Policymakers' Uncertainty

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Uncertainty is a ubiquitous concern emphasized by policy-makers. We study how uncertainty affects decision-making by the Federal Open Market Committee (FOMC). We distinguish between the notion of the Fed-driven uncertainty that is induced by the policy choice and the classic notion of uncertainty that emanates from within the economy and which the Fed takes as given. A simple theoretical framework illustrates how the Fed-driven uncertainty introduces a wedge between the standard Taylor-type policy rule and the optimal decision. Using internal Fed deliberations, we provide the first quantification of the types of uncertainty that the Fed perceives and their effects on the policy stance. The FOMC members' uncertainty about inflation strongly predicts a more hawkish policy stance that is not explained either by the internal Fed's forecasts or by the measures of public uncertainty. In contrast, policymakers' uncertainty about growth has no impact on policy decisions beyond these standard controls. Consistent with a model of inflation scares, policymakers' inflation uncertainty reflects their constant worries about losing the nominal anchor. We argue that the desire to maintain inflation credibility is an important driver of the FOMC's decisions and provide evidence from the FOMC transcripts consistent with this channel.

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I. Introduction

Alan Greenspan famously said, "(...) uncertainty is not just a pervasive feature of the monetary policy landscape; it is the defining characteristic of that landscape" (Greenspan, 2004). Yet, despite the ubiquitous emphasis on uncertainty in central bankers' speeches and statements, we know little about how policymakers' uncertainty and, more broadly, their beliefs about higher-order moments of economic outcomes affect policy decisions. In this paper, we evaluate how uncertainty affects policy in the context of the decision-making by the Federal Open Market Committee (FOMC). To do so, we overcome important theoretical and empirical challenges.

Theoretically, the effect of uncertainty on monetary policy is ambiguous. In a frequently-quoted result, Brainard (1967) postulated that policymakers should adopt a more conservative stance when faced with uncertainty. However, the theoretical predictions are highly model-specific: depending on the assumptions about the structure of the economy and policymakers' preferences, uncertainty can induce a more or less aggressive optimal policy response or no response at all.

We introduce a framework in which we assume that policymakers know their objective function,[2] but they face two broad types of uncertainty that impact policy. The first, which we refer to as Fed-driven uncertainty, is the uncertainty about the variables that the Fed targets, such as output and inflation, that is induced by the policy choice itself. While many existing models of monetary policy under uncertainty implicitly capture this channel, the ambiguous predictions from this literature are easy to explain in our framework based on the way in which policy affects the degree of uncertainty. One important example of the Fed-driven uncertainty relates to the Fed's concern about low-probability but costly outcomes, where the probability of those outcomes depends on the policy choice. We argue that policymakers are particularly worried about the risk of losing their hard-earned credibility if they do not take a strong enough stance on inflation. We then empirically show that the Fed-driven uncertainty of this kind has been a hallmark of the Fed's decision making since the 1980s.

The second type of uncertainty emanates from the uncertainty inherent in the economy or financial markets, but importantly, it is not affected directly by the policy choice. Instead, this channel operates *through* the level of target variables and policy reacts to it only because of its impact on the variables that the Fed cares about.

[2]This is consistent with Williams (2019): "I wish I could now tell you with certainty what will happen to the economy, but anyone who promises they can see into the future is a charlatan. However, what I can do is provide you with some insight into how I assess the health of the economy and what that means for my view on the monetary policy decisions before us."

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Motivated by this framework, we then provide the first set of empirical results on how, if at all, the different uncertainty types affect the Fed's behavior. The challenges to answering this question pertain to both measuring policymakers' perceptions of uncertainty and disentangling their effect from other confounders, most importantly, the first-moment beliefs about the state of the economy. Our empirical approach relies on analyzing the deliberations of the FOMC recorded in the transcripts of the scheduled FOMC meetings between 1987 and 2015. Given the wealth of information that is available, the FOMC setting is well-suited to study the impact of uncertainty on decision-making. At each meeting, we observe nearly verbatim statements by individual FOMC members and the Federal Reserve Board staff.

The richness of this information allows us to construct the three kinds of measures to describe the policymaking process. First, and most important for our analysis, we generate textual measures of FOMC policymakers' perceived uncertainty (PMU, for short) distinguishing uncertainty about inflation and real economy (as well as financial markets). For a precise attribution, we develop a set of algorithms that match uncertainty phrases with topic-specific phrases at a sentence level. Second, we construct measures of FOMC members' sentiment capturing their directional views on the real economy and inflation. Third, to analyze the effects on policy, we develop a new textual measure of the policy stance based on the balance of hawkish and dovish language—the hawk-dove score—of the FOMC members. This approach allows us to span the entire 1987–2015 sample, including the zero-lower-bound period.[3] In addition, through the Greenbook (now Tealbook) forecasts prepared by the staff prior to each meeting, we also gain access to the baseline macroeconomic projections that policymakers are equipped with before they enter the meeting.

We exploit the typical structure of the FOMC meetings to derive the above measures. With minor exceptions, the meetings during our sample are comprised of two key monetary policy rounds, each serving different objectives. In the first round, which we refer to as the economy round, policymakers discuss the economic and financial market developments and the baseline outlook. This step lays the foundation for the second round—the policy round—which contains discussions about the appropriate policy choice and during which the policy decision takes place. We thus study how uncertainty and sentiment manifest in the economy round affect stance communicated in the policy round.

With the measures of the policymakers' beliefs and their policy stance, we provide new insights about the drivers of the decision-making at the FOMC. We find that uncertainty in the economy round of the meetings predicts policy stance even when controlling for the

[3]We document that the hawk-dove score varies in an intuitive way and is a highly significant predictor of the federal funds rate (FFR) target. Importantly, its predictive power for the FFR is not subsumed by the Greenbook forecasts that are usually included in estimated Taylor rules, which implies that the policy stance derived from the text reflects in large part deviations from the rule.

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Greenbook forecasts and other public uncertainty measures such as VIX or economic policy uncertainty index of Baker et al. (2016).

The key new insights stem from our ability to distinguish between the types of uncertainty, which we show to have distinct effects on policy. A higher real-economy and financial markets PMU predict a looser policy stance. To the extent that this type of uncertainty influences the economy akin to a negative demand shock, our result is broadly consistent with the standard real-options channel of uncertainty (e.g., Bloom, 2009). However, because the effect is generally subsumed by the Greenbook controls and public uncertainty measures, it also indicates that the staff forecasts largely incorporate the impact of this type of uncertainty on the economy and inflation.

By contrast, higher inflation PMU predicts a more hawkish policy stance, and its effect remains robust to controlling for a variety of plausible confounding factors. This finding suggests a new separate channel at work that has not been widely discussed in the recent literature: The FOMC members' desire to maintain credibility for inflation control is an important driver of the FOMC's decisions. To explore this idea further, we document that in our sample inflation PMU tends to comove more closely with perceptions of rising inflation (there are only a few instances of perceived inflation declines). Consistent with credibility concerns introducing a wedge between objective and policymakers' perceived uncertainty, we then show that the FOMC members' inflation PMU is distinct from that of the Fed staff, and the effect of inflation PMU on policy stance is entirely driven by the FOMC members. However, given that neither inflation sentiment nor PMU predict future inflation outcomes, policymakers' inflation beliefs in the meeting are an expression of worry that does not materialize in the sample we study. We present narrative evidence from the transcripts' language consistent with this channel.

The issue of central bank efforts to maintain credibility is timely. Powell (2022), giving the remarks to open the 2022 Jackson Hole Symposium, spoke forcefully about the Fed's focus and determination for inflation control. Earlier, Goodfriend (1993) emphasized the role of "the acquisition and maintenance of credibility for its commitment to low inflation" during the Volcker and the early Greenspan Fed. This concern with credibility is warranted. Indeed, credibility allows the FOMC to better manage economic expectations, as "achieving through word and deed" well-anchored inflation expectations can lead to better policy outcomes (Bernanke, 2022).

Therefore, our finding that the Fed-driven inflation uncertainty affects policy on the basis of credibility concerns has important implications for how we model monetary policy decisions. Many standard New Keynesian models assume full information and rational expectations and are solved under the assumption that the central bank can, and must, commit to its

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policy reaction function. In such models, credibility is established by the once-and-for-all announcement of the reaction function. This contrasts with the assumption of period-by-period discretion. Our results suggest the need for considering the central bank's fighting continually over time to establish credibility, and then using it to counter recessions when faced with adverse shocks as in some recent literature.

Bianchi and Melosi (2018) study constrained discretion in monetary policy in which the central bank is able to deviate from active inflation stabilisation temporarily but at the cost of unanchoring inflation expectations. Carvalho et al. (2022) and Gáti (2022) find that optimal policy responds aggressively to movements in the long-run inflation expectations. Our findings suggest that, over the 1987–2015 sample, the FOMC has been preemptively aggressive to prevent the *feared* changes in inflation expectations.

Our results also have implications for empirical analysis of monetary policy. In particular, the assumption of stable reaction functions seems unlikely. Clarida et al. (2000) estimated monetary policy reaction functions for the US before and after Volcker's tenure, concluding that the Fed was much more sensitive to expected inflation in the post-Volcker era. Our findings suggest that the FOMC's concerns about credibility lead it to endogenously vary its degree of hawkishness.

The remainder of the paper proceeds as follows. In Section II, we lay out the different theoretical channels proposed in the literature through which uncertainty can affect monetary policy and illustrate the effects of uncertainty on policy in a simple framework. In Section III, we discuss our empirical strategy, the measurement of policymakers' uncertainty via the PMU indices, sentiment and policy stance from FOMC transcripts. In Section IV, we analyze the effect of uncertainty on policy stance. In Section V, we relate these findings to the narrative evidence on policymakers' concern with credibility. Section VI concludes.

II. Uncertainty and Optimal Monetary Policy

II.A. A simple static policy choice framework

To clarify the impact that uncertainty can have on monetary policy choices, we introduce a simple static framework capturing the decision problem of the policymaker. Assume that the policymaker has a standard quadratic loss function over deviations of inflation from target and the output gap:

$$L(\pi, y) = (\tilde{\pi}_i)^2 + \lambda (\tilde{y}_i)^2, \tag{1}$$

where $\tilde{\pi}_i = \pi_i - \pi^*$, $\tilde{y}_i = y_i - y^*$, π^* is the inflation target and y^* is the medium-term potential output. The subscript i indicates that economic outcomes depend on the policy.

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The policymaker chooses an interest rate $r \in -1, 0, +1$ to minimize expected losses.[4] Let $r_0 (\equiv r = 0)$ denote the interest rate choice corresponding to the baseline economic outlook (such as Alternative B in the Bluebook / Tealbook); $r_{-1} (\equiv r = -1)$ corresponds to policy easing relative to the baseline (Alternative A) and $r_1 (\equiv r = 1)$ to a tightening (Alternative C). One can think about the typical choice between the levels of the nominal interest rate, but more broadly, the decision could involve quantitative easing or tightening, or a change in the communication via the forward guidance.

The policymaker perceives that the economic outcomes are uncertain, so that $\tilde{\pi} \sim G_\pi$ and $\tilde{y} \sim G_y$. We assume the distributions G are unimodal with finite variance. Let $\overline{x}_i$, $\hat{x}_i$, $\sigma^2_{x,i}$ denote the mean, mode, and variance of the distribution of outcome variable $x \in \{\tilde{\pi}, \tilde{y}\}$ under interest rate $r_i \in \{-1, 0, +1\}$.

Under higher (lower) interest rates, both inflation and output are lower (higher). As a simple benchmark, we assume that the effect of tightening and loosening on inflation and output is symmetric and known; we model these impacts as linear given by δ and ϕ, respectively, i.e, $(\overline{\pi}_1, \overline{y}_1) = (\overline{\pi}_0 - \delta, \overline{y}_0 - \phi)$ and $(\overline{\pi}_{-1}, \overline{y}_{-1}) = (\overline{\pi}_0 + \delta, \overline{y}_0 + \phi)$. We also explore scenarios where parameters ϕ, δ are unknown.

Importantly, we allow for the possibility that uncertainty itself is policy induced, which we refer to as Fed-driven uncertainty. We suppose that there exists a baseline uncertainty about variable x given by σ^2_x, as well as a component driven by the policy choice i, $\Delta\sigma^2_{x,i}$. The overall uncertainty is then the policy-specific combination, $\sigma^2_{x,i} = \sigma^2_x + \Delta\sigma^2_{x,i}$. We assume $\Delta\sigma^2_{x,0} = 0$, so that baseline uncertainty is associated with r_0 ($\sigma^2_{x,0} = \sigma^2_x$).

As is standard in these environments, decisions depend on minimizing expected losses. Let $\overline{L}_i$ be the expected loss from choosing r_i. The decision to tighten monetary policy follows if $\overline{L}_1 < \overline{L}_0$ which is given by:[5]

$$\overline{L}_1 < \overline{L}_0 : \delta\overline{\pi}_0 + \lambda\phi\overline{y}_0 > \frac{\delta^2 + \lambda\phi^2}{2} + \frac{\overbrace{(\sigma^2_{\pi,1} - \sigma^2_{\pi,0})}^{\equiv \Delta\sigma^2_{\pi,1}} + \lambda \overbrace{(\sigma^2_{y,1} - \sigma^2_{y,0})}^{\equiv \Delta\sigma^2_{y,1}}}{2} \tag{2}$$

Intuitively, equation (2) represents the "burden of proof" policymakers require to raise rates. When the linear combination of the mean deviation of inflation from target and the deviation of output from its potential under the accommodative policy r_0 is sufficiently high, the

[4] It is often the case that policy decisions amount to a comparison of two plausible options (Hansen and McMahon, 2015), but it is also plausible that a comprehensive policymaker would cycle through alternatives comparing losses until the lowest possible loss is achieved.

[5] A decision to loosen is given by $\overline{L}_{-1} < \overline{L}_0$ and the condition is similar to Equation (2) except the economic conditions term on the left hand side are multiplied by -1 and the extra variance terms compare the choice of r_{-1} relative to r_0 ($\Delta\sigma^2_{x,-1}$).

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policymaker will choose to tighten, r_1. Equation (2) clarifies that tighter policy becomes more likely when inflation and output are further above their reference values. The $\Delta\sigma^2_{x,1}$ terms measure the extra variance of variable x under r_1 relative to r_0. Therefore, given our assumption on the baseline uncertainty, $\Delta\sigma^2_{x,1}$ essentially shifts the burden of proof required to tighten the policy.

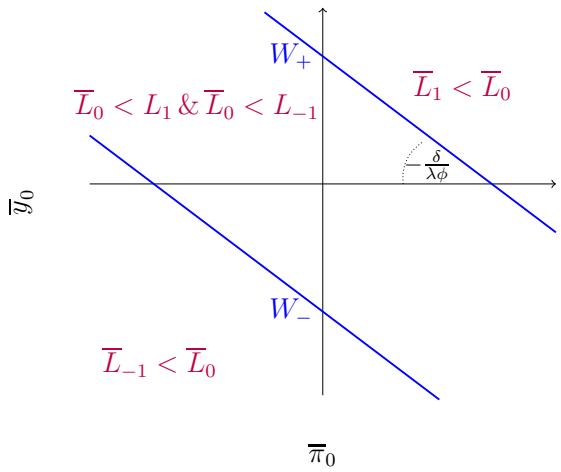

Figure 1. No Fed-driven uncertainty. This figure presents the decision boundaries for a policymaker when the mean forecast is $\overline{\pi}_0$ and $\overline{y}_0$. The figure is drawn for $\Delta\sigma^2_{\pi,i} = \Delta\sigma^2_{y,i} = 0$.

Figure 1 depicts the decision rule for both tightening and loosening using indifference curves. The slope of the decision boundary is determined by the relative sensitivity of output and inflation to the alternative interest rate, as well as the weight λ that the policymaker attaches to output.[6] The curves trace out combinations of mean inflation and output for which $\Delta\sigma^2_{\pi,1}$, $\Delta\sigma^2_{y,1}$, $\Delta\sigma^2_{\pi,-1}$, and $\Delta\sigma^2_{y,-1}$ are all zero. Points to the northeast of the upper line (intercept is $W_+ \equiv \frac{\delta^2+\lambda\phi^2}{2}$) represent combinations of inflation and output deviations under the baseline such that the policymaker will choose r_1. Points to the southwest of the lower line (intercept is $W_- \equiv -\frac{\delta^2+\lambda\phi^2}{2}$) indicate where the policymaker will choose r_{-1}.

II.B. How uncertainty affects monetary policy

The framework above helps illustrate two broad channels through which uncertainty can affect policy decisions. The first case is when uncertainty is an exogenous shock to economic conditions to which policy responds. The second case is the Fed-driven uncertainty whereby the extent of uncertainty is endogenous to the interest rate choice.

[6] To take an extreme case, suppose that the policymaker cares only about inflation so that $\lambda = 0$. Then, the curve in Figure 1 becomes vertical through $(\frac{\delta}{2}, 0)$, and r_1 is chosen whenever the inflation rate under the baseline is further from its target value than half the effect of changing rates ($(\pi_0 - \pi^*) > \delta/2$).

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II.B.1. Baseline: Certainty equivalence

Before we explore these channels, it is worth laying out the baseline when uncertainty has no effect on policy at all. This result, known as certainty equivalence, emerges in many classic monetary models and is a standard property of a linear-quadratic environment: the structure of the economy is linear and the policymaker's loss function is quadratic. As such, the central bank reacts to its assessment of the economy in the same way no matter if policymakers' uncertainty about economic outcomes is high or low (see, e.g., Blinder (1999)).

In the decision rule (2), *certainty equivalence* arises when uncertainty in output or inflation does not change the set of economic outcomes for which the policymaker prefers r_1 or r_{-1} over r_0. Since baseline uncertainties, given by σ_π^2 or σ_y^2, do not enter the decision rule, certainty equivalence holds when the variance in outcomes is exogenous to the policy choice; $\Delta\sigma_{\pi,i}^2 = \Delta\sigma_{y,i}^2 = 0$. These conditions are typically present in monetary models in which shocks to π and y are exogenous and are independent of the policy choice.[7]

II.B.2. Uncertainty as an economic shock

A growing macro literature focuses on how uncertainty impacts economic agents outside the central bank. While specific theoretical mechanisms differ, rising uncertainty tends to act akin to a negative demand shock, causing a rapid drop, rebound, and overshoot in employment, output, and productivity growth (e.g., Bloom, 2009; Basu and Bundick, 2017; Leduc and Liu, 2016). In line with its mandate, the central bank reacts to such an uncertainty shock, as it would to other demand shocks. Such reaction is consistent with the static model presented above. Consider a situation in which baseline uncertainty, e.g., σ_y^2, affects economic conditions via a mapping $y_{0,t} = f(\sigma_y^2)$ and $f'(\sigma_y^2) < 0$, i.e., a positive uncertainty shock worsens the FOMC's assessment of the economy, y_0, which in turn leads to policy accommodation. This demand shock logic does not overturn the certainty equivalence in that the optimal policy response does not change, but rather, uncertainty now affects policy because it is itself a source economic fluctuations.

II.B.3. Fed-driven Uncertainty

Equation (2) clarifies that certainty equivalence does not hold when policy choices endogenously affects the variance of outcomes. That is, certainty equivalence does not hold when $\Delta\sigma_{\pi,i}^2, \Delta\sigma_{y,i}^2 \geq (\leq) 0$ (with one inequality strict).

[7] In a broader model, an additional condition requires the distribution of outcomes to be symmetric. This is also typically the case in standard models where shocks to π and y are normally distributed.

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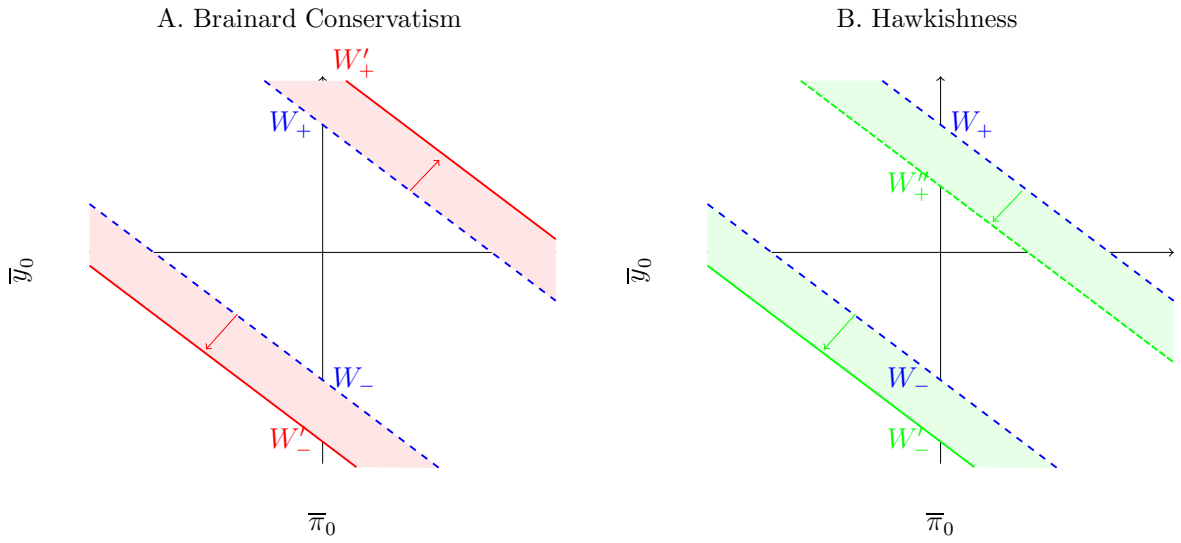

Figure 2. Effect of uncertainty on the decision boundary. These figures present the decision boundaries for a policymaker when the mean forecast is $\overline{\pi}_0$ and $\overline{y}_0$. The left figure is drawn for $\Delta\sigma^2_{x,1} > 0$ and $\Delta\sigma^2_{x,-1} > 0$. The right figure shows the effect of $\Delta\sigma_{x,-1} > 0$ and $\Delta\sigma_{x,1} < 0$.

We thus refer to the Fed-driven (or Fed-induced) uncertainty as being the key for uncovering uncertainty effects on policymaking. Intuitively, when a specific interest rate r_i generates additional (less) volatility in inflation or output relative to an alternative r_j, r_i becomes less (more) attractive, all other things equal.

