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ARTICLE

Optimal forward guidance in monetary policy: Can central banks sway the public with projections?

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Abstract

Because economic outcomes depend on private-sector expectations, central banks might be tempted to guide these by publishing projections of key macroeconomic variables. We find that optimal projections require misleading the public. Optimal non-misleading projections are time-inconsistent. Non-misleading time-consistent projections can only improve policy outcomes if the public's forecasts are noisier, or inconsistent with implemented policy. Since the public only has incentives to be guided by policymakers' projections when most vulnerable to being mislead, these cannot be trusted blindly. Consistent with this, we find statistically significant systematic deviations between FOMC projections and professional forecasts for US inflation and GDP growth.

Keywords: Central bank projections; forward guidance; survey forecasts; monetary policy

1. Introduction

In recent years, many central banks, including the Federal Reserve, have started publishing projections of future values of macroeconomic variables such as GDP growth, inflation, unemployment, and even forecasts of future interest rate targets.[1] When such projections influence the private-sector expectations, they can affect policy outcomes, since current inflation and output are posed to depend on expected future inflation, according to the popular New Keynesian Phillips curve model.[2] More generally, there appears to be a growing consensus that monetary policy affects the economy largely through private-sector expectations [Woodford (2004), Svensson (2005), and Blinder et al. (2008)]. Each central bank does things differently, and it is beyond our scope to describe all these practices. Instead, we derive optimal policy and projections under different assumptions about the projections' influence on private-sector expectations in the canonical New Keynesian Phillips curve model of monetary policy. We then contrast our results with data from FOMC projections.

We find that optimal projections are misleading, with the most desirable policy outcomes arising when the public's expectations are distorted away from the values consistent with implemented policy. Optimal non-misleading projections are time-inconsistent, just as optimal commitment, implying that policymakers have incentives to deviate from the projected path in the last minute, even when they do not plan to do so ahead of time. Optimal non-misleading time-consistent projections have no impact, assuming rational expectations, as these would be identical to the public's own forecasts. Projections can improve policy outcomes even if not misleading or time-inconsistent, when the public's forecasts are noisier than policymakers' forecasts. The same applies if the public's forecasts are inconsistent with implemented policy, but in this case projections can also deteriorate policy outcomes, for example if inducing people to believe that policymakers are less willing, or less able, to fight inflation, leading to higher inflation expectations.

Since the public only has incentives to let itself be guided by policymakers' projections when most vulnerable to being mislead, these must be viewed with skepticism. Consistent with this, we find statistically significant systematic deviations between FOMC projections and surveys of professional forecasters for US inflation and GDP growth.

Our point is not that the Fed, or any other central bank, use projections to mislead the public, but that they have incentives to do so, which is consistent with previous findings that policymakers have incentives not to reveal private information truthfully [Canzoneri (1985), Cukierman and Meltzer (1986), Stein (1989), and Garfinkel and Oh (1995)]. To test this empirically, we would ideally want to compare policymakers' official projections with their private forecasts to study whether the projections reveal their private beliefs truthfully, or if on the contrary, there is some bias to attempt to sway the public. For example, official projections might presume future adherence to a rule or target in an attempt to raise credibility and realize gains from commitment, while policymakers' private forecasts acknowledge a likely deviation to discretion. However, because policymakers' private forecasts are not publicly available, we instead use survey forecasts of professionals as a proxy. Another option would be to use surveys of households or consumers, but these have less incentives to forecast accurately. Furthermore, the forecasting methods and information used by professionals is more likely to be closer to a policymaker's approach compared to the average household or consumer, thus making it more likely that any systematic deviations are due to the described policymaker bias, and not other differences. From a practical point of view, household surveys also tend to yield less comparable observations due to differences in forecast variables, horizons, or precision.[3]

We find that FOMC projections of output growth are higher than those in the comparable surveys for 2008–2015, and below for 2016–2019, both in statistically significant ways. Furthermore, there is highly statistically significant evidence for FOMC inflation projections consistently being lower than comparable survey forecasts during the 2008–2019 period as a whole. We do not find statistically significant differences in the overall quality of FOMC projections and professionals forecasts. Hence, despite its good forecasting record, the FOMC's projections have failed to dictate the public's expectations. This stands in stark contrast with past studies that assume policymakers can dictate private expectations through projections [Svensson (2005) and Woodford (2007)], an assumption that affects both optimal policy and optimal projections, and forward guidance in practice. However, our findings are not inconsistent with projections having had *some* influence on expectations, as for example Coibion et al. (2021) argue.

The next section provides a brief introduction to the New Keynesian sticky price model, which is widely used to study and guide monetary policy. It also presents the standard optimal commitment and discretionary solutions, which serve as benchmarks for later results. Section 3 shows that optimal projections are misleading and can yield better economic outcomes than the standard optimal commitment policy. In addition, it illustrates that providing misleading projections can improve outcomes even after these are no longer believed by the public. Section 4 confirms that the optimal non-misleading projections are time-inconsistent in the same way, and for the same reason, that optimal plans are. In Section 5, we turn to the case with imperfect credibility, showing that the optimal projections are inconsistent with the optimal policy, just as with perfect credibility. Section 6 studies non-misleading time-consistent projections, finding that these can only improve policymaking if the public's expectations are inconsistent with the implemented policy, or noisier than policymakers' projections. Section 7 motivates why policymakers might want to project more than inflation, the only variable whose expectations affect the policy objective in the mainstream model. In Section 8, we study the FOMC's projections and compare these with survey forecasts from professionals. Section 9 contrasts our empirical findings from the FOMC case study with the theoretical results. Proofs for results and some extensions are provided in the appendix.

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2. Model

In a framework with monopolistic competition, menu costs, and staggered price-setting, Rotemberg (1982) and Calvo (1983) derive the New Keynesian Phillips curve:

$$\pi_t = \beta \hat{E}_t \pi_{t+1} + \kappa x_t + u_t \tag{1}$$

which relates present inflation π_t to expected next-period inflation $\hat{E}_t \pi_{t+1}$, contemporaneous output x_t, and a cost-push shock u_t. It is private-sector price-setters' inflation expectations that are relevant in the Phillips curve, and these may or may not be rational, depending on the case below, so we denote these as $\hat{E}_t$ to distinguish from E_t, which is usually understood to imply rational expectations. The exogenous shock is assumed to be known to satisfy

$$u_t = \rho u_{t-1} + a_t \tag{2}$$

where a_t is white noise. The parameters $\beta \in (0, 1)$, $\kappa > 0$, and $\rho \in (0, 1)$ are assumed to be known constants. Inflation π_t and output x_t are measured in terms of deviations from their flexible-price values, that is, the values they would attain in the absence of nominal rigidities. Hence, as Rotemberg and Woodford (1999) and Woodford (2003) show, minimizing the distortions due to nominal rigidities, reflected by their impact on the utility of a representative consumer, can be accomplished at any time $t = 0$ by minimizing

$$L_0 = E_0 \sum_{t=0}^{\infty} \beta^t l_t \tag{3}$$

where

$$l_t = \pi_t^2 + \lambda x_t^2 \tag{4}$$

and $\lambda > 0$ is a known constant. Details, and extensions, of this popular framework are discussed by Clarida et al. (1999), Svensson and Woodford (2002), and Woodford (2003), among others.

There are several reasons why the public's expectations might not be rational. It could be that they do not know all the details of the model, are not savvy enough to solve it, or that it is just not worth their time and effort to stay on top of it [rational inattention, see Sims (2003)]. This could easily drive them to be guided by policymakers' projections, especially if they do not know the exact policy objective (3), or if policymakers are otherwise thought to have any advantage, such as advance or private information about macroeconomic fundamentals. While the underlying reason for why the public might let itself be guided by the projections could affect their behavior, and thus the optimal policy and projections, and even the model itself [see e.g Mackowiak and Wiederholt (2009)], the present study aims at obtaining general results. It is important to emphasize that at a minimum, these require assuming that the model described above is invariant to the underlying rationale for the public's expectations not being rational. When this is the case, the underlying motivation is irrelevant when policymakers' projections are assumed to be believed blindly, as long as this remains true over time. However, the optimal policies and projections with imperfect credibility would still be sensitive to these underlying aspects, so we cannot obtain explicit generic solutions for this case.

From the perspective of any period $t = 0$, the optimal commitment plan is the infinite sequence of current and future inflation $\{\pi_t\}_{t=0}^{\infty}$ that minimizes the loss function (3) subject to the Phillips curve (1). As shown by Clarida et al. (1999) and Woodford (1999), the optimal commitment policy assuming rational expectations is (see Section A.1)

$$\pi_0 = -\frac{\lambda}{\kappa} x_0 \tag{5}$$

and

$$\pi_t = -\frac{\lambda}{\kappa} x_t + \frac{\lambda}{\kappa} x_{t-1} \tag{6}$$

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for $t = 1, 2, 3, \ldots$ While this optimal plan minimizes the objective function (3), it is, as argued by Kydland and Prescott (1977), not time-consistent. The reason is that if policymakers reoptimized in any later period $\tau > 0$, they would want to deviate from the promised commitment rule (6) in period τ and instead enforce

$$\pi_\tau = -\frac{\lambda}{\kappa} x_\tau \tag{7}$$

while committing to implement

$$\pi_t = -\frac{\lambda}{\kappa} x_t + \frac{\lambda}{\kappa} x_{t-1} \tag{8}$$

in all later periods $t = \tau + 1, \tau + 2, \tau + 3, \ldots$ If policymakers reoptimized every period, they would implement

$$\pi_t = -\frac{\lambda}{\kappa} x_t \tag{9}$$

in all periods $t = 0, 1, 2, \ldots$, making it the optimal discretionary policy. The policy objective (3) is strictly positive under both optimal commitment and discretion. Exactly how much lower it is with commitment depends on the parameters, which there is some disagreement about, particularly with respect to κ and λ [see Assenmacher-Wesche (2006), Dennis (2004), Givens (2012), Schorfheide (2008), and Söderström et al. (2005)].

3. Optimal misleading projections

This section determines the optimal strategy for policymakers when their projections are fully believed and thus shape public expectations perfectly, even if inconsistent with the policy they actually implement.

