
Economic Outlook and Monetary Policy

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Advanced Workshop for Central Bankers
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The views I express here are my own and do not necessarily reflect the views of the Federal Reserve Bank of Chicago or within the Federal Reserve System.

Topics for Today

■ Growth

- Sector developments; potential output; forecast

■ Inflation

- Recent developments; Phillips curve issues

■ Financial conditions

- The yield curve and recessions

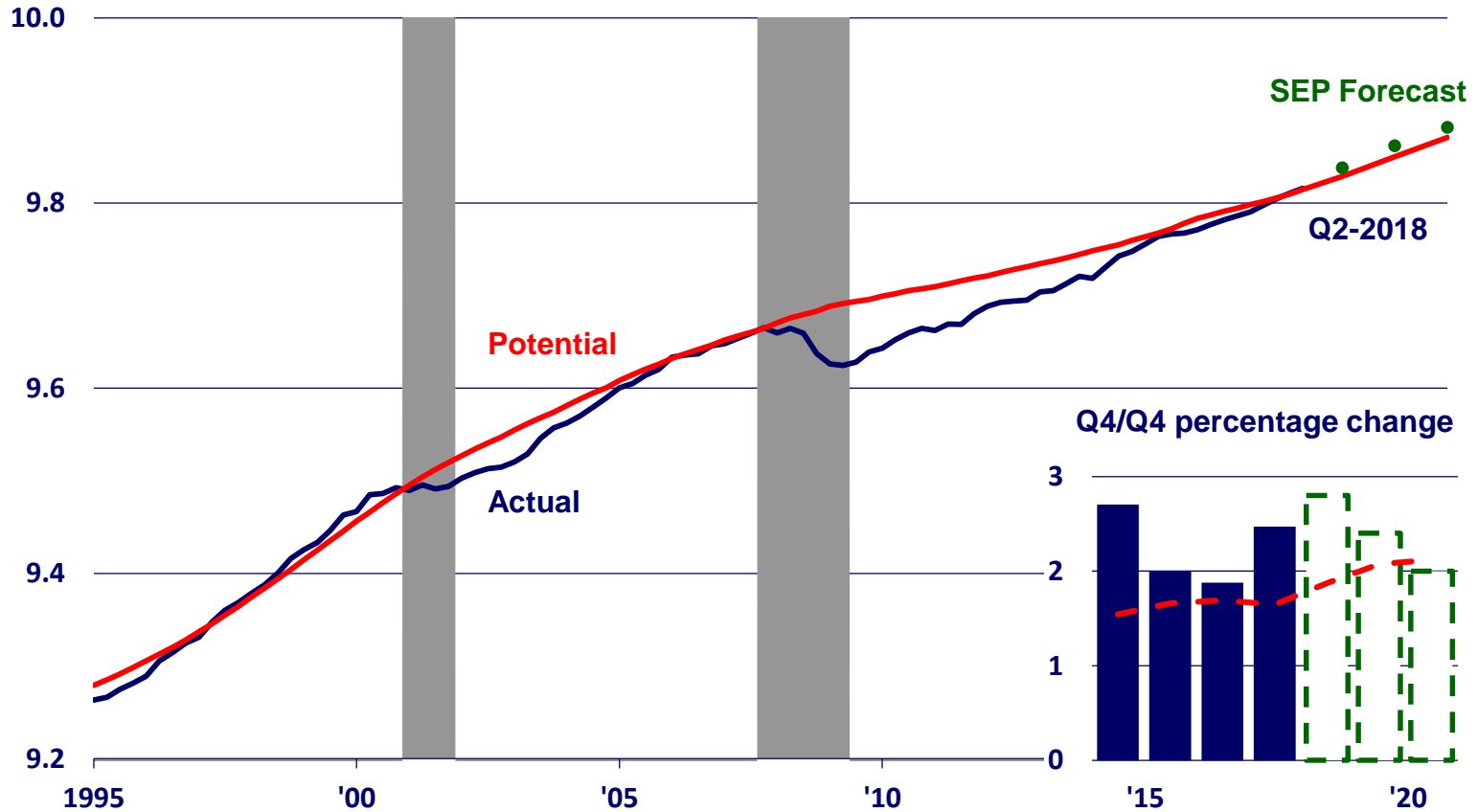
■ Monetary policy

- Unconventional policies at the ELB; outlook for policy; estimates of r^*

Economy Close to Potential by Most Estimates

Real and Potential GDP

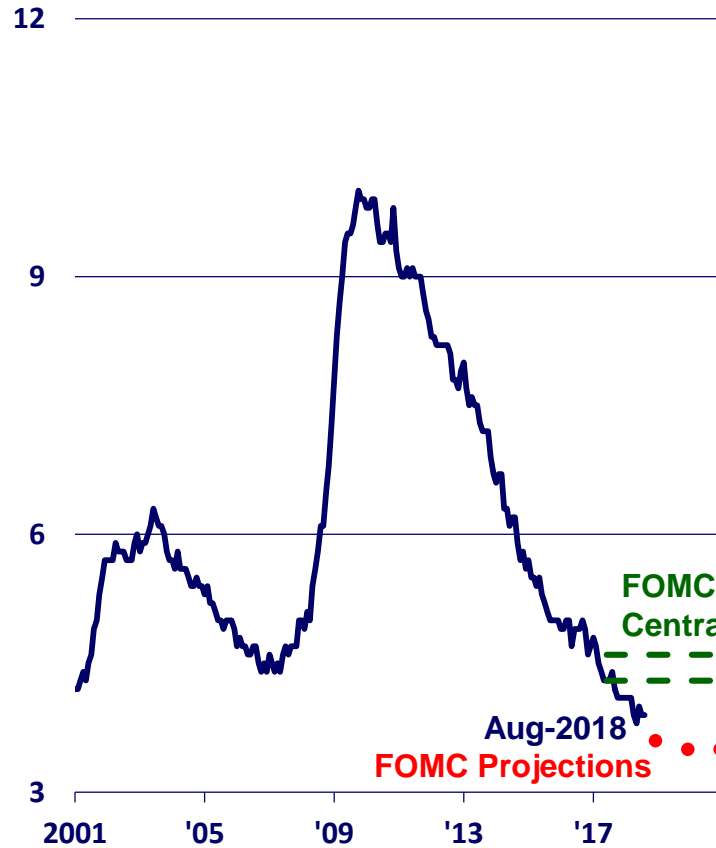
(log bil. 2009 \$, saar)



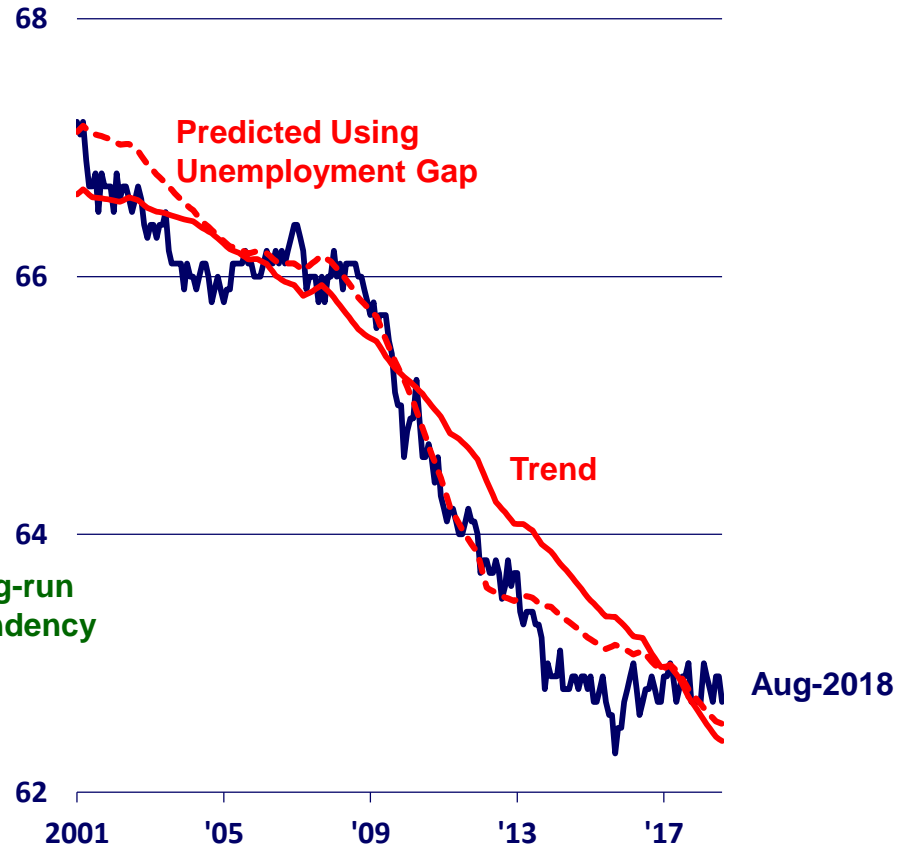
Source: BEA (actual), CBO (potential, with FRBC adj for NIPA revisions), FOMC's Summary of Economic Projection from Haver Analytics

Labor Markets

Unemployment Rate
(percent)



Labor Force Participation Rate
(percent)

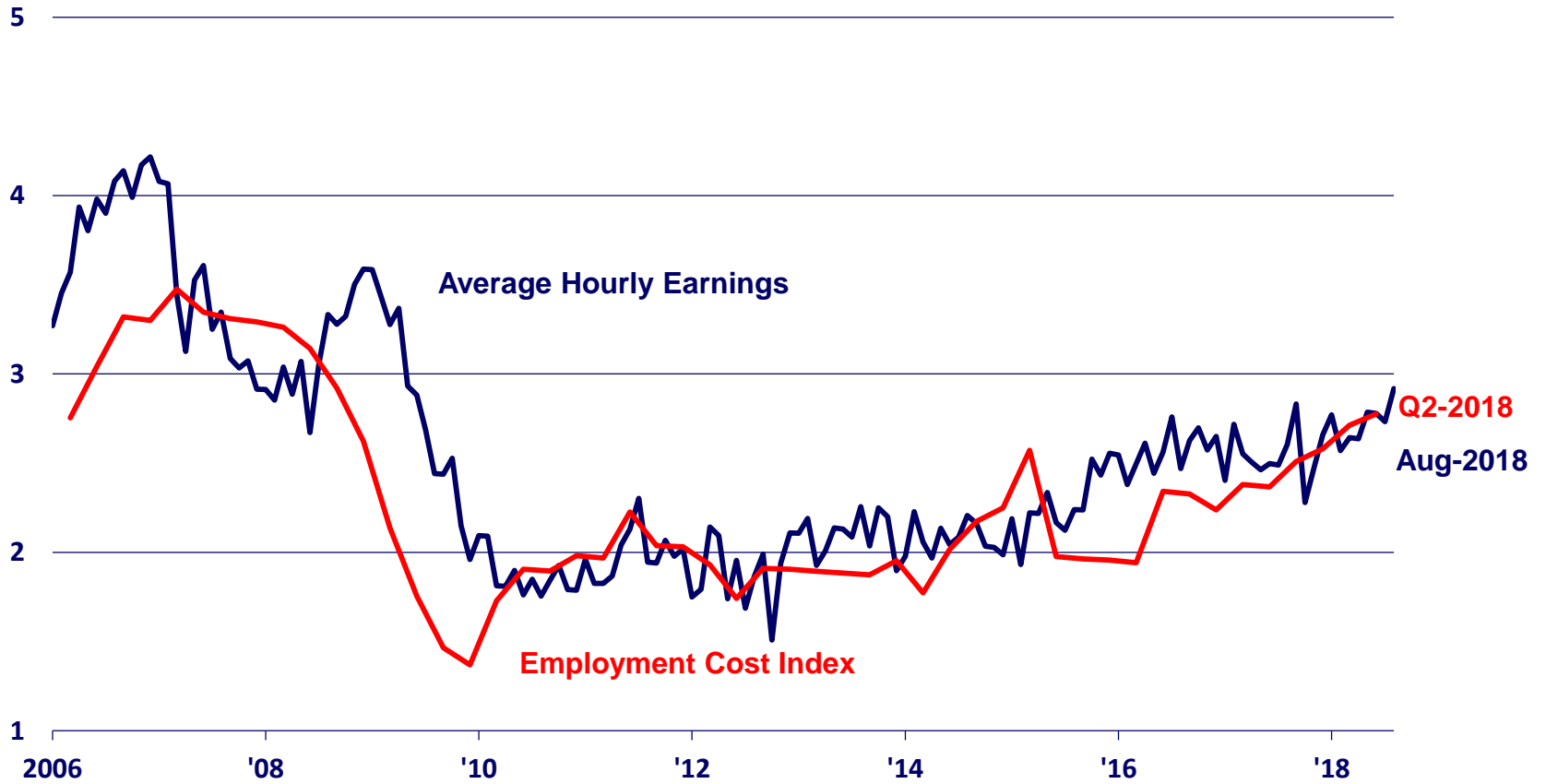


Source: BLS and FOMC's Summary of Economic Projections from Haver Analytics
Trend and predictions from gap taken from Chicago Fed staff estimates

Wages

Wage Growth

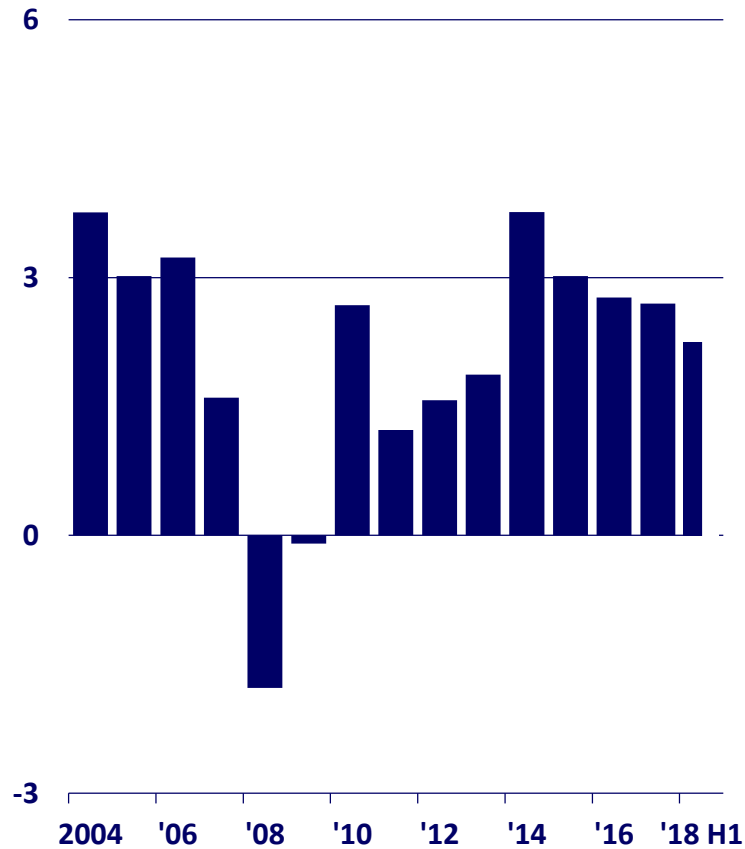
(year over year percentage change)



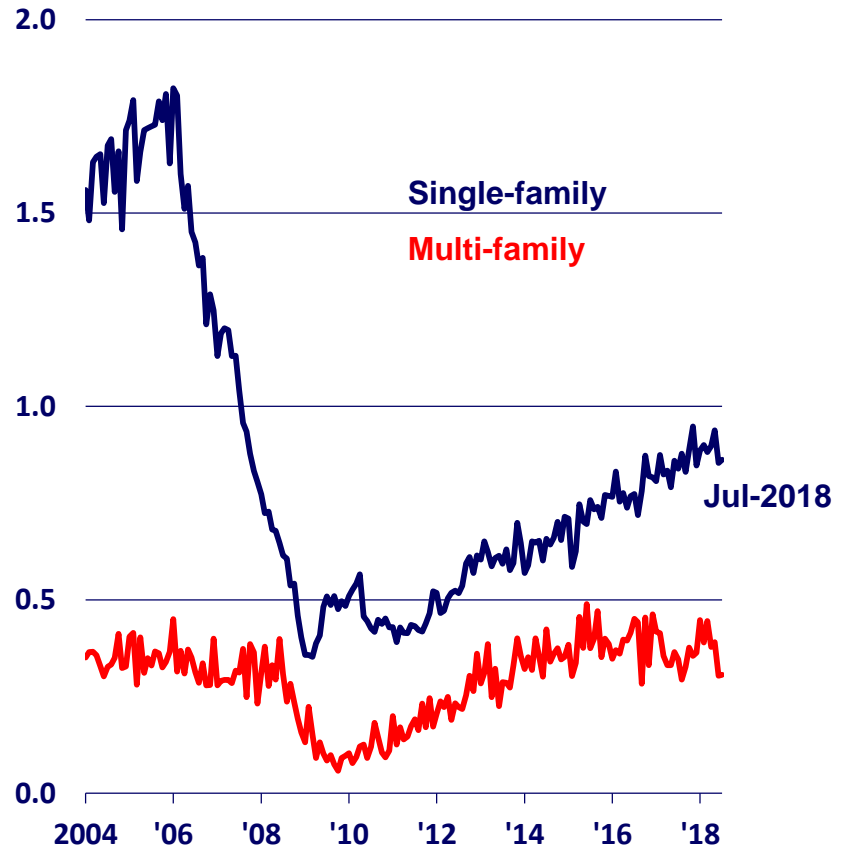
Source: BLS from Haver Analytics

Household Sector

Real Personal Consumption exp.
(Q4/Q4 percentage change)



