



Use of Models at the Chicago Fed

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November 19, 2024

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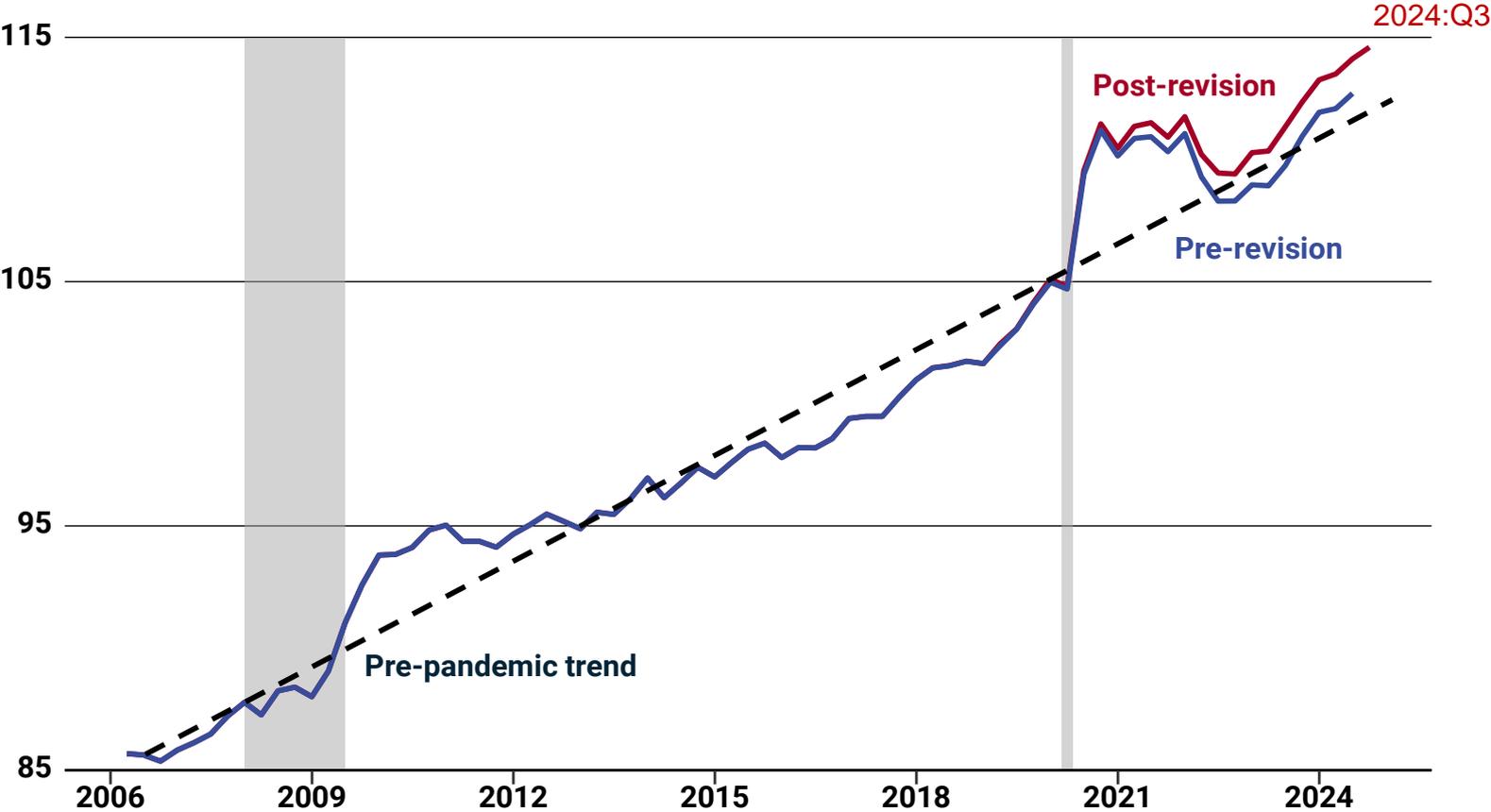
Roadmap

- **Theoretical models**
 - Organize and discipline thinking
 - Common language
- **Empirical models**
 - Explaining the data
 - Forecasting
 - Simulations
- **Economic and policy situation today**

Productivity trend may be increasing

Productivity

(Index, 2017=100)



Note: Trend line calculated from 2007:Q4 to 2019:Q4
Source: Bureau of Labor Statistics and Bureau of Economic Analysis via Haver Analytics

What might it mean for monetary policy?

- **Solow growth model**

$$Y_t = K_t^\alpha \left[A_t L_t \right]^{1-\alpha}$$

$$S_t = sY_t = \dot{K}_t + (1 - \delta) K_t$$

L_t grows at rate n ; A_t grows at rate g

$$\text{MPK} = \frac{\partial Y}{\partial K} = r = \alpha \left[\frac{n + g + \delta}{s} \right]$$

