

A Comparison of Fed “Tightening” Episodes since the 1980s*

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This article examines how the real economy and inflation and inflation expectations evolved in response to the six tightening episodes enacted by the FOMC from 1983 to 2018. The findings indicate that the sixth episode (2015–18) differed in several key dimensions compared with the previous five episodes. In the first five episodes, the data show the FOMC was generally tightening into a strengthening economy with building price pressures. In contrast, in the final episode the FOMC began its tightening regime during a deceleration in economic activity and with headline and core inflation remaining well below the FOMC’s 2 percent inflation target. Moreover, both short- and long-term inflation expectations were drifting lower. These developments helped explain why there was a one-year gap between the first and second increases in the federal funds target rate in the final episode. Another key difference is that in three of the first five episodes, the FOMC continued to tighten after the yield curve inverted; a recession then followed shortly thereafter. However, in the final episode, the FOMC ended its tightening policy about eight months before the yield curve inverted.

JEL Codes: E3, E4, E5, N1.

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“The FOMC has always recognized that in a tightening cycle, if we stop too soon, inflationary pressures will resurge and make it very difficult to contain them again. We therefore always tend to take out the insurance of an additional fed funds increase, fully expecting that it may not be necessary.”

Former Federal Reserve Chairman Alan Greenspan¹

1. Introduction

The Federal Open Market Committee (FOMC) voted to establish a target range for the intended federal funds rate of 0 percent to 0.25 percent at the conclusion of its December 15–16, 2008, meeting. Although the decision was implemented during one of the nation’s worst economic and financial crises, this decision was nonetheless historic. In the FOMC’s Greenbook prepared for this meeting, Board staff predicted that the federal funds target rate would remain at the zero (effective) lower bound (ZLB) through the end of 2012.² But this four-year period turned out to be an unprecedented seven years.

With the economy into the sixth year of expansion, and inflation pressures projected to increase modestly, the FOMC announced at the conclusion of its December 15, 2015, meeting that it was raising its target range by 25 basis points. (Note: Henceforth, the analysis will characterize the midpoint of the range as the federal funds target rate, or FFTR.) The initial tightening action—defined as the first increase in the FFTR during the sequence of increases—was the first since June 2006.

Following liftoff in December 2015, the FOMC then paused for a year. Not only was inflation well below the 2 percent target rate at liftoff, but low inflation also persisted through 2016. Moreover, short-term inflation expectations also drifted lower, while long-term inflation expectations remained unchanged at 2 percent. From this standpoint, as will be discussed in this paper, economic conditions

¹Greenspan (2007, p. 156).

²The Greenbook was the economic conditions and forecast document distributed by the Board staff before each FOMC meeting. It is now known as the Tealbook Part A. See the Long-Term Outlook table on pages I–18 in the December 10, 2008, Greenbook: <https://www.federalreserve.gov/monetarypolicy/files/FOMC20081216gbpt120081210.pdf>.

at the initial stages of the 2015 episode were unique compared with previous episodes. In their defense, the FOMC announced that even after this tightening action, monetary policy was accommodative.

Altogether, from December 2015 to December 2018, the FOMC lifted its policy rate nine times, in increments of 25 basis points. At the conclusion of the December 18–19, 2018, meeting, the FOMC’s target range for the federal funds rate was 2.25 to 2.5 percent. This turned out to be the final increase in this tightening episode, and the sixth to have occurred during the Great Moderation (post-1983) period.³ With downside risks to the economy emerging, the FOMC reduced its policy rate by 75 basis points over the second half of 2019. The FOMC then returned the policy rate to the ZLB in mid-March 2020 because of the contraction in economic activity spawned by COVID-19. On June 8, 2020, the National Bureau of Economic Research Business Cycle Dating Committee announced that the nation’s longest business expansion ended in February 2020.

This article will proceed as follows. Section 2 will identify the six tightening episodes during this period and briefly discuss economic and financial conditions during each episode. Sections 3 and 4 will discuss the Board staff’s forecast accuracy for real GDP growth before, during, and after the tightening episodes, and then whether financial market participants accurately gauged the extent of the tightening at the beginning of each episode. Section 5 examines responses of key economic and inflation measures before and after each episode. Section 6 concludes.

2. Six Tightening Episodes

The literature that examines economic and financial market developments during individual U.S. monetary tightening episodes is relatively sparse. For this paper, a tightening action occurs when the FOMC votes to raise the FFTR.⁴ Laforte and Roberts (2014) employ

³This article uses the term “tightening” to refer to policy decisions by the FOMC to raise the federal funds rate target.

⁴Most central bank models presume that raising the short-term nominal policy rate will, via the expectations effect, also raise key longer-term interest rates faced by firms, households, and governments who borrow in capital markets. Economic textbooks generally assert that business capital spending (fixed investment) is sensitive to changes in interest rates. However, the empirical evidence is less

the model used by the staff of the Board of Governors of the Federal Reserve System to show that a 100 basis point increase in the federal funds target increases the size of the output gap (real GDP as a percent of real potential GDP) by about 0.4 percentage point in the first two years, while lowering the core inflation rate by less than 0.1 percentage point.⁵ Willems (2020) uses a data set of annual observations for 162 countries to show that an increase of 100 basis points in the central bank's target rate reduces real GDP by an average of 0.5 percent over a four- to five-year period. He finds the effect is nearly four times larger for advanced economies (−1.1 percent) than for emerging and developed economies (−0.3 percent).

Adrian and Estrella (2009) examined whether tightening cycles since 1955 helped to predict future economic outcomes. They concluded that most tightening actions generated increases in the unemployment rate and a narrowing or inversion of the yield curve. The latter, they argue, is a useful indicator of future economic activity during periods of tighter monetary policy. More recently, Orphanides (2015) examined episodes during the Great Moderation within the context of the pending normalization of monetary policy in 2015. Orphanides argued that the FOMC could improve economic outcomes by employing a more systematic policy (i.e., rules based) rather than a discretionary policy. Other contributions that examined policy discussions of past tightening episodes within a broader context (i.e., not a systematic analysis of individual episodes) can be found in Greenspan (2007) and Hetzel (2008).

This paper uses two primary criteria to identify beginning and ending dates of tightening episodes: FOMC documents (e.g., Records of Policy Actions or FOMC Statements issued after the meeting) and the time series of the FOMC's federal funds target rate to identify the daily dates of the beginning and ending of tightening episodes. The latter is useful because in the early 1980s the Committee more

supportive of this view. See Sharpe and Suarez (2015) for a recent assessment. More broadly, Willis and Cao (2015) use a time-series model to show that employment across most industries has become less sensitive to changes in the federal funds rate since 1984.