Result 1. *When policymakers' projections $\hat{\pi}_{t+1}$ are believed, so that the public's policy expectations $\hat{E}_t \pi_{t+1}$ match these exactly, irrespectively of any deviations with implemented policy and realized outcomes, the optimal policy is to implement*

$$\pi_t = 0 \tag{10}$$

in all periods $t = 0, 1, 2, \ldots$, while projecting future inflation according to

$$\hat{\pi}_t = -\beta^{-1} \rho^{-1} u_t \tag{11}$$

for $t = 1, 2, 3, \ldots$, thus making the optimal projections misleading. The corresponding value of the policy objective (3) is $L_0 = 0$. (Proof in Section A.2).

Hence, if policymakers can mislead the public, shaping inflation expectations with projections that are inconsistent with the implemented policy, they can achieve their objectives (3) to a greater extent than with a credible commitment to the optimal plan (5)–(6). For comparison, imagine that in any period $t = 0$ policymakers could mislead the public into believing the policy rule

$$\pi_t = -\beta^{-1} \rho^{-1} u_t \tag{12}$$

would be implemented in periods $t = 1, 2, 3, \ldots$, so that the public's expectations $\hat{E}_t \pi_{t+1} = E_t \hat{\pi}_{t+1} = -\beta^{-1} u_t$, while actually implementing equation (10) in all periods $t = 0, 1, 2, \ldots$ Policymakers would then do better, in terms of the policy objective (3), than with standard commitment (5)–(6). How is this possible? While time-inconsistent, at any point in time the standard commitment solution assumes expectations of future policy are consistent with what policymakers actually plan to implement, and vice versa. This internal consistency is violated in the alternative commitment strategy proposed at the beginning of the present paragraph. In

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other words, standard commitment is only misleading if policymakers reoptimize and therefore deviate from the original optimal plan. The alternative strategy is misleading even without reoptimization.

If the shock u_t and inflation π_t were perfectly observable, it would be obvious that projections generated with equation (11) are inconsistent with the implemented policy (10) whenever $u_t \neq 0$, and policymakers' projections would lose credibility. Moreover, if the public could observe the implemented policy (10), deduce it by studying past realizations, or derive it by reproducing the policy problem and policymakers' logic, the public's inflation expectations would instead be determined by the implemented policy. In reality, however, there are several factors that can make it difficult for the public to determine whether policymakers' projections are consistent with the implemented policy. The most obvious is the uncertainty tied to forecasts, and in particular, the difficulty in accurately predicting macroeconomic variables even just a few quarters ahead. In addition, there is model uncertainty and misspecification, unknown parameter values, and the fact that different committee members voting on policy might favor different models, or may be acting strategically.[4] Also, central banks might not be able to achieve exactly the inflation rate they desire, contrary to what is assumed in our model. Because of these difficulties, policymakers could easily get away with manipulating their projections, and due to the potential gains, they have incentives to do so. This, however, means that the public should not trust policymakers' projections, which renders these all but useless.[5]

4. Optimal time-inconsistent projections

Next, we assume that policymakers' projections must be consistent with both current policy and the one that policymaker's plan to implement in the future. We assume policymakers' projections are fully credible and shape public expectations perfectly despite the fact that optimal plans are time-inconsistent.

Result 2. *When policymakers' projections are believed, so that the public's policy expectations match these, and projections and implemented policy are constrained to be mutually consistent (so as to maintain credibility), it is optimal to implement, and project, using the standard commitment solution (5)–(6). Time inconsistency implies that policymakers have incentives to deviate from the projected path and instead implement the standard discretionary solution (9). (Proof in Section A.3).*

Assuming perfect credibility, policymakers can influence expectations exactly the same through projections as by committing to a rule and thus yield the same optimal commitment solution. However, both approaches suffer from time inconsistency. The optimal policy to implement in the contemporary period is discretion (9), while the optimal policy to promise to implement in the future, or more generally, to shape policy expectations, is the commitment rule (6). The reason is that $\pi_{\tau+1}$ has an impact on π_τ and y_τ through expectations $\hat{E}_\tau \pi_{\tau+1}$ in period τ and prior, but no such impact in period $\tau+1$ when π_τ, y_τ and $\hat{E}_\tau \pi_{\tau+1}$ have already been realized. Thus, from the perspective of any period before $\tau+1$, the commitment rule (6) is optimal for period $\tau+1$, but from the perspective of period $\tau+1$, discretion (9) is optimal for period $\tau+1$. Hence, from today's perspective (3), it is optimal for policymakers to implement the commitment rule (6) in all future periods and thus to use it to project ahead and shape expectations about future variables. But when policymakers reconsider at any later time, they would want to implement the optimal discretionary policy (9) in the contemporary period, thus deviating from past projections that assumed the commitment rule (6) would be implemented.[6] Hence, the optimal projections are time-inconsistent for the same reason that the optimal plan is. If the cost to policymakers of deviating from the previously projected path is high enough, for example due to the loss of credibility, or prestige, the projections can serve as a commitment device. However, the same would be true if there were a cost to deviating from a preannounced rule.

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From a theoretical point of view, maintaining the public's trust requires the same whether their expectations are influenced through a commitment to a rule or projections: that the they be able to verify that the optimal commitment rule (6) is actually being implemented, or at least, that they do not observe evidence to the contrary. However, in practice it can be more difficult to check if a preannounced rule is followed, versus determining whether realized outcomes and past and present projected values are mutually consistent, that is, based on the same policy equation. This is especially true when policymakers do not provide details about how their projections are generated, or the underlying model. As long as past realizations of economic variables are observable, it is fairly trivial to plug realizations of π_t, x_t, and x_{t-1} into a preannounced rule (6) to verify whether or not the commitment to implement it has been honored. Projections, on the other hand, do not require any public commitment to a particular policy equation, and without knowing the underlying model or implemented policy, it is difficult to determine if previously projected values are mutually consistent with the realized ones. Realized values of π_t and x_t depend on the contemporaneous shocks u_t, which projections cannot forecast perfectly (due to the white noise shock a_t). Hence, projections are almost always going to be off the mark, and even large deviations do not necessarily imply, or prove, manipulation, as they could be caused by large unanticipated shocks. Instead, without additional information, the only way to verify manipulation may be if projection errors are not white noise. This, however, does not necessarily imply manipulation if the underlying model, or future policy, is also unknown to policymakers, who may then be making systematic mistakes in their honest projections.

With manipulation, and deviations from commitment, being more difficult to detect with projections than with an explicit commitment to a rule, policymakers might prefer projections, so as to reap the gains from such deviations. But this also means that it may be harder to establish and maintain credibility with projections, which is required in order to reap the gains from commitment. From this point of view, the two strategies, committing to a rule and providing projections, can complement each other. The preannounced rule provides an easy way to verify that the commitment is being implemented, strengthening also the credibility of projections by providing the public with information that can be used to contrast these against realized values. At the same time, projections tell people exactly what their expectations of future values should be, instead of relying on them to compute these. However, projections can also weaken the credibility of commitments, for example, to an inflation target when policymakers themselves project to miss said target.

5. Projections with imperfect credibility

The present section abandons the extreme assumptions of projections perfectly dictating private-sector expectations or having absolutely no impact on these. In this case with imperfect credibility, we assume that the degree to which official projections influence the public's expectations depends on their past record. The more accurate past projections have been, the higher the credibility, and the larger the influence of current projections. But if current credibility depends on past projections and policy, then current projections and policy will affect future credibility, and thus future expectations, which policymakers' decisions must take into account.

Result 3. *When policymakers' projections affect the public's policy expectations, the optimal projections are inconsistent with the optimal policy, unless policymakers commit ahead to the optimal plan, in which case they have incentives to deviate from the projected commitment path, and instead implement the discretionary solution. (Proof in Section A.4).*

The intuition behind Result 3 is the same as for Result 2. In fact, Result 3 holds for any nonzero influence of projections on public's expectations, including when policymakers' credibility is perfect. When committing or projecting ahead, policymakers must take into account the

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effect they can have on all expectations, since doing so allows them to achieve their objectives better. However, when they later choose the inflation rate to implement, some of these expectational effects are in the past, and no longer relevant, and thus ignored, driving a wedge between policy and projections. While some of these effects may be negligible, and thus irrelevant, such as those the current projection about a value far into the future has on current expectations about next-period inflation, the current projection of next-period inflation will have some impact if policymakers' projections have any credibility.[7]

While time inconsistency remains as long as policymakers use their influence to shape the public's expectations, the optimal discretionary and commitment policies will generally differ from those discussed in the previous sections when credibility is imperfect. The reason is that now policy is assumed to affect expectations about future policy even if policymakers do not commit ahead due to the impact current policy has on future credibility.[8] The optimal policy and projections will depend on exactly how policymakers' actions are assumed to affect their credibility and hence influence future expectations.

6. Time-consistent projections

Next, we consider whether there is any scope for projections to improve policy outcomes when these are neither used to mislead the public or to try to reap any gains from commitment. We consider three cases. First, we assume the public is fully rational and can forecast economic variables just as well as policymakers and are therefore not affected by policymakers' projections. Second, we consider the case where the public's forecasts are noisier than policymakers', but still consistent with the implemented policy. Finally, we study the situation where the public's expectations are inconsistent with policymakers' actions.

Result 4. *When the public's expectations are rational, and independent of policymakers' projections and actions, it is optimal to implement the standard discretionary policy (9), and policymakers' projections are irrelevant. (Proof in Section A.5).*

In the ideal case where the public can replicate the policy problem perfectly, and thereby form expectations rationally, they would correctly anticipate the optimal discretionary policy (9). Consequently, their own forecasts would be identical to policymakers' projections. However, when this is not the case, and the public's expectations are noisier than policymakers' projections, or inconsistent with the implemented policy, the projections can, if believed, improve policy outcomes (3) even when they are not used as a commitment mechanism or to mislead the public. The following two results show this.

Result 5. *If believed by the public, policymakers' projections can improve policy outcomes (3) without being misleading or time-inconsistent, and while still implementing the standard discretionary policy (9), when the public's expectations are rational, but more noisy than policymakers' projections. Even reducing the noise in the public's expectations, without eliminating it altogether, improves outcomes. (Proof in Section A.6).*

Result 6. *If believed by the public, policymakers' projections can improve policy outcomes without being misleading or time-inconsistent, and while still implementing the standard discretionary policy (9), when the public's expectations are inconsistent with the implemented policy. However, policy outcomes can also deteriorate when projections are used to make the public's expectations consistent with the implemented policy. (Proof in Section A.7).*

The latter two results assume policymakers use their projections to correct the public's noisy or inconsistent expectations, while still implementing the standard discretionary policy (9). However, it follows from Results 1–3 that this is a suboptimal strategy. Any influence policymakers have on expectations, through projections or implemented policy, should be exploited to

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optimize the policy objective (3). As is shown above, doing so makes the optimal projections be inconsistent with the optimal policy.

