dependency on past values of the index as well as two CPI-U categories—food at home and alcoholic beverages:

$$\pi_t^{PCE\ food\ at\ home} = \alpha_1 \pi_{t-1}^{PCE\ food\ at\ home} + \alpha_2 \pi_t^{CPIU\ food\ at\ home} + \alpha_3 \pi_t^{CPIU\ alc.beverages} + \varepsilon_t$$

For that equation, $R^2 = 0.99$; Durbin–Watson = 1.66.

Both CPI-U series in that equation have their own econometric equations with cyclical components; the equation for the CPI-U index for food at home also includes terms to capture persistence and sensitivity to global and supply-side factors (discussed below). CBO's forecasts for food and energy inflation are not included in the agency's equations used to project core inflation. However, those forecasts have downstream effects on other price series' projections because changes in food and energy prices influence production costs and consumer behavior, leading to potential ripple effects on core prices.

Shelter Prices. In CBO's projections, the shelter services category includes two main components: rent of primary residence and owners' equivalent rent (OER). OER is an imputed rent measure calculated by BLS that corresponds to the value of the service a home gives its owner by offering shelter. CBO generates projections for two CPI-U shelter service indexes: rent and OER. Those two indexes are then used to generate a projection of the PCE price index for shelter services. The approach aligns with the BLS and BEA method because BEA relies on the BLS measures. CBO's methods for projecting the CPI-U measures are discussed below.

The PCE price index for shelter services exhibits highly cyclical behavior, strong persistence, and weak sensitivity to global and supply-side factors (see Table 2). Those characteristics are represented in the equations CBO uses to project rent and OER inflation in the CPI-U. The agency projects inflation in the PCE price index for shelter services by using the two CPI-U series:

$$\pi_t^{housing} = \alpha_1 \pi_t^{CPIU\ resrent} + \alpha_2 \pi_t^{CPIU\ OER} + \varepsilon_t$$

For that equation, R^2 = 1.00; Durbin–Watson = 0.30.

Inflation in shelter services costs has generally been higher than overall inflation in the economy. That difference contributes significantly to the 0.3 percentage-point wedge between overall inflation in the PCE price index and the CPI-U because shelter services are higher weighted in the CPI-U than in the PCE price index. Because of the lower-frequency sampling BLS uses to construct the underlying rent and OER indexes, shelter services inflation responds with a lag to changes in the business cycle (Bureau of Labor Statistics 2023b).

Core Services Prices Less Shelter Prices. The category of core services less shelter—also known as "other services"—makes up 49 percent of the PCE price index and 27 percent of the CPI-U. Because that category makes up such a large share of the PCE price index, it tends to be highly correlated with core PCE inflation. The category is characterized by being highly cyclical, persistent, and sensitive to global and supply-side pressures.

To project the PCE other services price index, CBO relies on forecasts of other services less medical services inflation and medical services inflation. CBO's projections for other services less medical services inflation depend on several components: past inflation in that category to reflect persistence, past economic slack to account for cyclicality, and a measure of core imported goods inflation to capture global and supply-side pressures:

$$\pi_t^{other\ services\ less\ medical\ services} = \alpha_0 + \alpha_1 \pi_{t-1}^{adjusted\ core\ imported\ goods} + \beta(L)\pi_t^{other\ services\ less\ medical\ services} + \gamma(L) slack_t + \varepsilon_t$$

For that equation, R^2 = 0.70; Durbin–Watson = 1.73.

The forecast for medical services prices depends on projections of producer prices indexes for physician, inpatient, and outpatient services. Projections for those producer prices are calculated using Medicare payment rates as projected by CBO's analysts. The equation below is used in CBO's projections of core services less shelter to combine the forecast for medical services inflation and the forecast for other services less medical services inflation:

$$\pi_t^{other\ services} = \alpha_0 + \alpha_1 \pi_t^{medical\ services} + \alpha_2 \pi_t^{other\ services\ less\ medical\ services} + \varepsilon_t$$

For that equation, R^2 = 1.00; Durbin–Watson = 2.62.

Core Goods Prices. CBO projects four core PCE goods price indexes; those projections include measures of prices for three categories of durable goods—new and used motor vehicles and parts (henceforth motor vehicles), home electronics, and other durable goods. The category of other durable goods includes furnishings and household equipment, recreational books, musical instruments, sporting equipment, recreational vehicles, and other durables. The furnishings and household equipment category accounts for about half of the other durable goods measure.

One measure of core nondurable goods—nonfood, nonenergy nondurable goods (henceforth, other nondurable goods)—also is included in the agency's projections. That category includes apparel and footwear; pharmaceutical products; nondurable recreation supplies; nondurable household goods; tobacco products; magazines, newspapers, and stationery; and personal care products.

Goods are generally more tradable because they can be shipped and manufactured internationally. Goods price inflation has a weaker relationship with domestic economic conditions than services and is more closely tied to international factors such as the exchange value of the dollar (which in turn affects import prices). International factors thus have a greater influence on the prices of most types of goods than does labor market slack in the United States. Therefore, goods categories are usually noncyclical and are sensitive to supply-side factors such as international trade conditions (see Table 2). Goods prices also tend to be less persistent than services prices: Goods prices can adjust more rapidly to changes in market conditions because their production is less reliant on labor than services.

Motor Vehicles. The PCE price index for motor vehicles is not highly cyclical, displays some persistence, and is sensitive to supply-side factors. Before 2020, that index was not highly sensitive to supply-side factors (see Table 2). However, after the surge of inflation in that category in 2021, car prices have become a notable example of the pandemic's downstream effects on supply chains and prices. The pandemic significantly strained global supply chains as factories struggled to produce enough semiconductors for new vehicles. The shortage of semiconductor chips affected production of electronic components used in vehicles, delaying and reducing output. As a result, the supply of motor vehicles could not meet the surge in demand, particularly for used cars and trucks. The combination of supply chain disruptions and increased demand caused prices for motor vehicles to surge during the pandemic.

The experience with surging motor vehicle prices as the United States emerged from the pandemic highlights how supply-side factors can substantially affect goods prices, even for categories normally not especially sensitive to typical changes in supply. That behavior underscores the importance of considering supply-side factors in projecting inflation, especially for goods categories that can be affected by global supply chains and market conditions. The econometric equation that CBO uses for motor vehicle inflation includes those supply-side factors, along with international trade conditions, inflation expectations, past inflation in the category, and changes in consumer spending patterns after the pandemic and other key economic events:

$$\pi_t^{motor\ vehicles} = \alpha_0 + \alpha_1 \pi_{t-1}^{motor\ vehicles} + \alpha_2 NAFTA_t + \alpha_3 growth\ in\ imported\ goods\ prices_t + \alpha_4 \pi_{t-1}^{energy\ goods} + \alpha_5 great\ recession_t + \alpha_6 (slack_t \times covid_t) + \varepsilon_t$$

For that equation, R^2 = 0.43; Durbin–Watson = 2.15.