⁵The workhorse model is known as FRB/US. See <http://www.federalreserve.gov/econresdata/notes/feds-notes/2014/november-2014-update-of-the-frbus-model-20141121.html>. As the authors of this note show, other outcomes are possible if one makes different assumptions.

closely monitored growth of the M1 and M2 monetary aggregates. Moreover, they did not publicly announce when the federal funds rate was changed. It was not until the press release following the February 4, 1994, meeting that the FOMC begin to publicly communicate decisions to change the federal funds target rate in real time.

Table 1 lists the six tightening episodes based on these criteria: from March 1983 to August 1984; from March 1988 to May 1989; from February 1994 to February 1995; from June 1999 to May 2000; from June 2004 to June 2006; and from December 2015 to December 2018. A stricter definition of when a tightening cycle *ends* was developed by Adrian and Estrella (2009). They define the end of a cycle based on a set of criteria for the level of the federal funds rate relative to the beginning of the cycle or the end of the cycle. Comparing the ending points in Table 1 with Adrian and Estrella’s methodology produces slightly different ending dates for the 1988–89 episode (March 1989); the 1994–95 episode (April 1995); and the 1999–2000 episode (July 2000).

Table 1 shows that the magnitude of tightening actions—as measured by the increase in the nominal FFTR—varied across episodes. The average increase was slightly less than 300 basis points, with a maximum increase of 425 basis points and a minimum increase of 175 basis points. The table also reveals that there were relatively few dissents at the time of liftoff and at the final tightening action.

2.1 Treasury Market Yields During Tightening Episodes

Financial market participants routinely price financial assets like Treasury securities on the basis of current and expected changes in monetary policy. Figure 1 (A–F) shows how short- and long-term Treasury yields changed during each of the six tightening episodes. Each chart plots the daily close of the FOMC’s FFTR, the three-month Treasury-bill constant maturity yield, and the 10-year Treasury note constant maturity yield. Vertical lines denote the initial and final actions by the FOMC to increase its FFTR. Implicitly, each chart also reveals the evolution of the term spread, or yield curve.

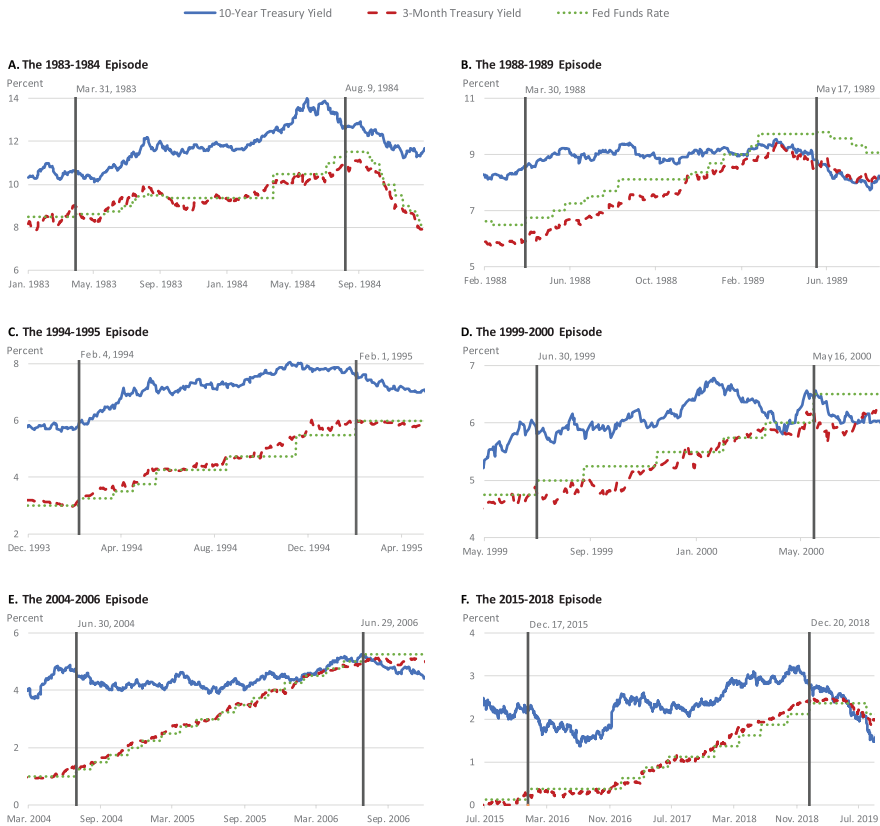
There are several observations to be gleaned from the charts in Figure 1. First, from a broad perspective, nominal short- and

Table 1. FOMC Tightening Actions and Dissents, 1983 to 2018

First Tightening Action	Initial FFR Target (%)	Final Tightening Action	Final FFR Target (%)	Total Tightening (Percentage Points)	Dissent at Initial Action?	Dissent at Final Action?
March 31, 1983	8.5	August 9, 1984	11.5	3.00	None	Yes (1) Wallich wanted easier policy
March 29, 1988	6.50	May 16, 1989	9.8125	3.31	Yes (1) Seger wanted easier policy	Yes (1) Melzer wanted easier policy
February 4, 1994	3.00	February 1, 1995	6.00	3.00	None	None
June 30, 1999	4.75	May 16, 2000	6.50	1.75	Yes (1) McTeer thought tightening was unnecessary	None
June 30, 2004	1.00	June 29, 2006	5.25	4.25	None	None
December 16, 2015	0 to 0.25	Dec. 19, 2018	2.25 to 2.50	2.25	None	None

Source: Board of Governors of the Federal Reserve System and Federal Reserve Bank of St. Louis.

Figure 1. Changes in Short- and Long-Term Treasury Yields During the Six Tightening Episodes



long-term Treasury interest rates rose during the duration of each tightening episode—that is, from the initial increase to the final increase in the FFTR. However, the increases varied across episodes. Second, the three-month bill rate closely followed the path of the FFTR. However, there were periods in the 1988–89 and 1999–2000 episodes when the three-month rate traded below the FFTR for several months. The opposite pattern held over the last several months of the 2015–18 episode, when the three-month yield traded above the FFTR. Third, the average increase in the 10-year nominal Treasury rate across episodes (95 basis points) was appreciably less than the average increase in the FFTR. However, there was considerable

variance—from only 23 basis points in the 1988–89 episode to 199 basis points in the 1983–84 episode.

