

# FCI-plot: Central Bank Communication Through Financial Conditions

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## Abstract

We develop a model of central bank communication where market participants' uncertainty about desired financial conditions creates misunderstandings (“tantrums”) and amplifies the impact of financial noise on asset prices and economic activity. We show that directly communicating the expected financial conditions path (FCI-plot) eliminates tantrums and recruits arbitrageurs to insulate financial conditions from noise. In contrast, communicating expected interest rates is “lost in translation”: because the mapping from interest rates to financial conditions is inherently incomplete, interest rate projections leave substantial residual uncertainty about the central bank’s intended financial conditions. We demonstrate that scenario-based FCI-plot communication enhances recruitment when market participants disagree with the central bank regarding scenario probabilities, enabling an “agree-to-disagree” equilibrium where markets help implement central bank objectives despite differing views.

**JEL Codes:** E12, E32, E44, E52, E58, G10

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# 1. Introduction

Unlike fiscal policy, which directly affects households and firms, monetary policy transmits to the real economy indirectly through financial markets. Households and firms respond to *financial conditions*—primarily, long-term interest rates, stock prices, house prices, and exchange rates—rather than to the policy rate itself. While monetary policy influences these financial conditions, they are ultimately determined in financial markets. This critical intermediary role makes effective central bank communication with financial markets essential for the successful implementation of monetary policy. Yet important questions remain: What specific advantages does enhanced communication with markets provide for monetary policy effectiveness, and which communication strategies best deliver these benefits? How should central banks manage frequent disagreements with market participants?

In this paper, we argue that clearer communication with financial markets improves monetary policy outcomes through two main channels: by eliminating market misunderstandings of policy (what we refer to as “tantrums”) and by recruiting sophisticated market participants to insulate financial conditions from financial noise (non-fundamental trading flows). We develop a framework in which the central bank communicates its expected path of financial conditions (FCI-plot) and demonstrate that this approach reduces tantrums and recruits market forces in support of policy objectives. In contrast, communicating expected interest rates alone is “*lost in translation*”—the inherently incomplete mapping from interest rates to financial conditions leaves market participants uncertain about the central bank’s intended financial conditions. We show that scenario-based FCI-plot communication further strengthens these benefits, particularly when market participants disagree with the central bank about the likelihood of different near-term scenarios. This enables an “agree-to-disagree” equilibrium where markets help implement the central bank’s objectives despite differing views.

We motivate our model and arguments by presenting five empirical facts about the interactions between monetary policy and financial markets. First, monetary policy transmits to the real economy primarily through financial conditions—a broad set of asset prices and interest rates that shape aggregate demand. Second, the mapping from interest rates to financial conditions is inherently incomplete: financial conditions indices are driven predominantly by risky asset prices, and monetary policy affects financial conditions through channels well beyond expected interest rates. Third, excess volatility of risky asset prices, driven by time-varying sentiment, risk premia, and financial noise, creates ripple effects through financial conditions to macroeconomic outcomes, ultimately

hampering monetary policy implementation. Fourth, sophisticated financial market participants frequently hold beliefs that diverge from the central bank’s beliefs. And fifth, these participants have diverse views on future financial conditions even after conditioning on their economic outlook, suggesting that they are uncertain about how the central bank will steer financial conditions in different scenarios. Together, these facts highlight the central role of financial conditions in monetary policy transmission and the risk that policy intentions conveyed solely through interest rates are “lost in translation.”

We theoretically investigate policy communication by developing a stylized model in which financial conditions—represented by an aggregate asset price—constitute the main channel through which monetary policy affects aggregate demand. The model features four types of agents: households, noise traders, arbitrageurs (the Arbs), and the central bank (the Fed).<sup>1</sup> Households’ spending depends on financial conditions; noise traders introduce non-fundamental flows that generate excess volatility in financial conditions; and the Arbs attempt to stabilize financial conditions by trading against noise. The Fed sets the policy interest rate to close output gaps, but does so gradually, reflecting a preference for smooth and predictable paths. Importantly, the Fed and the Arbs may disagree about key macroeconomic variables, such as potential output. These disagreements make the Arbs uncertain about the Fed’s policy stance—particularly about the financial conditions it aims to achieve—creating the possibility of misunderstandings and a need for communication.

The model shows that when the Arbs are uncertain about the Fed’s intended financial conditions, two concerns arise: “tantrum shocks,” where the Arbs misinterpret the Fed’s intended financial conditions; and “excess volatility in financial conditions,” as the Arbs trade cautiously against noise due to uncertainty. Given the Fed’s gradualism, without communication both tantrum shocks and excess volatility result in excessive output gap fluctuations.

We demonstrate that the Fed’s communication of its expected financial conditions path mitigates both problems. By announcing the financial conditions it aims to achieve in the present, the Fed eliminates tantrum shocks in which the Arbs misinterpret the Fed’s intended conditions. Furthermore, announcing the financial conditions the Fed expects to implement in the future reduces the Arbs’ uncertainty about future financial conditions. Greater clarity, in turn, encourages the Arbs to trade against noise more aggressively,

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<sup>1</sup>Throughout this paper, we often use “the Fed” as a shorthand for a generic central bank. Unless explicitly stated or quoting directly, our arguments and recommendations are not intended as specific advice for the Federal Reserve. The underlying insights are general and apply broadly across monetary policy institutions.

thereby recruiting them to insulate financial conditions from noise. We further show that scenario-based FCI-plot communication—specifying how the Fed expects financial conditions to adjust under alternative near-term economic scenarios—significantly enhances the framework. This is because disagreeing arbitrageurs primarily require insight into the Fed’s reaction function across different conditions rather than the Fed’s evaluation of particular scenarios. Overall, FCI-plot communication enables an “agree-to-disagree” equilibrium where markets help implement the central bank’s objectives despite differing views.

In contrast, we show that the Fed’s communication of expected interest rates (forward guidance) is “lost in translation”—it fails to mitigate tantrums or excess volatility. This limitation reflects the inherently incomplete mapping between interest rates and financial conditions, both in our model and in practice. While interest rates influence financial conditions, they represent just one factor among many that determine overall financial conditions. Consequently, when the Fed announces only its intended interest rate path, market participants still face substantial uncertainty about expected financial conditions—the variable that ultimately matters for macroeconomic outcomes. This uncertainty persists because participants must make their own assumptions about how various financial factors beyond interest rates will evolve, leading to potential misinterpretations of policy intentions.

We conclude with a proof-of-concept visualization of our FCI-plot framework. This prototype, constructed using historical data, shows how this communication tool would have signaled the central bank’s intended financial conditions during both normal periods and times of financial stress. This visualization demonstrates the practical potential of our theoretical framework and illustrates how the FCI-plot approach could bridge the gap between central bank intentions and market outcomes—even when beliefs diverge.

**Related Literature.** This paper contributes to the vast literature on central bank communication and transparency (see Geraats (2002, 2014); Blinder et al. (2008); Blinder (2009); Van der Cruijssen and Eijffinger (2010) for reviews). Many studies show that central bank transparency has grown in recent years, and that standard communication tools have made monetary policy more predictable. Our model is consistent with these findings and provides a theoretical foundation for central bank communication. As envisioned by Blinder (1998), the central bank in our framework engages in communication to convey its *beliefs* to the market. We further argue that communicating in terms of financial conditions rather than interest rates is more effective, and we show that this communication improves policy in two ways: by mitigating tantrums in which the markets misunderstand policy

objectives, and by recruiting the arbitrageurs to trade against noisy flows that contaminate financial conditions.<sup>2</sup>

At the theoretical level, our paper builds on our earlier work that investigates the connections between financial markets and monetary policy (see Caballero and Farhi (2018); Caballero and Simsek (2020, 2021, 2023, 2024b,a, 2026); Caballero et al. (2024, 2025)). The most closely related paper is Caballero et al. (2024), where we develop a New-Keynesian model with noise and limits to arbitrage that provides a rationale for Financial Conditions Targeting—a framework in which the central bank *commits* to stabilize future financial conditions around a target level to encourage arbitrageurs to trade against noisy flows. This policy improves monetary policy by “recruiting” the arbitrageurs to insulate the real economy from financial noise.

In contrast, the present paper shows that even without such commitment mechanisms, when arbitrageurs are uncertain about the central bank’s beliefs, simply *communicating* the central bank’s expected FCI level (FCI-plot) can activate the recruitment effect. While commitment strategies remain powerful tools, our analysis here highlights how communication alone can deliver significant benefits.<sup>3</sup>

The theory is also related to our earlier work on the policy implications of disagreements between markets and the central bank (Caballero and Simsek (2022)). The main difference is that in our current model policy transmits through financial conditions (as we see in the data), whereas in Caballero and Simsek (2022) policy transmits through interest rates as in the textbook New-Keynesian model. We confirm the finding in Caballero and Simsek (2022) that greater policy transparency mitigates tantrums, but we further argue that communicating in terms of financial conditions rather than policy interest rates is more effective in achieving this benefit.

The empirical facts we present largely synthesize the insights from various strands of the literature that we discuss in Section 2. In Section 2.5, we present new evidence (to our knowledge) that shows financial market participants’ forecasts of *future financial conditions* are highly heterogeneous and uncorrelated with their forecasts of macroeconomic conditions. This complements Bauer et al. (2024b,a), who show that professional forecasts of future policy interest rates *are* correlated with forecasts of macroeconomic

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<sup>2</sup>See Woodford (2005) for additional rationales supporting central bank communication and Amato et al. (2002) for a model in which central bank communication might be excessive. A related discussion addresses optimal central bank communication strategies; for example, whether central banks should present a unified message or express diverse perspectives—mirroring the varying viewpoints among policymakers (see, e.g., Ehrmann and Fratzscher (2007); Vissing-Jorgensen (2019)).

<sup>3</sup>Beyond our own work, this paper is part of a large literature on New Keynesian models with risk and asset prices (Kashyap and Stein, 2023; Pflueger et al., 2020; Kekre and Lenel, 2022, 2025; Kekre et al., 2023; Beaudry et al., 2024; Adrian and Duarte, 2018; Adrian et al., 2020).

conditions—a fact that we verify with a different survey.

We organize the rest of the paper as follows. Section 2 presents the empirical facts about monetary policy and financial markets that motivate our analysis. Section 3 develops a theoretical model that clarifies how communication about financial conditions can reduce market overreactions (“tantrums”) and mobilize arbitrageurs to offset noise. Section 4 presents a prototype FCI-plot. Section 5 concludes. Appendix A contains the proofs of all the propositions and Appendix B the details of the empirical analysis.

## **2. Motivating facts about monetary policy and financial market interactions**

*“So, of course, monetary policy does, famously, work with long and variable lags. The way I think of it is, our policy decisions affect financial conditions immediately. In fact, financial conditions have usually been affected well before we actually announce our decisions. Then, changes in financial conditions begin to affect economic activity... within a few months.”* (Chair Jerome Powell’s Press Conference, September 21, 2022)

In this section, we present five key facts about monetary policy and financial market interactions that motivate our analysis of central bank communication: (i) Monetary policy transmits through financial conditions; (ii) The mapping from interest rates to financial conditions is inherently incomplete—interest rates are only one of many factors driving financial conditions, and monetary policy affects financial conditions through channels well beyond expected rates; (iii) Financial conditions are inherently noisy and routinely deviate from levels compatible with macroeconomic stabilization, thereby generating or amplifying macroeconomic fluctuations; (iv) Sophisticated financial market participants are opinionated and routinely disagree with the central bank’s views; (v) These market participants have diverse views about future financial conditions, even conditional on their economic outlook, suggesting that they are uncertain about how financial conditions will unfold in different macroeconomic scenarios. Taken together, these facts highlight the central role of financial conditions in monetary policy transmission and the risk that policy intentions conveyed solely through interest rates are “lost in translation”—leaving markets uncertain about the financial conditions the central bank aims to achieve.

