Monetary Policy Inclinations*

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Abstract

We examine whether central banks should complement their inflation forecasts with interest-rate projections. Introducing a central bank loss function that accounts for deviations from announcements, we incorporate the publication of policy inclinations into a dynamic monetary model. We show that, in the presence of cost-push shocks, the publication of interest-rate forecasts tends to improve welfare.

Keywords: central banks, transparency, Federal Reserve, ECB, policy inclinations

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1 Introduction

The range of current practice regarding the publication of policy inclinations by central banks is wide, extending from complete silence to explicit quarter-by-quarter numerical projections.\(^1\) Advocates of forward guidance argue that facilitating public understanding about the likely future path of policy can increase policy effectiveness. By contrast, many central bankers fear that the public would tend to interpret policy inclinations as commitments to future action, which would reduce flexibility in responding to unexpected developments.

While policy inclinations may convey private information from the central bank,\(^2\) we consider in this paper the case where there are no information asymmetries and the central bank uses forward guidance to affect the public’s expectations about future monetary policy. We explicitly model the costs incurred by the central bank if it deviates from its announcements.\(^3\) The central bank may suffer these costs if its prestige depends on the precision of its forecasts. Forecasts that often fail to come about may impair the public perception of the central bank’s competence and may also endanger the re-appointment of the central bank’s chief executives.

There is anecdotal evidence in favor of the existence of non-negligible costs caused by deviations. Many central bankers are reluctant to publish interest-rate forecasts as they fear that they will be judged according to the resulting forecast error. Svensson (2009, p. 24) reports that members of the Swedish Riksbank’s board agreed to refrain from signaling the likely outcome of the next monetary-policy meeting beforehand because such signals might “pre-commit some members and distort the final decision”.\(^4\) An extreme example of personal costs caused by deviating from previous statements is

\(^1\)For an interesting overview of the arguments for and against forward guidance, see Geraats et al. (2008).

\(^2\)Ferrero and Secchi (2009) study forward guidance when the private sector updates its forecasts through recursive least squares learning algorithms.

\(^3\)In a highly influential article, Rogoff (1985) proposes a model where deviations from exogenously given intermediate targets affect the central bank’s loss function (see also Cukierman and Liviatan (1991) and Gersbach and Hahn (2006)).

\(^4\)Svensson (2009) also emphasizes that in general central banks should try to avoid commitment to their forecasts.
the case of the President of the Bank of England, Mervyn King, who announced that Northern Rock would not be bailed out in the course of the ongoing financial crisis. When he had to back-pedal shortly afterwards, he came under severe criticism and lost credibility.\(^5\)

In this paper, we develop a framework for examining the social desirability of announcing interest-rate forecasts, given that the central bank already publishes inflation forecasts. We choose the dynamic New Keynesian model (see Clarida et al. (1999)) as our underlying workhorse. The main findings of our paper are the following: First, due to the costs of deviating from previous statements, inclinations can be used to influence the public’s expectations about inflation and output. In particular, increases in interest-rate forecasts entail a reduction in expectations about inflation and output. Second, the publication of interest-rate forecasts in addition to inflation forecasts may be socially desirable.

The beneficial effect of forward guidance can be explained as follows: In the New Keynesian framework drawn upon in this paper, the welfare level attainable under commitment cannot be achieved under discretion, due to the forward-looking nature of the Phillips curve. As current inflation depends on expectations about future inflation, the central bank could stabilize current inflation by promising to stabilize future inflation more strongly. However, the public knows that this behavior will not be optimal for the central bank in the future. Interest-rate announcements represent a way of making a credible promise to strongly stabilize future inflation because the public knows that the central bank will find it costly to deviate from its announcements.

The paper is organized as follows: In the next section we present our model. Section 3 details our findings. In particular, we assess the consequences of forward guidance for the public’s expectations and social welfare. Section 4 concludes.

