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Announcements, Inflation Targeting and Central Bank Incentives

By Carl E. Walsh

University of California, Santa Cruz, and Federal Reserve Bank of San Francisco

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This paper studies the incentives a central bank faces in announcing inflation targets when the central bank has private information about the economy and the public is uncertain about the central bank's preferences. Targeting rules in the absence of announcements reduce the inflationary bias of discretionary policy, but they distort the central bank's response to private information about the economy. This distortion is eliminated when the central bank is allowed to announce the inflation target. Announcements also affect credibility, although the way they do so depends on the exact definition of credibility that is employed.

Introduction

In standard models of monetary policy in which dynamic inconsistency plays a prominent role, announcements from the central bank about its policy intentions are not believable; the central bank has an incentive to lie. Yet central banks often do make announcements, and they are legally required to do so in some cases. The Bank of England, for example, must issue periodic inflation reports. The chairman of the Federal Reserve is required by the Humphrey–Hawkins Act to testify before Congress twice each year to explain the Fed's policy actions and to detail the Fed's outlook for future economic developments. Similarly, the Reserve Bank of New Zealand is required under the Reserve Bank Act of 1989 to publish policy statements that spell out its plans; the January 1994 legislation governing the Banque de France requires its governor to appear before Parliament; and the European Central Bank must, under the Maastricht Treaty, report at least annually to the European Parliament. If public statements about policy intentions are not credible, the question naturally arises as to why central banks are frequently required to make them.

The answer, of course, is that announcements do provide the public with some information. Given the growing interest in policy transparency, particularly among those central banks that have adopted some form of inflation targeting, it is perhaps surprising that there has been relatively little explicit analysis of how inflation targeting requirements might combine with reporting requirements to influence the informational content of announcements, the conduct of stabilization policies and the central bank's credibility. The purpose of this paper is to analyse the way inflation targeting affects the incentives the central bank faces in announcing targets when the central bank has private information about the economy and the public is uncertain about the central bank's preferences.

Inflation targeting has seen increased popularity in recent years, but a fixed target for inflation is generally suboptimal in the face of supply shocks, while state-contingent targets are viewed as not feasible. An important result of this paper is that allowing the central bank to announce its own inflation target

can produce an optimal policy response to new information even though the announcement does not fully reveal the central bank's private information.

Announcements by the central bank have the potential to influence private-sector expectations, and this does seem to be recognized by central banks. The testimony of the chairman of the Federal Reserve before Congress focuses on the Fed's view of the economy, likely shifts in velocity and short-term policy objectives, all of which seems consistent with the idea that the Fed tries to convey through its announcements information about its view of the economy and about its own policy objectives. This introduces a strategic aspect to the central bank's decisions about what to announce, but the ability of a central bank to convey credibly its private information about the economy may be limited by the public's uncertainty about the central bank's true policy objectives.

Situations in which the central bank has private information have previously been studied extensively. Backus and Driffill (1985a, b), Cukierman and Meltzer (1986), Vickers (1986) and Cukierman and Liviatan (1991) were among the first to study models in which the public is uncertain about the central bank's 'type', usually identified either as its preference between output and inflation stabilization or its ability to commit. In these models, the public must attempt to infer the central bank's type from its policy actions, and equilibria in which central banks may deviate from one-shot optimal policies in order to develop reputations have been studied. These models emphasize the informational content of the central bank's actions, since any announcement by the policy-maker about her type would not be credible. More recently, Muscatelli (1996, 1998), Nolan and Schaling (1996), Briault *et al.* (1997), Beetsma and Jensen (1998), and Schaling *et al.* (1998) focus on the role of the degree of conservativeness, non-state-contingent inflation targets, and comparisons between inflation targets and inflation contracts when the central bank's preferences are uncertain.[1]