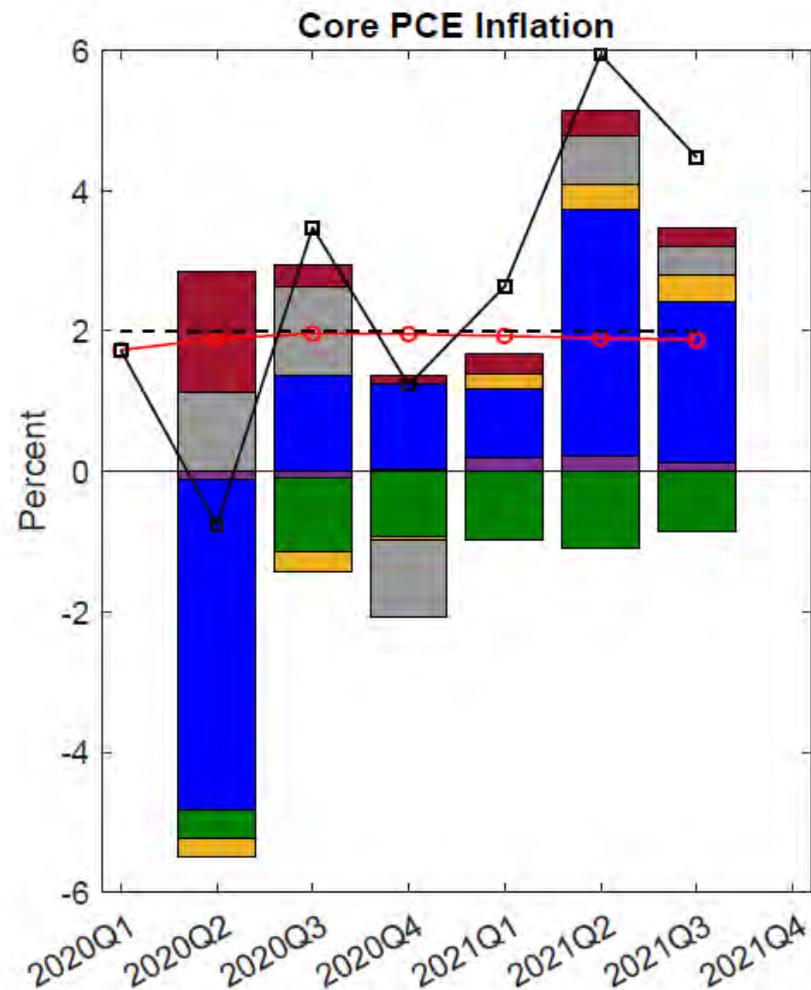
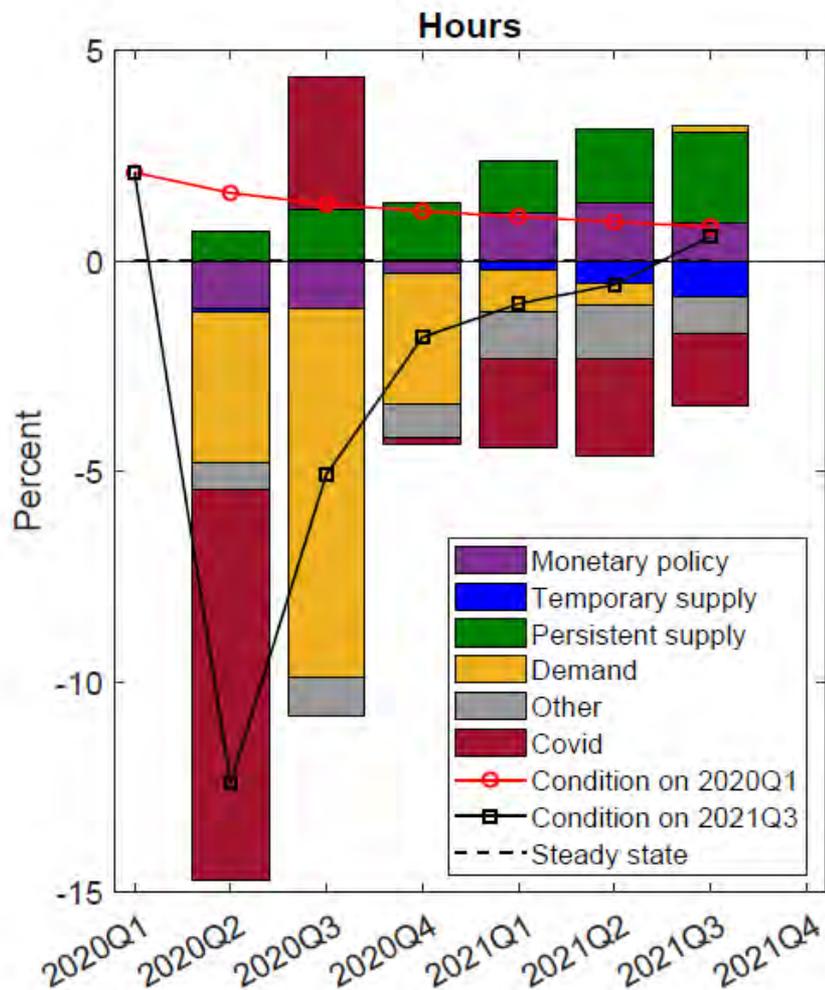
What might it mean for monetary policy?

- **New Keynesian model – dynamics & policy objectives**
 - Intertemporal Euler equation => consumption smoothing
 - “Devine coincidence” => close output gaps \Leftrightarrow stabilize inflation; Interest rate is policy tool to close the gaps
 - Transitory productivity shock hitting today => stimulate consumption today to avoid output gap => lower r
 - Persistent productivity shock means => hold back consumption today to avoid overshooting and inflation => higher r
 - These kinds of discussions took place in the 1990s
- **Other examples**
 - Search and matching models to help explain labor markets
 - Preferred habitat models when thinking about QE
 - Etc., etc....

FRBC empirical models

- **Explaining the data**
 - Giving structural interpretations to incoming data
 - DSGE; term structure
- **Forecasting GDP and major aggregates, inflation, unemployment**
 - “Nowcasting” the current quarter: monthly indicators to forecast quarterly sector-by-sector; small dimensional models relating labor market to GDP; large dimensional BVAR.
 - Medium term forecasts: medium scale VARs, DSGE; ad hoc modeling
 - In the end: write down a judgmental forecast

Using the DSGE to think about Covid

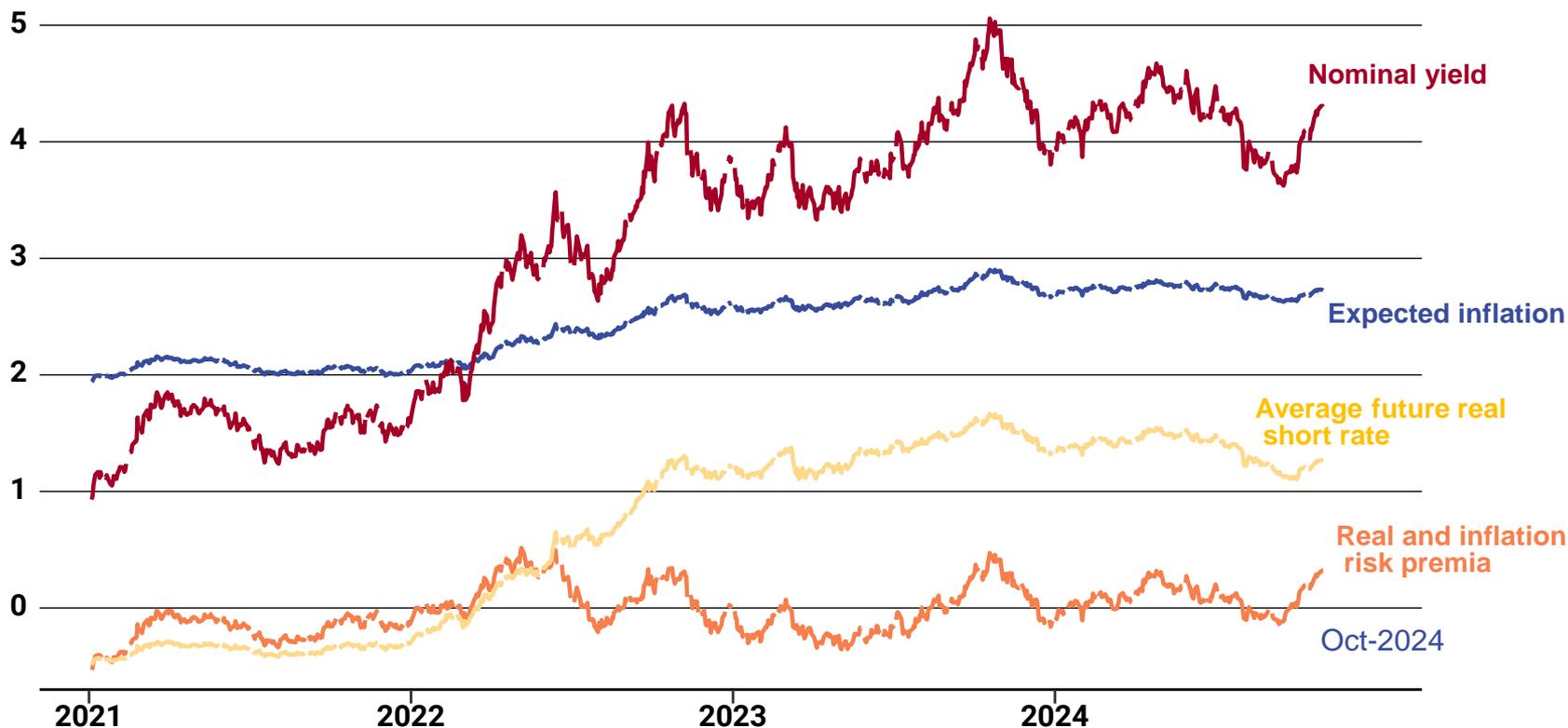


Source: <https://www.chicagofed.org/publications/working-papers/2022/2022-39>

10-year Treasury rate decomposition

D'Amico, Kim, Wei term-structure model

(10 year percent, annualized)