2 Model

We consider the standard New Keynesian model (see Clarida et al. (1999)). The behavior of price-setters is described by a Phillips curve

$$\pi_t = \delta \mathbb{E}_t[\pi_{t+1}] + \lambda y_t + \xi_t,$$

where we use $\pi_t$ and $y_t$ to denote (log) inflation and (log) output in period $t$. Following Clarida et al. (1999), we express each variable as a deviation from its long-run level. Parameter $\delta$ represents the common discount factor with $0 < \delta < 1$, and parameter $\lambda$ with $\lambda > 0$ describes how strongly an increase in output affects inflation. Variable $\xi_t$ represents a cost-push shock given by an AR(1) process

$$\xi_t = \rho \xi_{t-1} + \varepsilon_t,$$

where $0 < \rho < 1$. We assume that the $\varepsilon_t$'s are i.i.d. from a normal distribution with variance $\nu^2$ and zero mean. The IS curve is given by

$$y_t = \mathbb{E}_t[y_{t+1}] - \sigma (i_t - \mathbb{E}_t[\pi_{t+1}]),$$

where $\sigma > 0$ and $i_t$ is the nominal interest rate.\(^6\) It can be derived from the consumption Euler equation of a representative household.

Moreover, we assume a quadratic function for per-period social losses

$$l_t = \pi_t^2 + ay_t^2,$$

where $a > 0$ represents the relative significance of output stabilization. Thus social welfare is represented by the expected sum of discounted per-period social losses

$$L_t = \mathbb{E}_t \sum_{j=0}^{\infty} \delta^j l_{t+j}.$$  

In each period $t$, the central bank publishes an inflation and an interest-rate projection for period $t+1$. We use $\pi^P_{t+1}$ to denote the inflation forecast and $i^P_{t+1}$ for interest-rate forecasts.

\(^6\)The natural real rate of interest is not present in (3) because we assume that it is constant and express each variable as a deviation from its long-run level.
The central bank’s loss function consists of two components. First, the central bank cares about social losses $l_t$. Second, we introduce a new component into the central bank’s loss function. As discussed in the Introduction, we assume that the central bank faces costs incurred by forecast deviations. Formally, the central bank’s losses in period $t$ are

$$l_t^{CB} = l_t + b \left( \pi_t - \pi_t^P \right)^2 + c \left( i_t - i_t^P \right)^2,$$

(6)

where $b > 0$ and $c \geq 0$. If a central bank has announced forecast values $\pi_t^P$ and $i_t^P$ in period $t - 1$, it faces the quadratic costs $b \left( \pi_t - \pi_t^P \right)^2$ and $c \left( i_t - i_t^P \right)^2$ if the forecasts fail to materialize in period $t$.

Parameters $b$ and $c$ give the relative weight of the costs incurred by the central bank for forecast deviations. For large values of $b$ and $c$, the central bank attaches high significance to deviations from its forecasts over and against per-period social losses. By contrast, low levels of these parameters imply that the costs incurred by forecast deviations are small in comparison to social losses. The parameter constellation $b > 0$ and $c = 0$ describes the case where the central bank does not suffer costs if the interest-rate forecast fails to come about. This case is equivalent to a central bank that publishes inflation forecasts but not interest-rate forecasts. In this paper, we examine the publication of interest-rate announcements for a central bank that already publishes inflation forecasts. In line with this objective, we will therefore compare situations with positive $c$ with one where $c = 0$, for a fixed value of $b > 0$.

In each period $t$, the central bank minimizes expected intertemporal losses

$$L_t^{CB} = \mathbb{E}_t \sum_{j=0}^{\infty} \delta^j l_{t+j}^{CB},$$

(7)

As explained in more detail in the next section, we apply the “discretionary solution” (see Backus and Driffill (1986), Oudiz and Sachs (1985), and Söderlind (1999)).

### 3 Solution

We use the algorithm presented in Söderlind (1999) to compute the discretionary solution. In each period, the central bank re-optimizes by choosing its policy and its
forecasts, taking the process by which the public forms its expectations as given. This process must be consistent with the policy actually conducted by the central bank.