Two of the tightening episodes triggered very different behavior in the long-term Treasury bond market. The first was the 1994–95 tightening period. This episode is unique in Federal Reserve monetary history for a couple of reasons. First, the economy was strengthening in 1994, as real GDP increased from 2.6 percent in 1993 to 4.1 percent in 1994, but there were few obvious inflation pressures. From 1992 to 1994, CPI inflation slowed from 3.1 percent to 2.6 percent.⁶ However, the Board staff forecasted that inflation would remain above 3 percent in 1994 (3.3 percent) and in 1995 (3.1 percent).⁷ As a result, the Greenspan FOMC adopted a “more radical approach: moving gently and preemptively, before inflation even appeared.”⁸ A second aspect of this episode was the form of forward guidance the Committee would use to signal pending policy changes in the FFTR at future meetings. For example, Greenspan signaled the Committee’s intent a month before—in congressional testimony—to increase the federal funds target rate. Then, at the conclusion of the February 4, 1994, meeting, the FOMC released for the first time a post-meeting statement.⁹ The FOMC continued to issue post-meeting statements over the next few years, but only at meetings where a policy change occurred. Beginning with the May 18, 1999, meeting, statements were released after each FOMC meeting.¹⁰ Beginning with the June 30, 1999, statement, the FOMC began to report the target for the federal funds rate.

⁶Unless noted otherwise, yearly changes in output and inflation are reported as percent changes from the fourth quarter of one year to the fourth quarter of the following year.

⁷Reported in the January 28, 1994, Greenbook, Part 1, pp. 1–12.

⁸Greenspan (2007, p. 154).

⁹Despite these signals, financial markets appeared to be taken by surprise, as the subsequent turmoil was termed “the bond market massacre” by *Fortune* magazine. See <http://fortune.com/2013/02/03/the-great-bond-massacre-fortune-1994/>. By contrast, Borio and McCauley (1995) examined bond market volatility across several countries and found little evidence that the volatility stemmed from actions by monetary or fiscal policymakers.

¹⁰At the May 18 meeting, Greenspan proposed including a “tilt” in the statement, which, in his view, allowed the FOMC “to move in light of a lot of small indications in the CPI that may suggest a rise in inflation.” See the May 18, 1999, FOMC Transcript, p. 58. This tilt, whether intentional or not, signaled the start of the 1999–2000 tightening episode at the following meeting in June.

A markedly different set of circumstances in the Treasury market occurred during the fifth tightening episode. This episode, which began in June 2004 and ended in June 2006, was dubbed the “lower for longer” period. Over this two-year period, encompassing 17 meetings, the FOMC raised its federal funds target rate from 1 percent to 5.25 percent in increments of 25 basis points. However, from May 2004 to early January 2006, long-term Treasury yields remained within a fairly narrow trading range—roughly between 4 percent and 5 percent—despite the steady increase in the FFTR.¹¹ This event was subsequently termed “the Conundrum” by former Fed Chairman Alan Greenspan.¹² Eventually, long-term yields turned sharply higher, rising by a little less than 100 basis points from mid-January 2006 to early July 2006.

A fourth observation is a common—though not uniform—pattern in the Treasury market during the duration of a Fed tightening action. Namely, short-term rates eventually rise by more than long-term rates, leading to, first, a gradual flattening of the yield curve and then, second, an inversion of the yield curve. Indeed, yield curve inversions occurred in three of the six episodes 1988–89, 1999–2000, and 2004–06. In each of these three episodes, the FOMC increased its FFTR *after* the yield curve inversion. The Committee’s behavior was consistent with the asymmetric objective function highlighted in the Greenspan quote above.

A fifth observation from the charts in Figure 1 pertains to the final tightening episode. Prior to the final tightening action on December 20, 2018, 10-year Treasury yields were falling, resulting in a flattening of the yield curve. But unlike three of the previous five episodes, the FOMC’s final tightening move occurred before the inversion of the yield curve. Indeed, there was much commentary among FOMC participants about the causes and significance of the flattening yield curve during 2018.¹³ One might conjecture that the Committee, recalling the earlier episodes when the FOMC continued

¹¹There was some parallel with the 1988–89 episode. Long-term rates peaked early in the tightening cycle, at about 9.25 percent during the week ending May 27, 1988. The 10-year yield would not surpass this level until the week ending August 12; however, over this period the FOMC would raise the federal funds target rate by 113 basis points.

¹²See Thornton (2018) for discussion and analysis of this event.

¹³See, for example, the Minutes of the July 31–August 1, 2018, FOMC meeting.

to raise its FFTR after an inversion of the yield curve, refrained from taking similar action. Regardless, the yield curve would eventually invert in 2019, but well after the final tightening action.¹⁴

3. Evolving Economic Conditions and Forecast Accuracy during Tightening Episodes

Policymakers confronted a changing macroeconomic environment over the periods encompassed by these tightening episodes that bore little resemblance to episodes before 1983. For example, from 1983 to the start of the pandemic in early 2020, the FOMC was routinely confronted by lower inflation and lower unemployment rates during expansionary periods compared with most episodes that occurred during the 1960s and 1970s. The former period has come to be known as the Great Moderation, while the latter period is known as the Great Inflation (high and rising unemployment rates). Figure 2 captures another key element of the post-1983 economic environment: The steady decline in the natural (real) rate of interest (r^*).¹⁵ In monetary policymaking, r^* is often used as a benchmark for measuring the stance of policy.¹⁶ All else equal, lower inflation and a lower r^* meant that the peak nominal FFTR was sequentially lower during each tightening episode, as seen in Figure 1A–F.

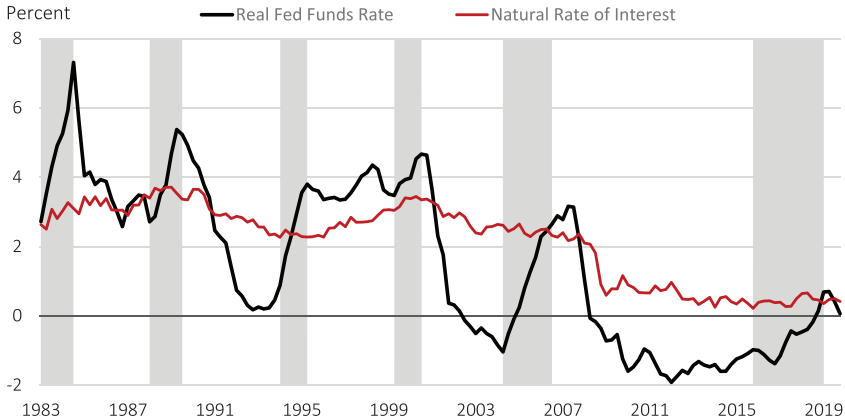
Figure 2 shows that in the first part of the 1991–2001 expansion, the 2001–07 expansion, and the 2009 to 2020 expansion, the real FFTR was well below r^* for extended periods. By contrast, the

¹⁴The yield curve inverted briefly in late March 2019. It would remain inverted from May 23, 2019, to October 10, 2019.