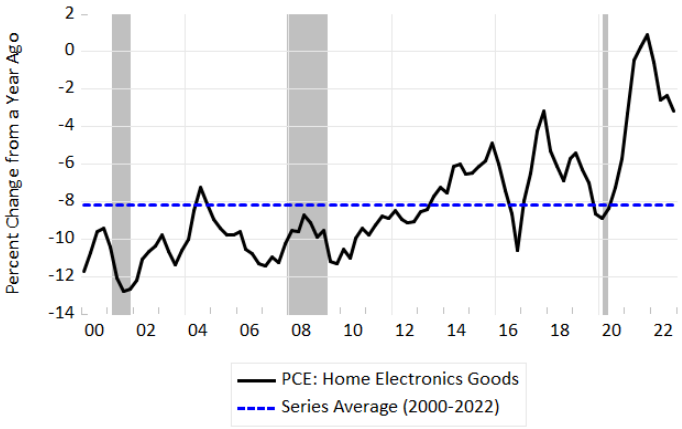
The equation for inflation in the index for motor vehicles includes several dummy variables that capture the effects of policies and economic crises on the supply of motor vehicles. The "NAFTA" dummy variable is set equal to one after 1995; it denotes the enactment of the North American Free Trade Agreement and captures the legislation's effects on motor vehicle prices. The "great recession" dummy variable is equal to one over the 2009–2015 period; it denotes the years of the financial crisis and recovery. Both variables mark periods during which price growth patterns shifted.

The last dummy variable, "covid," is set equal to one from 2020 to the end of the forecast period. The variable reflects the change in the elasticity of supply of motor vehicles that occurred after the 2020 pandemic. The covid dummy variable is interacted with a measure of slack, capturing a shift in the relationship between supply, demand, and prices in the market for motor vehicles that occurred during the pandemic and continued even as the economy recovered.

Home Electronics. The PCE price index for home electronics is not cyclical, persistent, or highly sensitive to global or supply-side pressures. Inflation in the PCE price index for home electronics has been negative over a long period (see Figure 5).

Figure 5.

Inflation in Prices for Home Electronics



Data source: Bureau of Economic Analysis.

PCE = price index for personal consumption expenditures.

Technological advancements have led to cheaper, more efficient, and sophisticated electronic devices, leading to lower prices for consumers. Furthermore, arbitrage opportunities arising from

global trade have caused those prices to decline over time. Home electronics can be produced and manufactured in various locations worldwide, allowing consumers and businesses to take advantage of price disparities in different markets. As a result, productivity gains in the global marketplace have contributed to the decline in home electronics prices over time.

Home electronics prices are hard to forecast because they are not cyclical, are not sensitive to global and supply-side pressures, and generally decline over time. CBO's forecast depends on past inflation in the category, investment of private firms in computers, and nominal import-weighted exchange rates:

$$\pi_t^{electronics} = \alpha_0 + \alpha_1 \pi_{t-1}^{electronics} + \alpha_2 \pi_{t-2}^{electronics} + \alpha_3 Growth\ of\ PPI_{t-1}^{computers} + \alpha_4 exchange\ rate\ growth_t + \varepsilon_t$$

For that equation, $R^2 = 0.44$; Durbin–Watson = 1.69.

The variable for growth of the producer price index for private investment in computers helps capture general trends in electronics prices because nonresidential investment decisions indicate overall demand and production conditions in the industry. Finally, nominal import-weighted exchange rates are included because they can influence the tradability of home electronics. Fluctuations in exchange rates affect the cost of imported electronics in dollars and thus prices in the domestic market.

Other Durable Goods. The final durable goods category in the PCE price index, other durable goods, is cyclical, persistent, and displays some sensitivity to global and supply-side factors. The large share of home furnishings in the category makes it more cyclical than the indexes for home electronics and motor vehicles because home prices, and demand for home purchases, tend to be highly cyclical. When demand for homes increases, increased demand for home furnishings will follow and put upward pressure on prices in the other durable goods category. Therefore, the econometric equation for other durable goods depends on past values of the index, past values of house price growth, international exchange rates, and fiscal relief to consumers:

$$\pi_t^{other\ durables} = \alpha_1 exchange\ rate\ growth_t + \alpha_2 House\ Price\ Growth_{t-5} + \gamma_1 \pi_{t-1}^{other\ durables} + \gamma_2 \pi_{t-3}^{other\ durables} + \delta_2 (slack_t \times fiscal\ relief_t) + \varepsilon_t$$

For that equation, $R^2 = 0.62$; Durbin–Watson = 1.79.

The "fiscal relief" variable included in the equation is a dummy variable set equal to one during the quarters consumers received direct fiscal aid during the pandemic (the third quarter of 2020, the first quarter of 2021, and the second quarter of 2021).

The inclusion of house price growth in the equation accounts for the connection between home furnishings and home purchases.[11] To account for variations in consumer demand for items in that category, import-weighted exchange rate growth and the interaction of the fiscal relief dummy variable with economic slack are included. Much as with home electronics, the durable goods category exerts downward pressure on overall inflation measures because of historically low inflation rates in the category.

Other Nondurable Goods. The final core goods price index that CBO projects is a measure of core nondurable goods, or "other" nondurable goods. The other nondurables measure is not cyclical, displays only weak persistence, and is not highly sensitive to supply chain factors (see Table 2). To capture those characteristics, CBO's projections of inflation in the category rely on a dummy variable that accounts for changes in tobacco taxation rates (set equal to one after the second quarter of 2009) and past values of inflation in the category.[12]

$$\pi_t^{other\ nondurables} = \alpha_0 + \alpha_1 \pi_{t-1}^{other\ nondurables} + \alpha_2 \pi_{t-4}^{other\ nondurables} + \alpha_4 tobacco\ tax_t + \varepsilon_t$$

For that equation, R^2 = 0.38; Durbin–Watson = 1.81.

Because the category includes many types of products, it can be highly volatile. As with inflation in other goods categories, inflation in the nondurable goods category is typically below economywide inflation.

How CBO Projects CPI-U inflation

CPI-U and core CPI-U inflation projections are constructed using individual price indexes (see Equations 4 and 5). CBO's projections for energy goods, energy services, other core nondurable goods, and durable goods price indexes in the CPI-U rely directly on projections of corresponding PCE price indexes.