In each period $t$, there are three predetermined variables ($\xi_t$, $\pi^P_t$, and $i^P_t$) and two non-predicted ones ($\pi_t$ and $y_t$). The central bank’s instruments in period $t$ are $i_t$, $\pi^P_{t+1}$, and $i^P_{t+1}$. In Appendix A, we explain in more detail how Söderlind’s algorithm can be applied in our case.

For our numerical simulations, we need to specify a set of plausible parameter values. We choose the parameter values used in Clarida et al. (2000), i.e. $\delta = 0.99$, $\rho = 0.9$, $\lambda = 0.3$, $\sigma = 1$. In addition, we set $a = 0.3$, which is consistent with the evidence reviewed in Cecchetti and Krause (2002). Finally, we need to discuss the likely size of $b$ and $c$. It seems improbable that the deviation costs for the forecasts will be higher than the costs of deviating from the inflation target, so values of $b$ and $c$ that are smaller than 1 seem plausible for both interest-rate and inflation projections. Thus we explore interest-rate forecasts for the range $b, c \in [0, 1]$. The variance of the shocks $\varepsilon_t$, which is denoted by $\nu^2$, is irrelevant for our welfare comparisons, so we make no assumption about its size.

### 3.1 The impact of projections on expectations

It is intriguing to study the impact of inflation and interest-rate projections on the public’s inflation and output expectations. For this purpose, we note that Söderlind’s algorithm yields a $(2 \times 3)$-Matrix $C$ that describes how the non-predetermined variables $\pi_t$ and $y_t$ depend on the state variables $\xi_t$, $\pi^P_t$, and $i^P_t$ (see Appendix A):

$$
(\pi_t, y_t)' = C (\xi_t, \pi^P_t, i^P_t)'
$$

---

7The social loss function can also be derived from microeconomic foundations (see Woodford (2002)). In this case, $a = \lambda/\theta$ would hold, where $\theta$ is the elasticity of substitution in the Dixit-Stiglitz index of aggregate demand (see Woodford (2002), p. 22). This approach tends to generate lower values for $a$. For example, a plausible value for $\theta$ is 11, which implies a mark-up of 10% over marginal costs. Consequently, $a = 0.3/11 \approx 0.03$. This lower value would not have a qualitative impact on our results.

8A detailed discussion of plausible and optimal values of $b$ is available upon request.
With the help of $E_t \xi_{t+1} = \rho \xi_t$, this equation can be used to describe expectations about inflation and output

$$\left( E_t \pi_{t+1}, E_t y_{t+1} \right)' = C \left( E_t \xi_{t+1}, E_t \pi^P_{t+1}, E_t i^P_{t+1} \right)' = C \left( \rho \xi_t, \pi^P_{t+1}, i^P_{t+1} \right)' \quad (9)$$

Thus the entries in $C$ describe how expectations about inflation and output depend on the cost-push shock and the central bank’s forecasts.

We are primarily interested in the entries of $C$ in the second and third column, which can be interpreted as the efficiency with which the central bank can influence expectations by its forecasts of inflation and the interest rate. For example, $C_{13}$, which is the third entry in the first row of $C$, describes the change in inflation expectations resulting from a one percentage point increase in the interest-rate forecast.

For $c = 0$, $i^P_t$ ceases to be a state variable, as it does not affect the central bank’s losses. Because, in line with Söderlind (1999), we consider solutions where non-predetermined variables depend only on state variables, $C_{13}$ and $C_{23}$ are zero in this case. While this follows directly from the applied equilibrium concept, it can also be verified numerically that the respective coefficients in $C$ converge to zero as $c$ becomes smaller. The observations that $C_{13} = 0$ and $C_{23} = 0$ for $c = 0$ imply that interest-rate projections cannot be used to affect the public’s expectations in this case. These considerations confirm our previous statement that our framework collapses to the scenario where the central bank publishes only an inflation forecast but no forecast about the interest rate if $c = 0$.

**Numerical Finding 1**

The entries in $C$ satisfy $C_{11} > 0$, $C_{12} > 0$, $C_{22} > 0$ for the parameters specified at the beginning of Section 3. For positive values of $c$, $C_{13} < 0$ and $C_{23} < 0$ hold in addition.