Housing Starts
(millions of units, annual rate)

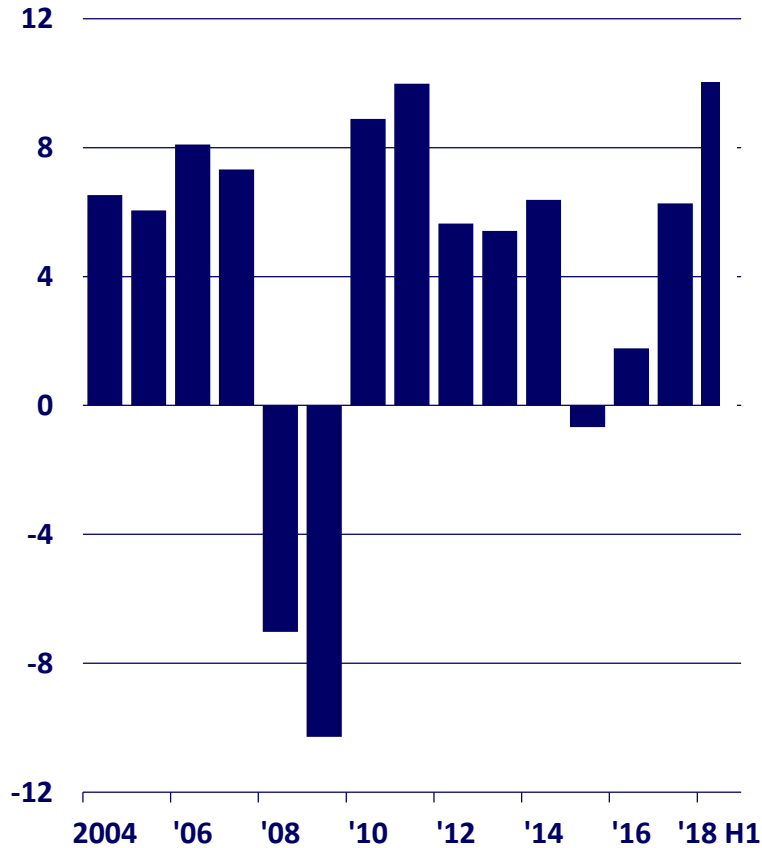


Source: BEA and Census Bureau from Haver Analytics

Business Sector

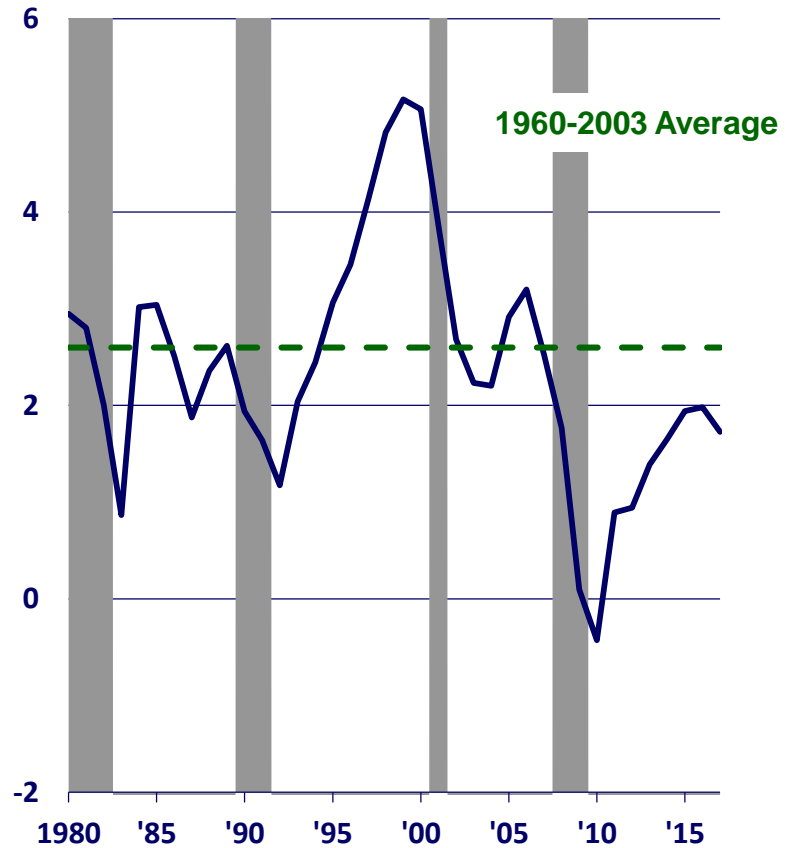
Business Fixed Investment

(Q4/Q4 percentage change)



Capital Deepening

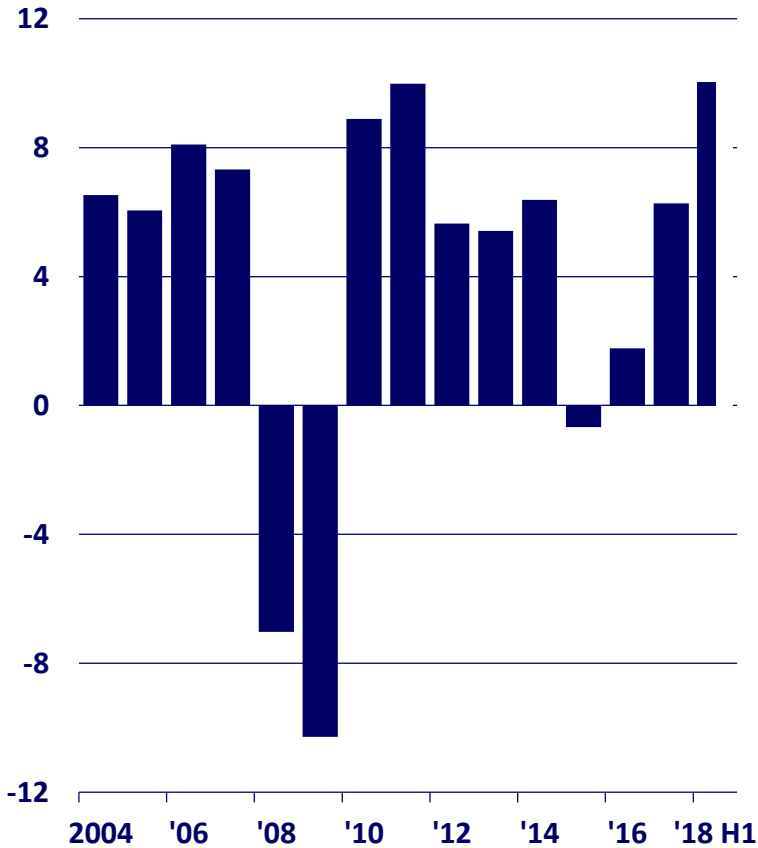
(percent change in input of capital services to trend hours)



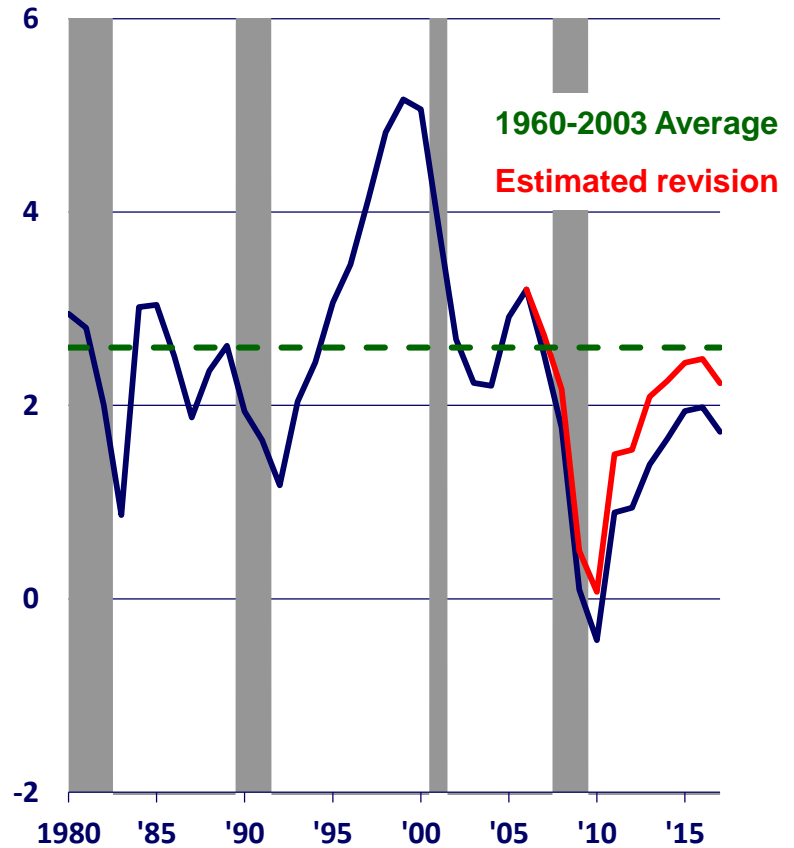
*Estimated revision for capital services calculated from internal Chicago Fed staff estimates
Source: BEA, BLS, and CBO from Haver Analytics*

Business Sector

Business Fixed Investment
(Q4/Q4 percentage change)



Capital Deepening
(percent change in input of capital services to trend hours)

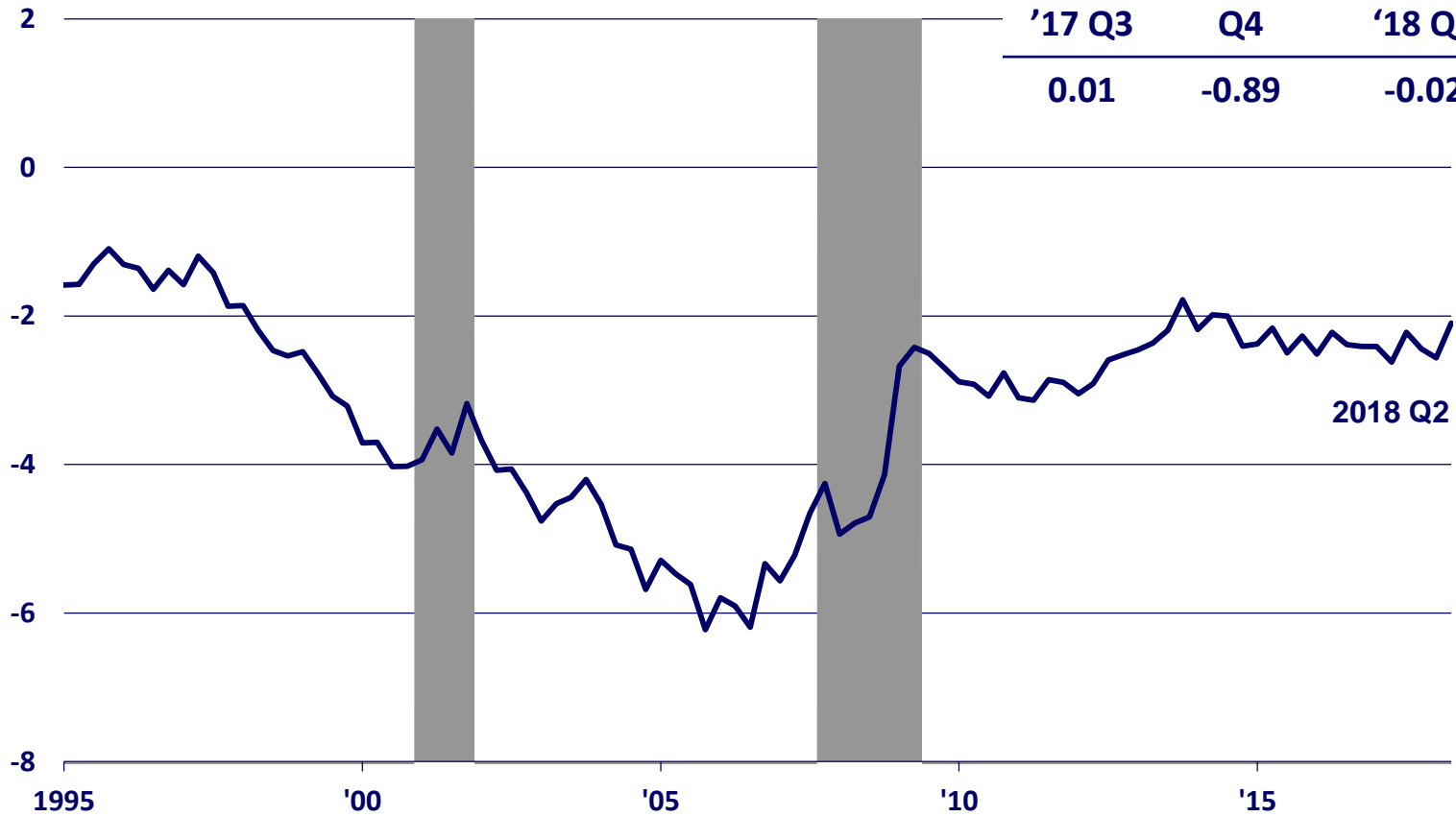


*Estimated revision for capital services calculated from internal Chicago Fed staff estimates
Source: BEA, BLS, and CBO from Haver Analytics*

International Trade

Current Account Balance

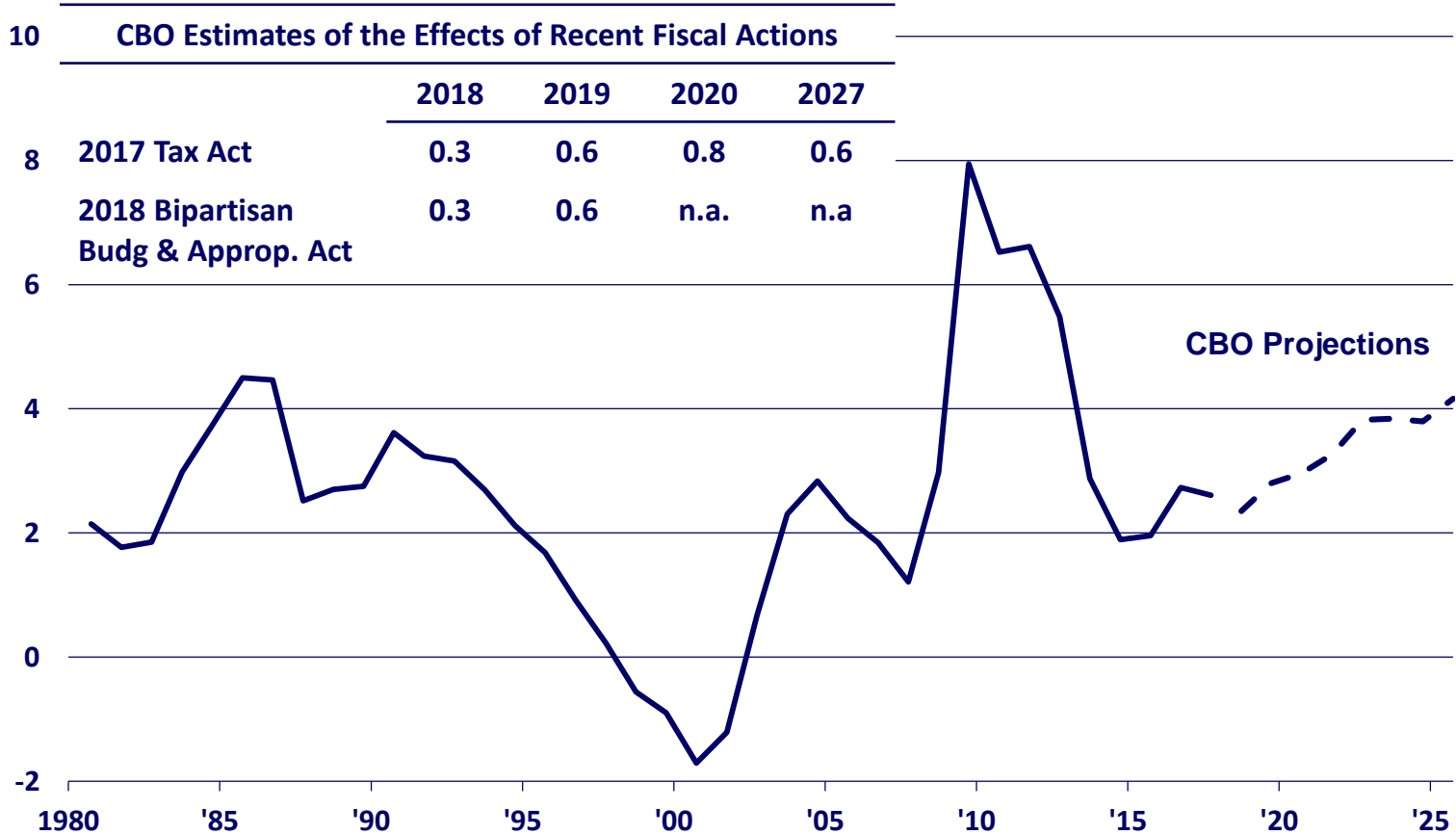
(as a percentage of GDP, NIPA basis)



