A Comparison of Fed "Tightening" Episodes since the 1980s

Kevin L. Kliesen

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FEDERAL RESERVE BANK OF ST. LOUIS
Research Division
P.O. Box 442
St. Louis, MO 63166

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Abstract
Deciding to undertake a series of tightening actions present unique challenges for Federal Reserve policymakers. These challenges are both political and economic. Using a variety of economic and financial market metrics, this article examines how the economy and financial markets evolved in response to the five tightening episodes enacted by the FOMC since 1983. The primary aim is to compare the most-recent episode, from December 2015 to December 2018, with the previous four episodes. The findings in this article indicate that the current episode bears some resemblance to previous Fed tightening episodes, but also differs in several key dimensions. For example, in the first four episodes, the data show the FOMC was generally tightening into a strengthening economy with building price pressures. In contrast, in the fifth 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 most-recent episode. Another key difference is that in three of the first four 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. It remains to be seen if a recession follows this inversion.

JEL Classification: E3, E4, E5, N1

Key Words: Federal Open Market Committee, monetary policy, macroeconomy, inflation, yield curve, recession

Kevin L. Kliesen is a research officer and economist at the Federal Reserve Bank of St. Louis. Kathryn Bokun, Rachel Harrington, Brian Levine, and Lowell Ricketts provided research assistance.

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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 Fed Chairman Alan Greenspan

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 in the midst of one 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. But this four-year period turned out to be eight years. Such an extended period of a near-zero nominal federal funds target rate was unprecedented in U.S. economic history.

Although Chairman Bernanke raised the prospect of a taper in the Fed’s asset purchases in May 2013, which roiled financial markets, it was not until late 2015 that a hike appeared imminent. Indeed, 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 mid-point of the range as the federal funds target rate, or FFTR.]

1 Greenspan (2007, p. 156).
2 The Greenbook was the economic conditions and forecast document distributed by the Board staff before each FOMC meeting. It is now known as the Tealbook. See the Long-Term Outlook table on page I-18 in the Dec. 10, 2008, Greenbook: https://www.federalreserve.gov/monetarypolicy/files/FOMC20081216gbpt120081210.pdf.
This was the first increase in the FFTR rate 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 inflation subsequently decelerated modestly further over the first half of 2016. Moreover, measures of short- and long-term inflation expectations also drifted lower. The initial tightening action also occurred against the backdrop of an appreciable decline in manufacturing production that commenced in late 2014 and ended in May 2016. From this standpoint, the economic circumstances surrounding the tighter monetary policy 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 may have been the final increase in this tightening episode. By the time of the July 30-31, 2019, meeting, with downside risks to the economy emerging, the FOMC reduced its policy rate by 25 basis points. The policy rate was reduced by 25 basis points again at the September 17-18 meeting, and an additional 25 basis points at the October 30-31, 2019, meeting.

It remains to be seen if the current tightening episode has ended, or if the 2019 rate cuts constitute a mid-cycle correction, similar to those that occurred in 1995 and 1998. In the September 2019 Summary of Economic Projections, seven participants projected at least one 25-basis-point increase in the FFTR by the
fourth quarter of 2020. However, these projections seemed tenuous with recession risks appearing to rise in late summer and early fall 2019. By the December 2019 meeting, 13 of 17 participants projected no change in the FFTR in 2020. However, the expectation of a 25-basis-point increase in 2021 and an additional 25-basis-point increase in 2022 remained. Nevertheless, this article will assume that the tightening episode which began in December 2015 came to an end in December 2018.

The 2015-2018 tightening episode is the fifth to have occurred during the period known as the Great Moderation (post-1983). The four previous episodes occurred from March 1988 to May 1989; from February 1994 to February 1995; from June 1999 to May 2000; and from June 2004 to June 2006. In addition to the economic circumstances noted above, the fifth episode differs from previous episodes in several ways. First, the initial tightening in the fifth episode (December 2015) occurred 78 months after the recession trough (June 2009). This is a marked contrast with the June 2004 liftoff, which occurred 31 months after the November 2001 trough and the February 1994 liftoff, which occurred 35 months after the March 1991 trough. Second, during the first four episodes, the federal funds target rate (FFTR) at its peak was, on average, 308 basis points above its starting point. After the December 2018 meeting, the mid-point of the FFTR range was only 225 basis points above its starting point. Third, the current expansion has seen an unemployment rate reaching lows not seen for more than

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

5 Historically, tightening episodes commence shortly after the end of the recession. For example, from 1958 to 1980, the average interval between the trough month and the month of the first tightening was a little more than four months.
50 years (3.5 percent), but with an inflation rate remaining stubbornly below the
FOMC’s 2 percent target for most of this expansion.

This article will proceed as follows. First, it will discuss the political
economy of interest rate increases by the central bank. This is otherwise known as
the institutional aspects of monetary policymaking. Although some lament that
the current state of affairs between the Trump Administration and the Chairman
of the Federal Reserve has damaged the latter’s independence, U.S. presidents and
members of Congress have long attempted to influence monetary policymaking in
some fashion for decades. The article will then briefly discuss, at a high level, the
monetary policy transmission mechanism. The next two sections 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. The last
section discusses how U.S. economic and financial market conditions evolved in
the face of Fed tightening episodes during the Great Moderation period. A key
aspect of this section will be to compare and contrast the first four Fed
“tightening” episodes—that is, those from 1988 to 2006—with the fifth episode.

One complication is the role of the Federal Reserve’s balance sheet policy
during the current episode. In previous tightening episodes, scant attention was
paid to the size of the balance sheet—and rightly so. While the current and
prospective size of the balance sheet is important in some dimensions, this article
will not assess balance sheet policy and other tools that FOMC policymakers used
to accomplished their objectives of returning the federal funds rate and the size of
the Federal Reserve’s balance sheet to its preferred levels. Rather, the focus in the
last tightening episode, as with the previous four, will be solely on economic and financial market responses to changes in the federal funds target rate. Readers interested in this aspect of normalization are referred to other sources.  

FED TIGHTENINGS AND INSTITUTIONAL FACTORS

The debate surrounding the FOMC’s decision to raise the federal funds target rate is generally more contentious than the decision to reduce the federal funds target rate. There are several institutional factors at work in this regard, but two seem most prominent. The first factor is political opposition. Hetzel (2012) terms this an ongoing competition for control over money creation between the monetary and political authorities. In this vein, as former Federal Reserve Chairman Arthur Burns lamented in his 1979 Per Jacobsson Lecture (“The Anguish of Central Banking”), the FOMC’s decision to increase its policy rate often “evoked violent criticism” of its actions. Burns is a rather unique case, as Meltzer (2009) documents, because of his unusual relationship with President Nixon. On the one hand, Burns resented the Administration’s public and private criticism of the Fed’s monetary policy, while on the other hand Burns ostensibly strived to use all his power to assist the president and his economic goals.

