Inertia in the Fed's Monetary Policy Rule

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Abstract

Using information from fixed-income markets, I document a sharp change in expected inertia in the Federal Reserve's monetary policy rule. Prior to 1992, markets anticipate a modest amount of short-run inertia. Subsequently, markets anticipate substantial long-run inertia. This change in expected inertia predates, and to some extent causes, an increase in inertia in the Fed's actual monetary policy rule. In early 1994 Chairman Greenspan effectively changed the rule, emphasizing meeting markets' expectations of short-run changes in the Fed funds rate. Markets anticipated inertial policy, thus the Fed delivered it. I argue that both the policy change and the markets' anticipation of inertial policy were grounded in the experience of the 1990–1991 recession and its aftermath. Conflicting estimates of inertia in the literature rely on flawed econometric techniques.

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A well-established literature documents substantial inertia, also described as gradualism or partial adjustment, in the Federal Reserve's policy rule. In an influential article, Clarida, Galí, and Gertler (2000) estimate monetary policy rules inspired by Taylor (1993). A typical policy rule is

$$i_t = (1 - \rho)i_t^* + \rho i_{t-1} + e_t, \tag{1}$$

where the target policy rate i_t^* is a parameterized function of inflation and the output gap. The coefficient ρ measures inertia. Over the sample 1960 through 1996, Clarida et al. (2000) estimate "...only between 10 and 30 percent of a change in the interest rate target is reflected in the Funds rate within a quarter of the change." (pp. 157-158) Subsequent research using various techniques arrives at the same conclusion, such as Coibion and Gorodnichenko (2012) and Carvalho, Nechio, and Tristão (2021). Coibion and Gorodnichenko (2012) observe "...much of the recent macroeconomics literature has simply assumed interest-rate smoothing on the part of central bankers ..." (p. 128).

The magnitude of inertia matters both to macroeconomics and finance. As suggested by Goodfriend (1991) and formalized by Woodford (2003), high inertia magnifies the business-cycle effects of innovations in the policy rate. Households and firms respond to anticipated cumulative changes rather than simply the initial change. Similarly, the dynamics of the short rate, and thus the dynamics of the entire term structure, depend on how gradually the Federal Reserve responds to macroeconomic information.

I study policy inertia using high-frequency (daily) and low-frequency (FOMC cycle) innovations in interest rates, expected inflation, and expected economic activity. Most of the analysis follows the spirit of Hamilton, Pruitt, and Borger (2011), using innovations in the term structure of interest rates to infer the market's perception of policy inertia. Two considerations motivate this choice. First, key effects of inertia depend on its expected magnitude. Agents' reactions to policy-rate innovations depend on their beliefs about inertia rather than actual inertia. Second, using expectations rather than realizations converts dynamic regressions such as (1) into contemporaneous regressions, leading to more statistical power. Other empirical analysis here follows the spirit of a methodology adopted by Coibion and Gorodnichenko (2012), examining the dynamic response of the funds rate to low-frequency macroeconomic news.

The evidence reveals a sharp shift in market expectations of inertia in the early 1990s. Data from fixed-income futures markets provide the clearest picture. I estimate sensitivities

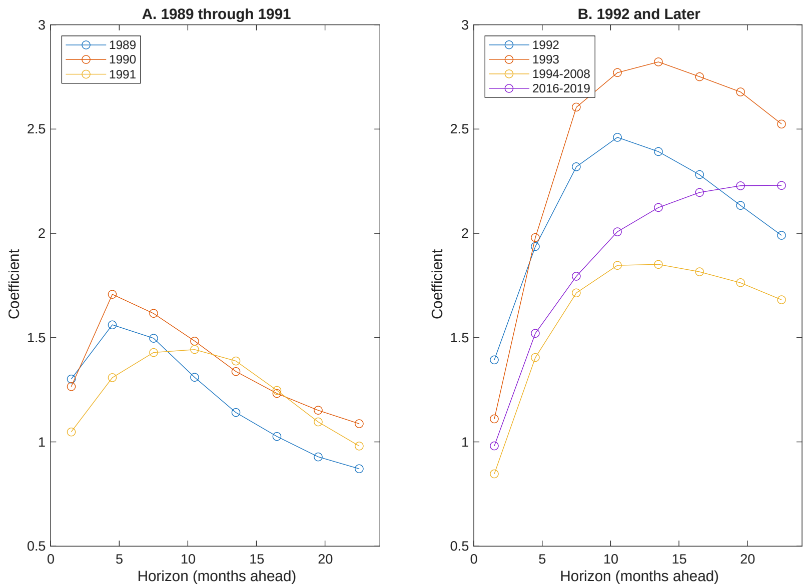

Figure 1. Regressions of changes in Eurodollar futures rates on the contemporaneous change in a near-term Fed funds futures rate, for non-FOMC meeting days. Dependent variables are daily changes of rates implied by Eurodollar futures prices for the first 8 quarterly contracts. The explanatory variable is the change in the rate implied by the Fed funds futures price for the contract month that begins after the next FOMC meeting date. Regressions are estimated separately for the sample periods indicated in the figure.

of daily changes in Eurodollar futures rates to contemporaneous changes in a near-term Fed funds futures rate. Kuttner (2001) estimates similar regressions, using a sample of FOMC meeting dates to study monetary policy surprises. I use samples of only non-meeting dates to study the policy rule. Changes in the term structure of futures rates indicate how market participants anticipate the Fed will react over time to the news on a given day.

Panels A of Figure 1 displays estimated coefficients for the each of the years 1989 (when Fed funds futures data are first available on Bloomberg) through 1991. Panel B displays estimates for the individual calendar years 1992 and 1993, as well as the multi-year samples 1994 to 2008 and 2016 through 2019. The data sample ends just prior to the pandemic and excludes the zero-lower-bound period from December 2008 through December 2015. Standard errors, not displayed, range from 0.05 to 0.19.

For each year from 1989 through 1991, the estimates imply that investors anticipate modest short-run policy inertia. Panel A shows that for these years, the cumulative expected change in short rates peaks somewhere between three and eight months ahead, at roughly 1.5 times the initial change. The cumulative expected change then declines as the horizon increases, such that two-year-ahead Eurodollar futures rates move approximately one-to-one with the expected initial change.

Panel B documents a remarkable shift in anticipated short-rate dynamics. Beginning in 1992, markets anticipate that an innovation in the funds rate will be followed by steady changes in the funds rate in the same direction for many months. Magnitudes of persistence and cumulative expected changes vary widely across different post-1992 sample periods, but all the samples exhibit much more anticipated inertia than do those examined in Panel A. For example, estimates of the cumulative expected change at the two-year horizon across different samples range from about 1.6 to 2.5 times the expected initial change.

Additional results using nonfarm payroll surprises explicitly tie the patterns in Figure 1 to macroeconomic news. Evidence also shows that since the early 1990s, expectations of inertia tightly vary with anticipated economic activity. Market participants expect more gradual monetary policy at times when they expect higher economic growth.

Lower-frequency data shed light on expectations of inertia prior to the availability of futures data. News arriving between successive FOMC meetings affects both the contemporaneous Fed funds rate (i.e., the rate set by the FOMC after observing the information) and market participants' expectations of future Fed funds rates. Greenbook innovations in forecasts of inflation and output growth capture some of this information. Regressions of changes in the Fed funds rate, the three-month Treasury yield, and the one-year Treasury yield on contemporaneous Greenbook forecast innovations show that from late 1960s through 1991 (excluding the disinflation period from September 1979 through 1982), market participants expect little inertia.

Using these lower-frequency data, I also investigate the magnitude of inertia using realizations of future Fed funds rates rather than expectations of future rates. Regressions of changes in contemporaneous and future Fed funds rates on Greenbook forecast revisions trace out the response over time of the funds rate to macroeconomic news. The main conclusion to draw from these results is that the data do not speak clearly. Point estimates suggest minimal policy inertia during the 1970s and more substantial inertia from the mid-1990s onward. However, the standard errors are too large to change the mind of a skeptic.

I argue the shift in the early 1990s was driven by the recession of 1990–1991 and its aftermath. More precisely, the market and the Fed draw lessons from this period that in combination lead to a permanent shift in expectations of inertia. From the market's perspective, an eyeball test strongly suggests that the Fed follows a highly inertial strategy during this easing cycle. The funds rate declines from 8.25% at the beginning of 1990 to 3% at the end of 1992, in fifteen 25 b.p. increments and three 50 b.p. increments. Chairman Greenspan seemingly confirms the eyeball test. His congressional testimony in early 1993 refers to the "purposely gradual" easing actions through 1992.[1]

Yet Greenspan's testimony seems to be an exercise in revisionist history. Transcripts of the FOMC meetings from 1990 through 1992 make clear that the Committee is not following an inertial strategy. Instead, they cut the funds rate repeatedly because members of the Committee, and in particular Greenspan, are repeatedly surprised by the recession of 1990–1991 and the continued economic weakness into late 1992.

As the Fed's easing cycle nears its end by mid-1992, Greenspan concludes that the recession and weak recovery were driven by the unwinding of firms' and households' balance sheets—an unwinding caused by declines in the values of previously overpriced assets. He also concludes that the large cumulative decline in rates did not trigger higher inflation expectations because the decline was gradual and anticipated. Thus going forward, he emphasizes the predictability of policy. Unexpected tightening can trigger asset-market losses, while unexpected easing can weaken the market's confidence in the Fed's commitment to low inflation.

He puts this new strategy into action at the February 1994 FOMC meeting. In his words, he "went berserk" at the meeting, pleading with the other FOMC members to begin a tightening cycle by initially raising the funds rate only 25 b.p. rather than 50 b.p.[2] Thus the inertial strategy is, to some extent, accidental. The Fed prefers to avoid surprising the market and the market expects the Fed to follow an inertial strategy.

This research connects most closely to Rudebusch (2002), Hamilton et al. (2011), and Coibion and Gorodnichenko (2012). Most of my analysis focuses on the market's expectation of monetary policy rather than actual monetary policy. Thus, the results do not explicitly

[1] Greenspan (1993b), p. 7.

[2] He uses this phrase at the May 2004 FOMC meeting to describe his remarks at the February 1994 meeting. Board of Governors of the Federal Reserve System (2004), p. 86.

contradict the view that the Federal Reserve followed a high-inertia strategy before the early 1990s. But the idea that the Fed has consistently followed a strongly inertial strategy, yet the market did not recognize it until the early 1990s, strains credulity.

I also reevaluate some of the existing empirical literature, arguing that it offers little support for substantial inertia prior to the early 1990s. Econometric problems loom large. Coefficient estimates on lagged dependent variables as in (1) are inconsistent in the presence of persistent omitted variables. McKinnish (2005) shows in a general panel data setting that estimated coefficients on lags cannot be used to distinguish between the presence of persistent omitted variables and slow adjustment of the dependent variable. I argue that the methods used in the monetary policy literature to address this problem are inadequate.

By studying innovations rather than levels, I circumvent the omitted variable problem. My use of high-frequency innovations follows Hamilton et al. (2011), who find substantial evidence of inertia using data beginning in 1994. They do not examine prior data. My use of low-frequency innovations resembles a particular instrumental variable estimation method used in Coibion and Gorodnichenko (2012). In principle, their instrumental approach also circumvents the omitted variable problem. In practice, they ask too much of their data, rendering their inference uninformative. I also follow the narrative approach of Coibion and Gorodnichenko (2012), who find strong evidence of inertia in the transcripts of FOMC meetings beginning in 1994. They do not report narrative evidence for prior years.

Section 1 motivates my econometric approach. Section 2 describes the data. Section 3 presents the empirical results. Section 4 links the shift in inertia during the early 1990s to the lessons of the 1990–1992 economic downturn. Section 5 discusses in more detail existing methods to infer the magnitude of inertia in the Fed's policy rule. Section 6 concludes.

1 Motivating the Econometric Approach

This section uses a stylized description of the central bank's monetary policy rule to motivate the empirical approach taken in Section 3. It is a statistical model designed to describe an equilibrium rather than a fundamental model that motivates an equilibrium. The empirical analysis does not attempt to uncover structural coefficients, thus an equilibrium model does not offer any advantages.

1.1 A multifactor policy framework

The target policy rate depends on current economic conditions and longer-term trends, which I label collectively as factors. These factors can include the output gap, output growth, inflation, financial conditions, and trends in the central bank's long-run inflation target and long-run real rates. They can also include perspectives of the members of the FOMC committee (leaning dovish or hawkish).

The N-vector x_t captures these components. The factors follow mean-zero independent autoregressive processes with time-invariant dynamics. Denote their autocorrelations as

$$\text{Cor}(x_{n,t}, x_{n,t-k}) \equiv \delta_{n,k}. \tag{2}$$

These autocorrelations appear in the analysis that follows, thus I introduce notation to keep track of the vector of autocorrelations through lag k:

$$\Upsilon_{n,k} \equiv (\delta_{n,0}\ \delta_{n,1}\ \ldots\ \delta_{n,k})'. \tag{3}$$

Factor news arrives at each date. This news consists of contemporaneous innovations to the factors. Innovations are i.i.d.,

$$x_{n,t} - E_{t-1}x_{n,t} = \eta_{n,t}, \quad E(\eta_{n_1,t}\eta_{n_2,t}) = 0\ \forall\ n_1 \neq n_2, \quad \text{Var}_{t-1}(\eta_{n,t}) = \sigma_n^2. \tag{4}$$

The factors drive the FOMC's target policy rate. Ignoring a constant term, the policy target rate is linear in the factors with factor-specific loadings

$$i_t^* = \sum_{n=1}^{N} \phi_n x_{n,t}. \tag{5}$$

The relation between the target rate and the actual policy rate accommodates inertia parameterized by the coefficient ρ. Again ignoring a constant term, the policy rate is

$$i_t = (1-\rho)i_t^* + \rho i_{t-1}, \tag{6}$$

or equivalently

$$i_t = (1-\rho)\sum_{k=0}^{\infty}\rho^k i^*_{t-k}. \tag{7}$$

Unlike Equation (1), (6) and (7) do not include error terms, often described as monetary policy shocks. In some sense their absence is only about labeling. Policy shocks can be included in the functional form for the target rate. However, including them in the target rate imposes the restriction that monetary policy shocks are also subject to inertia as parameterized in (7). Section 3.1 presents some evidence about inertia associated with monetary policy shocks.

Before getting into detailed implications of this framework, it is worth mentioning a missing feature that can complicate some econometric methods to infer inertia. The setting rules out news about future target rates that does not affect the current target rate. For a richer specification of news, consider a target rate that depends only on expected inflation next quarter,

$$i^*_t = \phi_\pi E_t(\pi_{t+1}).$$

The assumption that (4) characterizes all news rules out the possibility that news arrives at t about inflation at $t+k, k>1$, that is not embedded in news about inflation at $t+1$. A richer setting allows for independent sources of news about different forecast horizons. For example, we could write one-quarter-ahead expected inflation as

$$E_t(\pi_{t+1}) = \delta E_{t-1}(\pi_t) + \eta_{1,t} + \eta_{2,t-1}.$$

The news $\eta_{2,t-1}$ is observed at $t-1$, and investors know that it affects inflation beginning at $t+1$.