Source: BEA from Haver Analytics

Government

Federal Government Deficit (w/ Cyclical Adjustment) (as a percentage of GDP)

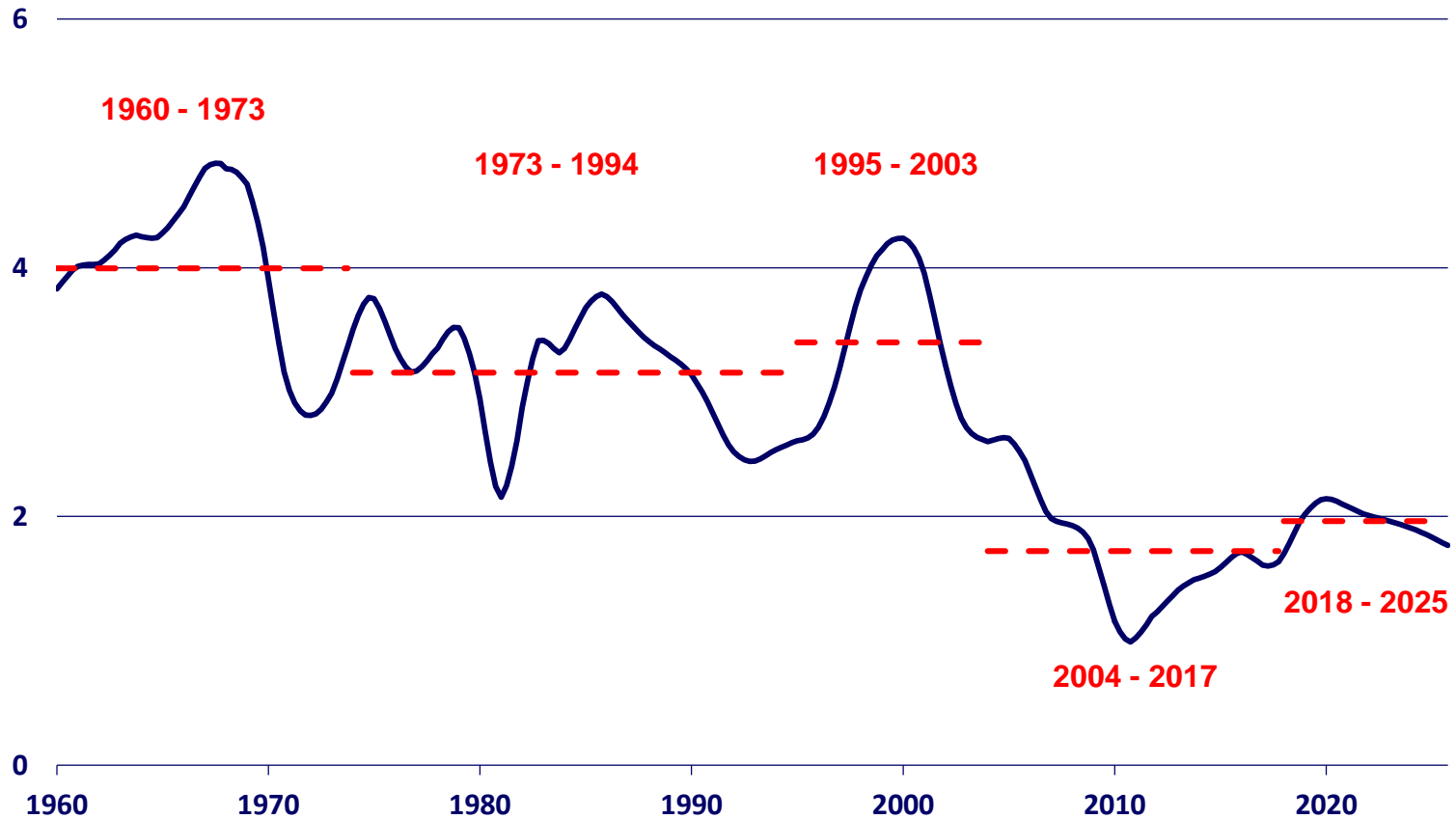


Source: CBO Budget and Economic Outlook: 2018 to 2028, April 2018

Potential GDP Growth Appears to Have Slowed

CBO Real Potential GDP

(Q4/Q4 percentage change)



Source: Congressional Budget Office from Haver Analytics

Potential GDP Growth Appears to Have Slowed

- **Slower population growth and declining labor force participation imply slower growth in available workers**
- **Slower growth in capital investment and disappointing total factor productivity growth imply slower labor productivity growth**

Trend Growth In	1995-2003	2004-2017	2018-2025
Available Workers	1.2	0.7	0.5
Labor Productivity	2.2	1.1	1.4
TFP¹	1.8	0.9	1.1
GDP	3.4	1.7	2.0

Source: CBO

1. TFP is for nonfarm business sector

FOMC Growth and Unemployment Forecasts

Median forecast, June 2018 Summary of Economic Projections

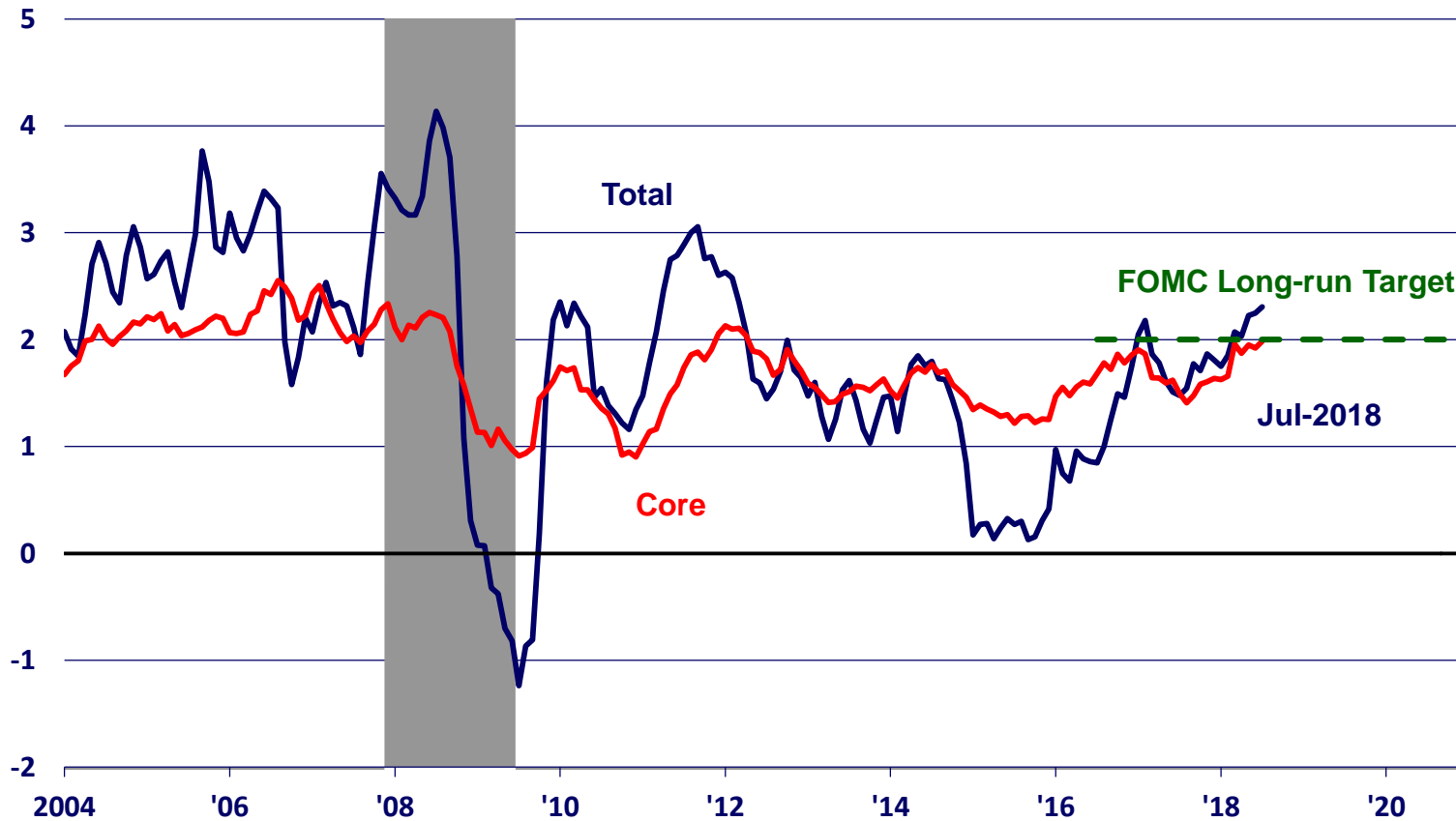
Variable	2018	2019	2020	LR
GDP¹	2.8	2.4	2.0	1.8
Unemployment²	3.6	3.5	3.5	4.5
Memo: August Blue Chip³				
GDP	3.0	2.2		2.0⁴
Unemployment	3.7	3.5		4.3⁴

1. Q4-to-Q4 percent change
2. Q4 Average
3. August 10, 2018 Blue Chip consensus
4. From March 10, 2018 Blue Chip consensus

Inflation Appears Finally Back to Target

PCE Price Index

(12-month percent change)

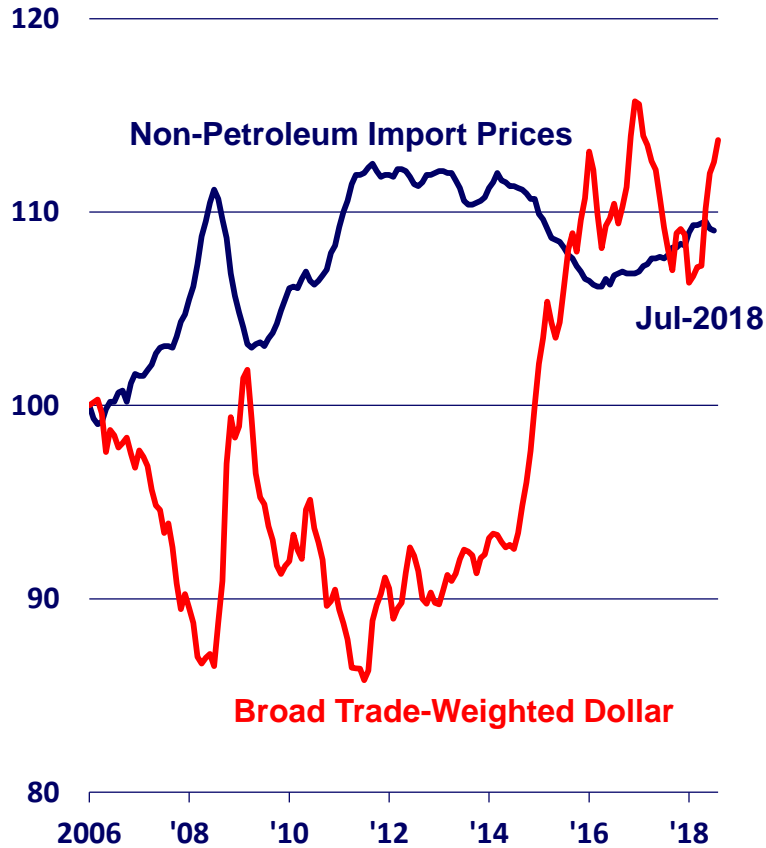


Source: BEA and FOMC's Summary of Economic Projections from Haver Analytics

Dollar and Oil Prices

Short Term Inflation Factors

(index, 2006=100)



Brent Crude Oil Prices and Futures

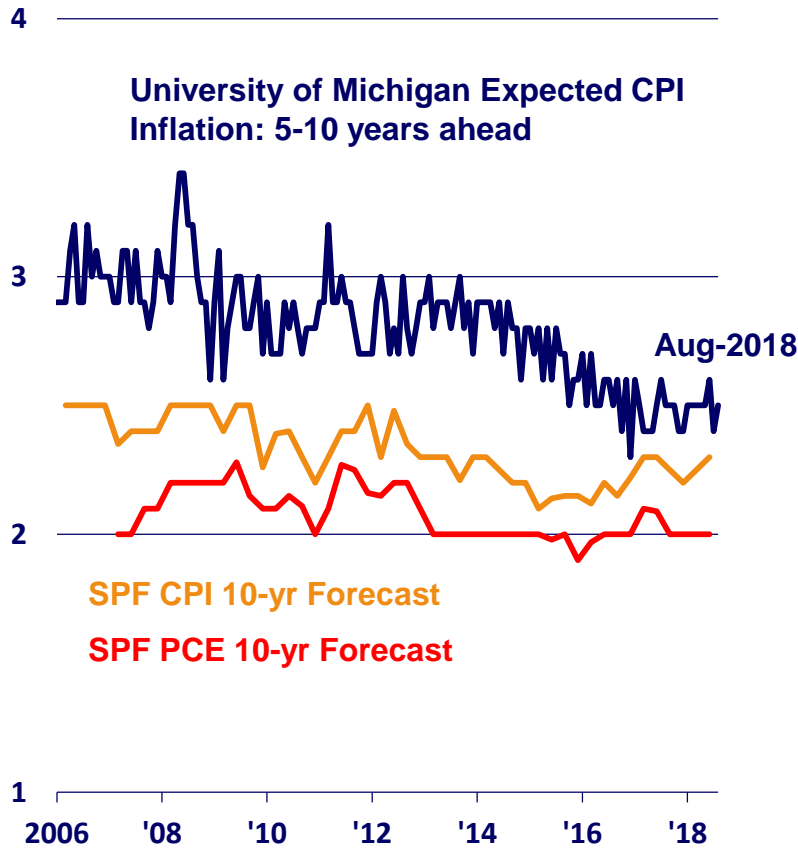
(\$/barrel)



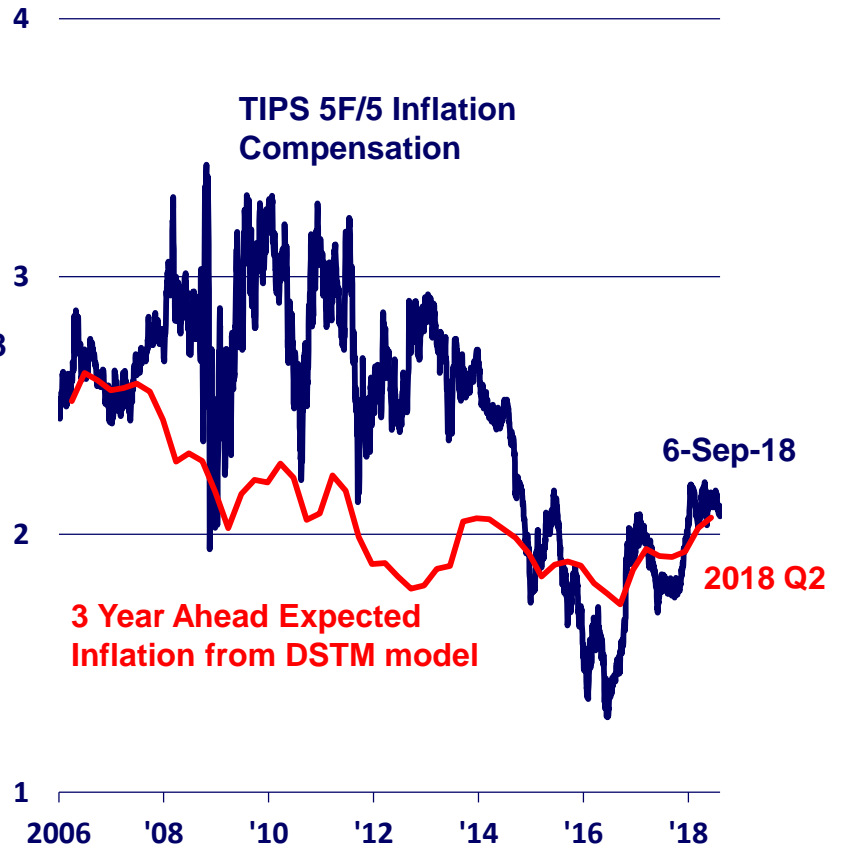
Source: BLS, Federal Reserve Board, and ICE from Haver Analytics

Inflation Expectations

Inflation Surveys (percent)



Market Pricing (percent)