Andersen (1989) analyses announcements when the central bank's type is unknown and develops conditions under which expectations can be based on the central bank's announcements and not just on its actions. In Andersen's model, there are only two possible central bank types, and he does not deal with the role that targeting requirements might play in affecting the credibility of announcements. Cukierman (1992, ch. 14) also allows the central bank to make announcements that may partially reveal its type to the public. However, he does not analyse the strategic aspect of the central bank's decision about what to announce, assuming instead that the announcement is a noisy signal of the central bank's true policy plans.[2]

Canzoneri (1985), Persson and Tabellini (1993) and Walsh (1995a), among others, examine situations in which the central bank has private information about the state of the economy. Persson and Tabellini (1993) show how an optimal central bank contract based on the central bank's announcement can be used to induce the central bank to follow the optimal commitment policy. However, Persson and Tabellini consider only the case in which there is uncertainty about the state of the economy and not when there is uncertainty about the central bank's preferences. The credibility of a central bank's announcements about the economy, however, may be significantly influenced by the public's uncertainty about the central bank's true preferences.

This paper extends previous work on central bank announcements by analysing the situation in which the central bank is penalized for target deviations but can reveal its information about the economy by the target it announces. As Persson and Tabellini stress, announcements can convey information and constrain the central bank's subsequent behaviour. If the central bank is evaluated on the basis of an inflation targeting rule, then, by announcing a target inflation rate, the central bank is both revealing information and influencing the benchmark against which its performance may be evaluated. A central bank planning to generate a surprise inflation might wish to announce a low target inflation rate in order to reduce the expected rate of inflation; but, if it is then evaluated based on its ability to achieve its announced target, it will not wish to announce a value that is too low.

Muscatelli (1998) provides the closest analysis to the present paper.[3] He examines the role of an inflation target announced by the central bank when the public is uncertain of the central bank's type preferences in a framework similar to the one employed here. The major difference is in the nature of the alternative regimes that are compared. He uses as a benchmark the case in which a target inflation rate is set below the socially optimal rate, as Muscatelli (1996) and Svensson (1997) have shown will mimic the type of linear inflation contract studied in Walsh (1995a). I compare a general non-state-contingent target to a central bank announced target. As discussed below, this difference highlights alternative aspects of the role of announcements and reflects a focus in this paper on the effect of announcements and inflation targeting on credibility.

While targeting rules in the absence of announcements do reduce the inflationary bias of discretionary policy, they do so at the cost of distorting the central bank's response to its private information about the economy. A key result of this paper is that this distortion is eliminated when the central bank is allowed to announce a target for the inflation rate. Even though the central bank will not truthfully reveal its private information, the announcement leads to an optimal response to private information and reduces the average inflation bias relative to targeting without announcements. This result is of interest since the need for state-contingent inflation targets is well known, but equally well recognized are the difficulties involved in implementing such policies. In the framework used here, a state-contingent targeting rule is implemented simply by letting the central bank announce its own target for the inflation rate. Announcements also affect credibility, although the way they do so depends on the exact definition of credibility that is employed.

I. The Basic Model

The basic model is a variant of Cukierman and Meltzer (1986), simplified by assuming that all random elements are serially uncorrelated. Thus, the equilibrium will involve a sequence of one-shot games. Reputational considerations are also ignored.[4] These simplifications allow one to focus on the information revealed by announcements rather than on the past history of the central bank's actual actions.

As in Barro and Gordon (1983), the central bank is assumed to have as its objective the maximization of

$$(1) \qquad V = E^{cb}[s(y - y_n) - \tfrac{1}{2}(\pi - \pi^*)^2],$$

where y is (log) output, y_n is the economy's full-information level of output, π is the rate of inflation and π^* is the socially desired or optimal rate of inflation (which could be positive, negative or zero). The parameter s in the central bank's preference function is assumed to be known only to the central bank. In Cukierman and Meltzer this parameter is treated as a random variable that is serially correlated. In this case, the monetary authority's policy actions are used by the private sector to update their beliefs about the value of s. Following Garcıa de Paso (1993), let s denote the weight on output in the social objective function, and assume that the unconditional expected value of s is equal to s.