Source: Federal Reserve Board via Haver Analytics

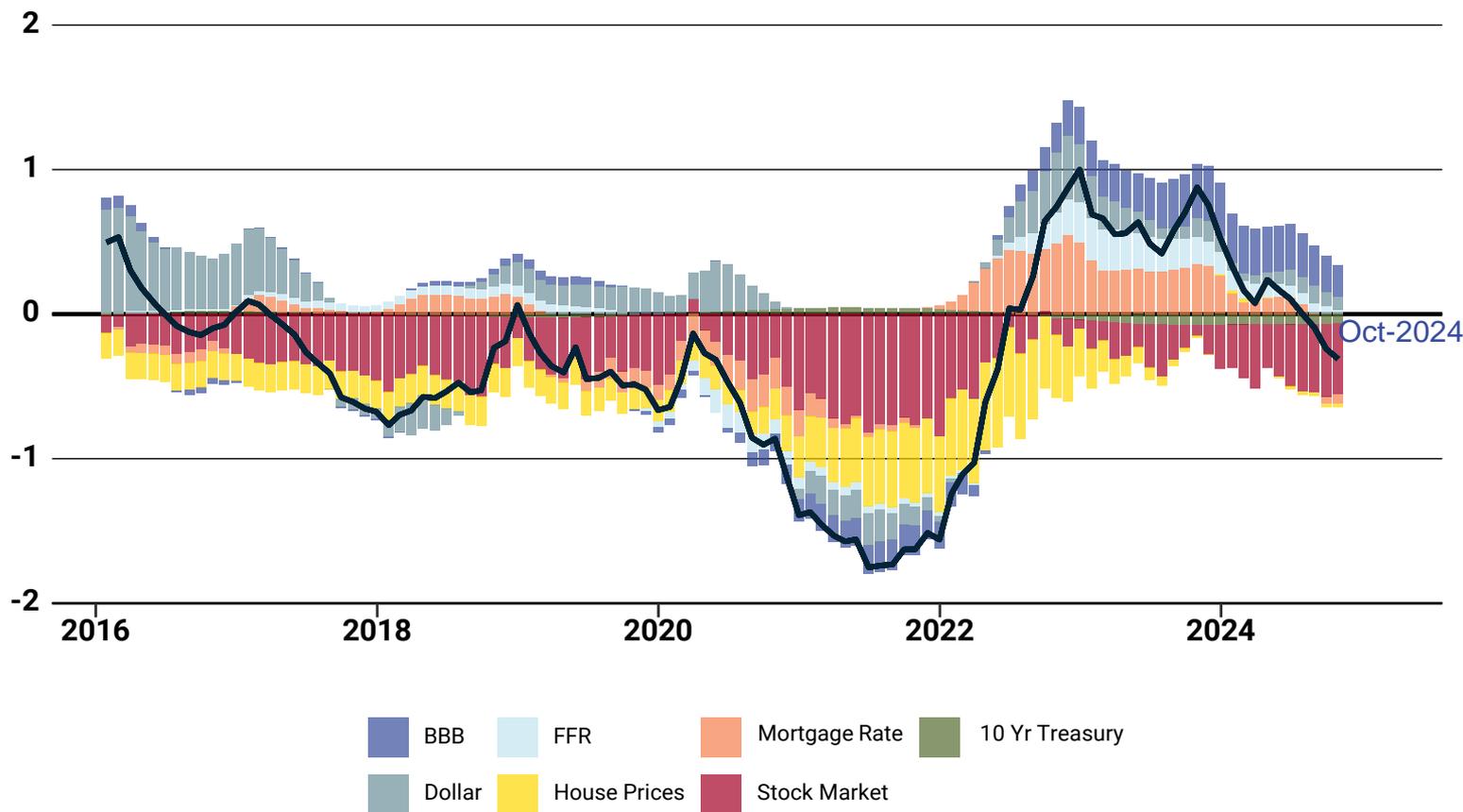
Federal Reserve Board models

- **Main unified one is FRB/US**
 - Large scale model. “Semi structural”. Specifications for “target” consumption, investment, etc. as you would expect from theory, then partial adjustment of actuals to targets
 - Use for informing forecasts and running simulations of alternative economic scenarios and monetary policy functions
- **Other macro models: SIGMA; DSGEs**
- **Have lots of sector and smaller aggregate models that inform forecast/analysis**