7. Projecting multiple variables

In the stylized model above, only inflation expectations are relevant for economic outcomes and the policy objective (3), but in practice policymakers typically include also projections of other variables. One reason might be that they have a more general framework in mind. For example, if the policy objective includes the interest rate, either due to rate smoothing or a desire to keep it at its flexible-price value, the New Keynesian IS curve [see McCallum and Nelson (1999)]

$$x_t = E_t x_{t+1} - \sigma r_t \tag{13}$$

becomes relevant. It hypothesizes that a change in the interest rate r_t, measured in terms of deviations from its flexible-price value (also known as the natural rate of interest), drives a wedge between current and expected next-period output due intertemporal substitution, the degree of which is governed by the parameter $\sigma > 0$. Furthermore, expectations about the future value of the policy interest rate become relevant through the yield curve when the rate r_t in the IS equation (13) is of longer maturity than the typical overnight policy rate. While such changes to the model would affect the optimal policies and projections derived above, it would not change the general results.

Projecting several key variables in the economy might also help strengthen credibility by showing a bigger picture. For example, a projection of higher future inflation might be more plausible if a buoyant economy with low unemployment is expected. Moreover, the relationships between variables implies that they are somewhat interchangeable. For instance, the Phillips curve (1) can alternatively be expressed as:

$$\pi_t = \beta^{J+1}\hat{E}_t\pi_{t+J+1} + \kappa x_t + u_t + \sum_{j=1}^{J} \beta^j \hat{E}_t \left(\kappa x_{t+j} + u_{t+j}\right) \tag{14}$$

after substituting forward J periods and applying the law of iterated expectations. Here, it is expectations of output x_{t+j} and the shock u_{t+j}, both J periods into the future, that are the protagonists instead of next-period inflation explicitly.

8. FOMC projections and survey forecasts

Finally, we turn to studying projections in practice and compare with actual private-sector forecasts. Since its 2007 October meeting, the FOMC has published projections of real GDP growth, unemployment, and inflation after some of its policy meetings. These have been released with its policy statement, at the Chairman's press conference within hours of the meeting, or in the minutes released 3 weeks afterward.[9] Projections of the future target federal funds rate were included starting in 2012. Projections have been provided about four times a year, for the January, March/April, June, and October/November/December FOMC meetings, with the schedule changing slightly over time. The projections cover the concurrent year, and 1 and 2 years ahead. Each FOMC member, whether or not voting in that particular meeting, submits a projection. These individual submissions are not publicly available until transcripts are released 5 years later. Instead, the FOMC makes immediately available the range of the individual projections, and what it calls the central tendency, that is, the minimum and maximum projected values after eliminating the three lowest and three highest ones. Since September 2015, the FOMC has included the median projection in the immediate releases.

The FOMC projects the average fourth-quarter civilian unemployment rate, and fourth-quarter over fourth-quarter growth rates of real GDP and prices for personal consumption

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expenditures (PCE). This makes it difficult to compare with survey forecasts, which typically focus on annual averages and the consumer price index (CPI). The FOMC's particular, and changing, schedule further complicates comparison, as the surveys follow more regular patterns. For example, the Survey of Professional Forecasters (SPF) operates with deadlines in the middle of February, May, August, and November.[10] Consequently, the FOMC's January and March projections are both compared with the SPF February forecast, the FOMC's April and June projections are compared with SPF May, the FOMC's September value is compared with SPF August, while the FOMC's October, November, and December projections are all compared with the SPF November forecast. This way the predictions are at most a month apart. Even if close in time, predictions can vary significantly, especially if new data is released in between.[11] Comparing with Greenbook projections, Romer and Romer (2000) find that these small differences in timing do not appear to have much impact. We find that even differences as short as a month can make a difference and therefore check for robustness by comparing FOMC projections also with one-period leads and lags of the matched-up SPF forecast. This is particularly important with time trends in the data, which are prevalent. The dates used in the figures below are those of the second day of the FOMC meetings for which the corresponding projections were produced. We do not know the exact dates the projections and forecasts were generated, which could vary across respondents.[12]

The Wall Street Journal's Economic Forecasting Survey (EFS) provides monthly forecasts. It samples more than 60 economists, with responses due on the Tuesday following the Bureau of Labor Statistics release of the Employment Report on the first Friday of the month, making the deadline anywhere between the 5th and 11th day of the month. It provides individual data, which were used to determine median forecasts.[13] Due to differences in timing, we compare with both the forecast immediately preceding and succeeding the corresponding FOMC projection. Since only three FOMC meetings involving projections during the period 2008–2019 ended before the 12th day of the month, surveys from the month the meeting was held are referred to as the preceding forecast, and the survey from the following month as the succeeding one. The only exceptions are the three early November FOMC meetings in 2009–2011, for which we use forecasts from the month of the meeting and the prior month.

Each of the four figures compare forecasts and projections for each of the following variables: (1) unemployment, (2) GDP growth, (3) PCE inflation, and (4) the federal funds rate target. Each figure has one panel for each of the individual years 2008–2019, plotting predictions for that year against the time at which these were produced (corresponding FOMC meeting), together with the realized value (latest revised). In all figures, the FOMC median projection is plotted in solid black dots connected by solid black lines. SPF survey median forecasts are red circles, with smaller red squares for the financial services subgroup and small red diamonds for respondents not employed in financial services.[14] EFS preceding forecasts are orange multiplication signs ($\times$), while the succeeding ones are plus signs ($+$). A star ($*$) means the forecasts preceding and succeeding a given meeting coincide. Greenbook (now Tealbook) projections prepared ahead of each FOMC meeting by staff at the Board of Governors are plotted as green squares (at the time of writing released only up to December 2017). The straight dotted black line represents the realized value of the variable being forecast.

To evaluate whether any observed deviations between FOMC and survey expectations are statistically significant, we rely on binomial tests to compute the probability of x out of N observations deviating in the same direction, ignoring the order, and throwing out any ties. The reported p-values are for two-tailed hypothesis tests, that is, the two-sided probability of results being at least as lopsided as observed, assuming that the underlying distributions were truly the same (50–50% probability of being above or below when not identical). The binomial test does not require many observations to be able to yield statistically significant results, potentially just six at the usual 5% significance level, which is an advantage given the limited number of observations in our data set. It also does not require any assumptions about the underlying data generating process.

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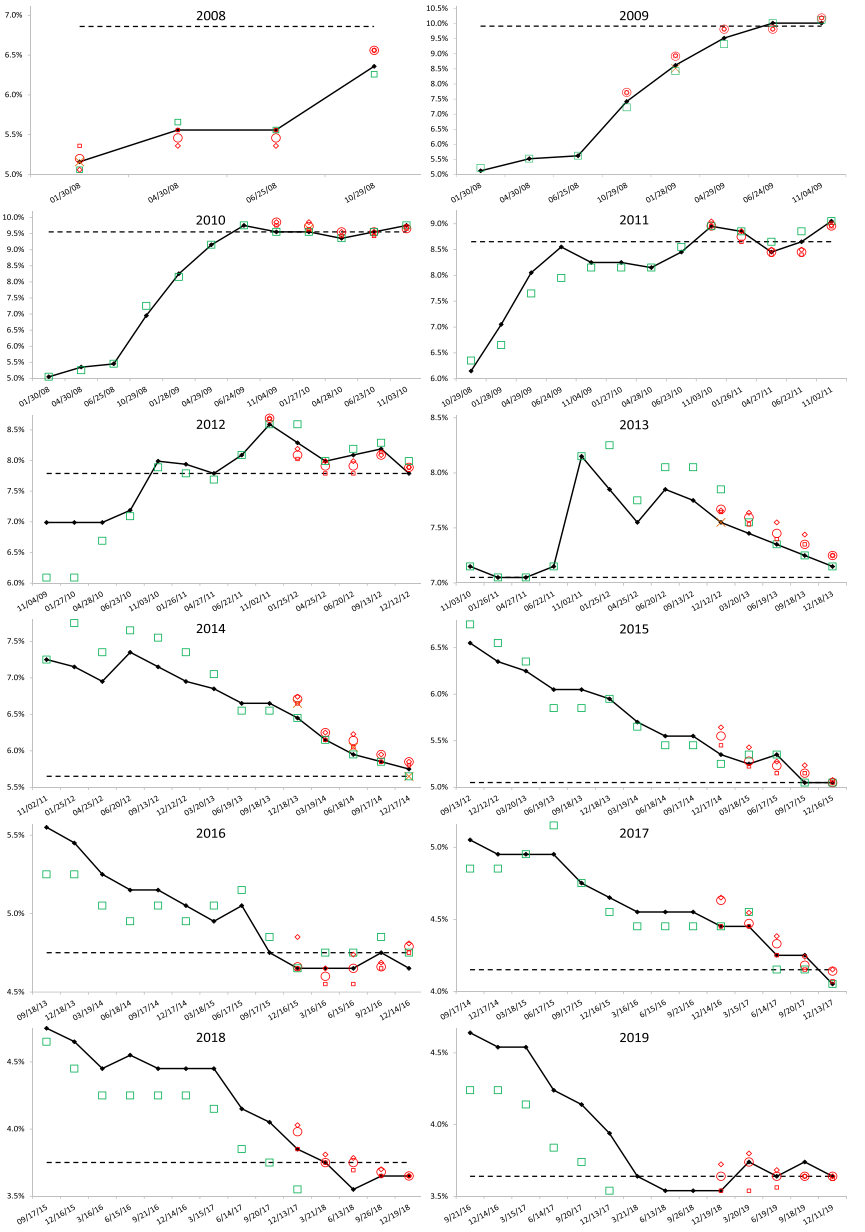

Figure 1. Projections and forecasts of unemployment.

8.1. Civilian unemployment rate

Figure 1 shows projections and forecasts of the fourth-quarter average unemployment rate from 2008 to 2019. The SPF only asks about unemployment expectations 1 year ahead, so there are only 60 observations to compare with FOMC projections. The EFS focuses on June and December unemployment, only sporadically asking for fourth-quarter average unemployment, thus yielding only four comparable observations.