Such news affects the term structure of yields at $t-1$ as investors price it into bonds. In practice, this type of news plays an important role in term structure behavior. Researchers developed multifactor term structure models in part to capture news about future short-term rates that is embedded in longer-term yields but not in the current short rate.[3] The next subsection discusses why this type of news can affect some methods for inferring inertia.

Returning to the framework, use straightforward algebra to write the policy rate as an

[3] For a textbook treatment of these models see, e.g., Singleton (2006).

infinite sum of current and past scaled innovations

$$i_t = (1-\rho)\sum_{n=1}^{N}\phi_n\sum_{k=0}^{\infty} f(k;\rho,\Upsilon_{n,k})\eta_{n,t-k}, \tag{8}$$

with the scaling function defined recursively as

$$\begin{aligned} f(0;\rho,\Upsilon_{n,0}) &\equiv \delta_0; \\ f(k;\rho,\Upsilon_{n,k}) &\equiv \delta_k + \rho f(k-1;\rho,\Upsilon_{n,k-1}). \end{aligned} \tag{9}$$

The scaling function plays an important role in what follows. For concreteness, consider a unit innovation at t to factor n. By definition, the contemporaneous, one-period-ahead, and two-period-ahead responses are proportional to $f(0;\rho,\Upsilon_{n,0})$, $f(1;\rho,\Upsilon_{n,1})$, and $f(2;\rho,\Upsilon_{n,2})$ respectively. These three function values are

$$f(0;\rho,\Upsilon_{n,0}) = \delta_{n,0} = 1, \quad f(1;\rho,\Upsilon_{n,1}) = \delta_{n,1}+\rho, \quad f(2;\rho,\Upsilon_{n,2}) = \delta_{n,2}+\delta_{n,1}\rho+\rho^2. \tag{10}$$

The first terms of each function value are the direct effects of the innovation at t on the factor at $t+k, k=0,1,2$. The autocorrelations determine the speed at which the direct effect dies out over time. In the absence of inertia, there are no other terms. Inertia adds a term at k equal to the inertial coefficient times the scaling function value at $(k-1)$. The special case in which the autocorrelations are those for an AR(1) process provides a little more intuition. With an AR(1) persistence parameter δ, the scaling factor function simplifies to

$$\text{AR(1) special case:} \qquad f(k;\rho,\delta) \equiv \begin{cases} \frac{\rho^{k+1}-\delta^{k+1}}{\rho-\delta}, & \rho \neq \delta; \\ (k+1)\delta^k, & \rho = \delta. \end{cases} \tag{11}$$

Figure 2 plots the scaling function for three choices of ρ and autocorrelations of an AR(1) process with persistence parameter $\delta = 0.85$. Interpreting a period as one quarter, this persistence corresponds a business-cycle frequency, with a half-life of a little more than four quarters. The value $\rho = 0.8$ is close to the estimates using quarterly data produced by Clarida et al. (2000) and Coibion and Gorodnichenko (2012). For this value, the scaling function peaks at four quarters ahead. In other words, the maximum effect on the policy

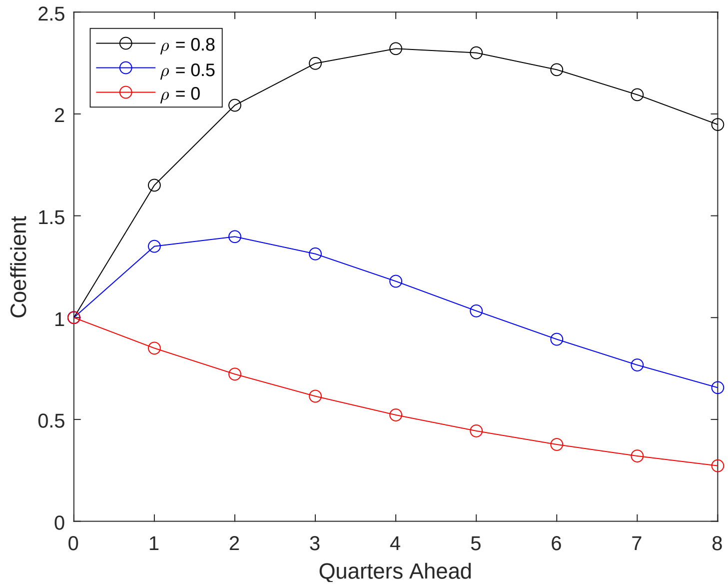

Figure 2. Model-implied sensitivity of the k-ahead policy rate to a target-rate innovation. The model's monetary policy rule exhibits inertia with inertial parameter ρ. The target rate follows an AR(1) process with persistence parameter $\delta = 0.85$, where time is measured in quarters. The contemporaneous sensitivity is normalized to one.

rate of an innovation to the target rate is reached a year after the innovation is realized. The value $\rho = 0.5$ has a maximum effect at about two quarters. When inertia is zero, the contemporaneous effect is largest.

1.2 Exploiting the information in innovations

From (8), the innovation in the j-ahead expected policy rate is

$$(E_t - E_{t-1})\, i_{t+j} = (1-\rho) \sum_{n=1}^{N} \phi_n f(j; \rho, \Upsilon_{n,j}) \eta_{n,t}. \tag{12}$$

This subsection considers empirical implementations of (12) that require observations of some of the news on either the left or right sides.

1.2.1 Observed innovations in expected policy rates

Assume we observe innovations to both the period-t policy rate and the expected j-ahead policy rate. Regress the latter on the former,

$$(E_t - E_{t-1})\, i_{t+j} = \beta_j\, (E_t - E_{t-1})\, i_t + e_{j,t}. \tag{13}$$

Using (12), the regression coefficient is

$$\beta_j = \sum_{n=1}^{N} \left(\frac{\phi_n^2 \sigma_n^2}{\sum_{k=1}^{N} \phi_k^2 \sigma_k^2} \right) f(j; \rho, \Upsilon_{n,j}). \tag{14}$$

Equation (14) shows that the regression coefficient is a weighted average of the scaling functions (9) for the N factors driving the target policy rate. These scaling functions differ only through the factors' autocorrelations. If the factors all have roughly business-cycle persistence, then a weighted average of their scaling functions looks like the scaling factors in Figure 2.

Equation (14) also shows that regressions such as (13) cannot identify the inertial coefficient. The coefficients also depend on the volatilities and autocorrelations of all the factors affecting the policy rate. Instead, a set of regression estimates for different horizons j provides a credibility test for high inertia. For example, coefficients that steadily rise with the forecast horizon for a year or so are consistent with the high-inertia plot in Figure 2. Coefficients that rise with the forecast horizon for three to six months are consistent with the low-inertia plot, while coefficients that decline with the forecast horizon are consistent with minimal or no inertia.

Following a literature beginning with Kuttner (2001) and Gürkaynak, Sack, and Swanson (2005), I use high-frequency changes in fixed-income futures prices in place of the expectation innovations of (13). In other words, I use equivalent-martingale innovations rather than physical-measure innovations,

$$\left(E_t^{\mathcal{Q}} - E_{t-1}^{\mathcal{Q}}\right) i_{t+j} = \beta_j \left(E_t^{\mathcal{Q}} - E_{t-1}^{\mathcal{Q}}\right) i_t + e_{j,t}. \tag{15}$$

Section 3.1 implements this type of regression.

The first use of term structure information to test for high inertia appears in Rudebusch

(2002). Contrasting his methodology with mine helps explain why I adopt this approach. Rudebusch recognizes that when monetary policy is highly inertial, there will be times when market participants anticipate substantial future changes in the policy rate. These anticipated changes will be impounded into the slope of the term structure. He concludes informally that high inertia corresponds to substantial predictability (high R^2s) of forecasting regressions

$$i_{t+m} - i_{t+n} = b_0 + b_1 S_{m,n,t} + e_{m,n,t},$$

where $S_{m,n,t}$ is the slope of the term structure at t from horizon n to horizon m. For the sample 1988 through 2000 he finds little predictability at horizons beyond a few months ahead, and therefore concludes there is little inertia in monetary policy.

However, high predictability is neither a necessary nor sufficient condition for high inertia. The voluminous term structure literature documents that the slope of the yield curve also varies for other reasons.[4] For example, Section 1.1 notes that market participants have information about expected future changes in policy rates that is not created by inertia. This information creates the kind of predictability that Rudebusch attempts to find. In addition, the compensation that investors require to bear interest-rate risk also changes over time, leading to changes in the slope of the term structure. This variation attenuates the predictability that Rudebusch attempts to find, and can even reverse the sign of the predictability. Therefore the term structure regressions studied by Rudebusch and those who follow his approach such as Coibion and Gorodnichenko (2012) are uninformative about the magnitude of inertia.

By contrast, with regression (15), any news about expected future policy rates that is orthogonal to news about the current policy rate does not contaminate the coefficient estimate. It goes into the residual. Similarly, news about risk premia goes into the residual unless it is correlated with news about the current policy rate.

1.2.2 Adding some observed macroeconomic news

Now assume that in addition to observing innovations in expected policy rates, we observe the innovation in one or more of the factors driving the target rate. For concreteness, assume we observe the innovation to factor n. Project innovations in the expected policy rate on

[4] See, e.g., Singleton (2006).

the innovation,

$$(E_t - E_{t-1})\, i_{t+j} = \beta_j \eta_{n,t} + e_{j,t}. \tag{16}$$

The regression coefficient is

$$\beta_j = (1-\rho)\phi_n f(j; \rho, \Upsilon_{n,j}). \tag{17}$$

The residual picks up all other factor innovations at time t. Estimation replaces the physical-measure expectations with equivalent-martingale expectations. As with (15), the term structure of coefficients for different horizons j provides a credibility test for high inertia. Section 3.2 implements this type of regression.

1.2.3 Using only observed macroeconomic news

Continue to assume we observe innovations to a factor driving the target rate. The dynamic response of the policy rate to news is characterized by the contemporaneous response, the one-period-ahead response, and so on. Tracking these responses through J steps ahead, write the $(J+1)$-period change in the policy rate as

$$i_t - i_{t-J-1} = \alpha_k + \sum_{j=0}^{J} \beta_j \eta_{n,t-j} + e_{J,t}. \tag{18}$$

The coefficients on the news included in (18) are given by (17).

Unlike (16), regression (18) does not use observed innovations in expected future policy rates. It uses realized future rates as proxies for these expectations. These proxies necessarily introduce considerable noise into parameter estimates, as we will see in Section 3.6.

2 Data

The empirical analysis in Section 3 uses a combination of daily term structure data and FOMC-cycle macroeconomic data.

2.1 Futures

Trading of Fed funds futures contracts on the Chicago Board of Trade (CBOT) begins in October 1988. Bloomberg maintains daily closing prices beginning in December 1988. I use daily closing prices from Bloomberg that span January 1989 through December 2019, ending the sample just before the pandemic. Contracts pay based on calendar-month averages of daily effective Fed funds rates. Changes in the contract price from day to day correspond to changes in $\mathcal{Q}$-measure expectations of calendar averages of future fund rates.

Owing to both the monthly averaging and the timing of FOMC meetings, working with these data requires some care. First, we need notation.

m_t :	index of calendar month for day t
$FF_t^{(h)}$:	day t Fed funds futures rate, contract expiring at the end of month $m_t + h - 1$
τ_t :	day of nearest scheduled FOMC meeting on or after day t

The month index ranges from 1 for January 1989 through 372 for December 2019. The funds rate implied by the price of the nearest-expiration contract is $FF_t^{(1)}$. Daily changes in Fed funds futures rates are

$$\Delta FF_t^{(h)} \equiv \begin{cases} FF_t^{(h)} - FF_{t-1}^{(h)}, & m_t = m_{t-1}; \\ FF_t^{(h)} - FF_{t-1}^{(h+1)}, & m_t = m_{t-1} + 1. \end{cases}$$

I use these data to measure the expected 'immediate' FOMC response to news that arrives on day t. To clarify the desired measure, consider two dates in March 1994, on either side of the FOMC's scheduled meeting on March 22. Market participants use the news that arrives on March 15 to update their predictions of the FOMC's next choice of the funds rate. The FOMC's immediate (i.e., March 22) reaction to the news will affect only a few of the daily rates that determine the average funds rate for March 1994 and affect all of the daily rates that determine the average funds rate for April 1994. Therefore the day-t change in the April futures rate measures the expected immediate FOMC response.

Now consider news that arrives on March 25, after the March FOMC meeting. This news might not affect the FOMC's rate-setting decision until the next scheduled meeting on May 17. If so, the FOMC's reaction to this news will not affect the average funds rate in March or April, partially affect the average funds rate in May, and fully affect the average funds rate in June.

Complicating this narrative is the possibility that the FOMC chooses to meet prior to the regularly-scheduled meeting of May 17; or, more precisely, that market participants assign some positive probability to an early meeting. If market participants think this might happen, they will impound more of March 25 news into the May contract and perhaps some of the news into the April contract. (In fact, the FOMC held a conference call on April 18 to raise the funds rate.) Since we do not know the probability that market participants assign to an early meeting, the day-t change in the June contract rate is the best measure of the expected immediate FOMC response.

More generally, define the expected immediate change in the Fed funds rate as of day t by

$$\Delta FF_t \equiv \Delta FF_t^{(2+m_{\tau_t}-m_t)}. \tag{19}$$

For 35% (57%) of days in the sample studied here, the upcoming FOMC meeting is in the same (next) calendar month as the daily observation. For the other days the upcoming meeting is two calendar months in the future. Note the (19) is never calculated using the nearest-expiration contract, in contrast to the methodology commonly used to study monetary policy news on FOMC dates. Kuttner (2001) explains why the use of the current-month contract requires assuming that the effective funds rate changes at most once during that month, and does so only on a date known in advance (the FOMC meeting date).

Price data for three-month Eurodollars futures contracts are available on Bloomberg beginning with December 1986, earlier than Fed funds futures data. As with Fed funds futures, the sample ends in December 2019, prior to the pandemic. Contracts are settled using the three-month LIBOR rate at settlement, thus daily changes in the implied rates are changes in $\mathcal{Q}$-measure expectations of three-month LIBOR. I use the first eight contracts that expire on the usual cycle of March, June, September, and December. Daily changes are constructed accounting for rollover due to contract expirations. The notation is

$$\Delta ED_t^{(h)} \equiv \text{change in the rate implied by the } h \text{ nearest 3-month Eurodollar contract.}$$

The resulting term structure ranges up to 21–24 months ahead, depending on precise expiration dates. Trading of expiring contracts ends at the end of Monday prior to the third Wednesday of quarterly-cycle months.

As with Fed funds futures contracts, we want to consider when news on day t can be impounded into Eurodollar futures rates. Continuing with the Fed funds example, consider news arriving on either March 15 or March 25 1994. A Eurodollar futures contract just expired on March 14. None of the active contracts on either March 15 or March 25 will settle until mid-June, well after the FOMC scheduled meetings of both March 22 and May 17. Any immediate reaction by the FOMC to the news will be fully impounded into the three-month LIBOR rate in mid-June.