3 Year Ahead Inflation Expectations calculated from internal Chicago Fed staff estimates

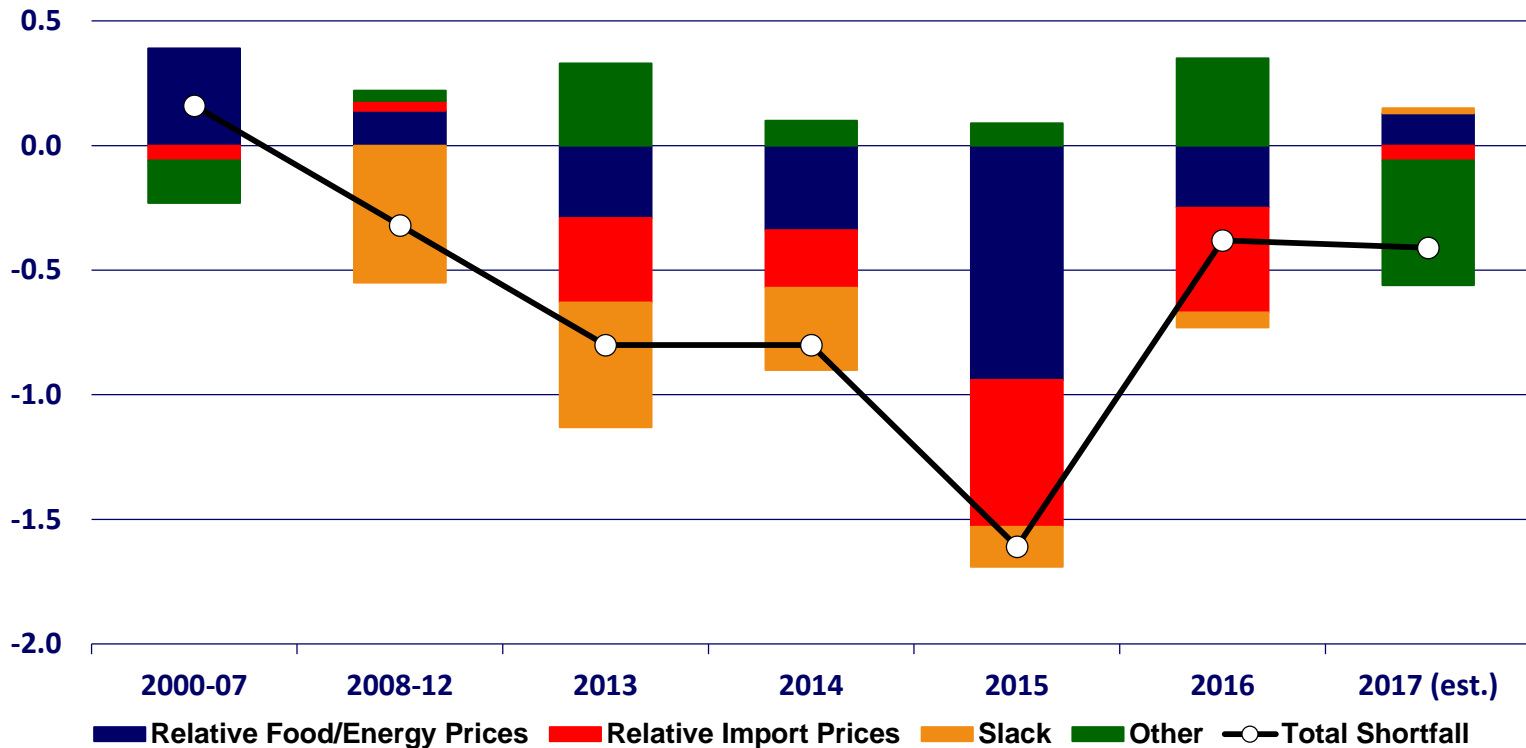
Source: University of Michigan, Federal Reserve Board, and Federal Reserve Bank of Philadelphia (Survey of Professional Forecasters--SPF)

Decomposition of Inflation

Deviation of Inflation from 2 Percent (percent)

$$\pi_t = \pi_t^c + \omega_t^e RPIE_t + \omega_t^f RPIF_t$$

$$\pi_t^c = 0.4 * \pi_t^e + 0.36 * \pi_{t-1}^c + 0.23 * \pi_{t-2}^c - 0.08 * SLACK_t + 0.56 * RPIM_t + \varepsilon_t$$

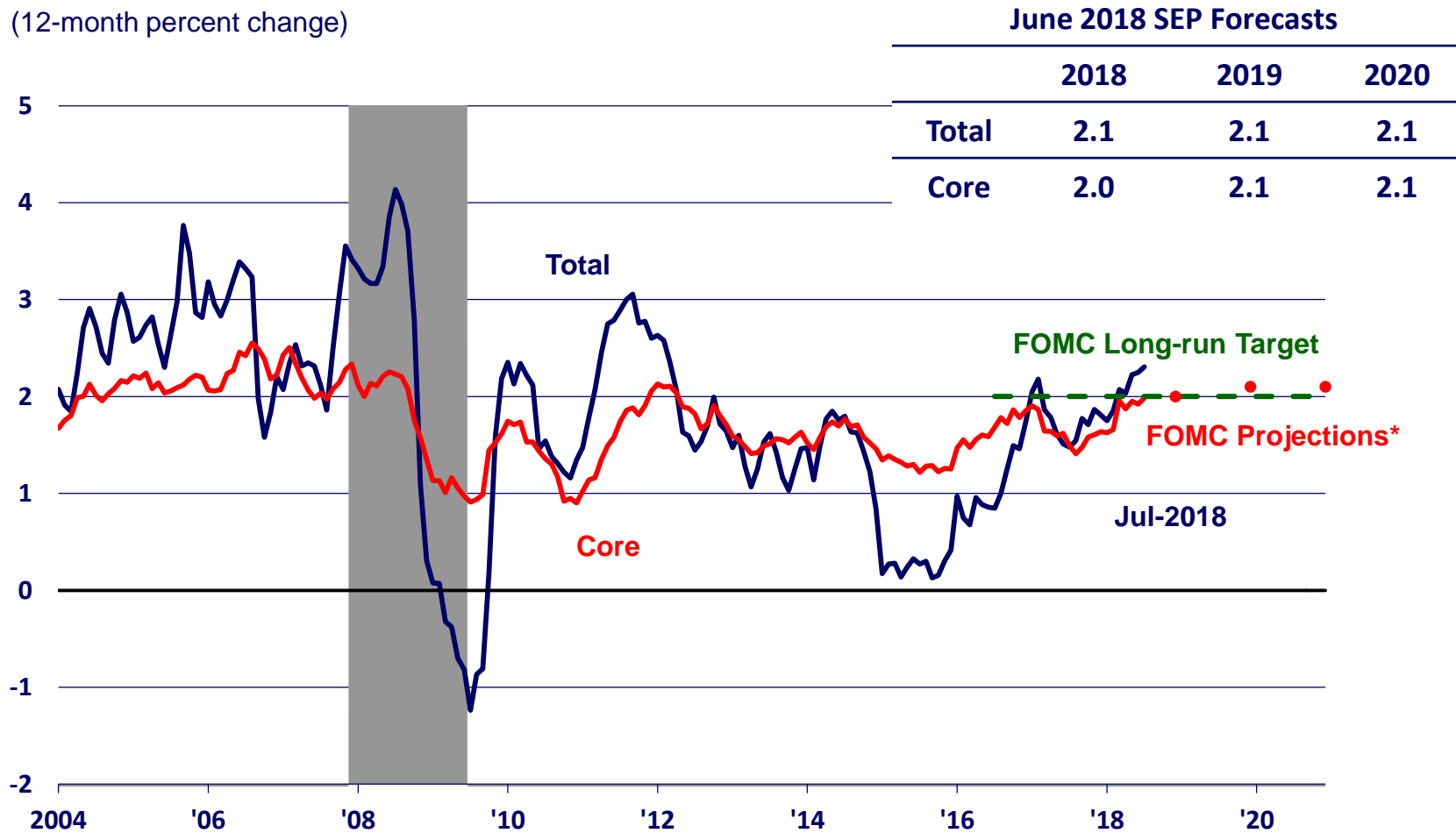


Source: Federal Reserve Board of Governors, "Inflation, Uncertainty, and Monetary Policy", speech by Janet Yellen, September 26, 2017

Inflation Outlook: Slight Overshooting

PCE Price Index

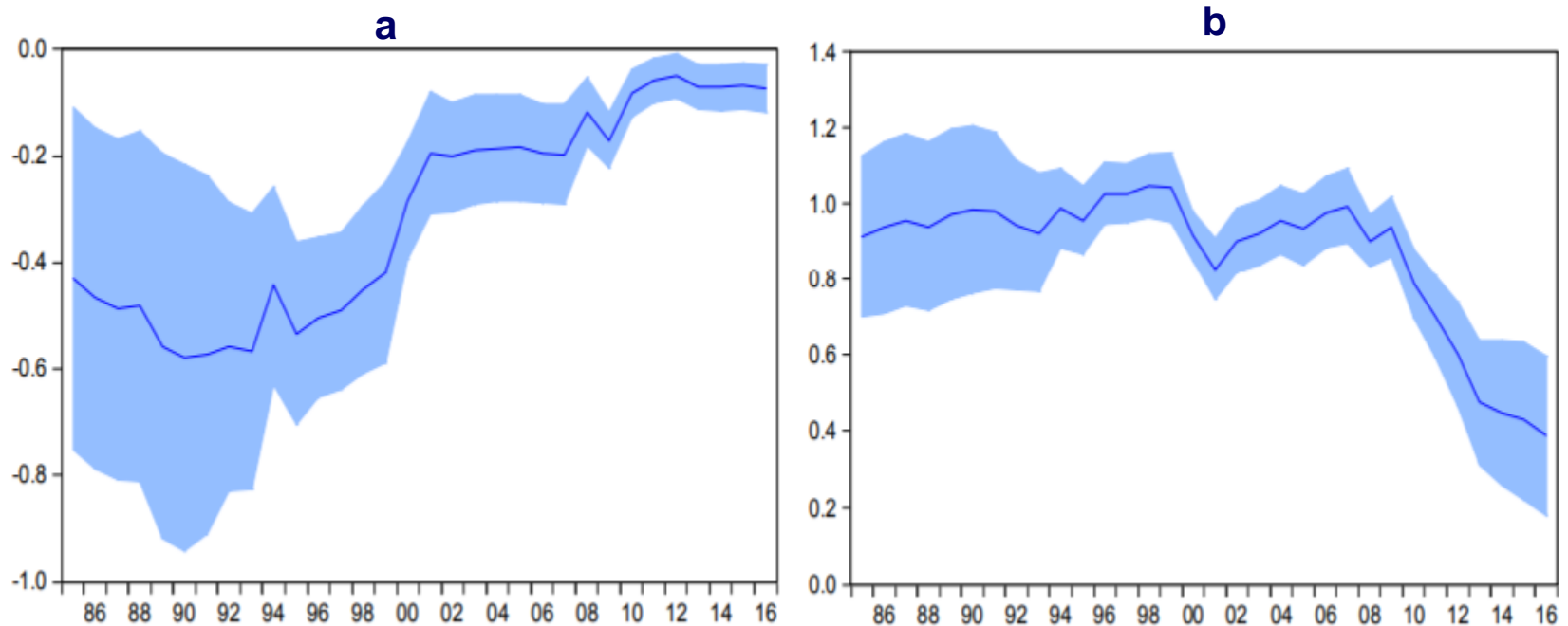
(12-month percent change)



Source: BEA and FOMC's Summary of Economic Projections from Haver Analytics

Evolution of the Phillips Curve

Coefficients of $\pi^c_t = a(u_t - u^*_t) + b \pi^c_{t-1} + \varepsilon_t$
(20-year rolling regression)



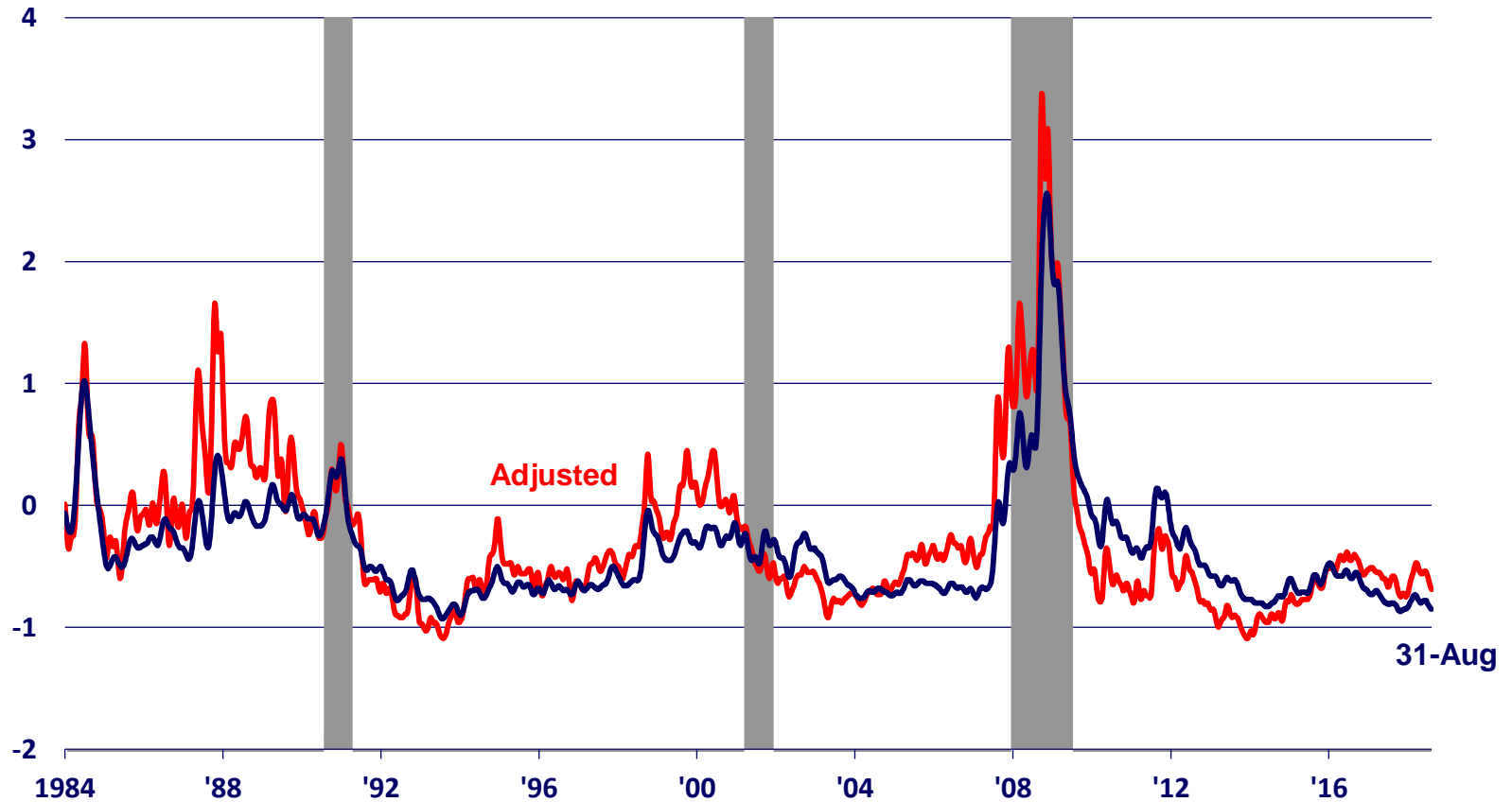
Source: Christopher Erceg, James Hebden, Michael Kiley, Daved Lopez-Salido, and Robert Tetlow (2018).
“Some Implications of Uncertainty and Misperception for Monetary Policy”, Finance and Economic Discussion Series 2018-059. Board of Governors of the Federal Reserve System.

Implications of Small a , $b < 1$

- $\pi^c_t = a (u_t - u^*_t) + (1-b) E^p[\pi^c_t] + b \pi^c_{t-1} + c X_t + \varepsilon_t$
- Small a : Inflation unlikely to pick up substantially as $u < u^*$
- $b < 1$: Non-accelerationist Phillips curve; if inflation expectations anchored, inflation will settle at $E^p[\pi^c_t]$
- Caveats:
 - Nonlinear Phillips curve?
 - What does it take to unhinge $E^p[\pi^c_t]$ in either direction?