While the binomial test for the 2008–2019 period as a whole rejects that the observed differences in SPF and FOMC predictions of unemployment are exclusively due to noise, with the SPF

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median forecast above that of the FOMC in 35 out of 51 non-tied observations (p-value 0.01), the result is not robust to comparing with the one-period lead and lag of the matched-up SPF forecast. Hence, we cannot be confident that the result is not an artifact of imprecise matching, a serious danger with the time trends in the data. Looking at the subgroups of the SPF reveals that it is the nonfinancial services respondents that push the SPF median forecast above that of the FOMC (on average predicting 0.08 percentage points higher unemployment), illustrating that there are important differences between these two subgroups. We cannot find any significant patterns in the differences between FOMC projections and those from the Greenbook, or between the SPF and Greenbook.

The mean squared errors (MSE) of the matched-up SPF forecasts are a mere 3% lower than for FOMC projections (14% lower for financial services subgroup), but 133% higher for the lagged SPF forecast and 61% lower for the one-period lead.[15] Greenbook MSE are 17% higher than those of FOMC projections.

8.2. Real GDP growth

Figure 2 plots projections and forecasts of fourth-quarter over fourth-quarter real GDP growth for 2008–2019 together with the realized values. The SPF only forecasts GDP 1 year ahead on a quarterly basis. In addition, it asks for GDP levels, so the implied fourth-quarter to fourth-quarter growth rate can only be computed unambiguously for surveys from the first and fourthquarters. Because of this, the SPF only provides 23 comparable observations. For the EFS survey, we have 115 matching preceding forecasts and 122 succeeding ones.

For the 2008–2019 period as a whole, there are no statistically significant deviations between the different forecasts and projections of GDP growth. However, splitting the sample into two periods, we find that FOMC projections are systematically above EFS forecasts for 2008–2015 and below for 2016–2019, in statistically significant ways, both for surveys preceding and succeeding meetings (largest p-value is 1×10^{-5}). These results are robust to ignoring the crisis years 2008 and 2009 (largest p-value is 8×10^{-6}). For individual years, the differences are statistically significant for both EFS surveys preceding and succeeding FOMC meetings for 2013, 2014, 2017, and 2018.

FOMC projections are generally not more accurate than the EFS. In fact, the MSE of the EFS are 12% and 18% lower than the MSE of FOMC projections for preceding and succeeding surveys, respectively, but these are not statistically significant differences. Greenbook MSE are 3% lower than those of the FOMC, but still 10% higher than for preceding EFS (in sample where all three are available).

Greenbook forecasts do not deviate systematically from those of the FOMC in a statistically significant way, except for the single year 2011 (p-value 0.02), but Greenbook forecasts are systematically above both preceding and succeeding EFS over the period 2008–2015 (largest p-value is 0.012). We could not find any significant differences between SPF forecasts and any of the other measures.

On average over the period 2008–2019, FOMC median projections of GDP growth were higher than the EFS median forecasts by 0.04 percentage points in terms of the preceding ones and by 0.07 for the succeeding ones. For 2008–2015, the corresponding numbers are 0.17 and 0.21, while they are −0.13 and −0.13 for 2016–2019. Annual averages deviate as much as 0.39 for 2011 and −0.19 for 2018. In terms of absolute deviations, which give a better picture of the typical size of the deviations without positive and negative ones canceling each other out, we have 0.22 for both preceding and succeeding surveys. Annual averages of absolute deviations are all within the 0.07–0.39 range. The single largest deviation is of 0.9 percentage points in 2011, but deviations of half a point or more occurred at least once for all years before 2016. As Figure 2 shows, there is much more variation in the magnitude of deviations between GDP growth forecasts and projections than in their sign.

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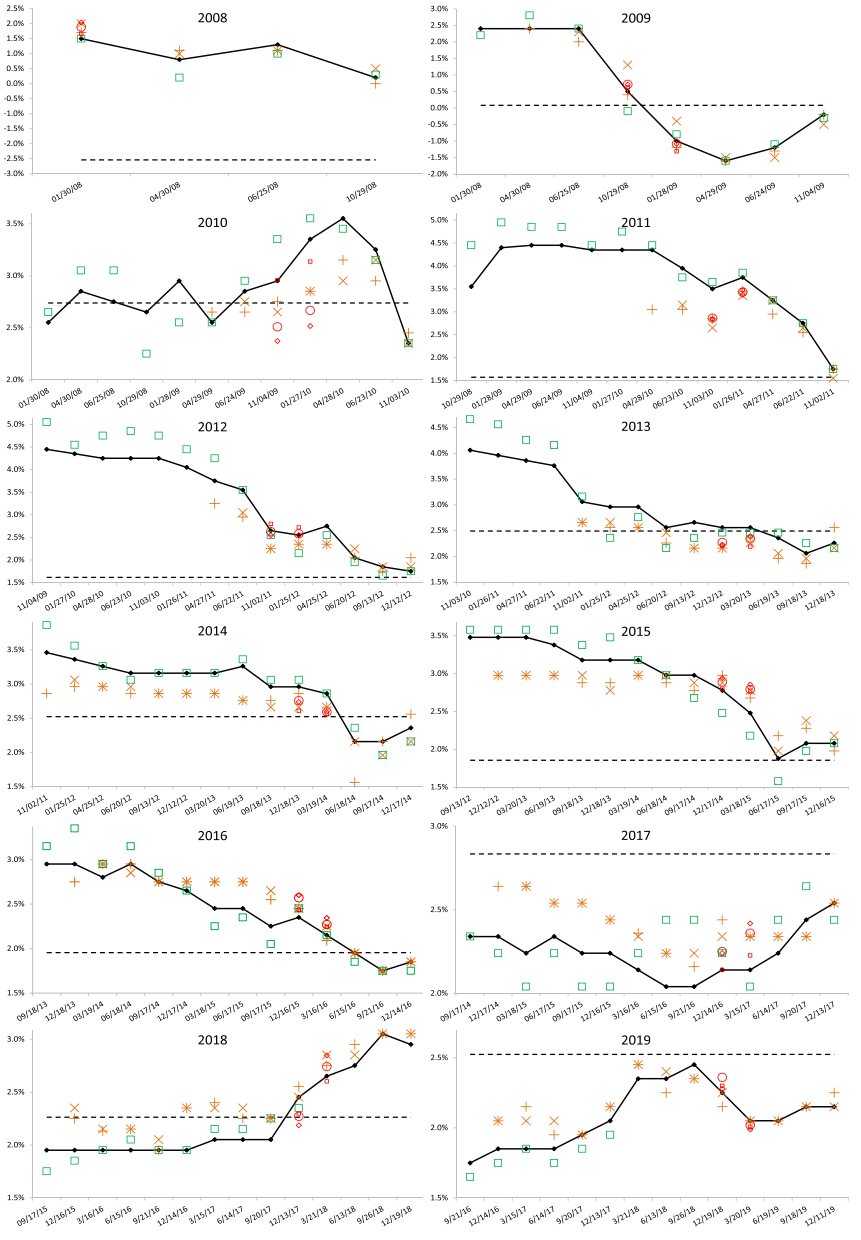

Figure 2. Projections and forecasts of real GDP growth.

8.3. PCE inflation

Figure 3 plots projections and forecasts of fourth-quarter over fourth-quarter PCE inflation rates. Of the surveys, only the SPF asked for PCE inflation during our sample period and yields 135 comparison points. None of the surveys included core PCE inflation at the time, which the FOMC also projects.

The figure shows that the FOMC systematically projected lower inflation than the SPF in the period 2010–2015, and not always correctly so (2011 and 2012). The binomial test reveals that

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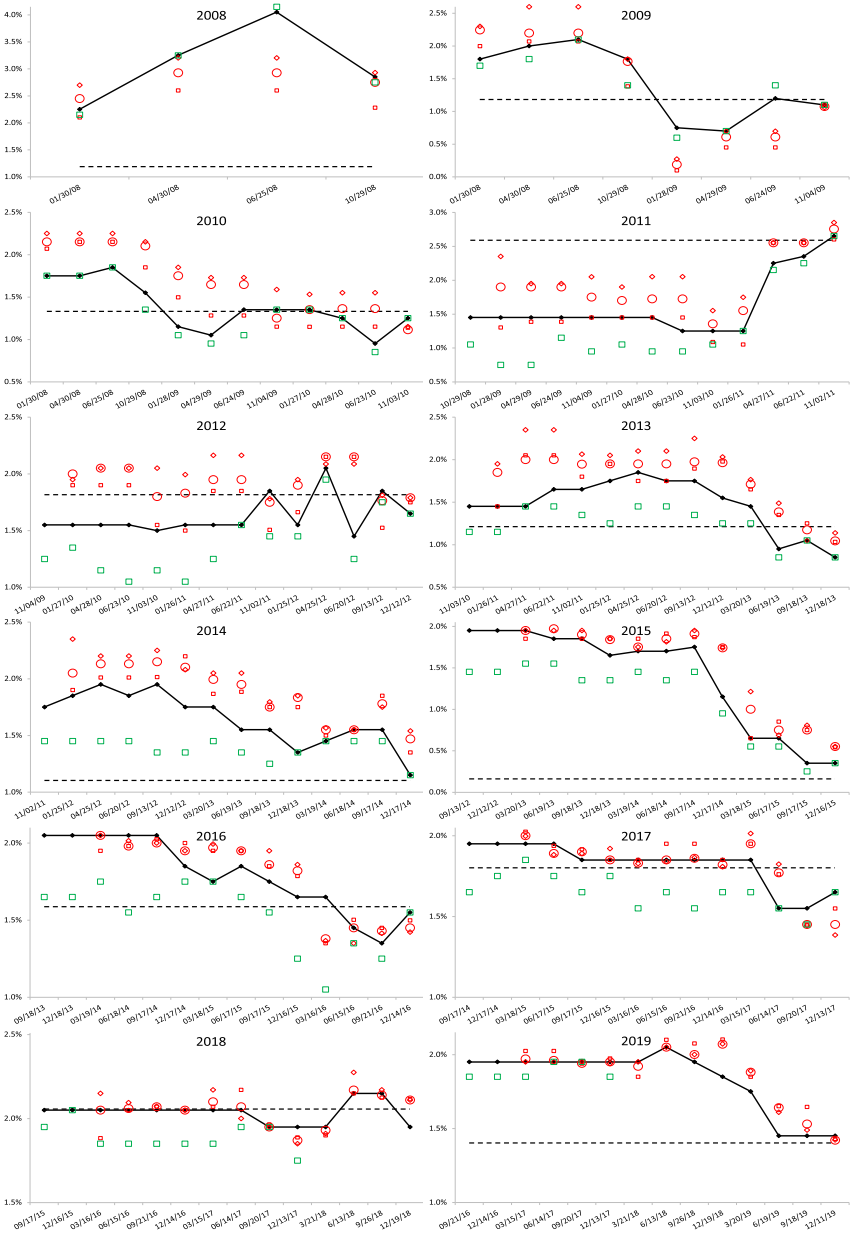

Figure 3. Projections and forecasts of PCE inflation.

