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Inflation Dynamics and the Phillips Curve

Remarks by

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Member

Board of Governors of the Federal Reserve System

at

Ec10b Principles of Economics Lecture
Department of Economics, Faculty of Arts and Sciences, Harvard University

Cambridge, Massachusetts

April 7, 2025

Governor Adriana D. Kugler presents a lecture about inflation dynamics and the Phillips Curve to students in Harvard University's Ec10b Principles of Economics class on Monday, April 7, 2025.

In the lecture she discusses how pandemic-era inflation came in a series of waves: food, core goods, core services and housing. She then talks about the Phillips curve as a model to capture inflation dynamics. Finally, Governor Kugler explores additional augmentations to the Phillips curve model that could help better explain the most recent inflation episode.

Here are the slides from her presentation.

Inflation Dynamics and the Phillips Curve

Governor Adriana D. Kugler
Federal Reserve Board

Harvard University
Ec10b Principles of Economics Lecture

April 7, 2025

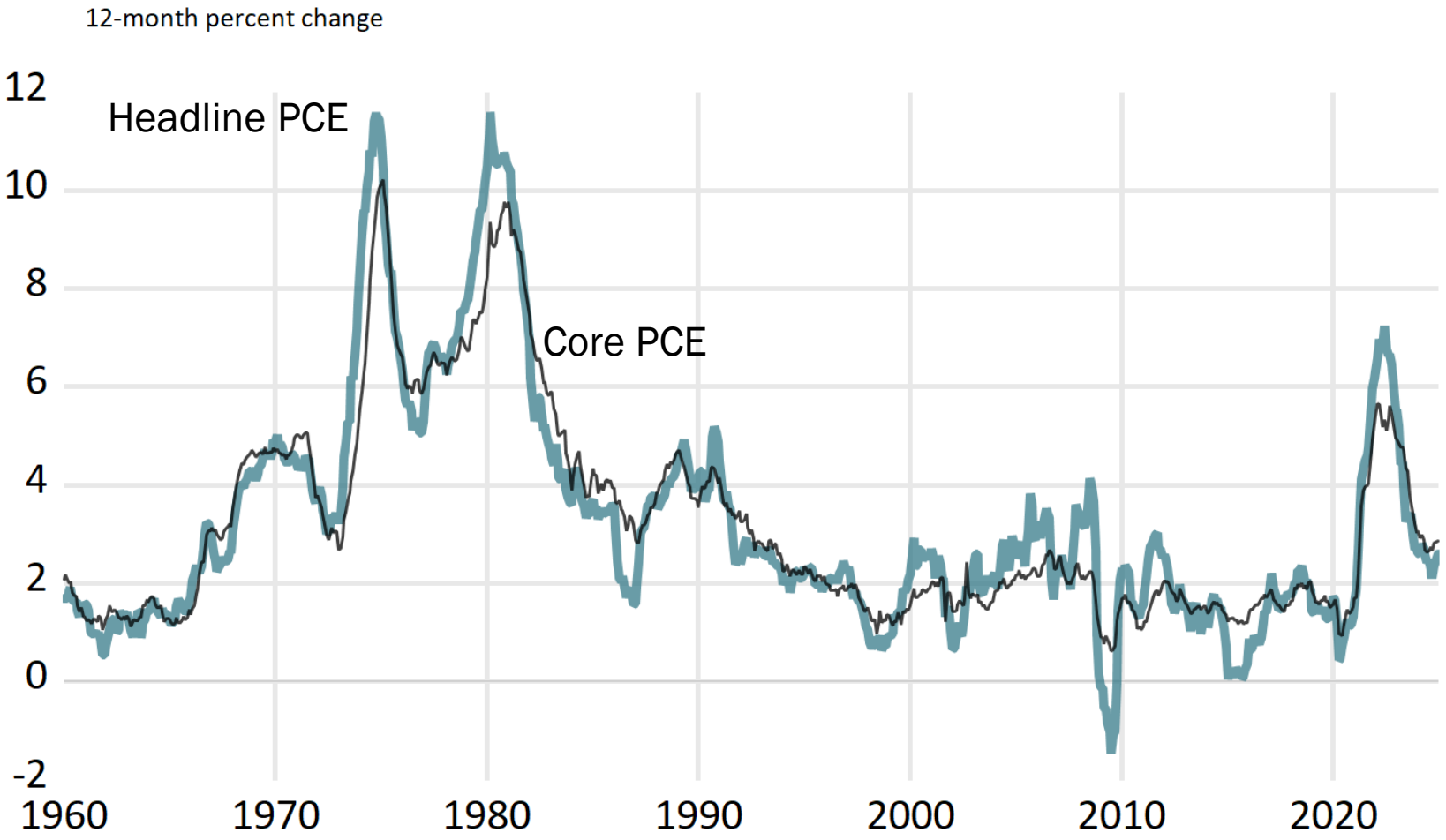
Roadmap of Lecture

- Bird's eye view of inflation since 1960
- Pandemic waves of inflation for different components: food, core good, core services ex. housing, housing inflation and driving shocks
- Basics on the derivation of the expectations-augmented Phillips curve
- Baseline model: a better-fitting Phillips curve with long-run inflation expectations
- How to augment baseline model to better capture recent inflation
- Empirical results: Dynamic simulations with variants of baseline model

A Bird's Eye View of Inflation

"Two mountains enclosing a plain"

A Look at Inflation Data in the Long-Run

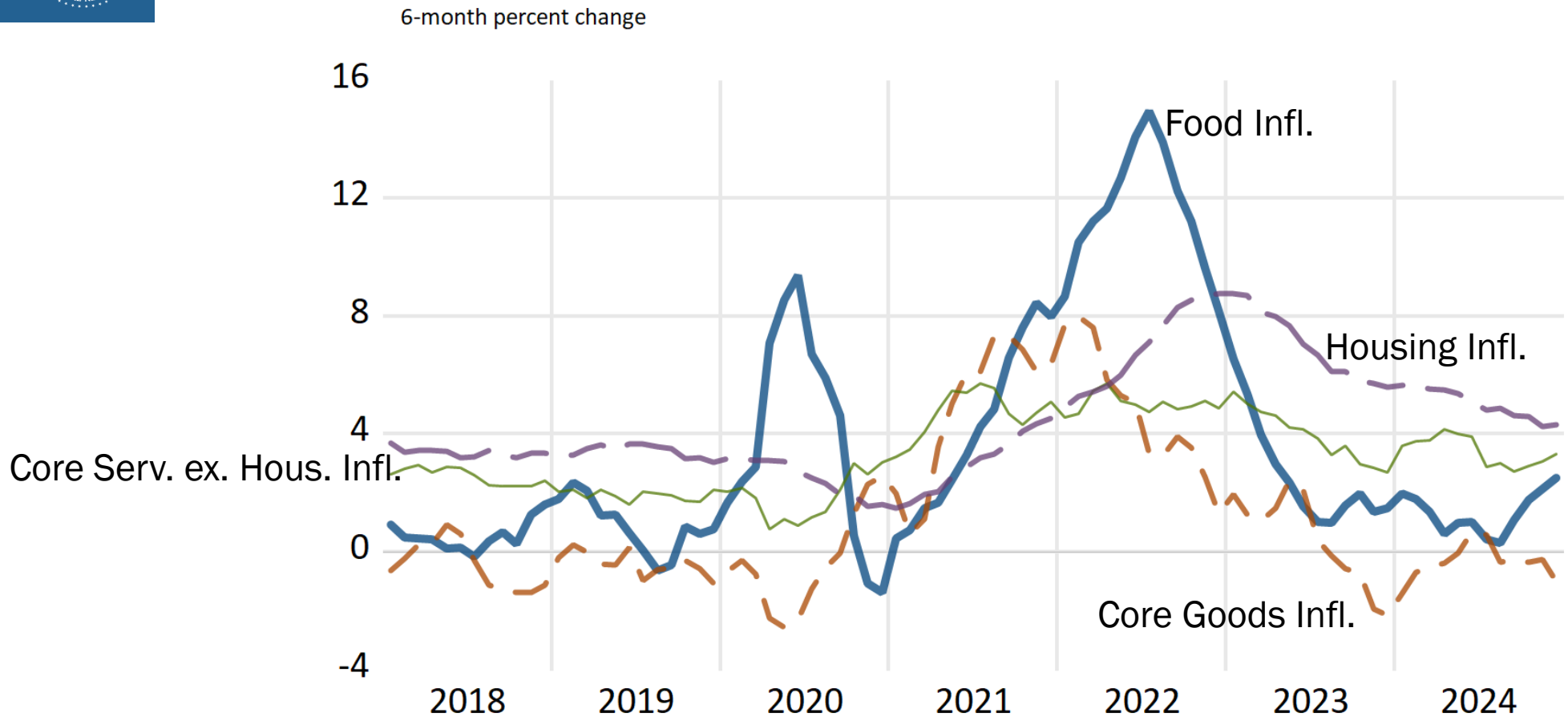


Note: Headline PCE is the personal consumption expenditure price index. Core PCE excludes food and energy. Data are monthly.
Sources: U.S. Bureau of Economic Analysis. Haver Analytics.