CBO projects energy prices in the CPI-U by using regression equations based on the corresponding PCE categories:

$$\pi_t^{CPIU\ energy\ goods} = \alpha_1 \pi_t^{PCE\ energy\ goods} + \varepsilon_t$$

$$\pi_t^{CPIU\ energy\ services} = \alpha_1 \pi_t^{PCE\ energy\ services} + \varepsilon_t$$

[11] The measure of house price growth used in the equation is the Federal Housing Finance Agency's (FHFA) seasonally adjusted index of purchase-only house prices. The side equation for the FHFA house price index depends on disposable income, past values of the series, and residential investment.

[12] Effective April 1, 2009, the federal excise tax on a pack of cigarettes increased from $0.39 to $1.01.

Similarly, CBO projects the CPI-U for core nondurable goods by using the projection of the PCE for core nondurable goods:

$$\pi_t^{CPIU\ other\ nondurables} = \alpha_1 \pi_t^{PCE\ other\ nondurables} + \varepsilon_t$$

Finally, CBO projects the CPI-U for durable goods by using three PCE series (motor vehicles, electronics, and other durable goods). Those PCE measures are adjusted and combined into one CPI-U measure:

$$\pi_t^{CPIU\ durable\ goods} = \alpha_1 \pi_t^{PCE\ motor\ vehicles} + \alpha_2 \pi_t^{PCE\ electronics} + \alpha_3 \pi_t^{PCE\ other\ durables} + \varepsilon_t$$

The equations for CPI-U energy goods, energy services, core nondurable goods, and durable goods are all econometric equations with R^2 values close to one. Those regressions are all run using CBO's quarterly forecasts for PCE price index components from the early 1990s to the most recently available data. The high R^2 values indicate that the equations are highly accurate in capturing relationships between variables in the PCE price index and the CPI-U, as well as yielding reliable projections for the respective price indexes.

The six remaining price indexes in the CPI-U are calculated using their own econometric equations. For five of those six price series, the CPI-U forecast serves as the basis of CBO's projections. Thus, the PCE inflation forecast for those indexes depends on the corresponding CPI-U counterparts. However, for the last of the six—the CPI-U measure of core services less shelter—the projections are independent of projection of PCE inflation.

Food Prices. CBO creates projections for two measures of food prices in the CPI-U: food at home (grocery store prices) and food away from home (restaurant meals).

The CPI-U index for food at home displays cyclical behavior, persistence, and sensitivity to global and supply-side factors (see Table 2). Thus, the econometric equation for food at home prices includes economic slack, past inflation in the category, and energy goods prices. The inclusion of energy goods prices is intended to capture supply-side effects because shipping costs have a large effect on food at home prices.

$$\pi_t^{food\ at\ home} = \sum_{i=1}^{2} \alpha_i slack_{t-i} + \alpha_2 \pi_{t-1}^{food\ at\ home} + \sum_{i=1}^{2} \beta_i \pi_{t-i}^{energy\ goods} + \varepsilon_t$$

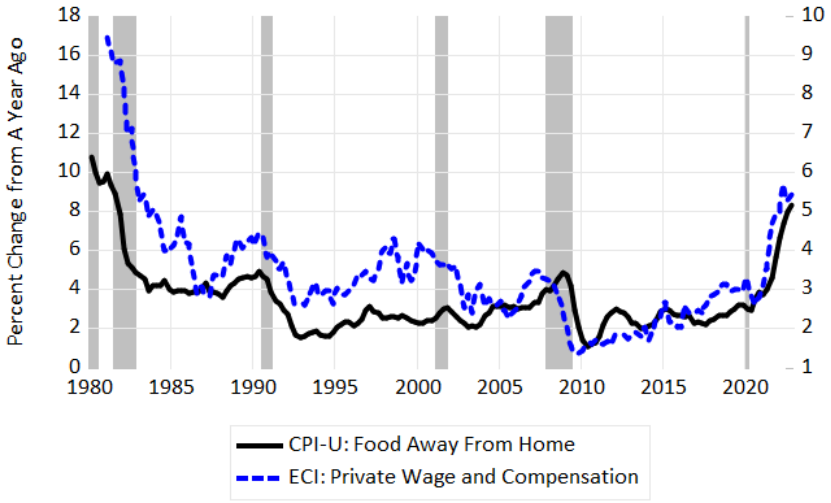
For that equation, $R^2 = 0.61$; Durbin–Watson = 2.01.

The food away from home index is cyclically sensitive, persistent, and not highly sensitive to global and supply-side factors. The index is closely tied to labor market conditions and is highly influenced by wage inflation because labor makes up a significant portion of total costs in that sector of the economy. Inflation in the food away from home index and growth of the

employment cost index for wages and compensation closely track each other over time (see Figure 6).

Figure 6.

Inflation in Prices for Food Away From Home and in Wages



Data source: Bureau of Labor Statistics.

CPI-U = consumer price index for all urban consumers; ECI = employment cost index.

Because of special characteristics of the food away from home index, CBO's projections rely on economic slack, inflation expectations, and wage inflation. The inclusion of inflation expectations—specifically, the two past quarters of the index—reflects the effects of anticipated price changes and helps account for the enduring effects of past inflation on the food away from home index.

$$\pi_t^{food\ away\ from\ home} = \beta_0 + \sum_{i=0}^{2} \alpha_i slack_{t-i} + \alpha_3 \pi_{t-1}^{food\ away\ from\ home} + \alpha_4 \pi_{t-2}^{food\ away\ from\ home} + \alpha_5 wage\ growth_{t-1} + \varepsilon_t$$

For that equation, R^2 = 0.69; Durbin–Watson = 2.02.

Alcoholic Beverages. The category of alcoholic beverages displays highly countercyclical behavior, persistence, and sensitivity to global and supply-side factors. The countercyclical nature of that index means that prices of alcoholic beverages have a strong positive relationship with the lagged unemployment gap (when unemployment in the economy rises for approximately six months, prices of alcoholic beverages tend to increase). The alcoholic

beverages category encompasses beverages for both off-premises (home) and on-premises (bars and restaurants) consumption. Therefore, projections of the alcoholic beverages index depend on measures of economic slack as well as the forecasts for food at home and food away from home because those indexes capture underlying trends in grocery and restaurant prices.