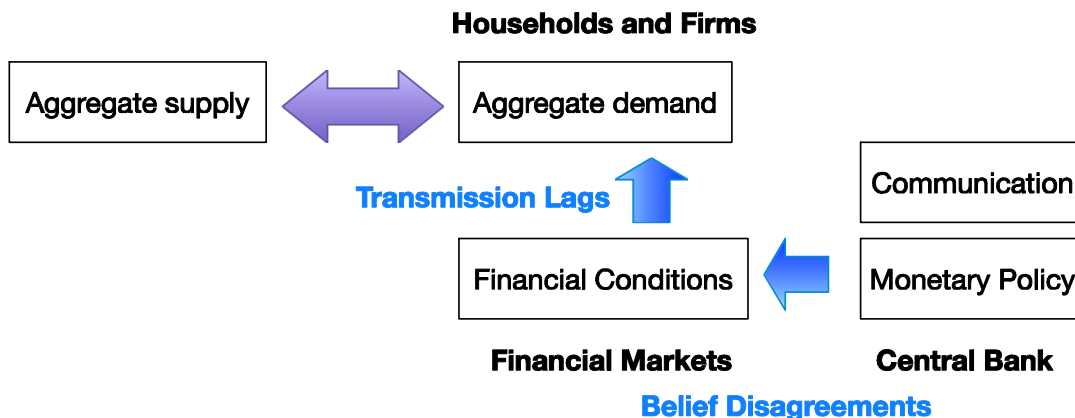


Figure 1: Monetary policy transmission through financial conditions.

## 2.1. Monetary policy transmits through financial conditions

Chair Powell’s quote illustrates that monetary policy influences aggregate demand indirectly—through financial markets—rather than operating directly in goods and services markets as fiscal policy does. When a central bank adjusts its policy rate or conveys policy news, the immediate impact is on asset prices, which then shape broader financial conditions and ultimately real economic activity. In fact, Keynes (1936) noted:

*“...there are not many people who will alter their way of living because the rate of interest has fallen from 5% to 4% (...) Perhaps the most important influence (...) depends on the effect of these changes on the appreciation or depreciation in the prices of securities”* (as quoted by Beaudry et al. (2024)).

Moreover, financial conditions affect the economy with significant lags.<sup>4</sup> These lags, together with the need to estimate unobservable variables such as potential output, make monetary policy inherently belief dependent and create a central role for communication.

As shown in Figure 1, this transmission mechanism creates a policy framework in which the central bank employs its tools to influence financial conditions, which in turn shape the behavior of households and firms. Conceptually, the term “financial conditions” in this figure represents a weighted average of aggregate asset prices—such as stock prices, borrowing rates, and exchange rates—that drive economic activity. This raises several natural questions: how do we measure financial conditions, which assets are their primary drivers, and how tightly does the central bank’s main tool—the policy interest rate—

<sup>4</sup>For instance, Chodorow-Reich et al. (2021) find that the impact of a stock price shock on labor market outcomes peaks 4 to 8 quarters after the initial shock. Romer and Romer (2004) find similar lags for the effect of monetary policy shocks on output.

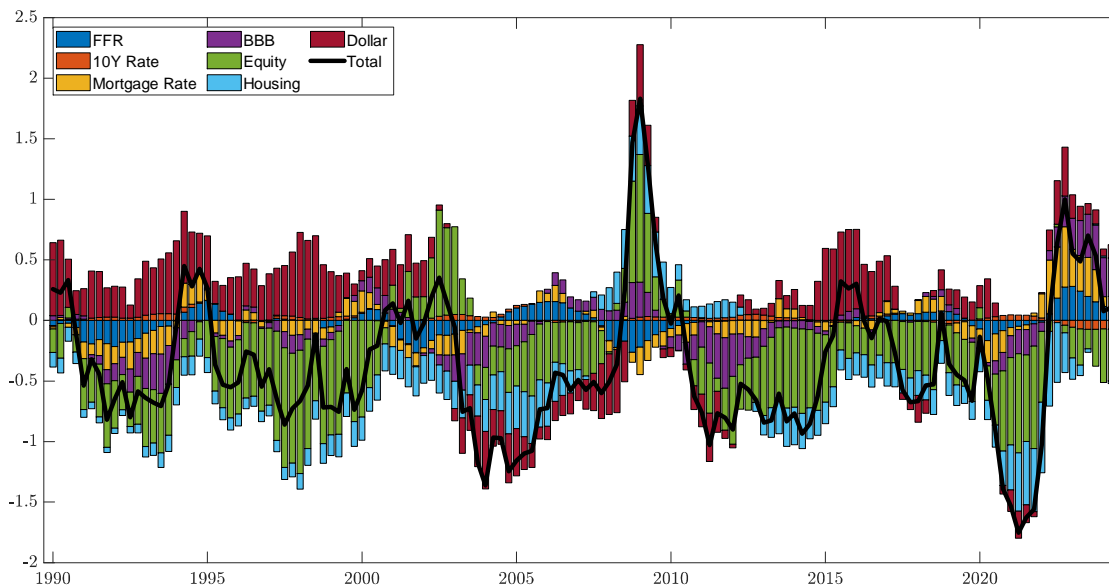


Figure 2: FCI-G index (with a three-year lookback) and its drivers over 1990Q1-2024Q2. Positive values imply recent financial conditions will reduce GDP growth in the next year. Data is from Ajello et al. (2024).

map to these broader conditions? Recently developed financial conditions indices (FCIs) provide answers and reveal that this mapping is far from complete.

## 2.2. The mapping from interest rates to financial conditions is incomplete

An FCI attempts to measure the impact of recent developments in financial markets on future GDP growth, quantifying the *market-based* policy transmission plotted in Figure 1. There are several well-known financial conditions indexes, such as the Goldman Sachs FCI (see Hatzius and Stehn (2018)), the National FCI by the Chicago Fed, and the FCI-Growth index (FCI-G) by Ajello et al. (2023). The FCI-G is notable for relying on the FRB/US model and other large-scale DSGE models developed by the Federal Reserve. These models are disciplined by empirical evidence and incorporate the various channels by which financial markets affect economic activity, including the borrowing and investment effects of various interest rates, the wealth effects of stock and house prices, and the expenditure switching effects of exchange rates. Hence, the FCI-G provides a summary statistic of how recent asset price and interest rate changes are expected to influence output growth over the next year according to the Federal Reserve’s structural models.

Figure 2 plots the FCI-G index along with its drivers in recent years. As the figure

shows, fluctuations in the index are driven primarily by risky asset prices—specifically, stock prices and exchange rates, and occasionally house prices—rather than by various yields. While these assets may not individually influence economic activity more strongly than interest rates, their heightened volatility generates larger swings in overall financial conditions, making them disproportionately important for monetary policy transmission.

This dominance of risky asset prices in driving financial conditions already suggests that the mapping from interest rates to financial conditions is incomplete. A growing body of evidence confirms this point by showing that monetary policy affects financial conditions through channels well beyond expected interest rates. One of the early papers documenting this channel is Bernanke and Kuttner (2005), who find that the bulk of the effect of conventional monetary policy surprises on the stock market comes from changes in the equity premium rather than from changes in expected real risk-free rates or expected cash flows. Subsequent research further demonstrated that monetary policy shocks significantly impact risk premia across various asset classes (see, e.g., Bekaert et al. (2013); Hanson and Stein (2015); Gertler and Karadi (2015)). Bauer et al. (2023) synthesize the insights from this literature and show that monetary policy shocks have strong and persistent effects on a risk appetite index, which in turn drives a substantial part of the transmission of monetary policy to financial markets.<sup>5</sup>

Recent work by Boehm and Kroner (2024) provides further evidence. They show that conventional yield curve changes explain surprisingly little variation in stock prices and exchange rates around FOMC announcements, and identify a “Fed non-yield shock” that drives substantial variation in equity prices and exchange rates despite having no impact on the yield curve.

We refer to this incomplete mapping from interest rates to financial conditions as the “lost in translation” problem. Even if the central bank communicates its expected interest rate path perfectly, market participants face residual uncertainty about intended financial conditions because interest rates are only one of many factors that determine overall financial conditions. This evidence underscores the value of developing a communication strategy that addresses financial conditions directly, rather than relying on interest rate projections that may be lost in translation.

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<sup>5</sup>Nagel and Xu (2024) provide a dissenting view by arguing that conventional interest-rate based monetary policy shocks affect stock prices mostly due to yield curve changes. However, they note that the yield curve moves partly due to changes in the term premium, which is consistent with our point that monetary policy does not transmit only through expected short-term interest rates.

### 2.3. Financial conditions are “noisy” and induce large macroeconomic fluctuations

A robust body of finance literature emphasizes that risky asset prices feature “excess” volatility that is unrelated to expected cash flows. This phenomenon is driven in part by time-varying sentiment (e.g., Shiller (2014)), time-varying risk premiums (e.g., Cochrane (2011)), or time-varying noise in inelastic markets (e.g., De Long et al. (1990); Gabaix and Koijen (2021)). Given that financial conditions—as captured by the FCI-G index—greatly impact macroeconomic activity according to the Fed’s structural models, a natural question arises: Does the “excess volatility” in asset prices also induce “excessive” macroeconomic fluctuations?

We have recently addressed this question in two different studies. Our first study (Caballero et al. (2024)) builds upon Gabaix and Koijen (2021), who provide a measure of noisy flows into the aggregate stock market and show that this type of noise can induce substantial swings in stock prices. We show that these noisy flows also influence financial conditions and macroeconomic activity: a noisy flow shock into the stock market increases stock prices and loosens financial conditions, which in turn increases output gaps and inflationary pressures. The Fed eventually raises the policy interest rate and stabilizes the output gap, but with a substantial delay, likely reflecting its preference for gradual interest rate adjustments.

Our second study (Caballero et al. (2025)) introduces and empirically estimates FCI\*, the analogue of  $r^*$ , within a framework in which financial conditions along with demand shocks drive economic activity as in Figure 1. Conceptually, FCI\* is the level of FCI that closes the expected output gap. Therefore, FCI gaps—the differences between the observed FCI and the FCI\*—are related to output gaps. This feature enables us to infer the latent FCI\* from the observed FCI and the estimated output gaps. We operationalize this idea by developing and estimating a two-equation macroeconometric model along the lines of Laubach and Williams (2003); Holston et al. (2023), and using the FCI-G measure by Ajello et al. (2023).

Figure 3 illustrates our estimated FCI\* in the top panel along with the estimated output gaps in the bottom panel. Our estimates show that the latent FCI\* series mainly reflects *macroeconomic* forces rather than financial market developments, loosening in demand recessions and tightening in an inflationary boom. In contrast, the observed FCI partly reflects financial market shocks, which induces FCI gaps. These gaps are especially large during the onset of large recessions, such as the Global Financial Crisis (GFC), where the observed FCI tightens, reflecting the distress in financial markets, whereas the

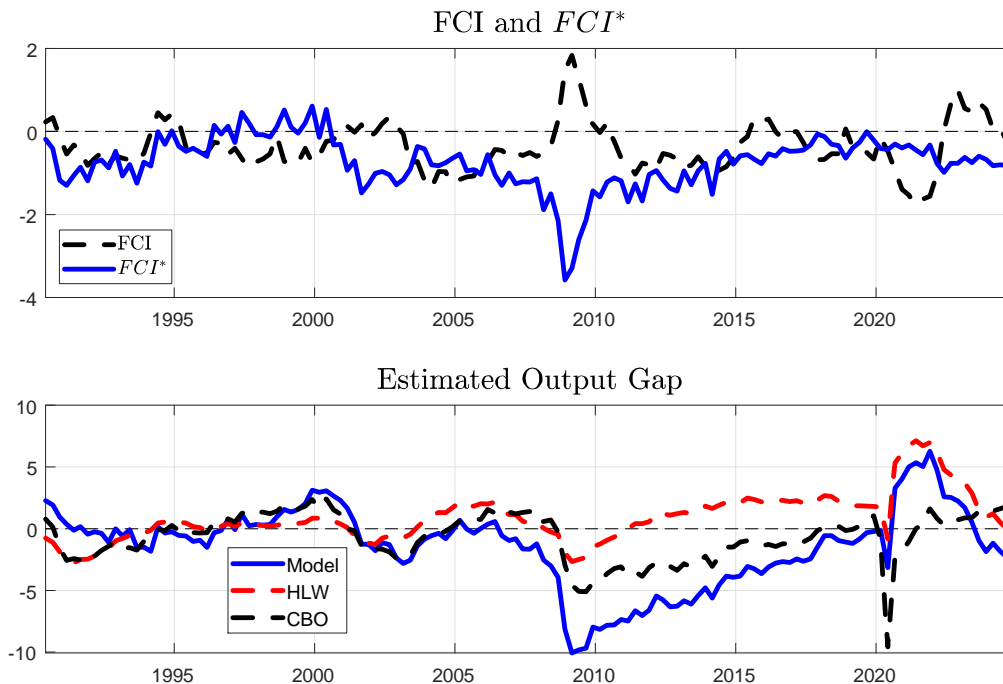


Figure 3: Top: FCI (black) and  $FCI^*$  (blue). Bottom: output gap estimates from our two equation macroeconomic model (blue), Holston et al. (2023) (red) and CBO (black). All estimates are one-sided. Reprinted from Caballero et al. (2025).