For the sample studied here, 60% of the daily observations are similar to this example, in the sense that the next scheduled FOMC meeting precedes the next Eurodollar futures contract expiration. An additional 25% of the observations have the next contract expiration fewer than 10 days before the next scheduled meeting. In the empirical analysis that follows I do not split samples based on the relative timing of contract expiration dates. In practice, this choice has minimal effects on the results.

2.2 Macroeconomic information

Federal Reserve Board staff produce economic forecasts prior to every scheduled meeting of the FOMC. I use the term "Greenbook forecast," although the Fed now includes them in Tealbook A. The Federal Reserve Bank of Philadelphia maintains Greenbook datasets. Forecasts of real quarterly output growth (GNP prior to 1992Q1, then GDP) and the associated implicit price deflator are included in every Greenbook. Each Greenbook has a term structure of forecasts.

Nowcasts and one-quarter-ahead forecasts are available for every Greenbook beginning in November 1968. Two-quarter-ahead forecasts are available for every Greenbook beginning in February 1969. Output growth and inflation forecasts are quarterly growth rates compounded to an annual horizon. I use Greenbook data through 2019, ending prior to the pandemic.

With these data, measure time by regularly-scheduled FOMC meetings. Denote the calendar quarter of FOMC meeting t as q_t, and the k-ahead quarter as $q_t + k$. Use the notation E^G to refer to a Greenbook forecast. Define Greenbook forecast innovations of inflation and real output growth as

$$\begin{aligned} \eta^G_{\pi,t,k} &\equiv \left(E^G_t - E^G_{t-1}\right) \pi_{q_t+k}, \\ \eta^G_{y,t,k} &\equiv \left(E^G_t - E^G_{t-1}\right) \Delta y_{q_t+k}. \end{aligned} \tag{20}$$

The G superscripts and the explicit forecast horizons k distinguish these observed innovations from the factor innovations defined by the theoretical model's (4).

The Philadelphia Fed also maintains a dataset of output gap forecasts used by Board staff in the construction of Greenbook forecasts. Output gap forecasts up to five quarters ahead are available for every Greenbook beginning in August 1987. The output gap is the log difference between actual and potential output, measured in percent.

I also use surprises in nonfarm payroll announcements in conjunction with futures data. Surprises through May 1998 are from Money Market Services. Surprises from June 1998 through December 2019 are from Bloomberg.

2.3 Other term structure information

I use effective Fed funds rates, three-month Treasury yields, and one-year Treasury yields aligned with the FOMC cycle. They are used in conjunction with the Greenbook forecast innovations.

These values are measured just before and just after each FOMC meeting. The 'just before' values are those of the latest date prior to the date of the meeting's Greenbook. Therefore they are part of the information set used to produce the Greenbook. The 'just after' values are the median daily values across the three days immediately after the meeting. Prior to February 1994 the Fed did not immediately announce the outcome of any FOMC meeting. The three-day window allows actions taken by the open market desk to be incorporated into fixed-income markets.

Effective Fed funds rates are from the H.15 release of the Federal Reserve Board, available through the FRED database of the Federal Reserve Bank of St. Louis. The three-month yield is the secondary-market bill yield from the H.15 release. The one-year yield is interpolated from coupon bond prices by the Board following Gürkaynak, Sack, and Wright (2007). Both yields are converted to annually-compounded rates.

3 Empirical Evidence

This section studies inertia using both daily data from futures markets and longer-horizon data from FOMC meetings. The daily analysis offers high precision, while the FOMC-meeting analysis offers a long sample period.

3.1 Inertia through the lens of futures data

High-frequency term structure regressions follow the spirit of (15). The expected immediate change in the Fed funds rate defined by (19) serves as the main proxy for the daily innovation in the contemporaneous policy rate on the right side of (15). The dependent variables are contemporaneous changes in the term structure of Eurodollar futures contracts rates up to eight quarterly contracts ahead. The regressions are

$$\Delta ED_t^{(h)} = b_{FF}^{(h)} \Delta FF_t + e_{FF,t}^{(h)}, \quad h = 1, \ldots, 8 \tag{21}$$

Estimates of (21) are restricted to the post-1988 sample owing to the availability of Fed funds futures data. Similar long-short regressions using only Eurodollar futures data replace the right-side variable with the futures rate of the nearest-expiration Eurodollar futures contract,

$$\Delta ED_t^{(h)} = b_{ED}^{(h)} \Delta ED_t^{(1)} + e_{ED,t}^{(h)}, \quad h = 2, \ldots, 8 \tag{22}$$

The explanatory variable of (21) better captures the immediate monetary policy reaction to news. Therefore I limit estimates of (22) to pre-1989 data. No constant terms are included in these regressions because innovations are on both sides. Including constant terms has no appreciable effect on the results.

The goal of this exercise is to better understand the Federal Reserve's monetary policy rule, not deviations from the rule. Deviations, also known as monetary surprises, are realized primarily on days when the FOMC meets and does something unexpected. The regressions (21) and (22) should inform us about the rule rather than monetary surprises. Accordingly, I estimate the regressions excluding days with FOMC meetings, both scheduled and unscheduled. For two-day meetings, only the second day is excluded. I also estimate the regressions using only days with scheduled FOMC meetings in order to highlight how the anticipated dynamics of the rule differ from the dynamics associated with monetary surprises.

The introduction discusses Figure 1, which displays estimates of (21) using non-FOMC days. The time-to-expiration for contract h varies from $3(h-1)$ months to $3h$ months. The horizontal axes of Figure 1 plot each contract at the midpoint of its range. The main observation to take from the figure is the sharp break in the term structure of coefficients after 1991.

Similar evidence appears in Table 1. The first row reports estimates of (22) for December 1986 through December 1988. These results are consistent with minimal inertia in the monetary policy rule. The peak response to the shortest Eurodollar futures rate is only 1.1. The response of the 24-month-ahead Eurodollar futures contract is slightly less than one-to-one. The table's second row combines data from 1989 through 1991. For this sample, the response peaks at the second-shortest contract, and the response of the 24-month-ahead contract is slightly less than one-to-one.

Post-1991 data exhibits much more inertia. The 1994 through late 2008 results are particularly interesting, hence I discuss those in some detail. Table 2 shows that the expected cumulative response peaks about a year after the news arrives. However, the peak is a little less than twice the initial change in the Fed funds futures rate, well below the peak in 1992–1993. More surprisingly, the point estimate for the short-expiration Eurodollar contract is less than one, which is incompatible with inertia as modeled in Section 1.1.

A somewhat broader modeling framework can explain both the relatively low peak and the low initial coefficient. Rather than a model with only business-cycle innovations and a single coefficient of inertia, allow for two types of innovations with different inertial coefficients. One type is a business-cycle innovation with high inertia and the other is a highly transitory innovation with no inertia. For example, sometimes the Fed aggressively responds to transitory market disruptions. Regression coefficients average across responses to these two types of news. The Internet Appendix contains a parameterized example that produces coefficients similar to those reported in Table 1 for the 1994–2008 period.

Table 2 reports corresponding parameter estimates for scheduled FOMC meeting days. Of course, the sample sizes are much smaller than those in Table 1. The standard errors are correspondingly larger, especially for the 2016–2016 sample. Nonetheless, we can confidently conclude that there is no evidence that monetary policy innovations are associated with anticipated inertia. The largest point estimate across all the samples is only 1.22.

3.2 Futures and macroeconomic information

The regressions (21) and (22) treat macro news as latent. The underlying logic presumes, but cannot verify, that changes in the futures rates are driven by macro news. Here I examine a particular type of observable macro news, the Bureau of Labor Statistics release of nonfarm payroll employment. Gürkaynak, Sack, and Swanson (2005) examine yield curve responses to the surprise component of many macroeconomic announcements. They find that the one-year forward rate is most responsive to nonfarm payroll. The explanatory power of nonfarm payroll is sufficiently strong to shed light on inertia during the samples studied here, even though the announcements are monthly.

Regressions use day t's surprise component of the announcement to explain the day-t change in futures rates. Denoting the surprise with a tilde,

$$\Delta y_t = b\,\widetilde{NFP}_t + e_t, \qquad y_t \in \{FF_t, ED_t^{(h)}, h = 1, \ldots, 8\} \tag{23}$$

No constant term appears because both sides of (23) are innovations. The surprises are scaled by their standard deviation over the December 1986 through December 2019 sample, excluding the zero-lower-bound period.

Table 3 contains results for five sample periods. In combination, they point to substantially greater inertia beginning in 1992 than before 1992. During both 1986 through 1988 and 1989 through 1991, the expected cumulative innovation in short rates peaks at the second Eurodollar rate, three to six months ahead. The response of the sixth Eurodollar rate is rate equal to or less than the response of the first Eurodollar rate. During both 1992 through 1993 and 1994 to 2008, the peak is at the fifth Eurodollar rate, twelve to fifteen months ahead. During 2016 through 2019 the peak is at the eighth Eurodollar rate. Across the final three sample periods, the response of the eighth Eurodollar rate to NFP news at least 2.5 times the response of the near-term Fed funds rate.

As a caveat, note that the first three samples have between 21 and 30 observations. The standard errors do not pin down the estimates with high precision. Moreover, they are valid only asymptotically, a requirement unlikely to be satisfied with such a small number of observations. Therefore these results should be viewed evidence that corroborates the higher-precision estimates of regression (21) rather than results that can stand alone.

3.3 State dependence

The model of Section 1.1 does not allow for state-contingent inertia. In particular, inertia does not depend on whether the Federal Reserve anticipates a boom or a recession. Other research generalizes the fixed-coefficient partial adjustment model of the Fed's policy rule. Aasstveit, Cross, Furlanetto, and van Dijk (2024) and Florio (2006) introduce state-dependence in policy inertia, concluding that it depends on both the easing/tightening cycle and the identity of the Fed chair.

I test this restriction of no state-dependence by generalizing regression (21). The sensitivity of Eurodollar futures rates to the near-term Fed funds rate is allowed to depend on the Federal Reserve's forecast of an expected change in the output gap. For day t, this conditioning information is the five-quarter-ahead forecast of the output gap less the output gap nowcast from the most recent Greenbook dated prior to t. A maintained assumption is that this forecast is in the information set of market participants at day t, so their conditional expectations of inertia may depend on it.

Denoting this conditioning information as

$$E_t^G(\Delta g) \equiv E_t^G\left(gap_{q_t+5} - gap_{q_t}\right), \tag{24}$$

the regression is

$$\Delta ED_t^{(h)} = b_0^{(h)} + b_1^{(h)} E_g^G(\Delta g) + \left(b_2^{(h)} + b_3^{(h)} E_t^G(\Delta g)\right) \Delta FF_t + e_{FF,t}^{(h)}, \quad h = 1, \ldots, 6. \tag{25}$$

I remove the sample mean from the expected change in the output gap to simplify the interpretation of the coefficient on the change in the Fed funds futures rate. The regression includes a constant term and the expected change in the output gap to prevent the cross-term from picking up any level effects.

Table 4 reports regression results for the period of high expected inertia, 1992 through 2019 (excluding the ZLB period). One set of regressions excludes all FOMC meeting dates and the other includes only scheduled meetings. Although the results of Table 1 do not support unconditional expected inertia for monetary surprises, I include the scheduled-meeting results to check whether there is is state-dependent inertia.

The results reveal a very strong positive relation between expected high economic growth and expected inertia. Consider, for example, the Eurodollar futures rate for the 8th-nearest contract, expiring in 21 to 24 months. The point estimates imply that when the expected five-quarter change in the output gap is at its mean, this rate responds about two-to-one to the near-term Fed funds futures rate. When the expected change in the output gap is one percentage point higher than its mean, the point estimates imply a sensitivity of about 2.4.

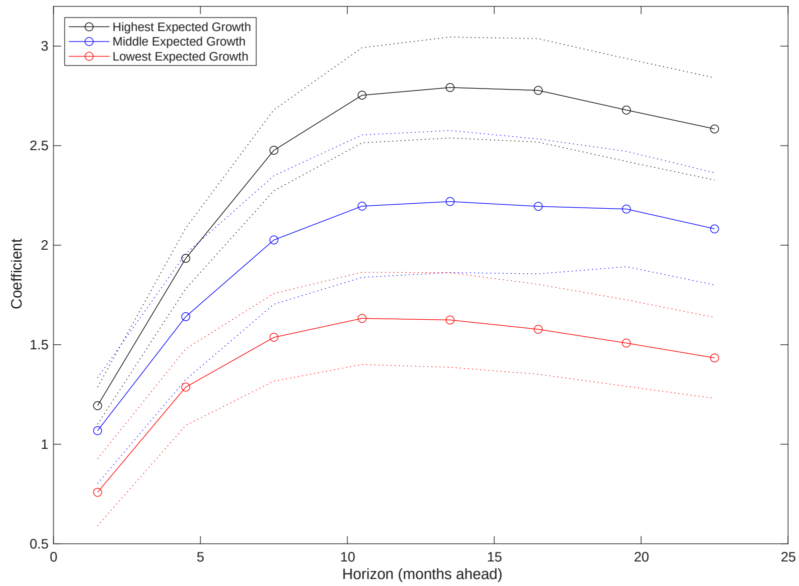

Figure 3. Regressions of daily changes in Eurodollar futures rates on the contemporaneous change in a near-term Fed futures rate, sorted by expected growth in the output gap. Daily changes in three-month Eurodollar futures rates are regressed on the contemporaneous change in a near-term Fed funds futures rate. Daily data are sorted into three groups using the most recent Greenbook forecast of five-quarter-ahead growth in the output gap. The figure displays point estimates and two standard error bounds. The sample is 1992 through 2019, excluding the zero-lower-bound period of December 2008 through December 2015.

The t-statistic on the cross term exceeds 6.

Not surprisingly, results for only scheduled FOMC meeting days differ considerably from those for non-FOMC days. There is no evidence of either inertia on average or inertia dependent on expected output growth.

I also use a less parametric method to evaluate conditional expected inertia on non-FOMC days. Sort the daily observations of the expected change in the output gap (24) into terciles, and estimate the unconditional regression (21) on each set of data. Figure 3 displays the parameter estimates along with two-standard-error bounds on the estimates. Expected inertia increases strongly with expected growth in the output gap. Consider a unit change in the near-term Fed funds futures rate. For the lowest tercile of expected growth in the output gap, the two-year-ahead Eurodollar futures rate response is a little less than 1.5 For the middle tercile, the response exceeds 2.0, and for the upper tercile the response exceeds

2.5.

All of these results tied to futures prices offer strong evidence of a large shift towards inertia in monetary policy after 1991. These data do not allow us to determine whether monetary policy exhibited inertia prior to the mid-1980s. The following analysis uses lower-frequency data to examine inertia beginning in the late 1960s.