Inflation Waves

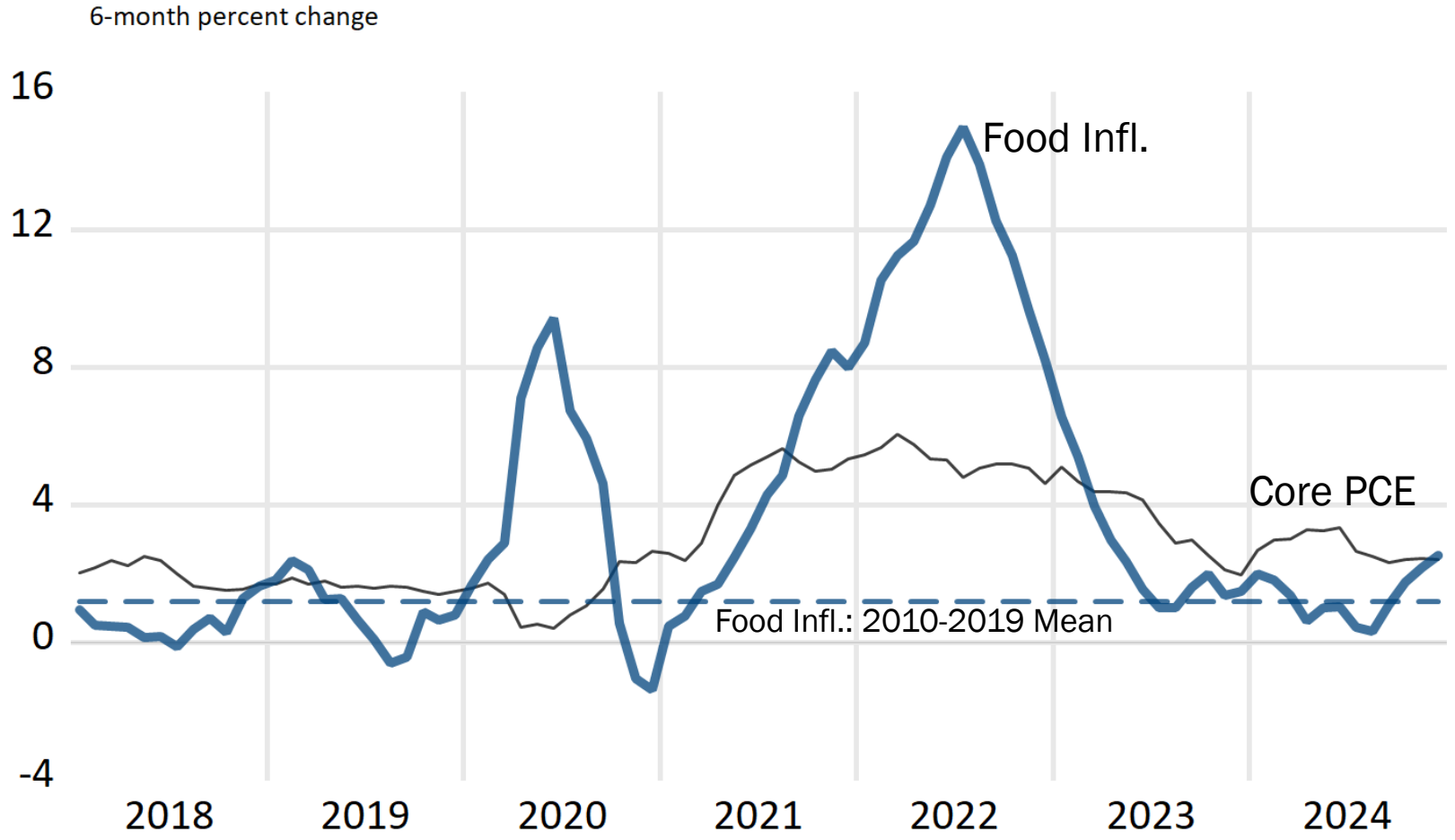
How did inflation manifest itself in the recent run-up? Was it a uniform wave?

Waves in Inflation Components



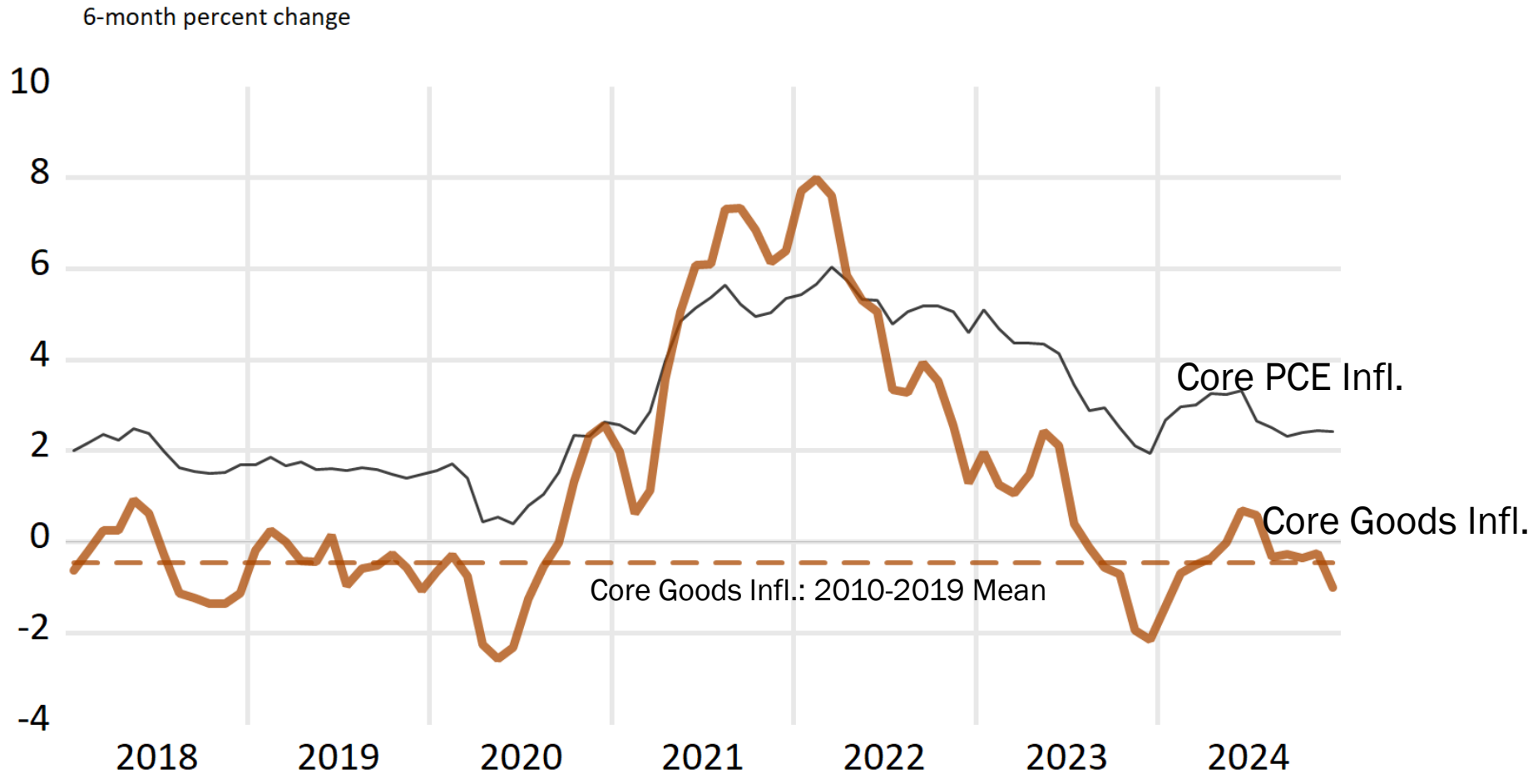
Note: Food inflation is the personal consumption expenditures (PCE) price index for food.
Core goods is the personal consumption expenditures (PCE) price index for goods excluding food and energy.
Core services ex. housing is the personal consumption expenditures (PCE) price index for Core services ex. housing.
Housing inflation is the personal consumption expenditures (PCE) price index for housing services.
Sources: U.S. Bureau of Economic Analysis. Haver Analytics.