This finding is intuitive. An increase in the interest-rate forecast lowers expectations about inflation and output ($C_{13} < 0$ and $C_{23} < 0$). As the public knows that the central bank will find it costly to deviate from its forecast when $c > 0$, a higher interest-rate forecast will result in a higher interest rate, which means that output and inflation will be lower. Similarly, an increase in the inflation forecast leads to higher expectations
about inflation and output ($C_{12} > 0$ and $C_{22} > 0$). Finally, higher realizations of $\xi_t$ entail higher inflation expectations for given inflation and interest-rate forecasts ($C_{11} > 0$).

To sum up, the costs incurred by the central bank if it deviates from its announcements enable it to affect expectations about inflation and output. This effect makes it possible for the central bank to influence current output and inflation through forward guidance, which opens up the potential for forward guidance to improve welfare.

### 3.2 Impulse responses

It is instructive to study the impulse responses to a shock $\varepsilon_0 = 1$ (where $\varepsilon_t = 0, \forall t \neq 0$). We choose the parameter values introduced at the beginning of Section 3 ($\delta = 0.99$, $\rho = 0.9$, $\lambda = 0.3$, $\sigma = 1$, and $a = 0.3$). For the weight of the costs of forecast deviations, we assume $b = 0.2$ and $c = 0.2$, which implies that the inflation target is five times as important as the forecast targets. Figure 1 illustrates the dynamic evolution of inflation in three cases: no forecasts (black dotted line), inflation forecasts only (black broken line), and additional interest-rate forecasts (black solid line). The respective inflation forecasts in the second and third case are displayed as a gray broken line and a gray solid line.

In period 0, inflation forecasts are zero in both forecasting scenarios (see the gray broken line and the gray solid line) because $\varepsilon_0$ was unknown to the central bank when it announced its inflation projection in period $-1$. As a consequence, inflation in period 0 is smaller in both forecasting scenarios than in the case without announcements because the central bank attempts to align inflation with the forecast made in the previous period. In subsequent periods, inflation is also lower in both forecasting scenarios compared to the case without forecasts. This effect stems from the ability of the central bank to moderate the expectations about future inflation through the publication of forecasts. According to the New Keynesian Phillips curve, this has a moderating influence on current inflation as well. In the case where the central bank publishes an interest-rate projection over and above its inflation forecast, this additional tool
for moderating inflation expectations makes the central bank even more successful in dampening inflation, as can be confirmed by comparing the black solid line with the black broken line.

Interestingly, in both forecasting scenarios the central bank’s inflation projections may be overly optimistic compared to an optimal forecast. In Figure 1, inflation forecasts are closer than expected inflation to the inflation rate optimal in the long run, which has been normalized to zero. This is a consequence of the fact that the central bank may have an incentive to forecast low inflation rates to moderate current inflation. In the next period, the central bank is not perfectly committed to its forecast and thus chooses somewhat higher rates of inflation.

It is crucial to note that our analysis does not imply that the central bank’s inflation forecasts will be unconditionally biased in the sense that the long-run average of inflation forecasts will be lower than the long-run average of realized inflation. However, it suggests a shock-dependent bias. In particular, positive cost-push shocks in the forecasting period, indicated by above-average inflation rates, lead to systematic underprediction of future inflation. Conversely, in the presence of negative cost-push shocks and correspondingly low inflation rates, our model entails that the central bank overpredicts inflation. A careful empirical analysis of this bias is beyond the scope of this paper. Nevertheless it is interesting to note that the Reserve Bank of New Zealand, which was a pioneer of the inflation-targeting strategy, has identified a downward bias in its projections from 1994-2002 for the one-year horizon.9 At the same time, average inflation (2%) was higher than the mid of the target band (0% to 3%). This anecdotal evidence is at least not inconsistent with the existence of a shock-dependent bias.