The structure of the economy is given by three equations. The first is an aggregate supply relationship in which deviations of y from y_n depend on inflation surprises, owing to the presence of nominal wage contracts, and on an aggregate supply shock ϕ:

$$(2) \qquad y = y_n + (\pi - \pi^e) + \phi.$$

In (2), π^e denotes the public's expectation; the information set on which this expectation is based is specified in more detail below, but a maintained assumption will be that ϕ is not in the public's information set. The coefficient on inflation is normalized to equal one.

The aggregate supply shock may, in the absence of any policy response, have direct effects on the aggregate price level that, in the current period, translate into effects on the inflation rate. It may not be desirable to completely offset the inflation effects of ϕ contemporaneously because of the implications for output of doing so. Thus, the optimal inflation rate is assumed to depend on the realization of the aggregate supply shock:

$$(3) \qquad \pi^* = \pi_0 + \beta\phi.$$

The third equation describing the economic environment is a simple quantity equation linking inflation to the central bank's setting of the growth rate of the money supply, m, and a velocity shock, v:

$$(4) \qquad \pi = m + v.$$

The central bank's private information about the economy will consist of its forecasts of the velocity and supply shocks, denoted v^f and ϕ^f. These can be thought of as the central bank's internal forecasts, and as such their values are unverifiable.

The socially optimal policy is given by

$$(5) \qquad m^s = \pi_0 + \beta\phi^f - v^f.$$

Money growth is set equal to the central bank's forecast of the optimal inflation rate, $\pi_0 + \beta\phi^f$, adjusted to offset fully the forecast of the velocity shock. The policy rule given by (5) maximizes the expectation of the objective function (1), subject to the constraint that the public's expectations are consistent with the policy rule.

Actual policy under discretion will depend on the timing of the sequence of moves in the strategic game involving the central bank and the public. The initial stage of the game is the contract design stage or, employing the terminology of Lohmann (1992), the institutional design stage. In this stage, any targeting or reporting requirements are determined. Then, each period nature picks a central banker. Central bankers are characterized by the weight, s, they place on the output objective in (1). Assume there is a continuum of central bankers indexed by $s > 0$ with density function $f(s)$. The realized value of s will be referred to as the central banker's type; the central banker knows its own type, but s cannot be observed by the public. Denote the variance of s around s by σ_s^2.

Once in office, the central banker observes its forecasts of velocity and the supply shock; as in Canzoneri (1985) and Garfinkel and Oh (1993), these forecasts are private and unverifiable. Having observed v^f and ϕ^f, and knowing its type s, the central bank can announce a target for the inflation rate. After the central bank makes its announcement, the public forms expectations about inflation. Given the assumed lack of serial correlation in the model, the public's information consists of the structure of the economy (equations (2)–(4)), the form of the central bank's objective function (equation (1)) and the announcement made by the central bank. Finally, given the public's expectations, the central bank sets its policy instrument m; output and inflation are then realized.

In the absence of any reporting or targeting requirements, it is straightforward to derive the equilibrium rate of money growth under discretion (see e.g. Cukierman 1992):

$$m^d = \pi_0 + \beta\phi^f - v^f + s = m^s + s > m^s. \tag{6}$$

The inflationary bias under pure discretionary policy is $s > 0$.

II. Inflation Targeting

Suppose the central bank is penalized for deviating from a preset inflation target.[5] Such a situation will be interpreted as a flexible targeting regime (Walsh 1998, ch. 8) in which the central bank is concerned with meeting its inflation target but also remains concerned with its utility function given in (1). That is, if a central bank with preferences given by equation (1) is subject to a targeting requirement, then it will act to maximize an objective function given by

$$V^T = V - \tfrac{1}{2}kE^{cb}(\pi - \pi^T)^2, \tag{7}$$

where $k > 0$ and π^T is the inflation target.[6] Two alternative arrangements for setting π^T are considered. In the first, $\pi^T = E(\pi^*) = \pi_0$; the target is simply set equal to the unconditional expectation of the socially desired inflation rate. In the second, π^T is equal to the central bank's announced target π^a. In either case, the parameter k determines the implicit penalty borne by the central bank for target deviations. A large k implies that the central bank faces a large penalty for such deviations.