¹⁵The natural rate of interest (r -star, or r^*) is calculated by Holston, Laubach, and Williams (2017). In monetary policymaking, r^* is a time-varying, model-based estimate of the real short-term interest rate required to keep inflation and the unemployment rate at the FOMC's target rates. Estimates of r^* are imprecise (i.e., have wide confidence bands). Holston, Laubach, and Williams (2017) estimate the sample average standard error is 1.1 percentage points. Their published point estimate for r^* in 2016 was 0.4 percent. Holston, Laubach, and Williams suspended the reporting of their r^* measure following the onset of the pandemic in early 2020.

¹⁶If the real FFTR is below r^* , then policy is deemed accommodative, leading to faster output growth, falling unemployment rates, and rising inflation pressures. The opposite would occur if the real FFTR was above r^* . The real federal funds target rate is defined as the nominal rate less the four-quarter percent change in the PCE price index excluding food and energy.

Figure 2. The FOMC’s Real Federal Funds Target Rate and an Estimate of the Natural Rate of Interest (r^*) During Tightening Episodes

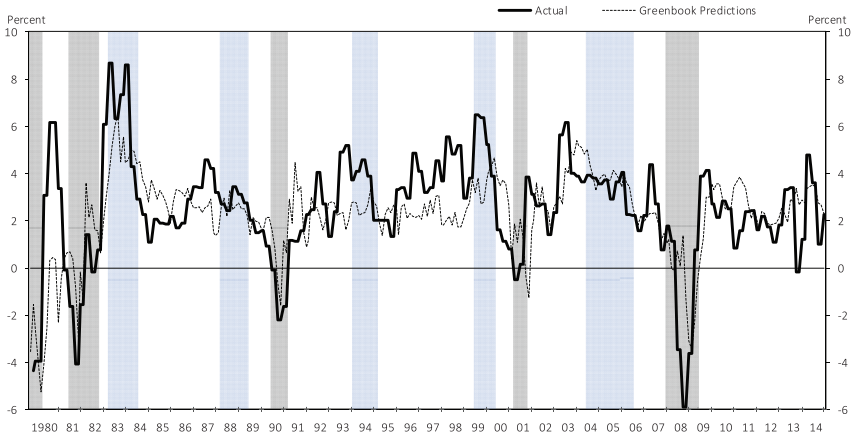


Source: Federal Reserve Bank of St. Louis and Haver Analytics.

Note: Gray shading indicates periods of Fed tightening actions.

real FFTR and r^* were more closely aligned before the onset of the 1988–89 tightening, and the real FFTR was well above r^* for about seven years from mid-1994 to early 2001; the latter episode is discussed in more detail below. However, in all cases the tightening actions resulted in an eventual modest overshooting of the policy rate ($\text{FFTR} > r^*$), leading to a recession in five of the six tightening episodes (the exception being the 1994 episode). One could argue that the recession following the sixth episode was not triggered by tighter monetary policy, but by sharply higher oil prices and the collapse in aggregate economic activity associated with the COVID-19 pandemic.¹⁷ Still, the real FFTR eventually exceeded r^* , but by much less than in the previous tightening episodes.

¹⁷Many private professional forecasters prior to the pandemic had noted the elevated probability of a recession in 2020 according to the December 2019 Blue Chip Consensus forecast. According to the forecast consensus, the probability of a recession in 2020 was about 33 percent. This probability was marginally lower compared with a year earlier when the consensus placed a roughly 35 percent probability of a recession in 2020.

Figure 3. Actual and Predicted Real GDP Growth

Source: Hetzel (2008).

Note: Observations correspond to FOMC meetings. Predictions are from the Greenbook and are for the annualized two-quarter rate of growth of real output (GNP before December 1991 and GDP thereafter). If an FOMC meeting is in the first two months of a quarter, the predicted growth rate is for the contemporaneous and succeeding quarter. If it is in the last month of a quarter, the predicted growth rate is for the succeeding two quarters. Actual growth is the subsequently realized growth rate, measure using the data available at the time of the publication of the “final” GDP estimate for the final quarter of the two-month growth rate. The final estimate is released in the last month of the quarter following a particular quarter. Blue shading indicates periods of Fed tightening. Gray shading indicates a recession.

Trends in the macroeconomy shown in Figure 2 are hard to spot on a meeting-by-meeting basis. Indeed, FOMC policymakers are regularly challenged because shocks and other factors that might alter the structural trends in the macroeconomy are difficult to identify in real time. We can see this in Figure 3, which shows the evolution of actual real GDP growth and the Board staff’s projection of real GDP growth during the periods before, during, and after the first five tightening episodes (blue-shaded intervals). The growth rates plotted are annualized two-quarter percent changes. The Board staff’s forecasts are reported in the Greenbook and the horizon extends well beyond two quarters.¹⁸ I use two-quarter-ahead forecasts for two

¹⁸Greenbook forecasts—today known as Tealbook A forecasts—inform FOMC policymakers about the staff’s expected short-to-medium-term path of key

primary reasons. First, the data set was readily available. Second, a reading of many FOMC transcripts during the Great Moderation period suggests that monetary policymakers tended to tether their policy discussions and decisions to economic developments that have transpired over the intermeeting period and their implication for the economy over the next six to nine months. Third, the forecasting literature suggests considerable erosion in forecast accuracy as the forecast horizon lengthens. For example, Breitung and Knüppel (2021) use Diebold-Mariano-type and encompassing tests to examine six-quarter-ahead macroeconomic forecasts from Consensus Economics. They find that the information content for quarter-to-quarter forecasted changes in U.S. real GDP growth reaches a maximum at two to three quarters ahead.¹⁹

Some notable patterns are apparent in Figure 3. First, in the first four tightening episodes (blue-shaded intervals), the Greenbook forecasts generally underestimated the strength of real GDP growth. However, this pattern did not prevail in the fourth episode. In terms of the post-tightening period, which were recessionary periods (gray-shaded intervals) in all except the 1993–94 tightening episode, there generally does not appear to be a consistent pattern. Perhaps not surprisingly, the Greenbook forecasts did not foresee the timing and depth of the Great Recession and Financial Crisis (the period following the fourth tightening episode). Belongia and Ireland (2018) examined Greenbook forecasts from 1987 to 2012 and argued that the FOMC set the FFTR in a manner consistent with the Board staff’s forecast for the output gap and inflation. They further argued that the FOMC was less responsive to Greenbook forecasts around turning points in the business cycle.

Visual inspection of actual and projected outcomes can be informative but may mask the true accuracy of the forecasts that

economic indicators, including the nominal and real FFTR. The author thanks Robert Hetzel for sharing the data plotted in Figure 3. The sixth tightening episode is not shown because Tealbook forecasts are released with a five-year lag.