FOMC projections for inflation being lower than the corresponding SPF forecasts in 96 out of 123 cases (excluding ties), as we observe from 2008 to 2019, has a p-value of 3×10^{-10}. This result is robust to shifting the timing of the SPF forecasts by one period in either direction so that FOMC projections are compared with SPF forecasts produced at least 2 months prior (p-value less than 2×10^{-12}), or at least 2 months after (p-value 2×10^{-5}), respectively. The results remain unchanged when ignoring the crisis years 2008 and 2009 (p-value 3×10^{-11}). On a year-by-year basis, the differences between FOMC projections and SPF forecasts are statistically significant for 2011–2015, but only for 2012–2014 are they also significant for both the one-period lead and

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lagged SPF. There are significant differences between SPF forecasts from respondents in the financial services industry and others, with the latter group consistently predicting higher inflation during the 2008–2014 period (by 0.28 on average). However, both groups systematically forecast higher inflation than FOMC projections (p-values of 5×10^{-4} and 5×10^{-11}, respectively, for 2008–2019).

Greenbook inflation forecasts are systematically lower than FOMC projections in a statistically significant way for each individual year 2011–2018 (highest p-value is 0.03) and also for the 2008–2019 period as a whole, with only 2 out of 107 non-tied observations being higher (p-value below 2×10^{-12}). Greenbook forecasts are also systematically lower than those of the SPF, with only 11 out of 119 non-tied observations being higher (p-value below 2×10^{-12}).

On average over the period 2008–2019, the FOMC median projection for inflation was 0.15 percentage points below the SPF median, but annual averages vary between −0.34 for 2008 and 0.29–0.31 for 2010–2013. In terms of absolute deviations, the average was 0.21 percentage points. The single largest deviation was a full percentage point in 2008, but deviations of half a point occurred at least once in all years 2008–2015. As Figure 3 shows, there is much more variation in the magnitude of deviations between inflation forecasts and projections than in their sign. Greenbook projections of PCE inflation were for the period 2008–2019 on average 0.2 percentage points below the FOMC median, with annual averages varying between 0.32 for 2011 and 0.03 in 2008. In terms of absolute deviations, the numbers are almost identical, since there are only two instances of positive deviations. The single largest deviations are of 0.7 percentage points in 2011, and half a point at least once in each of the years 2012–2016. Greenbook forecasts were on average 0.35 percentage points below SPF forecasts during 2008–2019.

MSE for SPF forecasts are 7% higher than those for FOMC projections for the 2008–2019 period as a whole, while Greenbook MSE are practically the same as for the FOMC. Year by year, the SPF MSE are usually slightly higher than for the FOMC, but much lower for 2008 and 2011, years in which the FOMC grossly underestimated and overestimated inflation, respectively. The same applies for Greenbook forecasts. None of the differences in terms of MSE are statistically significant.

8.4. Federal fund rate target

Figure 4 plots projections and forecasts of the federal funds rate target from 2012 to 2019. The EFS is the only survey to include this variable, yielding 87 comparable preceding forecasts and 84 succeeding ones.

While the binomial test finds that succeeding EFS forecasts have a statistically significant tendency to be below FOMC forecasts (p-value 5×10^{-4}), it cannot reject the null hypothesis of no systematic deviations for preceding ones. This fits with the downward time trend in predicted values in our sample and again illustrates the need for caution with respect to the timing of forecasts when comparing these. On average, succeeding EFS forecasts are 0.07 percentage points below the corresponding FOMC projections, while preceding ones are just 0.01 below.

The binomial test does not find systematic deviations between Greenbook forecasts and FOMC projections for the 2012–2019 period as a whole, or for any individual year. MSE for Greenbook, FOMC, and EFS forecasts are basically identical (except for succeeding EFS, which are about 12% lower).

9. Discussion of FOMC projections

FOMC forecast errors are obviously not white noise, displaying a strong autocorrelation, as do those of the SPF, EFS, and Greenbook. Hence, all are making systematic errors over time and are in that sense not unbiased. Assuming that policymakers' private beliefs are adequately captured

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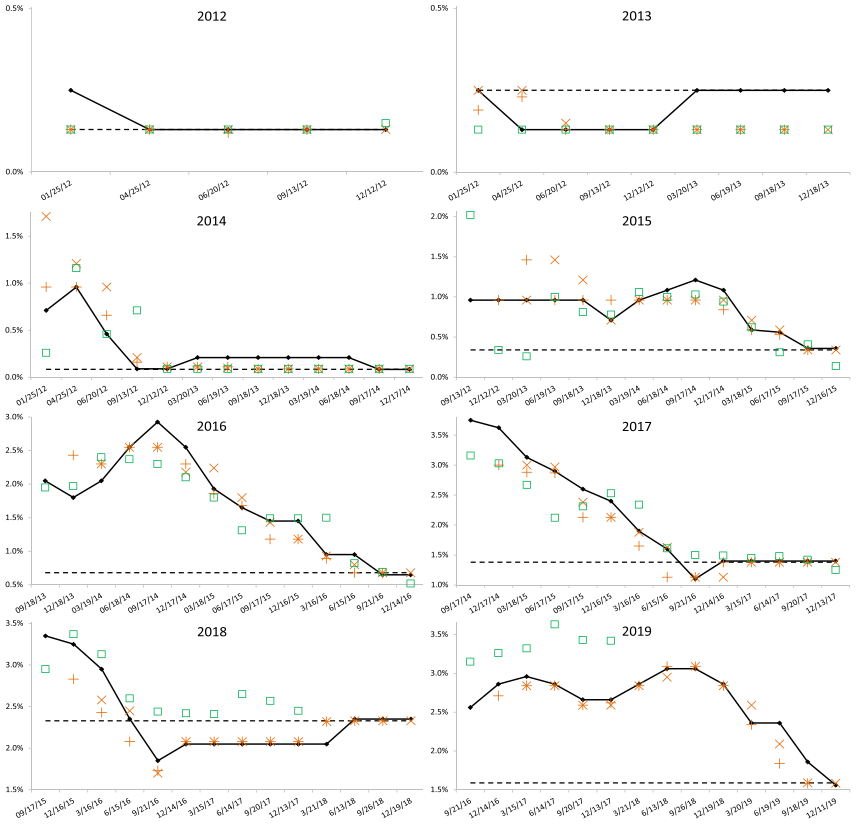

Figure 4. Projections and forecasts of the federal funds rate target.

by the surveys of professional forecasters, the statistically significant deviations observed between FOMC projections and survey forecasts for inflation and GDP growth imply a policymaker bias. Furthermore, one could argue that FOMC projections deviated from professionals' forecasts in ways that would be helpful for policymakers to achieve their stabilization objectives. Recovering from the most severe and long-lasting recession in decades would, according to any model with self-fulfilling expectations, including the IS curve (13), be helped along by higher expectations of economic growth and lower expectations of inflation, the latter to ward of fears of a need to tighten monetary policy.[16] However, while the FOMC's projections of GDP growth were less accurate than the comparison survey in terms of MSE for the 2008–2019 period as a whole, the opposite is true for inflation. But even for inflation, the FOMC's projections performed worse than private forecasts for some individual years, notably 2008 and 2011–2012. The same applies in 2012 and 2016–2019 for the federal funds rate target, a variable completely under policymakers' control. Nevertheless, the noise in forecasts and projections is so high that none of the observed differences in MSE are statistically significant. Hence, if projections were used to try to mislead or sway the public, this was not of a large enough magnitude or in a systematic enough way to be detectable through the noise, in terms of statistically significant differences in MSE. Similarly, if projections corrected inconsistent public expectations or reduced the noise in their forecasts, this also does not come through in terms of projections of statistically significant higher quality than private forecasts, despite the significant differences that remain between the two. There is no doubt, however, that projections have not allowed the FOMC to dictate the public's expectations, at least in

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terms of inflation and output growth. This is consistent with our finding from the theoretical part that the public cannot fully trust projections. Our empirical findings do not, however, preclude the possibility of projections having had *some* influence on expectations, as for example Coibion et al. (2021) find.

When projections do influence expectations, the threat of losing credibility and ability to impact expectations in the future could also prevent policymakers from releasing misleading or time-inconsistent projections, just as Barro (1986) and Rogoff (1987) argue that the threat of losing their credibility can prevent policymakers from deviating from previous commitments. When the penalty, in terms of lower attainment of policy objectives due to lost influence on expectations in the future, is higher than the immediate gains from misleading or deviating, policymakers may prefer not to do so. When credibility is imperfect to start with, projections considered too far-fetched or improbable could even have an immediate negative impact on economic outcomes and policy objectives through an instantaneous loss of credibility and influence. Hence, even when such extreme projections are truthful and would eventually be proven right, policymakers might be better off adjusting these to be more in line with preexisting expectations in order to avoid a temporary loss of credibility.

The pattern observed for inflation, where SPF respondents' forecasts are systematically higher than those of the FOMC, which are in turn systematically higher than the Greenbook's, would be consistent with policymakers adjusting official projections to be more in line with private-sector expectations, assuming policymakers perceive Greenbook forecasts as the gold standard. Greenbook projections are prepared to guide the policy discussion at FOMC meetings and are available to FOMC members prior to submitting their final individual projections. This would also provide a motive for keeping Greenbook forecasts confidential, as is current practice. Of course, it could also be that policymakers are simply swayed by the Greenbook, without necessarily believing it holds the truth, or most accurate forecast. In fact, the MSE of Greenbook inflation forecasts does not differ significantly from that of the median FOMC projection, despite the projections themselves differing systematically. The secrecy around Greenbook forecasts could just be to prevent these from influencing the public's expectations directly.