However, Nixon was not the first president to try to strong-arm the Fed. Another well-known episode occurred in January 1951 during the Truman Administration, when the President summoned the entire FOMC to a meeting at

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6 Those interested in this aspect of the normalization process are referred to Frost, et. al. (2015), Ihrig, Meade, and Weinbach (2015), and Williamson (2015).

the White House to ensure that the Fed’s peg of short-term interest rates continued. Other actions and criticisms occurred during the Johnson Administration in the 1960s. Although President Johnson often used personal interactions in an effort to convince William McChesney Martin not to raise the Fed’s policy rate, at other times he employed others—such as CEA Chair Walter Heller—to arm-twist Martin. Nixon also used surrogates to criticize Burns’ policies.

Subsequent Fed Chairman also encountered political pressure of one kind or another. In 2019, Paul Volcker wrote about a previous episode not widely known outside of the Federal Reserve. In the summer of 1984, Chairman Volcker was summoned to the White House for a meeting with President Reagan and Treasury Secretary James Baker. At the “awkward” meeting, Baker told Volcker that the president ordered him not to raise rates before the [1984] election. Volcker said that he walked out of the meeting without saying a word. Writing about the episode years later, Volcker remarked that “it was a striking reminder about the pressure that politics can exert on the Fed as elections approach.”

Historically, Congress was also not averse to signaling its displeasure of Fed actions. Long-time Congressional critics of the Fed included the Texas Congressmen Wright Patman and Henry Gonzalez. For example, in August 8 This is documented by, among others, Meltzer (2003) and Conti-Brown (2016).
9 See Bremner (2004), especially chapter 9. In one particularly humorous episode during the fall of 1965, President Johnson announced to Martin that he was scheduled to go into the hospital for a gall bladder operation. As Bremner writes: “You wouldn’t raise the discount rate while I’m in the hospital, would you? Martin waited a second and, in a reply that became legendary with the Fed, said: ‘No, Mr. President, we’ll wait until you get out of the hospital.’” (p. 206)
1974, the Committee on Banking and Currency, chaired by Representative Patman, held a hearing to discuss monetary policy, inflation and interest rates. The unique aspect of this hearing was that, in addition to testimony from Chairman Burns, Congress also heard testimony from five of the 12 Federal Reserve District Bank Presidents. Nearly 20 years later, the U.S. Senate Banking Committee convened all 12 Reserve Bank Presidents to testify on the effects of monetary policy on the state of the economy. At least twice a year, the Chair of the Fed testifies before Congress. This is one of the methods Congress uses to hold the Fed accountable for its actions. However, it is highly unusual when Congress extends this accountability to all 12 Fed Presidents.

More recently, President Trump has repeatedly criticized Chairman Jerome Powell and other members of the FOMC for raising interest rates that, in his view, triggered sharp declines in equity prices in late 2018, a strengthening foreign exchange value of the U.S. dollar, and slowing economic growth. Although FOMC policymakers routinely argue that fulfilling the Fed’s Congressional mandate and economic considerations are the only factors that drive their policy actions, at least one academic paper offers some support for the view that President Trump’s Twitter-based criticisms of the Fed’s actions have had their intended effects.

Political pressure on the Fed often stemmed from the belief that monetary

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12 District Bank Presidents giving testimony were from Chicago, New York, Philadelphia, St. Louis, and San Francisco. See https://fraser.stlouisfed.org/files/docs/historical/federal%20reserve%20history/inflation/HR_94_2_071974.pdf.

13 See https://babel.hathitrust.org/cgi/pt?id=pst.000021241659&view=1up&seq=7.

14 For example, see the October 25, 2018, Wall Street Journal interview with President Trump, where the president labels the Fed as the “biggest risk” to the economy.

15 See Bianchi, Kind, and Kung (2019).
policy actions are regularly designed to favor the wealthy and financial market participants (“Wall Street”) at the expense of the “working class” and those on fixed incomes. More recently, some have argued that the nontraditional monetary policy actions implemented during the immediate aftermath of the Financial Crisis and Great Recession have done much to increase income and wealth inequality. In an early contribution on the political economy of the monetary policy, Kane (1980) argued that the Fed’s purpose was to serve as a “political scapegoat” for members of Congress and other elected officials. In another early contribution, Havrilesky (1994) deployed a public choice framework to argue that Congressional preferences to redistribute income leads to erratic monetary growth.

A second institutional factor confronting the Fed is when to begin the liftoff. As the FOMC transcripts show, policy discussions—both when to tighten and by how much, and when to ease and by how much—are often intense. These internal deliberations, at least in recent years, have increasingly made their way into the public speeches by Federal Reserve officials. Internal deliberations can spill over into the public domain in the form of dissents. As seen in Table 1, the tightening actions that are studied in this paper elicited few dissents at the beginning or conclusion of the episodes. The next-to-last column on the right

16 Greenspan (2007) asserted that this was the view of Texas Congressman Henry Gonzalez. He also wrote about an episode when New York Republican Senator Alfonse D’Amato accused him of worrying more about inflation than people who were starving. Similarly, President Johnson accused Chairman Martin of indifference to U.S. serviceman dying in Vietnam.
17 For a U.S. perspective, see Montecino and Epstein (2015). For a European perspective, see Lenza and Slacalek (2019).
19 Kliesen, Levine, and Waller (2019) highlight the upsurge in verbal communication by Federal Reserve Presidents and Governors in the aftermath of the financial crisis.
highlights dissents (if any) at the beginning of the tightening episode, while the far-right column highlights dissents (if any) at the last tightening action of the episode. Of the four tightening actions prior to the final episode, there was one dissent at the initial and final meetings of the 1988-89 period. There was a dissent for the initial tightening action that occurred at the June 30, 2000, meeting but not at the final meeting. There were no dissents at the initial and final meetings for the 1994-95 and 2004-2006 tightening episodes. If, as this paper assumes, the fifth tightening episode concluded at the December 19, 2018, meeting, then this episode will have elicited no dissents either at the beginning or at the end.

In many ways, tightening actions affect the economy by influencing market expectations of the timing and magnitude of the future monetary policy actions. But of course, other transmission mechanisms are also at work. The next section will briefly describe some of these mechanisms, which will set the stage for the economic and financial comparisons seen in the next-to-last section of the paper.