Financial Conditions

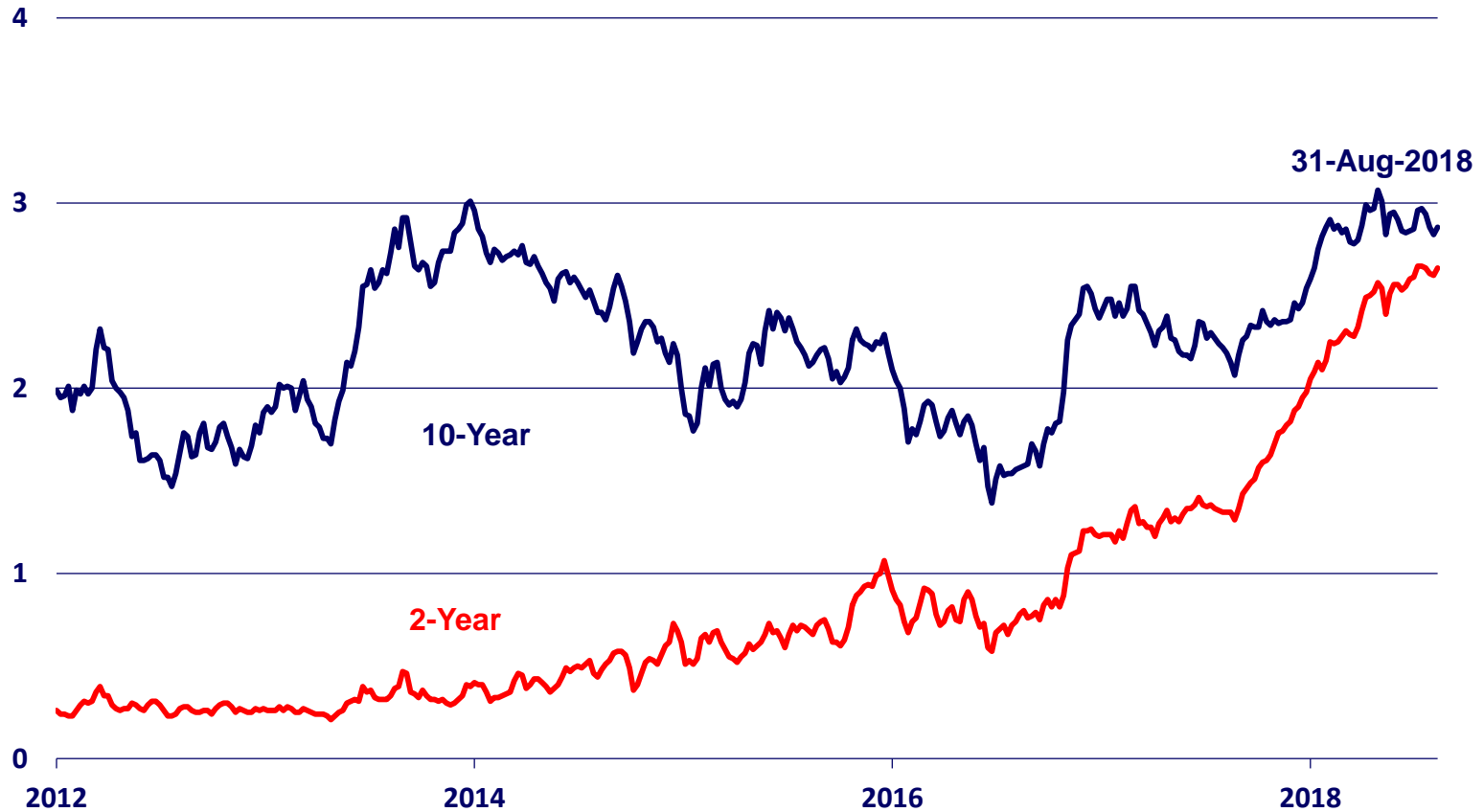
Chicago Fed's National Financial Conditions Index (relative to average)



Source: Federal Reserve Bank of Chicago

Flattening Yield Curve

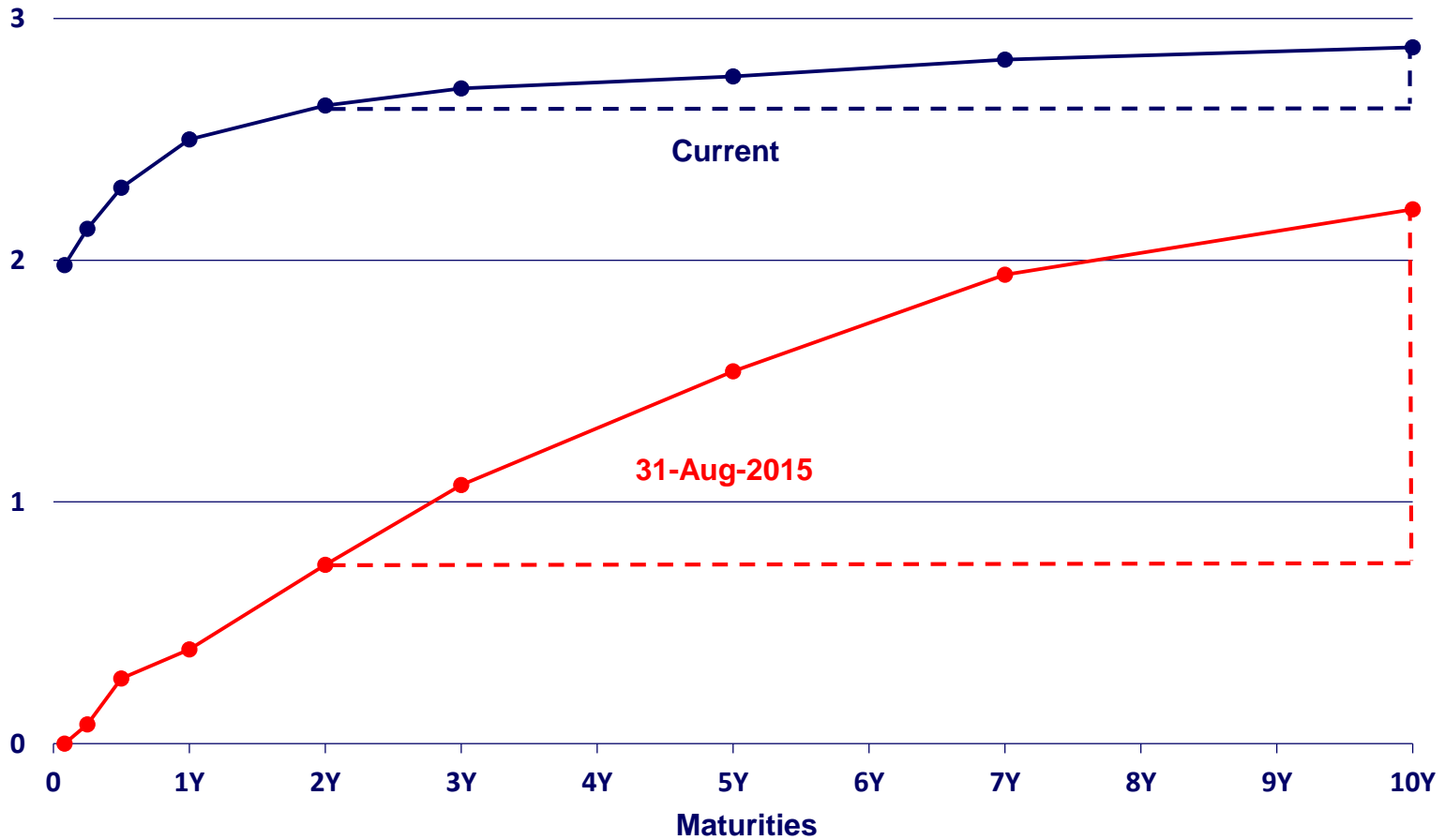
Treasury Rates (percent)



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

Yield Curve Slope

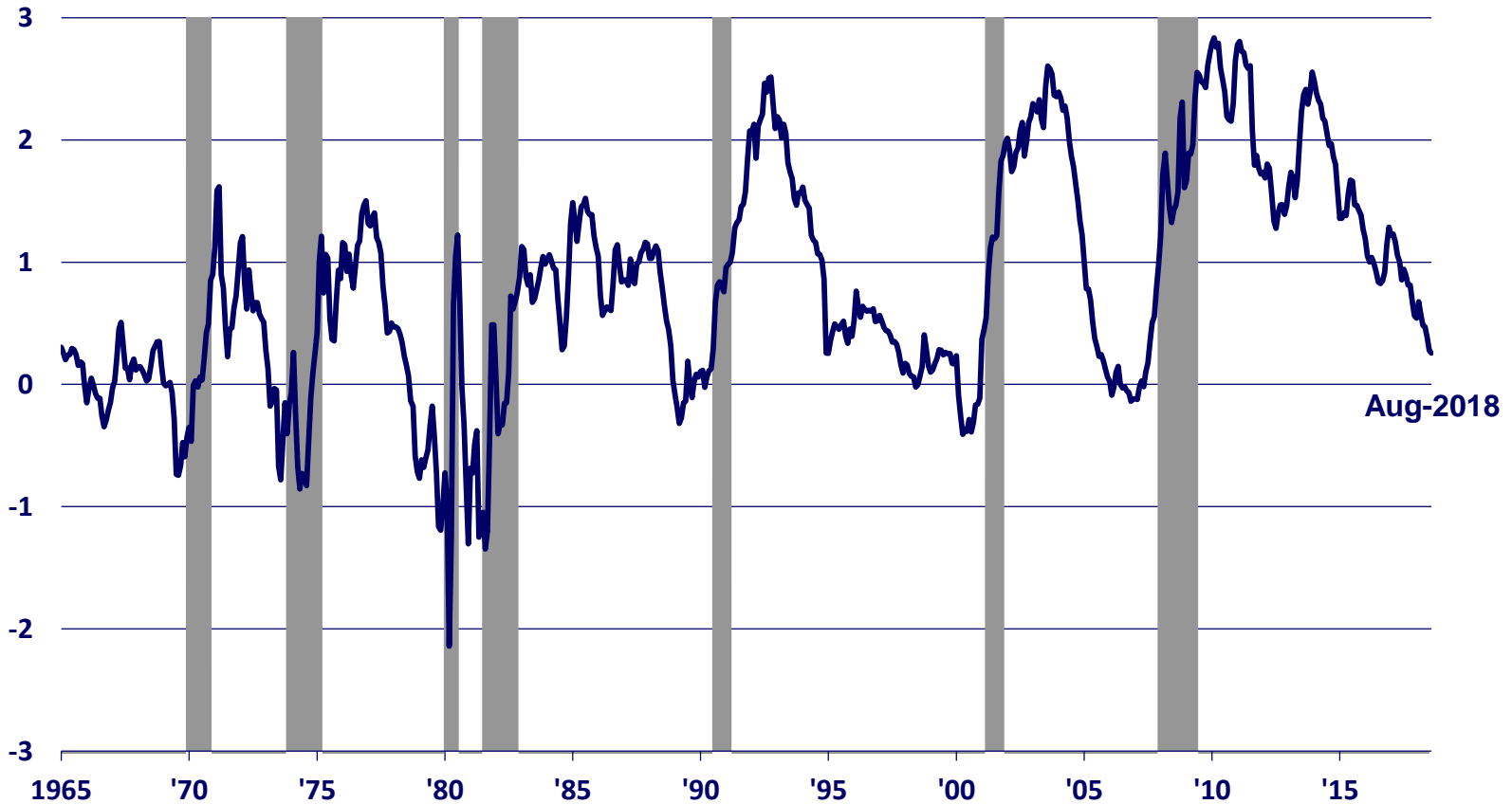
Yield Curve (percent)



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

Yield Curve Slope and Recessions

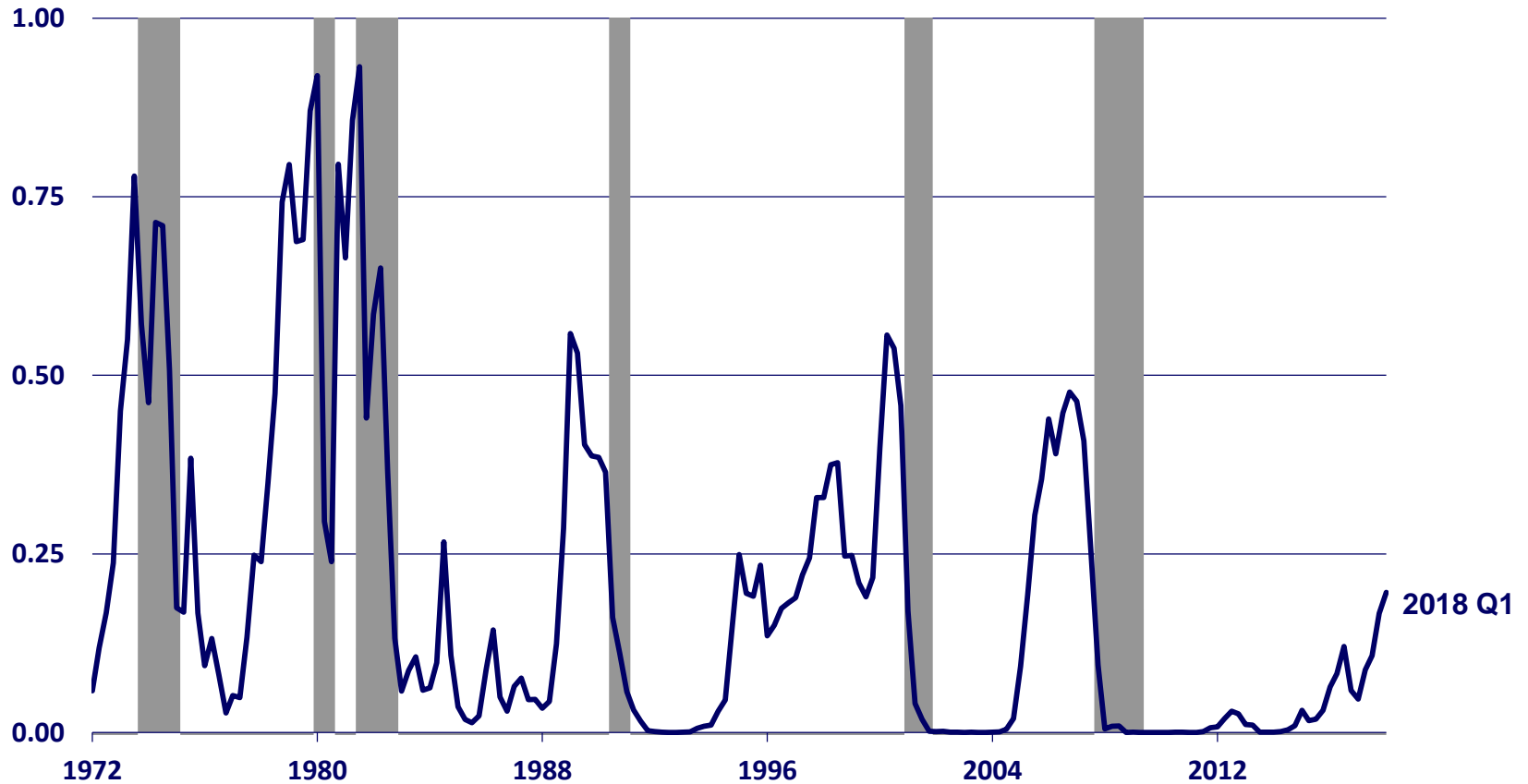
Treasury 10 year rate minus 2 year rate
(percentage points)



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

Yield Curve Slope and Recessions

Probability of recession in the next year
(percent)



Source: Eric Engstrom and Steven Sharpe, "(Don't Fear) the Yield Curve", FEDS Notes, Board of Governors of the Federal Reserve System

Yield Curve Slope: Expectations and Risk

- $r_t^{10} \approx \frac{1}{10} E_t[r_t^1 + r_{t+1}^1 + r_{t+2}^1 + \dots + r_{t+10}^1] + tp_t^{10}$

r_t^1 1-year interest rate; r_t^{10} 10-year interest rate
 tp_t^{10} term premium; \approx real rate risk plus inflation risk

- Yield curve slope: $r_t^{10} - r_t^1$. It will flatten when:
 - Relatively
 - ◆ Looser monetary policy tomorrow vs. today
 - ◆ Tighter monetary policy today vs. tomorrow
 - Risk premia fall

Probit Estimates: Prob. Enter Recession in a Year

	Engstrom- Sharpe ¹	Benzoni, Chyruk, Kelley ²
Short spread	-0.35 (<0.01)	-0.41 (<0.01)
Long spread	-0.06 (0.43)	
Long real risk spread		0.20 (<0.01)
Long inflation risk spread		-0.12 (<0.01)
Current short real rate		-0.24 (0.04)

P-values in parentheses.

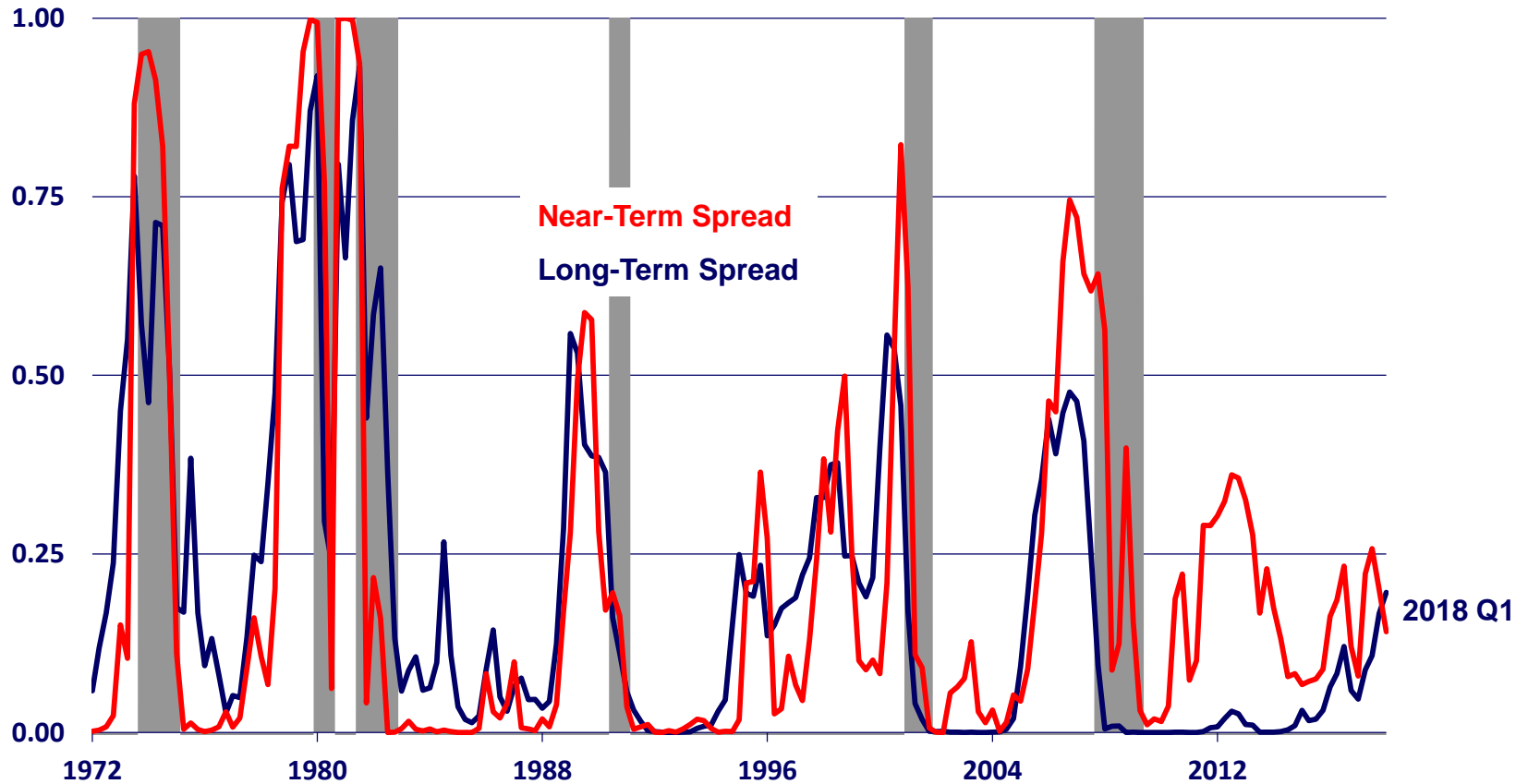
1. Short spread = 6-qtr fwd – current 3-m T-bill; long spread = current 10 yr – 2 yr Treas.