In FOMC discussions (see transcripts from January and June 2007), several members voiced qualms about long-run projections of inflation that are too far away from its mandate for price stability, particularly since the FOMC states that "Longer-run projections represent each participant's assessment of the rate to which each variable would be expected to converge under appropriate monetary policy and in the absence of further shocks to the economy." From this point of view, the FOMC's inflation projections, and the Greenbook's, should convey its commitment to low inflation, or at least not be inconsistent with such a commitment, while survey forecasters face no such constraint. However, for the years studied, both FOMC and SPF long-run forecasts are mostly within the target range, making this constraint mute.[17]

The FOMC has motivated its move toward providing projections by arguing that this leads to increased transparency. This is reflected in transcripts from FOMC meetings in 2007 (January), where the idea of publishing projections, and different options for doing so, were discussed at length. Some other motivations were that it would increase the Fed's credibility and accountability, strengthen its commitment to price stability, and that it could make monetary policy more effective. Arguably, projections give the public an idea about where FOMC members believe the economy is heading, thus providing a rationale for their policy decisions. In this sense, it may be useful to make immediately available to the public also the Greenbook forecasts, which apparently carry considerable weight in the policy discussion. It could also be useful to specify in more detail how FOMC projections are generated. On the other hand, Amato et al. (2002), Geraats (2002) and Jensen (2002) argue that transparency can sometimes deteriorate economic outcomes. Moreover, FOMC projections give insight into any divisiveness that might exist within the committee, which can increase uncertainty about its future actions, especially since the FOMC states that "Each participant's projections are based on his or her assessment of appropriate monetary policy."

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Meeting transcripts (January and June 2007) show that the FOMC has discussed the influence its projections can have on the public's expectations. In particular, some members expressed concerns about the public taking the projections as a commitment by the FOMC to realize the projected values. As mentioned above, there also seems to be some concern that the public's beliefs about the Fed's willingness to defend its goal of price stability, relative to that of stimulating economic activity, might be affected by its projections, especially those of long-run inflation. At the same time, former Fed Chairs Bernanke and Yellen have both stressed the importance of the post-meeting statements by the FOMC and the Chair's press conference as the primary way in which the FOMC tries to convey information about future policy to the public (Bernanke (2016) and Chair Yellen's press conference on March 19, 2014). Hence, it is unclear to what extent the FOMC itself believes that projections can, or should, be used to impact the public's expectations. While being more precise and informative than its traditionally vague statements, and having been given a more and more prominent role in its communication over time, projections may have a greater impact on expectations when only single consensus values are released, as is common among most central banks. From this point of view, the FOMC's chosen path may not be the best suited to influence the public's expectations. At the same time, it is worth noting that our main results carry through whether policymakers influence expectations through projections or statements. Policymakers have incentives to use their influence to mislead the public in an effort to achieve better policy outcomes.

10. Conclusions

Our theoretical analysis shows that policymakers have incentives to use projections to try to mislead the public. Furthermore, they have incentives to deviate from the previously projected path, even when not planning to mislead the public. Hence, we find that policymakers' projections should be viewed with skepticism. Consistent with this, survey expectations of professional forecastsers for inflation and GDP growth differ systematically from the FOMCs projected values in statistically significant ways, thus rejecting the idea that these allow for controlling the public's expectations, at least in the FOMC's case over the 2008–2019 period. However, we cannot dismiss the possibility that the projections may have had *some* influence on expectations. At the same time, there is a lack of studies on the impact of projections on economic outcomes. One might think that policymakers have nothing to lose, and that in the worst case, projections are just ignored. However, we show that correcting the public's inconsistent expectations can sometimes deteriorate policy outcomes. Furthermore, it is easy to imagine that inaccurate projections, especially if less accurate than those of other forecasters, could deteriorate the public's trust in policymakers' abilities to understand and manage the economy, which could bring about expectations that lead to worse economic outcomes. Less favorable expectations can arise even when projections are accurate, by revealing policymakers true preferences, or by making the public draw incorrect inferences about these. For example, policymakers' projections could reveal, or make the public believe, that policymakers are not as hawkish on inflation as previously thought, leading to higher inflation expectations and worse economic outcomes.[22]

Notes

1 Projections are also provided by the ECB and central banks of Australia, Canada, England, Japan, New Zealand, Norway, Sweden, and Switzerland.

2 While internal projections have played a role in monetary policy for a long time, for example, through forecast targeting [Hall (1985), Hall and Mankiw (1994), King (1994), Bowen (1995), and Svensson (1997 and 1999)], our focus is on the more recent practice of making projections publicly available immediately [Svensson (2005) and Woodford (2007)].

3 For more on this in the US context, see footnote 13.

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4 Tillmann (2011) examines differences among inflation forecasts submitted by voting and nonvoting members of the FOMC, showing that the latter deviate strategically from the consensus, arguably to influence the committee's policy decisions.
5 While the public may benefit from being mislead in terms of a lower loss from distortions due to menu costs (3), this ignores the cost of suboptimal decisions individuals might make as a result of having biased inflation expectations.
6 While it is optimal to deviate to discretion assuming policy expectations for the next period are locked into the commitment rule (6), if projections remained credible despite deviations, policymakers would be better off implementing Result 1, where optimization is not subject to the constraint that policy and projections be mutually consistent.
7 With imperfect credibility, projections about values far into the future can affect expectations about immediate conditions when people use these to evaluate the credibility of policymakers' projections. For example, if a projected value deviates greatly from the public's own prior, it may affect the credibility, and hence influence, of policymakers' projections about other periods. Likewise, projections about other variables than inflation may affect the credibility of the inflation projection, the only expectations that matter explicitly in the framework above.
8 See Section A.5 for details.
9 From 1979 to 2007, projections were produced twice a year (January and June, in preparation for Congressional testimony in February and July). Starting April 2011, projections were released in conjunction with the Chairman's post-meeting press conference and are more recently also summarized in the policy statements published immediately after the meetings.
10 SPF questionnaires are sent out at toward the end of the month preceding the survey release, following the release of the NIPA advance report.
11 Official estimates of GDP and personal expenditures are released at the end of the month. Unemployment data are released at the beginning of each month. Not all survey respondents exhaust the deadline, and some might not use the most up-to-date information.
12 Initial FOMC projections are due by the end of the day on the Friday before the FOMC meeting but may be revised at any time until the beginning of the session on the second day of the meeting. Previously, the final deadline was the day after the meeting ended.
13 The Blue Chip Economic Indicators also provide monthly forecasts. However, for the variables we are interested in, it only reports the mean forecast, not the median or individual forecasts. Furthermore, it focuses on annual averages and the CPI and GDP deflator. Because of these differences, we do not compare with this survey. The Livingston survey measures expectations of quarterly GDP growth, unemployment, and CPI inflation. However, due to its biannual nature, it only provides one matching forecast per year and was therefore excluded. The University of Michigan's Surveys of Consumers and the New York Fed's Survey of Consumer Expectations both track inflation expectations 12 months ahead but do not ask respondents about any specific price index. The latter also asks about the 12-month inflation rate in 3 years but even so would only provide two comparable observations per year. For unemployment and GDP, these two surveys only ask about the direction of change. According to these surveys of consumers, their inflation expectations were always considerably higher during our sample period than those registered by the SPF, both among respondents working in the financial services and otherwise. This implies that except for the Michigan survey in 2011, they were always further away from the realized PCE inflation rate than what the SPF or FOMC were.
14 Some respondents are excluded from both SPF subgroups as their employment sector was not recorded.
15 MSE tend to be larger the further ahead the forecast, where even as little as a month can make a significant difference. Hence, to make MSE comparisons as fair as possible, we limit the sample to that for which all forecasts and projections being compared are available. This is why the MSE for SPF forecasts relative to that of FOMC projections varies with leads and lags. The SPF values and errors are the same, but the timing affects which of the FOMC projections we compare with.
16 Some may say that deflation was a greater concern than inflation during the postcrisis years, and that it would have been more useful to project higher inflation. However, none of our measures, including FOMC and Greenbook projections, are consistent with serious fears of deflation.
17 Moreover, in 2008, the only year in our sample that inflation expectations rose above 2.5%, FOMC projections were actually higher than the SPF forecasts.
18 The reduced-form solution under discretion (9) is $\pi_t = \lambda((1-\beta\rho)\lambda+\kappa^2)^{-1}u_t$ and $x_t = -\kappa((1-\beta\rho)\lambda+\kappa^2)^{-1}u_t$, which can be obtained by the method of undetermined coefficients. This method is used to obtain expressions for all loss values (3) in the present study.
19 This alternative equilibrium is a feasible option under commitment and so must be inferior to optimal commitment.
20 With uncertainty, the condition $\hat{\pi}_t = \pi_t$ is stricter than we need, since all that is required is that there be no systematic deviations between actual inflation and its projected path ($E_t\hat{\pi}_{t+1} = E_t\pi_{t+1}$). However, this means that there would be no way for policymakers to systematically take advantage of such deviations, even if we allowed for these, so there is no impact on the optimal strategy.
21 Studying short-term commitments, Jensen (2013) shows that the Lagrangian approach used above is valid even when the commitment only applies I periods into the future, whether or not period $t=0$ is the first one in which policymakers commit. Hence, committing, or projecting ahead, the optimal policy is to follow the standard optimal plan for as long as the commitment lasts.

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22 When policymakers project N periods ahead, choosing $\hat{\pi}_t$ in $t-N$, the first-order condition is $E_{t-N}\sum_{j=t-N}^{\infty}\beta^{j-t+N}x_j \times \partial\hat{E}_j\pi_{j+1}/\partial\hat{\pi}_t = 0$ so that the optimal projection depends on the effects that $\hat{\pi}_t$ may have on expectations $\hat{E}_{t-N}\pi_{t-N+1}, \ldots, \hat{E}_{t-1}\pi_t$, all of which policymakers will have incentives to ignore when choosing policy π_t in period t. Some of these effects would even be ignored when policymakers reoptimize with respect to $\hat{\pi}_t$ in later periods (e.g., in $t-1$ as above), making the updated projection inconsistent with those produced earlier, if the now ignored effects were nonzero.

References

Amato, J. D., S. Morris and H. S. Shin (2002) Communication and monetary policy. *Oxford Review of Economic Policy* 18(4), 495–503.

Assenmacher-Wesche, K. (2006) Estimating Central Banks' preferences from a time-varying empirical reaction function. *European Economic Review* 50(8), 1951–1974.

Barro, R. J. (1986) Reputation in a model of monetary policy with incomplete information. *Journal of Monetary Economics* 17(1), 3–20.

Bernanke, B. S. (2016) Federal Reserve economic projections: What are they good for? In: *Ben Bernanke's Blog*. Brookings Institute.