HOW DOES MONETARY POLICY AFFECT THE ECONOMY: CHANNELS OF INFLUENCE

The Fed’s monetary policy actions are transmitted to the economy and financial markets through several channels of influence. These dynamics are often complex and difficult to disentangle in real time, given that monetary policy changes typically affect the economy with a lag. Most 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 supportive of this view.\textsuperscript{20} Higher interest rates also work through the exchange rate channel.

One econometric method of modeling these effects is to use a structural forecasting model to assess the effects of an increase in the FOMC’s intended federal funds target rate. Laforte and Roberts (2014) employ the workhorse model used by the staff of the Federal Reserve Board of Governors 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 points in the first two years, while lowering the inflation rate by only about 0.1 percentage point.\textsuperscript{21}

The article will examine two other channels. The first is the effect of a central bank’s actions to alter the amount of funds that commercial banks (depository institutions) can lend to households and firms to finance expansion of their businesses.\textsuperscript{22} The second is the economic effect of changes in interest rates on prices of financial assets such as stocks, and the foreign exchange value of the U.S. dollar. This section will serve as the foundation for the empirical analysis reported in the final section of the paper.

\textsuperscript{20} See Sharpe and Suarez (2014) for a more 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.

\textsuperscript{21} The workhorse model is known as FRB/US. See \url{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.

\textsuperscript{22} There are two other effects that are not discussed here. First, tighter monetary policy tends to reduce business sales and profits, which can affect the firm’s balance sheet. Second, monetary policy can affect bank lending through the “risk-taking” channel. In this channel, changes in the FOMC’s policy rate affect both the quality and quantity of bank credit. See Dell’Ariccia et al. (2017) for a fuller discussion.
FIVE TIGHTENING EPISODES

The literature that examines the economic and financial market effects on U.S. monetary tightening episodes is relatively sparse. 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. 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).

Figure 1 (a-e) shows the pattern of short- and long-term interest rates during each of the five tightening episodes. Each chart plots the weekly average (of daily data) of: the FOMC’s FFTR, the 1-year Treasury constant maturity yield, and the 10-year Treasury constant maturity yield. Implicitly, each chart also reveals the evolution of the spread between short- and long-term Treasury yields. The term spread is commonly referred to as the yield curve. The slope of the yield curve—particularly an inverted yield curve—is generally viewed as an accurate barometer of future economic conditions. In particular, inverted yield curves
nearly always presage a business expansion peak, albeit of varying horizons.\textsuperscript{23}

As seen in Figure 1a, the first Fed tightening is the 1988-89 episode, which ran from March 29, 1988, to May 16, 1988. At the conclusion of the FOMC meeting on March 29, the Committee voted to raise its federal funds rate from 6.5 percent to 6.75 percent. As seen in Table 1, there was one dissent at the March 29 meeting. In the six weeks prior to liftoff, yields on 1- and 10-year Treasury securities were little changed. Expectations seemed to change immediately prior to liftoff, as both short- and long-term Treasury yields began to rise shortly before the Fed’s action. As Table 2 documents, the FOMC press release that accompanied this meeting stressed that stronger-than-expected economic conditions were posing upside risk to the Fed’s price stability mandate. Eventually, the FOMC would raise its policy rate to 9.81 percent on May 17, 1989. However, it remained at that rate for only two weeks, as the Fed shortly thereafter reversed this final tightening action.

Figure 1a is illustrative because it shows a common—though not uniform—pattern in the Treasury market during 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. On the week ending April 1, 1988, the difference between the 10-year and 1-year Treasury security yields measured 179 basis points. By the week ending January 27, 1989, the short-term rate and the long-term rate were both 8.97 percent. The yield curve would subsequently invert during the week ending Feb. 3, 1989, reaching a maximum inversion of 34 basis points the week ending March

\textsuperscript{23} See Wheelock and Wohar (2009) for a recent survey of the literature on this topic.
Despite this bearish economic signal, the FOMC would continue to raise its federal funds target rate by 81 basis points in three increments after the yield curve inverted: the weeks ending Feb. 17, March 3, and May 19. By July 1990, the U.S. economy had entered a recession according to the National Bureau of Economic Research Business Cycle Dating Committee.

Figure 1b depicts the second Fed tightening action, which occurred from February 1994 to February 1995. This episode is unique in Fed monetary history for a couple of reasons. First, although the economy was strengthening in 1994, as real GDP increased from 2.6 percent in 1993 to 4.4 percent in 1994, there were little obvious inflation pressures. From 1992 to 1994, CPI inflation slowed from 3.1 percent to 2.6 percent. However, the Board staff forecasted that inflation would remain above 3 percent in 1994 (3.3 percent) and in 1995 (3.1 percent). As a result, the Greenspan FOMC adopted a “more radical approach: moving gently and preemptively, before inflation even appeared.” Second, financial markets appeared to be taken by surprise despite Greenspan’s attempt a month before—in Congressional testimony—to signal a pending increase in the federal funds target rate. The subsequent turmoil in financial markets was termed “The Bond Market Massacre” by Fortune magazine.

Table 2 documents that, unlike the previous tightening episode, the FOMC moved in a preemptive fashion to “preclude the necessity for more vigorous and

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24 Unless 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.
disruptive policy moves later *if* inflation pressures were allowed to intensify”
(emphasis added). Under this preemptive policy, as seen in Figure 1b, the FOMC raised the intended federal funds target rate from 3 percent to 6 percent in the course of a year. Similar to the 1988-89 episode, the gradual increase in short-term rates eventually flattened the yield curve, from 214 basis points the week ending Feb. 4, 1994, to 60 basis points the week ending Dec. 30, 1994. However, unlike the 1988-89 episode, the yield curve did not invert and, also unlike the earlier episode, the economy avoided a recession. Real GDP growth averaged 1.3 percent over the first half of 1995. Greenspan subsequently termed this episode of monetary policy tightening “one of the Fed’s proudest accomplishments during my tenure.”

The third episode occurred a few years after the second tightening episode. In late summer and fall of 1998, the global economy was buffeted by developments that came to be known as the Asian financial crisis and Russian debt default episode. The FOMC responded to these developments by cutting the FFTR, in three separate instances, by a total of 75 basis points. The last of the three rate cuts was at the November 17, 1998, meeting when the FOMC reduced its FFTR from 5 percent to 4.75 percent. The fed funds rate remained at this level until June 30, 1999, when the FOMC raised its policy rate by 25 basis points to 5 percent. Over the following year, as seen in Figure 1c, the FOMC would raise the federal funds target rate six times—the last of which occurred on May 16, 2000, when the Committee raised the rate by 50 basis points to 6.5 percent. Table 2 documents that the FOMC’s rationale for tightening bore some similarities with

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the preemptive action taken during the 1994-95 episode. Namely, labor markets had strengthened but stronger productivity growth was containing actual inflationary pressures. Nonetheless, the Committee was worried about a “potential emergence” of inflationary pressures.