¹⁹See also Reifschneider and Tulip (2019), who compare the predictive accuracy of Federal Reserve Board staff with FOMC participants and other forecasters (e.g., Congressional Budget Office and Blue Chip) from 1996 to 2015. They find that uncertainty about the economic outlook is “quite large” and that the predictive differences across forecasters for key economic variables like real GDP growth and inflation are “quite small.”

Table 2. Greenbook Forecast Accuracy Before, During, and After Tightening Episodes (root mean square errors, %)

	One Year Before Tightening Period	During Tightening Period	One Year After Tightening Period
Medians for Five Episodes	2.6	1.6	1.2
Maximum RMSE (Episode)	2.7 (1983–84)	2.9 (1983–84)	2.3 (1999–2000)
Minimum RMSE (Episode)	1.7 (2004–06)	0.6 (1988–89)	0.8 (1988–89)
Source: Author's calculations based on data plotted in Figure 4.			

polycymakers relied upon. Table 2 measures Greenbook forecast accuracy (actual less predicted) over three intervals for each of the tightening episodes from the projections and actual outcomes shown in Figure 3. Specifically, the table shows the root mean-squared forecast error (RMSE) for (i) four quarters preceding the beginning of the tightening episode; (ii) the period during the tightening episode; and (iii) the year following the tightening episode. The medians of the five episodes are reported, along with the maximum and minimum RMSE.

Table 2 shows that Greenbook forecasts for real GDP growth were least accurate (highest RMSE) during the four quarters prior to the beginning of the tightening policy. The median RMSE for the five episodes was 2.6 percent, which was about 63 percent larger than the RMSE during the tightening period and more than twice as large as the median RMSE during the one-year period following the end of the tightening episode. The bottom part of Table 2 shows that the Greenbook's forecast accuracy varied. However, the largest RMSEs were generally associated with the 1983–84 episode, while the smallest RMSEs were generally associated with the 1988–89 episode.

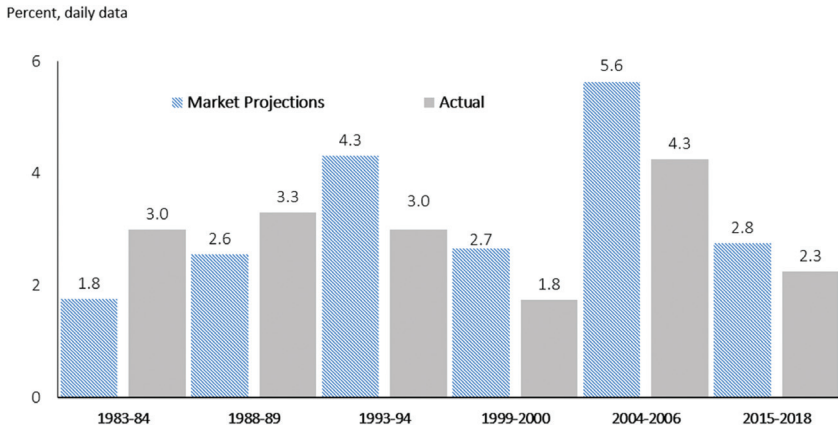
4. Assessing Financial Market Expectations during Tightening Episodes

One of the challenges in measuring responses of firms, households, and financial market participants to the Fed's tightening actions

is accounting for expectations about the timing and magnitude of these actions. Regarding the timing of liftoff, the FOMC over time has sought to minimize disruptions to financial markets and economic activity by improving the communication of pending actions to change policy (or not change policy). The 2013 taper tantrum episode is viewed as a counterexample. Improved communication has sometimes taken the form of forward guidance about the future path of the FFTR. If successful, forward guidance can help bring private-sector expectations into closer alignment with the FOMC's intentions, thereby enhancing the effectiveness of monetary policy. Consistent with this view, Poole (2005) found that policy decisions by the FOMC since 1994 elicited little news in the federal funds futures markets. This finding suggests that markets had successfully priced in pending policy decisions by the FOMC. Poole (2005) also found evidence that market expectations of future Fed policy actions were informed importantly by news in the monthly employment report following the introduction of “forward-looking” language in the August 2003 FOMC statement. In a similar vein, Swanson (2006) shows that forecasts of the FFTR by financial markets and private-sector forecasters have become more accurate since the Federal Reserve began a concerted effort since the late 1980s to improve the quantity and quality of its public communication (transparency).

Beyond the scope of the Fed's actions on the expectations of financial markets and forecasters, there is also the issue of how much the Fed should tighten. The magnitude of the Fed's tightening action depends on several factors. This includes, most obviously, the evolving state of the U.S. economy. Markets could be assessing the future state of the economy, and then mapping this trajectory into a well-known policy rule like the Taylor rule. But markets also condition their bets on future policy actions by the FOMC. Markets might also employ a rule of thumb or a heuristic based on previous tightening episodes, or communication from FOMC policymakers about the future stance of monetary policy. These bets are then priced into financial market prices. Gürkaynak, Sack, and Swanson (2005) use high-frequency (intraday) data to show that monetary policy announcements explain a very large variation in long-term Treasury yields that work through the expectations of future policy actions that are reflected in federal funds futures and eurodollar futures rates one-year out.

Figure 4. Magnitude of Tightening Episodes: Actual vs. Expectations



Source: CBOT, CME, FRB.

Figure 4 provides some assessment of the market's expectations about the magnitude of the FOMC's tightening actions relative to the actual amount of Fed tightening. In this case, market expectations are measured at the beginning of the tightening episode using expected future yields derived from three-month eurodollar contracts. No attempt is made to adjust expectations *during* the tightening episode. Specifically, the market's projected tightening in Figure 4 is the terminal value of the farthest traded three-month eurodollar contract less the initial federal funds rate immediately prior to liftoff. Moreover, these eurodollar rates are adjusted for risk premium effects.²⁰

Figure 4 shows that markets underestimated the magnitude of the tightening in the first two tightening episodes by about 125 and 75 basis points, respectively. However, in the final four episodes,

²⁰Yields on eurodollar futures are adjusted by subtracting the estimated forward-swap rate for a given period and time to maturity. The adjustment averages 25 basis points in the 1988, 1994, and 1999 episodes, 15 basis points in the 2004 episode, and 24 basis points in the 2015 episode.