Effects of financial markets – FRB/US

Financial Conditions Impulse on Growth

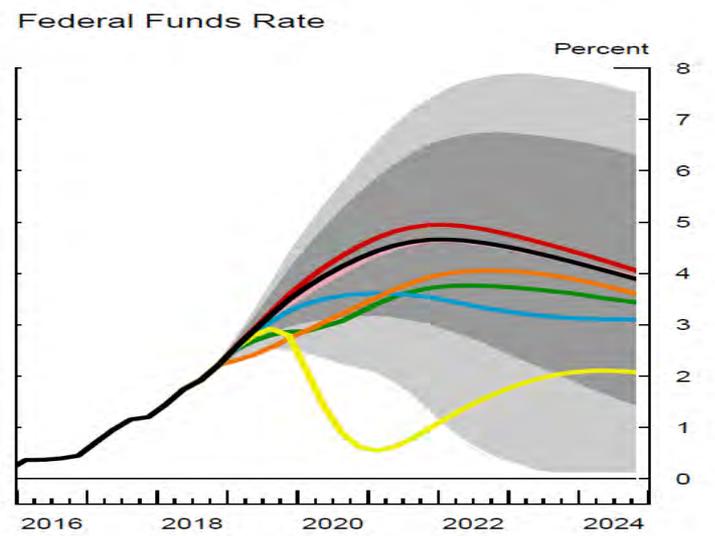
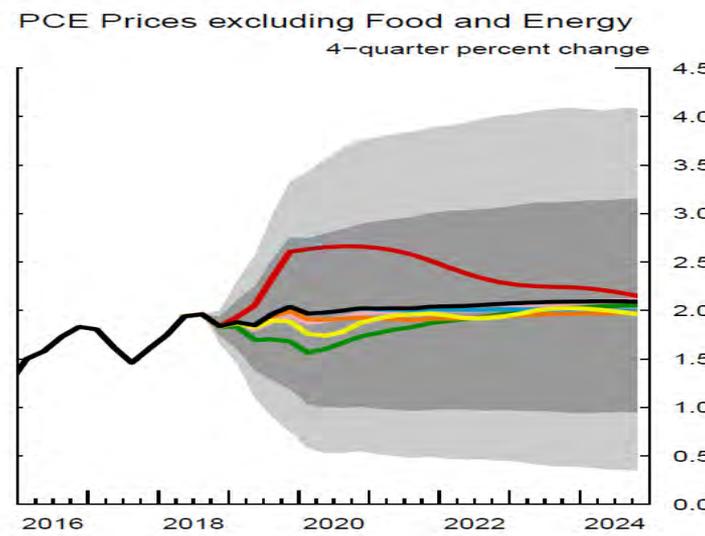
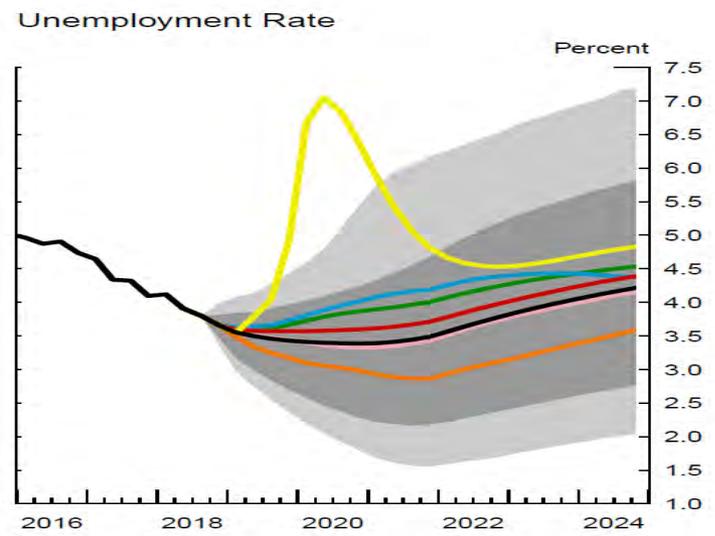
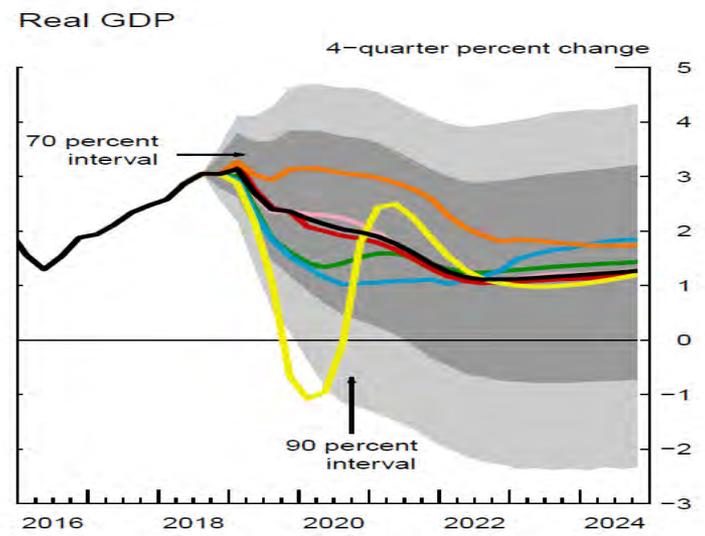
(Contributions to GDP growth over the next year, percent)



Source: Federal Reserve Board of Governors

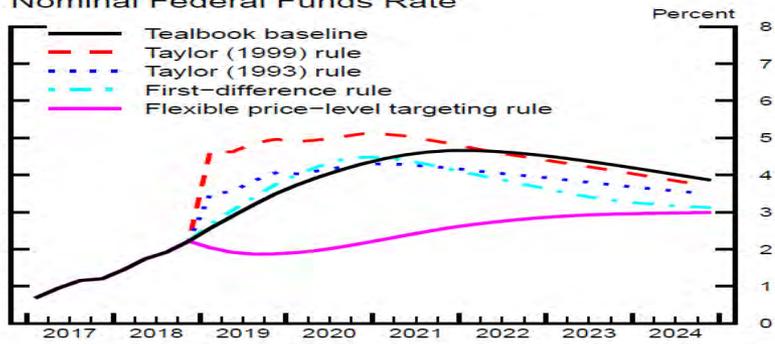
Confidence Intervals Based on FRB/US Stochastic Simulations

- Tealbook baseline and extension
- Financial-based recession
- Stronger supply side
- Supply constraints
- Greater interest rate sensitivity
- Foreign slowdown
- Lower oil prices