Figure 2 illustrates the effect of Fed-driven uncertainty on the decision rule. As in Figure 1, the middle between the curves represents the region when the policymaker prefers the status quo, r_0. The changing uncertainty between the baseline and alternative ($\Delta\sigma^2_{x,1} \neq 0$ and/or $\Delta\sigma^2_{x,-1} \neq 0$) induce shifts in the decision boundaries (the W intercepts change).[8] Using this simple illustration, we now discuss two sources of Fed-driven uncertainty studied in the literature: the parameter uncertainty and the tail risks.[9]

Parameter Uncertainty

When policy alternatives generate additional uncertainty over the baseline ($\Delta\sigma^2_{x,1} > 0$ and $\Delta\sigma^2_{x,-1} > 0$), the decision boundaries shift outwards, meaning that the policymaker prefers the baseline for a larger range of forecasts. Panel A of Figure 2 displays this situation as a

[8]For simplicity, we consider situations in which $\Delta\sigma^2_{\pi,i}$ and $\Delta\sigma^2_{y,i}$ go in the same direction, but the policymaker could believe that a given policy has offsetting effects on output and inflation volatilities.

[9]Another class of models emphasises policymakers' desire for robustness: the policymaker is uncertain about their economic model and seeks a policy that is robust to the worst possible form of misspecification (Hansen and Sargent, 2001, 2008; Giordani and Söderlind, 2004; Giannoni, 2007). While a desire for robustness manifests itself through a more aggressive reaction, it is not quite the same as the Fed-driven uncertainty that we emphasise. Robust control policymakers, in an environment of uncertainty, simply fear a worst-case world (parameterisation) and, as a result, the optimal policy is more aggressive.

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shift in indifference curve intercepts from W_+ to W'_+ and W_- to W'_- (from dashed blue line to solid red line). The shaded areas indicate the regions of the baseline outlook, for which the FOMC would previously choose tighter or looser policy, but now chooses the baseline.

This analysis captures the classic work on parameter uncertainty of Brainard (1967). Brainard (1967) assumes a single policy multiplier, equivalent to δ and ϕ parameters in our framework, which is stochastic. The policymaker only knows the distribution from which it is drawn. The famous result is that optimal policy should be less aggressive relative to policy pursued under certainty—a result known as the Brainard conservatism principle.[10]

The opposite behavior to conservatism arises if, instead, $\Delta\sigma^2_{x,1} < 0$ and $\Delta\sigma^2_{x,-1} < 0$ (not shown graphically). If $r = 1$ and $r = -1$ lead to less inflation/output variance ($\Delta\sigma^2_{x,1} < 0$ and $\Delta\sigma^2_{x,-1} < 0$), the intercepts shift toward the origin making activist policy more likely. Such an effect is consistent with Söderström (2002) who emphasises uncertainty about the parameter of inflation persistence that induces the policymaker to become *more* aggressive in their policy. In his model, when the dynamics of inflation are uncertain, the amount of uncertainty facing policymakers is greater, the further away the inflation rate is from its target. So a policy which brings inflation closer to target, actually reduces the uncertainty around future inflation outcomes. Therefore, the optimal policy is more aggressive for a given baseline and pushes inflation closer to the target more strongly than in the certainty case. This effect is a form of the Fed-driven uncertainty because uncertainty depends on the deviation of inflation from the target, which itself indirectly reflects policy actions.

Tail Risks

While the scenarios in Panel A of Figure 2 consider situations where $\Delta\sigma^2_{x,1}$ and $\Delta\sigma^2_{x,-1}$ are of the same sign, in practice different policies can affect volatility in different directions. We illustrate such scenarios in the context of tail risks, where policy mistakes can be associated with a small probability of large losses.

Tail risks are common in the literature on the equity risk premium and disaster risk (Barro, 2006), consumption collapses (Nakamura et al., 2013) and salience (Bordalo et al., 2012), but they are not typically considered in the context of monetary policy decisions. However, Greenspan (2004) explains that FOMC policymaking is an exercise in risk management: policymakers try to set policy that reflects "a judgment about the probabilities, costs, and benefits of the various possible outcomes under alternative choices for policy." This motivates us to explore the idea that the probabilities of tail events can be related to the chosen interest

[10] In our framework, let $\delta \sim G_\delta$ and $\phi \sim G_\phi$, where the G distributions are unimodal, symmetric and have finite variance (as in Brainard (1967)). Let the mean of these distributions correspond to the certainty values used so far. The decision rule in equation (2) features $\mathbb{E}\left[\delta^2\right] + \lambda\mathbb{E}\left[\phi^2\right]$ in place of $\delta^2 + \lambda\phi^2$ and this means, by Jensen's Inequality, the burden of proof necessary to change rates becomes higher.

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rate. Two natural channels for monetary policy tail risks regard (i) policymakers' credibility considerations, and (ii) financial stability risks.

The first channel explores the idea of credibility loss in a situation initially described as an "inflation scare" by Goodfriend (1993). That is, if policy is not sufficiently aggressive against inflation, there is a chance that the central bank loses its credibility which leads to a large inflation realization.[11] Crucially, the likelihood of losing the nominal anchor is related to the policy choice. Tighter monetary policy reduces the chance of losing the nominal anchor implying that $p_{-1} > p_0 > p_1$, where $p_i \equiv p(r_i)$ is the probability of the risk being realized.[12] As the tail probability decreases in the policy tightness, policymakers believe that tighter policy will reduce the variance ($\Delta\sigma^2_{x,1} < 0$) and looser policy will increase it ($\Delta\sigma^2_{x,-1} > 0$). This case is shown in Panel B of Figure 2, where both boundary intercepts shift down (the lines shift to the southwest) from W_+ to W''_+ and W_- to W'_-. Compared with a situation without Fed-driven uncertainty, the risk of losing credibility makes it more likely that the policymaker chooses to tighten (for $\overline{\pi}_0 > 0$ and $\overline{y}_0 > 0$): there is now greater hawkishness.[13]

From an empirical standpoint, the tail risk story helps conceptualize why wedges in the decision rule (2) might be time varying. It is natural to expect that the probability of the tail event varies over the business cycle. As such, the credibility concern may become more prominent at some points in time, leading to time-series variation in the policy behavior. Under parameter uncertainty, instead, the time variation in the effect of uncertainty on policy would require the policymaker to become more or less uncertain about parameters over time.

Moreover, assuming that the tail probabilities are relatively small, the modal outcome expected should not reflect these risks. If policymakers take action to rebuild their credibility when it is at risk, the realization they fear will never materialize. As such, by taking the credibility into account, the policymaker can ensure that, endogenously, the loss becomes less likely and, hence, market observers do not need to worry about it.

[11] This credibility loss could result from misjudgement of the neutral rate—the true r^* is higher than what policymakers thought, meaning that what was considered a neutral interest rate was actually over stimulating the economy such that effect on output is positive. Or a central bank could also lose credibility when they try to look through the first round effects of a supply shock but misjudge the extent of the second round effects that develop.

[12] Of course, at the ZLB the central bank may worry about the loss of the nominal anchor towards deflation. This scenario, is present, though not prominent, around 2008 and 2009 in the FOMC transcripts we analyze. Such a tail risk can be modelled as a mirror image of the risk we examine here.

[13] If instead $p_1 > p_0 > p_{-1}$, as might be the case in a financially vulnerable economy, $\Delta\sigma^2_{x,1} > 0$ and $\Delta\sigma^2_{x,-1} < 0$ leads to greater dovishness as the boundaries would shift up and out meaning that there are combinations of $\overline{\pi}$ and $\overline{y}$ that, absent the tail risk, the policymaker would choose r_1 but now they choose r_0 or even r_{-1}.

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III. Measuring Policymakers' Uncertainty and Policy Stance with Text

The main purpose of the framework above is to highlight the different channels through which uncertainty might affect decision-making for monetary policy. We thus need to construct empirical analogues of its main components. Before describing our algorithms, we review the main objects we measure and how we interpret these measures in the context of FOMC decision-making.

First and foremost, we require an assessment of policymakers' uncertainty about the target variables that enter their loss function, i.e., inflation and the real economy. Since FOMC members' views on uncertainty are not recorded in structured surveys over our whole sample period, we instead approximate them using the text of FOMC meeting transcripts.[14] It is important to recognize what this approach can and cannot capture. First, we view our language-based proxies as reflecting policymakers' overall perceived uncertainty about economic conditions ($\sigma^2_{x,i}$), not just that induced by the Fed's action ($\Delta\sigma^2_{x,i}$). Second, those proxies also potentially capture higher-order moments of the outcome distributions beyond the second moment. In the empirical results section, we will describe how we attempt to isolate the impact of Fed-driven uncertainty on policy stance.

Second, taking the decision rule in (2) to the data requires policymakers' expectations, $\overline{\pi}_0$ and $\overline{y}_0$. The typical approach in Taylor-rule type analysis is to introduce the Greenbook forecasts for inflation and real activity. However, the Greenbooks contain the staff's *modal* forecasts not policymakers' *mean* forecasts.[15] When outcome distributions are skewed, mean and modal outcomes no longer coincide. Moreover, the FOMC's modal forecast may differ from those of the staff.

To see the implications of these observations for decision-making, suppose that $\hat{\pi}_{\text{GB}}$ and $\hat{y}_{\text{GB}}$ are Greenbook (modal) forecasts for inflation and output, and that $\hat{\pi}_0$ and $\hat{y}_0$ are FOMC modal forecasts. For each macroeconomic variable x, define s_x to be the difference between the mean and the modal forecast ($\overline{x}_0 - \hat{x}_0$), and d_x to be the difference between FOMC's modal forecasts and the Greenbook forecast under alternative B ($\hat{x}_0 - \hat{x}_{\text{GB}}$). Taking account of these components, we can write $\overline{x}_0 = \hat{x}_{\text{GB}} + d_x + s_x$ and the decision rule in (2) becomes

[14] Beginning in 2007, individual member views on inflation, output, and employment are recorded in Summary of Economic Projections conducted every other meeting. One role of the SEP is to communicate the FOMC's views to the public, so forecasts have a signaling role. In contrast, transcripts are released with a five-year lag and so also better capture private views.

[15] As Bernanke (2016) describes the FOMC's Summary Economic Projections (SEP), "SEP projections are explicitly of the 'most likely' or modal outcomes rather than the range of possible scenarios." Likewise, the New York Fed forecast "is referred to as the 'modal' forecast in that it is intended to be the most likely of a wide range of potential outcomes" (Alessi et al., 2014).

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$$\overline{L}_1 < \overline{L}_0 \leftarrow \delta\left[\hat{\pi}_{GB} + d_\pi + s_\pi\right] + \lambda\phi\left[\hat{y}_{GB} + d_y + s_y\right] > \frac{\delta^2 + \lambda\phi^2}{2} + \frac{\Delta\sigma^2_{\pi,1} + \lambda\Delta\sigma^2_{y,1}}{2} \tag{3}$$

In our empirical analysis, it is straightforward to control for $\hat{\pi}_{\text{GB}}$ and $\hat{y}_{\text{GB}}$ with available Greenbook data. However, to capture the additional terms that appear on the left-hand side of (3), we also generate text-based measures of policymakers' sentiment towards the real economy and inflation as additional controls. We interpret these as proxying for the policymakers' first-moment beliefs about economic conditions.

Equation (3) makes clear that the wedge between FOMC mean and Greenbook modal forecasts can arise from skewness in the outcome distributions. It is conceivable that the sentiment we construct partly reflects FOMC beliefs about the skewness and how it relates to the policy choice. In this case, the policy effects we attribute to uncertainty in the empirical analysis will tend to *understate* the overall effect of uncertainty since sentiment also captures part of that effect. Still, we take a conservative approach and control for the first-moment text-based beliefs, even if doing so partly also absorbs the effect of higher-order moments.

Finally, detecting the impact of uncertainty on policy requires a measure of the policy stances that the FOMC adopts in the sample. The most obvious choice would be the FOMC's published policy decision, which is available every meeting. Instead, we use the FOMC's language to build a novel text-based policy stance measure. There are several reasons we view this approach as more appropriate. First, as we show below, policy views expressed in text describe the future policy path beyond the immediate decision, thus representing a broader notion of stance.[16] Second, part of the discussion in the transcripts relates to the crafting of public communication, which itself is an increasingly important policy tool. Third, the final years of our sample coincide with the zero lower bound period, and text allows us to measure policy stance consistently throughout the entire sample.

Before testing whether and how uncertainty impacts policymaking, we first provide an overview of the FOMC transcript corpus, and our methodology for measuring text-based uncertainty, sentiment, and policy stance. Further details are in Appendix B.

III.A. Transcript data

The main textual source we draw from is the nearly verbatim transcripts of Federal Open Market Committee meetings, available online.[17] These transcripts contain a fully attributed, statement-by-statement account of meetings with very light editing, for example to remove

[16] Meyer (2006) argues that the primary purpose of deliberation in FOMC meetings is to shape future, rather than current, decisions.

[17] See https://www.federalreserve.gov/monetarypolicy/fomc_historical.htm

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the names of specific banks with which the Fed conducts open market operations. The sample period we consider consists of the 228 meetings from August 1987 (the first meeting of Alan Greenspan's chairmanship) through December 2015 (the last meeting for which a transcript was available at the time of data processing).[18] Regular FOMC meetings occur eight times per year, with occasional special meetings convened via conference call during times of macroeconomic turbulence. Since the format of these calls is somewhat irregular, we only consider regular meetings in our analysis. The typical composition of the FOMC consists of 19 members, of which twelve are regional Fed Presidents and seven are Governors. During our sample, a total of 75 unique FOMC members appear in the transcripts in at least one meeting. A number of Fed staff economists also participate in the meetings.

Importantly, our measurement strategy exploits the regular structure of FOMC meetings. The first core part of the FOMC meetings is the *economy round*, which makes up 43% of the total sentences in the transcripts. The Fed staff economists first present their forecasts of economic activity (contained in Greenbooks/Tealbooks) along with supporting contextual information. Each FOMC member in turn presents his or her views on economic developments, which can differ from the views of the staff. These developments can be discussed in the context of alternative interest rate paths—which our framework shows can be an important part of evaluating uncertainty—but FOMC members do not advocate for particular policy choices at this stage. It is this part of meeting we use for constructing text-based measures of real economy and inflation distributions as perceived by the FOMC.

The second core part of the meeting is the *policy round*, which accounts for 24% of all sentences.[19] This round begins with the staff laying out different policy alternatives, after which FOMC members debate on which alternative to adopt before proceeding to a final vote. This section also includes a discussion of the public statement released along with the policy announcement. We use this round to derive text-based measures of policy stance.

While uncertainty language might appear in the policy round in discussion of economic conditions related to policy stance, it also reflects other factors such as hesitance about the correct policy stance, or how to communicate uncertainty to the public. In practice, separating out these distinct forms of uncertainty is a formidable challenge and, for this

[18] Only a small part of the May 1988 meeting was transcribed, so we treat it as a missing observation.

[19] The remainder of the transcripts, which we do not use, is largely made up of staff discussion of financial market conditions and discussion of special topics in monetary policy. The sectioning of meetings is done manually by us. One outlier in meeting structure is the September 2009 meeting, for which the policy and economic rounds were merged into one round. In this case, we manually classify sentences as either belonging to the economy round or the policy round. For further details on the structure of FOMC meetings and the composition of the committee, see Hansen et al. (2018).

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reason, we do not use uncertainty language in the policy round to measure uncertainty about economic conditions.

III.B. Uncertainty and sentiment

III.B.1. Measuring policymakers' uncertainty: PMU

At a high level, our measurement of topic-specific uncertainty is based on the local co-occurrence of terms denoting uncertainty and terms denoting the topic of interest.[20] To obtain the terms denoting uncertainty, we begin with the four base terms 'uncertain', 'uncertainty', 'risk', and 'risks'.[21] We then use a word embedding model—specifically the Continuous Bag-of-Words model (Mikolov et al., 2013)—applied to FOMC transcripts to generate an expanded set of terms.[22] A word embedding model represents each unique term in a corpus as a relatively low-dimensional vector in a vector space. Words whose vectors lie close together in the vector space share similar meanings.

Tables A-1 and A-2 display the fifty nearest neighbors for each of the seed words. In general, the neighbors are synonyms of the seeds, such as 'unclear' and 'unsure', or terms reflecting worries and concerns such as 'threat', 'fear', and 'wary'. This is consistent with uncertainty being discussed in the context of expected utility losses as perceived by FOMC members. At the same time, the nearest neighbors also contain generic terms not obviously related to uncertainty. We therefore further organize the lists using our domain expertise and remove irrelevant terms. Ultimately, we obtain 78 terms in total.[23]

The term lists we use to measure topics come from our judgment.[24] In the following analysis, we focus primarily on inflation and real economy topics, as in the framework of Section II. Since policymakers' concerns about the real economy might be affected by developments in financial markets, we include financial market uncertainty in some of the analysis below.

[20]The use of local co-occurrence patterns to build text-based proxies for economic phenomena has been pioneered by Mikael and Blix (2014) in the monetary policy context and by Hassan et al. (2019) to measure specific types of uncertainty in a corporate context. Our innovation is to apply these ideas to analyze the impact of perceived risk and uncertainty on policy preferences.

[21]The motivation for the seeds is that 'risk' and 'risks' capture objective uncertainty, while 'uncertain' and 'uncertainty' capture Knightian uncertainty. Combining both in discussion of economic uncertainty is common. For example, Bloom (2014) writes: "I'll refer to a single concept of uncertainty, but it will typically be a stand-in for a mixture of risk and uncertainty."

[22]This approach follows recent studies such as Hanley and Hoberg (2019), Atalay et al. (2020), Davis et al. (2020), and Bloom et al. (2021).

[23]The separate lists contain substantial overlap, which is another reason for the reduction to 78 terms.

[24]The reason we use a purely manual rather than partially automated approach as for the uncertainty list is that the topical terms are largely made up of phrases, and sequence embeddings are substantially more complex to build than single word embeddings.

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Finally, we also build a model uncertainty topic in line with the existing theoretical literature on uncertainty. Inflation terms are presented in Table A-3; real economy terms are in Tables A-4 through A-6; financial market-related terms are in Tables A-7 through A-10; and model-related terms are in Table A-11.

Appendix B provides full details of the construction of the topic-specific policymakers uncertainty indices, or PMUs. A sentence in the economy round is assigned to topic-k uncertainty if it contains a term from our uncertainty list and a term from the topic k list. Meeting-level PMU for topic k is then the number of terms in the economy round spoken in topic-k uncertainty sentences expressed as a fraction of total words spoken in the economy round overall. We denote the four meeting-level indices by $InfPMU_t$ for inflation PMU, $EcoPMU_t$ for the real-economy PMU, $MktPMU_t$ for financial markets PMU, and $ModPMU_t$ for model PMU. With uncertainty mentions that cannot be classified into a specific topic, we form a residual category, $OthPMU_t$, for other PMU.

Table A-12 presents summary statistics for each PMU index. We find that the average value of $ModPMU_t$ is substantially lower than the average value of the other indices, and it also varies little across meetings. This suggests model uncertainty is not a strong driver of FOMC decision making, which contrasts with the large academic literature on model uncertainty in monetary economics.[25] Since $ModPMU_t$ contributes little to overall uncertainty discussion, we focus the empirical analysis on the other three PMU indices.

Figure 3. Distribution of phrases in topic-specific PMU indices. The figure presents the distribution of terms within topic-specific uncertainty sentences. The size of the term is approximately proportional to its frequency. All topic-specific PMU indices are obtained from the economy round of the FOMC meetings. The sample period is 1987:08–2015:12. Full details of the construction are in appendix B.

Figure 3 shows the distribution of terms in topic-k uncertainty sentences. The size of the term in each word cloud is approximately proportional to its empirical frequency in topic-k uncertainty sentences.

[25] Another possibility is that—rather than discuss model uncertainty explicitly—FOMC members discuss the *implication* of model uncertainty, which is uncertainty about inflation or the economy and would be captured by our other topic-specific indices.

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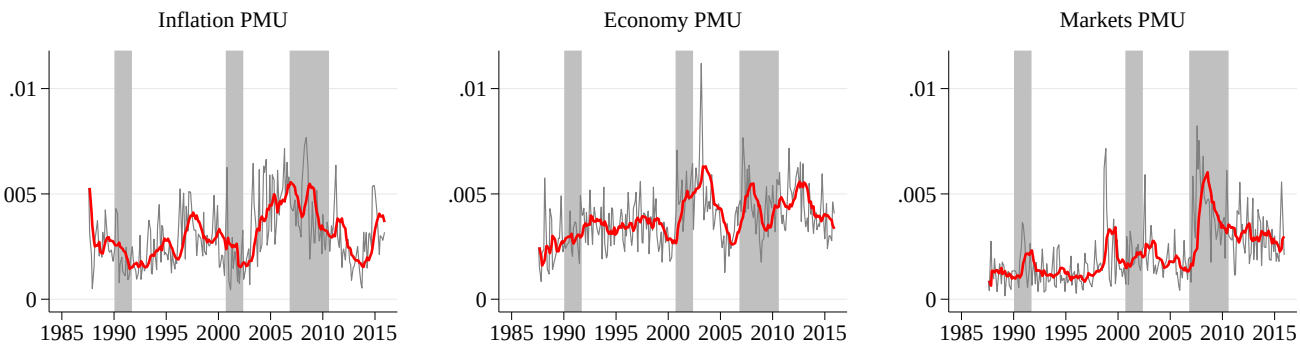

Figure 4. Topic-specific PMU Time Series. This figure displays the time series of the topic-specific PMU measures during the sample period 1987:08–2015:12. The grey curves represent the raw time series. The red curves are moving averages over the last eight meetings. The y-axis is expressed as the fraction of total economy round words contained in topic-k uncertainty sentences. Recessionary periods are shaded.

Figure 4 plots time series for the PMU measures during the sample. To highlight their features over time, we graph both unsmoothed series and their moving average over the past eight meetings; in the empirical analysis, we rely on the unsmoothed series. $InfPMU_t$ rises most quickly during the 2000s; $EcoPMU_t$ rises at the onsets of the bursting of the dot-com bubble and of the Global Financial Crisis (GFC); and $MktPMU_t$ in the early stages of the GFC. An important observation is that the PMU indices have substantial independent variation that cannot be captured a single common factor. The pairwise correlations between the three main indices are 0.07 for $InfPMU_t$ and $EcoPMU_t$, 0.12 for $InfPMU_t$ and $MktPMU_t$, and 0.38 for $EcoPMU_t$ and $MktPMU_t$.