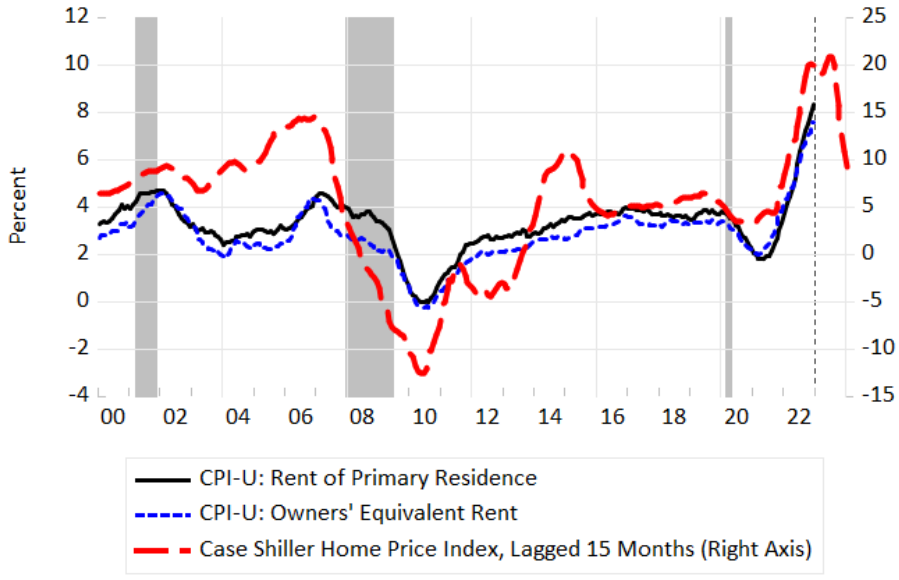
$$\pi_t^{alc.beverages} = \alpha_0 \pi_t^{food\ at\ home} + \alpha_1 \pi_t^{food\ away\ from\ home} + \sum_{i=2}^{3} \alpha_i slack_{t-i} + \varepsilon_t$$

For that equation, R^2 = 0.22; Durbin–Watson = 1.76.

Shelter Services Prices. CBO projects two measures of CPI-U shelter services inflation: rent and OER. Shelter services prices are highly cyclical, highly persistent, and sensitive to global and supply-side pressures (see Table 2). Those prices are closely linked with home prices and housing market conditions. When home prices rise, rents often increase as landlords adjust their rental rates to reflect the higher value of the property being rented. However, home prices tend to be more volatile than rents, and changes in house prices take more than a year to fully manifest in shelter cost inflation (see Figure 7).

Figure 7.

Inflation in Home Prices and Shelter Costs



Data sources: Bureau of Labor Statistics and S&P CoreLogic.

CPI-U = consumer price index for all urban consumers.

CBO's projections of rent inflation are based on several key components: past values of rent inflation, economic slack, and a lagged value of projections for house price growth.[13] Those components are included in the econometric equation for rent inflation to account for the cyclical nature of the rental market, the gradual response of rents to changes in house prices, and the persistence of rental price growth.

$$\pi_t^{rent} = \alpha_0 + \alpha_1 \pi_{t-1}^{rent} + \alpha_2 \pi_{t-2}^{rent} + \alpha_3 slack_{t-1} + \alpha_4 House\ Price\ Growth_{t-5} + \varepsilon_t$$

For that equation, $R^2 = 0.82$; Durbin–Watson = 1.89.

CBO's projections of OER inflation depend on past values of inflation in the category and the current and past values for inflation in the rent category. That approach is consistent with the methods BLS uses to construct the series. When measuring OER, BLS uses a subsample of units from its rent calculations and uses its own model to estimate OER (Bureau of Labor Statistics 2018):

$$\pi_t^{OER} = \alpha_1 \pi_{t-1}^{OER} + \alpha_2 \pi_t^{rent} + \alpha_3 \pi_{t-1}^{rent}$$

For that equation, $R^2 = 0.91$; Durbin–Watson = 1.72.

Because shelter has a different weight in the CPI-U and PCE indexes, the category has a large effect on differences between the series. CBO estimates that the wedge between CPI-U and PCE inflation is roughly 0.30 percentage points, on average (with CPI-U inflation being higher). The weighting difference between the series that can be attributed to shelter services averaged 0.40 percentage points over the decade before the pandemic.

Core Services Prices Less Shelter Prices. In contrast to the other categories discussed thus far, the core services less shelter (or "other services") index in the CPI-U is not linked to any component of the PCE price index, largely because of the substantial difference in the composition of that category between the CPI-U and PCE price index. In particular, the weight of the medical services category in each index is much larger in the PCE price index than in the CPI-U. Therefore, the forecast for medical services prices is not as influential in CBO's projections of the CPI-U as it is in the PCE price index because of its smaller weight in the PCE price index. Also, the PCE measure of core services less shelter includes items such as restaurant meals, certain financial services, foreign travel, and consumption by nonprofits on behalf of the consumer, which are not included in the CPI-U category.

[13] The measure of house price growth used in this equation is FHFA's seasonally adjusted index of purchase-only house prices, the same measure used in projections of the other durable goods index.

Inflation in the CPI-U measure of core services less shelter exhibits highly cyclical behavior and persistence, as in the PCE category. Thus, the forecast for core services less shelter in the CPI-U depends on economic slack, past inflation in the other services category, and a forecast of medical services prices (which depends on projections of producer prices for physician, inpatient, and outpatient services, as its PCE counterpart does).

$$\pi_t^{other\ services} = \alpha_0 + \sum_{i=1}^{3} \alpha_i slack_{t-i} + \sum_{j=1}^{2} \beta_j \pi_{t-j}^{other\ services} + \gamma \pi_t^{CPIU\ medical\ services} + \varepsilon_t$$

For that equation, $R^2 = 0.28$; Durbin–Watson = 2.08.

The long-run forecast for core services less shelter in the CPI-U is adjusted to maintain the historic wedge of 0.3 percentage points between the core CPI-U and core PCE price index.

Conclusion: The 2024 Economic Outlook for Inflation

Using a disaggregated approach to forecast inflation offers a flexible framework for incorporating specific shocks that affect the economy—such as pandemic-related disruptions to global supply chains—into the macroeconomic forecast. The method also allows projections of specific components of inflation to be used in budgetary analysis while maintaining consistency with CBO's macroeconomic projections.

The growth rate of the PCE price index—the Federal Reserve's preferred measure of inflation—reached 5.9 percent in 2022 and slowed to 2.7 percent in 2023.[14,15] In CBO's most recent projections from February 2024, inflation in the PCE price index is projected to slow to 2.1 percent in 2024 and 2.2 percent in 2025 (Congressional Budget Office 2024). By comparison, inflation in the core PCE price index, which excludes food and energy prices, rose to 5.1 percent in 2022 and then declined to 3.2 percent in 2023. CBO projects that the core PCE price index will grow by 2.4 percent in 2024 and 2.3 percent in 2025.