Similar to the previous two episodes, Figure 1c shows that short- and long-term interest rates were steadily rising during the third period of monetary tightening (late-June 1999 to mid-May 2000). However, unlike the previous two episodes, the term spread was relatively narrow, 84 basis points, at the start of the tightening episode. But as the FOMC continued to lift the federal funds rate, long-term rates generally followed in lockstep—until late January 2000, when the 10-year Treasury yield peaked at almost 6.8 percent. Thereafter, long-term rates would begin falling. But the FOMC continued to raise its policy rate, driving up the 1-year Treasury yield in the process. The yield curve would invert by the week ending March 24, 2000, the week of the FOMC’s penultimate increase in this tightening episode. The FOMC would raise the FFTR once more after the yield curve inversion (similar to the first episode). Eventually, the economy drifted into a recession a little more than a year later, in March 2001.

The fourth tightening episode was the so-called “lower for longer” period that began in June 2004 and ended in June 2006. Over this two-year period, encompassing 17 meetings, the FOMC raised its federal funds target rate from 1 percent to 5.25 percent in 25-basis-point increments. This period was unique in another key respect: 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.\textsuperscript{29} This event was subsequently termed “the Conundrum” by former Fed Chairman Alan Greenspan.\textsuperscript{30} Table 2 suggests that the Committee found it necessary to convey the view that, despite this tightening action, policy was still accommodative. Moreover, the Committee did not see any material upside or downside risk to the attainment of its economic goals over the next few quarters.

Eventually, as the FOMC continued to raise the FFTR, long-term rates moved higher in early 2006. Although the long-term rate exceeded the rate that prevailed in May 2004, the rise in long-term rates did not keep pace with the short-term rates. In response, the yield curve inverted during the week ending January 20, 2006, a week before the 14\textsuperscript{th} of 17 rate hikes. It would remain inverted for 11 consecutive weeks. The yield curve would then shift to a positive slope thereafter for nine consecutive weeks, but then invert again the week ending June 9, 2006, for another 52 consecutive weeks. In this episode, the FOMC raised its policy rate four times after the initial yield curve inversion, with the last tightening occurring early July 2006. This inversion, like the 1988-89 and 1999-2000 episodes, presaged the recession that occurred roughly 23 months after the initial inversion and then roughly 18 months after the last tightening action, as U.S. economic activity peaked in December 2007.

The final tightening episode examined in this article is shown in Figure 1e.

\textsuperscript{29} There 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 fed funds target rate by 113 basis points.

\textsuperscript{30} See Thornton (2012) for discussion and analysis of this event.
lifted the FFTR by 25 basis points. As seen in Table 2, the FOMC’s rationale for raising the FFTR was extraordinary and differs importantly from the previous episodes. For example, while the Committee noted improving labor markets, it also noted that the pace of economic activity was merely “moderate” and, moreover, there was scant evidence of building inflationary pressures because of declines in energy prices and prices of non-energy imported goods and services. Nevertheless, the Committee believed that inflation would eventually return to the 2 percent target rate because of strengthening labor market conditions. In the Minutes of the meeting released several weeks later, the FOMC indicated that it preferred to begin normalization before achieving its dual mandate objective to avoid the possibility of having to abruptly tighten if it had instead waited until its objectives had been met.

The FOMC would then remain on hold until a year later, when it would raise the policy rate another 25 basis points. The one-year interlude between tightening actions was unprecedented for the tightening episodes examined in this paper. Eventually, though, as the pace of economic activity and inflation picked up, the Committee would raise the FFTR eight additional times, in 25-basis-point increments, in 2017 and 2018. Similar to three of the previous four episodes (the exception being the 2004-2006 tightening), the FOMC would raise the fed funds rate at least once after the peak in 1- and 10-year Treasury yields. Both the 1- and 10-year rates peaked during the week ending November 9, 2018. At that time, the term spread (yield curve) measured 48 basis points. By the time of the December 19 meeting, the term spread was slightly less than 20 basis points. The spread would continue to flatten further and eventually the yield curve inverted the week
ending August 9. The inversion would persist until the week ending October 1, 2019.

**ASSESSING FOMC FORECAST ACCURACY DURING TIGHTENING EPISODES**

Policymakers confronted a changing macroeconomic environment over the periods encompassed by these tightening episodes that bore little resemblance to previous episodes. For example, since 1983, the FOMC was routinely confronted by lower inflation and lower unemployment rates compared with most episodes that occurred during the 1960s and 1970s. The one obvious exception was the sharp rise in the unemployment rate during the Great Recession and Financial Crisis. Another key development was the unexpected acceleration in labor productivity during the mid-1990s. Figure 2 shows another key development during this period: The steady decline in the natural (real) rate of interest ($r^*$). 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 Figures 1a-1e.

In the framework employed by the Board staff and many FOMC participants during this period, the real FFTR should equal $r^*$ when the economy is growing at potential and inflation was at the target rate. If the real FFTR was below $r^*$, then policy was deemed accommodative, leading to faster output

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31 The natural rate of interest is calculated by Holston, Laubach, and Williams (2017). R-star is a model-based estimate of the real short-term interest rate required to keep inflation and the unemployment rate at the FOMC’s target rates.

32 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.
growth, falling unemployment rates, and rising inflation pressures. The opposite would occur if the real FFTR was above \( r^* \). Figure 2 shows that in the first part of the 1990s expansion, the 2000s expansion, and the current expansion, the real FFTR was well below \( r^* \) for extended periods. By contrast, the real FFTR and \( r^* \) were more closely aligned before the onset of the 1988-89 tightening, while the real FFTR was well above \( r^* \) for about seven years—from mid-1994 to early 2001; this episode is discussed in more detail below. However, in all cases prior the tightening actions resulted in a modest overshooting of (FFTR>\( r^* \)), leading to an eventual recession in three of the previous four tightening episodes. The jury is still out on the fifth episode, although the overshooting was appreciably smaller than the previous episodes.