Blinder, A. S., M. Ehrmann, M. Fratzscher, J. De Haan and D. J. Jansen (2008) Central bank communication and monetary policy: A survey of theory and evidence. *Journal of Economic Literature* 46(4), 910–945.

Bowen, A. (1995) British experience with inflation targetry. In: Bowen, A. (eds.), *Inflation Targets*. London: CEPR.

Calvo, G. A. (1983) Staggered prices in a utility maximizing framework. *Journal of Monetary Economics* 12(3), 383–398.

Canzoneri, M. B. (1985) Monetary policy games and the role of private information. *American Economic Review* 75, 1056–1070.

Clarida, R., J. Gali and M. Gertler (1999) The science of monetary policy: A new Keynesian perspective. *Journal of Economic Literature* 37(4), 1661–1707.

Coibion, O., D. Georgarakos, Y. Gorodnichenko and M. Weber (2021) Forward Guidance and Household Expectations. NBER WP w26778.

Cukierman, A. and A. H. Meltzer (1986) A theory of ambiguity, credibility, and inflation under discretion and asymmetric information. *Econometrica* 54(5), 1099–1128.

Currie, D. and P. Levine (1993) *Rules, Reputation and Macroeconomic Policy Coordination*. Cambridge: Cambridge University Press.

Dennis, R. (2004) Inferring policy objectives from economic outcomes. *Oxford Bulletin of Economics and Statistics* 66(s1), 735–764.

Garfinkel, M. R. and S. Oh (1995) When and how much to talk credibility and flexibility in monetary policy with private information. *Journal of Monetary Economics* 35(2), 341–357.

Geraats, P. (2002) Central bank transparency. *The Economic Journal* 112(483), 532–565.

Givens, G. E. (2012) Estimating central bank preferences under commitment and discretion. *Journal of Money, Credit and Banking* 44(6), 1033–1061.

Hall, R. E. (1985) Monetary strategy with an elastic price standard. In: Price Stability and Public Policy: A Symposium Sponsored by the Federal Reserve Bank of Kansas City. Federal Reserve Bank of Kansas City.

Hall, R. E. and N. G. Mankiw (1994) Nominal income targeting. In: Hall, R. E. and N. G. Mankiw. (ed.), *Monetary Policy*. Chicago: University of Chicago Press.

Jensen, C. (2013) The gains from short-term commitments. *Journal of Macroeconomics* 35, 14–23.

Jensen, H. (2002) Optimal degrees of transparency in monetary policymaking. *Scandinavian Journal of Economics* 104(3), 399–422.

King, M. A. (1994) Monetary policy in the UK. *Fiscal Studies* 15(3), 109–128.

Kydland, F. E. and E. C. Prescott (1977) Rules rather than discretion: The inconsistency of optimal plans. *Journal of Political Economy* 85(3), 473–492.

Mackowiak, B. and M. Wiederholt (2009) Optimal sticky prices under rational inattention. *American Economic Review* 99(3), 769–803.

McCallum, B. T. and E. Nelson (1999) An optimizing IS-LM specification for monetary policy and business cycle analysis. *Journal of Money, Credit and Banking* 31(3), 296–316.

Rogoff, K. (1987) Reputational constraints on monetary policy. *Carnegie-Rochester Conference Series on Public Policy* 26, 141–182.

Romer, C. D. and D. H. Romer (2000) Federal reserve private information and the behavior of interest rates. *American Economic Review* 90(3), 429–457.

Rotemberg, J. J. (1982) Monopolistic price adjustment and aggregate output. *Review of Economic Studies* 49(4), 517–531.

Rotemberg, J. J. and Woodford, M. (1999) Interest rate rules in an estimated sticky price model. In: Taylor, J. B. (ed.), *Monetary Policy Rules*, pp. 57–126. University of Chicago Press.

Schorfheide, F. (2008) DSGE model-based estimation of the New Keynesian Phillips curve. *Federal Reserve Bank of Richmond Economic Quarterly* 94, 397–433.
Sims, C. A. (2003) Implications of rational inattention. *Journal of Monetary Economics* 50(3), 665–690.
Söderström, U., P. Söderlind and A. Vredin (2005) New-Keynesian models and monetary policy: A re-examination of the stylized facts. *The Scandinavian Journal of Economics* 107(3), 521–546.
Stein, J. C. (1989) Cheap talk and the fed: A theory of imprecise policy announcements. *American Economic Review* 79, 32–42.
Svensson, L. E. O. (1997) Inflation forecast targeting: Implementing and monitoring inflation targets. *European Economic Review* 41(6), 1111–1146.
Svensson, L. E. O. (1999) Inflation targeting as a monetary policy rule. *Journal of Monetary Economics* 43(3), 607–654.
Svensson, L. E. O. (2005) Monetary policy with judgment: Forecast targeting. *International Journal of Central Banking* 1, 1–54.
Svensson, L. E. O. and M. Woodford (2002) Indicator variables for optimal policy. *Journal of Monetary Economics* 50(3), 691–720.
Tillmann, P. (2011) Strategic forecasting on the FOMC. *European Journal of Political Economy* 27(3), 547–553.
Woodford, M. (1999) Commentary: How should monetary policy be conducted in an era of price stability. In: *New Challenges for Monetary Policy*, pp. 277–316. Federal Reserve Bank of Kansas City.
Woodford, M. (2003) *Interest and Prices: Foundations of a Theory of Monetary Policy*. Princeton: Princeton University Press.
Woodford, M. (2004) Inflation targeting and optimal monetary policy. *Federal Reserve Bank of St. Louis Review* 86, 15–42.
Woodford, M. (2007) The case for forecast targeting as a monetary policy strategy. *Journal of Economic Perspectives* 21(4), 3–24.

Appendix

A.1. Deriving optimal commitment and discretion

As shown by Clarida et al. (1999) and Woodford (1999), the optimal commitment policy can be found by minimizing

$$£ = \sum_{t=0}^{\infty} \beta^t \left(\pi_t^2 + \lambda x_t^2\right) - \theta_t \left(\beta \pi_{t+1} + \kappa x_t + u_t - \pi_t\right) \tag{15}$$

assuming rational expectations, and exploiting certainty equivalence [Currie and Levine (1993)]. Here, the variable θ_t is a Lagrange multiplier associated with the Phillips curve constraint (1). The first-order conditions,

$$\frac{\partial £}{\partial \pi_0} = 2\pi_0 + \theta_0 = 0, \tag{16}$$

$$\frac{\partial £}{\partial \pi_t} = 2\beta^t \pi_t - \beta\theta_{t-1} + \theta_t = 0 \tag{17}$$

for $t = 1, 2, 3, \ldots,$ and

$$\frac{\partial £}{\partial x_t} = 2\beta^t \lambda x_t - \kappa\theta_t = 0 \tag{18}$$

for $t = 0, 1, 2, \ldots,$ yield the optimal commitment policy (5)–(6).

A.2. Proof of Result 1

Proof. Replacing the public's inflation expectations $\hat{E}_t \pi_{t+1}$ with policymakers' projections $E_t \hat{\pi}_{t+1}$ in the Phillips curve (1) yields the Lagrangian:

$$£ = \sum_{t=0}^{\infty} \beta^t \left(\pi_t^2 + \lambda x_t^2\right) - \theta_t \left(\beta \hat{\pi}_{t+1} + \kappa x_t + u_t - \pi_t\right) \tag{19}$$

and the first-order conditions:

$$\frac{\partial £}{\partial \pi_t} = 2\beta^t \pi_t + \theta_t = 0 \tag{20}$$

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and (18), both for $t = 0, 1, 2, \ldots$, in addition to

$$\frac{\partial \pounds}{\partial \hat{\pi}_t} = -\beta\theta_{t-1} = 0 \tag{21}$$

for $t = 1, 2, 3 \ldots$ The latter (21) implies $\theta_t = 0$ for $t = 0, 1, 2, \ldots$, which combined with the other two first-order conditions, (18) and (20), yields the optimal policy (10) and $x_t = 0$. It follows that $l_t = 0$ for all $t = 0, 1, 2, \ldots$, so $L_0 = 0$.

Inserting for $\pi_t = x_t = 0$ in the Phillips curve (1) implies that the public's expectations must satisfy

$$\beta\hat{E}_t\pi_{t+1} + u_t = 0 \tag{22}$$

which holds for the assumed projections (11) when these determine expectations, so that

$$\hat{E}_t\pi_{t+1} = E_t\hat{\pi}_{t+1} = -\beta^{-1}u_t \tag{23}$$

□

A.2.1. Result 1b

Building on Result 1, we show that policymakers may have incentives to keep behaving as if the misleading projections are still believed after all credibility has been lost and projections have no influence on the public's expectations.

Result 1b. *Even after the optimal misleading projections (11) fail to deceive, and the public's inflation expectations are instead consistent with the implemented policy (10), continuing the strategy described in Result 1 can yield a preferable objective value (3) for policymakers than standard discretion (9).*

Proof. When the implemented policy is (10), and inflation expectations are consistent with this, we have

$$\hat{E}_t\pi_{t+1} = E_t\pi_{t+1} = 0 \tag{24}$$

for all $t = 0, 1, 2, \ldots$ This implies, inserting into the Phillips curve (1), that $x_t = \kappa^{-1}u_t$ and $l_t = \frac{\lambda}{\kappa^2}u_t^2$ for $t = 0, 1, 2, \ldots$, and therefore an objective value (3),

$$L_0^p = \frac{\lambda}{\kappa^2}E_0\sum_{t=0}^{\infty}\beta^t u_t^2 \tag{25}$$

which can be higher or lower than the corresponding loss

$$L_0^d = \frac{\lambda\left(\lambda + \kappa^2\right)}{\left(\left(1 - \beta\rho\right)\lambda + \kappa^2\right)^2}E_0\sum_{t=0}^{\infty}\beta^t u_t^2 \tag{26}$$

arising with standard discretion (9).[18] In particular, $L_0^d < L_0^p$ when

$$\left(1 - \beta\rho\right)^2\lambda + \left(1 - 2\beta\rho\right)\kappa^2 > 0 \tag{27}$$

while $L_0^d \geq L_0^p$ otherwise. □

When expectations become consistent with the implemented policy, and policymakers' misleading projections are no longer believed, it would not be optimal to keep implementing $\pi_t = 0$ if a policy change did not impact expectations (the optimal policy would then be the standard discretionary solution (9)). However, policymakers know that if they stop setting $\pi_t = 0$, expectations will change, so they face a choice between staying at the current equilibrium, or moving to the standard discretionary one. When $L_0^p < L_0^d$ they are better off remaining in this alternative

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equilibrium.[19] From above (27), we see that $L_0^p < L_0^d$ requires large β and ρ. This is because the benefit of having $\hat{E}_t\pi_{t+1} = 0$ is that the effects of a nonzero u_t-shock do not propagate toward the future through expectations, which is more important the more persistent these shocks are, and the more policymakers weight the future. $L_0^p < L_0^d$ is also more prone to occur the larger is κ and the smaller is λ, since then a u_t-shock has less impact on output and policymakers care less about output stabilization, respectively (when $\pi_t = 0\ \forall t$ the objective (3) depends only on output stabilization).