Next we examine the consequences of forecasts for output. As can be seen from Figure 2, output in period zero is clearly lower under inflation forecasts only (broken line) than it is in the case with no forecasts (dotted line). This follows from the observation that the central bank could not incorporate information about the shock $\epsilon_0$ into the forecast announced in period $-1$. Hence the central bank loses some of its flexibility in

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stabilizing the cost-push shock in period 0, which results in a major output deviation from target. In subsequent periods, this disadvantage disappears because the central bank forecasts the size of the shock correctly: \( \xi_t = \rho t \varepsilon_0 = \rho t, \forall t > 0 \). Nevertheless, output is somewhat lower in the scenario with inflation forecasts than in the case without forward guidance. In the scenario in which interest-rate forecasts are announced on top of inflation forecasts, the additional flexibility granted by interest-rate forecasts enables the central bank to lower deviations of output from its target in the initial period. However, in (most) future periods the increased efficiency in stabilizing inflation involves a loss in terms of output, as can be seen by comparing the solid line with the broken line in Figure 2.

### 3.3 Social value of publishing interest-rate forecasts

Finally, we examine whether welfare can be enhanced if the central bank announces projections of interest rates in tandem with its inflation forecasts. As a first step, we investigate how additional interest-rate forecasts affect the variance of inflation. In the previous subsection, we gave an example illustrating that the variance of inflation may decline due to additional interest-rate forecasts (see Figure 1). Interestingly, this pattern holds more generally, as can be shown numerically. For all parameters specified at the beginning of Section 3, the variance of inflation will be lower if the central bank complements its inflation forecasts with interest-rate projections. This is a consequence of our previous observation that interest-rate forecasts are a tool that the central bank can use to influence inflation expectations. For instance, interest-rate projections in addition to inflation forecasts allow to reduce inflation expectations and thus current inflation more effectively when the economy is hit by a positive cost-push shock.

According to numerical computations, additional interest-rate forecasts may have a moderately adverse impact on output variance if \( c > b \). To examine the aggregate consequences for welfare, we plot the welfare gains created by the additional publication of interest-rate forecasts as a function of \( b \) and \( c \) in Figure 3, which reveals that interest-rate projections are socially desirable. Hence the socially beneficial effect of interest-
rate projections on inflation variance is stronger than the potentially harmful effect on output variance.

4 Conclusions

We have shown that the publication of projections about future interest rates enables the central bank to affect expectations about inflation and output in an intuitive way. An increase in the interest-rate projection causes the public to expect a more contractionary policy in the future, thus reducing the public’s expectations about both inflation and output.

With regard to welfare, the release of interest-rate projections in addition to inflation forecasts has benign consequences for inflation variance but may be moderately harmful with respect to the variance of output. On balance, complementing inflation forecasts with interest-rate forecasts is plausible to increase welfare.

We could extend our model by incorporating demand shocks. These shocks would involve a disadvantage militating against the announcement of future interest rates, as future demand shocks cannot be perfectly known at the date when the interest-rate projections are made. Later, the costs from forecast deviations would result in insufficient stabilization of demand shocks and thus higher output variability. Hence whether the announcement of future interest rates is desirable depends on the nature of shocks.
A Computation of Discretionary Solution

Analogously to Söderlind (1999), we introduce $x_t := (\xi_t, \pi_t^P, i_t^P, \pi_t, y_t)'$ and define $x_{1t}$ as the column vector comprising the first three elements of $x_t$ and $x_{2t}$ as the column vector comprising the fourth and fifth entry of $x_t$. Accordingly, $x_{1t}$ contains the predetermined variables and $x_{2t}$ the non-predetermined ones. The policy instruments are subsumed in $u_t := (i_t, \pi_{t+1}^P, i_{t+1}^P)'$.