3.4 An overview of FOMC-meeting news

The following analysis uses Greenbook forecast revisions described in Section 2.2 and interest rate data described in Section 2.3. The data span 1968 through 2019. Separate empirical analyses are performed for three time periods. The first uses data from the end of 1968 through the FOMC meeting in July 1979, prior to the beginning of Volcker's tenure as Chair. I exclude the monetarist experiment/disinflation period through December 1982. The disinflation period is too short to draw reliable conclusions from the empirical approach taken here. Yet the data during this period are so volatile that combining the data with either an earlier or later sample obscures the data-generating process of the other sample.

The second period begins with January 1983 and ends either in December 1991 or December 1993, depending on the nature of the analysis. The third period uses data through 2019, excluding the ZLB period of December 2008 through December 2015.

In the spirit of the rule of Taylor (1993), I use news about expected inflation and expected economic growth to explain changes in the Fed funds rate, the three-month Treasury bill yield, and the one-year Treasury bond yield. The first step in this exercise is compressing the information in the term structure of inflation and growth forecasts into single measures to explain changes in the funds rate. I regress the change in the funds rate from FOMC-dates $t-1$ to t on Greenbook date-t forecast innovations for forecast horizons zero through two. Although forecast innovations for horizons greater than two quarters ahead are available for many of these dates, including them reduces the number of available observations yet adds little explanatory power. The regressions are

$$i_t - i_{t-1} = b_0 + \sum_{k=0}^{2} b_{\pi,k}\eta^G_{\pi,t,k} + \sum_{k=0}^{2} b_{y,k}\eta^G_{y,t,k} + e_t \tag{26}$$

where i_t represents the effective Fed funds rate. For this regression the middle period ends with December 1991 and the late period begins with January 1992.

One subtlety not made clear on the left side of (26) is that the funds rate at t is the rate just after the FOMC meeting, while the funds rate at $t-1$ is the rate just prior to that meeting's Greenbook date. This measurement choice ensures the left and right sides are truly contemporaneous. Consider macroeconomic information that arrives just before or during meeting $t-1$. This information is not in the Greenbook forecast for $t-1$, thus it first affects Greenbook forecasts for meeting t. By using the lagged pre-meeting rate on the left of (26) rather than the lagged post-meeting rate, I ensure that this macroeconomic information affects both the left and right sides of (26) for observation t. This choice creates a small amount of overlap in the residuals. I adjust asymptotic standard errors for one lag of moving average residuals using Newey and West (1987).

Equation (26) does not imply that the FOMC changes the funds rate only at meeting dates. Until the mid-1990s the FOMC routinely changed the rate between meetings. For example, macroeconomic information arriving between meetings $t-1$ and t might cause the FOMC to immediately change the funds rate. The data used with (26) cannot distinguish between intermeeting changes in the policy rate and changes that occur at meetings.

Results are in Table 5. For our purposes three conclusions stand out. First, prior to the disinflation period beginning in 1979, inflation news is only weakly related to contemporaneous innovations in the funds rate. Innovations in the nowcast and one-quarter-ahead expected inflation have similar coefficients, but neither t-statistic exceeds one. A Wald test cannot reject the hypothesis that all coefficients on inflation news are zero. However, we should not take this as evidence that inflation news is irrelevant to interest rates in the pre-disinflationary period. Evidence to follow shows that three-month and one-year Treasury bills covary with this news.

Second, after the disinflation period ends in 1982, the funds rate responds to revisions in the one-quarter-ahead inflation expectation. Revisions of other inflation forecasts are irrelevant. Third, over time the FOMC becomes more forward-looking with respect to news about output growth. Only the nowcast innovation matters in the early sample. Both the nowcast and one-quarter-ahead innovations matter in the middle sample, and only the one-quarter-ahead innovation matters in the late sample.

The evidence here allows us to compress the information in Greenbook forecast revisions. One variable summarizes relevant news about output growth and another summarizes news about inflation. The variable definitions vary across the three samples, in line with the increasingly forward-looking nature of the policy rate over time.

For the early sample, inflation news is the mean of the innovations to the inflation nowcast and the one-quarter-ahead inflation forecast. Output growth news is the nowcast innovation. For the middle sample, inflation news is the innovation to the one-quarter-ahead inflation forecast. Output news is the mean of the innovations to the output growth nowcast and the one-quarter-ahead output growth forecast. For the late period, inflation and output news are innovations to their corresponding one-quarter-ahead forecasts. The shorthand notation is

$$\hat{\eta}_{\pi,t} \equiv \begin{cases} \frac{1}{2}\left(\eta^G_{\pi,t,0} + \eta^G_{\pi,t,1}\right), & \text{early sample;} \\ \eta^G_{\pi,t,1}, & \text{middle and late samples,} \end{cases} \tag{27}$$

$$\hat{\eta}_{y,t} \equiv \begin{cases} \eta^G_{y,t,0}, & \text{early sample;} \\ \frac{1}{2}\left(\eta^G_{y,t,0} + \eta^G_{y,t,1}\right), & \text{middle sample;} \\ \eta^G_{y,t,1}, & \text{late sample,} \end{cases} \tag{28}$$

3.5 FOMC-frequency news and the term structure

In the spirit of the theoretical regression (16), I regress changes in the Fed funds rate, the three-month Treasury bill yield, and the one-year Treasury bond yield on inflation and output growth news defined by (27) and (28). Unlike the regressions of changes in futures rates on nonfarm payroll surprises, here we do not observe innovations in yields, only changes in yields. I therefore include constant terms in the regressions. The regressions are

$$z_t - z_{t-1} = b_0 + b_1\hat{\eta}_{pi,t} + b_2\hat{\eta}_{y,t} + e_t, \qquad z_t \in \{i_t,\ y_t^{3m},\ y_t^{1yr}\}. \tag{29}$$

As with (26), the lagged rate on the left is measured just prior to the Greenbook release for meeting $t-1$. The coefficients of the Treasury yield regressions are the responses of average $\mathcal{Q}$-expected short rates over the life of the security. Therefore differences between coefficients of Treasury yield regressions and coefficients of the Fed funds regression tell us whether investors expect (under $\mathcal{Q}$) the contemporaneous change in the funds rate to be followed by a change in the same direction, or instead to be partially reversed during the life of the security.

Table 6 contains estimation results for the three sample periods. The point estimates tell us that prior to 1992, the three-month yield responds more to inflation news than does the one-year yield, a pattern that reverses in the 1992 through 2019 sample. These estimates are consistent with the view that anticipated inertia is higher after 1991. Similarly, prior to 1992, responses of the three-month and one-year yields to output-growth news are approximately equal. This pattern is also consistent with minimal inertia.

Yet the post-1991 evidence muddies the picture. In this late sample, responses of the funds rate and the two Treasury yields to output-growth news are declining in maturity. In other words, the bonds are priced as if the funds rate response to output growth news will shrink during the first year rather than grow. This pattern is inconsistent with both the evidence from futures market discussed previously, and the evidence from Fed funds dynamics to be discussed next.

A time-varying liquidity premium along the lines of Nagel (2016) can help explain these anomalous results. Nagel shows that the liquidity premium on short-term Treasury securities rises when short-term rates rise. This effect damps the response of the three-month and one-year Treasury yields to news that raises expected future short-term rates. Futures contracts offer no liquidity premium, thus the evidence discussed in Section 3.1 and 3.2 are not contaminated by this effect.

3.6 A direct look at inertia

The final set of regressions investigate the dynamics of the funds rate rather than expected dynamics. Regress changes in the funds rate on contemporaneous and lagged inflation and output growth news,

$$i_t - i_{t-J-1} = b_0 + \sum_{j=0}^{J} b_{\pi,j}\hat{\eta}_{pi,t-j} + \sum_{j=0}^{J} b_{y,j}\hat{\eta}_{y,t-j} + e_t. \tag{30}$$

I estimate (30) separately for the periods 1969 through July 1979, January 1983 through December 1993, and January 1994 through December 2019, excluding the ZLB period. The break in the sample at the end of 1993 rather than 1991 is motivated by Chairman Greenspan's statements at the February 1994 meeting of the Federal Open Market Committee (FOMC), previously discussed in the introduction and examined in more detail in the next section. Regressions use overlapping observations. I exclude the first J observations from each sample to account for lags.[5]

Larger values of the maximum lag length J provide more information about the dynamic response of the funds rate to macroeconomic news, while smaller values provide more statistical accuracy owing to more non-overlapping observations. My choice of J tracks the response of the funds rate to news for one quarter after the contemporaneous response. This corresponds to $J = 3$ during the pre-disinflationary sample, when the FOMC meets monthly. It corresponds to $J = 2$ for the other two sample periods, with meetings about six weeks apart. The first two sample periods each have 43 non-overlapping observations and the final sample period has 74 non-overlapping observations. Unfortunately, tracking the dynamic response for six months results in only 21 non-overlapping observations in the first two sample periods and 36 in the final sample.

Figure 4 displays the point estimates and two standard error bounds for each regression. The most obvious message conveyed by the figure is that confidence intervals are wide. We can tell stories using the point estimates, and I do so below. However, the lack of precision prevents us from drawing any strong conclusions.

To understand how these estimates convey information about inertia, consider the top panel under Column A. These are estimated coefficients on inflation news for the early sample period. For concreteness, consider news at an FOMC meeting that expected inflation is one percentage point higher than expected at the previous meeting. The panel shows that the funds rate immediately increases by about 50 b.p. This increase in the funds rate is quickly substantially reversed. Two months (two meetings) later, only 20 b.p. of the initial increase remains. Point estimates after the contemporaneous coefficient are statistically indistinguishable from zero.

Point estimates in the figure reveal two patterns. First, prior to 1994, the funds rate responds with some inertia to news about expected output growth, but with no inertia to news about expected inflation. The response of the funds rate to output growth news steadily increases during the next quarter, while the response to inflation news does not. Second, during the 1994 through 2019 period, the funds rate responds with inertia to both inflation and output growth news. These patterns are consistent with higher overall inertia beginning in 1994, although confidence intervals are wide.

[5] I also exclude the first J observations after the end of the ZLB period.

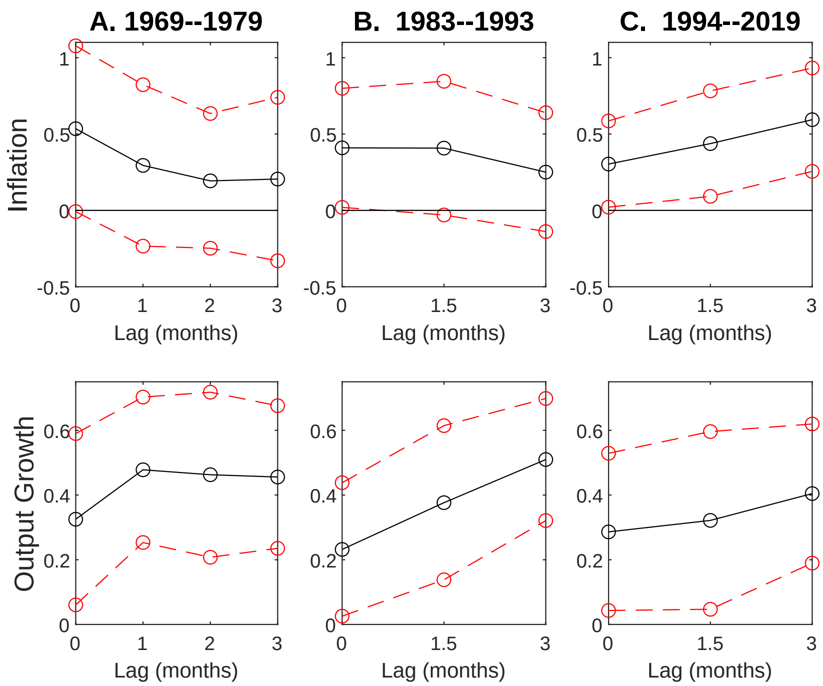

Figure 4. Regressions of three-month changes in the Fed funds rate on Greenbook news about expected inflation and output growth. The figure plots estimated coefficients and two standard error bounds for regression (30) in the text. Observations correspond to scheduled FOMC meetings. Scheduled meetings occur every month during the 1969 to 1979 sample and every six weeks during the other two sample periods.

4 The Early 1990s as a Break Point

This section argues that the Fed begins following a high-inertia strategy in 1994 in response to two lessons Chairman Greenspan draws from the recession and subsequent anemic recovery during 1990 through 1992. First, asset price revaluations can play a central role in business cycle fluctuations through balance-sheet effects on firms and households. Second, rate cuts will not destabilize inflation expectations if market participants anticipate the cuts and think they are consistent with an anti-inflationary policy rule.

In combination, these lessons lead the Fed to heavily weight private-sector beliefs when setting monetary policy. Unexpected increases in the funds rate can sharply devalue assets, potentially triggering balance-sheet restructuring, reducing investment and consumption. Unexpected decreases can trigger higher inflation expectations. At the same time, market

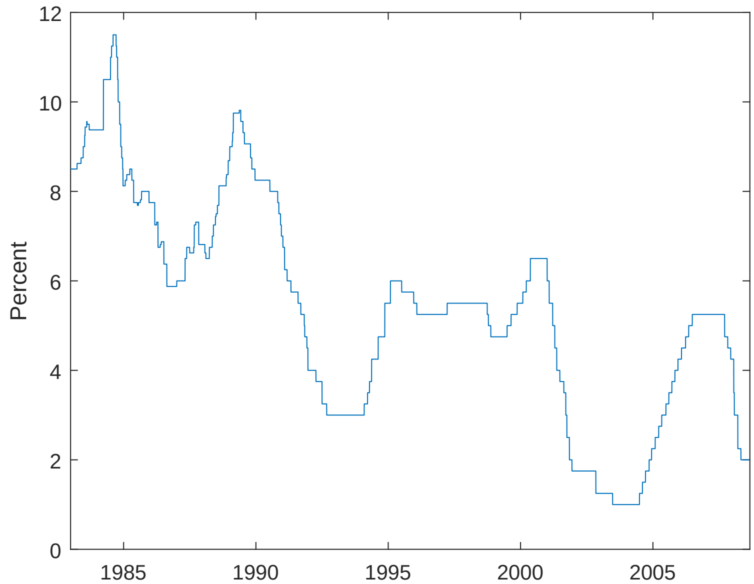

Figure 5. The Federal funds rate from the end of the disinflationary period until the beginning of the global financial crisis. The figure displays the funds rate chosen by the FOMC.

participants believe that the Fed is already following a high-inertia policy. In a nutshell, the Fed adopts an inertial policy because markets expect it.

4.1 Learning during 1990 through 1992

Recall the evidence from futures markets displayed in Figure 1 and discussed in both the introduction and Section 3.1. In 1992 and 1993, the futures market anticipates much more inertia in the funds rate than it anticipated prior to 1992. Figure 1 cannot tell us why market participants anticipated such high persistence. The most obvious explanation is that participants learned from recent Fed funds dynamics. Figure 5 displays daily values of the Fed funds rate from January 1983 through August 2008.[6] The eyeball test strongly suggests that the Fed has followed an inertial policy throughout the 1990s. In a speech titled "Gradualism," Bernanke (2004), who joined the Fed Board of Governors in 2002, agrees with the eyeball test, stating

[6]It shows the DFEDTAR series from FRED, constructed from FOMC meeting transcripts and FOMC statements.