Food Inflation



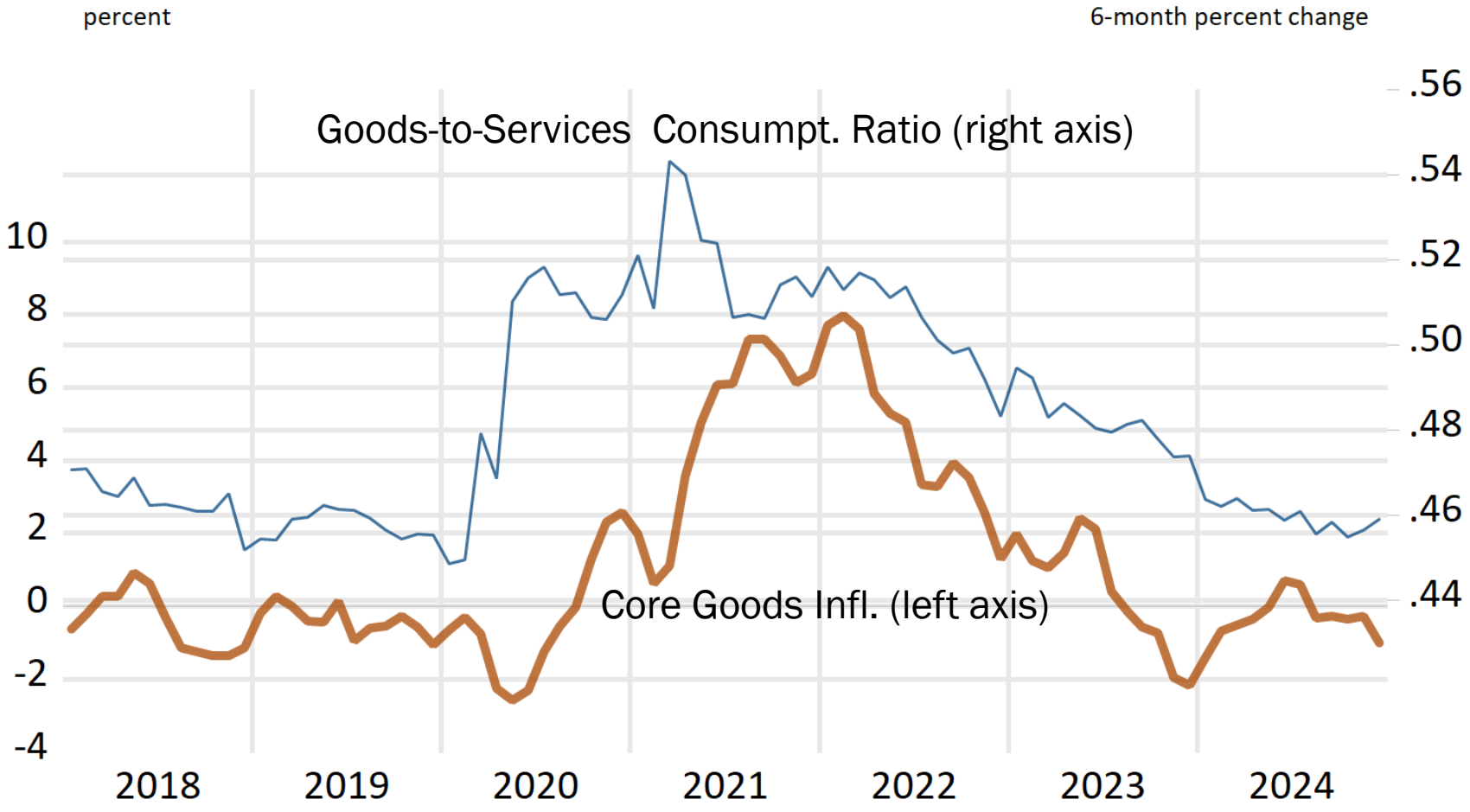
Note: Food inflation is the personal consumption expenditures (PCE) price index for food.
Core PCE is PCE price deflator that excludes food and energy. Data are monthly.
Sources: U.S. Bureau of Economic Analysis. Haver Analytics.

Core Goods Inflation



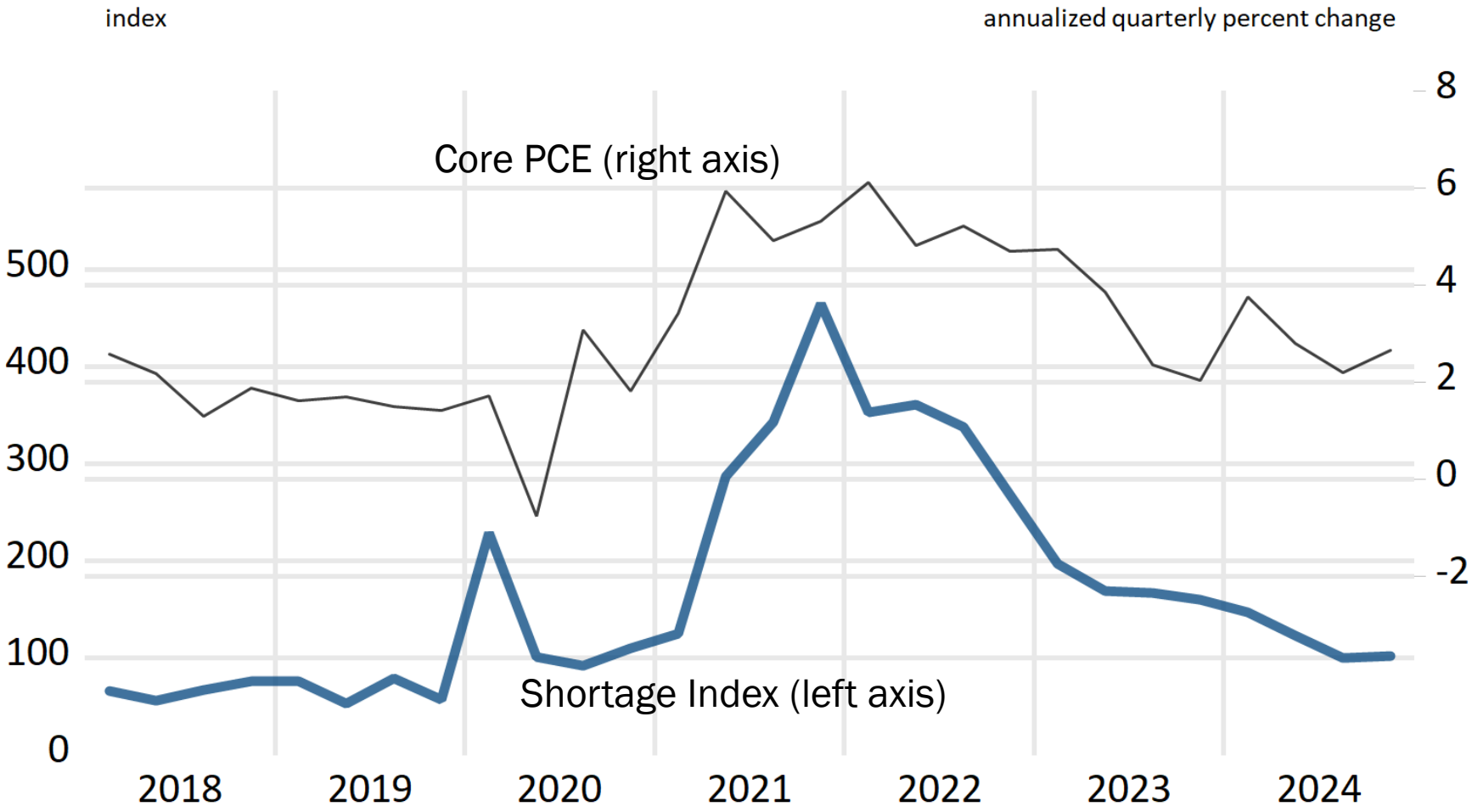
Note: Core goods is the personal consumption expenditures (PCE) price index for goods excluding food and energy.
Core PCE is PCE price deflator that excludes food and energy. Data are monthly.
Sources: U.S. Bureau of Economic Analysis. Haver Analytics.