Non-contingent targeting

When $\pi^T = \pi_0$, the central bank sets m to maximize (7), taking the public's expected rate of inflation as given. The first-order condition yields

$$(8) \qquad m^T(\pi_0) = \pi_0 + \frac{\beta\phi^f}{1+k} - v^f + \frac{s}{1+k},$$

where $m^T(\pi_0)$ denotes the value of m under targeting when the target inflation rate is π_0. Under this policy, actual inflation is equal to

$$(9) \qquad \pi = \pi_0 + \frac{\beta\phi^f}{1+k} + v - v^f + \frac{s}{1+k}.$$

Compared with the optimal policy given by (5), a fixed target reduces the average inflation bias from s to $s/(1+k)$, but the central bank's response to its forecast of the aggregate supply shock is distorted. The variance of $m^T(\pi_0)$ around the optimal commitment policy m^s is equal to $(s^2+\sigma_s^2)/(1+k)^2 + [k/(1+k)]^2\sigma_f^2$, where σ_f^2 is the variance of the central bank's forecast ϕ^f. Increases in k reduce deviations of $m^T(\pi_0)$ around m^s that arise from the variation in central bank preferences (the first term) but increase the deviations resulting from suboptimal responses to the central bank's forecast (the second term).

Expected social welfare under the non-state-contingent inflation targeting regime is given by

$$(10) \qquad E^T(V^*) = -\frac{1}{2}\left[\frac{\bar{s}^2+\sigma_s^2}{(1+k)^2} + \sigma_\eta^2 + \beta^2\sigma_e^2 + \frac{k^2\beta^2}{(1+k)^2}\sigma_f^2\right],$$

where σ_e^2 is the central bank's error variance in forecasting ϕ (i.e. the variance of $e \equiv \phi - \phi^f$), and σ_η^2 is the central bank's error variance in forecasting v (i.e. the variance of $\eta \equiv v - v^f$). The four terms in (10) arise from the inflation fluctuations resulting from central bank preference shifts, velocity forecast errors, supply shock forecast errors and the suboptimal response to supply shock forecasts caused by the targeting requirement when $k > 0$.

Targeting with announcements

An alternative to setting the target inflation rate equal to the unconditional expected social optimal rate is to let the central bank itself announce a target. When the central bank can set its own target inflation rate, the equilibrium announcement and setting for m are obtained by working backward from the final stage of the game. With its announcement made and the public's expectations given, the central bank's problem is to maximize

$$E^{cb}[s(m+v-\pi^e+\phi) - \tfrac{1}{2}(m+v-\pi_0-\beta\phi)^2 - \tfrac{1}{2}k(m+v-\pi^a)^2],$$

where the expectation is with respect to the joint distribution of the central bank's velocity and aggregate supply forecast errors. Solving the first-order condition for this problem yields the value of m under discretion with a

targeting rule and announcements:

$$(11) \qquad m^T(\pi^a) = \frac{\pi_0 + \beta\phi^f + s}{1+k} + \frac{k\pi^a}{1+k} - v^f.$$

Equation (11) shows that $m^T(\pi^a)$ is a weighted average of money growth under discretion $(\pi_0 + \beta\phi^f + s - v^f)$ and the value consistent with the announced target, $\pi^a - v^f$. The weights are $1/(1+k)$ and $k/(1+k)$, revealing how the announcement affects the actual policy (for $k > 0$) because of the weight given in (7) to achieving the target.