> As a general rule, the Federal Reserve tends to adjust interest rates incrementally, in a series of small or moderate steps in the same direction. ... The easing that spanned the 1990-91 recession and subsequent recovery is a better example of how drawn out the process of adjusting rates can be. That episode lasted for more than three years, from June 1989 to September 1992, and involved twenty-four policy actions that cumulated to a total reduction of 675 basis points in the funds rate. Of these twenty-four actions, twenty-one were rate cuts of 25 basis points, and three were cuts of 50 basis points. (p. 1)

Transcripts of the FOMC meetings from 1990 through 1992 tell a different story. The FOMC was repeatedly surprised by the recession of 1990–1991 and the continued economic weakness into late 1992, as it cut the funds rate from 8.25% at the beginning of 1990 to 3% in September 1992. The Internet Appendix contains extensive quotes from the transcripts supporting this conclusion. In particular, at no point does Chairman Greenspan advocate persistent future changes in the funds rate. Instead, at meeting after meeting, his view is that no additional reductions in the funds rate may be necessary. For example, at the March 1991 meeting, when the funds rate is 6%, he states[7]

> By far the highest probability at this stage seems to be that the healing process that we've been observing in recent weeks will continue and will gradually lead into a bottoming out and an economic upturn. ... If the economy is healing and recovering, then certainly no further easing is required at this stage ...

At the August 1991 meeting, when the funds rate is 5.5%, he states[8]

> ... one of the problems I think we're having is that when a recession is over, by definition, the economy is at the lowest point in a cycle and it feels awful ... It's very interesting to get a sense [of the views] in the political realm; there is a confusion as to whether "the recession ends" means the receding has come to an end or that the economy is back up to normal. I think the overwhelming evidence is that it's the latter [view] that we run into. ... there is clearly no policy purpose that I can see in moving rates lower immediately ...

[7]Board of Governors of the Federal Reserve System (1991a), p. 41.
[8]Board of Governors of the Federal Reserve System (1991b), pp. 36-37.

The NBER Dating Committee identifies the trough of the recession as May 1991. The subsequent recovery is historically weak, leading to repeated rate cuts through September 1992. By July 1992, Greenspan has formulated answers to two key questions concerning the reduction in the funds rate to a level not seen since the early 1970s. First, why has the reduction not stimulated substantial economic growth? Second, why has it not led to higher inflation? To put the latter question in perspective, the January 1990 Greenbook forecasts one-quarter-ahead PCE annualized inflation of 3.6%. The June 1992 Greenbook forecasts only 2.5%.

He attributes the slow recovery to balance-sheet restructuring by firms and households, induced by declines in values of previously overvalued assets. In January 1993 he testifies before Congress[9]

> . . . households and businesses have been struggling to redress structural imbalances unparalleled in the postwar period. The speculative bidding up of real estate and other asset prices over the course of the 1980s fostered an excessive accumulation of debt and assets. The subsequent weakening of asset prices in the early 1990s left the balance sheets of many households and businesses strained with debt overload. Banks and other intermediaries that had financed the buildup suffered losses that severely eroded capital. The pressures to work down debt, reinforced by understandably more conservative lending practices, slowed economic growth.

Greenspan attributes the absence of inflationary pressures to the lack of aggressive rate-cutting by the Fed. Slow adjustment kept the Fed from getting ahead of the market's expectations of anti-inflationary Fed policy. He testifies before the Senate in July 1992[10]

> Uncertainty about how far the process of balance-sheet adjustment would have to go and for how long the spending retrenchment of overleveraged debtors would continue has been a factor in shaping Federal Reserve policy over the past few years. This uncertainty has been shared by many other observers, who, based on past experience, were somewhat skeptical about the strength and persistence of spending restraint by both the private and public sectors, and dubious about

[9] Greenspan (1993b), p. 2.
[10] Greenspan (1992), p. 5.

> the persistence of disinflationary forces. Against that background, more rapid or forceful easing actions more than likely would have been interpreted by market participants as risking a resurgence of inflation. That would have led to higher rather than lower long-term interest rates.

Similarly, from his July 1993 congressional testimony,[11]

> The process of easing monetary policy, however, had to be closely controlled and generally gradual, because of the constraint imposed by the marketplace's acute sensitivity to inflation. ...this is a constraint that did not exist in an earlier time. Before the late 1970s, financial market participants and others apparently believed that, while inflationary pressures might surface from time to time, the institutional structure of the US economy simply would not permit sustained inflation. But as inflation and, consequently, long-term interest rates soared into the double digits at the end of the 1970s, investors became painfully aware that they had underestimated the economy's potential for inflation.

These statements strongly suggest that the Fed's planned to slowly ease during 1990 through 1992 because the economic weakness was tied to balance sheets. However, Greenspan does not mention this strategy in congressional testimony or FOMC meetings until mid-1992. More plausibly, he decides after the fact that gradual easing optimally responds to the economic conditions of 1990 through 1992.

4.2 Tightening in early 1994

The funds rate was 3% at the end of January 1994. The rate had not changed since the Fed lowered it from 3.25% in September 1992 and had not increased since May 1989. At the FOMC meeting in February 1994, committee members debated whether to immediately raise the funds rate by 25 b.p. or by 50 b.p. Greenspan wraps up the debate by advocating forcefully for a small adjustment. He does not want to surprise financial markets, potentially creating large declines in stock and bond prices. Excerpts of his remarks from that meeting and other FOMC meetings discussed below are contained in the Internet Appendix. At the same meeting he reverses his long-standing opposition to the FOMC publicly announcing

[11] Greenspan (1993c), p. 2.

its policy directives.[12] He wants market participants to understand clearly what the Fed is doing.

At the next FOMC meeting on March 22 1994, Greenspan explains his reasoning in more detail. He explicitly advocates a series of small increases in the funds rate to achieve his desired target, with these increases implemented immediately after regularly-scheduled meetings. His view is that participants will see a small step, know it is insufficient to achieve the necessary tightening, and therefore anticipate additional small steps at future meetings. He argues these small steps will not damage balance sheets and lead to greater certainty on the part of households and firms.

Two permanent changes to FOMC procedures soon follow these meetings. First, beginning with the May 1994 meeting, the staff Bluebook (now Tealbook B, a document describing monetary policy alternatives for the FOMC) prominently discusses near-term and medium-term expectations of changes in the funds rate implied by Fed funds futures prices. Second, the FOMC announces in February 1995 that all changes in monetary policy will be immediately publicly announced.

Of course, this new policy framework does not guarantee that Fed policy actions are always anticipated. For example, the cumulative 300 b.p. increase in the funds rate from February 1994 through January 1995 greatly surprises the Treasury market. See Kliesen (2025) for a recent review of the episode. On average, though, market predictions of near-term Fed policy actions are much more accurate beginning in 1994 than earlier. Lang, Sack, and Whitesell (2003) show that from 1994 through 2000, one-month-ahead and two-month-ahead changes in the monthly average effective Fed funds rate are strongly forecastable with Fed funds futures contract prices. They also show that forecastability using futures prices is much weaker during 1989 through 1993.

The above discussion points to the post-1993 period as one in which the inertial monetary policy rule is, in some sense accidental. The seeds of the equilibrium are planted during the drawn-out easing during the 1990–1991 recession and its aftermath. Market participants see 24 successive reductions in the Fed funds rate and reasonably, although incorrectly, conclude the Fed follows an inertial strategy. The Fed simultaneously places a new emphasis on meeting the market's expectations, and chooses to follow the inertial strategy.

[12]The exception is announcements of changes in the rate charged by the Fed's discount window.

5 Evaluating Standard Estimation of Inertial Policy Rules

This section discusses why standard methods of estimating monetary policy inertia are unreliable. These methods typically estimate the policy rule directly, either with OLS using real-time expectations or with instruments that are correlated with these expectations, such as lagged realizations. I illustrate OLS estimation of an inertial monetary policy rule using Greenbook forecasts of one-quarter-ahead inflation and the output gap.

Time is measured at the frequency of scheduled FOMC meetings from August 1987 through November 2019, excluding the ZLB period from December 2008 through December 2015. Section 2.3 describes how the funds rate is measured after an FOMC meeting. The funds rate and the inflation rate are measured in percent/year. The output gap is measured in percent. Estimation with OLS produces

$$i_t = \underset{(0.077)}{-0.067} + \underset{(0.015)}{0.078}\ E_t^G\left(gap_{q_t+1}\right) + \underset{(0.050)}{0.129}\ E_t^G\left(\pi_{q_t+1}\right) + \underset{(0.016)}{0.943}\ i_{t-1} + e_t, \tag{31}$$

$$T = 203,\ R^2 = 0.981.$$

Asymptotic standard errors, in parentheses, are adjusted for one lag of moving-average residuals using Newey and West (1987).

The estimated coefficient on the lagged funds rate implies extraordinarily high inertia. It takes almost 12 FOMC meetings (1.5 years) for half of an innovation in the target rate to be impounded into the funds rate. The asymptotic standard error indicates the estimate is highly precise. If the true coefficient is two standard errors less than the estimate, it still takes almost a year for half of an innovation in the target rate to be impounded into the funds rate.

5.1 Omitted variables

Taylor (1993) emphasizes that such parsimonious policy rules exclude substantial complexities. These missing complexities are, from an econometric perspective, omitted variables. The econometrics literature recognizes that coefficient estimates on lagged dependent variables are inconsistent in settings with persistent omitted variables. Most of this literature uses applied microeconomic settings, such as Heckman and Hotz (1989).

The monetary policy inertia literature explores the omitted variables problem by adding other variables to the policy rule. The informal logic, which is usually implicit in the literature, is that the problem is important in practice only if additional variables lower substantially the coefficient on the lagged policy rate. A “kitchen sink” implementation adds a variety of variables related to monetary policy, such as those in a monetary-model vector autoregression (VAR). Rudebusch (2002) notes that estimating these VARs typically produces “large and significant” coefficients on lagged rates. He interprets this as ruling out an important role for omitted variables other than perhaps for monetary policy shocks. A more targeted implementation uses theory to identify plausible omitted variables. Observables proxy for these omitted variables. Coibion and Gorodnichenko (2012) use proxies for asset-market conditions, imperfect information, and variations in long-run inflation and long-run economic activity. None of their proxies significantly lower estimates of inertia.

Two limitations make this methodological approach unhelpful. First, theory does not guarantee that adding variables correlated with omitted variables produces more accurate estimates of inertia. An extremely simple example illustrates that including such variables can have the opposite effect. Assume that the Fed sets the funds rate proportional to detrended log output,

$$i_t = \beta y_t, \tag{32}$$

where detrended log output follows an AR(1) process

$$y_t = \delta y_{t-1} + \epsilon_t, \qquad 0 < \delta < 1, \quad \text{Var}(\epsilon_t) = \sigma_\epsilon^2. \tag{33}$$

A simple candidate policy rule states that the policy rate follows an inertial process with noise,

$$i_t = b i_{t-1} + e_t. \tag{34}$$

This omission of detrended log output results in a positive estimate of inertia. The population coefficient estimate is the autoregressive coefficient δ in (33). An econometrician recognizes that (34) has an omitted variable. But rather than plugging in output, she plugs in a noisy measure of output growth,

$$x_t = y_t - y_{t-1} + n_t, \qquad \text{Var}(n_t) = \sigma_n^2. \tag{35}$$

The estimated policy rule is

$$i_t = b_1 x_t + b_2 i_{t-1} + e_t. \quad (36)$$

The population values of the coefficients are, from OLS analytics,

$$\operatorname*{plim}_{T\to\infty} \hat{b}_1 = \frac{\beta}{1+(\sigma_n^2/\sigma_\epsilon^2)}, \quad \operatorname*{plim}_{T\to\infty} \hat{b}_2 = \frac{1+\delta(\sigma_n^2/\sigma_\epsilon^2)}{1+(\sigma_n^2/\sigma_\epsilon^2)}, \quad (37)$$

with

$$\delta < \hat{b}_2 < 1.$$

Policy rule (36) fits the data better than does (34). As the variance of noise relative to the variance of the output innovation goes to zero, the R^2 of (36) goes to one. Yet although the true rule exhibits no inertia, the estimated rule (36) implies more inertia than does the simpler rule (34).

The second limitation with this methodological approach is that it offers no solution to the omitted variable problem. It is just a diagnostic. When the diagnostic points to an omitted variable, there is no obvious way to proceed. I illustrate this limitation in the context of (31).

Policy rule (31) does not include a time-varying long-run real rate. I augment the policy rule with a real-rate proxy. The Federal Reserve Bank of Cleveland produces monthly estimates of expected ten-year average real rates using Haubrich, Pennacchi, and Ritchken (2012). The expectations are inferred from a combination of Treasury yields, survey forecasts of inflation, inflation swap rates, and realized inflation.[13] For each scheduled FOMC meeting I use the most recent observation dated prior to the meeting's Greenbook date. Denote the expectations with a "C" superscript to highlight they are Cleveland Fed forecasts. The units are percent/year.

The OLS estimates are

$$i_t = \underset{(0.070)}{-0.201} + \underset{(0.017)}{0.130} E_t^G\left(gap_{q_t+1}\right) + \underset{(0.040)}{0.096} E_t^G\left(\pi_{q_t+1}\right) + \underset{(0.043)}{0.297} E_t^C\left(\overline{r}_{t,t+10yr}\right) + \underset{(0.024)}{0.815} i_{t-1} + e_t. \quad (38)$$

$$T = 203, \ R^2 = 0.986.$$

The estimated coefficient on the lagged funds rate implies much less inertia than does the

[13] The series is REAINTRATREARAT10Y on the St. Louis Fed FRED website.

estimate in (31). Half of an innovation in the target rate is impounded into the funds rate in less than six months (3.4 meetings). If the true coefficient is two standard errors less than the estimate, it takes a little more than a quarter (2.6 meetings).

The point of this example is not that the true magnitude of inertia is small. Instead, it shows that (31) is misspecified owing to an omitted variable. Given that (31) is misspecified, there is no particular reason to think that (38) is correctly specified. All we are able to conclude is that the estimates from this standard procedure are unreliable.

5.2 Instrumental variables with innovations

Coibion and Gorodnichenko (2012) offer an innovative solution to the omitted variable problem. Because their solution partially motivates the methodology adopted in this research, I want to clearly distinguish their approach from mine. They estimate inertial policy rules with instrumental variables (IV), using *only* contemporaneous and lagged structural shocks as instruments. Accurate estimates of inertia require only that the shocks are strongly correlated with innovations to the true target rate.

Using this IV approach, all variation in the lagged policy rate that is unspanned by the fundamental innovations drops out. This prevents the lagged rate from acting as a catch-all for omitted variables. Thus, the instruments do not need to span all innovations to the target in order to correctly identify the inertial coefficient.