III.B.2. Measuring policymakers' sentiment

To capture the additional wedges in equation (3), we complement the PMU measures by constructing text-based views on the evolution of inflation, the real economy, and financial markets. Following Hassan et al. (2019) and Shapiro and Wilson (2022), we refer to these measures as *sentiment*. As a convention, we label the discussions of falling inflation in meeting t as indication of negative inflation sentiment ($InfNeg_t$), discussions of weakening economic activity as negative sentiment about real economy ($EcoNeg_t$), and discussion of deteriorating financial conditions as negative market sentiment ($MktNeg_t$). We reverse those relations for the positive sentiment ($InfPos_t$, $EcoPos_t$, and $MktPos_t$). As a proxy for the overall sentiment, we then define balance measures as the difference between the positive and negative sentiment, e.g., for inflation $InfSent_t = InfPos_t - InfNeg_t$. Increases in the balance indicate a positive tilt in views about a given variable.

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Appendix B.2 details the construction of the sentiment indices. The basic idea is to count the frequency with which topic-specific terms (which generally overlap with those used for the topic-specific uncertainty) are preceded or followed by direction words that indicate positive or negative sentiment, respectively. In analogy to the PMU, we derive the sentiment proxies from the economy round of the meeting and scale the sentiment count by the number of total words in that round. Importantly, to avoid a mechanical relationship between PMU and sentiment, in sentiment construction we exclude all sentences that we use to obtain the PMU indices.

III.B.3. Uncertainty, sentiment, and economic outcomes

Figure 5 plots time series of sentiment and PMU for inflation and the real economy. For clarity we smooth all series with a moving average over the last eight meetings. Neither index displays clear countercyclical behavior which is usually expected from uncertainty indicators (e.g., Bloom, 2014). $InfPMU_t$ is strongly procyclical, suggesting that policymakers tend to express more uncertainty about inflation when the economy is doing well. Inflation concerns become prevalent from mid-2000s and reach their highest level in the first half of 2008. The procyclical $InfPMU_t$ is consistent with policymakers' worrying primarily about the demand-driven increases in inflation. Indeed, $InfPMU_t$ co-moves remarkably closely with $InfPos_t$ (i.e., increasing inflation). Perhaps more surprisingly, $EcoPMU_t$ also fails to display obviously countercyclical dynamics.[26] Compared to inflation, $EcoPMU_t$ however shows a weaker correlation with sentiment. For example, $EcoPMU_t$ increases and remains persistently higher through the end of 2013, even when negative sentiment about the economy subsides.[27] Table A-13 presents regressions of PMU on sentiment measures to formalize these statistical associations.

The constructions of PMU and sentiment are meant to conceptually distinguish between uncertainty about economic conditions and the direction of their expected evolution. The correlation between PMU and sentiment might mean, however, that our text-based measures do not separate these out cleanly. To verify that PMU does not simply indirectly capture

[26] Its highest reading occurs during the March 18, 2003 meeting, driven by the uncertainty about the timing and extent of the Iraq war and about the underlying economic conditions. In another major episode, $EcoPMU_t$ becomes elevated in the first-half of 2007 before the start of the official NBER-dated recession. The transcripts of the March 21, 2007 meeting highlight rising concerns about the growth outlook and heightened forecast uncertainty that are not yet associated with a direct downgrade of the economic forecasts. The uncertainty actually declines during the heights of the financial crisis even as policymakers continue to express negative sentiment about the real economy.

[27] $MktPMU_t$ is also strongly positively associated with $MktNeg_t$ (not shown in the figure for brevity). $MktPMU_t$ reaches its highest level already in the early phases of the global financial crisis, in August 2007, preceding the spike in the VXO (on October 29, 2008) by more than a year.

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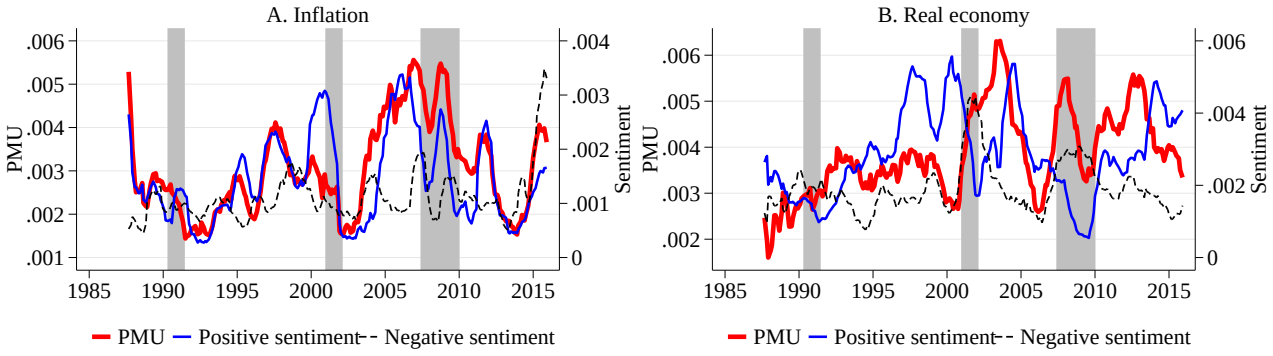

Figure 5. PMU and Sentiment This figure presents inflation and economy PMU indices superimposed against negative and positive sentiment. Positive (negative) sentiment indicates views of rising (declining) inflation or output. All text-based series are smoothed averages over the last eight FOMC meetings.

policymakers' directional beliefs, we regress Greenbook nowcasts for inflation and real GDP growth made in meeting $t + h$ on the meeting t Greenbook forecasts, meeting t PMU, and meeting t sentiment. We estimate these regressions for $h = 1, \ldots, 8$, i.e., up to eight meetings ahead. Table I presents the results.

At no future horizon does PMU predict future outcomes for inflation or real GDP growth. At the same time, economic growth sentiment is a strong, persistent predictor of future growth across all horizons. Inflation sentiment only predicts inflation over the short term after controlling for the contemporaneous Greenbook inflation forecast. As such, our text-based constructions organize language in a conceptually distinct way, with PMU capturing uncertainty and worries that are not systematically correlated with future outcomes. Moreover, this result is not sensitive to including period t controls. Appendix Table A-14 present univariate regressions of future Greenbook nowcasts on only PMU and again finds no systematic relationship.

III.C. Measuring policy stance

To assess the FOMC's policy stance in each meeting, we measure the frequency of occurrence of language indicating hawkishness and dovishness, scaled by the overall length (number of words) of the policy round. We exclude statements made by the staff in the policy round to focus on the FOMC member's policy views. Our classification of hawkish and dovish language takes into consideration both conventional policy as well as the unconventional tools during the zero-lower-bound period. This allows us to obtain a consistent measure

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A. Dependent variable: Greenbook CPI inflation nowcast h meetings ahead, $F_{t+h}(\pi_0)$

	$h=1$	$h=2$	$h=3$	$h=4$	$h=5$	$h=6$	$h=7$	$h=8$
$InfPMU_t$	0.039	-0.038	-0.042	0.011	-0.107	-0.070	0.038	0.044
	(0.62)	(-0.48)	(-0.38)	(0.08)	(-0.69)	(-0.42)	(0.27)	(0.45)
$InfNeg_t$	-0.260***	-0.164*	0.012	0.093	0.086	0.010	-0.058	-0.025
	(-3.49)	(-1.87)	(0.18)	(1.30)	(1.04)	(0.17)	(-0.98)	(-0.39)
$InfPos_t$	0.173***	0.144***	0.025	-0.131	-0.100	-0.120	-0.169*	-0.138
	(3.81)	(2.67)	(0.38)	(-1.32)	(-0.97)	(-1.42)	(-1.80)	(-1.47)
$\overline{F}_t(\pi)$	0.560***	0.457***	0.378***	0.351***	0.319***	0.321***	0.337***	0.335***
	(8.46)	(6.91)	(4.30)	(3.39)	(2.82)	(2.90)	(3.73)	(4.01)
$\bar{R}^2$	0.50	0.30	0.13	0.11	0.11	0.11	0.12	0.10
N	226	225	224	223	222	221	220	219

B. Dependent variable: Greenbook real GDP growth nowcast h meetings ahead, $F_{t+h}(g_0)$

	$h=1$	$h=2$	$h=3$	$h=4$	$h=5$	$h=6$	$h=7$	$h=8$
$EcoPMU_t$	-0.081	-0.058	0.032	0.069	0.029	-0.001	0.087	0.113
	(-1.60)	(-1.15)	(0.69)	(1.03)	(0.36)	(-0.02)	(1.01)	(1.23)
$EcoNeg_t$	-0.150***	-0.163**	-0.220***	-0.275***	-0.313***	-0.226**	-0.238**	-0.237**
	(-2.92)	(-2.40)	(-2.65)	(-3.00)	(-4.29)	(-2.28)	(-2.05)	(-2.32)
$EcoPos_t$	0.116**	0.127**	0.147**	0.149*	0.151*	0.193**	0.203**	0.190**
	(2.39)	(2.17)	(2.07)	(1.68)	(1.72)	(2.25)	(2.30)	(2.14)
$\overline{F}_t(g)$	0.623***	0.553***	0.401***	0.287***	0.227**	0.174	0.112	0.075
	(7.20)	(5.78)	(5.03)	(3.20)	(2.12)	(1.31)	(0.80)	(0.51)
$\bar{R}^2$	0.56	0.48	0.35	0.28	0.26	0.19	0.16	0.13
N	226	225	224	223	222	221	220	219

Table I. Predicting macro variables with textual measures of uncertainty and sentiment. The table reports predictive regressions of inflation and real GDP growth by textual PMU and sentiment indices derived from the economy round of the FOMC meeting transcripts. The regressions are estimated at the FOMC meeting frequency with the forecast horizon ranging from the next meeting ($h = 1$) up to eight meetings ahead ($h = 8$). To make sure that the timing of the depend variable is consistent with the timing of the meetings, we use Greenbook nowcasts at future meetings as the dependent variable. The regression is $F_{t+h}(\pi_0) = \beta_0 + \beta_1 InfPMU_t + \beta_2 InfPos_t + \beta_3 InfNeg_t + \beta_4 \overline{F}_t(\pi) + \varepsilon_{t+h}$, where $F_{t+h}(\pi_0)$ is the CPI inflation nowcast at meeting $t+h$, and $\overline{F}_t(\pi)$ is the average forecast (across horizons) given at meeting t. We estimate analogous regressions for the real GDP growth. The coefficients are standardized. HAC standard errors to account for the overlap are reported in parentheses. The sample period is 1987:08–2015:12.

throughout the sample period. Appendix B.3 describes the details of the construction.[28] We denote the resulting scores in meeting t as $Hawk_t$ and $Dove_t$, respectively, and summarize the overall policy stance by taking the difference:

[28] Alternatively, one could use the voting records of individual FOMC members. However, it is known that despite differing views on the committee, the dissents have been rare over the period we study (Meade and Stasavage, 2008; Thornton and Wheelock, 2014). Meade (2005) pioneers the use of FOMC transcripts to codify the expressed policy preferences about the short-term interest rate. Istrefi (2019) and Bordo and Istrefi (2021) use a classification scheme of FOMC members based on narrative records in the public media that discuss policy preferences of individual FOMC members. The methodology does not allow the policy stance to vary meeting-by-meeting in response to economic conditions.

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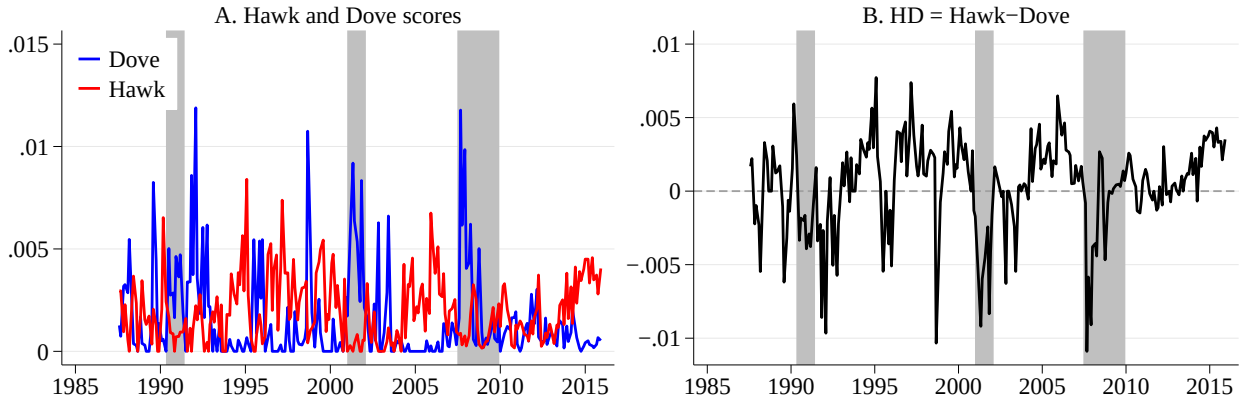

Figure 6. Textual measures of policy stance. The figure presents textual measures of policy preferences derived from the statements of FOMC members during the policy round of the FOMC meetings.

$$HD_t = Hawk_t - Dove_t. \tag{4}$$

Thus, HD_t reflects the tilt in the policy stance that emerges during meeting t.

Figure 6 presents the time series of the $Hawk_t$ and $Dove_t$ scores, and their balance HD_t. The dynamics of these variables display intuitive properties, with $Dove_t$ becoming elevated around recessions and in periods of financial turmoil, and $Hawk_t$ increasing in expansions. Importantly, the text-derived policy stance shows substantial variation in the post-2008 sample when short-term nominal interest rates are constrained at zero.

To validate HD_t as a measure of policy stance, we analyze its relationship with common proxies in the literature: deviations of the policy rate from a Taylor rule and high-frequency monetary policy surprises obtained from changes in market interest rates around FOMC announcements. The results of the regressions, all of which are estimated at meeting frequency, are in Table II.

In Panel A of Table II, we first project HD_t on typical variables included in the estimation of a policy rule. This specification, reported in column (1), serves as a benchmark to describe the systematic component of policy reflected in language. The explanatory variables include the Greenbook forecasts and forecast revisions for inflation and the real GDP growth, as well as a trend inflation variable, τ_t, to account for a slow adjustment in the inflation target over our sample.[29] Most loadings in column (1) are highly significant and have expected signs:

[29]Following Coibion and Gorodnichenko (2012), as Greenbook controls, we use longer-term CPI inflation forecasts (four quarters ahead, $F_t(\pi_4)$), and current quarter real GDP growth forecast (nowcast, $F_t(g_0)$). We also add forecast revisions between meetings ($FR_t(\pi_3), FR_t(g_1)$), following Romer and Romer (2004) to account for changes in forecasts in addition to levels. The trend inflation variable τ_t is constructed as the discounted moving average of past core inflation following Cieslak and Povala (2015). Including trend inflation allows the regression to capture the effect of deviations of expected inflation from the target on the policy rate.

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A. FFR target changes and Romer-Romer shocks

	(1) HD_t	(2) ΔFFR_t	(3) ΔFFR_t	(4) ΔFFR_t	(5) RR_t	(6) RR_t
HD_t			0.497***	0.334***	0.506***	0.601***
			(6.83)	(5.30)	(4.95)	(5.04)
$F_t(\pi_4)$	0.613***	0.684***		0.523***		0.115
	(3.64)	(3.79)		(2.97)		(0.73)
$F_t(g_0)$	0.382***	0.546***		0.456***		-0.085
	(2.99)	(6.60)		(5.75)		(-1.14)
τ_t	-0.695***	-0.374***		-0.226**		0.043
	(-3.81)	(-3.30)		(-2.06)		(0.26)
$FR_t(\pi_3)$	0.073	0.051		0.022		0.088
	(1.43)	(0.86)		(0.39)		(1.30)
$FR_t(g_1)$	0.152***	0.136**		0.092		-0.168**
	(2.79)	(2.30)		(1.32)		(-2.55)
L.FFR_t		0.587	1.766***	-0.091		
		(1.14)	(3.18)	(-0.15)		
L2.FFR_t		-0.875*	-1.801***	-0.159		
		(-1.84)	(-3.40)	(-0.29)		
$\bar{R}^2$	0.29	0.52	0.45	0.59	0.25	0.30
N	227	169	169	169	163	163

B. Market-based measures of monetary policy surprises

	(1) GSS target	(2) GSS path	(3) GK MP0	(4) GK ED12m	(5) NS news
HD_t	0.169	0.178***	0.382***	0.409***	0.290**
	(1.33)	(2.74)	(4.00)	(4.92)	(2.33)
R^2	0.028	0.032	0.15	0.17	0.084
N	196	196	190	199	154

Table II. Validity of textual measures of policy stance. The table reports regressions of various measures of monetary policy stance on the textual *HD* score derived from the policy round of the FOMC meeting transcripts. Panel A reports regressions of changes in the FFR target and Romer-Romer shocks on the *HD* variable, with and without Greenbook controls (forecasts $F_t(\cdot)$ and forecast updates $FR_t(\cdot)$). The τ_t variable controls for the perceived inflation target. The sample period is 1987:08–2015:12 in column (1); 1987:08–2008:12 in columns (2)–(4), i.e., excluding the zero-lower bound episode, and 1987:08–2007:12 in columns (5)–(6), when Romer-Romer shocks are available from Ramey (2016). HAC t-statistics with eight lags are reported in parentheses. Panel B reports regressions of monetary policy surprises on the *HD* variable. Columns (1) and (2) contain high-frequency target and path surprises following the approach of Gürkaynak et al. (2005) as updated by Swanson (2018) (1991:07–2015:10 sample). Columns (3) and (4) use shocks from Gertler and Karadi (2015) obtained from the current month fed fund futures (MP0, sample 1988:11–2012:06) and 12-month ahead Eurodollar futures (ED12m, sample 1987:08–2012:06). Column (5) is based on surprises from Nakamura and Steinsson (2018) (sample 1995:02–2014:03). Robust t-statistics are reported in parentheses. All regressions are estimated at the frequency of FOMC meetings. The coefficients are standardized.

higher expected growth and higher expected deviation of inflation from the target predict a more hawkish tilt in the policy language. At the same time, the regression $\bar{R}^2$ of 29% leaves more than two-thirds of the variation in the policy language unexplained by the rule.

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Columns (2)–(4) focus on explaining changes in the actual policy instrument—the federal funds rate (FFR) target—with the policy language. Although our textual proxies are available until 2015:12, we estimate these regressions through 2008:12, given that the FFR is at the zero-lower bounds thereafter. To account for the policy inertia we include two lags of the FFR, following Coibion and Gorodnichenko (2012). The estimates show a strong explanatory power of the policy language for the FFR target. In column (3), a one-standard-deviation increase in HD_t is associated with an approximately 0.5 standard-deviation increase in the FFR target (about 14 basis points) with a t-statistic of 6.8. Given the results in column (1), the significance of HD_t could simply reflect the policy rule as opposed to the deviation from it. However, column (4) shows that this is not the case: the HD_t score remains economically and statistically significant also with a full set of controls.

In columns (5)–(6), we present analogous results using a widely-adopted measure of monetary policy shocks proposed by Romer and Romer (2004).[30] Since Romer-Romer shocks are constructed from changes in the policy rate at each meeting purged of Fed's information (Greenbooks), it is not surprising that the results in column (5)–(6) are very similar to those based on FFR target in columns (2)–(4). The HD_t language alone explains a quarter of variation in Romer-Romer shocks. Figure A-1 plots HD_t against the Romer-Romer shocks to illustrate their systematic relationship.

In Table II, panel B, we explore the relationship between language and monetary policy surprises identified from high-frequency changes in interest rates around the FOMC announcements. As these surprises differ in construction details (maturities of interest rates and sample periods), we consider proxies from several recent studies: Swanson (2018) who extends and updates the estimates of target and path factors in Gürkaynak et al. (2005, GSS), Gertler and Karadi (2015, GK), and Nakamura and Steinsson (2018, NS). Across the board, we find a positive relationship with the HD_t score, which is somewhat stronger for surprises identified from longer-term interest rates.

One motivation for gauging policy stance from text is that such measure is likely to reflect broader forward-looking views on policy, as opposed to just the contemporaneous action. To evaluate this property, in Table III we use HD_t to forecast the future path of policy rates. The HD_t variable remains a significant predictor of FFR target changes up to eight meetings ahead, controlling for the meeting-t Greenbook forecasts. Figure A-2 plots the time series of HD_t against the policy rate, showing that fluctuations in HD_t generally lead policy rate movements.

[30] We obtain the Romer-Romer shock series from the data set accompanying Valerie Ramey's handbook chapter on propagation of macro shocks (Ramey, 2016). The shocks are available during the pre-zero-lower-bound sample 1987:08–2007:12.

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Dependent variable: Change in FFR target over subsequent h meetings, $\Delta FFR_{t+h,t} = FFR_{t+h} - FFR_t$

	(1) $h=1$	(2) $h=2$	(3) $h=3$	(4) $h=4$	(5) $h=5$	(6) $h=6$	(7) $h=7$	(8) $h=8$
HD_t	0.080***	0.12***	0.20***	0.25***	0.25***	0.23**	0.21*	0.23*
	(3.29)	(2.71)	(2.75)	(2.83)	(2.71)	(2.36)	(1.88)	(1.83)
GB controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$\bar{R}^2$	0.45	0.48	0.48	0.48	0.50	0.51	0.53	0.53
$\Delta\bar{R}^2$	0.039	0.028	0.039	0.036	0.024	0.012	0.0068	0.0064
N	162	162	162	162	162	162	162	162

Table III. Validity of textual measures of policy stance. The table reports predictive regressions of changes in the FFR target rate over h meetings ahead by the textual measure of policy stance *HD*. The regressions are estimated at the frequency of FOMC meetings, controlling for Greenbook forecasts, trend inflation τ_t and two lags (t and $t-1$) of the FFR target (the same controls as in Table II). All explanatory variables (except the lagged FFR target) are measured as of meeting t. The dependent variables (future changes in the FFR target) span the horizon from the next meeting up to eight meetings ahead. The maximum sample (for the eight-meetings-ahead forecast) uses data over the 1987:08–2008:12 period. The *HD* variable is standardized, FFR is expressed in percent. HAC standard errors to account for overlapping data are reported in parentheses.

IV. (How) Does Uncertainty Affect Policy Stance?

We now explore the relationship between the uncertainty policymakers perceive and their policy stance. Since all PMU and sentiment indices are constructed from the economy round of the meeting, they are predetermined by the time the policy round begins, and from which we derive policy stance of the FOMC members.