$FCI^*$  loosens, reflecting the greater stimulus needed by the macroeconomy.

These gaps reflect well-known real-time constraints on policy—most notably central banks’ preference for rate-smoothing and the presence of transitory cost-push pressures. In (Caballero et al. (2024)) we use a semi-structural VAR approach that incorporates these types of frictions to estimate financial conditions targets that the Fed could in principle implement without violating standard constraints. In Section 4, we use this analysis to construct a prototype FCI-plot: the financial conditions the Fed expects to see in the near future under optimal policy. As we will see, the FCI-plot often deviates from the observed FCI as well, but less so than the  $FCI^*$ . The pattern parallels conventional interest-rate policy: the optimal path does not leap immediately to  $r^*$ , but converges toward it gradually.

Overall, while our two studies use very different methodologies, they reach a similar conclusion: “excess volatility” in financial markets induces “excessive” macroeconomic fluctuations that are only partially stabilized by the Fed. As we will argue later in the paper, appropriate communication with sophisticated market participants can enable the Fed to better smooth financial-noise driven macroeconomic fluctuations.

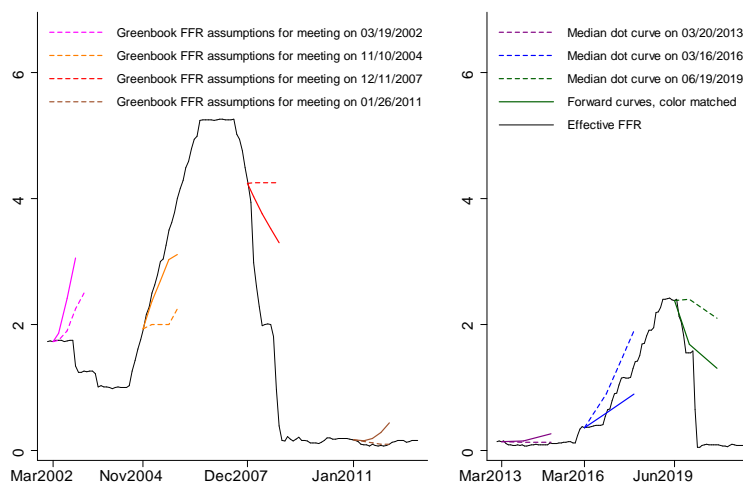


Figure 4: Dotted lines: the Fed prediction for Fed funds rates for select FOMC meetings—from either the Greenbook assumptions (left panel) or the FOMC dots (right panel). Solid lines: the forward Fed funds rates for the same meetings. Thin black line: the Fed funds rate. Reprinted from Caballero and Simsek (2022).

## 2.4. Markets routinely disagree with central banks

Central bank communication is directed primarily toward sophisticated financial market participants. A defining feature of this audience is that they are both *informed* and *opinionated* (see Caballero and Simsek (2022)). Market participants often hold strong, independent beliefs about the state of the economy and the appropriate monetary policy response—views that frequently diverge from those of the central bank. Figure 4 illustrates this point by showing that forward interest rates, which largely reflect market expectations for the federal funds rate (FFR), often deviate from the Fed’s own median projections. Such divergences are not rare exceptions but a persistent feature of the policy landscape. They are correlated with differences in macroeconomic outlooks such as inflation expectations (see Caballero and Simsek (2022)), suggesting that they stem in part from differing views about the economy.

These differences in economic outlook do not reflect “different information” available to markets and the central bank—both are sophisticated with access to similar data. As Blinder (2007) notes, in monetary policy virtually all the data that matter are common knowledge. Bauer and Swanson (2023) confirm that market participants do not consider the Fed to have superior information about the state of the economy. Rather, forecast differences mostly reflect different interpretations of the same data—what we refer to as belief disagreements.

Importantly, these disagreements do not imply that markets ignore central bank communications—on the contrary, markets follow them closely precisely because the central bank sets policy. These policy decisions are influenced by the central bank’s beliefs (such as whether they expect future economic activity to be strong or weak) as well as their preferences (such as whether they prioritize stabilizing inflation over the output gap). Hence, communication does not persuade markets of the Fed’s views, but lets them infer the likely direction of policy. In fact, disagreements substantially increase the need for communication: when the central bank’s views closely mirror market views, policy uncertainty is minimal, but when views diverge, market participants face considerable uncertainty about the path of policy.

## **2.5. Conditional on economic outlook, markets are uncertain about future financial conditions**

Our final empirical point is that, while market participants appear to understand the Fed’s reaction function in terms of interest rates, they do not seem to understand it in terms of financial conditions. We document this using data from the MacroPolicy Perspectives Shadow Survey Coronado and Rosner-Warburton (2025), which asks market participants: “What is your expectation for broader U.S. financial conditions over the next year? (scale of 1-4, where 1=Ease, 4=Tighten a lot).” Table 1 tests whether forecasters who expect different macroeconomic conditions also expect correspondingly different monetary policy responses. Column 2 shows that they do when the policy response is measured by interest rates: forecasters expecting higher unemployment predict lower rates, while those expecting higher inflation predict higher rates (see also Bauer et al. (2024b)). However, Column 1 shows that the same pattern does not hold when the policy response is measured by financial conditions: forecasters’ expectations for financial conditions are largely unrelated to their macroeconomic outlook. One interpretation is that market participants do not fully understand how the Fed will steer financial conditions in different macroeconomic scenarios—precisely the type of uncertainty that FCI-plot communication is designed to reduce.

## **3. A Stylized Model of FCI-plot Communication**

In this section, we develop a stylized model consistent with the empirical facts discussed in Section 2. We begin with a simplified version of the model from Caballero et al. (2024), which captures the mechanism by which noise shocks affect financial conditions, market

Table 1: Relationships Between Monetary Policy Forecasts and Economic Outlook

	(1)	(2)
	FC change (until Q4)	FFR change (until Q4)
Unemployment forecast (Q4)	0.040 (0.023)	-0.110** (0.031)
Core PCE forecast (Q4)	-0.018 (0.036)	0.204** (0.046)
Forecaster and Quarter FE	Yes	Yes
Observations	1,752	1,730
Adjusted R-squared	0.378	0.878

Note: Data come from the quarterly Shadow Survey of Market Participants conducted by MacroPolicy Perspectives from 2017-2024. The dependent variables are forecaster-level predictions of financial conditions changes (column 1) and FFR changes (column 2) over a four-quarter horizon. Independent variables are forecaster-level predictions of unemployment four quarters ahead (quarterly average) and core PCE inflation four quarters ahead (measured as year-over-year change). FFR, unemployment, and core PCE forecasts are interpolated from the end-of-year forecasts provided in the survey. All regressions include forecaster and quarter fixed effects, with standard errors (in parentheses) clustered by forecaster and quarter. \* and \*\* denote statistical significance at the 5% and 1% levels, respectively.

volatility, and aggregate demand. Our main contribution is to extend this framework to analyze how central bank communication can mitigate the adverse effects of disagreement between markets and the Fed about economic conditions. Formal proofs are relegated to the appendix.

The model has four agents: households, noise traders, arbitrageurs (the Arbs, denoted by subscript  $A$ ) and the central bank (the Fed, denoted by subscript  $F$ ). Households transmit financial conditions into aggregate spending decisions, noise traders submit noisy financial flows that affect financial conditions, the Arbs absorb these flows and partly stabilize financial conditions, the Fed sets the interest rate to steer financial conditions and close the output gap (see Figure 1). Importantly, the Arbs and the Fed may have different beliefs about potential output, which creates a need for communication. These belief disagreements reflect different interpretations of the data rather than different information (see Section 2.4).

### 3.1. A macroeconomic model with noise and limits to arbitrage

**Real economy.** On the supply side, (the log of) potential output follows a path  $\{y_t^*\}$ . For now, potential output follows a deterministic path that is known by all agents. Later,

we introduce uncertainty and disagreements about  $\{y_t^*\}$ , which will motivate central bank communication.

Due to nominal price stickiness, log output,  $y_t$ , is determined by aggregate demand and can depart from potential output. For simplicity, prices are fully sticky. Our insights are robust to allowing for partially flexible prices via a standard Phillips curve (see Caballero et al. (2024)).

On the demand side, there are two types of households: hand-to-mouth agents and (asset holding) households. Hand-to-mouth agents do not play an important role beyond decoupling the labor supply decisions from household consumption behavior. They supply all of the labor and spend all of their income. Since their spending is driven by output, which is endogenous, they create a Keynesian multiplier effect but they do not drive aggregate demand.

Aggregate demand is driven by (asset holding) households. These households own the aggregate risky asset (the market portfolio): a claim on firms' share of output ( $\nu Y_t$ ). They have expected log utility and make portfolio allocation and consumption-savings decisions. They delegate the portfolio decision to the portfolio managers, which we describe later. The upshot of these assumptions is the *output-asset price* relation

$$y_t = m + p_t, \tag{1}$$

where  $p_t$  denotes (the log of) the price of the market portfolio and  $m = \log\left(\frac{1-\beta}{\nu\beta}\right)$  is a constant derived parameter. The setup can be readily extended to incorporate non-financial demand shocks, but this specification will be sufficient for our purposes.

**Financial markets.** Households make a portfolio choice between two assets: the market portfolio and the risk-free asset (normalized to have zero net supply). The (log) return on the risk-free asset  $i_t = \log R_t^f$  is set by the central bank as we describe later. The (log) return on the market portfolio,  $r_{t+1} = \log R_{t+1}$ , is approximately given by

$$\begin{aligned} r_{t+1} &= \rho - (1 - \beta) m + (1 - \beta) y_{t+1} + \beta p_{t+1} - p_t \\ &= \rho + p_{t+1} - p_t. \end{aligned} \tag{2}$$

Here,  $\rho \equiv -\log \beta$  is the (log of) households' discount rate. The return depends on future output (through cash flows) and asset price, and inversely on the current asset price. The second line uses (1) to write future output in terms of the future asset price, which implies the return depends on the price changes.

Households delegate their portfolio choice to non-consuming managers. In each period, a fraction  $\eta$  of these managers are “noise traders” and their portfolio weight is given by  $\omega_{t,N} = 1 + \frac{1-\eta}{\eta}\mu_t$ . That is, they deviate from the optimal portfolio benchmark by an amount  $\frac{1-\eta}{\eta}\mu_t$ , where  $\mu_t$  denotes aggregate noise and  $\frac{1-\eta}{\eta}$  is a normalizing constant. For simplicity, we assume  $\mu_t$  follows an i.i.d. process  $N(0, \sigma_\mu^2)$  (the analysis extends to serially correlated noise shocks).

The remaining managers are “arbitrageurs” who choose their portfolio weights optimally as we describe below. Combining the managers’ positions, we obtain the market clearing condition

$$(1 - \eta)\omega_{t,A} + \eta \left(1 + \frac{1 - \eta}{\eta}\mu_t\right) = 1 \implies \omega_{t,A} = 1 - \mu_t. \quad (3)$$

In equilibrium, arbitrageurs must adjust their portfolio weight  $\omega_{t,A}$  to absorb the aggregate noise.