Coibion and Gorodnichenko (2012) estimate a policy rule similar to the estimated rule (31), although they also include Greenbook-expected real output growth as an explanatory variable. The instruments are lags zero through two of innovations to five plausibly structural variables. They are permanent technology shocks, purified innovations to the Solow residual, news shocks, oil supply shocks, and tax shocks.

The IV estimates they report support the conclusion that the policy function exhibits substantial inertia. However, their regression is uninformative because the instruments do not satisfy the relevance requirement for instrumental variables. The authors do not report first-stage F statistics to help evaluate whether their instruments are weak. Instead, they use Monte Carlo simulations of a dynamic New Keynesian model to show that the structural shocks in New Keynesian model can be used as instruments to identify the model's monetary policy rule.

Using their data, I evaluate the strength of their instruments. Details are in the Internet Appendix.[14] The instruments are largely irrelevant to the endogenous regressors. The Cragg-Donald test statistic for weak instruments is only 0.25, nowhere near any Stock and Yogo (2005) critical values for rejecting the null hypothesis that the instruments are weak. Estimation of their policy rule with Limited Information Maximum Likelihood (LIML), which is more robust to the presence of weak instruments, produces extraordinarily large standard errors.

More broadly, macroeconomic news appears to be only weakly related to the explanatory variables of monetary policy rules. I illustrate this problem by estimating (31) using Greenbook forecast revisions as instruments. The revisions are to the one-quarter-ahead output gap forecast and the one-quarter-ahead inflation forecast. Table 7 reports first-stage and second-stage results using lags zero through two of these forecast revisions as instruments. In a nutshell, the instruments are almost completely useless, just like those used by Coibion and Gorodnichenko (2012). The Cragg-Donald test statistic is only 0.06. Estimation using LIML produces a standard error on the lagged interest rate coefficient of about 19 (not 0.19).

Essentially, this IV approach asks too much of news. My empirical approach relies on news, but does not attempt to estimate a monetary policy rule. Instead, it takes on a narrower empirical task. Is high inertia plausible, given how news affects contemporaneous expected and realized future short rates? Has the answer to this question changed in the early 1990s?

6 Conclusion

Evidence from fixed income markets reveals a sharp break in the market's forecast of inertia in the Federal Reserve's monetary policy rule. Prior to 1992, markets anticipated modest inertia. Subsequently, markets anticipate much stronger inertia in response to macroeconomic news. This anticipation of high inertia likely had its roots in the recession of 1990 and the subsequent weak recovery, when the Fed steadily cut rates for almost two years. Yet at that time, the Fed was not following an inertial strategy.

Instead, it appears that the market's belief in inertia triggered the Fed's inertial strategy

[14]Thanks to the authors for posting their data on the journal's website.

beginning in 1994. Chairman Greenspan, drawing lessons from the same economic conditions of 1990 to 1992, begins to place substantial weight on the principle of not surprising markets. The marketplace anticipates inertia, thus the Fed acts with inertia.

These results strongly suggest that the Fed's high-inertia policy began by accident. Nonetheless, subsequent regimes at the Federal Reserve may have chosen to continue the policy based on optimality considerations. This purely empirical research does not pass judgment on whether the Federal Reserve's strategy is appropriate.

References

Aasstveit, Knut Are, Jamie Cross, Francesco Furlanetto, and Herman K. van Dijk, 2024, Asymmetric gradualism in US monetary policy, Tinbergen Institute Discussion Papers 24-074/III.

Bernanke, Ben S., 2004, Gradualism, Speech 540, Board of Governors of the Federal Reserve.

Board of Governors of the Federal Reserve System, 1991a, *Transcript of the Meeting of the Federal Open Market Committee*, Meeting held March 26, 1991.

Board of Governors of the Federal Reserve System, 1991b, *Transcript of the Meeting of the Federal Open Market Committee*, Meeting held August 20, 1991.

Board of Governors of the Federal Reserve System, 2004, *Transcript of the Meeting of the Federal Open Market Committee*, Meeting held May 4, 2004.

Carvalho, Carlos, Fernanda Nechio, and Tiago Tristão, 2021, Taylor rule estimation by OLS, *Journal of Monetary Economics* 124, 140-154.

Clarida, Richard, Jordi Galí, and Mark Gertler, 2000, Monetary policy rules and macroeconomic stability: Evidence and some theory, *Quarterly Journal of Economics* 115, 147-180.

Coibion, Olivier, and Yuriy Gorodnichenko, 2012, Why are target interest rate changes so persistent? *American Economic Journal: Macroeconomics* 4, 126-162.

Florio, Anna, 2006, Asymmetric interest rate smoothing, *Economics Letters* 93, 190–195.

Goodfriend, Marvin, 1991, Interest rates and the conduct of monetary policy, *Carnegie-Rochester Conference Series on Public Policy* 34, 7–30.

Greenspan, Alan, 1992, Testimony before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate, July 21, 1992.

Greenspan, Alan, 1993a, Testimony before the Joint Economic Committee, U.S. Congress, January 27, 1993.

Greenspan, Alan, 1993b, Testimony before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate, February 19, 1993.

Greenspan, Alan, 1993c, Testimony before the Subcommittee on Economic Growth and Credit Formation of the Committee on Banking, Finance, and Urban Affairs, U.S. House of Representatives, July 20, 1993.

Greenspan, Alan, 2004, Risk and uncertainty in monetary policy, *American Economic Review Papers and Proceedings* 94, 33-40.

Gürkaynak, Refet S., Brian Sack, and Eric Swanson, 2005, The sensitivity of long-term interest rates to economic news: evidence and implications for macroeconomic models, *American Economic Review* 95, 425-436.

Gürkaynak, Refet S., Brian Sack, and Jonathan H. Wright, 2007, The U.S. Treasury yield curve: 1961 to the present, *Journal of Monetary Economics* 54, 2291-2304.

Hamilton, James D., Seth Pruitt, and Scott Borger, 2011, Estimating the market-perceived monetary policy rule, *American Economic Journal: Macroeconomics* 3, 1-28.

Heckman, James J., and V. Joseph Hotz, 1989, Choosing among alternative nonexperimental methods for estimating the impact of social programs: The case of manpower training, *Journal of the American Statistical Association* 84, 862-874.

Haubrich, Joseph, George Pennacchi, and Peter Ritchken, 2012, Inflation expectations, real rates, and risk premia: evidence from inflation swaps, *Review of Financial Studies* 25, 1588-1629.

Kleisen, Kevin L., 2025, Risk management in monetary policymaking: The 1994-95 FOMC tightening episode, *Federal Reserve Bank of St. Louis Review* 107, 1-16.

Kuttner, Kenneth N., 2001, Monetary policy surprises and interest rates: Evidence from the Fed funds futures market, *Journal of Monetary Economics* 47, 523-544.

Lang, Joe, Brian Sack, and William Whitesell, 2003, Anticipations of monetary policy in financial markets, *Journal of Money, Credit, and Banking* 35, 889-909.

McKinnish, Terra, 2005, Lagged dependent variables and specification bias, *Economics Letters* 88, 55-59.

Newey, Whitney K., and Kenneth D. West, 1987, A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix, *Econometrica* 55, 703-708.

Nagel, Stefan, 2016, The liquidity premium of near-money assets, *Quarterly Journal of Economics* 131, 1927-1972.

Rudebusch, Glenn D., 2002, Term structure evidence on interest rate smoothing and monetary policy ineretia, *Journal of Monetary Economics* 49, 1161-1187.

Singleton, Kenneth J., 2006, *Empirical Dynamic Asset Pricing*, Princeton University Press.

Stock, James, and Motohiro Yogo, 2005, Testing for weak instruments in linear IV regression," in *Identification and Inference for Econometric Models*, Donald W.K. Andrews, Ed., New York: Cambridge University Press, 80-108.

Taylor, John B., 1993, Discretion versus policy rules in practice, *Carnegie-Rochester Conference Series on Public Policy* 39, 195-214.

Woodford, Michael, 2003, *Interest and Prices: Foundations of a Theory of Monetary Policy*. Princeton: Princeton University Press.

Table 1. Long–Short Regressions Using Futures-Implied Rates, for Days Without FOMC Meetings

The table reports parameter estimates of regressions of daily changes in three-month Eurodollar futures rates on contemporaneous changes in shorter-term rates. Expirations of the Eurodollar futures contracts range from the nearest-to-expiration (expiration in 0 to 3 months) to 8th-nearest (21 to 24 months). For all but one sample, the shorter-term rate is that of a near-term Fed funds futures contract, as defined in Section 2.1. For the 1986 through 1988 sample the shorter-term rate is that of the Eurodollar futures contract with the nearest expiration. Regressions, which do not include a constant term, use only days without an FOMC meeting. Asymptotic standard errors, adjusted for generalized heteroskedasticity, are in parentheses.

Date Range	Short Rate	Obs	Eurodollar Futures Contract: Nearest	2nd	3rd	4th	5th	6th	8th
12/1986 to	Nearest	479	-	1.10	1.08	1.06	1.03	1.01	0.98
12/1988	Eurodollar			(0.02)	(0.03)	(0.04)	(0.04)	(0.04)	(0.05)
1/1989 to	Fed funds	715	1.26	1.55	1.51	1.36	1.21	1.10	0.93
12/1991			(0.05)	(0.06)	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)
1/1992 to	Fed funds	486	1.32	1.95	2.40	2.55	2.51	2.41	2.14
12/1993			(0.06)	(0.07)	(0.10)	(0.11)	(0.11)	(0.11)	(0.11)
1/1994 to	Fed funds	3619	0.85	1.40	1.71	1.85	1.85	1.82	1.68
11/2008			(0.08)	(0.09)	(0.10)	(0.10)	(0.10)	(0.10)	(0.09)
1/2016 to	Fed funds	975	0.98	1.52	1.79	2.01	2.12	2.20	2.23
12/2019			(0.05)	(0.09)	(0.12)	(0.14)	(0.15)	(0.16)	(0.17)

Table 2. Long–Short Regressions Using Futures-Implied Rates, for Scheduled FOMC Meeting Days

The table reports parameter estimates of regressions identical to those described in the notes to Table 1. For this table the samples consist only of days when a scheduled FOMC meeting ends.

Date Range	Short Rate	Obs	Eurodollar Futures Contract						
			Nearest	2nd	3rd	4th	5th	6th	8th
12/1986 to	Nearest	17	-	1.16	1.22	1.20	1.19	1.15	1.18
12/1988	Eurodollar			(0.11)	(0.13)	(0.12)	(0.13)	(0.12)	(0.19)
1/1989 to	Fed funds	24	0.99	1.17	1.06	1.02	1.01	0.91	0.78
12/1991			(0.10)	(0.15)	(0.14)	(0.15)	(0.17)	(0.18)	(0.15)
1/1992 to	Fed funds	16	0.91	1.07	1.16	1.16	1.16	1.10	0.89
12/1993			(0.08)	(0.11)	(0.13)	(0.14)	(0.13)	(0.14)	(0.15)
1/1994 to	Fed funds	119	0.98	0.91	0.83	0.73	0.65	0.58	0.50
11/2008			(0.10)	(0.12)	(0.14)	(0.17)	(0.17)	(0.17)	(0.17)
1/2016 to	Fed funds	32	0.15	0.02	−0.10	−0.06	−0.17	−0.16	−0.22
12/2019			(0.62)	(0.79)	(0.91)	(0.89)	(0.82)	(0.77)	(0.62)

Table 3. Regressions of Daily Changes in Futures Rates on Nonfarm Payroll Surprises

The table reports coefficient estimates of regressions of daily changes in rates implied by futures prices on the surprise component of the nonfarm payroll announcement. Changes are expressed in basis points and the surprise is normalized by its standard deviation. Notes to Table 1 describe the rates in detail. Asymptotic standard errors, adjusted for generalized heteroskedasticity, are in parentheses.

Date		Near-Term	Eurodollar Futures Contract							
Range	Obs	Fed Funds	Nearest	2nd	3rd	4th	5th	6th	8th
12/1986 to	21	-	5.34	6.64	5.99	5.51	5.28	5.08	5.19
12/1988			(1.37)	(1.56)	(1.56)	(1.46)	(1.35)	(1.26)	(1.09)
1/1989 to	30	5.17	8.29	11.95	11.88	10.81	9.31	8.33	7.25
12/1991		(0.87)	(1.36)	(1.96)	(2.19)	(2.20)	(2.03)	(1.85)	(1.65)
1/1992 to	22	1.97	2.70	3.96	5.45	5.90	5.94	5.84	5.06
12/1993		(0.66)	(0.98)	(1.71)	(2.15)	(2.26)	(2.20)	(2.11)	(1.99)
1/1994 to	177	2.20	2.39	5.25	7.03	7.90	8.01	7.82	7.01
11/2008		(0.27)	(0.54)	(0.76)	(0.83)	(0.98)	(1.09)	(1.11)	(1.02)
1/2016 to	48	0.92	1.61	2.43	3.02	3.45	3.66	3.78	4.17
12/2019		(0.36)	(0.49)	(0.75)	(0.94)	(1.05)	(1.18)	(1.28)	(1.41)

Table 4. Sensitivity of Anticipated Inertia to the Business Cycle, 1992–2019

Daily changes in three-month Eurodollar futures rates are regressed on contemporaneous changes in a near-term Fed funds futures rate (ΔFF), the expected five-quarter change in the output gap ($E(\Delta gap)$), and the product of the change in the funds rate and the expected change in the output gap. Section 2.1 defines 'near-term' for this regression. Expected changes in the output gap are the most recent Greenbook forecasts and are demeaned. One quarter separates the expiration dates of adjacent Eurodollar futures contracts. The sample period is January 1992 through December 2019, excluding the zero-lower-bound (ZLB) period of December 2008 through December 2015. One set of regressions uses only days without an FOMC meeting ("all excluded") and another set uses only days with a scheduled FOMC meeting ("only scheduled"). The sets have 5,080 and 167 observations respectively. Asymptotic standard errors, adjusted for generalized heteroskedasticity, are in parentheses. One, two, and three asterisks represent p-values versus zero of 10%, 5%, and 1% respectively.