IV.A. Meeting-level results

Table IV studies the predictability of the policy stance *HD* with the PMU and the sentiment, including a variety of controls at the meeting level. All variables are standardized and coefficients are expressed in standard-deviation units.

We begin with the least restrictive specification and gradually add controls for additional covariates. To provide a baseline, column (1) and (2) project *HD* on the inflation and real-economy PMU and sentiment, respectively, without any controls. The PMUs in column (1) are highly significant, and jointly explain 15% of the *HD* variance. Notably, inflation and real-economy PMU predict policy stance with opposite signs. A one-sigma increase in *InfPMU* is associated with a 0.34-sigma increase in the *HD* score (t-statistic = 3.39); in contrast, a one-sigma increase in *EcoPMU* is associated with a 0.24-sigma decrease in the *HD* score (t-statistic = −3.97). Column (2) shows that the sentiment is also strongly predictive

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Dependent variable: HD_t policy stance score

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$InfPMU_t$	0.341***		0.281***	0.291***	0.177***	0.183***	0.159**
	(3.39)		(3.89)	(4.06)	(2.79)	(2.80)	(2.32)
$EcoPMU_t$	-0.238***		-0.151***	-0.128**	-0.124*	-0.116	-0.105
	(-3.97)		(-3.10)	(-2.37)	(-1.69)	(-1.50)	(-1.46)
$MktPMU_t$				-0.069			-0.120
				(-0.70)			(-1.19)
$InfSent_t$		0.204**	0.085	0.081	0.066	0.088	0.063
		(2.54)	(1.17)	(1.08)	(1.16)	(1.52)	(1.07)
$EcoSent_t$		0.498***	0.471***	0.436***	0.392***	0.374***	0.347***
		(5.71)	(5.91)	(5.60)	(4.38)	(3.62)	(3.91)
$MktSent_t$				0.048			0.038
				(0.66)			(0.54)
GB controls	No	No	No	No	Yes	Yes	Yes
Public uncertainty	No	No	No	No	No	Yes	No
Other PMUs	No	No	No	No	No	No	Yes
$\bar{R}^2$	0.15	0.30	0.38	0.38	0.43	0.44	0.45
N	227	227	227	227	227	227	227

Table IV. Predicting policy stance with PMU at the meeting-level. The table reports regressions of the policy stance score *HD* on topic-specific PMU indices. The controls include textual sentiment measures, GB forecasts, and proxies for public perceived uncertainty. The *HD* variable is derived from the statements of FOMC members in the policy round of the FOMC meeting, while the PMU and sentiment indices are based on the statements by the staff and FOMC members in the economy round of the meeting. All regressions are estimated at the frequency of FOMC meetings. The coefficients are standardized. HAC t-statistics with eight lags are reported in parentheses. The sample period is 1987:08–2015:12.

of policy stance. The coefficients have the expected signs: perceptions of increasing inflation or stronger real economy anticipate a more hawkish policy round of the meeting.

Importantly, the predictive content of uncertainty for policy stance is not subsumed by the variation in the sentiment in column (3). Inflation PMU drives out the significance of the inflation sentiment, consistent with the finding that increased inflation uncertainty correlates with policymakers' discussions of rising inflation. Table I has already established that inflation sentiment does not predict actual realizations of inflation except at very short horizons. Taken together, the results suggest that inflation sentiment is likely to reflect policymakers' worry about inflation getting out of control, but that worry does not materialize in our sample. Thus, controlling for *InfSent* in the regressions may subsume some of the impact of such worry that would otherwise affect the policy stance via *InfPMU*. In contrast, uncertainty and sentiment about the real economy contain largely independent information. Views of stronger economy captured by a heightened *EcoSent* lead to hawkishness, while increased uncertainty about the economy captured by *EcoPMU* produces a more dovish stance.

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Controlling for financial markets PMU and sentiment (*MktPMU* and *MktSent*) in column (4) weakens somewhat the economic and statistical significance of the real economy PMU, but not that of inflation. The financial markets-based measures are themselves insignificant, echoing Cieslak and Vissing-Jorgensen (2021) that the Fed reacts to financial markets only to the extent that they affect the Fed's beliefs about the real economy. Therefore, in the subsequent analysis, we do not focus on the financial markets PMU.

Columns (5) through (7) augment the specification to account for various potential confounders. Column (5) includes, in addition to the sentiment measures, also the Greenbook forecasts and the trend inflation (as described in Table II). Even with these variables, inflation PMU maintains a material effect on the policy stance: Compared to the specification in column (3), the coefficient on inflation PMU is reduced by about a third (from 0.28 to 0.18 standard deviation units). Instead, the real-economy PMU becomes only marginally significant, suggesting that a large part of its effect on policy can be absorbed by Greenbook forecasts and sentiment.

Column (6) introduces various measures of public perceptions of policy and macroeconomic uncertainty. As the aim is to account for the broad demand-shock channel of uncertainty described in Section II.B.2, we consider an extensive set of uncertainty proxies from the literature, including textual measures developed by Baker et al. (2016) and Husted et al. (2020),[31] option-implied volatility index (VXO) following Bloom (2009), and dispersion of survey forecasts about CPI inflation and real GDP growth. None of them drives out inflation PMU, while the importance of the real-economy PMU is further diminished.

Finally, for robustness, column (7) includes the full suite of our PMU indices, including the model PMU and the unclassified PMU category. Although some uncertainty mentions that we fail to classify within our main PMU indices are informative about policy-relevant uncertainty, the predictive power of inflation PMU is only marginally affected by their inclusion in the regressions. It is thus unlikely that our baseline macro PMU indices omit some key aspect of policymakers uncertainty regarding the policy-relevant outcomes.

IV.B. Interpretation

Although we do not provide a structural estimation of the decision model, given the above findings, it is worth returning to the framework from Section II to assess which channels

[31] Baker et al. (2016, BBD) develop an index of economic policy uncertainty (EPU) based on the frequency of articles in ten leading newspapers that mention both uncertainty and economic policy. Husted et al. (2020, HRS) adopt a related newspaper-based approach to construct a monetary policy uncertainty index (MPU) specific to the US monetary policy. These indices aim to reflect the degree of uncertainty that the public perceives about general economic policy and more specifically Fed's policy actions and/or their consequences.

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could plausibly explain the relationship between PMU and policy. As a starting point, under certainty equivalence, one would not expect to find any relationship between policymakers' expressed uncertainty and their policy stance. FOMC members might still use uncertainty language as a linguistic tool to describe their expectations, or how these differ from the Greenbook. However, such uncertainty should have no role except for explaining their economic beliefs. The fact that uncertainty does predict stance points to a wedge between the standard policy rule (obtained under the linear-quadratic framework) and the actual decision-making of the FOMC. This finding itself is informative in that many macro models are set up to satisfy certainly equivalence.

Through the lens of the simple decision rule in equation (2), once one controls for the FOMC's beliefs about future outcomes with a variety of proxies, any remaining correlation between PMU and policy stance arises from the Fed-induced uncertainty. Thus, while our textual measures do not directly capture the $\Delta\sigma_x^2$ terms in equation (2), a significant relationship between the PMU and *HD* in Table II suggest that Fed-induced uncertainty is a meaningful channel (i.e., $\Delta\sigma_x^2 \neq 0$). Moreover, as we mention in Section III, controlling for sentiment may in fact capture an additional effect of higher-order moments. In this case, the estimated effect of PMU on *HD* represents a lower bound on the actual impact of uncertainty on decision-making.

Under this interpretation, the key takeaway from Table II is that Fed-driven uncertainty pertains to the way policymakers think about inflation, but less so about the real economy. The significance of inflation PMU for stance is, to our knowledge, a novel finding in the literature. It also contrasts with a lack of incremental impact stemming from the real-economy PMU. Distinct from the policy-induced uncertainty, this points to the real-economy PMU as capturing primarily the demand channel of uncertainty. The FOMC members may discuss economic uncertainty as influencing their economic outlook. However, once this outlook is sufficiently controlled for, there should be no additional effect of this type of uncertainty on policy stance.

In terms of specific model predictions, the positively signed loading on inflation PMU in Table IV is worth noting. Brainard conservatism would predict that higher inflation PMU moderates the policy response, contrary to what we find. The positive coefficient on inflation PMU can be viewed as an inward shift in the decision boundary in Figure 1, $\Delta\sigma_{\pi,1} < 0$: A policymaker chooses to act, believing that not raising rates would increase inflation volatility. In theoretical settings with parameter uncertainty, the uncertainty about inflation persistence could in principle lead to more aggressive policy stance, as highlighted by Söderström (2002), potentially rationalizing our findings. However, Söderström (2002) shows that the net effect

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of uncertainty in his model (when multiple parameters are uncertain) is still qualitatively consistent with the Brainard conservatism.

Our findings do not preclude Brainard conservatism altogether, but rather they suggest that the net relationship between *InfPMU* and *HD* is positive. However, as we noted earlier, uncertainty about models is rarely discussed in FOMC deliberations and there is little time variation in it across meetings. This fits with Blinder's view: "While there is some formal literature on this problem [uncertainty over model selection], I think it is safe to say that central bankers neither know nor care much about this literature. I leave it as an open question whether they are missing much" (Blinder, 1999). Moreover, McMahon and Munday (2022b) find that parameter uncertainty, even for large time-variation in the uncertainty of the parameters generates changes in the reaction function that tend to be very small quantitatively.

While the framework of Section II emphasizes uncertainty-driven wedges in the policy reaction, it maintains the assumption of quadratic preferences. It is natural to ask whether the above results could simply arise from policymakers' asymmetric preferences over inflation, as considered in the recent literature (e.g., Kilian and Manganelli, 2008; Shapiro and Wilson, 2022). A straightforward argument against such interpretation is that, over the 1987–2015 period we study, asymmetry of preferences would be inconsistent with the Fed's mandate.

Several empirical facts also speak against simple asymmetric preferences being the direct driver of our findings. First, although the correlation with the positive sentiment is stronger, inflation PMU comoves positively with both positive and negative inflation sentiment. Second, we find that *InfPMU* is correlated with the absolute value of past inflation forecast errors in the Greenbook, but not by the directional errors. In practice, it appears that *InfPMU* does not just mechanically overweigh high unexpected inflation outcomes.

Even if their preferences are symmetric and quadratic, policymakers may nevertheless have additional motives to act on their inflation uncertainty. One relevant motive is the desire to maintain credibility in order to avoid costly scenarios in which inflation expectations become unanchored—a situation of "inflation scares" described by Goodfriend (1993). This aligns with views expressed by policymakers themselves, e.g., Bernanke (2007) states: "Indeed, intuition suggests that stronger action by the central bank may be warranted to prevent particularly costly outcomes."[32]

[32]More recently, Praet (2018) elaborates: "A more aggressive monetary policy response (...) is warranted when there is clear evidence of heightened risks to price stability, i.e. when it is established that the degree of inflation persistence is likely to be high and risks disanchoring inflation expectations. In this case, a forceful, frontloaded monetary policy response to weak or excess inflation may become necessary to signal the central bank's commitment to its objective, and thus nudge inflation expectations towards that objective and make them less backward-looking."

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Several pieces of evidence suggest that Fed's credibility may indeed play a role in rationalizing our results. First, policymakers' inflation uncertainty is very different from the uncertainty perceived by the public. Measures of public uncertainty about policy and macroeconomy, like the ones we use in Table IV are unlikely to proxy the uncertainty relevant for policymaking because such measures already condition on the expected FOMC behavior and the FOMC has maintained high credibility during our sample period. The distinct properties inflation PMU are consistent with this interpretation.[33] Second, as we show next, the entire effect of inflation PMU on policy stance stems from the views of the FOMC members and not the staff. If inflation credibility concerns are indeed an important driver of policy, we would expect them to primarily affect the uncertainty perceived by the actual decision makers, and less so the views of the staff.

IV.C. FOMC members vs. staff

The analysis so far exploits the variation in the PMU indices derived from the economy-round statements made by both the staff and the FOMC members. To explore the differences between the two groups, we construct staff- and FOMC members-specific PMU and sentiment, both scaled by the length of their respective statements. In Table V, we regress the policy stance *HD* on the group-specific PMU and the controls corresponding to specification in column (5) of Table IV. The results make clear that the effect of uncertainty on policy stems mainly from the views of the FOMC members, with the explanatory power of the staff PMU entirely driven out by the members' PMU.

Figure 7, displaying the group-specific PMUs, shows that the differences between members and the staff are particularly evident for inflation. The steep rises in inflation PMU in the 1990s and mid-2000s are entirely driven by the members' perceptions and not by the staff, providing another indication of the distinct nature of the policy-relevant uncertainty.

[33]To further analyze this point, Appendix Table A-15 regresses the public uncertainty proxies on PMU and sentiment. The BBD and HRS measures increase with *EcoPMU* and decline with economic and market sentiment. The distinct properties are particularly clear for *InfPMU*, which correlates negatively with BBD-EPU uncertainty and has only a weak positive correlation with inflation forecast dispersion. Otherwise, it is not associated with VXO nor growth forecast dispersion. Appendix Figure A-3 plots the time series of inflation and economy PMU against the respective public forecast dispersions. While largely unrelated before the financial crisis, *InfPMU* and inflation forecast dispersion have comoved more closely since then. Overall, however, the text-based PMUs contain substantial information not present in well-known public uncertainty measures.

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Dependent variable: Meeting-level HD_t policy stance score			
	(1)	(2)	(3)
$InfPMU_t$ (FOMC)	0.180***		0.183***
	(2.84)		(3.18)
$EcoPMU_t$ (FOMC)	-0.093		-0.087
	(-1.48)		(-1.36)
$InfPMU_t$ (Staff)		0.109*	0.011
		(1.81)	(0.23)
$EcoPMU_t$ (Staff)		-0.137*	-0.038
		(-1.93)	(-0.65)
GB controls	Yes	Yes	Yes
Sentiment	Yes	Yes	Yes
$\bar{R}^2$	0.43	0.33	0.43
N	227	227	227

Table V. Uncertainty of FOMC members vs. staff. The table reports regressions of meeting-level HD_t variable on uncertainty indices of staff and FOMC members. We control for sentiment (*InfSent* and *EcoSent*) specific to FOMC members (column (1)), staff (column (2)), and members and staff (column (3)). HAC t-statistics are reported in parentheses.

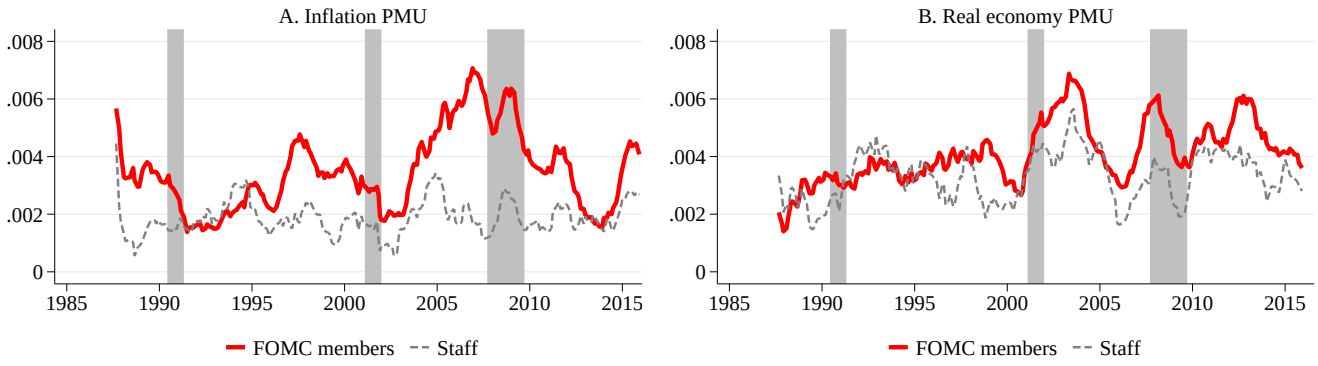

Figure 7. PMU of FOMC members vs. staff. This figure presents inflation and economy PMU indices constructed separately for FOMC members and the staff. Each uncertainty index is scaled relative to the overall length of the statements made by FOMC members or staff, respectively, in the economy round of the meeting. The series are smoothed averages over the last eight FOMC meetings.

IV.D. Dynamic effects of uncertainty on the policy rate

The *HD* variable encapsulates a broad notion of policy stance beyond contemporaneous actions reflected in the policy rate. However, it is also useful to quantify the magnitude of the uncertainty effects in terms of their dynamic impact on the actual policy instrument. The zero-lower bound limits the sample for which we can study the dynamic responses of the FFR target. Therefore, as an alternative to the FFR target, we extend the analysis over the full 1987:08–20215:12 period based on the shadow rate constructed by Wu and Xia (2016). We use Jordà (2005)'s local projection, regressing changes in the policy rate

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between the current and future meetings on the PMUs and controls from Table IV column (5). Additionally, in the projections we include BBD-EPU index to account for the demand channel of uncertainty, and two lags of the policy rate to account for its inertia. Finally, we focus on the dynamic effects of the FOMC members' PMU, given that it is their perceptions that predict the policy stance in Table 7.

Figure 8 presents the effect of a one-standard-deviation change in the inflation and real-economy PMUs on the cumulative change in the policy rate up to eight meetings ahead. The figure superimposes the estimates for the FFR target in the pre-zero lower bound period (marked as circles) and the shadow rate in the full sample (marked as triangles). The effect of uncertainty accumulates with the horizon. At eight meetings ahead, inflation PMU induces a 31 basis point FFR target increase. In economic terms, this magnitude is the largest among the covariates we consider and is slightly larger than that of a one-standard-deviation increase in the real GDP growth nowcast (28 basis points). The extended analysis with the shadow rate confirms a large cumulative impact of inflation PMU (34 basis points at the eight meeting horizon). At the same time, the long-run effect of the real-economy PMU is non-robust with statistical and economic magnitudes weakening further in the full sample.

One might be concerned that the effects of inflation PMU are local to a particular episode in our sample. Therefore, to visualize the predictive content of PMU for future policy, Figure 9 superimposes the level of the FFR target and the shadow rate against the FOMC members' inflation PMU (smoothed over the last eight meetings). The figure illustrates a systematic nature of the relationship whereby policy tightenings tend to be preceded by rising policymakers' perceptions of inflation uncertainty, and policy easings—by its declines.

IV.E. Individual-level results

One consideration in interpreting the meeting-level results is that they could arise from a disagreement among members as opposed to the common perceptions on the committee. We thus turn to estimating the language-based reaction functions at the individual FOMC-member level exploiting the granularity of our textual data. The results show that it is the common perception of uncertainty on the committee that affects the policy stance.

In Table VI, the dependent variable is the policy stance of member i in meeting t, HD_{it} (using the policy-round statements), and the explanatory variables are the corresponding uncertainty and sentiment scores of that member (using their economy-round statements). The goal is to study how a policymaker's own expression of uncertainty predicts their individual policy stance. All regressions include member fixed effects, and so the estimates represent

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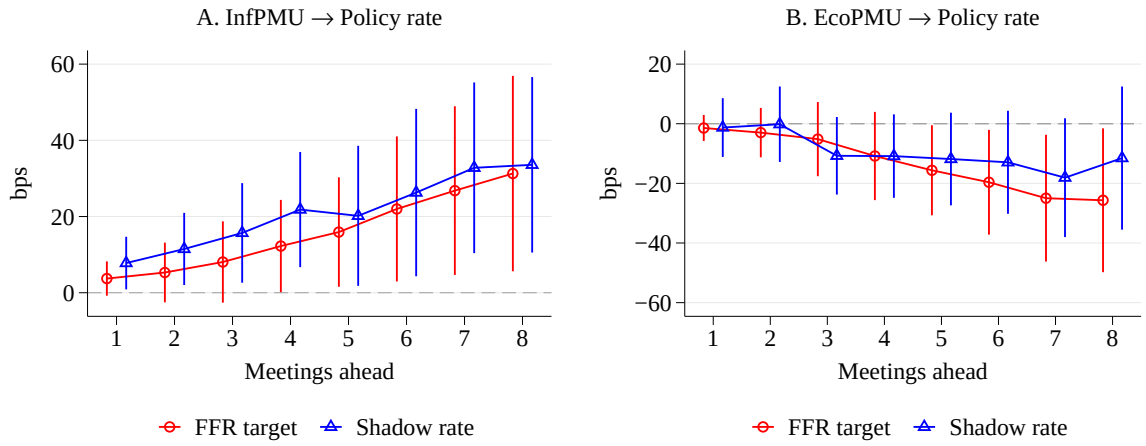

Figure 8. Cumulative effects of PMU on FFR. The figure presents the response of the policy rate (in basis points) to a one-standard deviation change in the PMU. Two measures of the policy rate are considered: the FFR target (circles) and the shadow rate of Wu and Xia (2016) (triangles). The coefficients are obtained from regressing cumulative changes in policy rate ($\Delta FFR_{t+h} = FFR_{t+h} - FFR_t$ and analogously for the shadow rate), on the PMU indices, and controls including GB forecasts, trend inflation τ_t, two lags of policy rate (t and $t-1$), the BBD EPU index and inflation and real economy sentiment (*InfSent*, *EcoSent*). The textual measures are obtained from statements of FOMC members in the economy round of the meeting. The spikes mark the 95% confidence intervals obtained with HAC standard errors. The maximum sample for the eight-meeting-ahead forecast is 1987:08–2008:12 using the FFR target and 1987:08–2015:12 using the shadow rate.

the within-individual reaction functions. Column (1) shows that, similar to the meeting-level results, also within-member inflation PMU is associated with more hawkishness, while real-economy PMU with more dovishness (although this latter effect is weak). The impact of inflation uncertainty on policy stance is not driven by the member-specific sentiment (column (2)).

To study the role of common perceptions on the committee vis-á-vis heterogeneity, column (3) additionally includes aggregate meeting-level PMU indices, and column (4) includes the time fixed effects. As both specifications render the member-level PMU insignificant, the explanatory power of uncertainty comes entirely from the time-series variation rather than from cross-sectional dispersion of views across members.