The arbitrageurs choose their portfolio weight to maximize expected log assets-under-management, after observing the risk-free rate and the current noise  $\mu_t$ :

$$\max_{\omega_{t,A}} E_{t,A} \left[ \log \left( W_t \left( R_t^f + \omega_{t,A} \left( R_{t+1} - R_t^f \right) \right) \right) \right].$$

Observe that we allow arbitrageurs to have their own beliefs. This problem effectively results in a standard mean-variance portfolio optimization. Assuming the market and the portfolio returns are log-normally distributed, the approximate optimality condition is given by:

$$\omega_{t,A}\sigma_{t,A}(r_{t+1}) = \frac{E_{t,A}[r_{t+1}] + \frac{var_{t,A}(r_{t+1})}{2} - i_t}{\sigma_{t,A}(r_{t+1})}. \quad (4)$$

The arbitrageurs’ demand for risk is equal to their (perceived) equilibrium Sharpe ratio.

Combining this with (3), we derive the *financial market equilibrium condition*:

$$E_{t,A}[r_{t+1}] = i_t + \frac{1}{2}var_{t,A}(r_{t+1}) - var_{t,A}(r_{t+1})\mu_t.$$

Substituting (2) into this condition, we obtain a present discounted value relation that describes the equilibrium aggregate asset price:

$$p_t = \rho + E_{t,A}[p_{t+1}] - \left( i_t + \frac{1}{2}var_{t,A}(p_{t+1}) \right) + var_{t,A}(p_{t+1})\mu_t. \quad (5)$$

Note that we have substituted the conditional return variance in terms of the conditional

price variance since  $r_{t+1} = \rho + p_{t+1} - p_t$ .

All else equal, the effect of noise on the aggregate asset price *increases with the return variance perceived by the arbitrageurs*. Intuitively, when the aggregate asset price is more volatile, arbitrageurs require a greater expected return to absorb noisy flows.

**Monetary policy.** The central bank (the Fed) sets  $i_t$  and determines output. As a benchmark, we assume the central bank follows the interest rate rule

$$i_t = E_{t-1,A} [i_t] + \theta \tilde{y}_t + v_t, \quad \text{where } \tilde{y}_t = y_t - y_t^*. \quad (6)$$

Here,  $E_{t-1,A} [i_t]$  is the interest rate the Arbs expect the Fed to set and  $v_t \sim N(0, \sigma_v^2)$  is an i.i.d. monetary policy shock.

Without the monetary policy shock term, the rule in (6) emerges from minimizing the gap-objective function  $G_t = \tilde{y}_t^2 + \frac{1}{\theta} (i_t - E_{t-1,A} [i_t])^2 + \beta E_t [G_{t+1}]$  (taking future actions as given). Hence, it captures a central bank that aims to minimize output gaps but also set predictable interest rates. This preference for predictability leads to a gradual adjustment of interest rates, which slows the central banks' response to shocks that create output gaps, such as the financial noise shock. The parameter  $\theta$  captures the speed at which the central bank responds to shocks.

We append the rule with an additional monetary shock term  $v_t$  to introduce some irreducible noise into the central bank's interest rate policy. In practice, this type of policy noise can emerge from various unmodeled considerations, e.g., disagreements inside the central bank, a concern with near-term inflationary pressures, and so on. In the model, these monetary policy shocks serve two purposes. First, they introduce a source of uncertainty to aggregate asset prices that is different from financial noise shocks. Second, and more importantly, they prevent full revelation of the Fed's beliefs to the Arbs when we introduce belief disagreements.

### 3.2. Benchmark equilibrium with common beliefs

We first consider a benchmark setup in which the Arbs and the Fed share identical beliefs. We use this setup to illustrate how financial noise affects the equilibrium asset price and output. The following result characterizes the equilibrium.

**Proposition 1** (Equilibrium with Common Beliefs). *Suppose the Arbs and the Fed agree: they both know that aggregate supply follows the deterministic path  $\{y_t^*\}$ , noise shocks are i.i.d. with  $N(0, \sigma_\mu^2)$ , and monetary policy shocks are i.i.d. with  $N(0, \sigma_v^2)$ . Suppose the*

parameters are such that the quadratic in (8) has two positive roots. Then, there is an equilibrium with

$$\begin{aligned} p_t &= p_t^* + \frac{1}{1+\theta} (\sigma^2 \mu_t - v_t), \quad \text{where } p_t^* \equiv y_t^* - m, \\ y_t &= y_t^* + \frac{1}{1+\theta} (\sigma^2 \mu_t - v_t) \\ i_t &= \rho + y_{t+1}^* - y_t^* - \frac{1}{2} \sigma^2 + \frac{\theta}{1+\theta} \sigma^2 \mu_t + \frac{1}{1+\theta} v_t \end{aligned} \tag{7}$$

The return is given by  $r_{t+1} = \rho + p_{t+1} - p_t$ . The perceived variance  $\sigma^2 = \text{var}_t(p_{t+1})$  is the smallest positive solution to the following fixed point problem:

$$\sigma^2 = \left( \frac{1}{1+\theta} \right)^2 \left( (\sigma^2)^2 \sigma_\mu^2 + \sigma_v^2 \right). \tag{8}$$

Here, “p-star” denotes the aggregate asset price compatible with zero output gaps (the model analogue of the “FCI-star” from Figure 3, with opposite sign due to the price-versus-yield representation). Eq. (7) shows that “p-star” is determined purely by *macroeconomic* factors: specifically, the aggregate supply  $y_t^*$  and the aggregate demand pressures captured by the intercept  $m$ . It does not depend on financial factors such as expected cash-flows, risk premium, or noisy flows. Those financial factors are absorbed into “rstar,” which in this model is given by

$$i_t^* = \rho + y_{t+1}^* - y_t^* - \frac{1}{2} \sigma^2 + \sigma^2 \mu_t.$$

The actual interest rate  $i_t$  differs from  $i_t^*$  for two reasons: it features a smaller response to noise shocks ( $\frac{\theta}{1+\theta} \sigma^2 \mu_t$ ) and it responds to monetary policy shocks ( $v_t$ ). Intuitively, to eliminate output gaps, the Fed needs to adjust the interest rate to insulate the FCI and the real economy from purely financial factors. In this model, this adjustment is incomplete due to the Fed’s preference for setting predictable interest rates. This allows financial shocks as well as monetary policy shocks to partially affect macroeconomic outcomes.<sup>6</sup>

Consider first the response to the monetary policy shock  $v_t$ . As expected, a positive monetary policy shock lowers the output gap. The impact is less than one-to-one since

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<sup>6</sup>Observe that  $i_t$  *fully* responds to changes in the growth rate of potential output  $y_{t+1}^* - y_t^*$ . This is because we have assumed the path of potential output follows a deterministic path known by both the Fed and the Arbs. Therefore, in the baseline model the interest rate adjustments due to deterministic potential output growth do not violate the Fed’s preference to set predictable interest rates. This will change when we introduce disagreements about potential output growth.

the endogenous response of monetary policy to output gaps stabilizes some of the initial impact.

Next, consider the response to the financial noise shock  $\mu_t$ . Since the central bank is gradualist, it reacts to the noise shock only partially, allowing this shock to affect the aggregate asset price. Consequently, aggregate return variance is driven not only by monetary policy shocks but also by financial noise shocks. Note also that greater return variance amplifies the noise shock’s impact on the aggregate asset price. Variance therefore satisfies a fixed-point problem that captures a vicious cycle: increased variance allows noise to have greater impact on aggregate asset price, which further increases variance and enables noise to have an even stronger effect, and so on.

In Caballero et al. (2024), we argue that this vicious cycle of volatility creates a rationale for Financial Conditions Targeting—a framework in which the central bank commits to stabilize future financial conditions to encourage arbitrageurs to trade against noisy flows, thereby “recruiting” them to insulate the real economy from financial noise. In the rest of this section, we show the right central bank communication strategy can also activate this recruitment mechanism.

### 3.3. Belief disagreements: Tantrums and volatility

To investigate the role of communication, we extend the model to introduce *belief disagreements* between the Fed and the Arbs. We show that, on average, the Fed implements the appropriate outcomes under its belief. However, the Arbs’ uncertainty about the Fed’s belief leads to additional asset price and output gaps for two different reasons. First, if the Arbs’ belief about the Fed’s belief is different from the Fed’s actual belief, this discrepancy induces *current* asset prices to deviate from the Fed’s desired level, resulting in excessive output gaps. We refer to these misunderstandings as *tantrums*. Second, the Arbs’ uncertainty about the Fed’s belief increases perceived *future* asset price variance, which amplifies the transmission of financial market noise to macroeconomic outcomes.

**Beliefs about “ystar” and “pstar”.** We now assume potential output is uncertain and agents have different beliefs about the path it follows. For the baseline disagreements model, we focus on the special case in which both agents think potential output is constant over time  $y_t \equiv y^*$ . However, the Fed thinks it is  $y_F^*$  and the Arbs think it is  $y_A^*$ . For now, we assume that agents never receive a signal about potential output so their initial beliefs do not change (we relax this assumption in Section 3.5).

These assumptions naturally imply disagreements about “pstar”: the Fed thinks

“pstar” is  $p_F^* \equiv y_F^* - m$  and the Arbs think it is  $p_A^* \equiv y_A^* - m$ . We view the disagreements about potential output as a simple modeling device to introduce disagreements about “pstar”. In Caballero and Simsek (2022) we obtain similar results when the Fed and the markets disagree about aggregate demand rather than potential output.

**Monetary policy.** We assume the Fed follows the rule in (6) with the difference that it stabilizes output gaps *around its own belief about potential output*

$$i_t = E_{t-1,A} [i_t] + \theta (y_t - y_{t,F}^*) + v_t. \quad (9)$$

**Beliefs about each other’s beliefs.** Since the Fed sets policy according to its own belief, the market wants to know the Fed’s belief even though it does not agree with it. Therefore, we need to specify agents’ beliefs about each other’s beliefs. To illustrate our points transparently, we keep the model simple, focusing on belief uncertainty only at the single date 0. Similar results hold in richer dynamic environments.

Specifically, for the baseline model in which each agent thinks “pstar” is constant, we assume the Arbs initially (at date 0) do not know the Fed’s belief. Their prior belief about the Fed’s belief about “pstar” is given by  $p_F^* \sim_A N(\tilde{p}_{FA}^*, \tilde{\sigma}_{FA}^2)$ . We can expect  $\tilde{p}_{FA}^*$  to be somewhere between the Arbs’ own belief and the Fed’s true belief, though we allow for more general cases. At date 1, the Arbs learn the Fed’s belief  $p_F^*$  correctly so they no longer face uncertainty. For simplicity, we assume the Fed knows the Arbs’ belief  $p_A^*$  throughout (it can learn this from asset prices). We next characterize the equilibrium.

**Equilibrium with disagreement.** First, consider the equilibrium from date  $t = 1$  onward so there is disagreement but no uncertainty about beliefs. The equilibrium is given by (7) but with the asset price replaced by *the Fed’s belief about “pstar”*. We note this result with the following proposition.

**Proposition 2** (Disagreement and Knowledge of Beliefs). *Consider the baseline model in which the Fed and the Arbs disagree about “pstar”,  $(p_F^*, p_A^*)$ , and consider date  $t \geq 1$  onward so they know each other’s beliefs. Then, there is an equilibrium in which*

$$\begin{aligned} p_t &= p_F^* + \frac{1}{1+\theta} (\sigma^2 \mu_t - v_t) \\ y_t &= y_F^* + \frac{1}{1+\theta} (\sigma^2 \mu_t - v_t) \\ i_t &= \rho - \frac{1}{2} \sigma^2 + \frac{\theta}{1+\theta} \sigma^2 \mu_t + \frac{1}{1+\theta} v_t \end{aligned} \quad (10)$$

The return is given by  $r_{t+1} = \rho + p_{t+1} - p_t$ . The perceived variance  $\sigma^2 = \text{var}_{t,A}(p_{t+1})$  is the smallest positive solution to the same fixed point problem as before in (8).