2. Short spread = 6-qtr ahead DSTM exp real rate – current real rate; long spreads are risk difference between 10-yr and 2-yr ahead DSTM risk premia

Yield Curve Slope and Recessions

Engstrom and Sharpe Recession Probabilities

(percent)

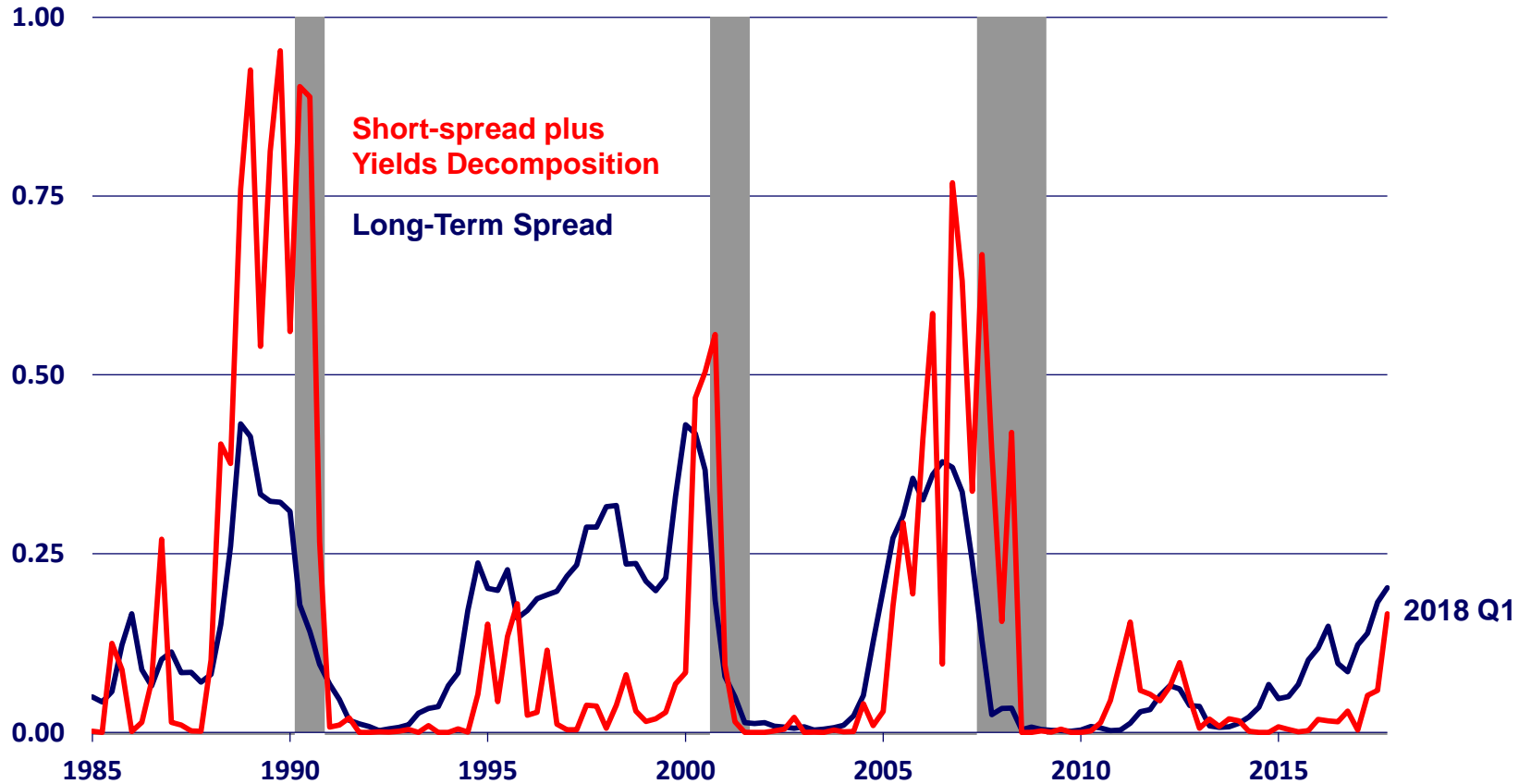


Source: Eric Engstrom and Steven Sharpe, "(Don't Fear) the Yield Curve", FEDS Notes, Board of Governors of the Federal Reserve System

Yield Curve Slope and Recessions

Benzoni et al Recession Probabilities

(percent)



Source: internal Chicago Fed staff calculations

Yield Curve Slope in August FOMC Minutes

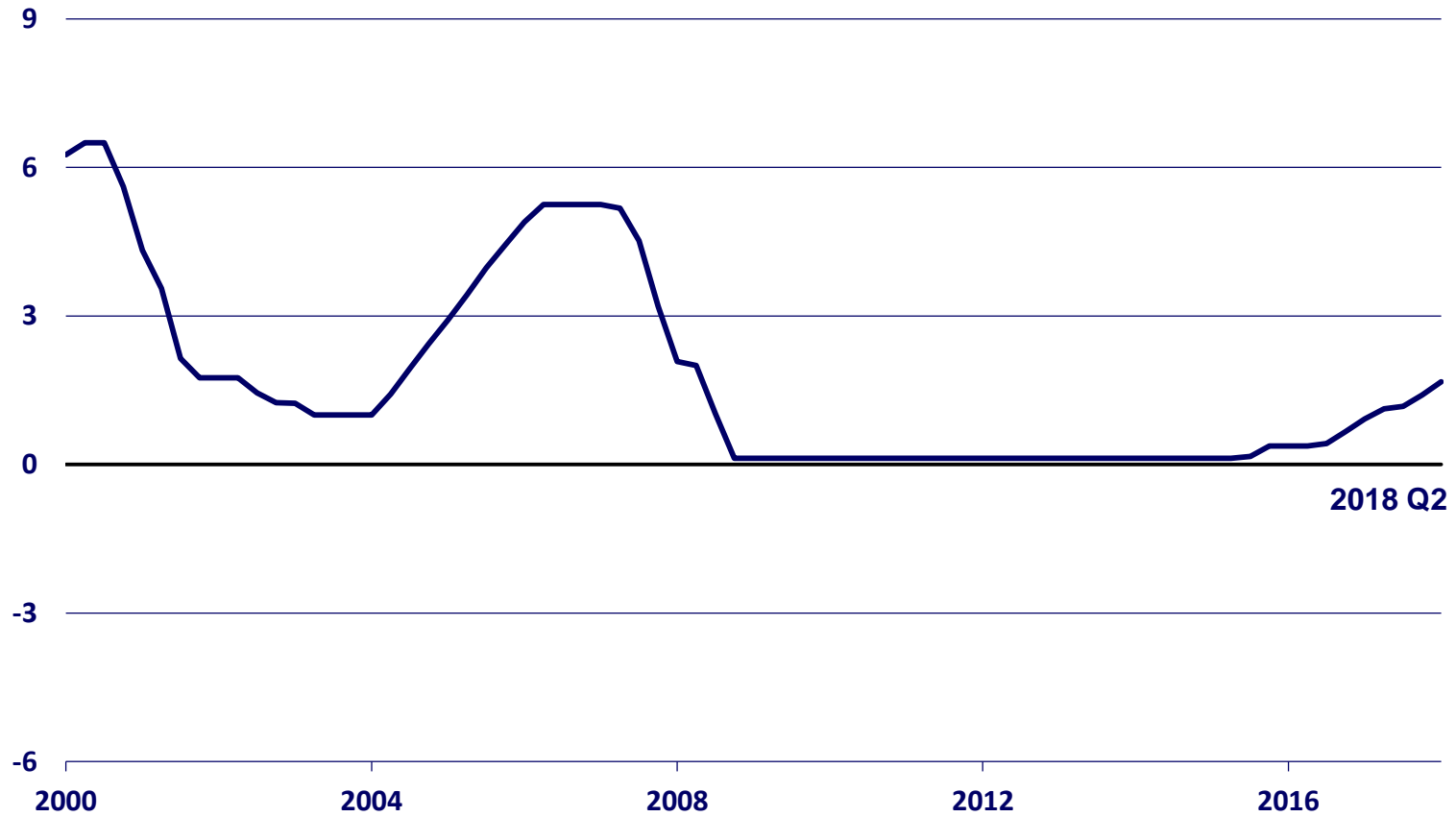
- **“Several participants cited statistical evidence for the United States that inversions of the yield curve have often preceded recessions. They suggested that policymakers should pay close attention to the slope the yield curve in assessing the economic and policy outlook.”**

Yield Curve Slope in August FOMC Minutes

- **“Other[s] emphasized ... inferring economic causality from statistical correlations was not appropriate. A number of global factors were seen as contributing ... central bank asset purchase programs and the strong worldwide demand for safe assets. In such an environment, an inversion of the yield curve might not have the significance that the historical record would suggest; the signal ... needed to be considered in the context of other economic and financial indicators.”**

Monetary Policy

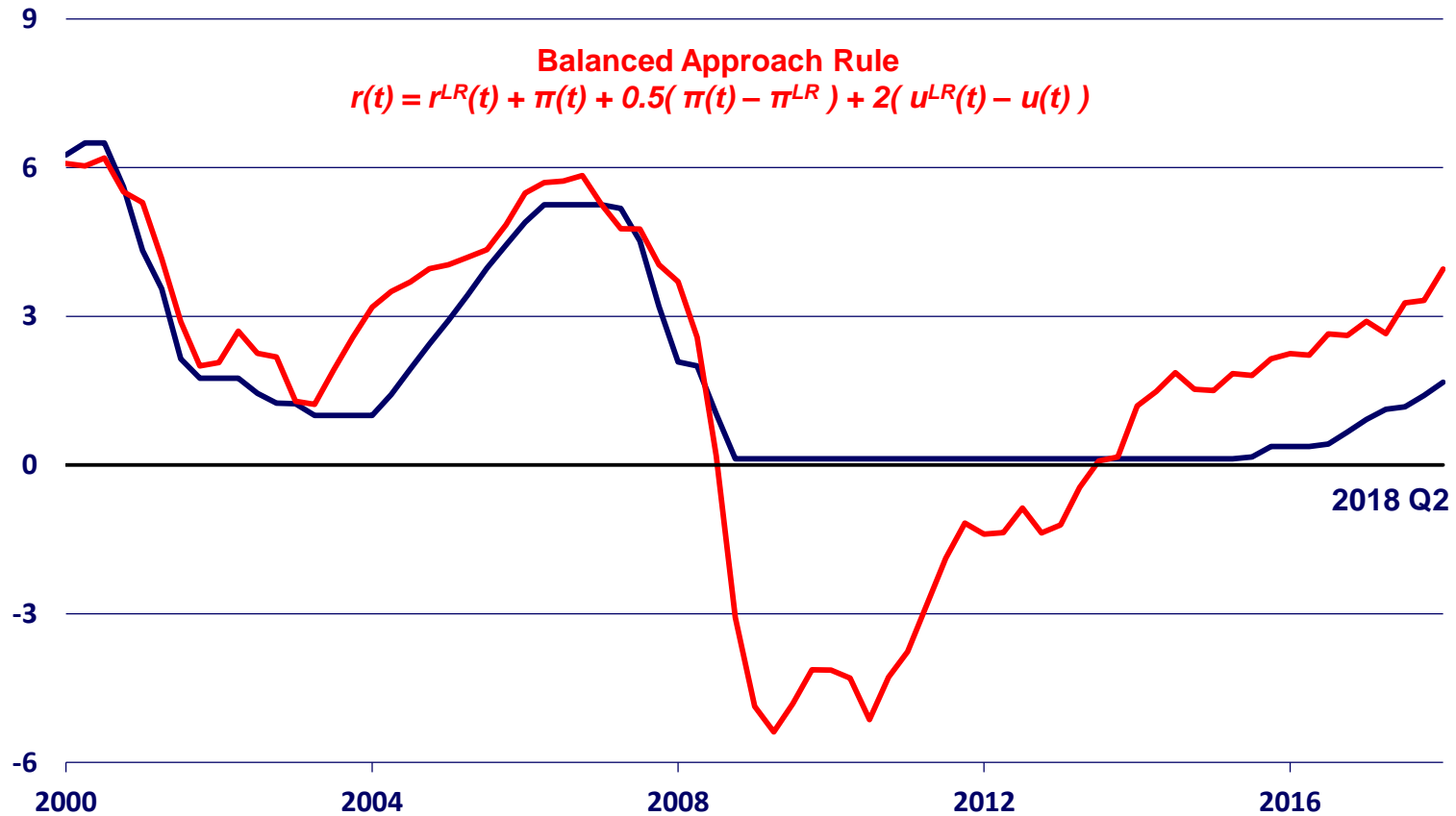
Federal Funds Target Rate (percent)



Source: July 2018 Monetary Policy Report, Board of Governors of the Federal Reserve System

Benchmarking Monetary Policy

Federal Funds Target Rate (percent)



$r^{LR}(t)$ and $u^{LR}(t)$ from Blue Chip Consensus Forecast.