Futures	Excluding FOMC Meetings			Only Scheduled Meetings		
Contract	$E(\Delta gap)$	ΔFF	Product	$E(\Delta gap)$	ΔFF	Product
Nearest to	−0.10*	0.93***	0.07	−0.07	0.93***	−0.08
Expiration	(0.06)	(0.06)	(0.05)	(0.32)	(0.07)	(0.05)
2nd to	−0.16**	1.55***	0.18***	0.06	0.93***	0.00
Expiration	(0.08)	(0.08)	(0.06)	(0.43)	(0.09)	(0.06)
3rd to	−0.21**	1.94***	0.33***	0.17	0.90***	0.10
Expiration	(0.10)	(0.09)	(0.07)	(0.59)	(0.11)	(0.09)
4th to	−0.24**	2.12***	0.41***	0.49	0.85***	0.19
Expiration	(0.11)	(0.10)	(0.08)	(0.72)	(0.13)	(0.13)
5th to	−0.26**	2.14***	0.43***	0.45	0.79***	0.21*
Expiration	(0.12)	(0.10)	(0.08)	(0.78)	(0.13)	(0.13)
6th to	−0.21*	2.11***	0.44***	0.23	0.73***	0.21
Expiration	(0.13)	(0.10)	(0.08)	(0.77)	(0.13)	(0.14)
8th to	−0.08	1.96***	0.43***	0.15	0.62***	0.19
Expiration	(0.12)	(0.09)	(0.07)	(0.72)	(0.12)	(0.15)

Table 5. Explaining Changes in the Fed Funds Rate with Contemporaneous Innovations in Greenbook Forecasts

Observations correspond to scheduled meetings of the FOMC. The Fed funds rate just after meeting t less the Fed funds rate just prior to meeting $t-1$ is regressed on Greenbook meeting t's forecast innovations in inflation and real GDP growth. The final column's sample excludes the zero-lower-bound period of December 2008 through December 2015. Asymptotic standard errors, in parentheses, are adjusted for generalized heteroskedasticity and one lag of moving-average residuals. One, two, and three asterisks represent p-values versus zero of 10%, 5%, and 1% respectively. The table also reports asymptotic Wald test statistics and p-values that all coefficients on inflation (output growth) are identically zero.

Innovation Type	Forecast Horizon (Q)	1/1969–7/1979 (122 Obs.)	1/1983–12/1991 (72 Obs.)	1/1992–12/2019 (Ex. ZLB, 167 Obs.)
Inflation	0	0.10	0.05	0.02
		(0.13)	(0.09)	(0.10)
Inflation	1	0.14	0.37***	0.26**
		(0.14)	(0.13)	(0.11)
Inflation	2	0.02	−0.06	0.13
		(0.17)	(0.18)	(0.16)
GDP Growth	0	0.18***	0.19**	0.02
		(0.05)	(0.78)	(0.05)
GDP Growth	1	−0.03	0.21**	0.27***
		(0.09)	(0.10)	(0.09)
GDP Growth	2	−0.03	−0.15	0.03
		(0.13)	(0.16)	(0.12)
R^2		0.08	0.31	0.21
Inflation Wald Test		3.22	8.55	9.72
		[0.359]	[0.036]	[0.021]
Output Growth Wald Test		13.05	29.16	16.43
		[0.005]	[0.000]	[0.001]

Table 6. Explaining Changes in Interest Rates with Contemporaneous Greenbook Innovations

Observations correspond to scheduled meetings of the FOMC. Changes in the Fed funds rate, the three-month Treasury bill yield, and the one-year Treasury bond yield are regressed on Greenbook forecast innovations in GDP growth and inflation. Explanatory variables are either innovations to the nowcast, innovations to the one-quarter-ahead forecast, or the average of these innovations. The funds rate and yields are medians of daily rates for the three trading days immediately after the meeting. Rate and yield changes are measured from just prior to meeting $t-1$ to just after meeting t. Standard errors, in parentheses, are adjusted for generalized heteroskedasticity and one lag of moving-average residuals. One, two, and three asterisks represent p-values versus zero of 10%, 5%, and 1% respectively.

Panel A. January 1969–July 1979 (128 Obs.)

Dependent Variable	Innovation Measure Inflation Average	 Growth Nowcast	R^2
Fed Funds	0.23	0.17***	0.07
	(0.14)	(0.05)	
Three Month Yield	0.30**	0.17***	0.09
	(0.14)	(0.05)	
One Year Yield	0.22*	0.19***	0.11
	(0.12)	(0.04)	

Panel B. January 1983–December 1991 (72 Obs.)

Dependent Variable	Innovation Measure 1Q-Ahead Inflation	 Growth Average	R^2
Fed Funds	0.39***	0.37***	0.29
	(0.13)	(0.07)	
Three Month Yield	0.27*	0.46***	0.38
	(0.14)	(0.06)	
One Year Yield	0.25*	0.46***	0.35
	(0.15)	(0.06)	

Continued on next page

Panel C. January 1992–July 2008, Excluding the ZLB Period (167 Obs.)

Dependent Variable	Innovation Measure 1Q-Ahead Inflation	1Q-Ahead Growth	R^2
Fed Funds	0.29***	0.29***	0.21
	(0.09)	(0.07)	
Three Month Yield	0.21**	0.28***	0.24
	(0.10)	(0.06)	
One Year Yield	0.26***	0.25***	0.27
	(0.08)	(0.04)	

Table 7. Instrumental Variables Estimation of a Policy Rule

Observations correspond to scheduled meetings of the FOMC. The Fed funds rate just after meeting t is regressed on Greenbook forecasts of the one-quarter-ahead output gap, one-quarter-ahead inflation, and the lagged Fed funds rate. Instruments are lags zero through two of forecast innovations to the output gap and inflation. The sample is December 1987 through December 2019, excluding the ZLB period from December 2008 through December 2015. The table reports F statistics for the hypothesis that the instruments have no explanatory power for the endogenous regressor. It also reports standard 2SLS parameter estimates and Limited Information Maximum Likelihood (LIML) estimates that are more robust in the presence of weak instruments. Standard errors and test statistics are adjusted for one lag of moving average residuals using Newey and West (1987).

Explanatory Variable	F Stat [p-val]	2SLS (Std Err)	LIML (Std Err)
Expected Output Gap	2.56	0.319	0.431
	[0.021]	(0.190)	(0.742)
Expected Inflation	1.91	0.062	−0.369
	[0.082]	(0.475)	(2.426)
Lagged Funds Rate	0.31	0.511	−0.079
	[0.933]	(0.528)	(18.86)

Inertia in the Fed's Monetary Policy Rule
Internet Appendix

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1 An Example of a Policy Rule

Section 3.1 presents evidence that the model of Section 1.1 is too simple. A single inertial coefficient does not appear to apply to all types of innovations to the Fed's target rate.

A trivial extension adds an entirely transitory innovation to the target rate. This can represent brief changes in the policy rate designed to address specific concerns, such as temporary illiquidity in asset markets. For simplicity, the Fed responds with inertia to a single factor,

$$x_t = \delta x_{t-1} + \eta_{1,t}, \qquad \text{Var}(\eta_{1,t}) = 1.$$

This factor operates at a business-cycle frequency. Another source of news leads the Fed to temporarily change the policy rate. The policy rate function modifies (8) in the text,

$$i_t = (1-\rho)\phi_1 \sum_{k=0}^{\infty} f(k;\rho,\delta)\eta_{1,t-k} + \phi_2\eta_{2,t}, \qquad \text{Var}(\eta_{2,t}) = 1,$$

where the scaling function is defined by (11) in the text.

The functional form for innovations in expected policy rates differs slightly from (12) in the text, because the function for contemporaneous innovations differs from those for expected future innovations. The new form is

$$(E_t - E_{t-1})\, i_{t+j} = \begin{cases} (1-\rho)\phi_1\eta_{1,t} + \phi_2\eta_{2,t}, & j = 0; \\ (1-\rho)\phi_1 f(j;\rho,\delta)\eta_{1,t}, & j > 0. \end{cases}$$

Then the regression

$$(E_t - E_{t-1})\, i_{t+j} = \beta_j\,(E_t - E_{t-1})\, i_t + e_{j,t}$$

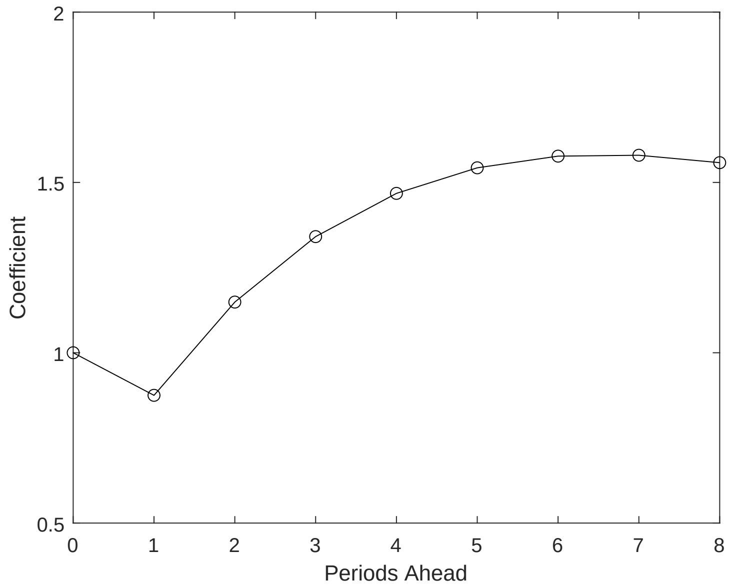

Figure IA1. Model-implied sensitivity of the k-ahead policy rate to a target innovation.

has population regression coefficients

$$\beta_j = \begin{cases} 1, & j = 0; \\ \frac{(1-\rho)^2\phi_1^2 f(j;\rho,\delta)}{(1-\rho)^2\phi_1^2+\phi_2^2}, & j > 0. \end{cases}$$

I illustrate how this model extension can generate patterns of regression coefficients that differ from those displayed in the text's Figure 2. The parameters are $\delta = 0.9$, $\rho = 0.85$, $\phi_1 = 1$, and $\phi_2 = 0.15$. Figure IA1 plots regression coefficients for this set of parameters.

2 Examining a Regression in Coibion and Gorodnichenko (2012)

Coibion and Gorodnichenko (2012) report second-stage results of IV estimation of the Federal funds rate on expected inflation, the expected output gap, expected real output growth, and the lagged funds rate. Column (2) of their Table 5 contains the estimates.

Using the data posted by the authors on the journal's website I calculate statistics for the first-stage regressions, as well as the Cragg-Donald test statistic for weak instruments. The main text reports the Cragg-Donald test. I also calculate the second-stage regression coefficients using standard 2SLS, which are identical to those in the original article. The standard errors I report differ slightly from those in the original article because I use a different Newey and West (1987) lag length for moving-average residuals. Finally, I report Limited Information Maximum Likelihood parameter estimates. All of these results are displayed in Table IA1.

Table IA1. Revisiting a Regression in Coibion and Gorodnichenko (2012)

This table reproduces and extends Table 5, Column (2), in Coibion and Gorodnichenko (2012). At the quarterly frequency, the Fed funds rate is regressed on the Greenbook inflation forecast, the output gap nowcast, the real output growth nowcast, and the lagged Fed funds rate. The instruments are lags zero through two of five types of fundamental shocks. The table reports F statistics for the hypothesis that the instruments have no explanatory power for the endogenous regressor. It also reports standard 2SLS parameter estimates, identical to those in Coibion and Gorodnichenko (2012), and Limited Information Maximum Likelihood (LIML) estimates that are more robust in the presence of weak instruments. Standard errors and test statistics are adjusted for one lag of moving average residuals using Newey and West (1987). There are 77 observations from 1987Q4 through 2006Q4.

Explanatory Variable	F Stat [p-val]	2SLS (Std Err)	LIML (Std Err)
Expected Inflation	2.97	0.600	3.010
	[0.001]	(0.180)	(127.8)
Expected Output Gap	0.70	0.176	3.0
	[0.778]	(0.115)	(153.9)
Expected Real Growth	2.13	0.274	−0.7
	[0.020]	(0.060)	(54.7)
Lagged Funds Rate	1.20	0.790	−1.2
	[0.299]	(0.131)	(108.8)

3 Evidence From Transcripts, Speeches, and Fed Staff Documents

This subsection uses transcripts of FOMC meetings, testimony by Chairman Greenspan to congressional committees, and Fed staff reports to characterize Chairman Greenspan's views about the economic weakness from 1990 to 1992.

3.1 Inertia or serially correlated shocks?

The NBER Business Cycle Dating Committee identifies July 1990 as a cycle peak, when the Fed funds rate is 8%. Greenspan states at the October 1990 FOMC meeting

> I still think we're in a situation in which there are forecasts of thunderstorms and everyone is saying well the thunder has occurred and the lightening has occurred and it's raining, but nobody has stuck his hand out the window. And at the moment it isn't raining. (p. 43)

Eventually the Fed begins to reduce the funds rate in repeated 25 b.p. increments. This pattern is largely a consequence of the operating procedures at the time. Rather than changing rates only at scheduled meetings, the FOMC routinely held conference calls whenever Greenspan decided that new information required a discussion about changing the funds rate. In addition, the FOMC occasionally gave the Open Markets Desk contingent directives, authorizing the Desk to change the funds rate between meetings if certain conditions were satisfied. For example, at the meeting where Greenspan does not detect rain, the FOMC directed the Desk to lower the funds rate from 8% to 7.75% if and when a 'meaningful' Federal budget agreement passes Congress. The Desk implemented the reduction four weeks after receiving the directive.

At the next FOMC meeting in November 1990, Greenspan recognizes ongoing economic weakness that justifies cutting the funds rate. He also notes that expectations of substantial inflation are no longer showing up in growth, which he interprets as evidence that the Fed's anti-inflation credibility is growing. He highlights a tradeoff between cutting rates as much as weak economic conditions suggest and avoiding cutting rates to solidify the Fed's anti-inflation credibility:

> The one great advantage that we have in all of this I think is that slowing inflation is now finally becoming credible. Certainly, the employment cost index was a very important indicator, and even now there's a lot of question about the zero average hourly earnings number that we saw in the October release. It is all consistent with a significant slowing down, which I think is beginning to show up in the underlying price data. . . . While it's still premature, and indeed I think it's potentially dangerously premature, to assume that we have it beaten, I think that for the first time there are hard numbers that suggest there's something going on . . .
>
> Under those conditions, it's very clear to me that if we are perceived as responding excessively easily to all of the other signs that would induce central bank ease, that the risks of the system cracking on us are much too dangerous. I think we have to be awfully careful. Nonetheless, I don't think that we have the choice at this stage of not trying to ease into the markets, being fully aware that at the first sign that we get of negative response we're going to have to stop. I don't know whether or not we can do more than a 1/4 point over the next several months. I would say the economy and M2 and the financial markets require it, but we may not have the choice. . . . And I would say that at this moment, if we had a money supply that was going up around 5 percent, I would be very concerned about moving in the direction of ease even in this context of weakness. But with the money supply doing what it's doing and the evidence of the continuous contraction that is going on, I would opt to ease 25 basis points right now and stay asymmetric [toward ease] with the understanding that only if the situation continues to worsen and is manifested in the credit aggregates in one form or another should we move again. But if there is any evidence of significant weakness in the dollar, I think we will have to pull back and harbor the thought; it's not inconceivable to me that at some point if we overdo it, we will have to move back up. Anyway, I would propose that as sort of the "least-worst" policy alternative that I can conceive of at the moment. In summary, it's essentially for us to go down 25 basis points and stay asymmetric and watch the system as closely as we can. (pp. 41-42)

In December 1990, Greenspan again recommends at 25 b.p. reduction in the Fed funds rate, highlighting the same tradeoff. Weak economic conditions call for even greater easing, but the risk of triggering inflation is too high.