Why does the Fed’s belief about “pstar” determine the equilibrium? Intuitively, the Fed can always adjust the interest rate to steer the financial conditions to the level it deems appropriate—subject to interest rate gradualism constraints. In this model, given the full persistence of beliefs, asset prices adjust to the Fed’s belief not only in the current period but also in future periods. Therefore, the Fed is able to implement its view without changing the equilibrium interest rate (its off-equilibrium adjustments ensure the asset price and output are aligned with its view). This in turn implies the gradualism constraints do not bind and the Fed can implement its view fully. While this result is rather extreme, our analysis only requires the Fed’s belief to have some impact on the equilibrium asset price, which holds in many variants of this model. In Section 3.5, we analyze an example in which the Arbs’ belief affects the interest rate the Fed needs to set to achieve its “pstar”, but the Fed’s belief is still the primary driver of the equilibrium asset price.

**Equilibrium with market’s uncertainty about the Fed’s belief.** Now consider the equilibrium at date 0, so there is disagreement *and the Arbs are uncertain about the Fed’s belief*. The following result characterizes the equilibrium in this case.

**Proposition 3** (Disagreement and No Communication). *Consider the baseline model in which the Fed and the Arbs disagree about “pstar”,  $(p_F^*, p_A^*)$ , and consider date  $t = 0$  so that the Arbs are uncertain about the Fed’s belief about “pstar” and have prior belief  $p_F^* \sim_A N(\tilde{p}_{FA}^*, \tilde{\sigma}_{FA}^2)$ . Then, there is an equilibrium in which the Arbs’ posterior belief about the Fed’s “pstar” (after observing the interest rate) is given by  $p_F^* \sim_A N(p_{FA}^*, \sigma_{FA}^2)$  where*

$$p_{FA}^* = (1 - \kappa)\tilde{p}_{FA}^* + \kappa\left(p_F^* - \frac{1}{\theta}v_0\right) \quad (11)$$

with  $\kappa = \frac{\theta^2/\sigma_v^2}{1/\tilde{\sigma}_{FA}^2 + \theta^2/\sigma_v^2}$  and  $\frac{1}{\sigma_{FA}^2} = \frac{1}{\tilde{\sigma}_{FA}^2} + \frac{\theta^2}{\sigma_v^2}$ . The tantrum shock—the difference between the Fed’s “pstar” and the market’s perception of it—is given by

$$\tau_0 = p_F^* - p_{FA}^* = (1 - \kappa)(p_F^* - \tilde{p}_{FA}^*) + \frac{\kappa}{\theta}v_0. \quad (12)$$

The rest of the equilibrium variables are

$$p_0 = p_F^* + \frac{1}{1+\theta} (\sigma_1^2 \mu_0 - v_0 - \tau_0) \quad (13)$$

$$y_0 = y_F^* + \frac{1}{1+\theta} (\sigma_1^2 \mu_0 - v_0 - \tau_0) \quad (14)$$

$$i_0 = \rho - \frac{1}{2} \sigma_1^2 + \frac{\theta}{1+\theta} (\sigma_1^2 \mu_0 - \tau_0) + \frac{1}{1+\theta} v_0 \quad (15)$$

The return is given by  $r_1 = \rho + p_1 - p_0$  where  $p_1 = p_F^* + \frac{1}{1+\theta} (\sigma^2 \mu_1 - v_1)$ . The perceived variance is

$$\sigma_1^2 = \text{var}_{0,A}(p_1) = \sigma_{FA}^2 + \sigma^2 \quad (16)$$

where  $\sigma^2$  is the solution to the same fixed point problem as before in (8).

This equilibrium differs from the earlier cases in two main respects. First, the Arbs' misunderstanding of the Fed's belief  $\tau_0 = p_F^* - p_{FA}^*$ —which we refer to as a “tantrum shock”—affects the aggregate asset price and output. Intuitively, when the Arbs think the Fed's “pstar” is lower than it actually is, they anticipate a lower aggregate asset price, and this anticipation reduces the aggregate asset price immediately. This tightening in financial conditions also reduces output below potential. The Fed offsets the tantrum shock by reducing the interest rate, but this offset is incomplete due to interest rate gradualism.

Second, return volatility is greater than before,  $\sigma_1^2 = \sigma_{FA}^2 + \sigma^2 > \sigma^2$ , which implies that financial noise has a greater effect on the aggregate asset price and output: The Arbs perceive greater uncertainty because they are unsure about the Fed's “pstar.” This induces them to trade less aggressively against noisy flows and enables those flows to have a larger impact on the aggregate asset price and output.

In sum, the Arbs' uncertainty about the Fed's belief creates inefficient macroeconomic fluctuations through two channels: by creating tantrum shocks that induce output gaps, and by enabling financial noise shocks to have a greater impact on output gaps. This naturally motivates communication policies designed to reduce the Arbs' uncertainty.

### 3.4. FCI-plot communication

Suppose the Fed can, *after* it observes current shocks  $\mu_0, v_0$ , send a truthful message to the Arbs to reduce their uncertainty about the Fed's belief. We focus on two types of messages: the Fed can announce either its expected aggregate asset price path for

the current and the next period (FCI-plot)  $(E_{0,F}[p_0], E_{0,F}[p_1])$ , or it can announce its expected interest rate path for the next period (rate-plot),  $E_{0,F}[i_1]$ . In both cases, the Fed also sets (and therefore announces) the current interest rate  $i_0$  as before. We compare these policies because they are in principle alternative methods to steer current financial conditions in the direction the Fed deems appropriate. We assume both announcements are truthful. Which one is more effective to mitigate tantrums and to recruit the Arbs to absorb noise shocks?

In this model, announcing FCI-plot is a very effective policy in the sense that it fully eliminates tantrum shocks and mitigates the impact of financial shocks. To see this, we conjecture an equilibrium in which after the announcement the market learns  $p_F^*$  and we are back to the case in which there is disagreement but knowledge of beliefs (see Proposition 2). Given this equilibrium, the Fed sets the interest rate

$$i_0 = \rho - \frac{1}{2}\sigma^2 + \frac{\theta}{1+\theta}\sigma^2\mu_0 + \frac{1}{1+\theta}v_0$$

and it announces the FCI path it expects to see as follows

$$\begin{aligned} E_{0,F}[p_0] &= p_F^* + \frac{1}{1+\theta}(\sigma^2\mu_0 - v_0). \\ E_{0,F}[p_1] &= p_F^*. \end{aligned}$$

Observe that along this equilibrium path  $i_0$  reveals  $v_0$  (since the Arbs know  $\mu_0$ ). Given  $v_0$ ,  $E_{0,F}[p_0]$  reveals  $p_F^*$ . Thus, the announcement  $(i_0, E_{0,F}[p_0])$  fully reveals both  $v_0$  and  $p_F^*$ .<sup>7</sup> Therefore, these announcements fully resolve the market's uncertainty about the Fed's "pstar", which verifies our conjecture that we are back to the case with disagreements but full knowledge of beliefs. Consequently, there are no tantrums and financial noise shocks have a smaller impact on the aggregate asset price since the Arbs perceive a smaller variance (see Proposition 2).

In contrast, announcing  $E_{0,F}[i_1]$  does not provide any additional information. To see this, note that Proposition 2 implies

$$E_{0,F}[i_1] = \rho - \frac{1}{2}\sigma^2.$$

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<sup>7</sup>In this example, announcing  $E_{0,F}[p_1]$  is redundant since  $E_{0,F}[p_0]$  together with  $i_0$  fully reveal  $p_F^*$ . However, this feature does not generalize to an extended model in which the market is uncertain about the Fed's views for both future and current financial conditions. Specifically, suppose the Fed thinks potential output is temporarily different than its long run level (say, due to a short-run supply shock) so its belief about "pstar" is given by  $p_{0,F}^* \neq p_F^*$  and  $p_{t,F}^* \equiv p_{1,F}^*$  for each  $t \geq 1$ . In this case, announcing  $E_{0,F}[p_1]$  in addition to  $E_{0,F}[p_0]$  would further reduce Arbs' uncertainty about near-term financial conditions.

This announcement contains no information about  $p_F^*$ ; in fact, it provides the Arbs with no information at all. Thus, it leaves the equilibrium at date 0 unchanged. Intuitively, the future asset price  $p_1$  depends not only on the future interest rate  $i_1$  but also on the Arbs' expectation for the subsequent asset price  $p_2$ . At date 1, the Arbs will learn  $p_F^*$ , and this will change their expectation for the price in subsequent periods  $E_{1,A}[p_2] = p_F^*$ . This expectation will keep  $p_1$  centered around  $p_F^*$  without need for an interest rate change. Thus, announcing the future rate the Fed expects to set is not informative about the financial conditions the Fed expects to implement. The following result summarizes this discussion.

**Proposition 4** (Disagreement and FCI-plot Communication). *Consider the baseline model in which the Fed and the Arbs disagree about “pstar”,  $(p_F^*, p_A^*)$ , and consider date  $t = 0$ .*

(i) *Suppose the Fed announces the FCI-plot  $(E_{0,F}[p_0], E_{0,F}[p_1])$  (credibly, but not as a commitment). Then, the equilibrium is the same as in Proposition 2 with  $t$  replaced by  $t = 0$ . In particular, the equilibrium does not feature tantrum shocks,  $\tau_0 = p_F^* - p_{FA}^* = 0$ , and financial noise shocks have a smaller impact on output gaps than in Proposition 3 since return variance declines to  $\sigma^2 < \sigma_1^2$ .*

(ii) *Suppose the Fed announces the rate-plot  $(i_0, E_{0,F}[i_1])$  (credibly, but not as a commitment). Then, the equilibrium is the same as in Proposition 3. In particular, the equilibrium features tantrum shocks that induce output gaps,  $\tau_0 = p_F^* - p_{FA}^*$  is generically non-zero, and financial noise shocks have a larger impact on output gaps than in the case with “pstar” communication since return variance remains at the higher level  $\sigma_1^2$ .*

We refer to the failure of interest rate communication in part (ii) as the “lost in translation” problem: even when the central bank communicates its expected interest rate path perfectly, this communication does not resolve market participants' uncertainty about intended financial conditions. In the current model, the translation failure is stark—the Fed implements its desired financial conditions entirely through expectations of future asset prices, without any need to adjust interest rates. More generally, interest rate communication would be lost in translation whenever the mapping from interest rates to financial conditions depends on factors that are uncertain or privately known to the central bank, such as time-varying views about how rate changes affect risk premia or asset valuations. The key insight is that communicating the policy instrument is no substitute for communicating the intended outcome when the link between the two is incomplete.

### 3.5. Scenario-based FCI-plot communication

So far, we have assumed that agents never learn about “pstar” so they never update their beliefs. The possibility of learning creates additional effects because agents expect the other agent to partially move toward their view (Caballero and Simsek (2022)). In this type of environment, communicating a scenario-based FCI-plot might be more effective than a simple FCI-plot, which we illustrate next.

Consider the same model as before but with the difference that at date 1, one of two states will be realized  $s_1 \in \{F, A\}$ . State  $s_1 = F$  reveals data that are more aligned with the Fed’s initial belief, whereas state  $s_1 = A$  reveals data more aligned with the Arbs’ initial belief. Consequently, when either state is realized, the agent whose belief is less aligned with the data updates its belief and moves closer to the belief of the other agent. We focus on the Fed’s belief, which drives the equilibrium, and assume it is given by  $p_{t,F}^* = p_F^*(s_1)$  for  $t \geq 1$  where

$$p_F^*(F) = p_F^* \quad \text{and} \quad p_F^*(A) \in (p_F^*, p_A^*).$$

If the realized state is aligned with its view, the Fed retains its original view. In contrast, if the realized state is aligned with the market’s belief, the Fed updates its view to move closer to the market’s view. Importantly, the extent to which the Fed will move toward the market’s view is also uncertain. At date 0, the market is uncertain about both  $p_F^*$  and  $p_F^*(A)$  and believes they are drawn from a joint distribution.

To describe the FCI-plot at date 0, we also need to specify the agents’ probability for the likelihood of each state  $s_1 \in \{F, A\}$ . Each agent would naturally assign a higher probability to the state that is more aligned with its initial belief. To make the analysis stark, suppose the Fed assigns probability one to state  $s_1 = F$  (and zero to  $s_1 = A$ ), whereas the market assigns probability one to state  $s_1 = A$ .