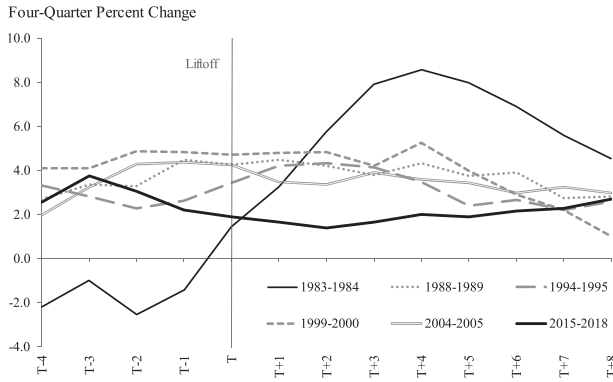
financial market participants overestimated the amount of tightening. The overestimates were especially pronounced in the 1993–94 and 2004–06 episodes—about 130 and 140 basis points, respectively. As noted above, the earlier episode was unique because the Fed’s preemptive approach appeared to catch the market by surprise, while the latter episode was unique because of its duration. It is important to emphasize, though, that these expectations were conditioned on the current and prospective state of the economy and other factors that prevailed at the time of liftoff. Finally, it was also the case that markets overestimated the total tightening in the 2015–18 episode, but by much less than the previous three episodes.²¹ This is consistent with the literature cited above that the FOMC’s shift to a more transparent communication paradigm provided markets with better information than in previous episodes.

5. Key Economic Indicators Before and After Past Tightening Episodes

The remainder of this article will examine the behavior of six key economic variables before and after the onset of tighter monetary policy in the six episodes highlighted in this paper. The six economic indicators are those that are generally of most interest to monetary policymakers: (i) the four-quarter growth in real GDP; (ii) the level of the unemployment rate; (iii) the four-quarter growth of the personal consumption expenditures price index, or PCEPI; (iv) the four-quarter growth of the personal consumption expenditures price index excluding food and energy prices (core PCEPI). These four series are reported in the FOMC’s quarterly Summary of Economic Projections. The fifth and six series are measures of short- and long-run inflation expectations: (v) the University of Michigan survey of household inflation expectations over the next 12 months (median estimate); and (vi) the 10-year-ahead forecast for PCEPI

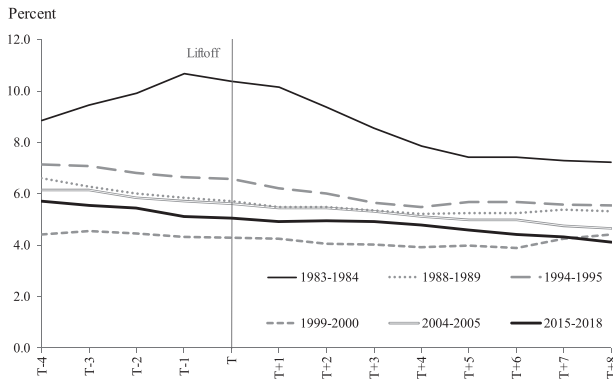
²¹At the December 2015 FOMC meeting, the median participant projected that the federal funds rate would increase from 0.4 percent at the end of 2015 to 3.3 percent in 2018. This cumulative projected tightening (2.9 percentage points) was very close to the expectations of financial market participants (2.8 percentage points).

Figure 5. Real GDP



Source: BEA/Haver Analytics.

Figure 6. Unemployment Rate



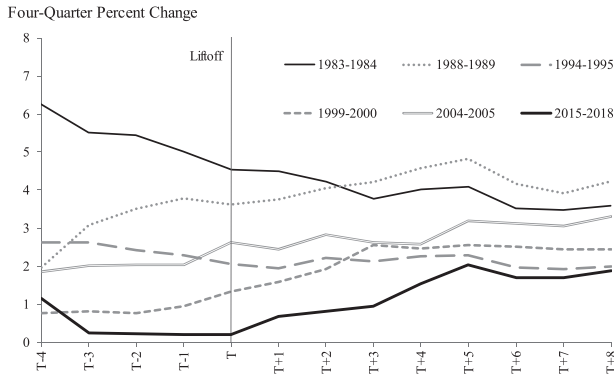
Source: BEA/Haver Analytics.

inflation based on the Federal Reserve Bank of Philadelphia’s Survey of Professional Forecasters and other sources.²²

The analysis in this section is based on Figures 5–10 and it will largely be descriptive in nature. The visual representation of the

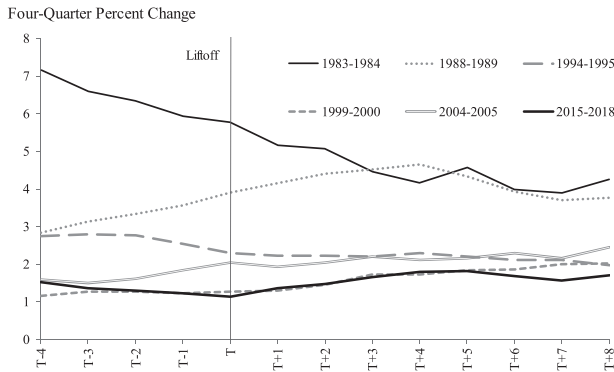
²²The data used in Figures 5–10 and throughout the article, unless indicated, are current-vintage data—that is, data vintages that existed at the end of 2021.

Figure 7. Personal Consumption Expenditures Price Inflation



Source: BEA/Haver Analytics.

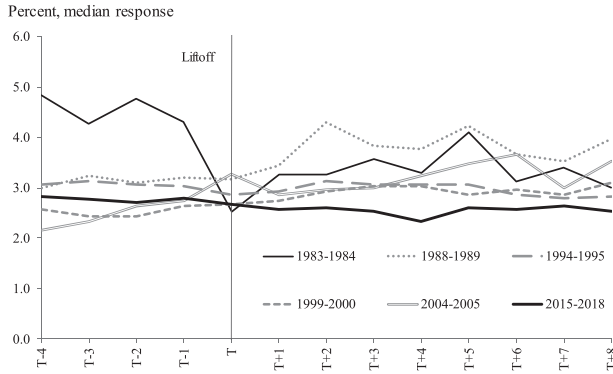
Figure 8. Core Personal Consumption Expenditures Price Inflation



Source: BEA/Haver Analytics.

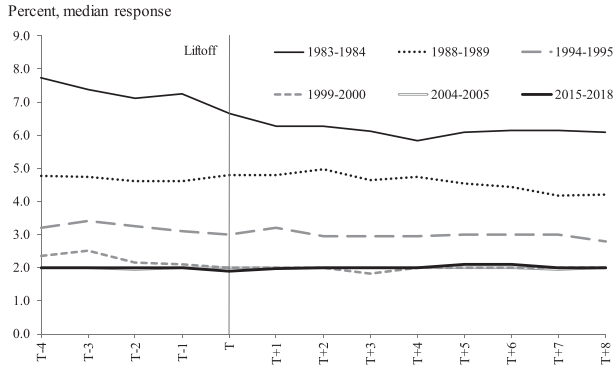
data in Figures 5–10 is a common method of comparing economic activity for some period before and after an arbitrary dividing point. For this paper, the vertical dividing point is the quarter when the FOMC began its tightening episode by raising its FFTR. The figures

Figure 9. 12-Month-Ahead Inflation Expectations (consumers)



Source: University of Michigan/Haver Analytics.