Trends in the macroeconomy registered 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 four tightening episodes (shaded intervals). The growth rates plotted are annualized two-quarter percent changes. The Board Staff’s forecasts are reported in the Greenbook.\(^{33}\) Greenbook forecasts—today known as Tealbook forecasts—inform FOMC policymakers about the staff’s expected short-to-medium-term path of key economic indicators, including the nominal and real FFTR. The fifth tightening episode is not shown because Tealbook forecasts are released with a

\(^{33}\) The author thanks Robert Hetzel for sharing the data plotted in Figure 3.
Some notable patterns about actual and expected economic outcomes are apparent in Figure 3. First, in the first three tightening episodes, the Greenbook forecasts underestimated the strength of real GDP growth. But again, this pattern did not prevail in the fourth episode. In terms of the post-tightening period, which were recessionary periods 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).34

Visual inspection of actual and projected outcomes can be informative, but may mask the true accuracy of the forecasts that policymakers relied upon. Figure 4 attempts to quantify Greenbook forecast errors from the projections shown in Figure 3 for the first four episodes. Specifically, the chart shows the average root mean-squared forecast error (RMSE) for each of the four tightening episodes plotted in Figure 3 for: (i) the year (four quarters) preceding the beginning of the tightening episode; (2) the period during the tightening episode; and (3) the year following the tightening episode. A lower (higher) RMSE indicates a higher (lower) degree of forecast accuracy. Since Greenbook forecasts are available only through 2014, we cannot examine forecast errors for the fifth episode.

Consistent with the visual evidence in Figure 3, forecast accuracy in the year preceding liftoff (tightening) was relatively low in the first three episodes

34 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.
(high RMSEs). Forecast accuracy tended to be much better during three of the four tightening episodes—with the 1999-2000 episode a notable exception. In the year following the tightening period, Greenbook forecast accuracy was mixed, with two of the four episodes registering further declines in the RMSE following the tightening period and two of the four registering higher RMSEs. The 1999-2000 period was especially interesting, since forecast accuracy (relatively high RMSEs) was the weakest of all episodes before, during, and after the tightening period.

ASSESSING FINANCIAL MARKET EXPECTATIONS DURING TIGHTENING EPISODES

One of the challenges in parsing the data in response to the Fed’s actions to increase its FFTR, is accounting for the extent to which the timing and magnitude of the actions were anticipated by households, businesses, and financial market participants. Regarding the timing of liftoff, the FOMC over time has sought to minimize disruptions to financial markets and economic activity by

35 I used the Summary of Economic Projections (SEP) to examine the forecast accuracy of the median FOMC member during the 2015-2018 episode. One-year ahead real GDP growth forecast errors (RMSEs) in 2014-2015 were 0.6 percent. Forecast accuracy improved during the tightening episode (2016-2018), with the RMSE falling to 0.4 percent. These results are not strictly comparable to the Greenbook forecast errors in Figure 4, but the pattern is nonetheless consistent with the two-quarter ahead forecast errors reported in Figure 4.

36 The 1999-2000 period was also notable because it encompassed the acceleration in labor productivity first noted by Chairman Greenspan. Most FOMC members were reluctant to accept Greenspan’s assessment that the actual data were underestimating labor productivity growth. As seen in Figure 4, the Greenbook forecasts also failed to incorporate the Chairman’s upbeat assessment. The predicted path for real GDP growth remained roughly constant, while actual real GDP growth continued to accelerate. But eventually, Greenspan was proved correct and the Greenbook forecasts for real GDP growth reflected this new-found optimism. However, while the Greenbook was forecasting stronger growth, the economy was beginning to slide into a recession—albeit a mild recession in 2001. Still, the Greenbook projections for real GDP growth lagged the actual economic outcomes, producing the relatively high RMSEs shown in Figure 4. See Anderson and Kliesen (2012).
improving the communication of pending actions to change policy (or not change 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 also found evidence that market expectations of future Fed policy actions were informed importantly by news in the monthly employment report.

The magnitude of the Fed’s tightening action depends on several factors. This includes, most obviously, the evolving state of the U.S. economy. But markets also condition their bets on future policy actions by the FOMC. 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. Markets might also employ a rule of thumb 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.

Figure 5 attempts to provide 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 5 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.\textsuperscript{37}

Figure 5 shows that markets have overestimated the magnitude of the tightening in four of the five tightening episodes—the exception being the 1988-89 episode. The market’s overestimates were especially pronounced in the 1993-94 and 2004-2006 episodes. Across these four episodes, the overestimate was slightly more than 100 basis points. It is important, though, to emphasize that these expectations are 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 and the FOMC overestimated the total tightening in the 2015-2018 episode, as judged by the December 2015 Summary of Economic Projections. Indeed, the total tightening projected by the FOMC was more than 100 basis points above the actual amount of tightening that occurred and roughly 75 basis points more than market expectations. However, it is also the case that the gap between the actual tightening (2.3 percent) and the expectation built into the market (2.8 percent) was appreciably smaller than the previous four episodes. One possible explanation is that the FOMC’s shift to a more transparent communication paradigm provided markets with better information than in previous episodes.

PAST TIGHTENING EPISODES: LETTING THE DATA SPEAK

The remainder of this article will compare the economy’s responses to tighter monetary policy in the current episode with responses during the previous

\textsuperscript{37} Yields 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.
four tightening episodes. The analysis will largely be descriptive, using the evolution of several economic and financial market series before and after the tightening episodes. Seven different perspectives will be emphasized: Aggregate economic activity (as measured by real GDP); personal consumption expenditures; expenditures for nonresidential and residential fixed investment; inflation and inflation expectations; banking and financial market activity; and the real trade-weighted value of the U.S. dollar (foreign exchange rate).

**Aggregate Economic Activity**

Figure 6a shows a spider chart depicting the four-quarter growth rates of real GDP. The vertical line benchmarks the quarter (across episodes) when the FOMC began its tightening episode (liftoff). The chart shows the growth of real GDP four quarters before liftoff and 15 quarters after liftoff for each episode. The last observation for the 1988-89 and 2004-2006 episodes are the real GDP growth rates for the quarter prior to the NBER designated recession quarter. The last observation for the 1999-2000 episode is the second quarter of 2000, which the NBER designated as a recession quarter; however, real GDP growth was still modestly positive (1.1 percent). When viewed through this lens, real GDP growth was positive through the first eight quarters for all tightening episodes.

Real GDP growth varied considerably both before and after each tightening episodes. Still, there is a common pattern—at least for the first four episodes. To show this, the solid black line in Figure 6b arbitrarily truncates the right tail of the distribution of real GDP growth at eight quarters and averages across the first four tightening episodes. Doing so better facilitates a comparison between the first four tightening episodes and the final tightening episode during
the first two years of tighter monetary policy. As seen in Figure 6b, real GDP growth during the first four tightening episodes was increasing prior to the liftoff quarter. Real GDP growth averaged 3 percent in the four quarters prior to the liftoff quarter; growth then strengthened to a little more than 4 percent during the liftoff quarter. On average, real GDP growth then strengthening slightly over the next four quarters.