Using (5), $m^T(\pi^a)$ can also be expressed as

$$m^T(\pi^a) = m^s + \frac{s}{1+k} + \frac{k(\pi^a - \pi_0 - \beta\phi^f)}{1+k},$$

showing that $m^T(\pi^a)$ deviates from the socially optimal value under commitment, m^s, by factors that depend on the inflationary bias under discretion, s, and on any deviation between the announced target inflation rate π^a and the central bank's own forecast of the optimal inflation rate, $\pi_0 + \beta\phi^f$. If the central bank truthfully announces its forecast of π^* (i.e. $\pi^a = \pi_0 + \beta\phi^f$), then $m^T(\pi^a) = m^s + s/(1+k)$, and $m^T(\pi^a)$ differs from m^s only by $s/(1+k)$.

The public is assumed to understand the incentive structure facing the central bank, so the public knows that m will be set according to (11). However, the public observes neither the central bank's forecasts nor its type, but instead must form expectations of these based on the central bank's announcement. Given the linear-quadratic structure of the model, the public's expectation of inflation, given the central bank's announcement, can be written as

$$(12) \qquad \pi^e = A_0 + A_1\pi^a,$$

where A_0 and A_1 are constants to be determined as part of the equilibrium.[7]

The central bank's problem, at the announcement stage, is to pick π^a so as to maximize its expected utility subject to (11) and (12). That is, π^a maximizes

$$(13) \qquad E^{cb}\{s(m^T + v - A_0 - A_1\pi^a + \phi) - \tfrac{1}{2}[(m^T + v - \pi_0 - \beta\phi)^2 + k(m^T + v - \pi^a)^2]\}$$

subject to (11). Differentiating (13) with respect to π^a, and using the envelope theorem and (11), the central bank's optimal announcement is given by

$$(14) \qquad \pi^a = \pi_0 + \beta\phi^f + s\left(1 - \frac{1+k}{k}A_1\right).$$

Substituting (14) into (11) implies that the central bank sets the money growth rate equal to

$$(15) \qquad m^T(\pi^a) = \pi_0 + \beta\phi^f - v^f + s(1 - A_1) = m^s + s(1 - A_1),$$

and actual inflation will be given by

$$(16) \qquad \pi = \pi_0 + \beta\phi^f + (v - v^f) + s(1 - A_1).$$

While it still remains to determine A_1, a comparison of (15) with (8) reveals an important effect that announcements combined with targeting have on the central bank's policy choice. With a fixed inflation target, (8) showed that the central bank adjusted m only partially in response to $\beta\phi^f$, its forecast

of the change in the optimal inflation rate. When the central bank itself announces the target inflation rate, (15) shows that this distortion in the central bank's response to its information ϕ^f is eliminated. The money supply is adjusted optimally in response to this private information.

Equation (16) shows that the inflation bias will equal $s(1-A_1)$. To determine A_1, note that for the public's beliefs given by (12) to be consistent with (16), $A_0+A_1\pi^a$ must equal $E(\pi|\pi^a)$. The least-squares projection of π on π^a yields the following equation for A_1:[8]

$$(17)\qquad A_1=\frac{\beta^2\sigma_f^2+(1-A_1)(1-((1+k)/k)A_1)\,\sigma_s^2}{\beta^2\sigma_f^2+\left(1-((1+k)/k)A_1\right)^2\sigma_s^2},$$

where σ_f^2 is the variance of the central bank's forecast and σ_s^2 is the variance of the preference shock. Letting $R=\beta^2\sigma_f^2/\sigma_s^2$ and $h=(1+k)/k$, A_1 is a solution to

$$(18)\qquad f(A_1)\equiv h^2A_1^3-3hA_1^2+(2+h+R)A_1-(1+R)=0.$$

Since h and R are non-negative, any solution to $f(A_1)=0$ must be positive. Note that $f'(A_1)=3h^2A_1^2-6hA_1+(2+h+R)$; for $A_1\geq 0$, $f'(A_1)$ is minimized at $A_1=h^{-1}$ and $f'(h^{-1})=3-6+2+h+R=-1+h+R>0$ (since $h>1$). Therefore, $f'(A_1)$ is positive for all $A_1\geq 0$. Since $f(0)=-(1+R)<0$ and $f(1)=(h-1)^2>0$, the continuity of $f(\,)$ implies there exists a unique solution to (18), A_1^*, such that $0<A_1^*<1$.[9]