Figure 10. 10-Year-Ahead PCE Inflation Expectations (forecasters)



Source: Board of Governors of the Federal Reserve System/Federal Reserve Bank of Philadelphia/Haver Analytics.

show values four quarters before liftoff and eight quarters after liftoff for each of the six tightening episodes (six lines in each chart).

The economic conditions that prevailed before and after the first and sixth tightening episodes were distinctly different than the other

four episodes.²³ In the first episode (1983–84), the four-quarter growth of real GDP (Figure 5) was modestly negative in the three quarters prior to liftoff, and the unemployment rate (Figure 6) had risen, on net, to a peak of about 10.75 percent one quarter prior to liftoff. However, headline (Figure 7) and core (Figure 8) inflation and short- and long-term inflation expectations (Figures 9 and 10) were declining rapidly. In the first episode, actual inflation and long-term inflation expectations continued to decelerate about a year after liftoff; however, short-term inflation expectations rebounded after liftoff. As the Record of Policy Actions for the March 29, 1983, FOMC meeting in Table 3 details, the participants believed that the recovery was under way, though with appreciable uncertainty. As it turned out, the economy continued to rebound strongly after liftoff, with real GDP growth averaging about 6.3 percent in the subsequent two-year period. The Committee also generally thought that the recent rapid growth in the monetary aggregates did not have a material effect on the outlook for inflation.

The sixth episode was similarly unique. Prior to the liftoff in December 2015, real GDP growth had slowed from about 4 percent in early 2015 to about 2 percent during the liftoff quarter. However, the unemployment continued to drift lower in the four quarters prior to the liftoff quarter. Interestingly, headline PCEPI inflation was anchored close to zero before liftoff, while core PCEPI inflation was slowing from about 1.5 percent to 1 percent. Short-term inflation expectations were also drifting lower before liftoff, while long-term inflation expectations remained anchored at 2 percent. Importantly, the sharp slowing in inflation and inflation expectations in 2015 reflected a 45 percent decline in nominal crude oil prices between the fourth quarter of 2014 and the fourth quarter of 2015. Thus, at the time of the liftoff, both headline and core inflation were well below the FOMC’s 2 percent target rate. In the Summary of Economic Projections released at the conclusion of the December 2015 meeting, the median FOMC participant projected that core inflation would remain under 2 percent through the end of 2017. Thus,

²³The working paper version of this article details the responses by several other economic and financial market indicators not detailed here (i.e., the major components of PCE, business loans, equity prices, and business loans). See <https://research.stlouisfed.org/wp/more/2020-003>.

Table 3. FOMC Description of Policy Decision at First Tightening Action

First Tightening Action	FOMC Description of Policy Action
March 31, 1983	<p>In the Committee's discussion of the economic situation and outlook, the members agreed that a recovery in economic activity appeared to be under way, although several commented that the evidence available thus far was too fragmentary to permit a firm evaluation of the strength of the upturn. While the staff projection of moderate growth for 1983 as a whole was cited as a reasonable expectation, members commented on the many uncertainties surrounding the economic outlook and expressed differing views regarding the direction of possible deviations from the staff projection. . . In discussing a policy course for the weeks immediately ahead, Committee members recognized that substantial uncertainties affected both the economic outlook and the interpretation of the monetary aggregates. Concern was expressed about the implications of the rapid growth in the monetary aggregates, particularly if it should continue. However, it was also noted that the rapid expansion of recent months, given the distortions related to various institutional changes, probably did not have the significance for future economic and price developments that it might have had in the past. (Record of Policy Action, March 29, 1983)</p>
March 29, 1988	<p>In the Committee's discussion of the economic situation and outlook, the members generally agreed that the information available since the February meeting pointed to a stronger expansion in business activity than they had anticipated earlier. Unfortunately, recent developments in the view of several members also increased the risks of more pressures on productive resources and more inflation. A number of members noted that the revised staff forecast was in line with their own projections and some also indicated that any deviations were likely to be in the direction of somewhat faster expansion and even higher rates of inflation. (Record of Policy Action, May 20, 1988)</p>
February 4, 1994	<p>In this situation, the members agreed that monetary policy should be adjusted toward a more neutral stance that would encourage sustained economic growth without a buildup of inflationary imbalances. The members recognized that timely action was needed to preclude the necessity for more vigorous and disruptive policy moves later if inflationary pressures were allowed to intensify. The history of past cyclical upswings had demonstrated the inflationary consequences and adverse effects on economic activity of delayed anti-inflation policy actions. (FOMC Minutes, Released March 25, 1994)</p>

(continued)

Table 3. (Continued)

First Tightening Action	FOMC Description of Policy Action
June 30, 1999	<p>Last fall the Committee reduced interest rates to counter a significant seizing-up of financial markets in the United States. Since then much of the financial strain has eased, foreign economies have firmed, and economic activity in the United States has moved forward at a brisk pace. Accordingly, the full degree of adjustment is judged no longer necessary. Labor markets have continued to tighten over recent quarters, but strengthening productivity growth has contained inflationary pressures. Owing to the uncertain resolution of the balance of conflicting forces in the economy going forward, the FOMC has chosen to adopt a directive that includes no predilection about near-term policy action. The Committee, nonetheless, recognizes that in the current dynamic environment it must be especially alert to the emergence, or potential emergence, of inflationary forces that could undermine economic growth. (FOMC Meeting Statement)</p>
June 30, 2004	<p>The Committee believes that, even after this action, the stance of monetary policy remains accommodative and, coupled with robust underlying growth in productivity, is providing ongoing support to economic activity. The evidence accumulated over the intermeeting period indicates that output is continuing to expand at a solid pace and labor market conditions have improved. Although incoming inflation data are somewhat elevated, a portion of the increase in recent months appears to have been due to transitory factors. The Committee perceives the upside and downside risks to the attainment of both sustainable growth and price stability for the next few quarters are roughly equal. With underlying inflation still expected to be relatively low, the Committee believes that policy accommodation can be removed at a pace that is likely to be measured. (FOMC Meeting Statement)</p>
December 15, 2015	<p>Information received since the Federal Open Market Committee met in October suggests that economic activity has been expanding at a moderate pace. Household spending and business fixed investment have been increasing at solid rates in recent months, and the housing sector has improved further; however, net exports have been soft. A range of recent labor market indicators, including ongoing job gains and declining unemployment, shows further improvement and confirms that underutilization of labor resources has diminished appreciably since early this year. Inflation had continued to run below the Committee’s 2 percent longer-run objective, partly reflecting declines in energy prices and in prices of non-energy imports. Market-based measures of inflation compensation remain low; some survey-based measures of longer-term inflation expectations have edged down. . . The Committee judges that there has been considerable improvement in labor market conditions this year, and it is reasonably confident that inflation will rise, over the medium term, to its 2 percent objective. (FOMC Meeting Statement)</p>

Source: Board of Governors of the Federal Reserve System.

it does not appear that the fear of above-target inflation was at the forefront of the Committee's concerns.