Eventually, as shown in Figure 6a, tighter monetary policy began to slow the pace of real GDP growth in the first four episodes. Indeed, recessions followed shortly thereafter in the 1988-89, 1999-2000, and 2004-2006 episodes. A notable exception occurred in the aftermath of the 1994-95 tightening episode. Although real GDP growth initially slowed sharply in response to the 300-basis-point increase in the FFTR, the economy eventually recovered because of a mid-course correction—the three 25-basis-point rate cuts from early July 1995 to late January 1996.

The pace of economic activity before and after the final tightening episode looks dramatically different. Prior to liftoff in December 2015, real GDP growth was slowing—from 4 percent three quarters prior to liftoff to about 1.25 percent two quarters after liftoff. However, despite tightening actions in 2016 and 2017, the pace of real GDP growth began to accelerate thereafter. Two years after liftoff, real GDP growth in the 2015-2018 episode was nearly identical to the average of the previous four episodes. The key difference, though, was the positive trajectory of real GDP growth in the 2015-2018 episode. Admittedly, averaging across episodes, as illustrated in Figure 6b, can mask key differences. But because volatility in the data tends to increase with the use of disaggregated
data, Figure 6b will be the template for the visual analysis reported in the final section of the paper.

*Consumption Expenditures*

Actions by the FOMC to raise its short-term interest rate target can adversely affect interest-rate-sensitive sectors of the economy, such as spending on durable goods. Figure 7a-7d plots the average growth rates four quarters before and eight quarters after for the final tightening episode and the previous four episodes for real personal consumption expenditures (PCE) and its three major components: durables, nondurables, and services. Figure 7a plots the growth of total PCE. The figure shows one key difference between the 2015-2018 tightening episode and the average of the previous four episodes. In the previous four episodes, real PCE growth strengthened modestly prior to liftoff, whereas in the 2015-2018 episode, real PCE growth was slowing. Following liftoff in the first four episodes, growth real PCE remained largely unchanged during the first three quarters of the tightening action by the Fed. However, in the 2015-2018 episode, real PCE growth drifted modestly lower after liftoff, before accelerating two years later.

Figures 7b-7d detail the pattern of consumption spending for durables (7b), nondurables (7c), and services (7d). These figures show that the growth of all three components of real PCE were slowing prior to liftoff in the 2015-2018 episode. The relative stability of consumption spending immediately after the tightening actions in the first four episodes occurs despite a sharp slowing on expenditures on durables. By contrast, spending on nondurables and services (on average) tends to be little changed in the immediate aftermath of increases in the
federal funds target rate in the first four episodes. Indeed, growth of real services consumption actually strengthens modestly and the growth rate six quarters after the tightening episode commences is essentially unchanged. The pattern in the last episode looks decidedly different, as growth of durables and nondurables continues to slow, but then begins to accelerate despite a rising federal funds rate. This pattern suggests that the state of the economy rather than interest rates mattered more to the consumer.

*Fixed Investment Expenditures*

It is commonly thought among economic analysts that lowering the FFTR will spur investment spending and that raising the FFTR will lower investment spending. However, the consensus of the academic literature seems to be that residential fixed investment is more interest-sensitive than nonresidential (business) fixed investment.\(^{38}\) Figures 8a and 8b starkly reveal another key difference between the 2015-2018 tightening episode and the average of the previous four episodes. Prior to liftoff, the growth of real business fixed investment (BFI) was strengthening in the earlier episodes, but slowing sharply in the final episode. Recall that manufacturing activity was decelerating from late 2014 to early 2016 in response to, among other factors, weakening global economic conditions. Figure 8a shows that the growth of real BFI in the previous episodes, on average, continued to accelerate over the first four quarters of the tightening episode. In the 2015-2018 episode, growth of real BFI remained slightly negative after liftoff, but then turned positive during the period of tighter monetary policy. Consistent with the literature, the pattern in these two episodes

\(^{38}\) See footnote 18 above. Also see Leamer (2015).
suggests that macroeconomic factors matter more for business capital expenditure plans than the actual and expected path of interest rates.  

Figure 8b shows the pattern of growth for real residential fixed investment (RFI) expenditures. Growth of real RFI appears to be much more sensitive to rising interest rates than does real BFI. In particular, growth of real RFI tailed off sooner and more sharply in the earlier tightening episodes compared with the average final episode. Moreover, in the previous four episodes, growth of real RFI remained positive during the first eight quarters of tighter monetary policy. Overall, though, in contrast to consumption and business fixed investment, the pattern in real RFI growth is broadly similar across all five episodes.

*Inflation, Inflation Expectations, and Financial Markets*

Historically, as seen in Table 2, the Fed tightens monetary policy in response to an actual or expected build-up in inflation pressures. Accordingly, the view of many monetary policymakers is that tighter monetary policy reduces inflation and eventually inflation expectations. This is a standard Phillips curve argument. Figure 9a plots headline inflation, which is measured by the chain-weighted personal consumption expenditures price index (PCEPI). Figure 9a shows yet a third difference between the 2015-2018 episode and the average of the previous four episodes.

In the first four tightening episodes, headline inflation was accelerating before liftoff previous four episodes. During the liftoff quarter, PCEPI inflation

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39 Jackson, Kliesen, and Owyang (2019) show that rising levels of uncertainty during a period of already-high levels of uncertainty produce negative amplification effects in consumption of durables and business fixed investment.

40 See the Greenspan quote at the beginning of this article.
averaged 2.4 percent. On average, inflation continued to accelerate, so that at its peak, five quarters after liftoff, inflation averaged about 3.25 percent. An exception to this pattern occurred during the 1994-95 episode, when inflation was slowing in the year following liftoff. [See the discussion above about the 1993-94 episode.]

By contrast, headline inflation was well below 2 percent and relatively stable prior to liftoff in the last episode. Thereafter, inflation began to accelerate after liftoff, similar to previous episodes. The pattern in Figure 9a thus shows why the Fed tightened in December 2015 despite slowing output growth (see Figure 6b)—inflation pressures were expected to increase further. However, during this eight-quarter interval, inflation reached the FOMC’s 2-percent target in only one quarter. Eventually, though, PCEPI inflation would rise to a little more than 2 percent nearly three years after liftoff in December 2015.\footnote{During the final episode, four-quarter headline inflation would eventually peak at 2.3 percent in the second quarter of 2018; inflation eventually slowed to under 1.5 percent over the first three quarters of 2019.} From a broader perspective, the inflation rates plotted in Figure 9a show that inflation was accelerating after liftoff. The key difference is that headline inflation averaged well above 2 percent in the first four episodes, but well below 2 percent in the final episode.