Finally, the last two columns include the full set of individual-level PMU indices, including financial markets, model, and the unclassified other PMU, without and with meeting fixed effects in columns (5) and (6), respectively. Individual member policy views are sensitive to the financial markets uncertainty, with increased $MktPMU_{it}$ associated with an easier stance, supporting the demand-shock interpretation of markets uncertainty. However, this

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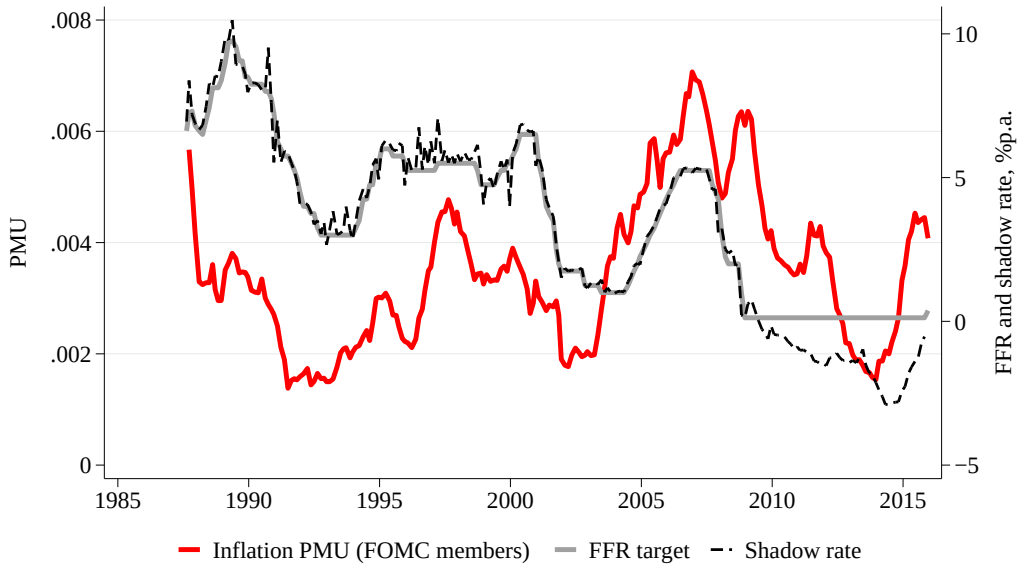

Figure 9. Inflation PMU and policy rate. The figure superimposes the inflation PMU of FOMC members measured in the economy round of the meeting against the policy rate: FFR target and the shadow rate from Wu and Xia (2016). The PMU is smoothed over eight meetings.

effect reflects common rather than member-specific variation and is subsumed by the meeting fixed effects in column (6). Model PMU ($ModPMU_{it}$) is not significant at the individual level, confirming that model misspecification is not a primary concern of policymakers driving our results. The residual uncertainty component ($OthPMU_{it}$) predicts easier policy stance even with time fixed effects, suggesting that idiosyncratic uncertainty perceptions do influence individual policy views but their effect on the overall policy stance of the committee is weak, given results in Table IV column (7).

V. The Role of Credibility in Policymaking

Having established that inflation PMU exerts significant impact on the FOMC's decision-making, we further expand on the idea in Section II.B.3 of how policymakers' credibility concerns could rationalize this behavior. We first review the existing literature on central bank credibility. Then, we draw on the narrative evidence from the transcripts to tie inflation uncertainty to the credibility concerns. Finally, we show how these concerns could affect the FOMC's communication with the public.

Blinder (2000), having surveyed central bankers and academics about credibility in monetary policy, concludes that "credibility matters in theory, and it is certainly believed to matter in practice." Bernanke (2022) notes that "achieving through word and deed" well-anchored inflation expectations can lead to better policy outcomes as it "enables the central bank to

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Dependent variable: Individual meeting-level HD_{it} policy stance score

	(1)	(2)	(3)	(4)	(5)	(6)
$InfPMU_{it}$ (ind)	0.12***	0.12***	0.00014	-0.011	0.11**	-0.0097
	(2.86)	(2.82)	(0.00)	(-0.30)	(2.62)	(-0.25)
$EcoPMU_{it}$ (ind)	-0.074	-0.058	0.018	0.012	-0.041	0.011
	(-1.65)	(-1.43)	(0.45)	(0.30)	(-1.03)	(0.29)
$InfPMU_{t}$ (agg)			0.93***			
			(4.97)			
$EcoPMU_{t}$ (agg)			-0.74***			
			(-3.63)			
$MktPMU_{it}$ (ind)					-0.16***	0.011
					(-2.70)	(0.25)
$ModPMU_{it}$ (ind)					-0.071	-0.15
					(-0.64)	(-1.38)
$OthPMU_{it}$ (ind)					-0.19***	-0.11**
					(-4.20)	(-2.40)
Sentiment	No	Yes	Yes	Yes	Yes	Yes
Meeting FE	No	No	No	Yes	No	Yes
Member FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.028	0.048	0.070	0.26	0.059	0.26
N	3925	3925	3925	3925	3925	3925

Table VI. Uncertainty of FOMC members: individual-level regressions. The table reports regressions of individual FOMC member's i policy stance at meeting t, HD_{it}, on individual PMU indices at that meeting (denoted with "(ind)"). Column (4) controls for aggregate PMU indices (denoted with "(agg)") calculated at the meeting-level. Standard errors are double-clustered at the meeting- and member-level.

respond more aggressively to recessionary demand shocks, and less aggressively to inflationary supply shocks." Reis (2022) explores the empirical history of the US Great Inflation and highlights how the Fed missed that the nominal anchor was drifting as early as 1967. This shows that despite the long-standing nominal anchor, credibility cannot be taken for granted.

While the previous few decades might have given the impression that credibility is well-established and inflation has been tamed, concern about credibility is timely. Speaking to the challenge of recently high inflation, Bernanke (2022) contends that "credibility earned by fighting inflation in the past can help," but also acknowledges that re-anchoring without a deep recession may be best achieved via a regime change that creates a visible shift in inflation dynamics. As relayed in the introduction, the Chair Powell's remarks to open the 2022 Jackson Hole Symposium have been an explicit attempt to drive home the FOMC's anti-inflation credibility.

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V.A. Existing models of credibility

In standard DSGE models credibility is typically associated with the central bank using a commitment technology such that once the commitment to a reaction function is credible, the central no longer needs to worry about it. In practice, central bankers emphasize that credibility has to be earned "by building a track record for honesty and inflation aversion (in that order of importance)" (Blinder, 2000).

Goodfriend (1993) discusses the importance of establishing credibility during the Volcker and early Greenspan Fed. The response to "inflation scares" of the 1970s was a large and sustained increase in the short-term real interest rate. Despite the cost of such action on real activity, the failure to act was considered even more costly in that it could lead to the loss of credibility and, subsequently, a weakening of the Fed's ability to control inflation in the future. Orphanides and Williams (2005) and King and Lu (2022) carry out formal modelling of inflation scares, emphasizing the preemptive aspect of the policy response. The signaling aspect of policy credibility is the focus of Cukierman and Meltzer (1986), Backus and Driffill (1985a), Backus and Driffill (1985b) and Hansen and McMahon (2015).

Carvalho et al. (2022) consider expectation formation and the anchoring of longer-term inflation expectations. Relatedly, Gáti (2022) embeds unanchored long-term inflation expectations in a general equilibrium New Keynesian model and finds the optimal policy responds aggressively to movements in long-run expected inflation. Our findings suggest that policymakers are preemptively aggressive to the *feared* changes in expectations. As attempted by Powell (2022), monetary policy can endogenously prevent moves in long-run expected inflation by regularly affirming the resolve to fight inflation.

Several recent DSGE models move away from the stark distinction between commitment and discretion. Debortoli et al. (2014) study imperfect commitment as a middle ground and call it loose commitment.[34] In their model, policymakers are endowed with a commitment technology, but they get a chance to revise their plans with some exogenous probability known by all. Higher credibility, associated with lower probability of revising plans, leads to higher welfare because it allows better management of the policy trade-offs. Bianchi and Melosi (2018) explicitly consider the idea of constrained discretion. The central bank can deviate from active inflation stabilization temporarily but at the cost of deanchoring inflation expectations. Given that agents learn slowly about the policymakers' approach, longer deviations are more likely to lead to a deanchoring. Hence, an inflation scare might precipitate a longer period of aggressive monetary response.

[34]The idea goes back to Roberds (1987). See also Schaumburg and Tambalotti (2007) for a related paper.

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V.B. Narrative evidence from FOMC deliberations

V.B.1. Inflation and credibility concerns

To explore whether policymakers' concern about credibility could underlie our empirical findings, we revisit narrative evidence in the transcripts. Here, we focus on representative examples indicating how credibility matters in policy decisions; Appendix C.3 contains a systematic chronological discussion of this issue throughout our sample.

Although policymakers' concern with inflation credibility is relatively persistent over time, its degree varies. In the second half of the 1990s, when inflation remained relatively low and stable, FOMC members nonetheless worried about their credibility. The May 2004 FOMC meeting is when inflation PMU started to increase strongly accompanied by concerns of rising inflation. Similarly, after a brief focus on deflation during the global financial crisis, by 2012 the FOMC quite quickly returned to worrying about the inflationary impact of the unconventional policies they pursued.

Janet Yellen, across her different roles on the FOMC over years, has regularly been concerned with credibility. In the September 1996 meeting, she said "...the risk of an increase in inflation has definitely risen, and I would characterize the economy as operating in an inflationary danger zone" and this warranted a small policy response because "a failure to shift policy just modestly in response to shifting inflationary risks could undermine the assumptions on which the markets' own stabilizing responses are based."

In November 2005, she was more sanguine about the risks but wary of the need to protect credibility: "Overall, I judge our credibility to be very much intact. Of course, our credibility going forward does depend on continued vigilance. The economy now appears to be close to full employment, with a good deal of momentum. And annual core inflation, at least as judged by the core PCE measure, remains near the upper end of my comfort zone and, arguably, inflation risks are tilted somewhat to the upside. So with respect to policy, I support at a minimum the removal of any remaining policy accommodation...So a few more increases, including one today, seem to me likely to be required."

As Chair, in the October 2014 meeting while inflation had fallen below 2% and was expected to fall further, she summarised the FOMC discussion: "In all, while most of you see these recent developments as largely transitory, and thus continue to expect that inflation will move gradually back toward 2 percent, some of you are concerned that we may be seeing the beginning of a worrisome downward adjustment in inflation expectations. As President Kocherlakota emphasized, a failure on our part to take decisive action could exacerbate this risk by diminishing the credibility of our commitment to our 2 percent inflation objective."

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Ben Bernanke, as Chair in the May 2004, worried about the balance of dealing with adverse inflation movements: "From a risk-management perspective, as we begin to raise rates we should weigh the risk of significantly impeding the labor market recovery against the risk of having to scramble to adjust to unexpectedly adverse inflation developments." He too paid attention to credibility concerns. In March 2006, he summarised the deliberations of the policy round as: "I took from the group some sense of at least a slight upside risk to inflation, reflecting the increasing resource utilization; the fact that inflation is somewhat on the high side of what many people describe as their comfort zone; and the fact that, if inflation does rise, there will be costs to bringing it back down and maintaining our credibility."

Other FOMC members also focused on credibility. Melzer (St Louis) spoke of credibility risks in 1997: "My reading of the economy supports the conclusion that we are at risk of losing the hard-won credibility of our commitment to hold inflation at 3 percent." In that same year, Guynn (Atlanta) thought that, with the economy around full employment, the committee had: "a unique opportunity with little downside risk to lean a bit more against the expected upward creep in inflation that most of us are forecasting and, in doing so, to underscore our resolve and credibility in the minds of financial market participants, business decisionmakers, and the general public."

Vice Chair, Ferguson, said in December 1999 that the FOMC "should not be afraid to act in a well-modulated fashion in order to maintain our hard fought victory over inflation and also our credibility." In March 2005, even as he was coming towards the end of his term, he was still focused on the FOMC's credibility and how policy actions could affect it: "given the stage of the cycle, the skew in the general risk assessment that I outlined, and the need to manage market expectations, I think we should use our statement to signal our awareness that inflation pressures may have picked up. The incoming data are indicative of that. If we are wrong on the upside risks, both we and the market will adjust. On the other hand, if we fail to reflect the existence of these upside risks, we could easily be perceived as being behind the curve, with negative consequences in terms of inflation dynamics and, potentially, our own credibility."

Broaddus (Richmond), in May 1999, recognised that his inflation fears had not been realized when he said: "I know I have been crying wolf around this table for a long time and my fears have not been realized, but we have to take each day as it comes, I guess. So, wolf!" This prompted laughter around the FOMC table. Of course, it is the credibility that he, and others, were so concerned about retaining that means they may have ultimately appeared wrong in their projection.

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V.B.2. Communicating hawkishness

How do policymakers convey their stance to the markets once they become more uncertain about inflation and, by extension, their own credibility? We have documented that inflation PMU predicts policy stance expressed in our *HD* measure. We have also argued that the *HD* variable contains information about policy path beyond the current action. To the extent that communication is key part of monetary transmission (Gürkaynak et al., 2005), this suggests that stance induced by policymakers' inflation uncertainty could be revealed to the public through a particular crafting of the statement.

In most meetings, the FOMC selects the so-called Alternative B policy from the Bluebook/Tealbook prepared by the staff. While Alternative B often forms the baseline, FOMC members frequently modify its language to convey their specific policy views in the statement revealed to the public. As one example of this process, in the November 2005 meeting, President Yellen's views (discussed above) lead her to support a more hawkish language than proposed with the Alternative B: "In implementing monetary policy, it seems to me that actions matter, but so do words, and I wanted to briefly open up the question of the statement. I think for today the words of alternative B should suffice, but Vincent has repeatedly suggested, and a number of you have emphasized, that we need to consider how to modify the statement language." She advocated for language closer to the Alternative C as "It eliminates the balance of risk statement and the policy accommodation language; and it substitutes a new forward-looking policy statement for the 'measured pace' phrasing." In this particular example, the FOMC went largely with the alternative B language and retained the "measured pace" guidance, but this is not always the case.

Table VII presents key statement changes made by the FOMC members for a few meetings before the global financial crisis, when our inflation PMU was particularly elevated. The "proposed" column shows the language associated with the Bluebook/Tealbook alternative chosen by the FOMC, and the "statement" column is the actual statement that was communicated to the markets. The table highlights how the proposed language (underlined) was altered in the final statement (capitalized).

In the May 2006 FOMC meeting, when the *InfPMU* was in the top 1% of its sample values, and the *HD* measure was in the top 5%, the FOMC changed the statement to emphasise the need to tighten in order to address the risk of increasing inflation. In June 2006, the FOMC placed increased emphasis on the potential need to tighten further to restrain inflation risks. In March 2007, the FOMC changed the statement to reflect their continued hawkish stance.

By the June 2007 meeting, both the *InfPMU* and *HD* measures were declining from recent peaks. The FOMC members were nonetheless still emphasising their vigilance on inflation.

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Meeting	Proposed	Statement
May 2006	To keep the risks to the attainment of both sustainable economic growth and price stability roughly in balance, some further policy firming may be needed. The Committee judges that any additional firming is likely to be modest. However, the extent and timing of any such firming will depend importantly on the evolution of the economic outlook as implied by incoming information.	THE COMMITTEE JUDGES THAT to some further policy firming may YET be needed TO ADDRESS INFLATION RISKS BUT EMPHASIZES that the extent and timing of any such firming will depend importantly on the evolution of the economic outlook as implied by incoming information.
June 2006	Although the moderation in the growth of aggregate demand should help to contain inflation pressures, the Committee judges that the risks to the attainment of price stability remain tilted to the upside. The extent and timing of any further policy action will depend importantly on the evolution of the economic outlook, as implied by incoming information.	Although the moderation in the growth of aggregate demand should help to LIMIT inflation pressures OVER TIME, the Committee judges that SOME INFLATION risks remain. The extent and timing of any ADDITIONAL FIRMING THAT MAY BE NEEDED TO ADDRESS THESE RISKS will depend on the evolution of the OUTLOOK FOR BOTH INFLATION AND economic GROWTH, as implied by incoming information.
March 2007	Despite the ongoing adjustment in the housing sector, the economy seems likely to continue to expand at moderate pace over coming quarters Supported in part by gains in personal income and consumer spending. Readings on core inflation have improved modestly in recent months, and inflation pressures seem likely to moderate over time. However, the high level of resource utilization has the potential to sustain inflation pressures. In these circumstances, the Committee principal policy concern remains the risk that inflation will fail to moderate as expected.	RECENT INDICATORS HAVE BEEN MIXED AND the adjustment in the housing sector IS ONGOING. NEVERTHELESS, the economy seems likely to continue to expand at moderate pace over coming quarters. RECENT readings on core inflation have BEEN SOMEWHAT ELEVATED. ALTHOUGH inflation pressures seem likely to moderate over time, the high level of resource utilization has the potential to sustain THOSE pressures. In these circumstances, the Committee PREDOMINANT policy concern remains the risk that inflation will fail to moderate as expected.
June 2007	Readings on core inflation have improved modestly in recent months. However, the high level of resource utilization has the potential to sustain inflation pressures. In these circumstances, the Committee predominant policy concern is the risk that the moderation in inflation will fail to be sustained.	Readings on core inflation have improved modestly in recent months. However, SUSTAINED MODERATION IN INFLATION PRESSURES HAS YET TO BE CONVINCINGLY DEMONSTRATED. MOREOVER, the high level of resource utilization has the potential to sustain THOSE pressures. In these circumstances, the Committee predominant policy concern REMAINS the risk that inflation will fail to MODERATE AS EXPECTED.
October 2007	Readings on core inflation have improved modestly this year. However, the Committee judges that some inflation risks remain, and it will continue to monitor inflation developments carefully. The Committee judges that the upside risks to inflation roughly balance the downside risks to growth.	Readings on core inflation have improved modestly this year BUT RECENT INCREASES IN ENERGY AND COMMODITY PRICES, AMONG OTHER FACTORS, MAY PUT RENEWED UPWARD PRESSURE ON INFLATION. IN THIS CONTEXT, the Committee judges that some inflation risks remain, and it will continue to monitor inflation developments carefully. The Committee judges that AFTER THIS ACTION, the upside risks to inflation roughly balance the downside risks to growth.

Table VII. Key changes to the FOMC statement made by the FOMC members

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This is true even in October 2007 when the committee actually chose the more dovish Alternative A action to reduce the FFR target rate, but altered the statement to emphasize that they continued to monitor inflation risks and their balance with output risks.

These examples illustrate how inflation uncertainty expressed in internal FOMC deliberations and captured with our text-based measures affects the policy stance, and ultimately, the way that the Fed communicates it with financial markets.

VI. Conclusions

We contribute to the literature by quantifying otherwise hard-to-measure factors driving monetary policymaking using texts of the FOMC deliberations. We show that policymakers' beliefs about the higher-order moments of the economic distributions affect the policy stance at the FOMC meetings during the 1987–2015 sample. Policymakers' perceptions of uncertainty about inflation and the real-economy drive a wedge between estimated policy rules using Greenbook forecasts and the actual decision-making of the committee. Uncertainty about the real-economy and inflation affect the policy stance in opposite ways. An increase in the real-economy uncertainty works similar to a typical negative demand shock, consistent with the uncertainty channel postulated in recent macro models.

Our key new results pertain to the effects of inflation uncertainty. Heightened inflation uncertainty leads to more hawkishness. We show that the uncertainty relevant for understanding the Fed decision-making deviates significantly from the public perceptions of uncertainty or objective measures of macroeconomic volatility. In particular, policymakers' uncertainty is associated with their skewed beliefs about increasing inflation.

The benefits of maintaining credibility, in terms of expectations management and better policy trade-offs, are well understood and appreciated by the FOMC. Our findings are consistent with credibility concerns introducing a wedge between objective and policymakers' perceived uncertainty. Endogenous concerns about the FOMC's own reputation for controlling inflation are important drivers of their policy. This finding has implications for the modelling of monetary policy decisions. Models that wish to explore optimal policy, communication or design, should consider the policymakers' need to earn their credibility to be able to use it to counter recessions when faced with adverse shocks.

Our results also have implications for empirical analysis of monetary policy. In particular, the assumption of stable reaction functions seems unlikely. Clarida et al. (2000) estimated monetary policy reaction functions for the US before and after Volcker's tenure, concluding that the Fed was much more sensitive to expected inflation in the post-Volcker era. Our findings suggest that the FOMC switches between modes of operation and that market

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surprises result from the endogenous switch from one mode (such as saving the economy) to the other (fighting inflation and building credibility). This is consistent with the earlier results in Cieslak (2018), Bauer and Swanson (2020), and McMahon and Munday (2022a).

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Internet Appendix for:

Policymakers' Uncertainty

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A. Dictionaries for Risk, Uncertainty, Topics, and Sentiment

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risk			risks		
Term	Similarity	Count in Econ Discussion	Term	Similarity	Count in Econ Discussion
risks	0.691266	3183	downside risk*	0.737511	1118
downside risk*	0.59828	1118	upside risk*	0.704978	585
threat	0.594511	135	risk	0.691266	3236
upside risk*	0.522107	585	threat	0.52743	135
danger	0.502593	121	skewed	0.501801	101
probability	0.484233	524	uncertainties	0.48339	505
possibility	0.475492	1010	~~downside~~	0.449301	707
likelihood	0.469565	224	~~tilted~~	0.448698	119
vulnerability	0.439843	72	danger	0.445836	121
dangers	0.406005	28	dangers	0.439822	28
~~headwind~~	0.402709	38	fatter	0.434411	14
chances	0.386979	65	~~outcomes~~	0.420205	291
fragility	0.374305	106	probability	0.412639	524
~~risktaking~~	0.373512	50	skew	0.40086	29
~~challenges~~	0.348706	174	~~challenges~~	0.395508	174
~~prospect~~	0.347213	242	~~juncture~~	0.393311	114
~~unwelcome~~	0.345361	42	modal	0.391584	131
sensitivity	0.343196	82	~~headwinds~~	0.385167	288
probabilities	0.342825	87	vulnerabilities	0.378889	59
~~breakout~~	0.34249	39	probabilities	0.375555	87
uncertainty	0.341431	2317	concerns	0.374206	628
~~consequences~~	0.339106	367	~~breakout~~	0.372844	39
concern* that	0.33652	678	possibilities	0.369255	98
odds	0.332704	190	uncertainty	0.362784	2317
fatter	0.331849	14	vulnerability	0.355743	72
concern	0.326579	1047	~~directive~~	0.355738	29
potentially	0.322536	275	tensions	0.35208	51
concerns	0.318465	628	~~crosscurrents~~	0.350524	49
tension	0.313301	101	odds	0.343869	190
~~spiral~~	0.312127	69	threats	0.33815	36
possibly	0.309975	290	fragility	0.337531	106
~~costly~~	0.309472	63	~~symmetric~~	0.336238	57
~~challenge~~	0.307298	179	~~asymmetry~~	0.333936	25
~~urgency~~	0.303853	28	~~skews~~	0.33296	14
~~instability~~	0.303578	91	~~urgency~~	0.3309	28
unease	0.303215	25	skewness	0.330203	7
vulnerabilities	0.302247	59	tension	0.325514	101
fear	0.299544	194	~~headwind~~	0.323167	38
skewness	0.298903	7	~~vigilant~~	0.319233	55
~~trap~~	0.297911	58	~~drags~~	0.31894	75
~~overshoot~~	0.296446	53	~~costpush~~	0.318601	4
~~problem~~	0.295296	1221	possibility	0.318443	1010
skew	0.29475	29	~~balanced~~	0.317706	646
worries	0.294228	132	tails	0.31724	28
threats	0.294017	36	~~challenge~~	0.316888	179
~~repercussions~~	0.289451	23	likelihood	0.315145	224
skewed	0.287008	101	imponderables	0.31498	10
volatility	0.284335	360	~~considerations~~	0.311688	184
doubts	0.283668	65	~~consequences~~	0.306922	367
~~juncture~~	0.283524	114	~~leaning~~	0.305052	38

Table A-1. Nearest Neighbors of Risk and Risks in FOMC Word Embeddings. This table shows the fifty nearest neighbors to the terms 'risk' and 'risks' for a word embedding model estimated from the economy round of the FOMC transcripts. For each neighbor term, we report the cosine similarity in the word embedding space and the count of the term in the economy round. We remove certain terms from our final dictionary if they are too generic (struck through).