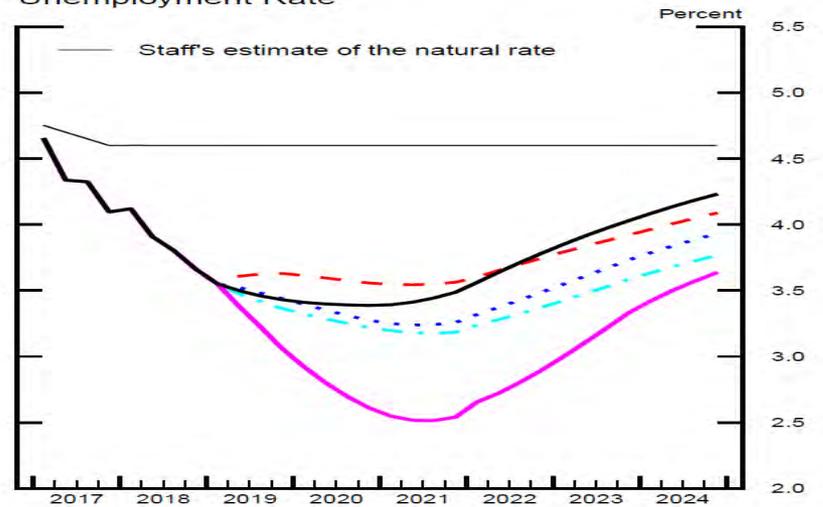


Simple Policy Rule Simulations

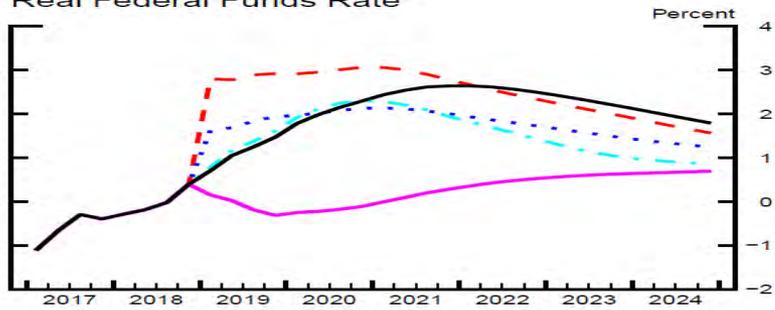
Nominal Federal Funds Rate



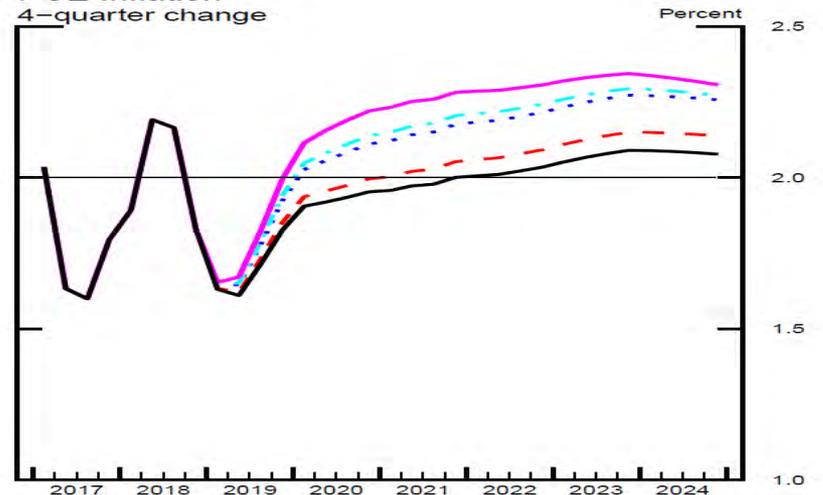
Unemployment Rate



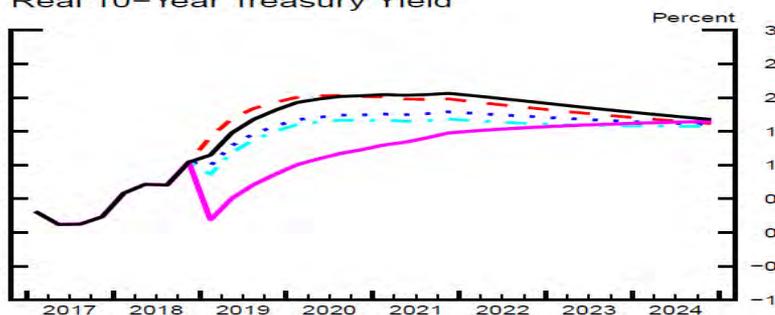
Real Federal Funds Rate



PCE Inflation 4-quarter change



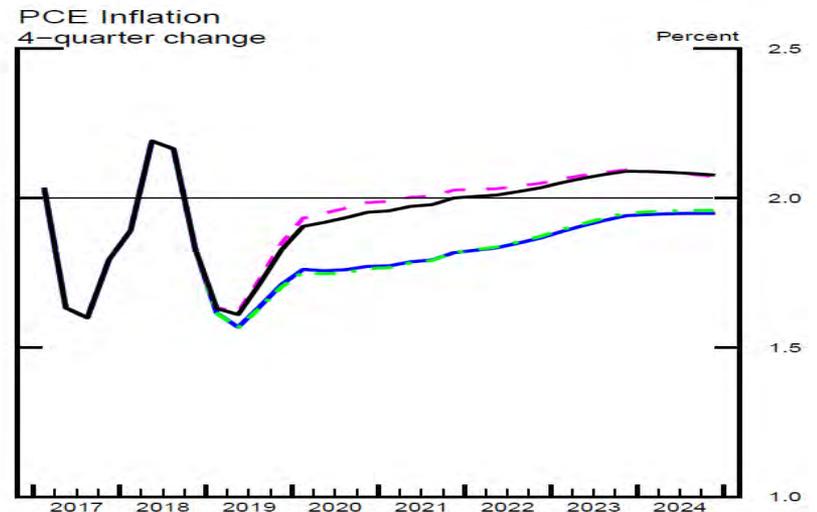
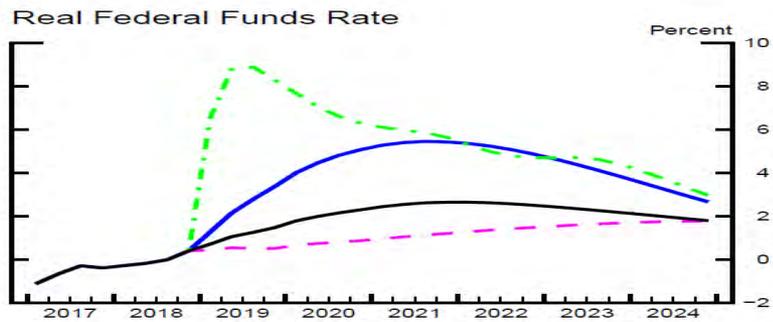
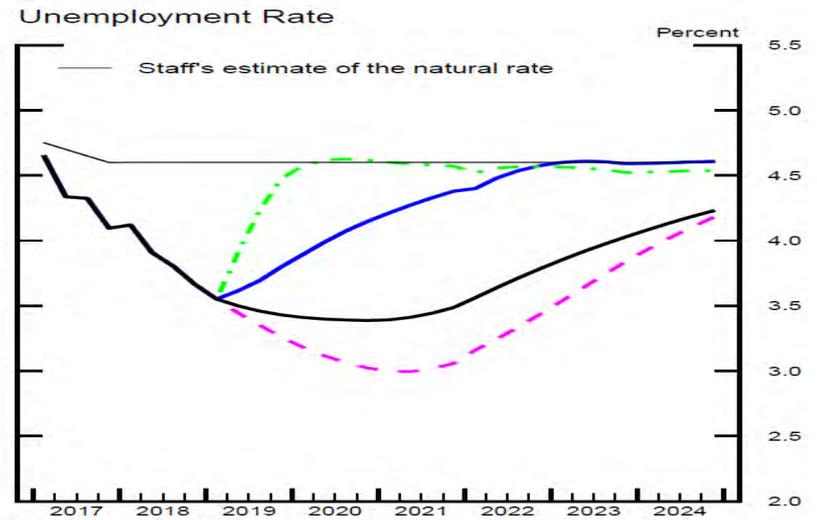
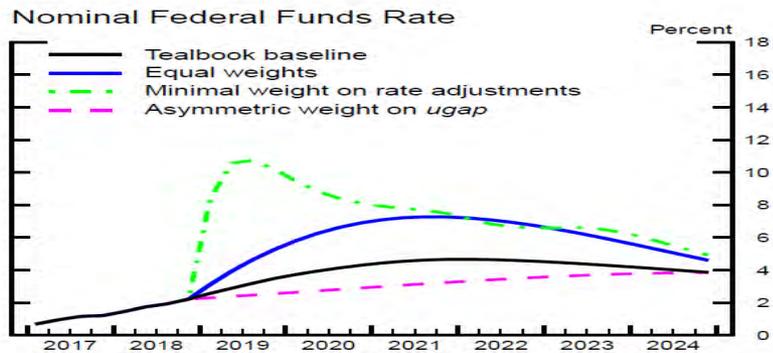
Real 10-Year Treasury Yield



Note: The policy rule simulations in this exhibit are based on rules that respond to core inflation rather than to headline inflation. This choice of rule specification was made in light of a tendency for current and near-term core inflation rates to outperform headline inflation rates as predictors of the medium-term behavior of headline inflation.

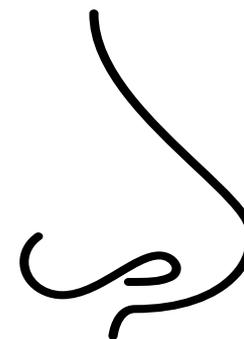
Optimal Control Simulations under Commitment

Committee's 2 percent objective



Note: Each set of lines corresponds to an optimal control policy under commitment in which policymakers minimize a discounted weighted sum of squared deviations of 4-quarter headline PCE inflation from the Committee's 2 percent objective, of squared deviations of the unemployment rate from the staff's estimate of the natural rate, and of squared changes in the federal funds rate. The weights vary across simulations. See the appendix for technical details and the box "Optimal Control and the Loss Function" in the June 2016 Tealbook B for a motivation.