Growth in the CPI-U and in the core CPI-U also is projected to slow through the next few years. In CBO's projections, after growing by 7.1 percent in 2022 and 3.2 percent in 2023, the CPI-U is expected to grow by 2.5 percent in 2024 and 2.5 percent in 2025. The core CPI-U, which

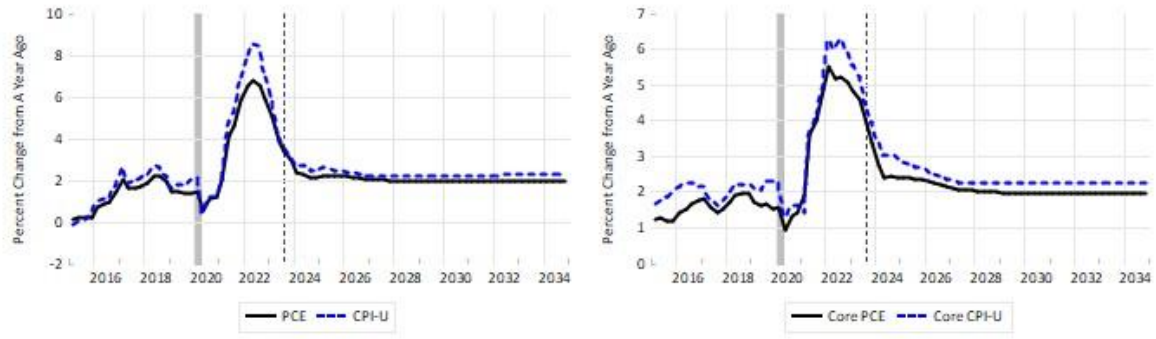
[14] Unless indicated otherwise, annual growth rates are measured from the fourth quarter of one year to the fourth quarter of the next.

[15] Values before 2024 reflect data available from BEA and BLS at the end of January 2024. The data contain values for the fourth quarter of 2023 that were not available when CBO developed its February 2024 projections for 2023 to 2034.

excludes food and energy prices, is projected to grow by 2.9 percent in 2024 and 2.6 percent in 2025, after increases of 6.0 percent in 2022 and 4.0 percent in 2023 (see Figure 8).

Figure 8.

Recent Projections of Inflation



Data source: Congressional Budget Office.

CPI-U = consumer price index for all urban consumers; PCE = price index for personal consumption expenditures.

CPI-U inflation usually grows faster than PCE inflation by roughly 0.3 percentage points, but in 2022 price growth in the CPI-U outpaced growth in the PCE price index by 1.2 percentage points. In 2023, the gap between those two measures narrowed toward its long-run average of 0.3 percentage points. The agency expects the gap between CPI-U and PCE inflation to increase and then decline below its historical average over the next few years. That behavior of the gap between inflation in the CPI-U and inflation in the PCE price index is driven largely by categories of goods and services with more weight in the calculation of the CPI-U than in the PCE price index, for example, the index for shelter services.

Shelter services inflation was highly persistent in 2023. Inflation in that category and in many core service categories remained high in the beginning of the year, even as inflation in many goods prices began to drastically decline. In CBO's projections, service price inflation remains more persistent and drives inflation over the next two years. Goods inflation continues to ease and maintains prepandemic rates. Using the disaggregated approach allows CBO to better understand those underlying factors and the composition of future inflation.

Appendix A: Other Measures of Consumer Prices

In addition to the widely used consumer price index for all urban consumers (CPI-U) and core CPI-U measures, the Bureau of Labor Statistics (BLS) publishes several other consumer price indexes aimed at capturing inflation across baskets of goods and populations. One of those measures is the chained CPI-U, designed to reflect consumers' substitution decisions. The main difference between the CPI-U and chained CPI-U is that the latter uses a Fisher aggregation method similar to the one used for price index for personal consumption expenditures (PCE price index). Over time the wedge between the CPI-U and the chained CPI-U is roughly 0.25 percentage points, whereas the wedge between the PCE price index and the CPI-U is 0.30 percentage points. When CPI-U is calculated as a chain-weighted index rather than with constant category weights, a wedge still remains between the chained CPI-U and the PCE price index because of compositional differences between the indexes.

Apart from the chained CPI-U, BLS also publishes other specialized indexes such as the consumer price index for all urban wage earners (CPI-W), which measures inflation for households headed by people without fixed salaries. The consumer price index for the elderly (CPI-E) is used to measure inflation across U.S. households headed by people age 62 or older. Those indexes cater to specific demographic groups and help convey a comprehensive understanding of inflation experienced across population segments.

The CPI-W is derived from a subsample of consumers from the CPI-U; however, households included in the CPI-W sample must earn more than half their income from wages and clerical earnings (Bureau of Labor Statistics 2018). As a result, the CPI-W does not include salaried workers, part-time workers, or the self-employed. It is sometimes used by policymakers to calculate cost-of-living adjustments and in wage negotiations. The wedge between CPI-U and CPI-W growth is usually zero on average, but in 2020–2022 CPI-W inflation outpaced CPI-U inflation.

The CPI-E is an experimental measure that involves reweighting of the CPI-U's basic components by using expenditure weights based solely on data from households whose heads are 62 or older. The CPI-E is not widely used but could allow policymakers to calculate cost-of-living adjustments more accurately for programs, such as Social Security, servicing that demographic. CBO does not project CPI-E inflation but does monitor how the index grows in comparison with other measures of inflation.

Projections of inflation in the CPI-W and chained CPI-U are based on CBO's projections of CPI-U inflation. Inflation in the CPI-W is set to grow at the same rate as inflation in the CPI-U, and the forecast for chained CPI-U inflation depends directly on the CPI-U forecast as well as seasonal and cyclical factors. In the long run, the chained CPI-U averages a growth rate of roughly 2 percent and the CPI-W, like the CPI-U, grows at 2.3 percent.

Appendix B: More Background on Empirical Tests

This appendix surveys how the Congressional Budget Office assesses the extent to which each price series exhibits cyclical behavior, persistence, and sensitivity to global and supply-side factors. The importance of sampling periods (including and excluding years affected by the pandemic) and other measures of economic slack and supply-side factors also are examined.

Cyclicality

The cyclical behavior of prices varies significantly, with some prices much more sensitive to economic slack than others. Regression analysis was conducted on each subcomponent of the price index for personal consumption expenditures (PCE price index) to determine which price series are most sensitive to fluctuations in measures of economic slack. Results show that most service prices are much more sensitive to cyclical changes than goods prices.