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uncertain			uncertainty		
Term	Similarity	Count in Econ Discussion	Term	Similarity	Count in Econ Discussion
!confident	0.460385	367	uncertainties	0.65845	505
fragile	0.455998	157	anxiety	0.515023	70
!sanguine	0.442406	101	angst	0.433309	24
murky	0.43732	24	skepticism	0.430759	68
unclear	0.436552	57	tension	0.427094	101
wary	0.428437	41	uncertain	0.426752	399
uncertainty	0.426752	2317	~~caution~~	0.423748	445
unsure	0.423955	14	downside risk*	0.418226	1118
~~poor~~	0.411094	194	~~challenges~~	0.414084	174
~~dependent~~	0.406995	119	pessimism	0.411988	179
apprehensive	0.404002	11	fragility	0.401378	106
vulnerable	0.401095	203	gloom	0.380074	65
stressed	0.397458	53	~~conflict~~	0.370107	47
~~challenging~~	0.391555	71	risks	0.362784	3183
~~bullish~~	0.38583	65	volatility	0.359692	360
bleak	0.385454	52	concerns	0.359599	628
skeptical	0.384238	169	!clarity	0.352539	89
~~attuned~~	0.383523	15	sensitivity	0.348326	82
uncertainties	0.383365	505	unease	0.347682	25
~~vigilant~~	0.382641	55	~~publicity~~	0.346734	31
~~cautious~~	0.378045	537	fog	0.343423	20
grim	0.376893	34	~~headwinds~~	0.341591	288
~~jury~~	0.376789	20	risk	0.341431	3236
agnostic	0.375537	31	~~surrounding~~	0.340727	163
!optimistic	0.372549	1249	worries	0.337692	132
~~muted~~	0.365712	87	!certainty	0.332492	91
unsettled	0.362423	22	doubts	0.328778	65
concern* about	0.361507	1634	concern	0.327687	1047
~~buoyant~~	0.360631	70	optimism	0.32465	498
~~disruptive~~	0.359961	50	~~pain~~	0.323275	31
~~depend~~	0.359918	198	ambiguity	0.322258	18
skittish	0.35904	18	error	0.320998	234
jittery	0.358658	11	skittishness	0.319675	9
precarious	0.357391	22	nervousness	0.319648	31
fog	0.357145	20	unknown	0.316516	32
fluid	0.357016	12	tensions	0.314929	51
!convinced	0.354622	173	imponderables	0.314825	10
pessimistic	0.354016	430	upside risk*	0.313048	585
!upbeat	0.352921	217	~~debate~~	0.312722	168
~~destabilizing~~	0.35242	22	~~awareness~~	0.312388	26
precise	0.352262	81	~~uncertaintyin~~	0.310427	3
uncomfortable	0.348358	102	~~disagreement~~	0.304366	57
~~assessing~~	0.345848	110	~~admits~~	0.302832	3
~~damaging~~	0.342869	39	~~science~~	0.29633	31
~~satisfactory~~	0.339921	66	~~apprehension~~	0.292553	16
anxious	0.33839	40	~~headwind~~	0.290777	38
~~worried~~	0.337316	410	~~instability~~	0.290598	91
ambiguous	0.335987	32	~~troubles~~	0.288294	35
problematic	0.33498	78	~~questions~~	0.288182	698
daunting	0.332674	19	~~worry~~	0.286513	402

Table A-2. Nearest Neighbors of Uncertain and Uncertainty in FOMC Word Embeddings. This table shows the fifty nearest neighbors to the terms 'uncertain' and 'uncertainty' for a word embedding model estimated from the economy round of the FOMC transcripts. For each neighbor term, we report the cosine similarity in the word embedding space and the count of the term in the economy round. We remove certain terms from our final dictionary if they are too generic (struck through). An exclamation mark preceding a term indicates it is only associated with the dictionary when it is negated, i.e., when it is immediately preceded by a negation phrase, which is one of {'less', 'no','not', 'little', 'don't', 'doesn't', 'hasn't', 'haven't', 'won't', 'shouldn't', 'didn't'}.

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Nouns	Match w/ direction words		Direction words	
	Negative	Positive	Group 1	Group 2
commodity price*	1	2	*abated*	*acceler**
consumer energy price*	1	2	*adjust* downward*	*adjust* upward*
consumer food price*	1	2	*contract**	*advanc**
consumer price index*	1	2	*cool**	*bolster**
consumer price index* cpi	1	2	*deceler**	*boost**
consumer price inflation	1	2	*declin**	*elevat**
consumer price*	1	2	*decreas**	*expand**
core consumer price inflation	1	2	*down*	*fast**
core consumer price*	1	2	*downturn*	*gain**
core cpi	1	2	*downward*	*go* up*
core cpi inflation	1	2	*downward adjust**	*heighten**
core inflation	1	2	*downward revision*	*high**
core pce inflation	1	2	*drop**	*increas**
core pce price inflation	1	2	*eas**	*mov* higher*
core pce price*	1	2	*fall**	*mov* up*
core price inflation	1	2	*fell*	*mov* upward*
core producer price*	1	2	*go* down*	*pick* up*
cost basic material*	1	2	*limit**	*rais**
cost* goods and services	1	2	*low**	*rallied*
cost* health care	1	2	*moderate**	*rally**
cost* labor	1	2	*moderati**	*rebound**
cost* living	1	2	*mov* down*	*recoup**
cost* us goods and services	1	2	*mov* downward*	*revis* up**
crude oil price*	1	2	*mov* lower*	*rise**
disinflation*	2	1	*pullback*	*rising*
disinflation* pressure*	2	1	*reduc**	*rose*
employment cost index*	1	2	*revis* down**	*run up*
energy prices	1	2	*slow**	*runup*
headline inflation	1	2	*slow* down*	*stop decline*
health care cost*	1	2	*soft**	*strength**
inflation*	1	2	*stagnate**	*strong**
inflation compensation	2	1	*stall**	*tick* up*
inflation expectation*	1	2	*subdu**	*up*
inflation level	1	2	*tick* down*	*upward*
inflation outlook	1	2	*tight**	*upward adjust**
inflation rate	1	2	*weak**	*upward revision*
inflation wage*	1	2	*weigh* on*	*went up*
labor compensation	1	2	*went down*	
labor cost pressure*	1	2		
labor cost*	1	2		
long* run inflation expectation*	1	2		
long* term inflation expectation*	1	2		
manufacturing price*	1	2		
material price*	1	2		
near* term inflation expectation*	1	2		
oil price*	1	2		
pce price index*	1	2		
pressure* inflation	1	2		
pressure* wages	1	2		
price index*	1	2		
price inflation	1	2		
price level stability	2	1		
price stability	2	1		
prices of durable goods	1	2		
prices of durables	1	2		
prices of manufacturing	1	2		
prices of material*	1	2		
producer price ind*	1	2		
producer price*	1	2		
real oil price*	1	2		
unit labor cost*	1	2		
wage gains	1	2		
wage inflation	1	2		
wage pressure*	1	2		
wage price pressure*	1	2		
wages	1	2		
inflation* pressure*	1	2		
price pressure*	1	2		
deflation* force*	2	1		
deflation* pressure	2	1		
deflation*	2	1		
prices of durable goods	1	2		
prices of durables	1	2		
prices of manufacturing	1	2		
prices of material*	1	2		

Table A-3. Noun Phrases and Direction Words Related to Inflation and Wages. The first column displays the phrases we associate with inflation and wage discussion in the FOMC transcripts. The second to fifth columns relate to the construction of inflation sentiment. An instance of positive sentiment occurs when a mention of one of the nouns with a 1 (2) recorded in the 'Positive' column is preceded or followed by a phrase from Group 1 (Group 2) within sub-sentences. Negative sentiment is constructed analogously.

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Nouns	Match w/ direction words		Direction words	
	Positive	Negative	Group 1	Group 2
aggregate demand	2	1	*adjust* downward*	*acceler**
aggregate inventory sales ratio	1	2	*adverse*	*adjust* upward*
aggregate spending	2	1	*contract**	*advanc**
building activity	2	1	*cool**	*better*
business activity	2	1	*cut**	*bolster**
business capital spending	2	1	*deceler**	*boost**
business confidence	2	1	*declin**	*elevat**
business demand capital equipment	2	1	*decreas**	*encourag**
business equipment investment	2	1	*deteriorat**	*expand**
business equipment spending	2	1	*disappoint**	*fast**
business equipment spending	2	1	*down*	*favor**
business equipment spending and industrial production	2	1	*downturn*	*gain**
business expansion	2	1	*downward*	*go* up*
business expenditure*	2	1	*downward adjust**	*heighten**
business fixed investment	2	1	*downward revision*	*high**
business fixed investment and household spending	2	1	*drag**	*improv**
business inventory investment	2	1	*drop**	*increas**
business investment	2	1	*eas**	*mov* higher*
business investment spending	2	1	*fall**	*mov* up*
business outlay*	2	1	*fell*	*mov* upward*
business outlays capital equipment	2	1	*go* down*	*pick* up*
business output	2	1	*held down*	*rais**
business purchas*	2	1	*hold down*	*rallied*
business purchases of transporation equipment	2	1	*increas* at slow* rate*	*rally**
business sector	2	1	*limit**	*rebound**
business sentiment	2	1	*low**	*recoup**
business spending	2	1	*moderate**	*revis* up**
business spending capital equipment	2	1	*moderati**	*rise**
business spending of transporation equipment	2	1	*mov* down*	*rising*
capacity utilization	2	1	*mov* downward*	*rose*
capital investment	2	1	*mov* lower*	*run up*
capital spending	2	1	*pressur**	*runup*
capital spending plan*	2	1	*pullback*	*stop decline*
civilian unemployment rate	1	2	*reduc**	*strength**
claim* unemployment insurance	1	2	*revis* down**	*strong**
construction activity	2	1	*slow**	*tick* up*
consumer confidence	2	1	*slow* down*	*tight**
consumer sector	2	1	*soft**	*up*
consumer sentiment	2	1	*stagnat**	*upward*
consumer spending	2	1	*stall**	*upward adjust**
consumption	2	1	*strain**	*upward revision*
consumption spending	2	1	*stress**	*went up*
current account deficit			*subdu**	
current account surplus			*take* toll on*	
disposable income	2	1	*tension**	
domestic components of spending	2	1	*tick* down*	
domestic demand	2	1	*took toll on*	
domestic economy	2	1	*weak**	
domestic final demand	2	1	*weigh* down*	
domestic spending	2	1	*weigh* on*	
domestic spending components	2	1	*went down*	
durable equipment	2	1	*worse**	
economic activity	2	1		
economic development*	2	1		
economic expansion	2	1		
economic growth	2	1		
economic outlook	2	1		
economic performance	2	1		
economic recovery	2	1		
economic situation	2	1		
employment	2	1		
employment growth	2	1		
employment rate	2	1		
excess capacity	1	2		
factory output	2	1		

Table A-4. Noun Phrases and Direction Words Related to Economic Growth (1). The first column displays a subset the phrases we associate with economic growth discussion in the FOMC transcripts (see other tables in sequence for other nouns). The second to fifth columns relate to the construction of growth sentiment. An instance of positive sentiment occurs when a mention of one of the nouns with a 1 (2) recorded in the 'Positive' column is preceded or followed by a phrase from Group 1 (Group 2) within sub-sentences. Negative sentiment is constructed analogously. Nouns with no number recorded in the second and third columns are used to contextualize uncertainty language but not for the construction of sentiment.

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Nouns	Match w/ direction words		Direction words	
	Positive	Negative	Group 1	Group 2
final demand	2	1	*adjust* downward*	*acceler**
gdp growth	2	1	*adverse*	*adjust* upward*
global economic growth	2	1	*contract**	*advanc**
gross domestic product	2	1	*cool**	*better*
high tech equipment investment	2	1	*cut**	*bolster**
high tech equipment spending	2	1	*deceler**	*boost**
household spending and business fixed investment	2	1	*declin**	*elevat**
household* spending	2	1	*decreas**	*encourag**
housing activity	2	1	*deteriorat**	*expand**
housing construction	2	1	*disappoint**	*fast**
housing demand	2	1	*down*	*favor**
income growth	2	1	*downturn*	*gain**
industrial production	2	1	*downward*	*go* up*
inventories	2	1	*downward adjust**	*heighten**
inventory accumulation	1	2	*downward revision*	*high**
inventory investment	2	1	*drag**	*improv**
inventory liquidation	2	1	*drop**	*increas**
inventory sales ratio	1	2	*eas**	*mov* higher*
investment condition*	2	1	*fall**	*mov* up*
investment demand	2	1	*fell*	*mov* upward*
investment high tech equipment	2	1	*go* down*	*pick* up*
investment manufacturing	2	1	*held down*	*rais**
investment situation	2	1	*hold down*	*rallied*
investment spending	2	1	*increas* at slow* rate*	*rally**
job growth	2	1	*limit**	*rebound**
labor demand	2	1	*low**	*recoup**
labor force participation	2	1	*moderate**	*revis* up**
labor market*	2	1	*moderati**	*rise**
labor market condition*	2	1	*mov* down*	*rising*
labor market indicator*	2	1	*mov* downward*	*rose*
labor market slack	1	2	*mov* lower*	*run up*
labor productivity	2	1	*pressur**	*runup*
manufacturing activity	2	1	*pullback*	*stop decline*
manufacturing capacity utilization	2	1	*reduc**	*strength**
manufacturing output	2	1	*revis* down**	*strong**
manufacturing production	2	1	*slow**	*tick* up*
manufacturing sector	2	1	*slow* down*	*tight**
motor vehicle assembl*	2	1	*soft**	*up*
motor vehicle production	2	1	*stagnat**	*upward*
motor vehicle purchas*	2	1	*stall**	*upward adjust**
motor vehicle sales	2	1	*strain**	*upward revision*
motor vehicle sector	2	1	*stress**	*went up*
new construction	2	1	*subdu**	
new home sales	2	1	*take* toll on*	
new orders	2	1	*tension**	
nominal gdp	2	1	*tick* down*	
nonfarm business sector	2	1	*took toll on*	
nonfarm payroll employment	2	1	*weak**	
nonresidential construction	2	1	*weigh* down*	
nonresidential construction activity	2	1	*weigh* on*	
orders and shipments of nondefense capital goods	2	1	*went down*	
orders of nondefense capital goods	2	1	*worse**	
outlays business equipment	2	1		
outlays high tech equipment	2	1		
outlays transporation equipment	2	1		
outlook economic activity	2	1		
output gap				
output growth	2	1		
payroll employment	2	1		
pce	2	1		
personal consumption expenditure*	2	1		
personal income	2	1		
potential output	2	1		
potential output	2	1		
private expenditures business equipment	2	1		

Table A-5. Noun Phrases and Direction Words Related to Economic Growth (2). The first column displays a subset the phrases we associate with economic growth discussion in the FOMC transcripts (see other tables in sequence for other nouns). The second to fifth columns relate to the construction of growth sentiment. An instance of positive sentiment occurs when a mention of one of the nouns with a 1 (2) recorded in the 'Positive' column is preceded or followed by a phrase from Group 1 (Group 2) within sub-sentences. Negative sentiment is constructed analogously. Nouns with no number recorded in the second and third columns are used to contextualize uncertainty language but not for the construction of sentiment.

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Nouns	Match w/ direction words		Direction words	
	Positive	Negative	Group 1	Group 2
private nonfarm employment	2	1	*adjust* downward*	*acceler**
private nonfarm payroll employment	2	1	*adverse*	*adjust* upward*
private sector investment	2	1	*contract**	*advanc**
private spending	2	1	*cool**	*better*
productivity	2	1	*cut**	*bolster**
productivity growth	2	1	*deceler**	*boost**
purchas* of motor vehicle*	2	1	*declin**	*elevat**
real activity	2	1	*decreas**	*encourag**
real business spending	2	1	*deteriorat**	*expand**
real consumer spending	2	1	*disappoint**	*fast**
real disposable income	2	1	*down*	*favor**
real disposable personal income	2	1	*downturn*	*gain**
real gdp	2	1	*downward*	*go* up*
real gdp growth	2	1	*downward adjust**	*heighten**
real gnp	2	1	*downward revision*	*high**
real personal consumption expenditure*	2	1	*drag**	*improv**
real spending	2	1	*drop**	*increas**
residential construction	2	1	*eas**	*mov* higher*
residential construction activity	2	1	*fall**	*mov* up*
residential investment	2	1	*fell*	*mov* upward*
resource use	2	1	*go* down*	*pick* up*
resource utilization	2	1	*held down*	*rais**
retail trade	2	1	*hold down*	*rallied*
shipments of nondefense capital goods	2	1	*increas* at slow* rate*	*rally**
spending and production	2	1	*limit**	*rebound**
spending business equipment	2	1	*low**	*recoup**
spending high tech equipment	2	1	*moderate**	*revis* up**
spending nonresidential structures	2	1	*moderati**	*rise**
spending transporation equipment	2	1	*mov* down*	*rising*
structural productivity	2	1	*mov* downward*	*rose*
total industrial production	2	1	*mov* lower*	*run up*
total nonfarm payroll employment	2	1	*pressur**	*runup*
unemployment	1	2	*pullback*	*stop decline*
unemployment insurance claim*	1	2	*reduc**	*strength**
unemployment level	1	2	*revis* down**	*strong**
unemployment rate	1	2	*slow**	*tick* up*
us economic activity	2	1	*slow* down*	*tight**
us economy	2	1	*soft**	*up*
outlook economy	2	1	*stagnat**	*upward*
inventory level*	1	2	*stall**	*upward adjust**
fiscal			*strain**	*upward revision*
deficit			*stress**	*went up*
surplus			*subdu**	
			take toll on*	
			*tension**	
			tick down*	
			took toll on	
			*weak**	
			weigh down*	
			weigh on*	
			went down	
			*worse**	

Table A-6. Noun Phrases and Direction Words Related to Economic Growth (3). The first column displays a subset the phrases we associate with economic growth discussion in the FOMC transcripts (see other tables in sequence for other nouns). The second to fifth columns relate to the construction of growth sentiment. An instance of positive sentiment occurs when a mention of one of the nouns with a 1 (2) recorded in the 'Positive' column is preceded or followed by a phrase from Group 1 (Group 2) within sub-sentences. Negative sentiment is constructed analogously. Nouns with no number recorded in the second and third columns are used to contextualize uncertainty language but not for the construction of sentiment.

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Nouns	Match w/ direction words		Direction words	
	Positive	Negative	Group 1	Group 2
aaa spread*	1	2	*adjust* downward*	*acceler**
baa spread*	1	2	*contract**	*adjust* upward*
corporate bond spread*	1	2	*cool**	*advanc**
corporate spread*	1	2	*deceler**	*adverse*
cost of bank credit	1	2	*declin**	*bolster**
cost of bond financ*	1	2	*decreas**	*boost**
cost of capital	1	2	*down*	*deteriorat**
cost of credit	1	2	*downturn*	*edge* up**
cost of equity	1	2	*downward*	*elevat**
cost of external capital	1	2	*downward adjust**	*expand**
cost of funding	1	2	*drop**	*fast**
cost of raising capital	1	2	*eas**	*gain**
cost of raising capital through equity	1	2	*edge* down*	*go* up*
credit cost*	1	2	*encourag**	*heighten**
credit default swap*	1	2	*fall**	*high**
credit risk spread*	1	2	*favor**	*increas**
credit spread*	1	2	*fell*	*mov* higher*
debt securities spread*	1	2	*go* down*	*mov* up*
equity risk prem*	1	2	*improv**	*mov* upward*
expected real return equit*	1	2	*limit**	*pick* up*
expected return equit*	1	2	*low**	*pressure**
financing cost	1	2	*moderate**	*rais**
funding cost	1	2	*moderati**	*rebound**
risk prem*	1	2	*mov* down*	*recoup**
risk spread*	1	2	*mov* downward*	*revis* up**
risk spread* corporate bonds*	1	2	*mov* lower*	*rise**
spread* corporate bond*	1	2	*narrow**	*rising*
spread* investment grade bond*	1	2	*pullback*	*rose*
spread* speculative grade bond*	1	2	*reduc**	*run up*
			revis down**	*runup*
			*slow**	*stop decline*
			*soft**	*strain**
			*subdu**	*strength**
			take toll on*	*stress**
			tick down*	*strong**
			took toll on	*tension**
			*weak**	*tick* up*
			weigh on*	*up*
			went down	*upward*
				*upward adjust**
				went up
				*widen**
				*worse**

Table A-7. Noun Phrases Related to Financial Markets (1). The first column displays a subset the phrases we associate with financial market discussion in the FOMC transcripts (see other tables in sequence for other nouns). The second to fifth columns relate to the construction of market sentiment. An instance of positive sentiment occurs when a mention of one of the nouns with a 1 (2) recorded in the 'Positive' column is preceded or followed by a phrase from Group 1 (Group 2) within sub-sentences. Negative sentiment is constructed analogously.