The evolution of $x_t$ can be written as

$$
\begin{pmatrix}
  x_{1t+1} \\
  \mathbb{E}_t x_{2t+1}
\end{pmatrix} = A \begin{pmatrix}
  x_{1t} \\
  x_{2t}
\end{pmatrix} + Bu_t + (\varepsilon_{t+1}, 0, 0, 0, 0)' ,
$$

where

$$
A := \begin{pmatrix}
  \rho & 0 & 0 & 0 & 0 \\
  0 & 0 & 0 & 0 & 0 \\
  0 & 0 & 0 & 0 & 0 \\
  -\frac{1}{\delta} & 0 & 0 & \frac{1}{\delta} & -\frac{\lambda}{\delta} \\
  \frac{\sigma}{\delta} & 0 & 0 & -\frac{\sigma}{\delta} & 1 + \frac{\sigma \lambda}{\delta}
\end{pmatrix}
$$

and

$$
B := \begin{pmatrix}
  0 & 0 & 0 \\
  0 & 1 & 0 \\
  0 & 0 & 1 \\
  0 & 0 & 0 \\
  \sigma & 0 & 0
\end{pmatrix} .
$$

The central bank’s loss function, which is $l_t^{CB} = \pi_t^2 + ay_t^2 + b (\pi_t - \pi_t^P)^2 + c (i_t - i_t^P)^2$, can also be written as

$$
l_t^{CB} = x_t' Q x_t + 2 x_t' U u_t + u_t' R u_t
$$

with

$$
Q := \begin{pmatrix}
  0 & 0 & 0 & 0 & 0 \\
  0 & b & 0 & -b & 0 \\
  0 & 0 & c & 0 & 0 \\
  0 & -b & 0 & 1 + b & 0 \\
  0 & 0 & 0 & 0 & a
\end{pmatrix} ,
$$

$$
U := \begin{pmatrix}
  0 & 0 & 0 \\
  0 & 0 & 0 \\
  -c & 0 & 0 \\
  0 & 0 & 0 \\
  0 & 0 & 0
\end{pmatrix} ,
$$

and

$$
R := \begin{pmatrix}
  c & 0 & 0 \\
  0 & 0 & 0 \\
  0 & 0 & 0
\end{pmatrix} .
$$

The central bank re-optimizes in each period $t$ by choosing $u_t$, taking the expectation formation process as given, which in turn must be consistent with the central bank’s policy. The solution in period $t + 1$ yields a value function that is quadratic in the predetermined variables $x_{1t+1}$ and a linear relationship between $x_{2t+1}$ and the predetermined variables $x_{1t+1}$, which can be stated as $x_{2t+1} = C_{t+1} x_{1t+1}$, where $C_{t+1}$ is a $(2 \times 3)$-Matrix. As the expectations private agents form in period $t$ must be consistent with $x_{2t+1} = C_{t+1} x_{1t+1}$, we obtain $\mathbb{E}_t x_{2t+1} = C_{t+1} \mathbb{E}_t x_{1t+1}$. The central bank’s
optimization problem is given by the Bellman equation:

\[ x'_{1t}V_{1t} + v_t = \min_{u_t} \left\{ x'_t Q x_t + 2 x'_t U u_t + u'_t R u_t + \delta \mathbb{E}_t \left[ x'_{1t+1} V_{1t+1} + v_{t+1} \right] \right\} \]

s.t. \( \mathbb{E} x_{2t+1} = C_{t+1} \mathbb{E} x_{1t+1}, \) Eq. (10) and \( x_{1t} \) given. 

(14)

This optimization problem can be solved recursively by the procedure introduced in Backus and Driffield (1986) and Oudiz and Sachs (1985) and implemented in matlab by Söderlind (1999). We apply these matlab routines.
References


Figure 1: Inflation and inflation forecasts over time following a shock $\varepsilon_0 = 1$. Three scenarios are considered: no forecasts, inflation forecasts only, and interest-rate forecasts in addition to inflation forecasts.
Figure 2: Output over time following a shock $\varepsilon_0 = 1$ for three scenarios: no forecasts (dotted line), inflation forecasts only (broken line), and additional interest-rate forecasts (solid line).
Figure 3: Welfare gains created by the publication of interest-rate forecasts, given that
the central bank releases inflation forecasts, as a fraction of the welfare gains that
could be reached by perfect commitment (in percent). Parameters: $\delta = 0.99$, $\rho = 0.9$,
$\lambda = 0.3$, $\sigma = 1$, $a = 0.3$. 