Figure 9b shows the core PCEPI inflation rate, a measure of underlying inflation pressures. Prior to liftoff, the trend in core inflation—increasing modestly—was broadly similar to headline inflation in the first four episodes. Moreover, after liftoff core inflation continued to accelerate on average during first four episodes. By contrast, in the final episode core inflation was modestly
decelerating before liftoff, but then began to accelerate modestly—though still remaining below 2 percent two years after liftoff in the final episode. As suggested by the FOMC statement language in Table 2, 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). It is possible that many FOMC members still believed in veracity of the Phillips curve framework, despite evidence that its usefulness as a guide to policymaking is much less appropriate in the final episode as it was in previous episodes. Indeed, Powell (2018) presented evidence that the slope of the Phillips curve and the inflation persistence coefficient was much lower in 2015 than in previous episodes.\footnote{42} Thus, consistent with Powell’s findings, and as seen in Figure 9b, the acceleration in core inflation never really materialized.\footnote{43} Seven quarters after liftoff, core inflation measured 1.5 percent—while this was about 25 basis point higher than the liftoff quarter, it was the same rate that prevailed four quarters prior to liftoff.

Monetary policymakers also monitor inflation expectations carefully because they generally view these expectations as a reliable indicator of, first, expected future inflation and, second, a measure of their credibility with financial markets and the public. Figure 10a plots one-year-ahead inflation expectations from the University of Michigan household survey. Figure 10b plots long-term (5-...
to 10-years ahead) inflation expectations also from the University of Michigan survey.

As seen in Figure 10a, short-term inflation expectations during the first four tightening episodes look similar to the developments in actual inflation reported in Figures 9a and 9b. Namely, short-term inflation expectations were modestly accelerating in the first four episodes before and after liftoff. However, there is a marked difference in the behavior of actual inflation and short-term inflation expectations following liftoff in the final episode. As seen in Figures 9a and 9b, both headline and core inflation were accelerating modestly in 2016. However, short-term inflation expectations, as seen in Figure 10a, were decelerating before liftoff and continued to decelerate after liftoff in the final episode. Despite actual inflation rising modestly after liftoff in 2016, the weaker trajectory short-term inflation expectations shortly after liftoff in Figure 10a helps explain why the FOMC paused for a year. As the economy began to improve in the second half of 2017, and short-term inflation expectations turned modestly higher, the FOMC resumed its tightening actions in December 2016.

Figure 10b shows long-term inflation expectations. Because the Michigan survey did not collect long-term inflation expectations during most of the first tightening episode (1988-89), the remaining five tightening episodes are plotted on one chart. Two developments are immediately apparent from Figure 10b. First, long-term inflation expectations have steadily declined over time.\footnote{Although not shown in Figure 10b, the peak long-run expected inflation rate reported by the Michigan survey was about 4.25 percent in 1990:Q2 and 4.5 percent in 1990:Q3.} The second notable development is that long-term inflation expectations during the tightening

It is apparent from Figures 9a-b and 10a-b 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 short- and long-term inflation expectations were moving in the opposite direction. It thus appears that the FOMC discounted the signal from inflation expectations, and chose instead to focus on 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.

The final set of charts plots the pattern of nominal nonfinancial business loans, nominal stock (equity) prices, and the real trade-weighted value of the U.S. dollar (exchange rate) immediately before and after the five tightening episodes. Figure 11 shows the four-quarter growth of nonfinancial business loans from the Federal Reserve’s Flow of Funds data. Similar to previous charts, there are noticeable differences between episodes. In the previous four episodes, business loan growth accelerated shortly before liftoff and growth continued to accelerate for a year after liftoff; loan growth then tapered off, but remained faster compared with the liftoff quarter growth rate. In the final episode, by contrast, loan growth was slowing modestly before liftoff. This was consistent with the moderating pace of aggregate economic activity in 2015 noted in previous charts. However, unlike the previous four episodes, loan growth then remained about unchanged for nearly
a year and a half, but then began to pick up as the growth of real GDP accelerated in 2017 and 2018.

Figure 12 plots the four-quarter growth of stock prices, as measured by the Wilshire 5000 stock price index. There are more similarities across episodes with the behavior of stock prices than with growth of business loans, real activity, and inflation. Across all episodes, stock price gains were slowing about one to two quarters before liftoff. This pattern is consistent with the notion that stock prices were falling on the expectation of tighter monetary policy. But a key difference, is that in the final episode, the growth in equity prices began to rebound two quarters after liftoff. Equity prices then rose sharply during the year-long interval between the first and second tightening actions. Across both episodes, though, the equity markets realized that the FOMC was tightening into a strengthening economy, so that stock prices were registering double-digit percentage gains—on average, across all episodes—more than two years after the Fed commenced monetary tightening.

Finally, Figure 13 plots the Federal Reserve’s real trade-weighted exchange rate index. The index measures the value of the U.S. dollar against a broad set of foreign currencies. Prior to liftoff, the dollar was strengthening in the final episode, despite a slower pace of aggregate U.S. growth. The final tightening episode is broadly consistent with the conventional view that tighter monetary policy leads to an appreciating currency: The value of the dollar appreciated by about 5 percent over the first five quarters of monetary tightening. By contrast, in the first four episodes, the average real value of the U.S. dollar was declining before liftoff, and continued to decline by an average of about 3 percent over the
first three quarters following liftoff. The expectation and realization of tighter monetary policy did not result in an appreciating currency in the first four episodes, on net, after eight quarters.

**Conclusion**

The decision to undertake a series of tightening actions presents unique challenges for Fed policymakers. These challenges are both political and economic. Using a variety of economic and financial market metrics, this article has examined the five monetary policy tightening episodes pursued by the FOMC since 1983. The primary focus was to compare and contrast the most recent episode, which began in December 2015 and ended in December 2018, with the previous four episodes. In the first four episodes, the data clearly suggest that the FOMC was tightening into a strengthening economy, sometimes with a lag, 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. The lone exception was the 1994-95 tightening episode. In that episode, neither development occurred.

The fifth episode was unique in many ways. Probably the most important difference is that, in the final episode, the FOMC began its tightening regime during a notable deceleration in economic activity, with headline and core inflation remaining well below 2 percent, but with short- and long-term inflation expectations trending lower. Thus, the prolonged gap between the initial tightening episode in December 2015 and the second action in December 2016 may be explained by the FOMC realizing it was tightening into a slowing economy. But as the economy began to improve in late 2016, the FOMC
eventually resumed tightening.