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Nouns	Match w/ direction words		Direction words	
	Positive	Negative	Group 1	Group 2
appetite* risk taking	2	1	*adjust* downward*	*acceler**
appetite* risk*	2	1	*adverse*	*adjust* upward*
appetite* risk* asset*	2	1	*contract**	*advanc**
appetite* risk* investment*	2	1	*cool**	*bolster**
appetite* taking risk*	2	1	*deceler**	*boost**
condition* credit market*	2	1	*declin**	*eas**
condition* financial market*	2	1	*decreas**	*elevat**
credit condition*	2	1	*deteriorat**	*encourag**
credit growth	2	1	*down*	*expand**
credit market*	2	1	*downturn*	*fast**
credit market condition*	2	1	*downward*	*favor**
credit market demand	2	1	*downward adjust**	*gain**
development financial market*	2	1	*downward revision*	*go* up*
financial condition*	2	1	*drop**	*high**
financial development*	2	1	*fall**	*improv**
financial instabilit*	1	2	*fell*	*increas**
financial market condition*	2	1	*go* down*	*loos**
financial market confidence	2	1	*limit**	*mov* higher*
financial market development*	2	1	*low**	*mov* up*
financial market index*	2	1	*moderate**	*mov* upward*
financial market indic*	2	1	*moderati**	*normaliz**
financial market pressure*	1	2	*mov* down*	*pick* up*
financial market price*	2	1	*mov* downward*	*rais**
financial market sentiment	2	1	*mov* lower*	*rallied*
financial market*	2	1	*pressure**	*rally**
financial situation	2	1	*pullback*	*rebound**
financial stability	2	1	*reduc**	*recoup**
investor* appetite*	2	1	*restrictive*	*revis* up**
investor* appetite* risk*	2	1	*revis* down**	*rise**
investor* confidence	2	1	*slow**	*rising*
investor* risk appetite*	2	1	*soft**	*rose*
investor* sentiment	2	1	*stagnate**	*run up*
investor* sentiment toward risk*	2	1	*stall**	*runup*
investor* sentiment toward risk* asset*	2	1	*strain**	*stop decline*
liquidity	2	1	*stress**	*strength**
pressure* financial market	1	2	*subdu**	*strong**
risk appetite*	2	1	*take a toll on*	*tick* up*
bank credit	2	1	*tension**	*up*
bank lending	2	1	*tick* down*	*upward*
banking supervision			*tight**	*upward adjust**
banking system	2	1	*took toll on*	*upward revision*
consumer credit	2	1	*turbulent*	*went up*
credit availability	2	1	*weak**	
credit quality	2	1	*weigh* on*	
domestic credit	2	1	*went down*	
domestic nonfinancial debt	2	1	*worsen**	
financial outlook	2	1		
financial system	2	1		
foreign exchange				
foreign exchange market*				
foreign exchange valu*				
household balance sheet*	2	1		
market exchange rate*				
market liquidity	2	1		
mortgage refinancing activity	2	1		
non market exchange rate*				
nonfinancial debt	2	1		
private credit	2	1		
private credit market*	2	1		
seasonal borrowing	2	1		
total domestic non financial debt	2	1		
total domestic nonfinancial debt	2	1		
us dollar				

Table A-8. Noun Phrases Related to Financial Markets (2). The first column displays a subset the phrases we associate with financial market discussion in the FOMC transcripts (see other tables in sequence for other nouns). The second to fifth columns relate to the construction of market sentiment. An instance of positive sentiment occurs when a mention of one of the nouns with a 1 (2) recorded in the 'Positive' column is preceded or followed by a phrase from Group 1 (Group 2) within sub-sentences. Negative sentiment is constructed analogously. Nouns with no number recorded in the second and third columns are used to contextualize uncertainty language but not for the construction of sentiment.

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Nouns	Match w/ direction words		Direction words	
	Positive	Negative	Group 1	Group 2
aaa yield*	1	2	*adjust* downward*	*acceler**
baa yield*	1	2	*contract**	*adjust* upward*
bond yield*	1	2	*cool**	*advanc**
corporate bond yield*	1	2	*deceler**	*bolster**
corporate debt yield*	1	2	*declin**	*boost**
corporate yield*	1	2	*decreas**	*elevat**
debt yield*	1	2	*down*	*encourag**
high grade corporate bond* yield*	1	2	*downturn*	*expand**
interest rate*	1	2	*downward*	*fast**
investment grade and speculative grade corporate bond* yield*	1	2	*downward adjust**	*gain**
investment grade corporate bond yield*	1	2	*downward movement*	*go* up*
long* term interest rate*	1	2	*downward revision*	*heighten**
long* term rate*	1	2	*drop**	*high**
mortgage interest rate*	1	2	*fall**	*increas**
real long* term interest rate*	1	2	*fell*	*mov* higher*
real long* term rate*	1	2	*go* down*	*mov* up*
speculative grade corporate bond* yield*	1	2	*limit**	*mov* upward*
yield* agency mortgage backed securities mbs	1	2	*low**	*pick* up*
yield* corporate bond*	1	2	*moderate**	*rais**
yield* corporate bonds and agency mbs	1	2	*moderati**	*rallied*
yield* mortgage backed securities	1	2	*mov* down*	*rally**
yield* private sector debt securities	1	2	*mov* downward*	*rebound**
comparable maturity treasury securities			*mov* lower*	*recoup**
discount rate*	1	2	*pullback*	*revis* up*
long* term treasury securities			*reduc**	*revision upward*
nominal treasury securities			*revis* down*	*rise**
real interest rate*	1	2	*slow**	*rising*
short* term interest rate*	1	2	*soft**	*rose*
us government securities			*stagnate**	*run up*
			*stall**	*runup*
			*subdu**	*stop decline*
			take toll on*	*strength**
			tick down*	*strong**
			*tight**	*tick* up*
			took toll on	*up*
			*weak**	*upward*
			weigh on*	*upward adjust**
			went down	*upward movement*
				upward revision
				went up

Table A-9. Noun Phrases Related to Financial Markets (3). The first column displays a subset the phrases we associate with financial market discussion in the FOMC transcripts (see other tables in sequence for other nouns). The second to fifth columns relate to the construction of market sentiment. An instance of positive sentiment occurs when a mention of one of the nouns with a 1 (2) recorded in the 'Positive' column is preceded or followed by a phrase from Group 1 (Group 2) within sub-sentences. Negative sentiment is constructed analogously. Nouns with no number recorded in the second and third columns are used to contextualize uncertainty language but not for the construction of sentiment.

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Nouns	Match w/ direction words		Direction words	
	Positive	Negative	Group 1	Group 2
asset index*	2	1	*adjust* downward*	*acceler**
asset indic*	2	1	*adverse*	*adjust* upward*
asset market*	2	1	*burst**	*advanc**
asset price index*	2	1	*contract**	*bolster**
asset price indic*	2	1	*cool**	*boost**
asset price*	2	1	*deceler**	*edge* up*
asset valu*	2	1	*declin**	*elevat**
equities	2	1	*decreas**	*encourag**
equity and home price*	2	1	*deteriorat**	*expand**
equity and home valu*	2	1	*down*	*fast**
equity and house price*	2	1	*downturn*	*favor**
equity and housing price*	2	1	*downward*	*gain**
equity index*	2	1	*downward adjust**	*go* up*
equity indic*	2	1	*downward movement*	*high**
equity market index*	2	1	*downward revision*	*improv**
equity market indic*	2	1	*drop**	*increas**
equity market price*	2	1	*eas**	*mov* high**
equity market valu*	2	1	*edge* down*	*mov* up*
equity market*	2	1	*fall**	*mov* upward*
equity price index*	2	1	*fell*	*pick* up*
equity price indic*	2	1	*go* down*	*rais**
equity price measure*	2	1	*limit**	*rallied*
equity price*	2	1	*low**	*rally**
equity valu*	2	1	*moderate**	*rebound**
equaity wealth	2	1	*moderati**	*recoup**
financial wealth	2	1	*mov* down*	*revis* up**
home and equity price*	2	1	*mov* downward*	*rise**
house and equity price*	2	1	*mov* lower*	*rising*
household wealth	2	1	*plummet**	*rose*
household* net worth	2	1	*pressure**	*run up*
housing and equity price*	2	1	*pull* back*	*runup*
price* of risk* asset*	2	1	*pullback*	*stop decline*
ratio of wealth to income	2	1	*reduc**	*strength**
risk* asset price*	2	1	*revis* down**	*strong**
s p 500 index	2	1	*slow**	*tick* up*
stock index*	2	1	*slow* down*	*up*
stock indic*	2	1	*soft**	*upward*
stock market index*	2	1	*stagnate**	*upward adjust**
stock market price*	2	1	*stall**	*upward movement*
stock market wealth	2	1	*strain**	*upward revision*
stock market*	2	1	*stress**	*went up*
stock price indic*	2	1	*subdu**	
stock price*	2	1	*take* toll on*	
stock prices index*	2	1	*tension**	
stock val*	2	1	*tick* down*	
us stock market price*	2	1	*tight**	
wealth effect*	2	1	*took toll on*	
wealth to income ratio	2	1	*tumbl**	
			*weak**	
			weigh on*	
			went down	
			*worse**	

Table A-10. Noun Phrases Related to Financial Markets (4). The first column displays a subset the phrases we associate with financial market discussion in the FOMC transcripts (see other tables in sequence for other nouns). The second to fifth columns relate to the construction of market sentiment. An instance of positive sentiment occurs when a mention of one of the nouns with a 1 (2) recorded in the 'Positive' column is preceded or followed by a phrase from Group 1 (Group 2) within sub-sentences. Negative sentiment is constructed analogously. Nouns with no number recorded in the second and third columns are used to contextualize uncertainty language but not for the construction of sentiment.

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parameter*
model*
measurement*
forecast error*
relationship*
error band*
nairu
trend
confidence interval*
uncertainty band*
confidence band*

Table A-11. Noun Phrases Related to Model. The table contains phrases we associate with model discussion in the FOMC transcripts.

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B. Algorithms for Uncertainty, Sentiment, and Policy Stance Construction

In this section, we describe in detail how we construct text-based measures of uncertainty, sentiment, and policy stance. The first step is to preprocess the transcripts by breaking each statement by each speaker into separate sentences using a standard sentence tokenizer. This yields 559,709 total sentences, which form the basic units of linguistic analysis for the algorithms we propose below.

B.1. Uncertainty construction

The construction of the uncertainty indices begins with the estimation of a word embedding model. Specifically, we use the Continuous Bag-of-Words (CBOW) model (Mikolov et al., 2013) estimated on the set of FOMC sentences contained in the economy round to obtain a vector representation of each unique term. We preprocess each sentence following standard steps of tokenization and stop word removal. We also replace a limited number of bigrams with a single term, e.g., 'downside risk' and 'upside risk.' We remove all sentences that do not contain at least five terms from the estimation corpus. The embedding model is estimated with 200-dimensional embedding vectors and a window size of five, which are typical defaults in the natural language processing literature. See Ash and Hansen (2022) for more background on word embedding models.

Tables A-1 and A-2 contain the fifty nearest neighbors for the terms 'risk', 'risks', 'uncertain', and 'uncertainty'. The similarity measure for computing nearest neighbors is cosine similarity, which is the cosine of the angle formed by two vectors in a vector space.[2] As described in the main text, we then manually prune the neighbors to arrive at our final set of uncertainty words.

Let $u_{t,s}$ be the count of uncertainty terms in sentence s. That is, the number of instances of any of the non-struck-through terms in tables A-1 and A-2 that appear in sentence s. For each topic (inflation and wages, economic growth, financial markets, model), we construct topic-specific uncertainty counts using the following procedure. For each sentence in each FOMC meeting:

1. Increase the topic k uncertainty count by $u_{t,s}$ if sentence s contains any term in the list associated with topic k. Thus, if a term from more than one topic set appears in sentence s, $u_{t,s}$ can be assigned to more than one topic.

2. If no term from any set of topic words appears in sentence s, assign $u_{t,s}$ to topic k if a topic-k term appears in sentence $s-1$ or sentence $s+1$ (whenever these sentences are uttered by the same speaker of sentence s).

3. If no topic k term appears in sentences $s-1$, s, or $s+1$ then leave $u_{t,s}$ unassigned.

[2]So, if two vectors point in the same direction, and have a zero angle between them, the cosine similarity is 1. If they point in opposite directions, and have an angle of 180 degrees, the cosine similarity is -1. Mathematically, the formula is the dot product of two vectors normalized to have unit length.

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We then normalize the topic-specific counts by the total number of terms in the economy round of the meeting. We denote policymakers' perceived inflation uncertainty in meeting t as $InfPMU_t$; real economic uncertainty as $EcoPMU_t$; financial market uncertainty as $MktPMU_t$; and uncertainty about models as $ModPMU_t$.

B.2. Sentiment construction

Here we describe the construction of sentiment for topic k (which corresponds to economic growth, inflation and wages, and financial markets). The algorithm follows closely that in Cieslak and Vissing-Jorgensen (2021) which use a similar approach to build a stock market sentiment index. Here we expand this to additional topics.

Sentiment is built exclusively using economy round language. We first remove any sentence in the economy round that either contains an uncertainty flag word, i.e. a term in the 'Term' columns of tables A-1 or A-2 that is not struck through, as well as sentences that immediately precede or follow such sentences. This ensures that sentiment is constructed using a different set of input words than the uncertainty measures, which avoids a mechanical relationship between the two.

The next step is to break all remaining sentences in the economy round into sub-sentences based on the presence of words in {'and', 'because', 'but',' if', 'or', 'so','that', 'when', 'where', 'while', 'although', 'however', 'though', 'whereas', 'despite'}. Let $\mathbf{p}_{t,s}$ be the sth phrase in meeting t generated by this rule.

As described in the tables above, each topic is associated with a set of nouns. Let $g_{k,m}$ be the mth noun associated with topic k. This noun will be associated with a set of positive words $\text{Pos}_{k,m}$ and a set of negative words $\text{Neg}_{k,m}$ according to the group definitions in the tables. The positive and negative sentiment measures in meeting t begin with the tabulations

$$\tilde{S}^{+}_{t,k} = \sum_{s}\sum_{m}\sum_{n} \mathbb{1}(w_{t,s,n} = g_{k,m}) \left[\mathbb{1}(w_{t,s,n-1} \in \text{Pos}_{k,m}) + \mathbb{1}(w_{t,s,n+1} \in \text{Pos}_{k,m})\right]$$
$$\tilde{S}^{-}_{t,k} = \sum_{s}\sum_{m}\sum_{n} \mathbb{1}(w_{t,s,n} = g_{k,m}) \left[\mathbb{1}\big(w_{t,s,n-1} \in \text{Neg}_{k,m}\big) + \mathbb{1}\big(w_{t,s,n+1} \in \text{Neg}_{k,m}\big)\right]$$

That is, we count the number of times topic-k words are immediately preceded or followed by (word-specific) positive and negative terms.[3] To obtain our final sentiment measure, we scale these counts by the number of total tokens in the economy round.

B.3. Preference construction

We now describe the algorithm for constructing the measures of hawkishness and dovishness used in the main text to capture policy preferences. For all meetings, we measure generic monetary policy

[3]Since in preprocessing we remove stop words, adjacency in this definition can include separation by stop words.

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preferences using the procedure detailed below. For meetings conducted in 2009 and onwards, we additionally measure preferences over the size of asset purchases as part of the Fed's quantitative easing program. The sentences we consider consist of those in the policy round since that is the section of the meeting pertaining to the articulation of preferences.

B.3.1. Generic monetary policy preferences

First, we exclude from the policy round any sentence in which the term 'increase' appears along with any of {cpi, inflation, yield*, treasury} to ensure we do not include language describing the direction of non-policy-related market prices and interest rates. We classify each remaining sentence as pertaining to monetary policy:

1. If it contains any phrase in the set {federal funds rate, funds rate, target rate, policy rate, interest rate, taylor rule, alternative a, alternative b, alternative c, directive, language, statement, symmetry, asymmetry, hawkish, dovish},
2. OR if 'policy' is in the sentence and NOT any phrase in the set {fiscal policy, supervisory policy, public policy, budget policy, tax policy, housing policy, regulatory policy, ecb policy, economic policy, government policy, inventory policy, health care policy, macro policy, macroeconomic policy, spending policy, legislation, law, regulation}.
3. OR if 'basis point' is found in the sentence AND any phrase in the set {[cut*, hik*, eas*, tight*, action*, moving, move, firming, recommendation, reduction, increase]}.

We define $Hawk'_t$ to be the count of terms in {tight*, hike*, increas*, hawkish, taper, liftoff} in policy sentences; and $Dove'_t$ to be the count of terms in {ease*, easing*, cut*, dovish, reduc*, decrea*} in policy sentences. Here we account for negation, and if any of the hawk (dove) terms is immediately preceded by one of {'less', 'no','not', 'little', 'don't', 'doesn't', 'hasn't', 'haven't', 'won't', 'shouldn't', 'didn't'}, it is counted as belonging to dove (hawk) set.

B.3.2. Quantitative easing preferences

We define policy round sentences beginning in 2009 as relating to quantitative easing whenever they contain the term 'purchase*' immediately preceded by a phrase in {mortgage backed securities, mbs, asset, treasur*, agency debt}.

We then define $Hawk''_t$ to be the count of terms in {reduc*, taper, stop, purchas*} within the set of QE sentences; and $Dove''_t$ to be the count of terms in {more, additional, further} within the set of QE sentences. We again account for negation.

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B.3.3. Overall preference measure

Let NP_t be the overall number of terms in the policy round in meeting t. Our hawk measure is

$$Hawk_t = \begin{cases} \frac{Hawk'_t}{\mathrm{NP}_t} & \text{if meeting } t \text{ occurs prior to 2009} \\ \frac{Hawk'_t + Hawk''_t}{\mathrm{NP}_t} & \text{if meeting } t \text{ occurs during or after 2009} \end{cases}$$

and $Dove_t$ is defined analogously.

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C. Additional Tables and Figures

C.1. Material for Section III

A. Summary statistics for PMU indices

	Mean(%)	Median(%)	St.dev.(%)	P10(%)	P90(%)	AR(1)
$InfPMU_t$	0.302	0.276	0.153	0.131	0.529	0.550
$EcoPMU_t$	0.388	0.386	0.138	0.226	0.566	0.463
$MktPMU_t$	0.222	0.180	0.149	0.071	0.426	0.571
$ModPMU_t$	0.066	0.061	0.044	0.018	0.119	0.107

B. Correlations of topic-specific PMU indices

	InfPMU	*EcoPMU*	*MktPMU*
EcoPMU	0.0735		
MktPMU	0.1218	0.3754	
ModPMU	0.2218	0.1131	0.0957

Table A-12. Descriptive statistics for PMU. The table reports summary statistics for the topic-specific PMU indices. All indices are obtained from the economy round of the FOMC meeting and represent the share of uncertainty-related mentions (by topic) relative to the total number of words in the economy round of the meeting. The sample period is 1987:08–2015:12, covering 227 meetings. Panel A expresses the summary statistics for PMU in percentages (e.g., the number 0.302 for the mean inflation PMU implies that on average uncertainty-related mentions constitute 0.302% of all words in the economy round). Column "AR(1)" reports the first order autoregressive coefficient (at the meeting frequency). Panel B reports the pairwise correlations between topic-specific PMU indices.

	(1) $InfPMU_t$	(2) $EcoPMU_t$
$InfPos_t$	0.623***	-0.195***
	(7.17)	(-2.98)
$InfNeg_t$	0.236***	-0.017
	(4.59)	(-0.30)
$EcoPos_t$	-0.154*	0.136*
	(-1.68)	(1.89)
$EcoNeg_t$	-0.063	0.344***
	(-1.10)	(6.22)
N	227	227
$\bar{R}^2$	0.41	0.13

Table A-13. Relationship between uncertainty and sentiment. This table reports regressions of PMU indices on sentiment. Sentiment proxies are based on sentences that do not contain uncertainty phrases. All measures are derived from the economy round of the FOMC meeting. The coefficients are standardized and HAC t-statistics with eight lags are reported in parentheses. The sample period is 1987:08–2015:12.

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A. Dependent variable: Greenbook CPI inflation nowcast h meetings ahead, $E_{t+h}(CPI)$

	$h=1$	$h=2$	$h=3$	$h=4$	$h=5$	$h=6$	$h=7$	$h=8$
$InfPMU_t$	0.029	-0.035	-0.063	-0.083	-0.181	-0.173	-0.109	-0.073
	(0.33)	(-0.38)	(-0.63)	(-0.63)	(-1.27)	(-1.16)	(-0.91)	(-0.87)
$\bar{R}^2$	-0.0036	-0.0033	-0.00051	0.0024	0.028	0.025	0.0073	0.00081
N	226	225	224	223	222	221	220	219

B. Dependent variable: Greenbook real GDP growth nowcast h meetings ahead

	$h=1$	$h=2$	$h=3$	$h=4$	$h=5$	$h=6$	$h=7$	$h=8$
$EcoPMU_t$	-0.073	-0.059	-0.002	0.008	-0.050	-0.056	0.023	0.047
	(-0.92)	(-0.76)	(-0.03)	(0.09)	(-0.50)	(-0.52)	(0.21)	(0.39)
$\bar{R}^2$	0.00088	-0.00093	-0.0045	-0.0045	-0.0021	-0.0015	-0.0041	-0.0024
N	226	225	224	223	222	221	220	219

Table A-14. Predicting macro variables with textual measures of uncertainty and sentiment. The table reports predictive regressions of inflation and real GDP growth by textual PMU and sentiment indices derived from the economy round of the FOMC meeting transcripts. The regressions are estimated at the FOMC meeting frequency with the forecast horizon ranging from the next meeting ($h=1$) up to eight meetings ahead ($h=8$). To make sure that the timing of the depend variable is consistent with the timing of the meetings, we use Greenbook nowcasts at future meetings as the dependent variable. The regression is $E_{t+h,0q}(CPI) = \beta_0 + \beta_3 InfPMU_t + E_{t,0q}(CPI)$, and analogously for the real GDP growth. The coefficients are standardized. HAC standard errors to account for the overlap are reported in parentheses. The sample period is 1987:08–2015:12.