How would FCI-plot work in this example? Conditional on the realization of  $s_1$ , belief uncertainty is resolved and the equilibrium at date 1 is still given by Proposition 2 but with  $p_F^*$  replaced by  $p_F^*(s_1)$ . Since the Fed thinks  $s_1 = F$  will be realized, it would truthfully announce its expected asset price for the next period as

$$E_{0,F}[p_1] = 1 \times p_F^* + 0 \times p_F^*(A) = p_F^*.$$

This announcement would *not* reveal any information about  $p_F^*(A)$ . Note also that the Arbs think state  $s_1 = A$  will be realized with certainty, so *they expect the future asset price to be  $p_F^*(A)$  rather than  $p_F^*$* . Therefore, the FCI-plot leaves considerable residual

uncertainty about the asset price the Arbs expect to see, resulting in a weak recruitment effect.

Consider instead a *scenario-based* FCI plot: suppose the Fed announces  $(E_{0,F}[p_0], \{E_{0,F}[p_1|s_1]\}_{s_1 \in \{F,A\}})$ . Specifically, for the future period, the Fed announces its expected “pstar” under different scenarios: the baseline scenario  $s_1 = F$  that it anticipates to see, and the alternative scenario  $s_1 = A$ . This announcement fully resolves the market’s uncertainty and generates an equilibrium similar to that in Proposition 3, with a strong recruitment effect. The following result completes the characterization of this equilibrium.

**Proposition 5** (Scenario-based FCI-plot Communication). *Consider the extended model in which the Fed and the Arbs disagree about both “pstar” at date 0,  $(p_F^*, p_A^*)$ , and “pstar” at different states of date 1, with the Fed’s belief given by  $(p_F^*(F) = p_F^*, p_F^*(A) \in (p_F^*, p_A^*))$ . At date  $t = 0$  the Arbs are uncertain about the Fed’s belief about “pstar” and have a prior belief given by  $p_F^* \sim_A N(\tilde{p}_{FA}^*, \tilde{\sigma}_{FA}^2)$  and  $p_F^*(A) | p_F^* \sim_A N(\tilde{p}_{FA}^*(A), \tilde{\sigma}_{FA}^2(A))$  that satisfy the assumption  $E_{-1,A}[p_F^*(A) - p_F^*] = 0$ . Suppose also that the Fed believes state  $s_1 = F$  will be realized with certainty, while the Arbs believe state  $s_1 = A$  will be realized with certainty.*

(i) *Suppose the Fed announces **the scenario-based FCI-plot**  $(E_{0,F}[p_0], \{E_{0,F}[p_1|s_1]\}_{s_1 \in \{F,A\}})$  (credibly, but not as a commitment). Then the Arbs learn the Fed’s belief fully and the equilibrium is given by*

$$\begin{aligned} p_0 &= p_F^* + \frac{1}{1+\theta} (p_F^*(A) - p_F^* + \sigma^2 \mu_0 - v_0) \\ y_0 &= y_F^* + \frac{1}{1+\theta} (p_F^*(A) - p_F^* + \sigma^2 \mu_0 - v_0) \\ i_0 &= \rho - \frac{1}{2} \sigma^2 + \frac{\theta}{1+\theta} (p_F^*(A) - p_F^* + \sigma^2 \mu_0) + \frac{1}{1+\theta} v_0. \end{aligned} \tag{17}$$

*The return is given by  $r_1 = \rho + p_1 - p_0$  where  $p_1 = p_F^*(s_1) + \frac{1}{1+\theta} (\sigma^2 \mu_1 - v_1)$ . The Arbs’ perceived variance  $\sigma^2 = \text{var}_{0,A}(p_1)$  is the smallest positive solution to the fixed point problem as before in (8).*

(ii) *Suppose the Fed instead announces the simple FCI-plot  $(E_{0,F}[p_0], E_{0,F}[p_1])$  (credibly, but not as a commitment). Then the Arbs fully learn  $p_F^*$  but remain uncertain about*

$p_F^*(A)$  and the equilibrium is given by

$$\begin{aligned} p_0 &= p_F^* + \frac{1}{1+\theta} (\tilde{p}_{FA}^*(A) - p_F^* + \sigma_1^2 \mu_0 - v_0) \\ y_0 &= y_F^* + \frac{1}{1+\theta} (\tilde{p}_{FA}^*(A) - p_F^* + \sigma_1^2 \mu_0 - v_0) \\ i_0 &= \rho - \frac{1}{2} \sigma^2 + \frac{\theta}{1+\theta} (\tilde{p}_{FA}^*(A) - p_F^* + \sigma_1^2 \mu_0) + \frac{1}{1+\theta} v_0 \end{aligned} \quad (18)$$

The return is given by  $r_1 = \rho + p_1 - p_0$  where  $p_1 = p_F^*(s_1) + \frac{1}{1+\theta} (\sigma^2 \mu_1 - v_1)$ . The Arbs' perceived variance is higher than in the previous case and given by

$$\sigma_1^2 = \text{var}_{0,A}(p_1) = \tilde{\sigma}_{FA}^2(A) + \sigma^2.$$

The first part verifies that scenario-based FCI-plot communication fully reveals the Fed's belief. This eliminates tantrums and recruits the Arbs to absorb noise as in Propositions 2 and 4. The second part verifies that simple FCI-plot communication reveals the Fed's belief only partially: the Arbs learn  $p_F^*$  but they remain uncertain about  $p_F^*(A)$ , which is the price they expect to see in the next period. Therefore, there are no tantrums (or misunderstandings) regarding the Fed's current "pstar", but the recruitment effect is weaker. In particular, since the Arbs face greater uncertainty than before,  $\sigma_1^2 > \sigma^2$ , noise shocks have a greater impact on the aggregate asset price and the output gap.

Finally, for both parts there is a new effect that emerges from disagreements and learning: unlike before, the Arbs expect the Fed to converge (partially) toward their belief so their expected price change between periods 0 and 1 is no longer zero (it is  $p_F^*(A) - p_F^* \neq 0$  for the first part and  $\tilde{p}_{FA}^*(A) - p_F^* \neq 0$  for the second part). For instance, when the Arbs perceive a higher "pstar" than the Fed  $p_A^* > p_F^*$ , they will typically expect "pstar" to increase  $p_F^*(A) - p_F^* > 0$  (since  $p_F^*(A) \in (p_F^*, p_A^*)$ ). This exerts immediate upward pressure on the asset price  $p_0$ . The Fed responds to this pressure by raising the policy interest rate, but it does so partially due to interest rate gradualism.<sup>8</sup> Consequently, when agents expect each other to learn, *disagreements* between the Fed and the Arbs inevitably create some output and asset price gaps. These disagreements-induced gaps reduce the Fed's objective function but they cannot be eliminated through (honest) communication since they do not stem from misunderstandings: they emerge

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<sup>8</sup>The technical assumption  $E_{-1,A}[p_F^*(A) - p_F^*] = 0$  ensures that from an ex-ante point of view this effect is equally likely to induce an interest rate hike or an interest rate cut (which ensures  $E_{-1,A}[i_0] = \rho - \frac{1}{2}\sigma^2$ ). This assumption will be satisfied if the Arbs ex-ante believe that the Fed's belief is equally likely to be more or less optimistic than the Arbs belief.

even when the Arbs correctly understand the Fed’s belief.

## 4. A Prototype FCI-plot

To illustrate how our proposed FCI-plot framework might look in practice, we next present a proof-of-concept construction from our analysis in Caballero et al. (2024). In this paper, we build upon the methodology described in McKay and Wolf (2023) and Caravello et al. (2024) to construct counterfactual paths for monetary policy. The basic idea is to combine an estimated VAR with estimated impulse responses to *policy shocks* in order to approximate *policy rules*. We focus on rules that minimize a loss of the form

$$\mathcal{L} = \sum_{t=0}^{\infty} \beta^t [\pi_t^2 + \tilde{y}_t^2 + \lambda_{\Delta i}(i_t - i_{t-1})^2]. \quad (19)$$

At any time  $t$ , the planner takes the history as given and chooses the policy that minimizes inflation gaps, output gaps, and the interest rate smoothing term. This type of loss is used as a benchmark in the optimal control exercises reported by the Fed staff to the FOMC (Federal Reserve Tealbook, 2016). We choose the degree of smoothing  $\lambda_{\Delta i}$  to match the interest rate variance observed in the data. Importantly, our VAR includes the FCI—in addition to the standard macroeconomic variables, which enables us to construct the forecasts of the FCI under the optimal policy—along with the forecasts of interest rates, inflation, and output gaps. Our main sample is 1990Q1:2019Q4. We start in 1990 since the FCI-G index starts in this year and we stop before the Covid period to avoid outliers (see Caballero et al. (2024) for details and robustness exercises).<sup>9</sup>

Figure 5 depicts *the FCI-plot*: current-quarter FCI expectations (solid blue line) and four-quarter-ahead FCI expectations (solid red line) under optimal policy. For comparison, we also plot the actual FCI (dotted black line) and the estimated FCI\* (dashed orange line) from our analysis in Section 2.3. Several features are worth emphasizing. First, the current-quarter FCI-plot (solid blue line) tracks the broad trajectory of actual FCI (dotted black line) while exhibiting markedly less volatility, particularly during crisis periods. For instance, the FCI-plot remains closer to neutral both when the actual FCI loosened during the Internet boom of the late 1990s and when the actual FCI tight-

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<sup>9</sup>These VAR outcomes do not account for the endogenous volatility reduction that our model suggests would arise from implementing an FCI-plot communication strategy. In practice, we would expect the realized FCI to become less volatile as market participants better understand the central bank’s FCI views. See Caballero et al. (2024) for a method to construct policy counterfactual evaluations that incorporates endogenous volatility effects.

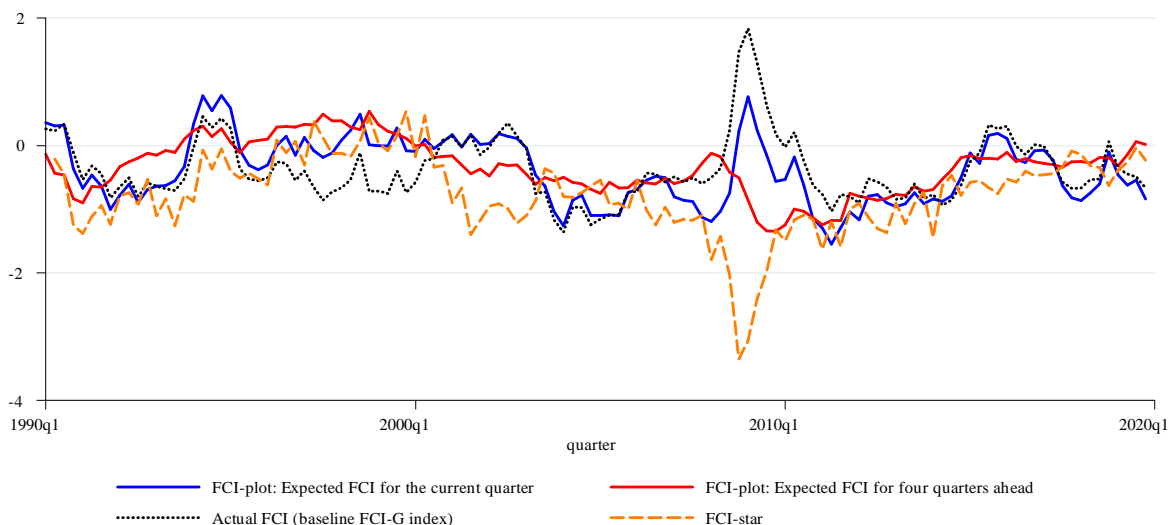


Figure 5: **A prototype FCI-plot.** The figure shows the expected FCI paths from a VAR-based counterfactual analysis in which monetary policy minimizes the loss function in (19) taking the history as given (see Caballero et al. (2024) for details). Solid blue (resp. red) line: expected FCI for the current quarter (resp. four quarters ahead). Dotted black line: baseline FCI-G index. Dashed orange line: FCI-star from Figure 3.

ened during the Global Financial Crisis (GFC). The FCI-plot communicates that these large movements in actual FCI were excessive from the standpoint of the Fed’s gap minimization objectives. Second, the four-quarter-ahead FCI-plot deviates from the actual FCI by larger amounts and reveals the gradual convergence path toward FCI\*. This is particularly visible in the GFC as well as the early 2000s recession, where the expected path showed a significant loosening ahead while actual conditions were tight. Overall, the FCI-plot provides meaningful information whenever there are large gaps between FCI and FCI\*; with the current FCI-plot mostly describing *the direction* in which the Fed would like to move the FCI and the four-quarter-ahead FCI-plot describing *the speed* at which the Fed is likely to bring the FCI toward FCI\*.