> . . . we have severe recessionary pressures. But recessions always end. . . . At some point we are going to come out of this and we want to make reasonably certain

> that when we do we're not looking at a degree of liquidity in the system that brings with it [higher] inflation rates and the next downturn much more quickly than is usual. So, I think that it's apparent that we have a fairly difficult next six months ahead. I don't think there's any particular short-term policy uncertainty. My judgment and what I hear as the general consensus around here, if I read it correctly, is that the money supply has become extraordinarily restricted and that we're looking at what is a very major credit contraction. The fact that the prime rate hasn't moved is an indication of the extent of that. And I think there is an inclination to ease up a bit further here. I'm becoming more convinced as the days go by that, while the optimum policy would be to somehow bring the funds rate down and [to generate] the associated credit with it until we get the economy in somewhat of a balanced growth position at which point [short-term rates] could stay down, the chances of being able to implement that are becoming increasingly small. It's just not credible that a central bank can't print money; and the more we try to print it, in figurative terms, the more likely it is that at some point we'll succeed beyond our wildest dreams. And while I would argue strongly that we have to get some downside policy cushion here, namely to make certain that we supply adequate credit into the system, I think we also have to be prepared for the fact that we may, and probably will, overdo it. At some point the equations will come out right and we are going to be required to start pulling back, probably earlier than we might be desirous of doing so. So, I would not at this particular stage leave out the possibility that we may overdo it, but I would not be overly concerned about that provided we are aware sufficiently in advance that that's what's happening. (p. 34)

Through early 1991, Greenspan views each reduction in the funds rate as perhaps the final cut in the cycle. For example, at the March 1991 FOMC meeting the funds rate is 6%. Greenspan anticipates an upturn, although he recognizes that a deepening recession will require further rate cuts:

> By far the highest probability at this stage seems to be that the healing process that we've been observing in recent weeks will continue and will gradually lead into a bottoming out and an economic upturn. ... That leads me to the second probability ... in which we could see a failure of the recovery to take hold, continued pressures on profit margins, business confidence falling, and finally a real dive in capital appropriations, which we haven't seen. And that would induce a secondary phase of the recession, which would deepen rather considerably. The probability of that is at this stage still rather moderate to small, but in my judgment non-negligible. I think that leads us then to a policy stance that really gets

> to this point: If the economy is healing and recovering, then certainly no further easing is required at this stage; but if we get a cumulative erosion, which leads to clear evidence that the capital goods markets are beginning to cave, then I think the proper action is probably a significant drop in the discount rate. (p. 41)

The NBER Dating Committee will eventually determine May is the trough of the recession. In August 1991, when the rate is 5.5%, Greenspan sees no need to lower the funds rate, arguing that the anecdotal evidence the FOMC receives is wrong:

> . . . one of the problems I think we're having is that when a recession is over, by definition, the economy is at the lowest point in a cycle and it feels awful. The anecdotal reports we're getting from a lot of people are a reflection of the fact that the levels of orders, activity, etc. are exceptionally low. It's very interesting to get a sense [of the views] in the political realm; there is a confusion as to whether "the recession ends" means the receding has come to an end or that the economy is back up to normal. I think the overwhelming evidence is that it's the latter [view] that we run into. . . . there is clearly no policy purpose that I can see in moving rates lower immediately . . . (pp. 36-37)

However, the recovery remains historically weak. The Greenbook prepared for the December 1991 meeting summarizes recent economic activity and the staff forecast:

> The information received since the last meeting of the FOMC suggests that economic activity leveled off during the summer and may well be slipping lower at present. Employment fell across a broad front last month, and industrial production appears to have dropped noticeably after three months of little change. The staff expects real gross domestic product (GDP) to be essentially flat in the current quarter and to decline somewhat in the first quarter of next year. (p. I-1)

The Fed continues to periodically cut the funds rate. The Greenbook prepared for the August 1992 meeting states "Data received after the last FOMC meeting revealed that the economy entered the summer with even less forward momentum than the staff had thought." (p. I-1).

3.2 Explaining the recession and weak recovery

When Greenspan recognizes the recession in late 1990, he interprets it as a standard credit crunch. Financial intermediaries cut back their lending to borrowers who previously were viewed as creditworthy. At the November 1990 FOMC meeting he states

> What we have basically is old-fashioned disintermediation; that is, it is not that the net underlying credit demands that finance the GNP are collapsing; they seem to be going up slower than they were but we sure enough seem to be seeing that the intermediation system–not only depository institutions but insurance companies, finance companies, and everybody else–seems to be pulling back. And what we are getting is the obvious tightness, which I think clearly is the major factor in a contraction of M2 and which is only one side of the depository institutions' balance sheets. You can basically see the thing squeezing down as we get loan officers pulling back.

To emphasize, at this point Greenspan sees weakness in loan supply but not loan demand. At the next FOMC meeting in December 1990, he reiterates this view:

> This is in a sense a balance sheet suppression, the type we've all been mentioning. It's really quite interesting to see the process, which is essentially one in which values continue to be under significant pressure. . . . So, overall what is occurring, as a number of you have said and one can sense it, is that the fear [felt by] banks and the fear of getting involved in the intermediation process are really putting a big suppression on things.

In his July 1991 Congressional testimony, he interprets the recession in the same way:[15]

> Going forward, we likely will see a continuation of the "credit correction" now under way. One aspect of this correction is the increased attention paid by regulators and the financial markets to the capital positions of financial intermediaries. The more prudent approach to capitalization and lending decisions is overwhelmingly a healthy development that ultimately will result in strengthened balance

[15]Testimony before the Subcommittee on Domestic Monetary Policy of the Committee on Banking, Finance, and Urban Affairs, July 16 1991.

> sheets for the nation's financial institutions and more assurance of stability of the financial system. In certain areas, however, the credit retrenchment appears to have gone beyond a point of sensible balance. In some cases, lender attitudes and actions have been characterized by excessive caution. As a result, there doubtless are creditworthy borrowers that are unable to access credit on reasonable terms. ... While a single bank may be able to do this without too much trouble, when the entire industry is trying to make the same balance sheet adjustment, it simply cannot be done without massive untoward effects.

By mid-1992, Greenspan expresses substantial concern that he might be wrong about the underlying sources of economic sluggishness. At this point he begins to focus on the role of asset prices, bubbles, and the balance sheets of households and firms. At the June 30/July 1 1992 FOMC meeting he says

> We are having a significant expansion in operating profit margins, cash flow in the corporate sector is improving, and we are beginning to see it in the capital goods markets. History tells us that that process will feed in through the increased incomes and employment that a number of people are looking for. ... Were that in fact the case, it's pretty obvious at this stage that where we are with monetary policy is probably where we ought to stay because there is no obvious need to move [rates] lower; in fact one can argue that it may be counterproductive in that context for us to move lower.
>
> There is, however, the other model which is evolving over time, which I would hate to be required to put into structural form and try to estimate its parameters. In fact, I'd even prefer not to put it down in writing because it might get too clear! I'm not being facetious. There is a sense that what we're looking at really gets to [such] a set of relationships here. Let me try it out and see where I get because I think it would explain what the phenomenon is and would suggest to us what to look for to test whether the hypothesis is working. I start with something we've discussed before: namely, to explain the nature of the balance sheet restraint that resulted from a significant rise in assets during the 1980s, funded by debt, and a subsequent decline in market values of assets which created balance sheet impairment. The balance sheet impairment [leads] individuals and businesses to move their cash flow from the purchase of goods and services and investment goods toward debt reduction or other balance sheet repairs, essentially shifting the consumption function in a manner to generate a much higher saving rate and basically a pulling back on investment incentives in the business sector. Now, that is a phenomenon we have seen many times in the past–it's called [the panics

> of] 1873, 1893, 1907. . . . It's the classic balance sheet/market value crunch which induces a very significant liquidity freeze-up in the banking system and induces a tremendous shift of cash flow toward savings rather than to the purchase of goods and services. And you get the classic Keynesian contraction at that time. (p. 65)

3.3 Ex-post inertia

Greenspan's new view implies that weak economic conditions continue until firms and households rebuild their balance sheets. In his view, the amount of time this restructuring takes depends on monetary policy. Greenspan continues his statement at the June/July 1992 FOMC meeting:

> It strikes me that what we effectively have been doing since 1989, I hope more consciously than otherwise, is to take the same adjustment process–which in the 19th century would have meant that the economy would have gone down sharply, the balance sheets would have been repaired reasonably quickly, and [the economy] would have come back the usual way–and by injecting significant and continuous amounts of liquidity into the system, we in effect have prevented the liquidity freeze-up and have stretched out the adjustment process. The question, of course, is whether there is more adjustment that has to be done this way or less. Or do we know? I suspect that at this point we don't really know. But I do think this explains, or can explain, what basically has been happening in the last two years. When we continue to inject liquidity in the system, the adjustment process takes place; and when we stop injecting liquidity, after a while the economy begins to show symptoms of weakness again. That is another way of saying that the unmedicated economy goes back to the way it used to behave in the 19th century and it begins to get the [liquidity] freeze-up until we re-inject even small amounts of liquidity and the adjustment process continues.

In this statement Greenspan begins to reinterpret the gradual reduction in the Fed funds rate during the previous two years as an optimal planned response to the particular economic conditions. He expands on this argument early in 1993 through congressional testimony. The slow adjustment kept inflation expectation from rising, leading to a reduction in long-term rates, thus lowering debt costs for firms and households. Lowered debt costs facilitated their debt restructuring. From his testimony in February 1993:[16]

> The halting, but substantial, declines in intermediate- and long-term interest rates that have occurred over the past few years have been the single most important factor encouraging balance sheet restructuring by households and firms and fostering the very significant reductions in debt service burdens. And monetary policy has played a crucial role in facilitating balance sheet adjustments–and thus enhancing the sustainability of the expansion–by easing in measured steps, gradually convincing investors that inflation was likely to remain subdued and fostering the decline in longer-term interest rates. (pp. 6-7)

In the same testimony he defends the gradual policy the Fed followed from 1990 through 1992 as optimal:

> Some have suggested that the decline in inflation permitted more aggressive moves and, had the downward trajectory of short-term interest rates been a bit steeper, that aggregate demand would have been appreciably stronger. I question that as well. Basing this argument on the lower inflation that has occurred is a *non sequitur*, the disinflation very likely would not have occurred in the context of an appreciably more stimulative policy, and such a policy could have led to higher inflation in the next few years. Moreover, such a policy would not have dealt fundamentally with the very real imbalances in our economy that needed to be resolved before sustainable growth could resume. And it would have run the risk of aborting the process of balance sheet adjustment before it was completed. The credibility of noninflationary policies would have been strained, and longer-term interest rates likely would be higher, inhibiting the restructuring of balance sheets and reducing the odds on sustainable growth. (p. 8)

3.4 1994 and beyond

The FOMC raises the funds rate at the end of the February 1994 meeting. Greenspan asks that the members who want a 50 b.p. increase to instead accept a 25 b.p. increase. He states

[16]Testimony before the Subcommittee on Economic Growth and Credit Formation of the Committee on Banking, Finance, and Urban Affairs, February 23 1993.

> You know, I rarely feel strongly about an issue, and I very rarely sort of press this Committee. But let me tell you something about what's gnawing at me here . . . I would be very concerned if this Committee went 50 basis points now because I don't think the markets expect it. You want to hit a market when it needs to be hit; there is no significant evidence at this stage of imbalances that require the type of action that a number of us have discussed. Were we to go the 50 basis points with the announcement effect and the shock effect, I am telling you that these markets will not hold still . . . I am telling you—and I've seen these markets—this is not the time to do this. . . . I do request that we be willing to move again fairly soon, and maybe in larger increments; that depends on how things are evolving. (p. 55)

At the same meeting he asks to make a public announcement of the decision.

> I am particularly concerned that if we choose to move tomorrow, we make certain that there is no ambiguity about our move . . . I'm very strongly inclined to make it clear that we are doing this but to find a way to do it that does not set a precedent . . . I would very much like to have the permission of the Committee to announce that we're doing it and to state that the announcement is an extraordinary event. (p. 29)

At the next FOMC meeting on March 22 1994, Greenspan explains his reasoning in more detail. Market participants do not anticipate an immediate large increase in the funds rate. Therefore such an increase has two damaging effects. First, the news hits asset prices, destabilizing markets. Second, the news creates uncertainty about the Fed's policy rule. He states in March 1994:

> I think we have to restore policy to neutrality as fast as we can. . . . If we were dealing strictly with the economic outlook as it stands now, there is no doubt in my mind that this economy could absorb a very large increase in interest rates without a problem. The difficulty I have is that I don't think the financial system can take a very large increase without a break in its tensile strength– which we strained significantly the last time but did not break. . . . there is another characteristic as well. One of the elements that I think we have all been observing with respect to the markets . . . is that when we were perceived as moving on the basis of economic data, the markets had a certain sense of what it was we were doing. . . . Now they are worried that they don't know when we

> are going to move, so we have this Sword of Damocles hanging over the market. They don't know whether we are going to move in 2 days, 5 days, or 12 days; they have no basis to judge and they are understandably nervous. (pp. 43-44)

He continues by describing how his preferred change in the funds rate will lead to further changes that are consistent with market expectations:

> A 50 basis point increase would move the funds rate to 3-3/4 percent. In my judgment that would not be perceived of as neutrality or where we ultimately have to be. My own view is that eventually we have to be at 4 to 4-1/2 percent. The question is not whether, but when. If we were to move 50 basis points, I think we would create far more instability than we realize, largely because a half point is not enough to remove the question of where we ultimately are going. I think there is a certain advantage in doing 25 basis points because the markets, having seen two moves in a row of 25 basis points at a meeting, will tend almost surely to expect that the next move will be at the next meeting—or at least I think the probability of that occurring is probably higher than 50/50. If that is the case and the markets perceive that—and they perceive we are going to 4 percent by midyear, moving only at meetings—then we have effectively removed the Damocles Sword because our action becomes predictable with respect to timing as well as with respect to dimension. My own impression, if we decide to move in that direction, is that the last move we might want to make—say, for example, the funds rate was at 3-3/4 percent and we decided 4-1/4 percent might be neutrality—is that perhaps we should add 50 basis points at that point. That would ring the gong as the end and we could in effect withdraw from the race . . . (p. 44)

The logic behind avoiding surprises relies, in part, on Greenspan's view that balance-sheet restructuring by firms and households was central to the economic weakness of 1990–1992. Thus it is worth noting that years later Greenspan (2004) returns to his original view that financial disintermediation was the culprit:

> However, the recovery also was more modest than usual, in large measure because of the notable financial "headwinds" that confronted businesses. Those headwinds were primarily generated by the constriction of credit in response to major losses at banks, associated with real-estate and foreign lending, coupled with a crisis in the savings and loan industry that had its origins in a serious maturity

mismatch as interest rates rose. With their access to managed funds threatened and the quality of their loan portfolio–and hence their capital–uncertain, these depositories were most reluctant to lend.

Policy eased gradually but persistently to counter the effects of these developments, with the funds rate falling to 3 percent by September 1992, its lowest level since the early 1960s. The uptilt to the term structure of interest rates in a generally low interest rate environment restored bank profitability and, eventually, bank capital. The credit crunch slowly lifted. (p. 34)