A_1^* will be a function of k, the weight placed on the monetary targeting deviation. A higher k, corresponding to a greater penalty for target deviations, leads to a rise in A_1^*, increasing the effect of announcements on the public's inflation expectations. Once the central bank has made an announcement, the costs of deviating from it increase with k. Thus, the public places greater weight on the announcement in forming expectations about inflation when k is large. As a result, the optimal setting for money growth declines as the weight placed on the targeting term rises, reducing the inflationary bias of discretionary policy.

The inflation bias under targeting with announcements is $s(1-A_1^*)$. The inflation bias under non-state-contingent targeting is, from (9), $s/(1+k)$. This implies that the inflation bias will be reduced when the central bank is required to announce its target if, and only if, $A_1^*>k/(1+k)=1/h$. To show that this is the case, note that, since $h>1$, $f(1/h)=R(1-h)/h<0$. With $f'(1/h)=-1+h+R>0$ and $f''(A_1)>0$ for $A_1>1/h$, it follows that $A_1^*>1/h$. Hence $s(1-A_1^*)<s/(1+k)$, and the inflationary bias is reduced when the central bank is required to announce its target inflation rate. Comparing (14) and (16) reveals that the announced inflation target will systematically understate the inflation rate the central bank expects to deliver under the targeting rule. The understatement is equal to sA_1^*/k.[10]

Letting $E^a(V)$ denote the expected social welfare under targeting with announcements,

$$(19)\qquad E^a(V)=-\tfrac{1}{2}[(\bar{s}^2+\sigma_s^2)(1-A_1)^2+\sigma_\eta^2+\beta^2\sigma_e^2].$$

It might appear from (16) that the optimal strategy for the government establishing an inflation targeting requirement for the central bank would be to let $k \to \infty$, since $\lim_{k\to\infty} A_1^* = 1$ and the average bias goes to zero. Letting k become arbitrarily large corresponds to a strict targeting rule in which the central bank's only objective is to minimize the expected value of $(\pi - \pi^a)^2$. The optimal policy for the central bank is then to set expected inflation equal to the announced target; this occurs when $m = \pi^a - v^f$. But under such a policy, the central bank's utility is $E^{cb}(v - v^f)^2 = \sigma_\eta^2$ which is independent of the actual value announced for the target. The choice of π^a by the central bank is now arbitrary, so such a policy cannot ensure that $m = \pi_0 + \beta\phi^f - v^f$. Nothing pins down the announcement.

Strict inflation targeting requires, then, that the government set the inflation target. With a government-set non-state-contingent target equal to the average socially optimal value π_0, expected social utility is

$$V^{ST} = -\tfrac{1}{2}(\beta^2\sigma_\phi^2 + \sigma_\eta^2). \tag{20}$$

Social utility depends on σ_ϕ^2 rather than on $\sigma_f^2 = \sigma_\phi^2 - \sigma_e^2 < \sigma_\phi^2$ since the central bank does not adjust money growth based on its forecast of the supply shock. Strict targeting eliminates the inflation variability arising from preference uncertainty, but it also eliminates any policy response to supply disturbances. Comparing (20) with expected social welfare with a finite value of k (given by (19)) shows that strict targeting is welfare-improving if, and only if,

$$(\bar{s}^2 + \sigma_s^2)(1 - A_1)^2 > \beta^2\sigma_f^2.$$

The right-hand side of this expression is proportional to the variance of the central bank's forecast of the supply shock and so captures the potential gain from allowing the central bank to engage in stabilization policies. The left-hand side reflects the cost of preference fluctuations that affect inflation when k is finite. Since A_1 is increasing in k, there always exists a finite k such that flexible targeting with announcements is preferred to a strict targeting regime with a non-state-contingent target.