Figure 6 provides a complementary visualization of the same data and illustrates how the central bank’s reaction function might appear in the FCI-plot framework. It displays the average FCI values grouped by output gap conditions (low, medium, and high). The visualization reveals a systematic pattern: during periods of negative output gaps (low), the actual FCI (gray) has typically been tighter than optimal, prompting the central bank to signal more accommodative financial conditions through both its current-quarter FCI-plot (blue) and an even more accommodative four-quarter-ahead FCI-plot

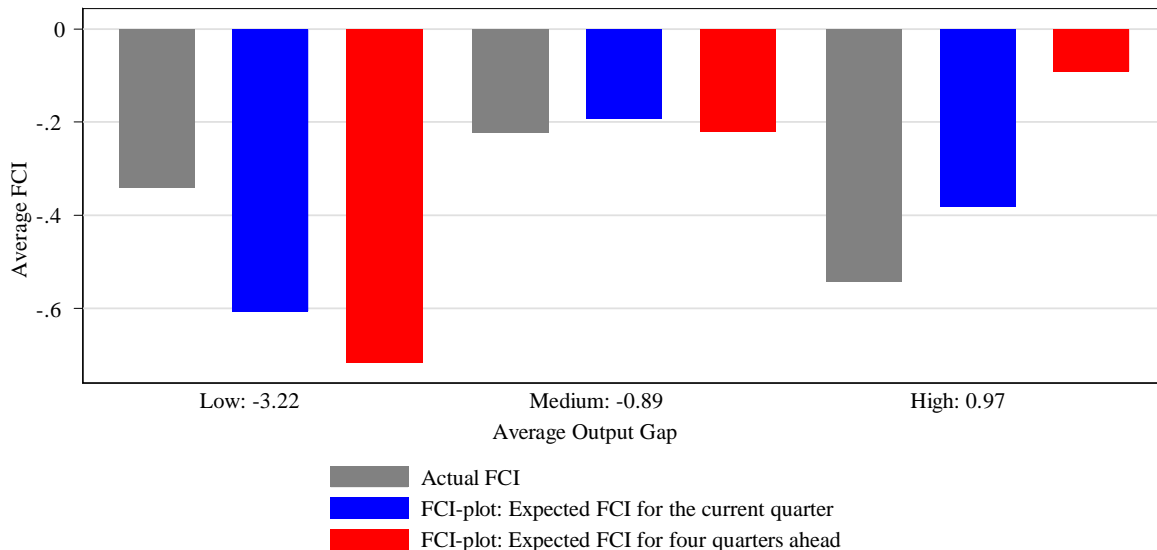


Figure 6: **FCI-plot by output gaps**. The figure shows the average values of the FCI-plot in Figure 5 by output gap bins. Blue bars (resp. red bars): expected FCI for the current quarter (resp. four quarters ahead). Grey bars: baseline FCI-G index.

(red). Conversely, during periods of positive output gaps (high), the actual FCI has been looser than ideal, with the central bank indicating progressive tightening through its FCI-plot projections. This representation clearly communicates the central bank’s state-contingent reaction function in terms of financial conditions rather than interest rates. Such clarity would allow market participants who disagree with the central bank’s output gap assessment to nevertheless make informed forecasts about future financial conditions based on their own economic outlook, thereby reducing uncertainty without requiring consensus.

While these visualizations provide useful illustrations of the FCI-plot concept, a full implementation would include additional features we propose, particularly confidence bands to acknowledge the imprecise control central banks have over financial conditions, and more detailed scenario-based projections beyond the simple output gap categories shown here. These enhancements would be especially valuable during periods of heightened uncertainty, such as the GFC period shown in the figure or the Covid-19 cycle.

This prototype demonstrates that constructing an FCI-plot is empirically feasible using existing techniques, data, and models already familiar to central banks. By showing not only the currently expected financial conditions but also the expected path over coming quarters, on average and in different scenarios, the central bank can better manage expectations and recruit arbitrageurs to help stabilize conditions around the desired path.

## 5. Conclusion

This paper examines how central banks can improve monetary policy transmission through enhanced communication with financial markets. We motivate our analysis with five empirical facts that highlight the central role of financial conditions in monetary policy transmission, the prevalence of disagreements between markets and the central bank, and the risk that policy intentions communicated through interest rates alone are “lost in translation.”

We then build a theoretical model consistent with these facts and explore its implications for policy communication. Our model demonstrates that arbitrageurs’ uncertainty about the central bank’s desired financial conditions creates the scope for misunderstandings (“tantrums”) and amplifies the effects of noise trading on financial conditions. We show that directly communicating the central bank’s expected financial conditions (FCI-plot) eliminates tantrums and recruits arbitrageurs to insulate financial conditions from noise. A scenario-based FCI communication further strengthens these benefits, particularly when the arbitrageurs disagree with the central bank about the likelihood of different near-term scenarios and would like to know the central bank’s “reaction function.” Overall, the FCI-plot communication enables an “agree-to-disagree” equilibrium in which markets help implement the central bank’s objectives despite differing views. In contrast, communicating expected interest rates alone fails to achieve these benefits.

We conclude by providing a prototype FCI-plot constructed from historical data to illustrate how our proposed framework might work in practice. Our prototype reveals how current-quarter projections track actual financial conditions with reduced volatility, while longer-horizon projections demonstrate the gradual convergence path toward optimal financial conditions. This is particularly evident during demand recessions, where the FCI-plot would have signaled easing intentions despite tight actual conditions. Although preliminary, this prototype shows how an FCI-plot framework could enhance policy transmission by clarifying central bank intentions especially at times of macroeconomic uncertainty.

Beyond the theoretical benefits we have identified, FCI communication offers practical advantages for policy transmission. Sophisticated financial market participants who directly influence asset prices and financial conditions speak the language of markets fluently but often lack deep familiarity with macroeconomic concepts. By communicating policy intentions in terms of expected financial conditions rather than exclusively through abstract concepts like output gaps, central banks can bridge this translation gap more effectively. The FCI-plot framework translates complex policy objectives into the met-

rics that matter most to market participants—eliminating the need for them to infer the central bank’s intended financial outcomes. This clarity enables market participants to develop trading strategies that align with policy goals, creating a more efficient transmission mechanism, especially when there are fundamental disagreements about economic outlook between the central bank and markets.

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## A. Omitted proofs

**Proof of Proposition 1.** First, we conjecture that

$$E_{t-1,A} [i_t] = \rho + y_{t+1}^* - y_t^* - \frac{1}{2}\sigma^2.$$

Then, the monetary policy rule (6) implies

$$\begin{aligned} i_t &= \rho + y_{t+1}^* - y_t^* - \frac{1}{2}\sigma^2 + \theta(y_t - y_t^*) + v_t \\ &= \rho + y_{t+1}^* - y_t^* - \frac{1}{2}\sigma^2 + \theta(p_t - p_t^*) + v_t, \end{aligned}$$

where the second equality uses (1). Substituting this to (5) yields

$$p_t + y_{t+1}^* - y_t^* = E_{t,A} [p_{t+1}] - \theta(p_t - p_t^*) - \nu_t + \sigma^2\mu_t.$$

In what follows, we guess that  $p_t = p_t^* + c_t$  where  $c_t$  is the term to be determined that satisfies  $E_{t,A} [c_{t+1}] = 0$ . With this guess, we obtain

$$p_t^* + y_{t+1}^* - y_t^* + c_t = p_{t+1}^* - \theta c_t - \nu_t + \sigma^2\mu_t$$

Observing that  $p_{t+1}^* - p_t^* = y_{t+1}^* - y_t^*$  and comparing coefficients yields

$$c_t = \frac{1}{1+\theta}(\sigma^2\mu_t - \nu_t).$$

This satisfies the conjecture  $E_{t,A} [c_{t+1}] = 0$  as  $\mu_t, \nu_t$  have zero mean. Therefore we have

$$p_t = p_t^* + \frac{1}{1+\theta}(\sigma^2\mu_t - \nu_t).$$

This in turn implies

$$\begin{aligned} y_t &= m + p_t \\ &= y_t^* + \frac{1}{1+\theta}(\sigma^2\mu_t - \nu_t). \end{aligned}$$

Finally, the equilibrium interest rate is given by

$$\begin{aligned} i_t &= \rho + y_{t+1}^* - y_t^* - \frac{1}{2}\sigma^2 + \theta(p_t - p_t^*) + v_t \\ &= \rho + y_{t+1}^* - y_t^* - \frac{1}{2}\sigma^2 + \frac{\theta}{1+\theta}(\sigma^2\mu_t - \nu_t) + v_t \\ &= \rho + y_{t+1}^* - y_t^* - \frac{1}{2}\sigma^2 + \frac{\theta}{1+\theta}\sigma^2\mu_t + \frac{1}{1+\theta}v_t. \end{aligned}$$

This satisfies our initial conjecture  $E_{t-1,A}[i_t] = \rho + y_{t+1}^* - y_t^* - \frac{1}{2}\sigma^2$ .

The endogenous return volatility satisfies

$$\begin{aligned}\sigma^2 = \text{var}_t(p_{t+1}) &= \text{var}_t\left(p^* + \frac{1}{1+\theta}(\sigma^2\mu_{t+1} - \nu_{t+1})\right) \\ &= \left(\frac{1}{1+\theta}\right)^2 \left((\sigma^2)^2 \sigma_\mu^2 + \sigma_\nu^2\right).\end{aligned}$$

Under the assumed parametric conditions, this quadratic has two positive roots. The solution corresponds to the smallest root, which corresponds to a stable equilibrium (the largest root is an unstable equilibrium). This completes the proof.  $\square$

**Proof of Proposition 2.** All the properties of the equilibrium for dates  $t \geq 1$  can be established using the same steps as in the proof of Proposition 1, after replacing  $y_t^*$  with  $y_F^*$  and  $p_t^*$  with  $p_F^*$ .  $\square$

**Proof of Proposition 3.** We first take the Arbs' beliefs in (11) as given and prove Eqs. (13 – 8). We then show that in this equilibrium Arbs' posterior beliefs are given by (11).

Given the Arbs' beliefs in (11) and the date  $t = 1$  equilibrium characterized by Proposition 2, Eq. (5) implies

$$\begin{aligned}p_0 &= \rho + E_{0,A}[p_1] - \left(i_0 + \frac{1}{2}\sigma_1^2\right) + \sigma_1^2\mu_0 \\ &= \rho + p_{FA}^* - \left(i_0 + \frac{1}{2}\sigma_1^2\right) + \sigma_1^2\mu_0,\end{aligned}\tag{A.1}$$

where we have used that  $\mu_1, v_1$  have zero mean and  $p_1 = p_F^*$ . Likewise, Eq. (2) implies that the endogenous return volatility is given by

$$\begin{aligned}\sigma_1^2 = \text{var}_{0,A}[r_1] &= \sigma_{FA}^2 + \left(\frac{1}{1+\theta}\right)^2 \left((\sigma^2)^2 \sigma_\mu^2 + \sigma_\nu^2\right) \\ &= \sigma_{FA}^2 + \sigma^2.\end{aligned}$$

Here, we have used the definition of  $\sigma^2$  from (8). This proves (16).