Prices are cyclical if they rise and fall along with the business cycle and if they have a statistically significant relationship with measures of economic slack (Stock and Watson 2020). CBO's preferred measure of economic slack, the unemployment gap, represents the difference between the unemployment rate and the noncyclical rate of unemployment. A positive unemployment gap indicates that the economy is operating below its potential and is in a contractionary phase of the business cycle, whereas a negative unemployment gap suggests that the economy is operating above its full potential and is in an expansionary phase. Cyclical price series should have a negative and statistically significant relationship with the unemployment gap.

A regression model with the following form was examined for each component to test which components of the PCE price index were cyclical:

$$\pi_t^s = \beta_0 + \beta_1 \pi_{t-1}^s + \beta_2 slack_t + \varepsilon_t$$

The term π_t^s represents annualized monthly inflation in sector s at time t, and the term $slack_t$ represents a measure of economic slack at time t. Here β_0 is a constant and can be thought of as sector-specific fixed effects. The coefficients β_1 and β_2 represent the relationship between inflation in each sector with past lags of inflation in that same sector and the slack measurement, respectively. For a price index to be cyclical, β_2 should have a negative and statistically significant value. According to the analysis, service prices are sensitive to cyclical economic activity (see Table B.1). Shelter services inflation, in particular, is highly cyclical.

Table B.1.

Cyclicality of Inflation Components

Inflation component	Unemployment gap (1999–2019)	Unemployment gap (1999–2022)	Unemployment gap adjusted (1999–2022)	Unemployed per job opening (1999–2019)	Unemployed per job opening (1999–2022)
PCE price index	–0.07	–0.00	–0.11	–0.01	–0.08
	(0.47)	(0.96)	(0.27)	(0.92)	(0.44)
Core PCE price index	–0.09	–0.03	–0.12	–0.09	–0.15
	(0.06)	(0.56)	(0.05)	(0.08)	(0.01)
Durable goods	0.06	0.13	–0.10	0.07	–0.14
	(0.58)	(0.29)	(0.49)	(0.50)	(0.34)
New and used motor vehicles and parts	0.43	0.35	0.14	0.58	0.80
	(0.00)	(0.10)	(0.58)	(0.00)	(0.75)
Home electronics	–0.02	0.18	–0.26	–0.37	–0.69
	(0.95)	(0.46)	(0.35)	(0.14)	(0.02)
Other durable goods	–0.15	–0.12	–0.33	–0.12	–0.35
	(0.28)	(0.41)	(0.05)	(0.40)	(0.04)
Nondurable goods	0.08	0.07	–0.02	0.33	0.12
	(0.82)	(0.52)	(0.94)	(0.37)	(0.73)
Energy nondurable goods	0.30	1.57	–0.65	3.61	1.98
	(0.93)	(0.63)	(0.86)	(0.34)	(0.60)
Food at home	–0.09	–0.42	–0.28	–0.03	–0.37
	(0.06)	(0.00)	(0.07)	(0.82)	(0.02)
Other nondurable goods	0.23	0.07	0.10	0.26	0.05
	(0.07)	(0.52)	(0.45)	(0.04)	(0.71)
Services	–0.23	–0.23	–0.26	–0.20	–0.26
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Energy services	–1.09	–1.08	–1.40	–0.74	–1.10
	(0.09)	(0.04)	(0.02)	(0.27)	(0.08)
Food away from home (CPI-U measure)	–0.14	–0.07	–0.17	–0.20	–0.20
	(0.01)	(0.23)	(0.01)	(0.00)	(0.00)
Shelter services	–0.26	–0.13	–0.16	–0.29	–0.18
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Medical services	–0.10	–0.01	–0.11	0.04	0.04
	(0.20)	(0.91)	(0.17)	(0.65)	(0.60)
Other services	–0.11	–0.16	–0.13	–0.07	–0.14
	(0.16)	(0.02)	(0.09)	(0.43)	(0.11)

Data sources: Bureau of Economic Analysis, Bureau of Labor Statistics, Congressional Budget Office, and Federal Reserve Bank of San Francisco.

Table shows estimates of equation outlined in this section by using the ordinary-least-squares method with monthly data from 1999 through 2022. Estimated coefficients and *p*-values (in parentheses) are reported. All quarterly variables were converted into monthly observations with quadratic interpolation methods. Shading shows significance at $p = 0.05$.

CPI-U = consumer price index for all urban consumers; PCE = price index for personal consumption expenditures.

Given the pandemic's substantial effect on labor market conditions in 2020–2022, the traditional unemployment gap measure may not fully capture labor market tightness during that crucial period. Further cyclicality tests that incorporated an adjusted measure of the unemployment rate were run to address that issue. That alternative measure accounts for temporary pandemic-era layoffs (Bok and Petrosky-Nadeau 2022). Using the adjusted unemployment rate to reexamine cyclicality over the period from 1999 to 2022, the analysis suggests that more sectors of the economy have become sensitive to cyclical fluctuations since the pandemic. Further tests were run, using the number of unemployed per job opening as a measure of slack. The unemployed per job opening measure became popular during 2021 because that measure was less volatile in 2020 (Furman and Powell 2021; Ball, Leigh, and Mishra 2022). Results from the unemployed per job opening exercise proved similar to those of the adjusted unemployment gap exercise.

In addition to its effect on unemployment, the pandemic had large effects on participation in the labor force. The relationship between those participation effects and price indexes is a subject of ongoing research.

Persistence

In this analysis, persistence refers to a positive correlation between inflation in one period and inflation in previous periods. Most price indexes have exhibited persistence over the course of a year. Inflation in services prices has been more persistent than inflation in goods prices. At one end of the spectrum, inflation in shelter prices displays strong persistence. On the other end, energy goods display little persistence.

To examine persistence across components of inflation, CBO ran a regression test on quarterly measures of inflation by using the following equation:

$$\pi_t^s = \beta_0 + \beta_1 slack_t + \gamma(L)\pi_t^s + \varepsilon_t$$

$\gamma(L)$ is a lag polynomial that varies with each specification. The first specification $(L = 1)$ tests whether inflation over the previous quarter predicts inflation in the next quarter. Later specifications—$(L = 2)$, $(L = 3)$, and $(L = 4)$—investigate the effects of two, three, and four previous quarters of inflation, respectively, on future price growth in each sector. In Table B.2, coefficients for L larger than 1 are the sum of all coefficients on all lags of past inflation values, and measures of statistical significance are from Wald tests with the null hypothesis $\gamma(L) = 0$.

Table B.2.