Two very important models

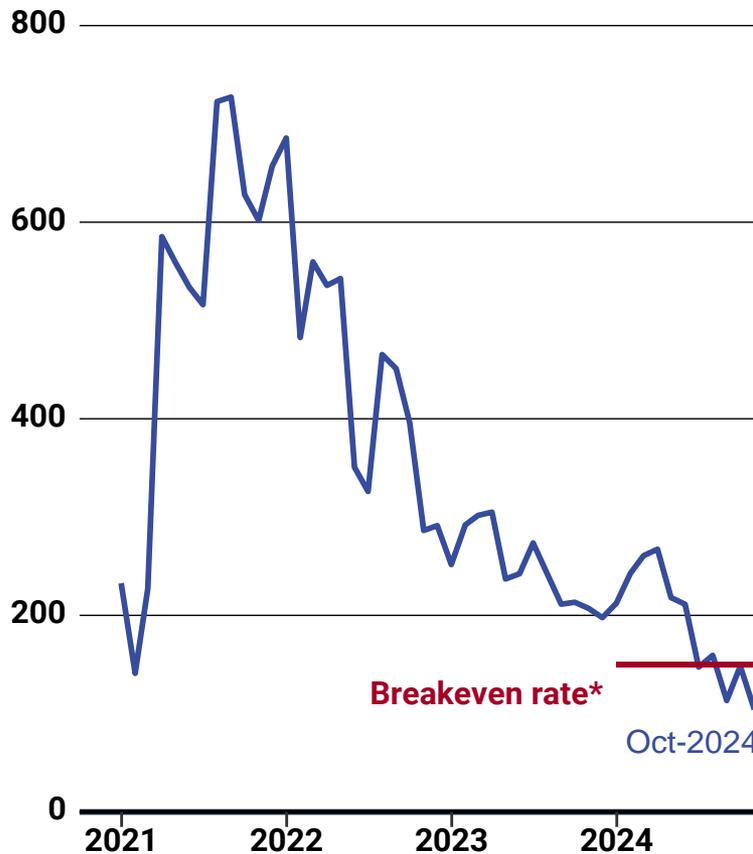


Economic and policy situation today

Labor market cooling, but still solid

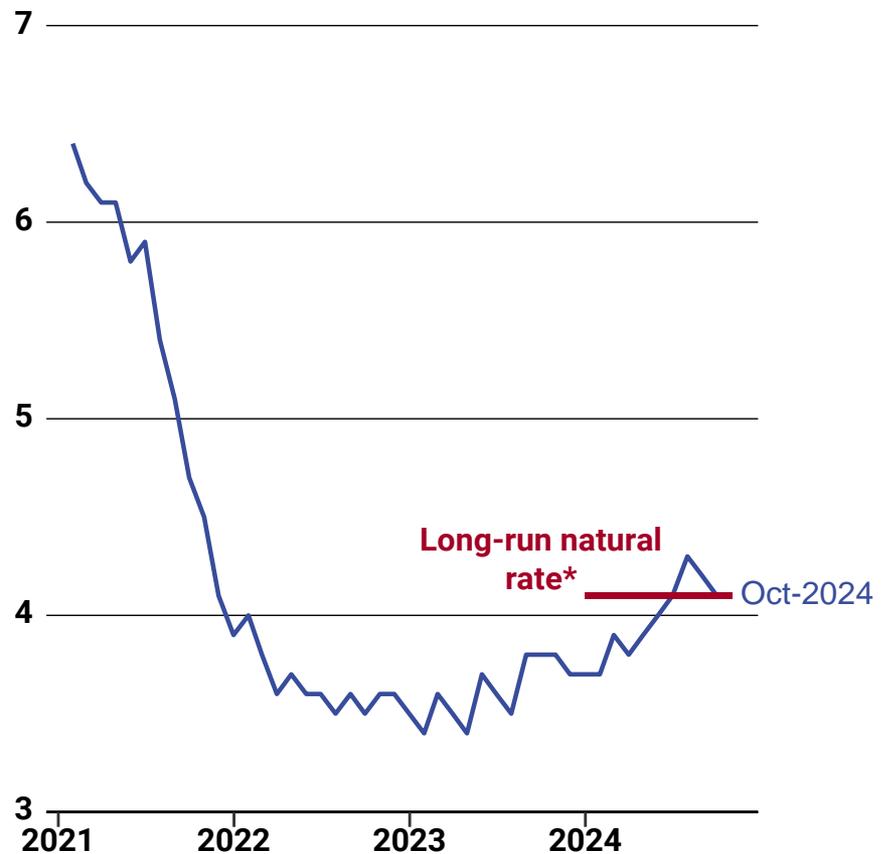
Payroll gains

(3-month moving average, SA)



Unemployment rate

(Percent, SA)



* Blue Chip Consensus

Source: Bureau of Labor Statistics via Haver Analytics

Layoffs and job-finding near pre-pandemic

UI claims and JOLTS layoff rate

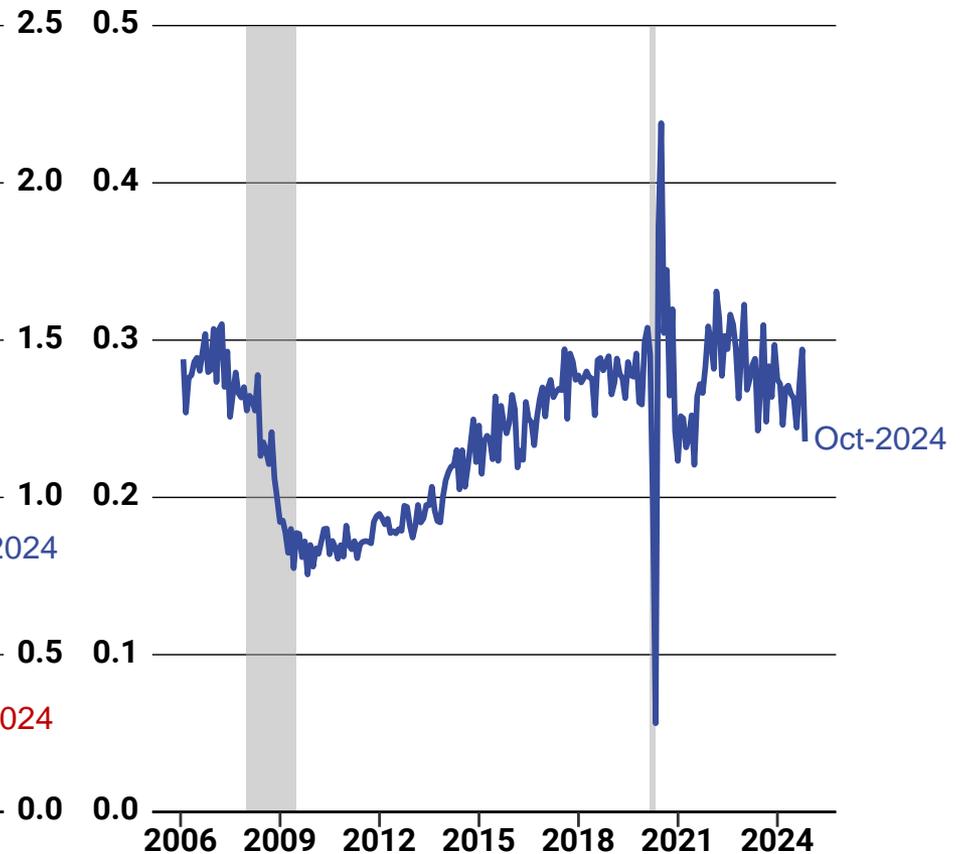
(Thousands, LHS; Percent, RHS)