Source: July 2018 Monetary Policy Report, Board of Governors of the Federal Reserve System

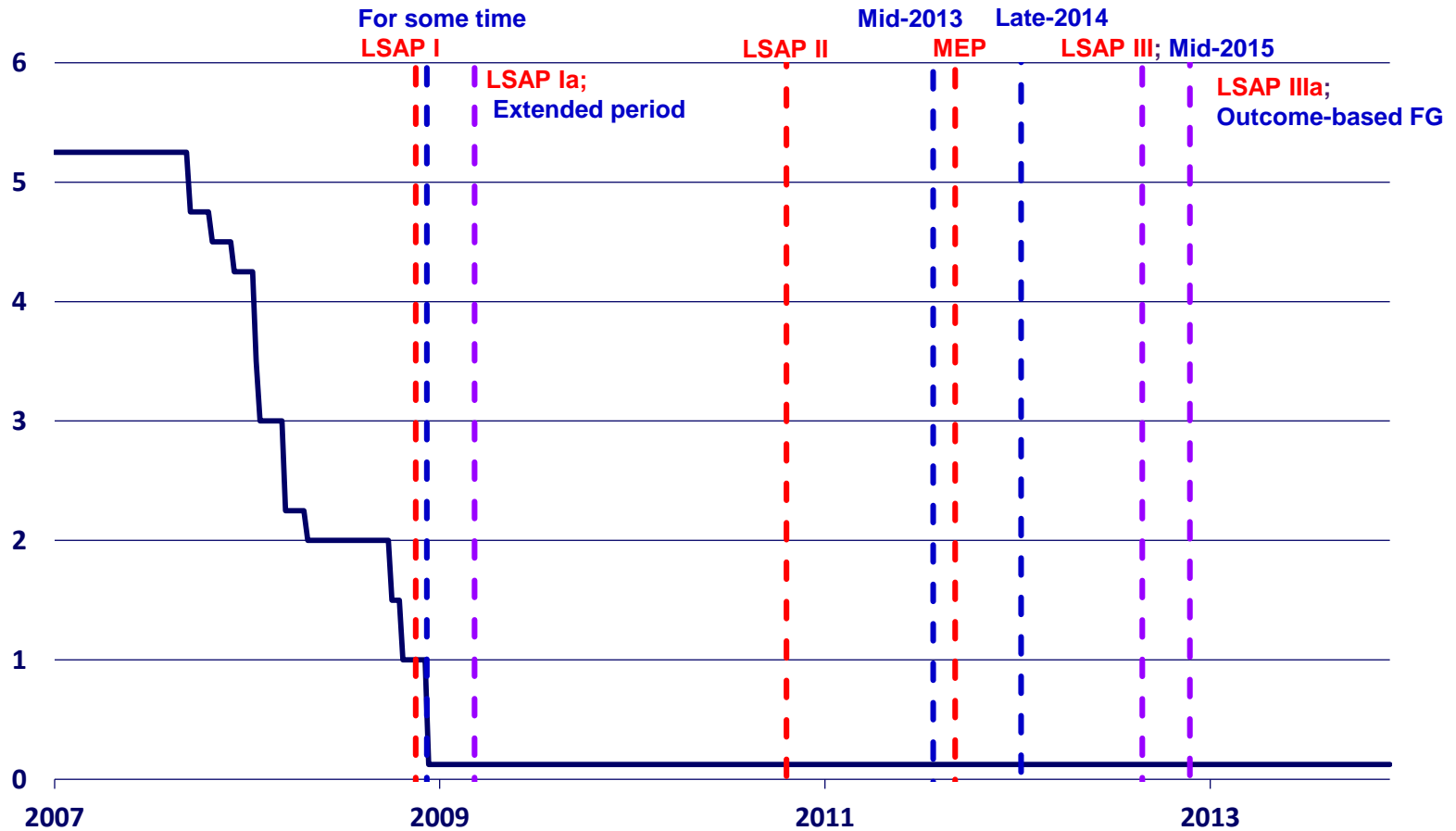
Nonconventional Policy Tools at the ELB

- $r_t^{10} \approx \frac{1}{10} E_t[r_t^1 + r_{t+1}^1 + r_{t+2}^1 + \dots r_{t+10}^1] + tp_t^{10}$
- Lowering long rates when can't change near-term r_{t+j}^1
 - Option 1: Communications -- Lower expectations of average future r_{t+j}^1 rates with forward guidance on future policy
 - Option 2: Buy long-term bonds to
 - ◆ Reduce tp_t^{10}
 - ◆ Reinforce option 1

Funds Rate and Nonconventional Policy

Federal Funds Target Rate

(percent)



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

Forward Guidance

- Economic conditions likely to warrant exceptionally low level of the funds rate:
 - Dec. 2008 “for some time”; Mar. 2009 “extended period”
 - Aug. 2011 “at least through mid 2013”; Jan. 2012 “at least through late 2014” and fed funds “dot plot” added
 - Sep. 2012 “for a considerable time after the economic recovery strengthens....at least through mid-2015”
 - Dec. 2012 as long as unemployment rate > 6-1/2 percent; projected inflation < 2-1/2 percent; longer-term inflation expectations well-anchored.

Forward Guidance

- **Dec. 2013: “... likely will be appropriate to maintain the current target range for the federal funds rate well past the time that the unemployment rate declines below 6-1/2 percent, especially if projected inflation...below ... 2 percent longer-run goal”**
- **December 2015 – May 2018**

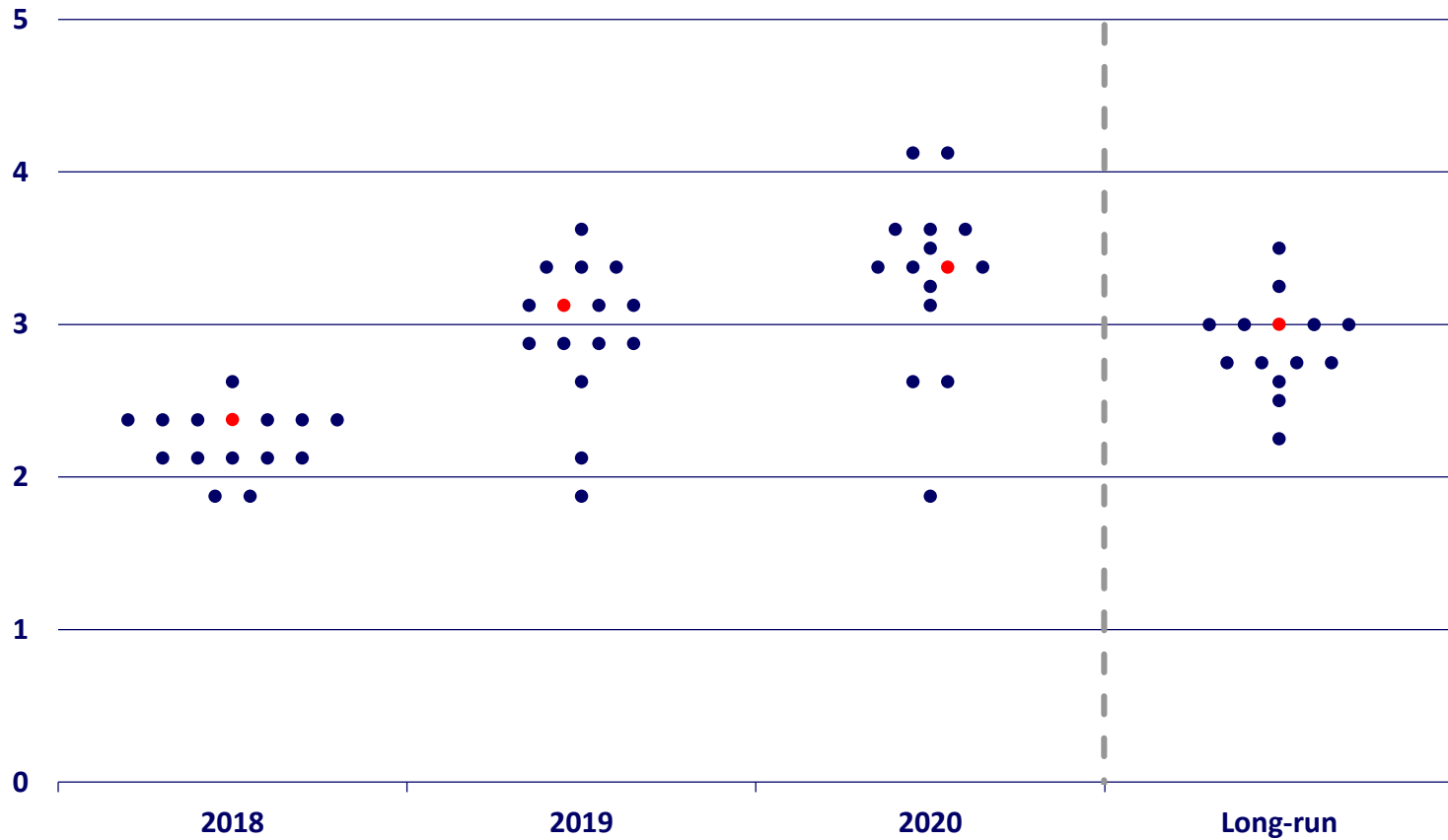
The Committee expects that economic conditions will evolve in a manner that will warrant only gradual increases in the federal funds rate; the federal funds rate is likely to remain, for some time, below levels that are expected to prevail in the longer run.

Asset Purchases

- **November 2008: \$100 bil. agency; \$500 bil. MBS**
- **March 2009: \$300 bil. Treasury; \$100 bil. agency; \$750 bil. MBS**
- **November 2010: \$600 bil. Treasury**
- **September 2011: MEP/Operation Twist**
- **September 2012: Open ended purchases of \$40 bil. MBS per month; MEP extension**
- **December 2012: Open ended purchases of \$45 bil. Treasury per month. (began tapering Dec 2013 completed Oct 2014)**
- **October 2017: Start winding down balance sheet.**

Monetary Policy

Target Federal Funds Rate at Year-End (percent)



Red dots indicate median.

Source: FOMC June 2018 Summary of Economic Projections

Gradual Balance Sheet Normalization

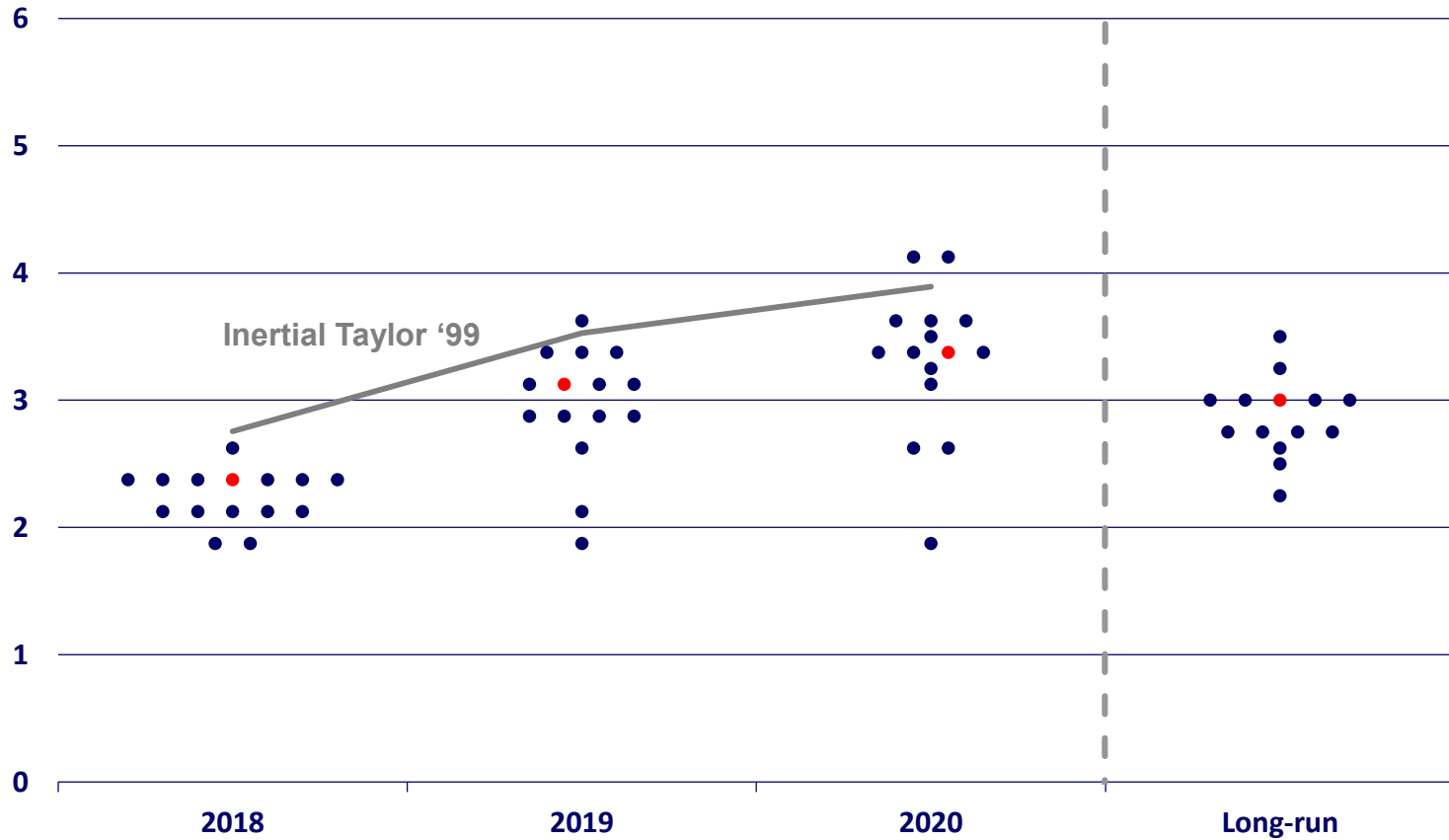
Projected SOMA Domestic Securities Holdings: Alternative Liabilities Scenarios
(billions \$)



Source: Federal Reserve Bank of New York 2017 Open Market Annual Report, published in April 2018

Benchmarking Monetary Policy

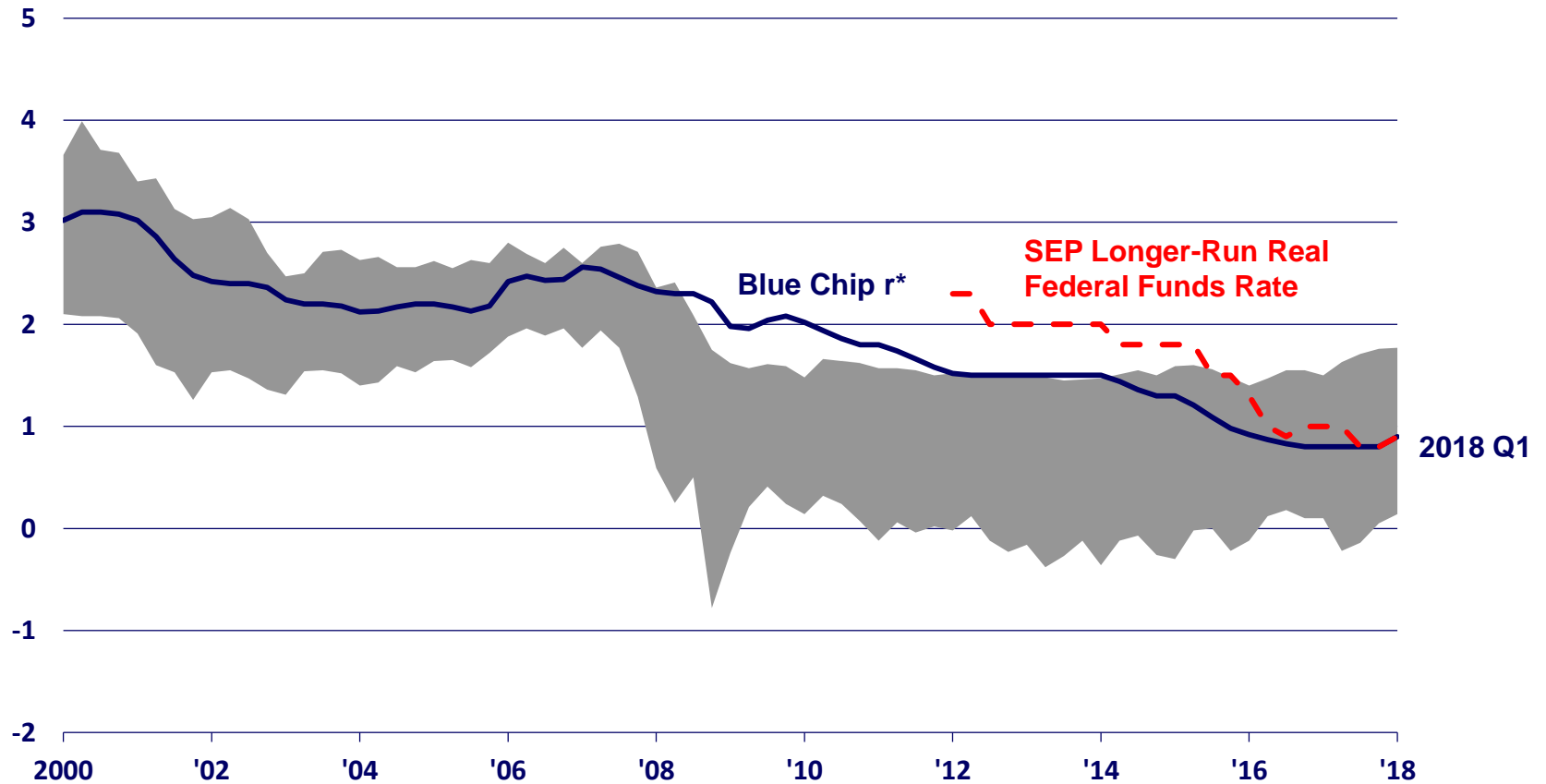
Target Federal Funds Rate at Year-End and Inertial Taylor Rule (percent)



Source: FOMC June 2018 Summary of Economic Projections

Estimates of the Real Natural Rate of Interest

Range of Estimates from econometric models, Blue Chip and SEP long-run r
(percent)



Source: July 2018 Monetary Policy Report, Board of Governors of the Federal Reserve System

Estimates of the Real Natural Rate of Interest

Time Series

$$\text{IS: } y_t^c = a_y(L)y_{t-1}^c + a_r(L)(r_{t-1} - r_{t-1}^*) + \varepsilon_t^{yc}$$

$$\text{PC: } \pi_t = b_y y_{t-1}^c + b_\pi(L)\pi_{t-1} + \varepsilon_t^\pi$$

$$r^* : \quad r_t^* = c g_t + z_t \\ z_t = d_z(L)z_{t-1} + d_x X_t + \varepsilon_t^z; |d_z(1)| \leq 1$$