Rotation to Goods



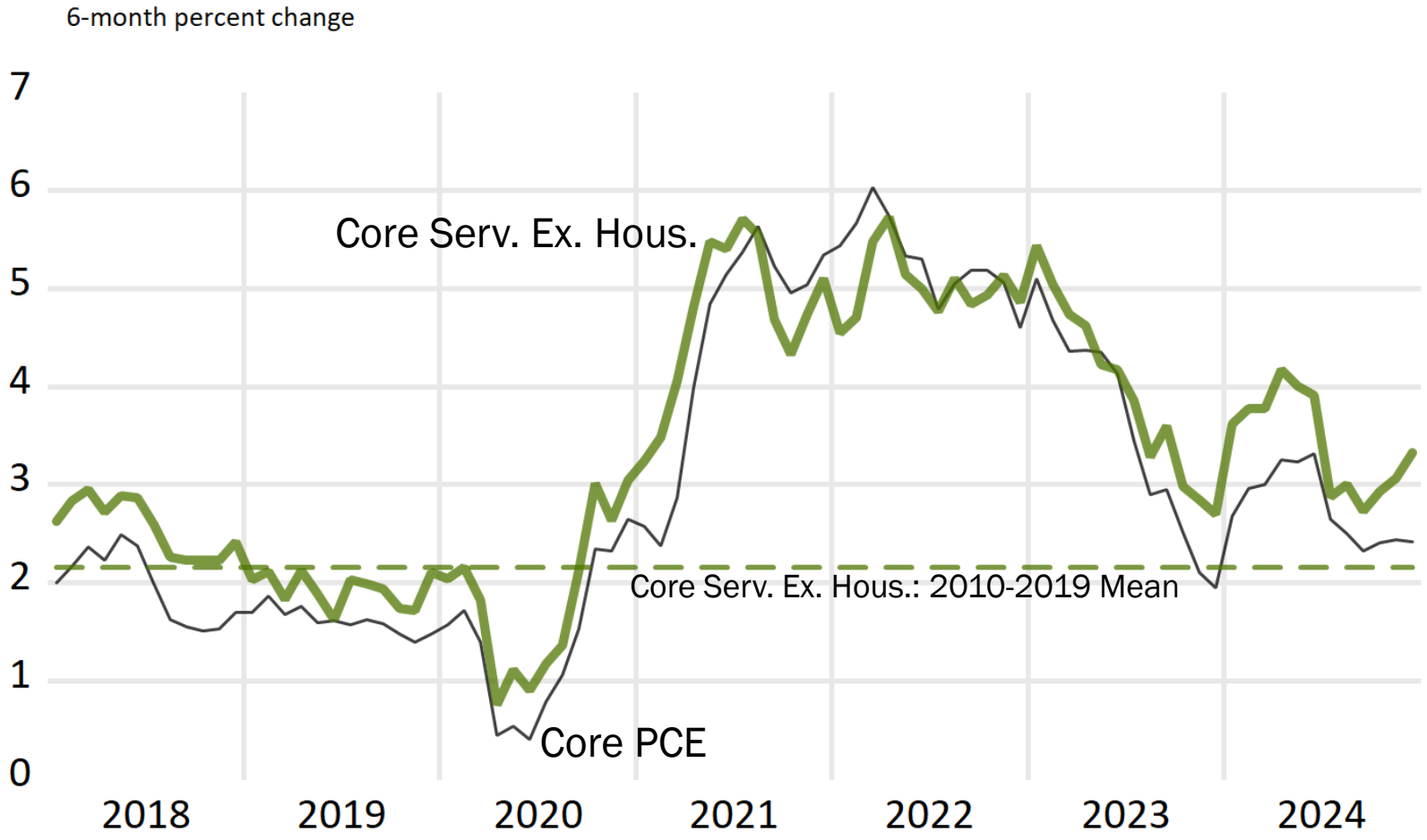
Note: Core Goods is personal consumption expenditures price (PCE) deflator for goods.
Goods to Services consumption ratio is nominal PCE goods to nominal PCE services consumption ratio. Data are monthly.
Sources: U.S. Bureau of Economic Analysis. Haver Analytics.

Indexes of Shortages



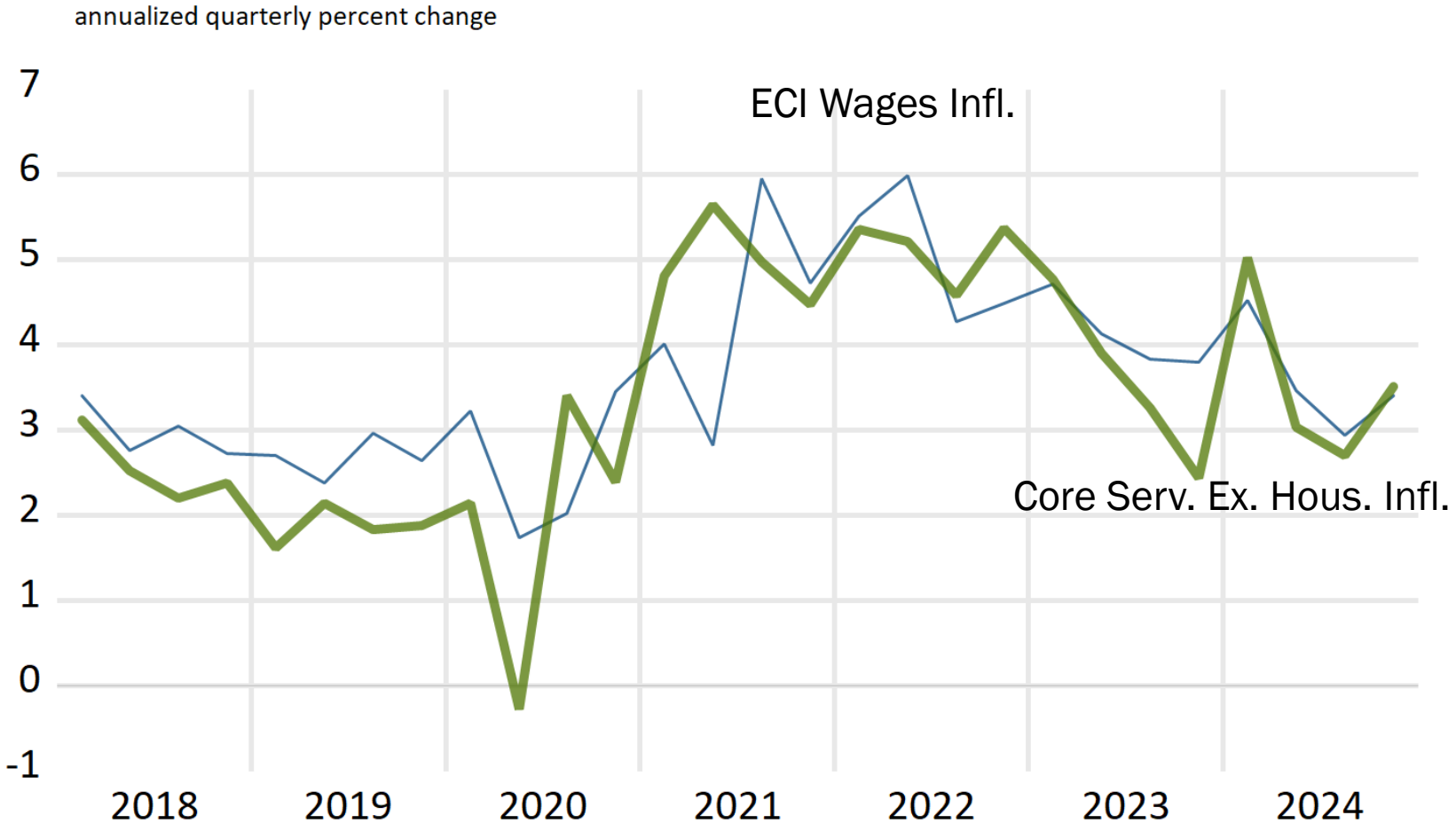
Note: Shortage index data are expressed in index points and are monthly.
Source: U.S. Bureau of Economic Analysis via Haver Analytics. https://www.matteoiacoviello.com/shortages.html.

Core Services ex Housing Inflation



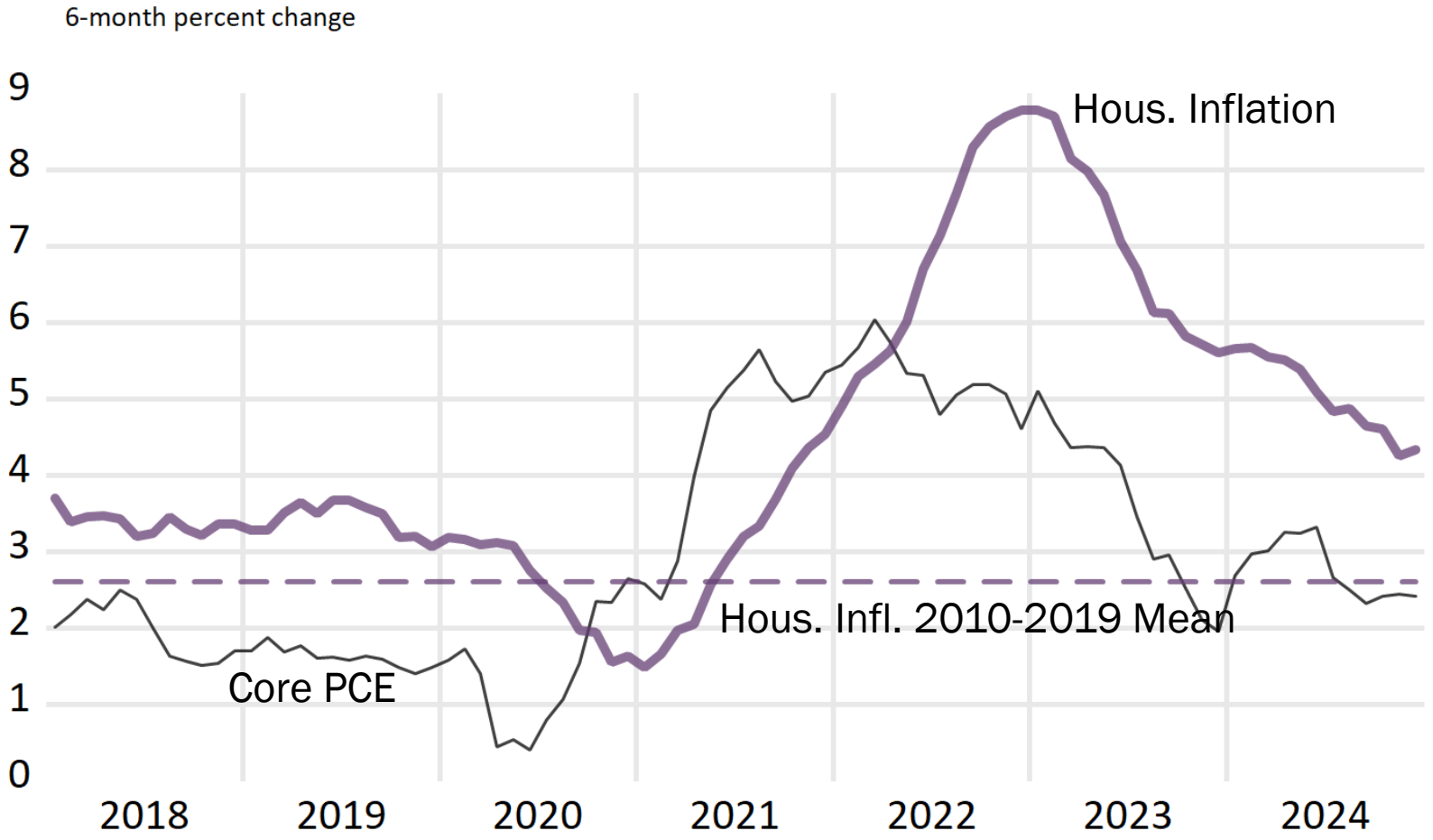
Note: Core services ex. housing is the personal consumption expenditures (PCE) price index for Core services ex. housing. Core PCE is PCE price deflator that excludes food and energy. Data are monthly.
Sources: U.S. Bureau of Economic Analysis. Haver Analytics.