Source: BLS and Dept. of Labor via Haver Analytics

Job Finding Rate

(Percent, SA)

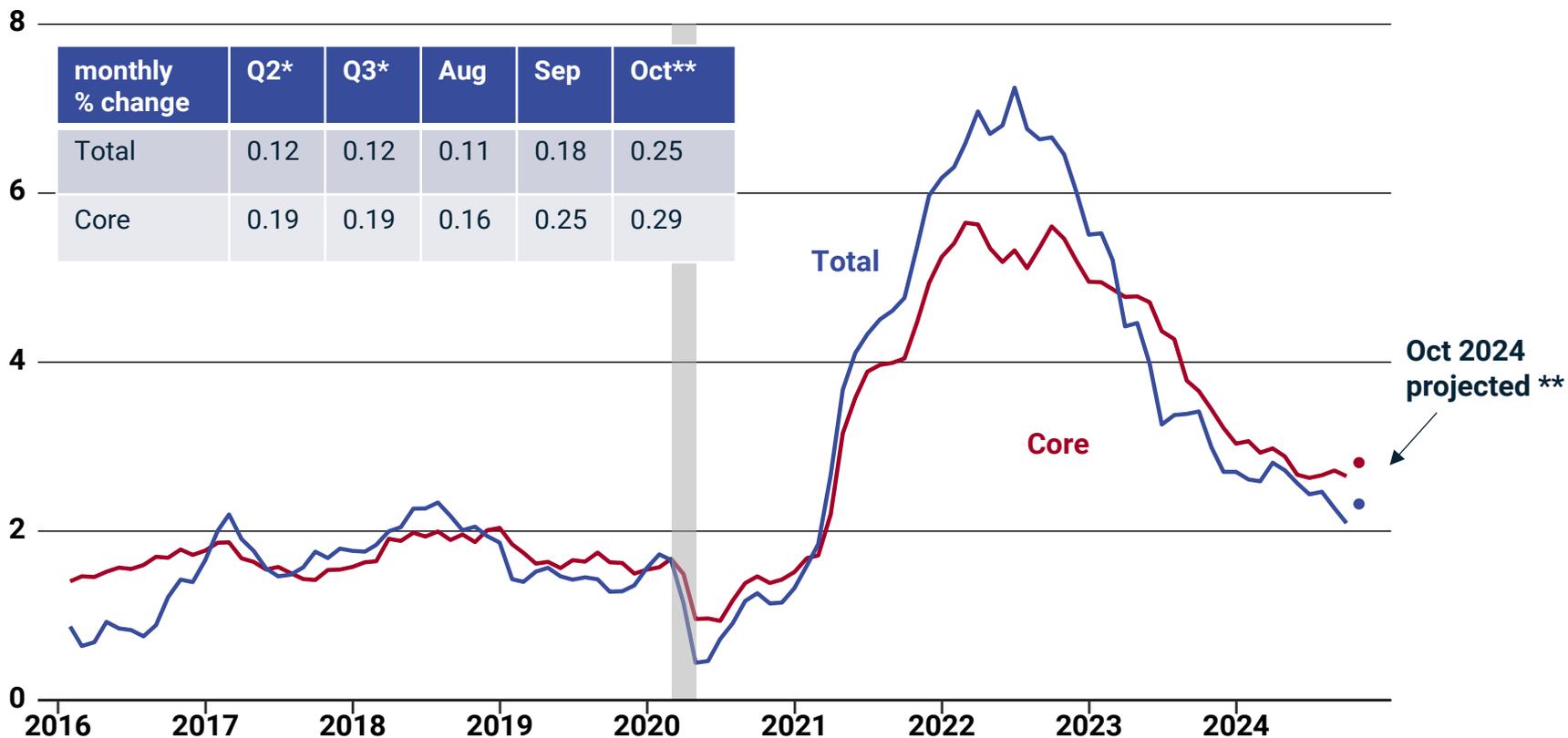


Source: Bureau of Labor Statistics via Haver Analytics

Inflation has cooled; last couple numbers bit high

PCE Price Index

(12-month percent change)



*Average monthly rate of inflation over the period

** Median projection of outside forecasters

Source: Bureau of Labor Statistics via Haver Analytics, Bloomberg

Financial market developments

Treasury Yields

(Percent)



Source: Board of Governors of the Federal Reserve System via Haver Analytics

TIPS Inflation Compensation

(Percent)