Setting $r = r^* \Rightarrow y_t^c \rightarrow 0$ in long run

New Keynesian

$$y_t^c = E_t[y_{t+1}^c] + a_r(r_t - r_t^*) + \varepsilon_t^{yc}$$

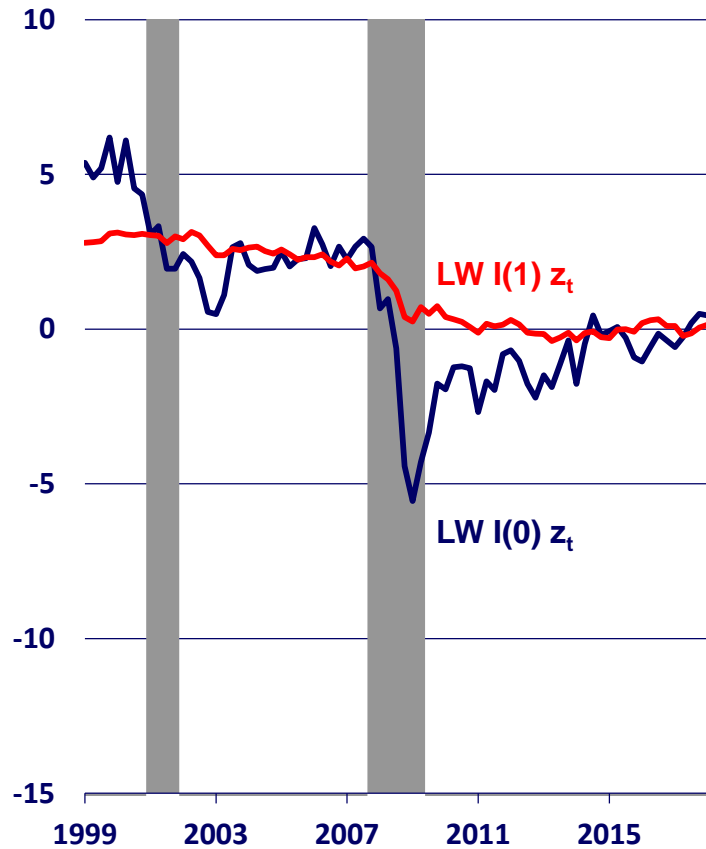
$$\pi_t = b_y y_t^c + \beta E_t[\pi_{t+1}] + \varepsilon_t^\pi$$

$$r_t = r_t^* + d_\pi \pi_t + d_{y^c} y_t^c + \varepsilon_t^r$$

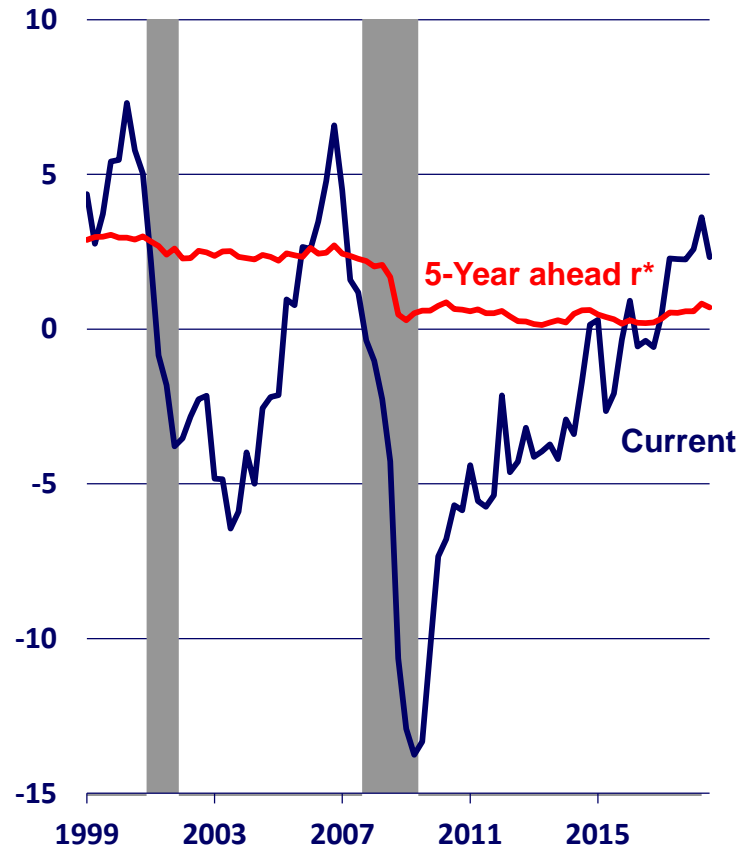
Setting $r = r^* \Rightarrow y_t^c = 0$ today

Estimates of the Real Natural Rate of Interest

Laubach-Williams r^*
(percent)



Chicago Fed DSGE r^*
(percent)



Source: Federal Reserve Bank of San Francisco and internal Chicago Fed staff calculations

Implications of r^* estimates

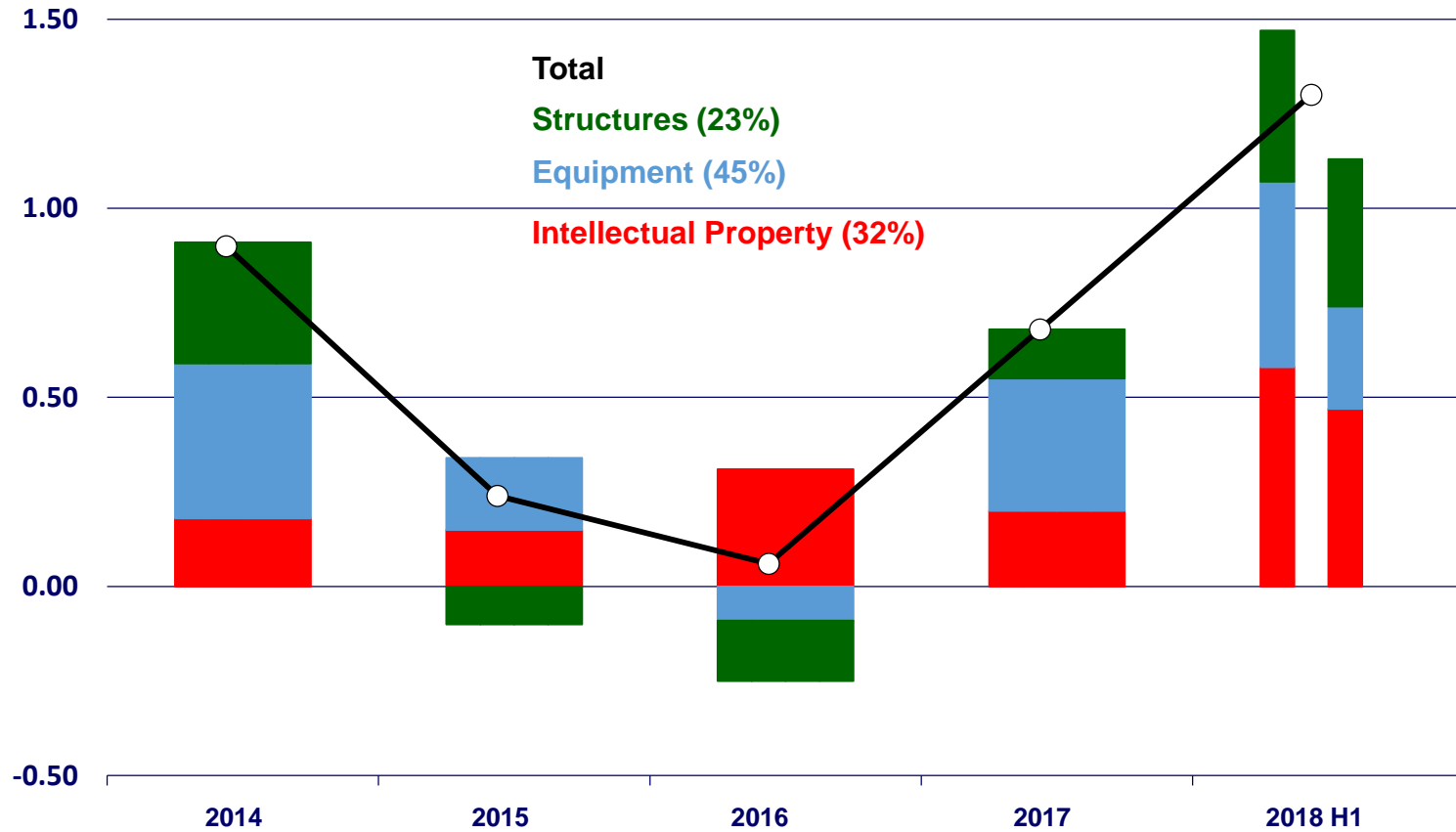
- **Great deal of uncertainty over r^* => Look to many indicators for judging the stance for policy**
- **Low r^* => Less room to the ELB**
 - **Say nominal $r^* \approx 2\text{-}3/4$ to 3 percent; even in less severe 1990 and 2001 recessions, Fed cut 5 percentage points**
 - **Consider alternative frameworks?**
 - **Target nominal income, price level, conditional price level, etc.**
 - **Recognize may have to use nonconventional tools again in the future**

Appendix

Investment

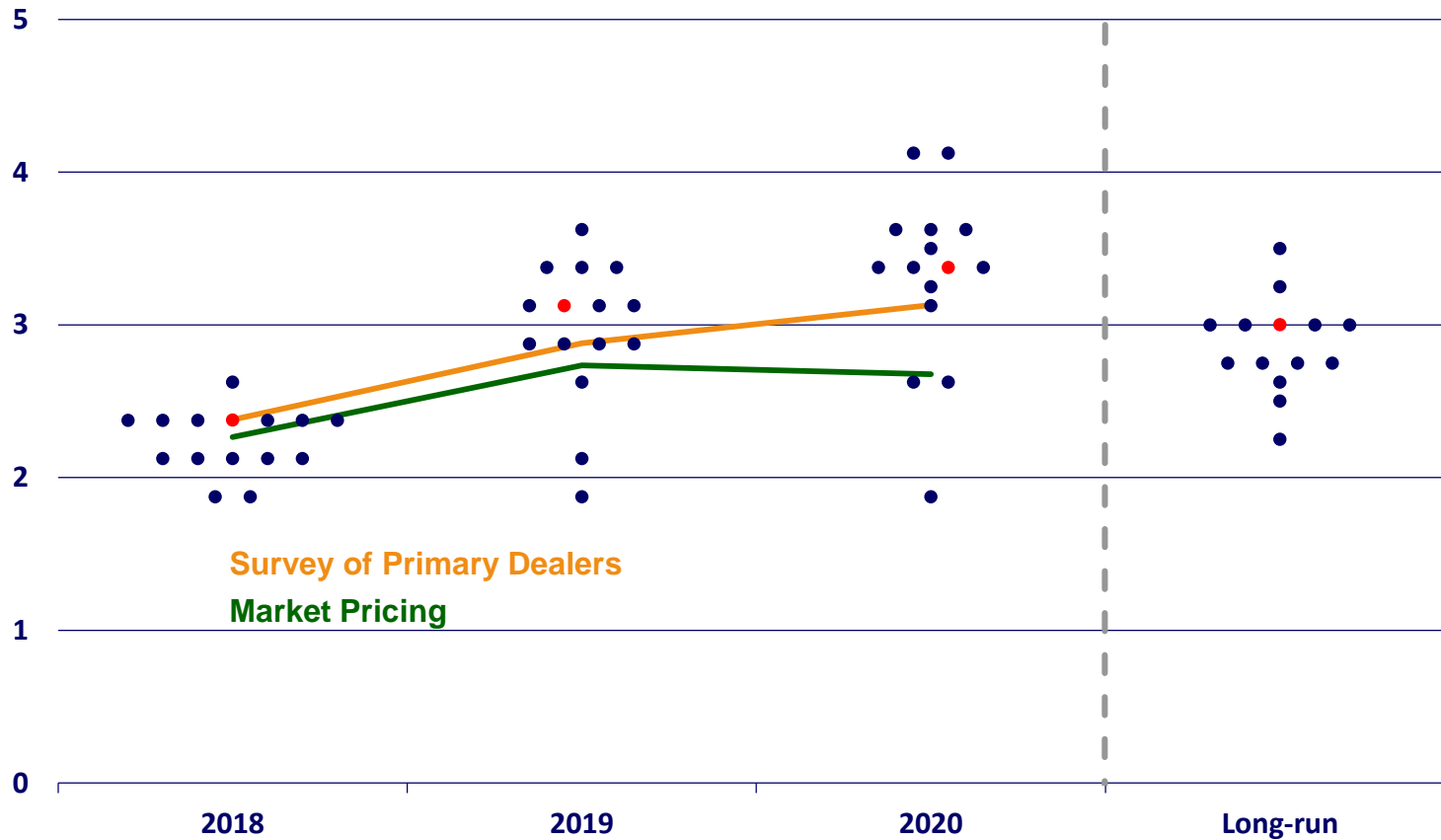
Private Nonresidential Fixed Investment

(contribution to percentage change in GDP)



Monetary Policy

Target Federal Funds Rate at Year-End (percent)

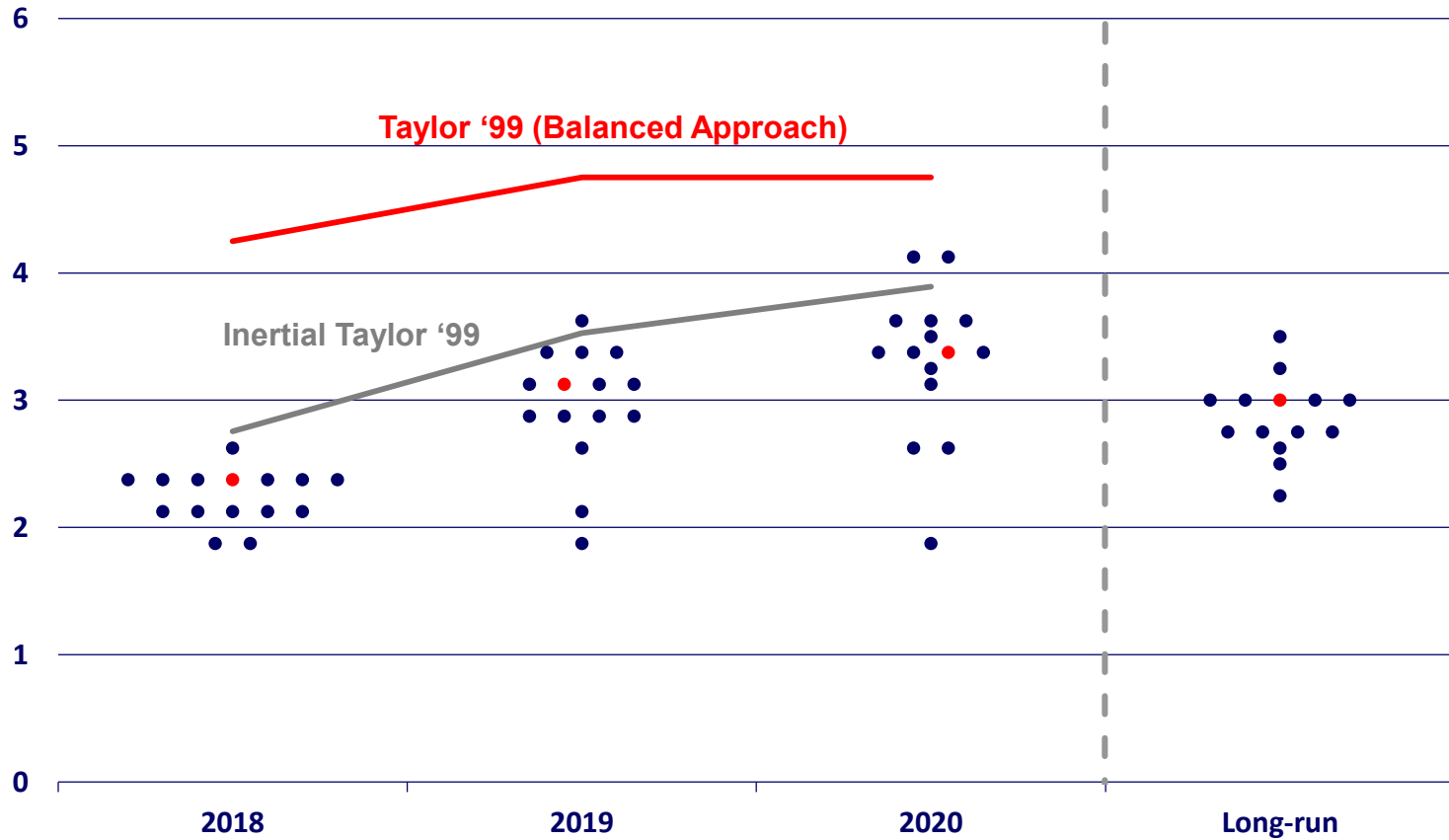


Market expectations as derived from OIS futures as of September 6, 2018 and the July/August Survey of Primary Dealers. Red dots indicate median.

Source: FOMC Summary of Economic Projections

Benchmarking Monetary Policy

Target Federal Funds Rate at Year-End and Inertial Taylor Rule (percent)



Source: FOMC June 2018 Summary of Economic Projections

Treasury Rates

10 Year Treasury (percent)



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

Estimates of the Real Natural Rate of Interest

D. Point estimates and uncertainty bands for neutral real rate in the longer run as of 2018:Q1

Study	Point estimate	95 percent uncertainty band
Del Negro and others (2017)	1.3	(.7, 2.1)
Holston and others (2017)	.6	(-2.5, 3.7)
Johannsen and Mertens (2016)	.7	(-1.3, 2.5)
Kiley (2015)	.4	(-.6, 1.6)
Laubach and Williams (2015)	.1	(-5.4, 5.6)
Lewis and Vazquez-Grande (2017)	1.8	(.5, 3.1)
Lubik and Matthes (2015)	1.0	(-2.3, 4.5)

SOURCE: Federal Reserve Board staff calculations, along with references listed in box note 7.