Core Services ex. Housing Inflation and Wages



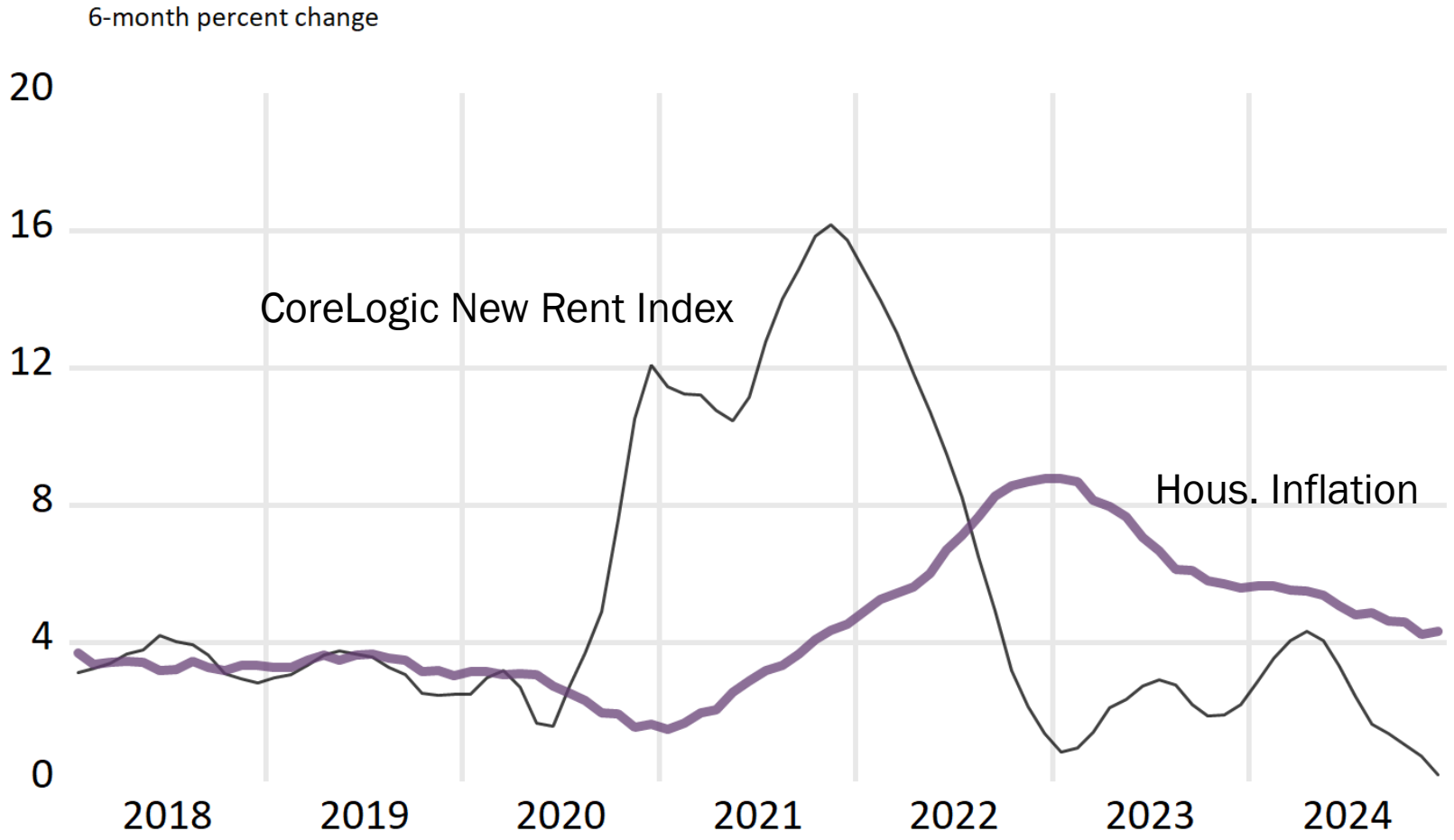
Note: ECI wages is the employment cost index for private industry. Data are quarterly.
Note: Core services ex. housing is the personal consumption expenditures (PCE) price index for Core services ex. housing.
Source: U.S. Bureau of Economic Analysis via Haver Analytics. Bureau of Labor Statistics.

Housing Services Inflation



Note: Housing inflation is the personal consumption expenditures (PCE) price index for housing services.
Core PCE is PCE price deflator that excludes food and energy. Data are monthly.
Sources: U.S. Bureau of Economic Analysis. Haver Analytics.

Housing Services Inflation and New Rents



Note: Housing inflation is the personal consumption expenditures (PCE) price index for housing services.
New rent index is single family detached rent index from CoreLogic.
Sources: U.S. Bureau of Economic Analysis. Haver Analytics. CoreLogic.

The Phillips Curve(s)

How to think of inflation and its relationship with the rest of the economy?

Wage Phillips Curve

Wage Phillips curve: workers bargain over expected real wage growth

- $w_t - p_t^e = w_{t-1} - p_{t-1} + \Delta prod_t + a - bU_t$

The expected real wage is the past real wage with two updates.

1) An update that factors in improvements in productivity

- Since workers would expect to earn more if they are more productive

2) An update related to current labor market conditions, summarized by the unemployment rate or other proxies for labor mkt tightness.

- If the unemployment rate is high, there will be a lot of competition for a job and workers expect slower salary growth; conversely, if the unemployment rate is very low, the labor market will be ‘tight’ and workers can bargain for higher wages.

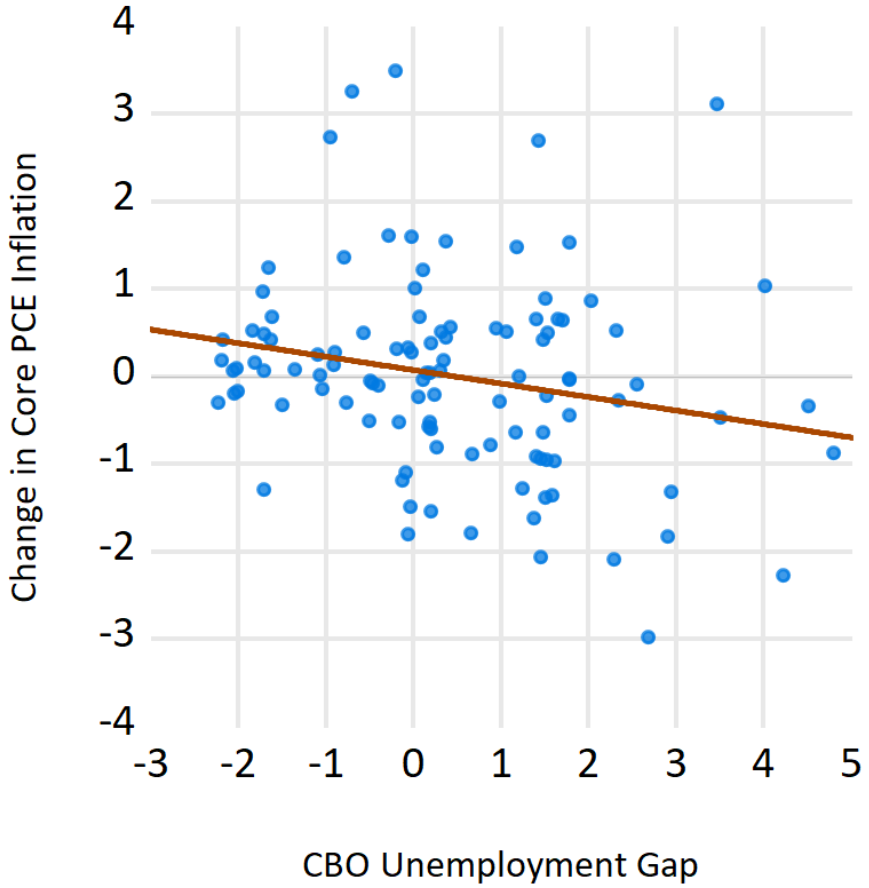
Expectations Augmented Phillips Curve

- Firms charge a mark-up μ over wages, net of productivity
  - $p_t = \mu_t + w_t - prod_t$
- Substituting mark-up equation in wage Phillips curve, you get the expectation augmented Phillips curve
  - $\pi_t = \pi_t^e + b(U_t - U_t^*)$
- Under assumption of simplest adaptive expectations, expected inflation is lagged inflation
  - $\pi_t^e = \pi_{t-1}$
- Plug in expectations augmented Phillips curve and assume that $\Delta\mu_t = 0$ to get the "accelerationist" Phillips curve
  - $\pi_t = \pi_{t-1} + b(U_t - U_t^*)$

Some Empirical Results

Which Phillips curve better captures inflation dynamics?