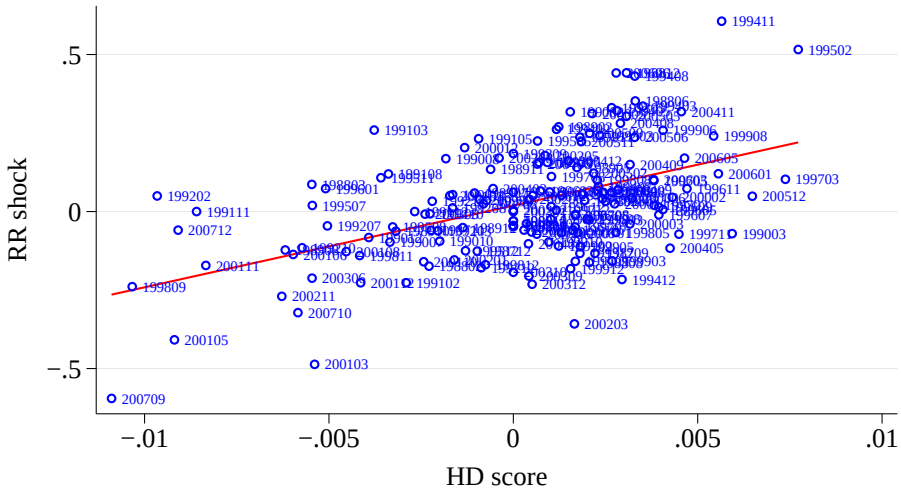

Figure A-1. *HD* measure of policy preferences vs. Romer-Romer shocks. The figure presents a scatter plot of the policy preferences *HD* against the Romer and Romer (2004) shocks. The *HD* measure is derived from the statements of the FOMC members during the policy round of the FOMC meeting.

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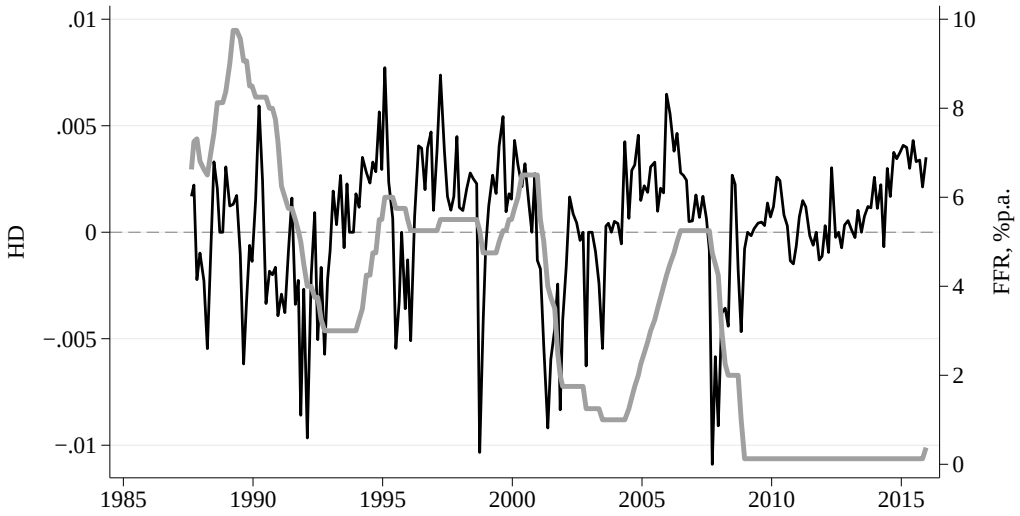

Figure A-2. Hawk-dove policy score and FFR target. The figure superimposes the hawk-dove score *HD* constructed for FOMC members in the policy round of the meeting against the FFR target.

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	(1) BBD EPU	(2) HRS MPU	(3) VXO	(4) Infl disp	(5) Growth disp
$InfPMU_t$	-0.340***	-0.080	-0.103	0.174*	-0.124
	(-4.32)	(-1.04)	(-1.30)	(1.90)	(-1.40)
$EcoPMU_t$	0.218**	0.315**	0.003	-0.283***	-0.203**
	(2.37)	(2.20)	(0.02)	(-2.68)	(-2.12)
$MktPMU_t$	-0.031	-0.018	0.032	0.109	-0.173
	(-0.32)	(-0.19)	(0.32)	(0.94)	(-1.49)
$InfSent_t$	-0.044	0.079	-0.077	-0.086	0.005
	(-0.66)	(1.00)	(-0.88)	(-1.07)	(0.05)
$EcoSent_t$	-0.336***	-0.012	-0.176	-0.382***	-0.455***
	(-4.44)	(-0.12)	(-1.61)	(-3.42)	(-3.80)
$MktSent_t$	-0.207***	-0.230***	-0.440***	-0.144	-0.081
	(-2.70)	(-3.16)	(-3.83)	(-1.27)	(-0.72)
$\bar{R}^2$	0.38	0.13	0.30	0.27	0.25
N	227	227	227	227	227

Table A-15. PMU vs. measures of public perceptions of uncertainty. The table reports regressions of measures of public perceptions of policy uncertainty on PMU indices. BBD EPU is the economic policy uncertainty index from Baker et al. (2016); HRS MPU is the monetary policy uncertainty index from Husted et al. (2020); VXO is the implied volatility measure from S&P500 options; inflation and growth dispersion are mean absolute deviation of forecasts CPI inflation and real GDP growth across individuals in the Blue Chip Financial Forecast survey. We report the first principal component of forecast dispersions across horizons from the current quarter up to four quarters ahead. The sample period is 1987:08–2015:12. All variables are scaled by their standard deviations. HAC t-statistics with eight lags are reported in parentheses. The regressions are estimated at the frequency of the FOMC meetings.

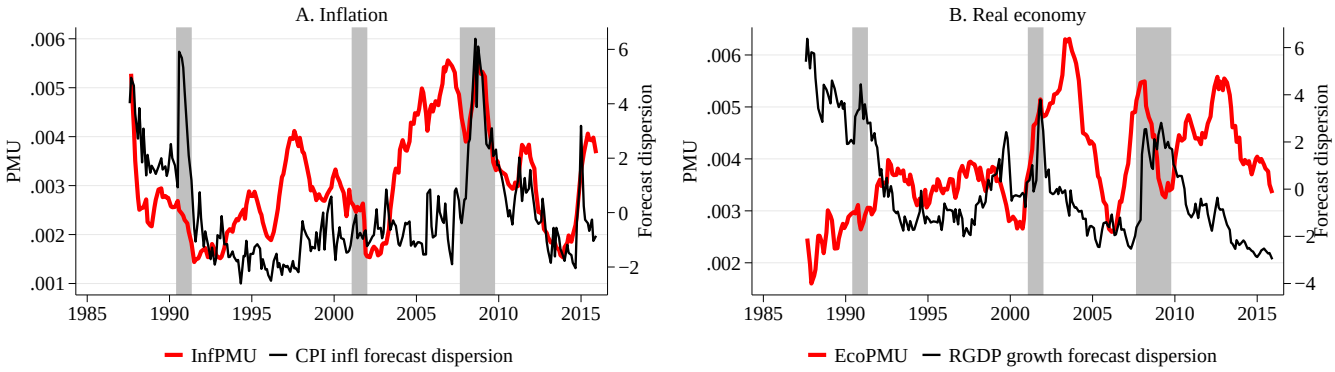

Figure A-3. PMU vs. public disagreement. The figure compares PMU with measures of disagreement in survey forecasts of inflation and real GDP growth. The surveys are quarterly forecasts from the Blue Chip Financial Forecasts (BCFF). BCFF dispersion is measured as mean absolute deviation of forecasts across individuals. We report the first principal component of forecast dispersions across horizons from the current quarter up to four quarters ahead. The text-based series are smoothed averages over the last eight FOMC meetings.

C.2. Material for Section IV

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C.3. Narrative Assessment of the Role of Credibility Concerns

As described in the text, this appendix provides a more complete narrative account of the evolving concerns for credibility in the FOMC policy deliberations. For this, we split the evolution of inflation concerns into four separate sub-samples: (i) the Mid-1990s, (ii) Post-Y2K recession, (iii) Recovery to GFC, and (iv) Post-GFC Concerns.

The issue also came up during the February 2005 special topic on "Price Objectives for Monetary Policy" there was lots of discussion of whether the Fed should adopt an explicit inflation target and lots of discussion of credibility. For example, Santomero (Philadelphia) emphasised the importance of the Fed's inflation fighting credibility and argued that this would be further enhanced by being explicit about the numerical definition of the inflation goals. "I also believe that moving to a regime of this type would increase flexibility and enhance our ability to achieve our other economic objectives. It is only because we had achieved a good deal of credibility over the years that we were able to lower the fed funds rate to 1 percent recently without igniting fears of inflation. And I would argue that this flexibility was important in contributing to the shallowness of the last recession."

C.3.1. Mid-1990s

In the second half of 1996, there were growing fears that a tight labor market would generate inflationary pressure. Yellen (San Francisco) noted in September 1996, "The probability of an increase in inflation is clearly higher when labor market slack is lower. For that reason, I conclude that the risk of an increase in inflation has definitely risen, and I would characterize the economy as operating in an inflationary danger zone." Discussing her policy view for that meeting, she said "My concern is that a failure to shift policy just modestly in response to shifting inflationary risks could undermine the assumptions on which the markets' own stabilizing responses are based."

In November, the risk of a pick up in inflation had not been borne out in the data but some members remained concerned. Meyer (Board) spoke of the on-going challenge that "trend growth at the prevailing unemployment rate will ultimately prove to be inconsistent with stable inflation going forward." Broadus (Richmond) argued for a credibility-enhancing surprise: "The projections do not show any further progress toward our basic longer-term price stability goal. And if that were the actual outcome over the next couple of years, the credibility of our longer-term strategy could be reduced, at least to some degree. For all these reasons, Mr. Chairman, I would still favor a 1/4 point increase in the funds rate today. Any tightening now obviously would surprise the markets. I recognize that that could have near-term consequences, but I think it could well help us over the longer run."

By the meeting in December, these worries has disappated further; Yellen said "So, I still feel that we need to avoid complacency about the potential for inflationary pressures to emerge from the labor market down the road. But while I think we cannot rule out the possibility that this long expansion is about to end with a period of stagflation and that that is a significant risk over the

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term of this forecast, that outcome is by no means a certainty. Capacity utilization, as a number of you have mentioned, is not strained at this point." Though some, such as Melzer (St Louis), were still concerned about the risk of lost credibility: "Economic forecasters have often interpreted our policy as a 3 percent cap on CPI inflation. Events in 1996 put us at considerable risk of losing credibility for even that modest goal.In my view, we should reaffirm our commitment to resist inflation above 3 percent."

The fears continue for some members into the first half of 1997. McDonough (New York) expresses concerns that he and the NY Fed staff have. Melzer continues to argue for credibility building measures; "My reading of the economy supports the conclusion that we are at risk of losing the hard-won credibility of our commitment to hold inflation at 3 percent." Guynn (Atlanta) said in May 1997 that "With the economy having gotten to a point where it must be near full employment, if not beyond it, we have a unique opportunity with little downside risk to lean a bit more against the expected upward creep in inflation that most of us are forecasting and, in doing so, to underscore our resolve and credibility in the minds of financial market participants, business decisionmakers, and the general public."

There was only a single 25bps rate increase in March 1997 and these concerns persisted until the demand-dampening effects of the Asian Financial Crisis in 1997, and the LTCM Collapse and Russian Default prompted some cuts in interest rates in late 1998. These concerns prompted monetary easing to calm markets and preemptively offset any negative impulses from the slowing global demand.

The effects were, however, relatively mild and once the economy had weathered the initial effects, thoughts returned to the tight labour markets and the risk of inflation. In March 1999, Broaddus emphasised the importance of the Fed's credibility, alongside growing productivity, in helping to sustain robust final domestic demand growth: "the high credibility of our low inflation strategy... supports the increases in real income and allows labor markets to operate at much lower unemployment levels without generating the potentially inflationary wage increases that have been typical historically. As I see it, maintaining this credibility is the key to what we can do to help sustain the expansion. In order to do that, I think we need to be sure we interpret the risks in the outlook as accurately as we can."

This is the reason that he sees it is time to switch out of support mode and begin to signal the Fed's anti-inflation tendency even if only in language and emphasis on the upside inflation risks. "What worries me the most, ironically, is that our high credibility may in some sense be permitting us to delay confronting this inflation risk. But if things ever begin to go in the other direction, I think they could unravel very quickly. So, as I said at the last meeting, I think it is time for us to get back in the ball game. In my view, a step toward an asymmetric directive would be a good way to do that."

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Ferguson (Board) was similarly concerned about the Fed's credibility. In December of 1999 he outlined his concerns to his colleagues: "In the longer run, obviously, as others have indicated, we don't want to lose our ongoing battle with inflation expectations and inflation, or risk any damage to our own credibility... We should continue to recognize the benign effects of productivity improvements on unit cost structures, but we also should not be afraid to act in a well-modulated fashion in order to maintain our hard fought victory over inflation and also our credibility."

Ultimately, inflation never took off. Broaddus, in May 1999, recognised that his fears had not been realised when he said: "I know I have been crying wolf around this table for a long time and my fears have not been realized, but we have to take each day as it comes, I guess. So, wolf!" This prompted laughter around the FOMC table. Of course, it is the credibility that he, and others, were so concerned about retaining that means they may have ultimately appeared wrong in their projection.

C.3.2. Post-Y2K recession

A (small) recession started in 2001, and the terrorist attacks on September 11 2001 further added to concerns about the US economy and the financial system. In this period, the FOMC were little concerned about the inflation risks and downside risks started to dominate. In fact, FOMC members began to push the *use* of their credibility in allowing them to switch into support mode. This includes members like Broaddus who had so often argued for the need to take a Hawkish stance to build credibility; in August 2001 he argues: "And, of course, now I think we do have considerable credibility. And with the downside risks still quite substantial, as you and others have mentioned, I think we need to take advantage of that credibility. To say the same thing a bit differently: Unlike the situation in a number of earlier postwar episodes, we don't need a recession to contain inflation or inflation expectations at this point." Similarly Parry (San Francisco), in December 2001, argues "With inflation well in hand and Federal Reserve credibility in good shape, I believe we have the flexibility to respond to these risks."

C.3.3. Recovery to GFC

Though the formal recession had ended by the end of 2001, the trough in the interest rate cycle didn't come until 2003 (the FOMC last cut by 25bps at its June 2003 meeting). But even as the FOMC was still cutting, concerns about inflation started to build. In the March 2003 FOMC meeting, Parry says: "As we all know, there are many risks to such an inflation forecast. In particular, we are uncertain about how much and how fast energy prices will pass through to other prices, about how much demand will increase from the economies abroad, and about whether stock prices or productivity growth will surge or fall. However, despite all the possible scenarios that could be constructed, the underlying tightness of labor markets and the recent extraordinary growth in demand imply a very high risk that core inflation will rise at a faster pace this year and next." In

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the policy go-around, he indicates his desire to signal the FOMC's toughness on inflation – "I also think it is important to reinforce to the public that we are focusing on the heightened inflation risks for the future." However, at that time most members did not see this risk as unduly concerning; as Hoenig said – "I am not convinced, however, that we need to be tightening aggressively. I think the gradual pace of tightening that we have followed is wise."

It wasn't until the middle of 2004 that inflation uncertainty was combined with a clear directional element to the worries; the May 2004 FOMC meeting is when the *InfPMU* is starting to pick up strongly accompanied by concerns of rising inflation. The discussion centers on shifting balance of risks on inflation. Geithner (NY Fed) says "We need to be more attentive now to the risk that a sustained increase in prices could materialize at an earlier point than had seemed likely, and we can afford, of course, to be less concerned with the risk of an unwelcome fall in the rate of inflation. The risks of being late compared with the risks of moving too early are now more symmetric. We need to adjust our statement accordingly, to position us to be ready to act soon if the numbers confirm the recent trend toward stronger employment growth." Bernanke (Chair) thinks about what this means for the risk-management approach to monetary policy: "From a risk-management perspective, as we begin to raise rates we should weigh the risk of significantly impeding the labor market recovery against the risk of having to scramble to adjust to unexpectedly adverse inflation developments."

By June, some members felt more convinced that that the FOMC needed to start raising rates. McTeer (Dallas) was explicit in his views: "As I indicated at our May meeting, I believe that the inflation risks are unambiguously on the upside and that we are behind the curve." Even Geithner seemed to be coming around to this view: "Developments since our last meeting support a reasonable degree of confidence in the strength of the expansion and somewhat more concern about the outlook for inflation.... We are somewhat more concerned about the inflation outlook...We face some risk that a modest increase in inflation expectationseven after the recent moderation of those expectations will feed through to higher compensation growth." The FOMC duly began a hiking cycle which took rates from 1% to 5.25% in June 2006.

Though over this period inflation remains contained, the concerns about it and the risk to the FOMC's credibility of getting it wrong is regularly expressed. Ferguson, in March 2005, says: "I find the baseline outlook to be credible and reasonable. But it is surrounded by a range of risks that I believe, as do others, are primarily on the upside... The economy is growing well and needs less and less stimulus; therefore, continuing to remove our accommodative policy at a measured pace seems to me reasonable." On the approach to deal with risks, he favours signalling the committee's concerns: "given the stage of the cycle, the skew in the general risk assessment that I outlined, and the need to manage market expectations, I think we should use our statement to signal our awareness that inflation pressures may have picked up. The incoming data are indicative of that. If we are wrong on the upside risks, both we and the market will adjust. On the other hand, if we fail

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to reflect the existence of these upside risks, we could easily be perceived as being behind the curve, with negative consequences in terms of inflation dynamics and, potentially, our own credibility."

Even the members of committee that were optimistic that inflation remained well in check expressed the importance of credibility. Yellen in November 2005 said: "So I see no indication of the '70s style wage-price spiral in the offing. Overall, I judge our credibility to be very much intact. Of course, our credibility going forward does depend on continued vigilance. The economy now appears to be close to full employment, with a good deal of momentum. And annual core inflation, at least as judged by the core PCE measure, remains near the upper end of my comfort zone and, arguably, inflation risks are tilted somewhat to the upside. So with respect to policy, I support at a minimum the removal of any remaining policy accommodation...So a few more increases, including one today, seem to me likely to be required."

Yellen also went on to support the use of stronger language than proposed with the Alternative B Bluebook option was also used to signal this stance: "In implementing monetary policy, it seems to me that actions matter, but so do words, and I wanted to briefly open up the question of the statement. I think for today the words of alternative B should suffice, but Vincent has repeatedly suggested, and a number of you have emphasized, that we need to consider how to modify the statement language." She pushed for langauge closer to the Alternative C statement as "It eliminates the balance of risk statement and the policy accommodation language; and it substitutes a new forward-looking policy statement for the 'measured pace' phrasing."

In March 2006, despite the significant tightening already completed, concerns remained about the upside to inflation. Bernanke summed up the committee discussion saying: "I took from the group some sense of at least a slight upside risk to inflation, reflecting the increasing resource utilization; the fact that inflation is somewhat on the high side of what many people describe as their comfort zone; and the fact that, if inflation does rise, there will be costs to bringing it back down and maintaining our credibility." While he goes on to state that he is "not at all alarmist about inflation", he argued that "it is very important for us to maintain our credibility on inflation and it would be somewhat expensive to bring that additional inflation back down. So my bottom line on inflation is that there is a very modest upside risk. Again, I think it's not a large risk but one that we probably should pay attention to."

C.3.4. Post-GFC Concerns

Inflation was not the main concern during the GFC period of 2008-2011. But by 2012, FOMC members again started to worry. In March 2012, Kocherlakota expressed the minority view that it was time to start worrying about inflation picking up again. "Indeed, my own outlook, like President George's, is that our accommodative policy will lead average PCE inflation to rise above 2 percent over the next two years. I'm less sanguine than she is that inflation will stabilize at that

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level, because that depends on policy choices, and we would have to make choices to make that happen."

In the same meeting, others acknowledged this risk but also expressed concerns about a downside risk ("I'm concerned that we could be misled yet again by hopeful signs early in the year followed by tepid growth later, and that a premature move toward policy firming could end up driving inflation further below our objective and retard what is already a long-delayed return to maximum employment.", Yellen) and an asymmetry in the ease of policy addressing the two risks ("How do we balance these risks? As Governor Yellen mentioned, I think theres an asymmetric nature to the upside and downside risks.We know what to do if inflation threatens to move persistently above target.", Raskin).

In August 2012, the debate concerns more stimulus. As Powell (Board) argues: "On the list of potential costs, I would include inflation, the difficulty of exit, the risk of creating expectations we cant meet, the prospect of capital losses, market function, and the grab bag of stability issues." Though others, such as Tarullo, dismiss this: "As I've listened, not just today but over the course of the last couple of years, I think I hear three kinds of costs that people are concerned, rightly, about: inflation, market functioning, and credibility of us as a central bank. On inflation, with all due respect to those who have made the argument, I must say that I do find the arguments a little conclusory. That is, the specter of runaway inflation sometime out in the indefinite future, as I've heard it, doesn't seem to me backed by an enormous amount of linear analysis that gets us from here to there and where are the real problems. And I have to say, I've tested this proposition on a fairly wide variety of non-Fed, mostly, but not exclusively, academic, economists, and even those who are on the hawkish side tend to be not too concerned about that particular prospect. They are more concerned about the other two things."[4]

These debates continue as the Fed continues its accommodative stance. And the lack of inflation means that the concers gradually diminish. By October 2014, the inflation worry is about credibility but from the downside. Chair Yellen sums up the position espoused by others including Kocherlakota, Rosengren and Evans: "In all, while most of you see these recent developments as largely transitory, and thus continue to expect that inflation will move gradually back toward 2 percent, some of you are concerned that we may be seeing the beginning of a worrisome downward adjustment in inflation expectations. As President Kocherlakota emphasized, a failure on our part to take decisive action could exacerbate this risk by diminishing the credibility of our commitment to our 2 percent inflation objective." Williams (SF Fed) argues against this concern: "Inflation has stabilized, and downside risks to inflation appear to have dissipated."

[4] "And lastly, on credibility, where I depart, I think, a little bit from what some of those who are inclined in my policy direction have said. I don't think I would want us to be saying that we will "do what it takes" because it isn't clear to me ultimately that we can do what it takes to solve the rather substantial economic problems that we face right now. My suggestion would be that we communicate an intention to "do what we can" and that we will continue to do what we can, with the appropriate set of costs and benefits being taken into account at each step of the way. Mr. Chairman, am I missing any wording issues that we're supposed to address here?"

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