Next consider the interest rate the Fed sets  $i_0$ . We conjecture that  $E_{-1,A}[i_0] = \rho - \frac{1}{2}\sigma_1^2$ . Using this conjecture along with the output asset price relation, we write the Fed's policy rule (9) as

$$i_0 = \rho - \frac{1}{2}\sigma_1^2 + \theta(p_0 - p_F^*) + v_0.\tag{A.2}$$

We next substitute (A.2) into (A.1) to obtain

$$p_0 = p_{FA}^* - \theta (p_0 - p_F^*) + \sigma_1^2 \mu_0 - v_0.$$

After rearranging terms, we obtain

$$p_0 - p_F^* = \frac{1}{1 + \theta} (\sigma_1^2 \mu_0 - v_0 - \tau_0) \text{ where } \tau_0 = p_F^* - p_{FA}^*.$$

The equilibrium output is given by a similar expression

$$y_0 - y_F^* = \frac{1}{1 + \theta} (\sigma_1^2 \mu_0 - v_0 - \tau_0).$$

Finally, substituting the asset price  $p_0$  back into (A.2), the equilibrium interest rate satisfies

$$i_0 = \rho - \frac{1}{2} \sigma_1^2 + \frac{\theta}{1 + \theta} (\sigma_1^2 \mu_0 - \tau_0) + \frac{1}{1 + \theta} v_0.$$

Taking the ex-ante expectation of this expression, we verify the conjecture  $E_{-1,A}[i_0] = \rho - \frac{1}{2} \sigma_1^2$ . This proves (13 – 15).

Finally, note that Eq. (11) implies

$$\begin{aligned} \tau_0 &= p_F^* - (1 - \kappa) \tilde{p}_{FA}^* - \kappa \left( p_F^* - \frac{1}{\theta} v_0 \right) \\ &= (1 - \kappa) (p_F^* - \tilde{p}_{FA}^*) + \frac{\kappa}{\theta} v_0. \end{aligned}$$

This proves (12). This completes the characterization of the equilibrium given the Arbs' posterior belief.

It remains to check that the Arbs' posterior beliefs is given by (11). To this end, we first substitute for  $\tau_0$  in (15) using (12) to write the interest rate as

$$\begin{aligned} i_0 &= E_{-1,A}[i_0] + \frac{\theta}{1 + \theta} (1 - \kappa) (\tilde{p}_{FA}^* - p_F^*) - \frac{\theta}{1 + \theta} \kappa \frac{1}{\theta} v_0 + \frac{1}{1 + \theta} v_0 \\ &= E_{-1,A}[i_0] + \frac{\theta (1 - \kappa)}{1 + \theta} (\tilde{p}_{FA}^* - p_F^*) + \frac{1 - \kappa}{1 + \theta} v_0. \end{aligned}$$

This in turn implies

$$\frac{(1 + \theta)}{\theta (1 - \kappa)} (i_0 - E_{-1,A}[i_0]) = \tilde{p}_{FA}^* + \frac{v_0}{\theta} - p_F^*.$$

Hence, arbitrageurs receive an endogenous signal for  $p_F^* - \tilde{p}_{FA}^*$ . Recall that they also have the prior beliefs  $p_F^* - \tilde{p}_{FA}^* \sim N(0, \tilde{\sigma}_{FA}^2)$ . Bayesian updating implies their posterior is given by

$p_F^* \sim N(p_{FA}^*, \sigma_{FA}^2)$  where

$$p_{FA}^* = \frac{\frac{1}{\tilde{\sigma}_{FA}^2}}{\frac{\theta^2}{\sigma_v^2} + \frac{1}{\tilde{\sigma}_{FA}^2}} \tilde{p}_{FA}^* + \frac{\frac{\theta^2}{\sigma_v^2}}{\frac{\theta^2}{\sigma_v^2} + \frac{1}{\tilde{\sigma}_{FA}^2}} \left( p_F^* - \frac{1}{\theta} v_0 \right)$$

and  $\frac{1}{\sigma_{FA}^2} = \frac{\theta^2}{\sigma_v^2} + \frac{1}{\tilde{\sigma}_{FA}^2}$ .

This proves (11) and completes the characterization of equilibrium. □

**Proof of Proposition 4.** Presented in the main text. □

**Proof of Proposition 5.**

**Part (i).** We conjecture and verify that the equilibrium is given by (17). We first check that the equilibrium fully reveals the Fed's belief. In equilibrium, the Fed announces

$$\begin{aligned} E_{0,F}[p_0] &= p_F^* + \frac{1}{1+\theta} (p_{FA}^*(A) - p_F^* + \sigma_1^2 \mu_0 - v_0) \\ E_{0,F}[p_1|F] &= p_F^* \\ E_{0,F}[p_1|A] &= p_F^*(A) \end{aligned}$$

along with the interest rate

$$i_0 = \rho - \frac{1}{2}\sigma^2 + \frac{\theta}{1+\theta} (p_F^*(A) - p_F^* + \sigma^2 \mu_0) + \frac{1}{1+\theta} v_0.$$

Observe that the announcement of  $E_{0,F}[p_1|A]$  fully reveals  $p_F^*(A)$ . Given  $p_F^*(A)$ , the announcement of the pair  $(i_0, E_{0,F}[p_0])$  fully reveals  $(v_0, p_F^*)$  as before as there are two equations in two unknowns. The announcement of  $E_{0,F}[p_1|F] = p_F^*$  provides further confirmation of  $p_F^*$ ; this confirmation is redundant in this example but would not be redundant in variants as we discuss in Section 3.4.

We then solve for the equilibrium when the Arbs know both  $p_F^*$  and  $p_F^*(A)$ . First, we conjecture that

$$E_{-1,A}[i_0] = \rho - \frac{1}{2}\sigma^2.$$

Then, the monetary policy rule (9) implies

$$\begin{aligned} i_0 &= \rho - \frac{1}{2}\sigma^2 + \theta(y_0 - y_F^*) + v_0 \\ &= \rho - \frac{1}{2}\sigma^2 + \theta(p_0 - p_F^*) + v_0, \end{aligned}$$

where the second equality uses (1). Substituting this to (5) yields

$$\begin{aligned} p_0 &= E_{0,A} [p_1] - \theta(p_0 - p_F^*) - \nu_0 + \sigma^2 \mu_0 \\ &= p_F^*(A) - \theta(p_0 - p_F^*) - \nu_0 + \sigma^2 \mu_0. \end{aligned}$$

Here, we have substituted  $E_{0,A} [p_1] = p_F^*(A)$ , which follows because the Arbs think state  $s_1 = A$  will be realized for sure. After rearranging terms, we obtain

$$p_0 = p_F^* + \frac{1}{1+\theta} (p_F^*(A) - p_F^* + \sigma^2 \mu_0 - \nu_0).$$

Using  $y_0 = m + p_0$ , this implies

$$y_0 = y_F^* + \frac{1}{1+\theta} (p_F^*(A) - p_F^* + \sigma^2 \mu_0 - \nu_0).$$

Finally, the equilibrium interest rate is given by

$$\begin{aligned} i_0 &= \rho - \frac{1}{2}\sigma^2 + \theta(y_0 - y_F^*) + v_0 \\ &= \rho - \frac{1}{2}\sigma^2 + \frac{\theta}{1+\theta} (p_F^*(A) - p_F^* + \sigma^2 \mu_0) + \frac{1}{1+\theta} v_0. \end{aligned}$$

Note also that this satisfies our initial conjecture  $E_{-1,A} [i_0] = \rho - \frac{1}{2}\sigma^2$  in view of the assumption  $E_{-1,A} [p_F^*(A) - p_F^*] = 0$ . Note also that  $\sigma^2$  is the solution to the same fixed point problem as before (8). This shows that the equilibrium is given by (17), completing the proof.

**Part (ii).** We conjecture and verify that the equilibrium is given by (18).

We first check that the equilibrium reveals the Fed's belief only partially. In equilibrium, the Fed announces

$$\begin{aligned} E_{0,F} [p_0] &= p_F^* + \frac{1}{1+\theta} (\tilde{p}_{FA}^*(A) - p_F^* + \sigma_1^2 \mu_0 - v_0) \\ E_{0,F} [p_1] &= E_{0,F} [p_1|F] = p_F^* \end{aligned}$$

along with the interest rate

$$i_0 = \rho - \frac{1}{2}\sigma^2 + \frac{\theta}{1+\theta} (p_F^*(A) - p_F^* + \sigma^2 \mu_0) + \frac{1}{1+\theta} v_0.$$

Since the Arbs already know  $\tilde{p}_{FA}^*(A)$ , the announcement of the pair  $(i_0, E_{0,F} [p_0])$  fully reveals  $(v_0, p_F^*)$  as before as there are two equations in two unknowns. The announcement of  $E_{0,F} [p_1|F] = p_F^*$  provides further confirmation of  $p_F^*$ . However, unlike before, these announcements do not reveal  $p_{FA}^*(A)$ . Therefore, after seeing these announcements, the Arbs posterior beliefs for the Fed's "pstar" in the state that is aligned with their view is given by  $p_F^*(A) | p_F^* \sim_A N(\tilde{p}_{FA}^*(A), \sigma_{FA}^2(A))$ .

We then solve for the equilibrium when the Arbs know  $p_F^*$  and have a posterior belief about  $p_F^*(A)$ . The proof follows similar steps as in the first part except the asset price is given by

$$\begin{aligned} p_0 &= E_{0,A}[p_1] - \theta(p_0 - p_F^*) - \nu_0 + \sigma_1^2 \mu_0 \\ &= \tilde{p}_{FA}^*(A) - \theta(p_0 - p_F^*) - \nu_0 + \sigma_1^2 \mu_0. \end{aligned}$$

In particular, since the Arbs think state  $s_1 = A$  will be realized and they are uncertain about the Fed's "pstar" in this state, their expected price is determined by their posterior belief. This in turn implies

$$\begin{aligned} y_0 &= y_F^* + \frac{1}{1+\theta} (\tilde{p}_{FA}^*(A) - p_F^* + \sigma_1^2 \mu_0 - \nu_0) \\ i_0 &= \rho - \frac{1}{2} \sigma^2 + \frac{\theta}{1+\theta} (\tilde{p}_{FA}^*(A) - p_F^* + \sigma_1^2 \mu_0) + \frac{1}{1+\theta} \nu_0. \end{aligned}$$

Note also that this satisfies our initial conjecture  $E_{-1,A}[i_0] = \rho - \frac{1}{2} \sigma^2$  because  $E_{-1,A}[\tilde{p}_{FA}^*(A)] = E_{-1,A}[p_F^*(A)]$  (the expectation of the posterior mean is the prior mean) and we assume  $E_{-1,A}[p_F^*(A) - p_F^*] = 0$ . Note also that since the Arbs believe the future price will be  $p_1 = p_F^*(A)$  and they are uncertain about  $p_F^*(A)$ , their perceived variance is larger than before and given by

$$\sigma_1^2 = \text{var}_{0,A}(p_1) = \tilde{\sigma}_{FA}^2(A) + \sigma^2.$$

This shows that the equilibrium is given by (18), completing the proof.  $\square$

## B. Data details

This appendix contains the details of our data sources and variable construction.

**FCI-G Index.** The FCI-G index is public and obtained from the Fed (available at <https://www.federalreserve.gov/econres/notes/feds-notes/a-new-index-to-measure-us-financial-conditions-20230630.html>). There are two versions of the index: a baseline and an alternative one-year lookback version. In our analysis, we employ the quarterly frequency version of the baseline FCI-G index. The baseline version computes the cumulative effect on one-year-ahead GDP growth of the three-month changes in financial conditions over the past three years.

**MacroPolicy Perspectives (MPP) Data.** The data come from the Shadow Survey of Market Participants conducted by Coronado and Rosner-Warburton (2025) (see <https://www.macropolicyperspectives.com/shadow-survey>). The surveys are conducted quarterly ahead of the FOMC meetings that are accompanied by a Summary of Economic Projections.

The dataset contains quarterly survey responses from market participants between 2017 and 2024, including forecasts for unemployment, core PCE inflation, the federal funds rate (FFR), and financial conditions. These forecasts are originally provided at annual horizons. To obtain forecasts at quarterly horizons, we apply linear interpolation to the annual horizon forecasts.

Before the regression, we trim outliers from the forecast variables using an interquartile range (IQR) approach. Specifically, for each forecast quarter, we calculate the 25th and 75th percentiles of each variable and define the IQR as the difference between them. Observations are identified as outliers if they fall below the 25th percentile minus two times the IQR or above the 75th percentile plus two times the IQR. Outliers identified through this procedure are removed from the sample.