The Accelerationist Phillips Curve: 1960-1986

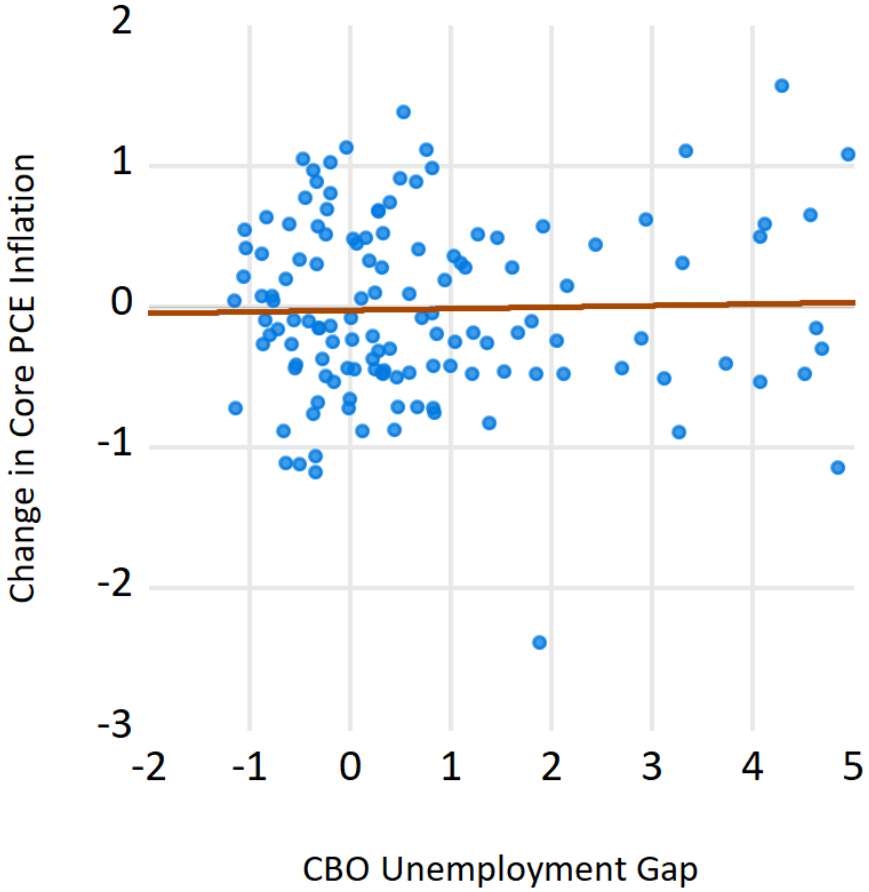


Note: Change in core PCE inflation is first difference of personal consumption expenditures price deflator that excludes food and energy.
CBO unemployment gap is the unemployment gap from the Congressional Budget Office (CBO).
Orange line is fit from regression of variable on y-axis to variable on x-axis.
Quarterly data from 1960Q1 to 1986Q4.
Sources: U.S. Bureau of Economic Analysis. Haver Analytics. Congressional Budget Office. FRB staff calculations.

Baseline Model

- The accelerationist Phillips curve
  - $\pi_t = \pi_{t-1} - b(U_t - U_t^*)$
- Implies that inflation will continue falling when $U_t > U_t^*$
- Those dynamics do not capture well the Great Moderation, in which inflation has been very flat and mean reverting to its long-run trend.
- A more general, better-fitting Phillips curve for my ***baseline*** model is
  - $\pi_t = a\pi_{t-1} + (1-a)\pi_t^{lre} - b(U_t - U_t^*)$
- Where π_t^{lre} are long-run inflation expectations

The Accelerationist Phillips Curve: 1987-2019



Note: Change in core PCE inflation is first difference of personal consumption expenditures price deflator that excludes food and energy.
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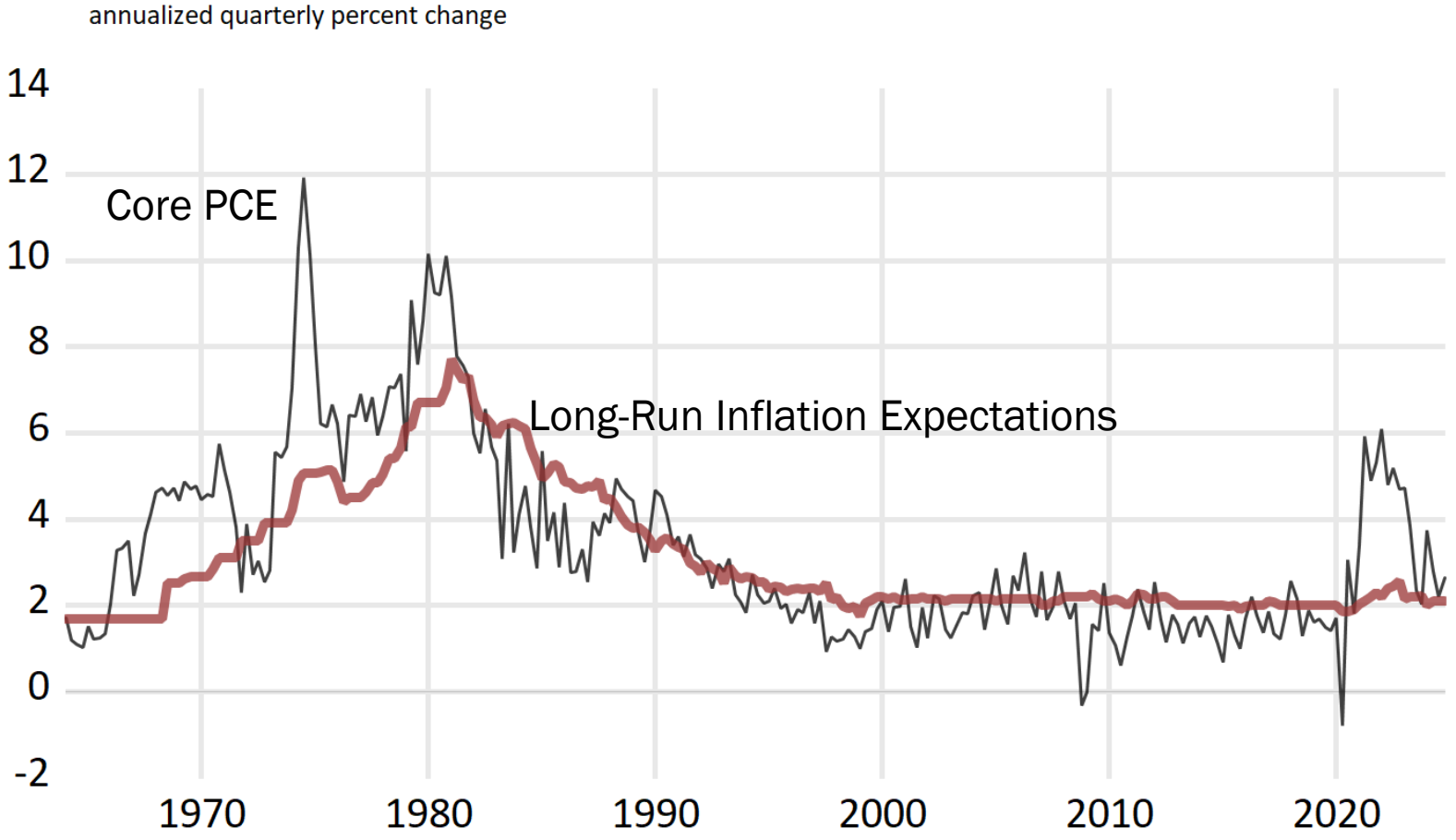
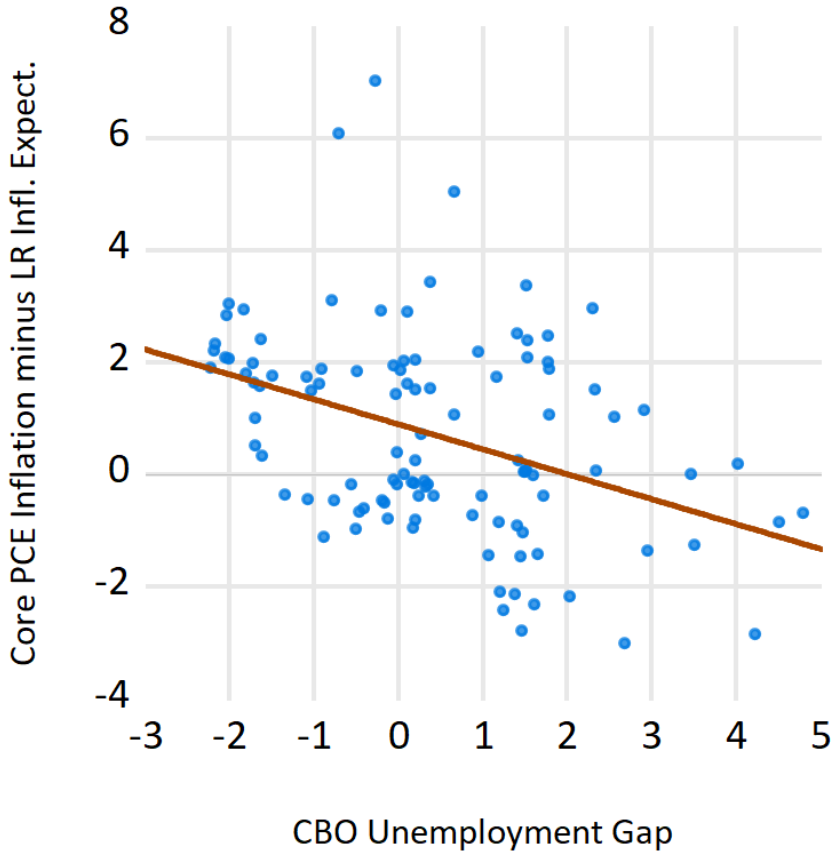
Quarterly data from 1987Q1 to 2019Q4.
Sources: U.S. Bureau of Economic Analysis. Haver Analytics. Congressional Budget Office. FRB staff calculations.