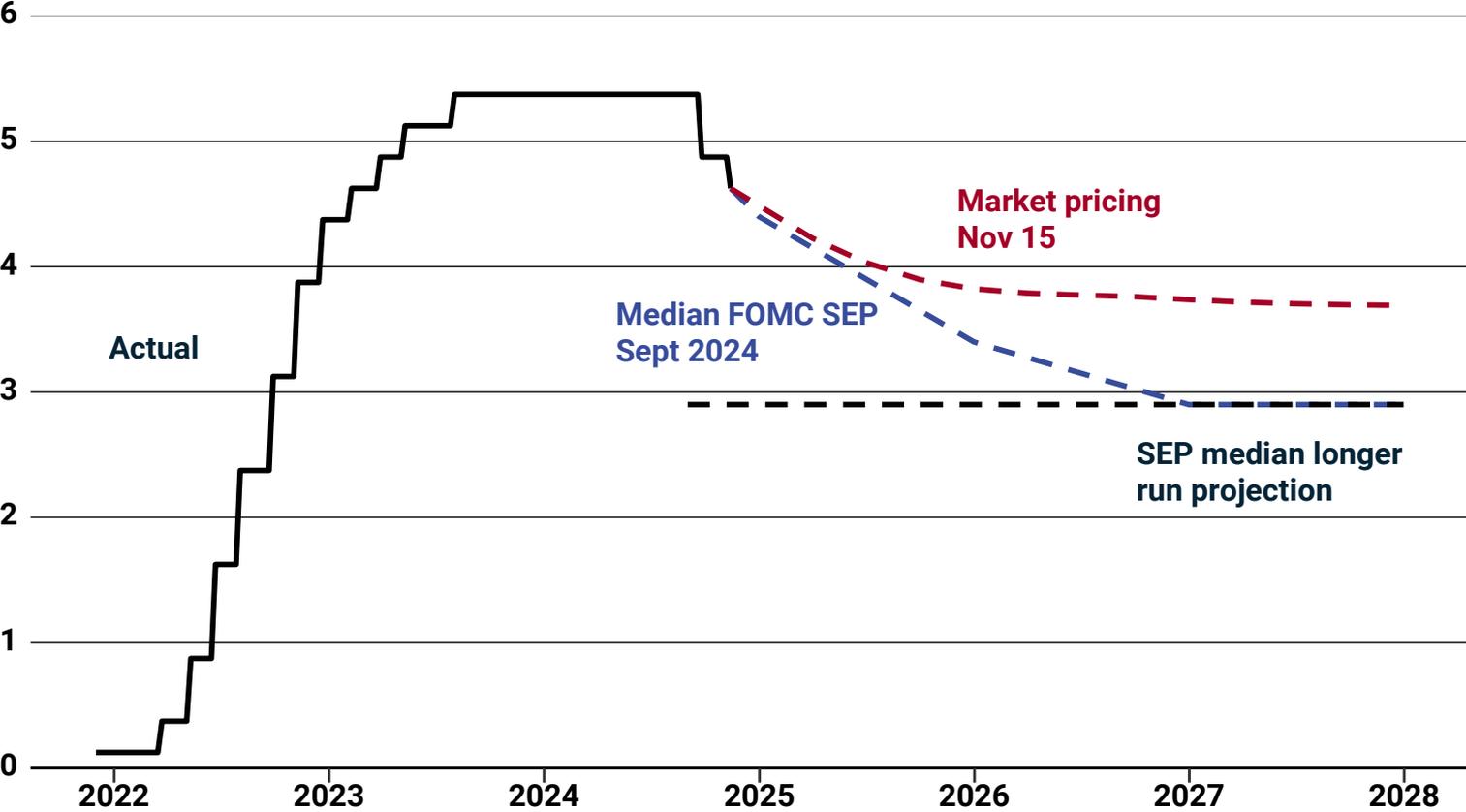


Source: Board of Governors of the Federal Reserve System

Fed funds rate path

Federal funds rate expectations

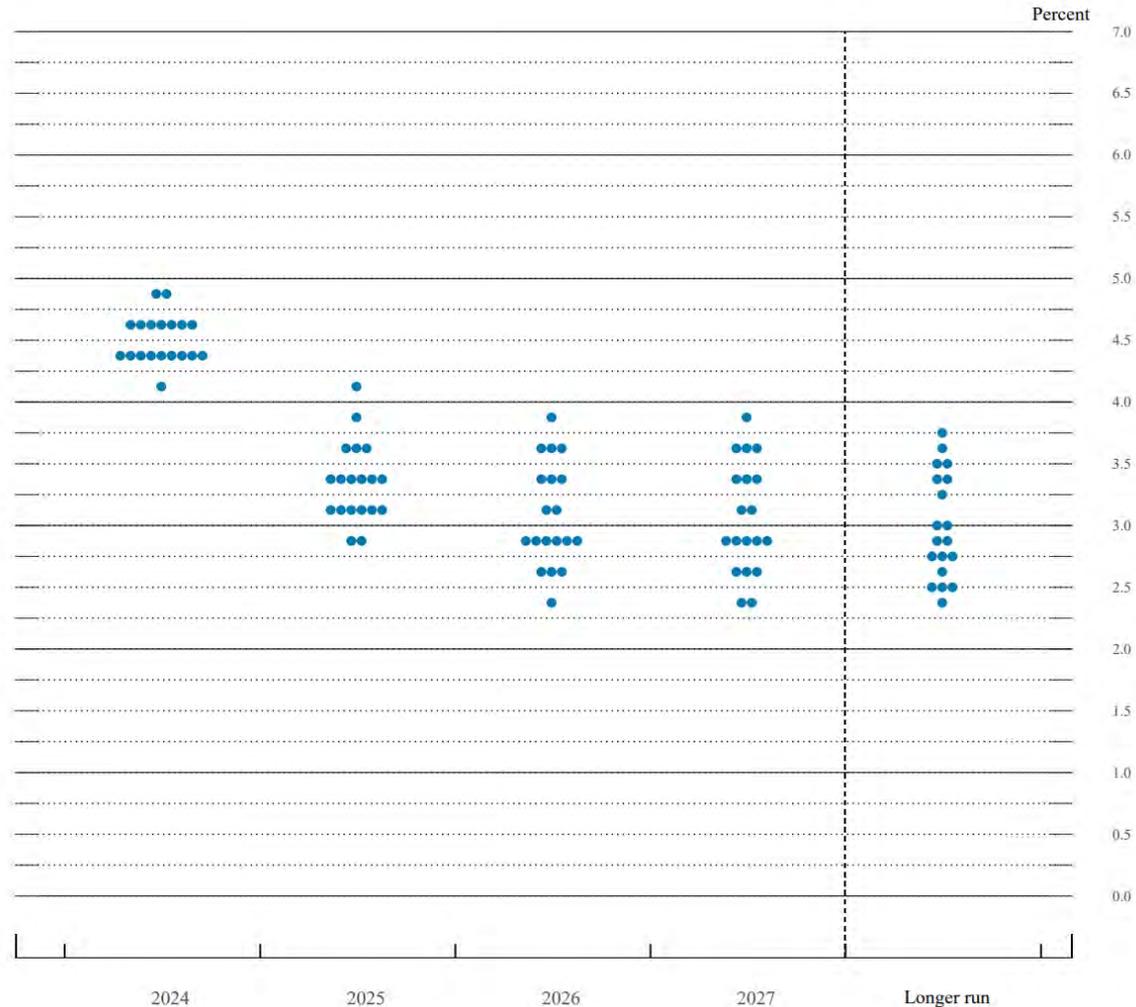
(Percent)



Sources: Federal Reserve Board of Governors

FOMC participants' funds rate projections

September 2024 FOMC



Source: Federal Reserve Board of Governors

September FOMC SEP median outlook

Projection	2024	2025	2026	2027	Long run
GDP	2.0	2.0	2.0	2.0	1.8
<i>June</i>	2.1	2.0	2.0		1.8
Unempl. rate	4.4	4.4	4.3	4.2	4.2
<i>June</i>	4.0	4.2	4.1		4.2
Total PCE	2.3	2.1	2.0	2.0	2.0
<i>June</i>	2.6	2.3	2.0		2.0
Core PCE	2.6	2.2	2.0	2.0	2.0
<i>June</i>	2.8	2.3	2.0		2.0

Source: FOMC Summary of Economic Projections, September and June 2024

Blue Chip Consensus forecasts

Variable	'24:Q3	'24:Q4	2024	2025
GDP¹	2.8	1.9	2.3	1.8
<i>September</i>	1.7	1.5	1.9	1.9
Unemploy. Rate²	4.2	4.2	4.2	4.2
<i>September</i>	4.2	4.3	4.3	4.3
PCE inflation¹	2.3	2.4	2.4	2.3
<i>September</i>	2.3	2.3	2.3	2.1
Core PCE inflation¹	2.7	2.8	2.8	2.3
<i>September</i>	2.6	2.7	2.7	2.2

¹Quarterly data are quarterly change at an annual rate; annual data are Q4/Q4 percent changes

²Quarterly data are quarterly average; annual data are Q4 level

Source: S&P and BlueChip via Haver Analytics; investment bank newsletters

Appendix

What might it mean for monetary policy?

- **New Keynesian model – dynamics & policy objectives**

$$y_t = E_t[y_{t+1}] - \frac{1}{\sigma}(i_t - E_t[\pi_{t+1}] - \rho).$$

$$x_t = E_t[x_{t+1}] - \frac{1}{\sigma}(i_t - E_t[\pi_{t+1}] - rr_t^*).$$

$$x_t = y_t - y_t^*$$

$$rr_t^* = \rho + \sigma(E_t[y_{t+1}^*] - y_t^*).$$

$$\pi_t = \beta E_t[\pi_{t+1}] + \kappa(y_t - y_t^*).$$