Persistence of Inflation Components, 1999 to 2022

Inflation component	Lag 1	Lag 2	Lag 3	Lag 4	Optimal lags (SIC)	Optimal lags (AIC)
PCE price index	0.50	0.51	0.60	0.54	1	1
	(0.00)	(0.00)	(0.00)	(0.00)		
Core PCE price index	0.66	0.82	0.92	0.83	2	4
	(0.00)	(0.00)	(0.00)	(0.00)		
Durable goods	0.71	0.79	0.87	0.79	4	4
	(0.00)	(0.00)	(0.00)	(0.00)		
New and used motor vehicles and parts	0.56	0.60	0.68	0.65	1	1
	(0.00)	(0.00)	(0.00)	(0.00)		
Home electronics	0.69	0.74	0.74	0.77	1	5
	(0.00)	(0.00)	(0.00)	(0.00)		
Other durable goods	0.66	0.72	0.88	0.84	3	3
	(0.00)	(0.00)	(0.00)	(0.00)		
Nondurable goods	0.26	0.17	0.27	0.23	1	1
	(0.01)	(0.18)	(0.10)	(0.23)		
Energy nondurable goods	0.11	0.06	0.10	0.09	0	0
	(0.27)	(0.69)	(0.56)	(0.66)		
Food at home	0.67	0.70	0.64	0.70	1	1
	(0.00)	(0.00)	(0.00)	(0.00)		
Other nondurable goods	0.40	0.53	0.53	0.43	1	2
	(0.00)	(0.00)	(0.00)	(0.01)		
Services	0.65	0.74	0.76	0.72	1	6
	(0.00)	(0.00)	(0.00)	(0.00)		
Energy services	0.46	0.37	0.29	0.24	1	1
	(0.00)	(0.00)	(0.03)	(0.13)		
Food away from home (CPI-U measure)	0.90	0.95	0.99	1.08	5	5
	(0.00)	(0.00)	(0.00)	(0.00)		
Shelter services	0.91	0.85	0.81	0.74	2	10
	(0.00)	(0.00)	(0.00)	(0.00)		
Medical services	0.33	0.58	0.74	0.77	3	3
	(0.00)	(0.00)	(0.00)	(0.00)		
Other services	0.50	0.60	0.61	0.54	1	2
	(0.00)	(0.00)	(0.00)	(0.00)		

Data sources: Bureau of Economic Analysis, Bureau of Labor Statistics, and Congressional Budget Office.

Table shows estimates of equation outlined in this section by using the ordinary-least-squares method with monthly data from 1999 through 2022. Estimated coefficients and *p*-values (in parentheses) are reported. Coefficients for lags larger than 1 are the sum of all coefficients on lags, and measures of statistical significance are results from joint tests. Shading shows lack of significance at $p = 0.05$; darker shading shows lack of significance at $p = 0.10$.

AIC = Akaike information criterion; CPI-U = consumer price index for all urban consumers; PCE = price index for personal consumption expenditures; SIC = Schwarz information criterion.

To get more insight into how persistent inflation is in each price index, CBO ran a test on autoregressions that depend solely on each price index and a constant. The test determined the optimal number of lags for those price series in simple autoregressive models, as determined by the Akaike and Schwarz information criteria. All tests were performed over a sample from 1999 to 2022 (see Table B.2).

Among the price categories, nondurable energy goods exhibited the least persistence (see Table B.2). That finding motivates CBO's approach, in which the agency relies on high-frequency information to project energy goods prices in the near term. Similarly, energy services prices also displayed weak persistence. The last category that displayed weak persistence was the other nondurable goods index. The nondurable goods sector is a broad category that includes many discretionary goods. The prices in that category might tend to be less persistent because consumers may cut back on discretionary items if inflation is high.

All other price series display some level of persistence, with durable goods inflation and shelter services inflation being especially persistent (Table B.2). Factors such as longer production cycles for durable goods or the slow adjustment of housing costs in shelter services may contribute to their higher level of persistence in inflation.

Sensitivity to Global and Supply-Side Factors

Global and supply-side factors—such as the cost of shipping, the cost of oil, labor supply, and import prices—influence prices for many goods and services. Two tests were conducted on components of the PCE price index to examine the role some of those factors have in inflation. The first test focused on the global supply chain pressure index (GSCPI). It aimed to determine whether heightened supply chain issues changed the relationship between prices and economic slack and whether heightened supply chain issues directly affected inflation. The second test examined the significance of CBO's adjusted core imported goods measure as a predictor of various subcomponents of inflation. Results show that supply-side factors are crucial for projecting goods prices and some services prices. Furthermore, the analysis shows that the influence of supply-side factors on prices grew during the 2020–2022 period.

GSCPI. The pandemic itself caused shipping delays, reduced labor force participation, and introduced additional supply shocks—making it hard for businesses to restock inventories and boosting inflation in certain components of the PCE price index (Shapiro 2020). To quantify the disruptions, the Federal Reserve Bank of New York developed the GSCPI. It employs several measures of shipping costs and supply chain–related information to measure the pressure on global supply chains each month. The GSCPI increased rapidly during the onset of the pandemic and remained high throughout 2021 and 2022, reflecting ongoing challenges faced by global supply chains during that period. To test the relationship of the measure with each subcomponent of inflation, CBO used the following equation:

$$\pi_t^s = \beta_0 + \beta_1 \pi_t^s + \beta_2 (GSCPI_t \times slack_{t-1}) + \beta_3 GSCPI_t + \beta_4 slack_{t-1} + \varepsilon_t$$

The variable $slack_{t-1}$ denotes the unemployment gap. The coefficient β_2 captures any change in the relationship between prices and economic slack due to heightened supply chain pressures, and β_3 captures the direct effects that supply chain pressures have on prices. A test was run to see whether either β_2 or β_3 was significant (see Table B.3). For the 1999–2022 period, nearly all goods price indexes have a strong statistical relationship with supply chain pressures, as do many service price indexes.

Because of the rapid increase in supply chain pressures over a short period in 2020–2022, using measures such as the GSCPI for forecasting can be challenging. It is hard to determine whether the significant relationship with price series is due to a genuine connection between prices and supply chains or whether other special factors arising from the pandemic influenced that relationship.

Imported Core Goods Price Index. In CBO's econometric equations for price indexes, a quantity-adjusted measure of relative inflation of imported core goods prices is commonly incorporated to account for the effect of imported goods on certain prices in the economy. Given the significant volume of goods imported into the United States, that relative inflation measure helps address the disparity between domestic economic slack and the prices of imported goods. To test the relationship of the measure with each subcomponent of inflation, CBO used the following equation:

$$\pi_t^s = \beta_0 + \beta_1 \pi_t^s + \beta_2 \pi_{t-1}^{adjusted\ core\ imported\ goods} + \beta_3 slack_{t-1} + \varepsilon_t$$

β_2 captures the relationship between price growth in the imported goods sectors and sector s in the economy. The table of results includes the coefficient β_2 for each equation, as well as the significance level for each sector.