Inflation and Long-Run Inflation Expectations



Note: Core PCE is PCE price deflator that excludes food and energy.
Long-run inflation expectations derived from FRB calculations, a survey conducted by Richard Hoey and from the Survey of Professional Forecasters, conducted by the Federal Reserve Bank of Philadelphia
Sources: U.S. Bureau of Economic Analysis. Haver Analytics. Federal Reserve Bank of Philadelphia and FRB staff calculations

Baseline Phillips Curve: 1960-1986



Note: Core PCE inflation minus LR infl. expect. is difference of personal consumption expenditures price deflator minus long run inflation expectations.
CBO unemployment gap is the unemployment gap from the Congressional Budget Office (CBO).
Long-run inflation expectations derived from FRB calculations, a survey conducted by Richard Hoey and from the Survey of Professional Forecasters, conducted by the Federal Reserve Bank of Philadelphia
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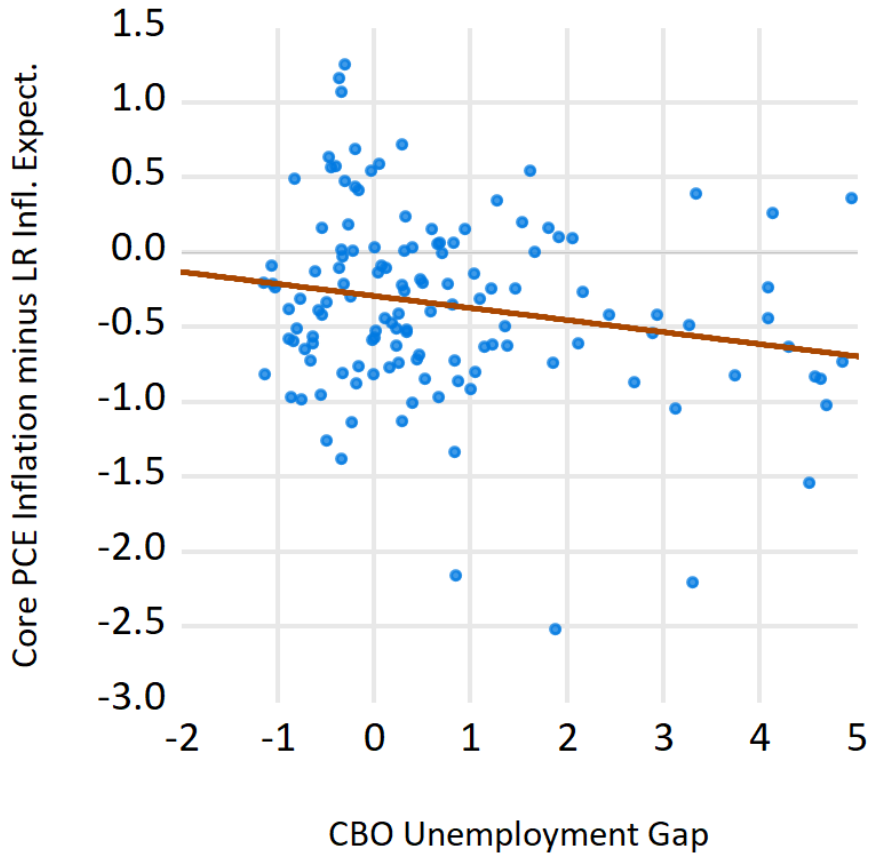
Sources: U.S. Bureau of Economic Analysis. Haver Analytics. Congressional Budget Office. FRB staff calculations.

Baseline Phillips Curve: 1987-2019



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Quarterly data from 1987Q1 to 2019Q4.
Sources: U.S. Bureau of Economic Analysis. Haver Analytics. Congressional Budget Office. FRB staff calculations.

Update of Baseline Model

In recent inflationary experience job openings climbed to more than 2 per unemployed workers, so alternative to unemployment rate for capturing tightness in labor markets is the V/U ratio

- $\pi_t = a\pi_{t-1} + (1-a)\pi_t^{lre} - b(V_t/U_t)$

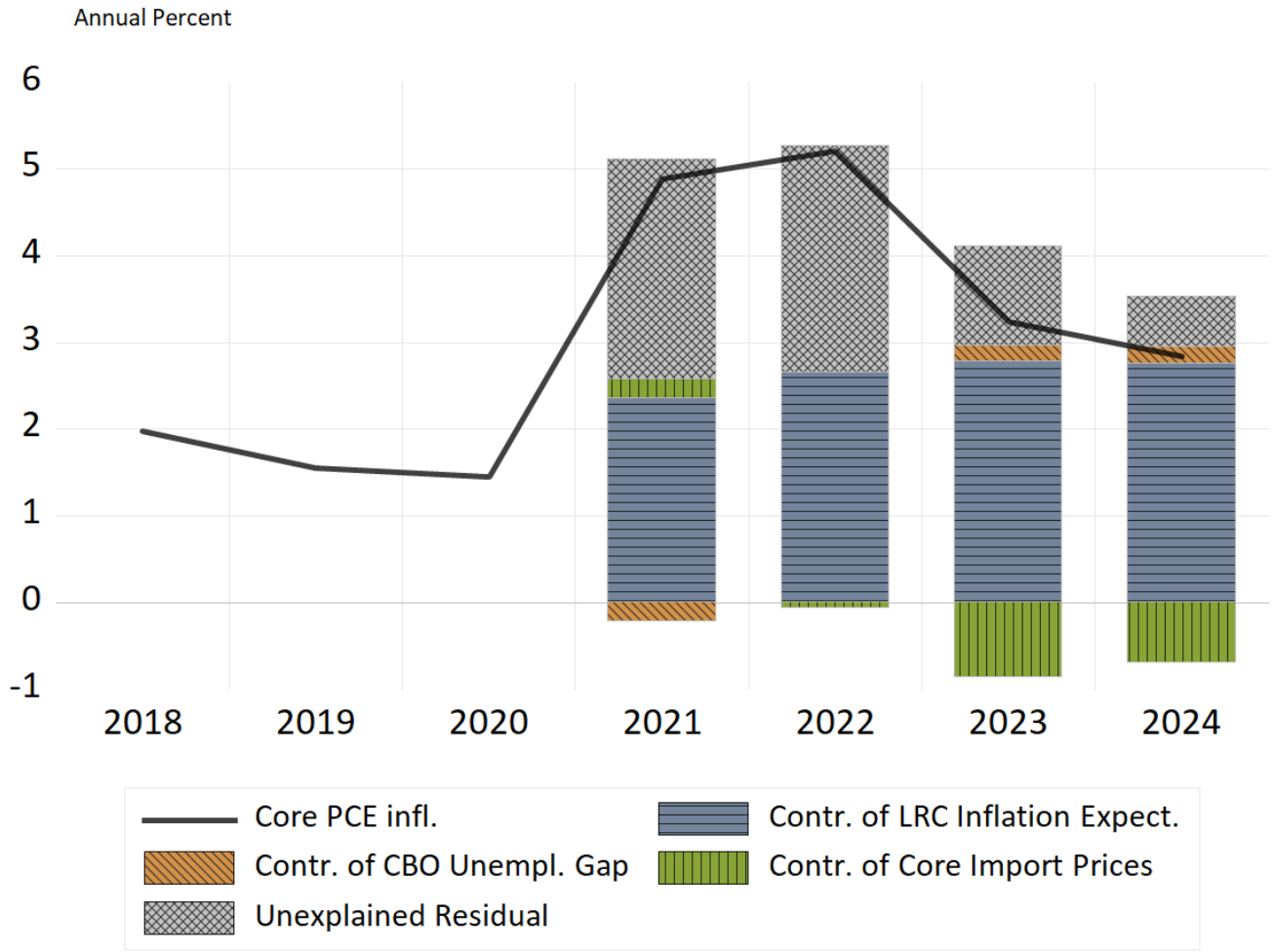
In addition, supply snarls also reportedly affected tightness in labor and product markets