A.3. Proof of Result 2

Proof. Imposing consistency between projections and policy, we have $\hat{\pi}_t = \pi_t$ and $\hat{E}_t\pi_{t+1} = E_t\hat{\pi}_{t+1} = E_t\pi_{t+1}$.[20] From the perspective of any period $t = 0$, that is, the very first one in which policymakers project ahead, the optimal initial-period policy and projections $I > 0$ periods ahead are given by the sequence $\{\pi_t\}_{t=0}^I$ that minimizes this Lagrangian (15). The first-order conditions are the same as above, equations (16)–(18) for $t \leq I$, yielding the same optimal present action (5), and optimal future actions (6), which are also the optimal projection equations, for $t = 1, 2, 3, \ldots, I$.

When $t = 0$ is not the very first period in which policymakers project ahead, projection equations, and thus policy, for periods $t = 0, 1, 2, \ldots, I-1$ are given by past optimal projections (6), assuming policymakers are bound by past projections and cannot deviate. If, instead, they can deviate, they would implement discretion (9) in $t = 0$, breaking with past projections (6). Either way, the optimal new projection $\hat{\pi}_I$ follows from the first-order conditions (17) and (18) for $t = I > 0$ and is again equation (6).[21] □

A.4. Proof of Result 3

Proof. If the public's expectations are not linear in terms of both policy and projections, we no longer have a linear-quadratic framework, so certainty equivalence will generally not hold. Inserting the Phillips curve (1) into the objective (3) yields

$$E_0 \sum_{t=0}^{\infty} \beta^t \left(\pi_t^2 + \frac{\lambda}{\kappa^2}(\pi_t - \beta\hat{E}_t\pi_{t+1} - u_t)^2 \right) \tag{28}$$

with first-order conditions

$$E_0 \left\{ \pi_t + \frac{\lambda}{\kappa} x_t - \frac{\lambda}{\kappa} \sum_{j=0}^{\infty} \beta^{j-t+1} x_j \frac{\partial \hat{E}_j \pi_{j+1}}{\partial \pi_t} \right\} = 0 \tag{29}$$

with respect to policy π_t for $t = 0, 1, 2, \ldots$, and

$$E_0 \sum_{j=0}^{\infty} \beta^j x_j \frac{\partial \hat{E}_j \pi_{j+1}}{\partial \hat{\pi}_t} = 0 \tag{30}$$

with respect to projections $\hat{\pi}_t$ for for $t = 0, 1, 2, \ldots$

It follows that when choosing $\hat{\pi}_t$ in $t-1$, the last period in which this value would be projected, the relevant first-order condition is

$$E_{t-1} \sum_{j=t-1}^{\infty} \beta^{j-t+1} x_j \frac{\partial \hat{E}_j \pi_{j+1}}{\partial \hat{\pi}_t} = 0 \tag{31}$$

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where $x_{t-1} \times \partial \hat{E}_{t-1}\pi_t / \partial \hat{\pi}_t$ enters. Consequently, the optimal choice of $\hat{\pi}_t$ in $t-1$ will depend on its effect on expectations $\hat{E}_{t-1}\pi_t$, unless these are independent of the projected value ($\partial \hat{E}_{t-1}\pi_t / \partial \hat{\pi}_t = 0$), or x_{t-1} happens to be zero. However, when choosing policy π_t in period t, the relevant first-order condition is

$$E_t \left\{ \pi_t + \frac{\lambda}{\kappa} x_t - \frac{\lambda}{\kappa} \sum_{j=t}^{\infty} \beta^{j-t+1} x_j \frac{\partial \hat{E}_j \pi_{j+1}}{\partial \pi_t} \right\} = 0 \tag{32}$$

which is independent of past expectations $\hat{E}_{t-1}\pi_t$. This difference drives a wedge between the optimal projection $\hat{\pi}_t$ and the optimal policy π_t, giving policymakers incentives to have the two differ.

If policymakers instead committed to the optimal policy π_t at the same time they decided the projection $\hat{\pi}_t$ in period $t-1$, the relevant first-order condition would be

$$E_{t-1} \left\{ \pi_t + \frac{\lambda}{\kappa} x_t - \frac{\lambda}{\kappa} \sum_{j=t-1}^{\infty} \beta^{j-t+1} x_j \frac{\partial \hat{E}_j \pi_{j+1}}{\partial \pi_t} \right\} = 0 \tag{33}$$

which does include $x_{t-1} \times \partial \hat{E}_{t-1}\pi_t / \partial \pi_t$ and would thus capture the effects π_t has on expectations $\hat{E}_{t-1}\pi_t$. However, when policymakers reconsider in the following period, the relevant first-order condition is (32), where this effect is ignored, giving policymakers incentives to deviate from the previously promised policy, and projection, whenever $x_{t-1} \frac{\partial \hat{E}_{t-1}\pi_t}{\partial \pi_t} \neq 0$. □

For discretion, note that the first-order condition (32) only yields the standard discretionary policy (9) when $E_t \sum_{j=t}^{\infty} \beta^{j-t+1} x_j \partial \hat{E}_j \pi_{j+1} / \partial \pi_t = 0$. Hence, it will generally yield a different optimal discretionary policy when π_t has some influence on expectations in any later period. For any nonzero $\partial \hat{E}_j \pi_{j+1} / \partial \pi_t$, policymakers will want to use this influence, thus deviating from standard discretion (9), unless output x_j is zero anyway, so that there is nothing to be gained from changing expectations $\hat{E}_j \pi_{j+1}$, and thus x_j.

The optimal standard commitment rule (6) follows from first-order condition (33) assuming $\partial \hat{E}_j \pi_{j+1} / \partial \pi_t$ equals zero for all $j \neq t-1$ and one for $j = t-1$. However, when the effects on expectations differ from this because credibility is imperfect, the optimal commitment rule would differ.

The first-order condition for projections (30) shows that policymakers need to use these to influence expectations exactly in the same manner as they do with policy. Any non-exhausted influence $\partial \hat{E}_j \pi_{j+1} / \partial \hat{\pi}_t \neq 0$ for $j = 0, 1, 2, \ldots$, can only be optimal if the corresponding output variable x_j is zero. Hence, the optimal policy and projections will depend on exactly how policymakers' actions are assumed to affect their credibility and hence influence future expectations. Ideally, policymakers would want to make all x_j's zero by pushing expectations to satisfy condition (22) so that the resulting policy implies $\pi_t = x_t = 0$ in all periods, making the objective value (3) zero, as in Result 1.

A.5. Proof of Result 4

Proof. In this case, the relevant Lagrangian is

$$\pounds = \sum_{t=0}^{\infty} \beta^t \left(\pi_t^2 + \lambda x_t^2 \right) - \theta_t \left(\beta \hat{E}_t \pi_{t+1} + \kappa x_t + u_t - \pi_t \right) \tag{34}$$

with first-order conditions (18) and (20) for $t = 0, 1, 2, \ldots$ since expectations $\hat{E}_t \pi_{t+1}$ are independent of policy and projections. Combining the two yields the optimal discretionary policy

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(9) for all periods $t = 0, 1, 2, \ldots$ Because policymakers' projections $\hat{\pi}_t$ have no influence on the Lagrangian (34), these are irrelevant. □

A.6. Proof of Result 5

Proof. Imagine that the public's expectations are

$$\hat{E}_t \pi_{t+1} = -\frac{\lambda}{\kappa} E_t x_{t+1} + \gamma v_t \tag{35}$$

where

$$v_t = \phi v_{t-1} + e_t \tag{36}$$

$\phi \in (-1, 1)$ and e_t is white noise. Solving for the reduced-form solution of the model given by the Phillips curve (1), discretionary policy (9) and the noisy expectations (35), using the method of undetermined coefficients, and inserting into the policy objective (3), yields the loss

$$L_0^n = L_0^d + \frac{\gamma^2 \lambda \left(\lambda + \kappa^2\right)}{\left((1 - \beta\phi)\,\lambda + \kappa^2\right)^2} E_0 \sum_{t=0}^{\infty} \beta^t v_t^2 \tag{37}$$

which is larger than L_0^d, more so the further γ is from zero (the greater the noise in expectations). Since $L_0^n > L_0^d$ for $\gamma \neq 0$, providing projections that make the public's expectations match the implemented discretionary policy, instead of its noisy counterpart (35), would yield the standard discretionary solution, and thus a preferable policy objective (3). □

A.7. Proof of Result 6

Proof. Assuming that the public's expectations are

$$\hat{E}_t \pi_{t+1} = \eta E_t x_{t+1} \tag{38}$$

where η is a constant, the value of the policy objective (3) would be

$$L_0^i = \frac{\lambda \left(\lambda + \kappa^2\right)}{\left(\lambda + \beta\rho\kappa\eta + \kappa^2\right)^2} E_0 \sum_{t=0}^{\infty} \beta^t u_t^2 \tag{39}$$

when discretion (9) is implemented. It follows that when η is between $-\lambda/\kappa$ and $(\beta\rho\lambda - 2\lambda - 2\kappa^2)/(\beta\rho\kappa)$, $L_0^d < L_0^i$, and the policy objective (3) would be lower if the public's expectations were corrected so as to be consistent with the implemented policy ($\eta = -\lambda/\kappa$). For all other values of η, $L_0^d > L_0^i$, and the policy objective (3) is preferable when the public's expectations remain inconsistent with the implemented policy. □

Expectations can of course be inconsistent with the implemented policy (9) in different ways than assumed above (38). While arbitrary, the case discussed is simple, yet general enough to illustrate that the result is ambiguous. Correcting the public's inconsistent expectations can improve or deteriorate policy outcomes.

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