Another key difference is that the FOMC ended its tightening actions prior to the inversion of the yield curve, which occurred in the second half of 2019. Thus, in the summer and fall of 2019, with recession risks on the upswing, the FOMC enacted three 25-basis-point cuts in the FFTR. By contrast, in three of the previous four episodes, the FOMC continued to tighten after an inversion, resulting in an eventual recession.
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Figures 1a-1e

**Figure 1a**
The 1988-1989 Episode

**Figure 1b**
The 1994-1995 Episode

**Figure 1c**
The 1999-2000 Episode

**Figure 1d**
The 2004-2006 Episode

**Figure 1e**
The 2015-2018 Episode

Source: FRB/Haver Analytics
Figure 2

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

Percent

Fed Tightening
Real Fed Funds Rate
Natural Rate of Interest

NOTE: Gray shading indicates periods of Fed tightening.
SOURCE: Federal Reserve Bank of St. Louis and Haver Analytics

Figure 3

Actual and Predicted Real GDP Growth

Notes: 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, measured 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, Grey shading indicates a recession.
Figure 4

**Average Greenbook Forecast Error for Real GDP 2-Qtr Growth**
Root Mean Squared Error

- Preceding Year
- During Tightening
- Following Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Error 1</th>
<th>Error 2</th>
<th>Error 3</th>
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<td>1993-94</td>
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<td>1999-2000</td>
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<tr>
<td>2004-2006</td>
<td>2.8</td>
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Source: Hetzel (2008) and authors' calculations.

Figure 5

**Magnitude of Tightening Episodes: Actual vs. Market Expectations**
Percent, daily data

<table>
<thead>
<tr>
<th>Year</th>
<th>Market Projections</th>
<th>Actual</th>
<th>SEP Projection</th>
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<td>1988-89</td>
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<td>1999-2000</td>
<td>5.5</td>
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<tr>
<td>2004-2006</td>
<td>2.8</td>
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<tr>
<td>2015-Present</td>
<td></td>
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Source: CBOT, CME, FRB, author's calculations
**Figure 6a**

![Graph of Real GDP Four-Quarter Percent Change]

**Source:** BEA/Haver Analytics

**Figure 6b**

![Graph of Real GDP Four-Quarter Percent Change]

**Source:** BEA/Haver Analytics
Figure 7a

Real Personal Consumption Expenditures
Four-Quarter Percent Change

- 2015-2018
- Average, Excluding 2015-2018

Source: BEA/Haver Analytics

Figure 7b

Real Personal Consumption Expenditures: Durables
Four-Quarter Percent Change

- 2015-2018
- Average, Excluding 2015-2018

Source: BEA/Haver Analytics
**Figure 7c**

**Real Personal Consumption Expenditures: Nondurables**
Four-Quarter Percent Change

![Graph showing Real Personal Consumption Expenditures: Nondurables](Image)

Source: BEA/Haver Analytics

**Figure 7d**

**Real Personal Consumption Expenditures: Services**
Four-Quarter Percent Change

![Graph showing Real Personal Consumption Expenditures: Services](Image)

Source: BEA/Haver Analytics

47
Figure 8a

Real Private Nonresidential Fixed Investment
Four-Quarter Percent Change

Source: BEA/Haver Analytics

Figure 8b

Real Private Residential Fixed Investment
Four-Quarter Percent Change

Source: BEA/Haver Analytics
Figure 9a

**Personal Consumption Expenditures Price Inflation**

Four-Quarter Percent Change

Source: BEA/Haver Analytics

Figure 9b

**Core Personal Consumption Expenditures Price Inflation**

Four-Quarter Percent Change

Source: BEA/Haver Analytics
Figure 10a

1-Year-Ahead Inflation Expectations, Median Increase
Percent

Liftoff

- 2015-2018
- Average, Excluding 2015-2018

Source: University of Michigan/Haver Analytics

Figure 10b

10-Year-Ahead Inflation Expectations, Median Increase
Percent

Liftoff

- 1994-1995
- 1999-2000
- 2004-2006
- 2015-Present

Source: University of Michigan/Haver Analytics
Figure 11

Nonfinancial Businesses Loans
Four-Quarter Percent Change

![Graph showing Nonfinancial Businesses Loans four-quarter percent change with data labels and source information.](image)

Source: Federal Reserve Board/Haver Analytics

Figure 12

Wilshire 5000 Stock Price Index
Four-quarter percent changes

![Graph showing Wilshire 5000 Stock Price Index four-quarter percent changes with data labels and source information.](image)

Source: Dow Jones/Haver Analytics
Figure 13

Real FRB Broad Trade-Weighted Exchange Rates
Index, Jan-06 = 100

Source: Federal Reserve Board/Haver Analytics
# Table 1

FOMC Tightening Actions and Dissents, 1998 to 2018

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<td></td>
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<td></td>
<td></td>
<td></td>
<td>Seger wanted easier policy</td>
<td>Melzer wanted easier policy</td>
</tr>
<tr>
<td>2. February 4, 1994</td>
<td>3.00</td>
<td>February 1, 1995</td>
<td>6.00</td>
<td></td>
<td>3.00</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>3. June 30, 1999</td>
<td>4.75</td>
<td>May 16, 2000</td>
<td>6.50</td>
<td></td>
<td>1.75</td>
<td>Yes (1)</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>McTeer thought tightening was unnecessary</td>
<td></td>
</tr>
<tr>
<td>4. June 30, 2004</td>
<td>1.00</td>
<td>June 29, 2006</td>
<td>5.25</td>
<td></td>
<td>4.25</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>5. December 16, 2015</td>
<td>0 to 0.25</td>
<td>Dec. 19, 2018</td>
<td>2.25 to 2.50</td>
<td></td>
<td>2.25</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

**SOURCE:** Federal Reserve Board of Governors and Federal Reserve Bank of St. Louis
### Table 2

<table>
<thead>
<tr>
<th>First Tightening Action</th>
<th>FOMC Description of Policy Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 29, 1988</td>
<td>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)</td>
</tr>
<tr>
<td>February 4, 1994</td>
<td>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)</td>
</tr>
<tr>
<td>June 30, 1999</td>
<td>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 prediction 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)</td>
</tr>
<tr>
<td>June 30, 2004</td>
<td>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)</td>
</tr>
<tr>
<td>December 15, 2015</td>
<td>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 has 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)</td>
</tr>
</tbody>
</table>

**SOURCE:** Federal Reserve Board of Governors