- $\pi_t = a\pi_{t-1} + (1-a)\pi_t^{lre} - b(U_t - U_t^*) + Shortage_t$

Additional Empirical Results

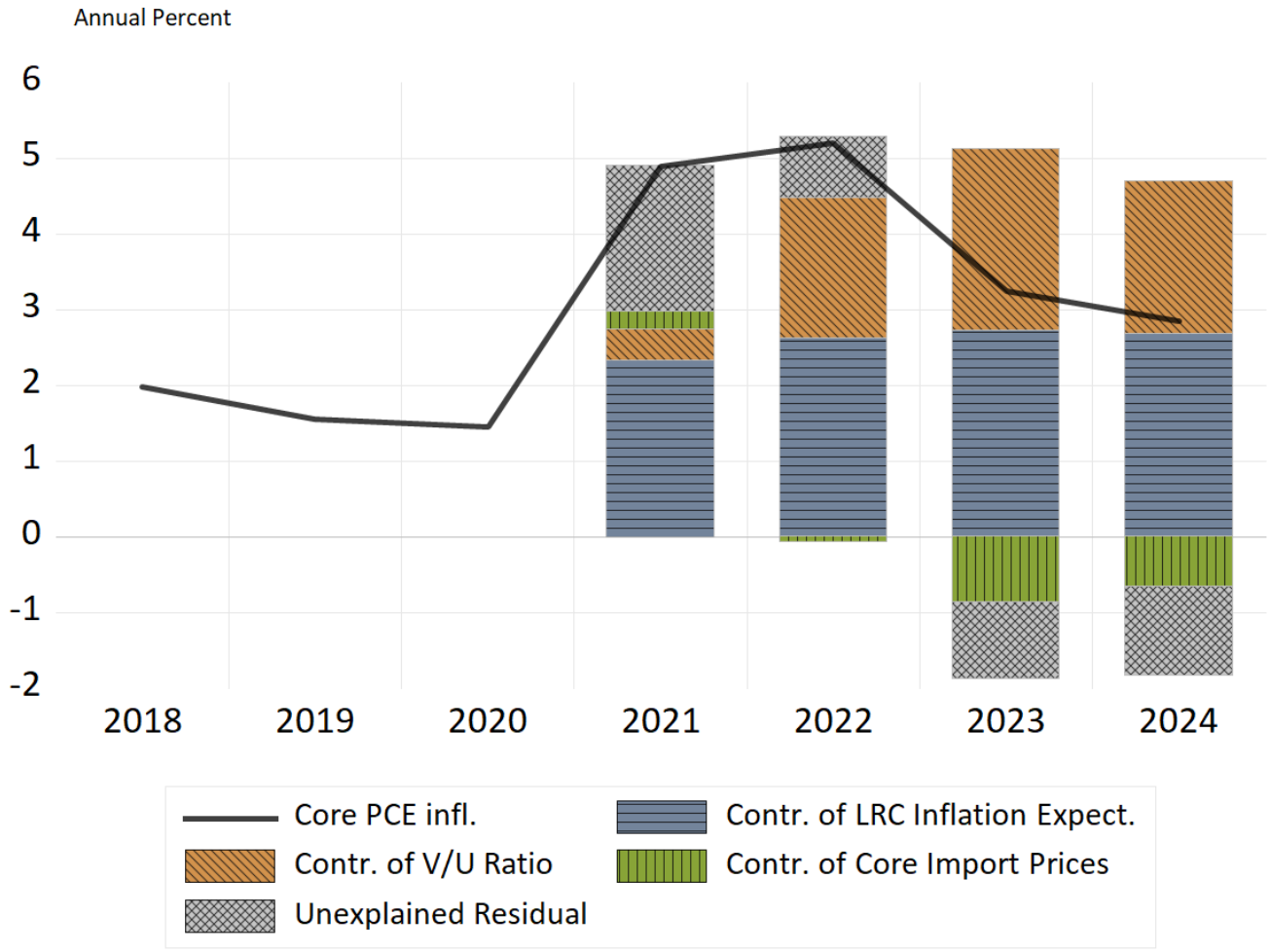
What have we learned from the recent run-up in inflation?

Dynamic Sim: Baseline Model



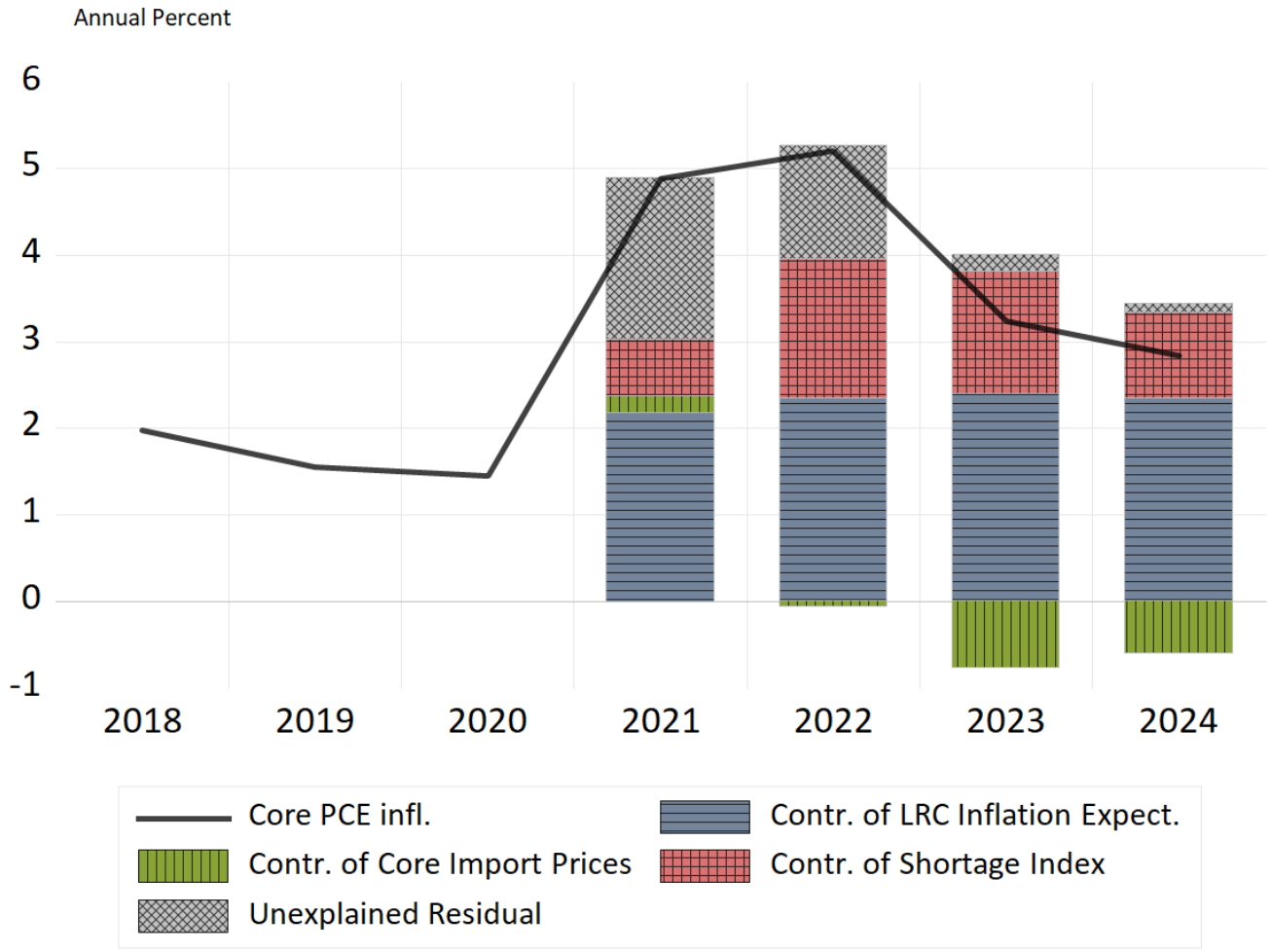
Note: Core PCE is the personal consumption expenditure price index excluding food and energy. Data are annual. Model estimated with data from 1960 to 2019.
Sources: U.S. Bureau of Economic Analysis. Haver Analytics. Congressional Budget Office. FRB staff calculations.

Dynamic Sim: V/U Model



Note: Core PCE is the personal consumption expenditure price index excluding food and energy. Data are annual. Model estimated with data from 1960 to 2019.
Sources: U.S. Bureau of Economic Analysis. Haver Analytics. Congressional Budget Office. FRB staff calculations.

Dynamic Sim: Shortage Model



Note: Core PCE is the personal consumption expenditure price index excluding food and energy. Data are annual. Model estimated with data from 1960 to 2019.
Sources: U.S. Bureau of Economic Analysis. Haver Analytics. Congressional Budget Office. FRB staff calculations.