Following liftoff in December 2015, real GDP growth continued to decelerate for two quarters, but then the economy began to pick up speed. The unemployment rate continued to drift lower, but inflation—particularly, headline inflation—began to accelerate, reaching the 2 percent inflation target five quarters after liftoff, and sooner than the Committee expected at the time of liftoff. Still, short-term inflation expectations continued to drift lower a year after liftoff, before rebounding slightly. Table 3 shows that the Committee at the time of liftoff acknowledged the below-target inflation rates and low inflation expectations but was confident that further improvement in labor markets would begin to push inflation higher.

The remaining four tightening episodes were broadly similar—namely, the FOMC was tightening into a strengthening economy, with a falling unemployment rate, and with rising inflation. As noted in Table 3, the FOMC generally noted these developments and were worried about the potential for rising inflation. However, in the 2004 episode, they initially noted that underlying inflation at the time of liftoff was “expected to be relatively low.”

5.1 Notable Differences Across Episodes

There were some notable differences across episodes. First, the conventional view that tighter monetary policy eventually leads to slower real GDP growth over the medium term generally only held in the four episodes that spanned 1988 to 2005. In these four episodes, real GDP growth was accelerating modestly in the four quarters before liftoff, remained roughly constant over the four quarters following liftoff, then output growth decelerated, on average, a little more than 1 percentage point in quarters 5–8 following liftoff. Second, the sixth episode was unique in that there was a year-long pause between liftoff and the second increase in the FFTR. In the fourth quarter of 2015, real GDP was up 1.9 percent from four quarters earlier, about a percentage point below the average of the previous four quarters (see Figure 5). Output growth would continue to decelerate modestly four quarters after liftoff, averaging 1.7 percent. But as the economy began to improve in the second half of 2016, and

short-term inflation expectations stabilized, the FOMC resumed its tightening actions in December 2016.

A third key difference is the behavior of short- and long-term inflation expectations during the 2015–18 episode. In the first five episodes, on average, short-term inflation expectations accelerated modestly following liftoff. This was consistent with the quote from Greenspan noted earlier, who indicated that the Fed appeared to have an asymmetric objective function—worrying more about a resurgence of inflation from tightening too little, and less about the risk of weaker output growth and employment from tightening too much. And this pattern generally held for long-term inflation expectations as well following liftoff in the first five episodes, as long-term inflation expectations continued to decelerate modestly after liftoff. But this pattern did not hold in the sixth episode.

At the October 2015 meeting, the FOMC concluded that it was appropriate to “wait for additional information” before beginning the normalization process, but also noted that “even after employment and inflation are near mandate-consistent levels, economic conditions may, for some time, warrant keeping the target federal funds rate below levels the Committee views as normal in the longer run.” As suggested by the FOMC statement language in Table 3, many FOMC members appeared to be worried about an acceleration in core inflation in the midst of improving labor market conditions (a falling unemployment rate).²⁴ This suggests that many FOMC members still relied on the Phillips-curve framework to forecast inflation, despite evidence that its usefulness as a guide to policymaking was much less appropriate in the final episode than it was in previous episodes.²⁵

²⁴The minutes of the December 13–14, 2016, FOMC meeting noted the following: “Many participants judged that the risk of a sizable undershooting of the longer-run normal unemployment rate had increased somewhat and that the Committee might need to raise the federal funds rate more quickly than currently anticipated to limit the degree of undershooting and stem a potential buildup of inflationary pressures.”

²⁵In a 2018 speech, Chair Powell presented evidence that the slope of the Phillips curve and the inflation persistence coefficient was much lower in 2015 than in previous episodes. See Powell (2018). Using Powell’s framework, the slope coefficient in 1994 was estimated to be -0.53 and the persistence coefficient was 1.03 . By 2015, the slope coefficient was -0.07 and the persistence coefficient was 0.45 . (Note: Author’s calculations are available on request.)

Nevertheless, it is apparent from Figures 7–10 that the FOMC faced a conundrum in the final tightening episode. Actual headline and core inflation was rising modestly following liftoff in December 2015, but inflation was still below the 2 percent inflation target. Moreover, short- and long-term inflation expectations were moving modestly lower. It thus appears that the FOMC discounted the signal from inflation expectations and chose instead to rely more on the signal from the modest upswing in actual inflation and, concurrently, that the continued fall in the unemployment rate—via Phillips curve effects—would trigger an acceleration in core inflation. Alas, this development failed to materialize to the degree many policymakers expected.

From a longer-term perspective, Figures 7–8 and 10 show that actual inflation and long-term inflation expectations have trended lower since 1983. Despite generally lower actual and expected inflation over time, as Figure 4 showed, the cumulative increase in the FFTR has not declined nearly as much. The median total increase in the FFTR during these six episodes was 308 basis points—ranging from a low of 175 basis points in the 1999–2000 episode, to a high of 425 basis points in the 2004–06 episode.

6. Conclusion

The decision to undertake a series of tightening actions presents unique challenges for Fed policymakers. Using a variety of economic metrics, this article has examined the six monetary policy tightening episodes pursued by the FOMC since 1983. In the first five episodes, the data clearly suggest that the FOMC was tightening into a strengthening economy, sometimes with a lag, and with building price pressures. As the FOMC continued to tighten, the yield curve eventually inverted in three of the four episodes and the economy subsequently fell into an economic recession. One exception was the 1994–95 tightening episode. In that episode, neither development occurred. The other exception was the 2015–18 episode. Although the U.S. economy fell into a deep recession in the spring of 2020, the primary cause was the direct and indirect effects of the COVID-19 pandemic. The sixth episode was unique in other ways. Probably the most important difference is that the FOMC began its tightening regime following a notable deceleration in real GDP growth,

with headline and core inflation remaining well below the FOMC’s 2 percent inflation target, and with short- and long-term inflation expectations trending slightly lower.

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