The tests show that before the pandemic, prices of goods were more responsive to supply-side pressures than prices of services (see Table B.3). In the sample period that includes the pandemic, nearly all goods price indexes have a strong statistical relationship with the adjusted core imported goods price measure, as do many service price indexes.

Table B.3.

Sensitivity of Inflation Components to Global and Supply-Side Factors

Inflation component	NYFED GSCPI (1999–2019)	NYFED GSCPI (1999–2022)	Adjusted core imported goods inflation (1999–2019)	Adjusted core imported goods inflation (1999–2022)
PCE price index	0.22, 0.64 (0.01)	0.09, 0.61*** (0.00)	1.77 (0.00)	1.75 (0.00)
Core PCE price index	0.12, 0.11 (0.11)	0.05, 0.53*** (0.00)	0.88 (0.00)	0.72 (0.00)
Durable goods	0.19, 0.69 (0.01)	0.12, 1.57*** (0.01)	0.84 (0.05)	1.40 (0.01)
New and used motor vehicles and parts	0.05, 0.26 (0.78)	0.11, 1.74*** (0.00)	0.66 (0.30)	2.19 (0.02)
Home electronics	–0.81, 2.87*** (0.00)	0.19, 2.21*** (0.00)	0.33 (0.74)	1.17 (0.29)
Other durable goods	0.53*, 0.51 (0.01)	0.10, 1.67*** (0.01)	0.99 (0.09)	1.83 (0.01)
Nondurable goods	0.50, 2.61* (0.02)	0.05, 1.37* (0.00)	4.52 (0.00)	5.29 (0.00)
Energy nondurable goods	–3.84, 16.96 (0.43)	0.51, 9.26 (0.22)	21.95 (0.16)	35.33 (0.02)
Food at home	0.50*, –0.049 (0.08)	–0.37***, 1.40*** (0.00)	2.64 (0.00)	2.32 (0.00)
Other nondurable goods	0.20, 0.11 (0.52)	–0.09, 0.64** (0.01)	–0.18 (0.73)	0.35 (0.50)
Services	0.16, –0.07 (0.35)	0.08, 0.35*** (0.00)	1.59 (0.00)	1.17 (0.00)
Energy services	0.71, 0.14 (0.77)	0.09, 1.9* (0.09)	14.54 (0.00)	11.14 (0.00)
Food away from home (CPI-U measure)	0.05, 0.00 (0.72)	0.05, 0.49*** (0.00)	0.13 (0.55)	0.14 (0.56)
Shelter	0.06, –0.12 (0.39)	0.01, 0.15** (0.00)	–0.40 (0.00)	–0.18 (0.15)
Medical services	0.09, –0.35 (0.46)	0.09, –0.05 (0.25)	0.68 (0.04)	0.45 (0.14)
Other services	0.17. –0.10 (0.52)	0.08, 0.32* (0.01)	1.72 (0.00)	1.56 (0.00)

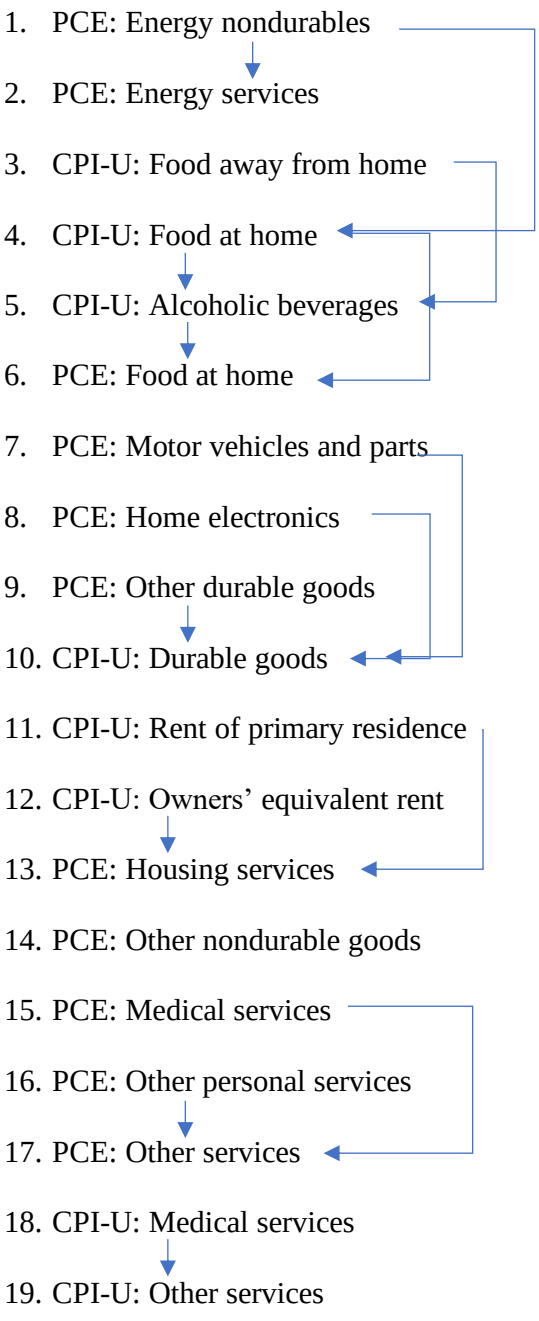
Data sources: Bureau of Economic Analysis, Bureau of Labor Statistics, Congressional Budget Office, and Federal Reserve Bank of New York.

Table shows estimates of equations outlined in this section by using the ordinary-least-squares method with monthly data from 1999 through 2022. Estimated coefficients and *p*-values (in parentheses) are reported. All quarterly variables were converted into monthly observations with quadratic interpolation methods. Shading shows significance of joint tests at $p = 0.05$. For individual tests on NYFED GSCPI, * = significant at $p = 0.05$; ** = significant at $p = 0.01$; *** = significant at $p = 0.001$.

CPI-U = consumer price index for all urban consumers; GSCPI = global supply chain pressure index; PCE = price index for personal consumption expenditures.

Appendix C: Ordering of Empirical Estimations

CBO's inflation projections involve several interconnected econometric equations. The most independent equations—not influenced by changes in other consumer prices—are estimated first, and equations influenced by other prices are estimated later:



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