Compared with the outcome of $\pi^T = \pi_0$ (from (9)), allowing the central bank to announce a target rate of inflation eliminates the distortion in the response to ϕ^f that would result from a fixed-target inflation rate and leads to a smaller inflation bias. Under flexible inflation targeting with an exogenously set inflation target equal to π_0, the bias is reduced relative to pure discretion, but the response to new information is distorted. This trade-off between optimally responding to new information and reducing the inflationary bias of discretion is the focus of a large literature (see e.g. Rogoff 1985, Canzoneri 1985, Lohmann 1992, Garfinkel and Oh 1993). The benefit of allowing the central bank to make an announcement is that it induces the central bank to respond optimally to its forecast of ϕ while still lowering the average inflation bias. As a result, the trade-off is eliminated. While the inflation bias is not completely eliminated, its reduction relative to the outcome under pure discretion does not come at the cost of distorting stabilization policy.[11]

The sequence of events in the preceding analysis assumed that the central bank formed its forecasts prior to making any announcements and prior to the public forming its expectations. No new information became available before the central bank set m. This sequence was designed to emphasize the

role of the central bank's announcement in conveying information and affecting expectations. More realistically, however, the central bank may obtain new information after making its announcement but prior to setting m. For example, the central bank may observe the actual aggregate supply disturbance ϕ, in which case it can condition m on ϕ rather than simply on ϕ^f. In this case, (14) continues to describe the optimal announcement by the central bank, and policy correctly adjusts m in response to ϕ^f. However, once the announcement is made, the target inflation rate is fixed and policy will incompletely respond to new information, just as occurred with a non-state-contingent target. As might be expected from the parallel with (8), the central bank adjusts m by $\beta(\phi-\phi^f)/(1+k)$ rather than by the socially optimal amount $\beta(\phi-\phi^f)$. This does not affect the relative ranking of the different policy regimes; allowing the central bank to be judged on the basis of a target inflation rate that it announces leads to a welfare gain relative to any non-state-contingent inflation target.

III. Credibility and the Value of Announcements

What is the value of having the central bank make (partially revealing) announcements? Comparing the utility under flexible inflation targeting with announcements (from (19)) to utility with a non-state-contingent target (from (10)), the gain from basing the target on the central bank's announcement relative to a non-state-contingent targeting rule is

$$E^a(V)-E^T(V)=\frac{1}{2}\left[\frac{\beta k}{1+k}\right]^2\sigma_f^2+\left[\frac{\bar{s}^2+\sigma_s^2}{(1+k)^2}\right][1-(1-A_1^*)^2(1+k)^2]>0, \tag{21}$$

where use has been made of the fact that $A_1^*>k/(1+k)$, which implies that $(1-A_1^*)(1+k)<1$.

The gain from making announcements arises from two sources. The first term in (21) arises from the central bank's ability to respond optimally to ϕ^f when it announces a target for the inflation rate. The second term in (21) arises from the reduction in the inflation bias that occurs when the announcement allows the public to improve its forecast of the central bank's true preferences.

As would be expected, the gain from basing the inflation target on the central bank's announcement is increasing in the variance of the forecastable component of aggregate supply shocks since announcing a target removes the distorted response to ϕ^f that occurs with a fixed target inflation rate. The gain from announcements is also increasing in the variance of the distribution of central bank preferences σ_s^2, since the announcement reduces the impact of s on average inflation.

While announcements allow an improvement over pure discretion and over an inflation target based on a fixed target rate, the announcement does not allow the public to infer perfectly either the central bank's type or its private information. That is, credibility is still imperfect. This raises an important question: how does inflation targeting affect the central bank's credibility?

Faust and Svensson (1998) argue that, if credibility is an assessment of the central bank made by the public, then it can only depend on the public's information set. This implies that credibility cannot depend on the central

bank's planned inflation rate. It also means that, in assessing the credibility of the central bank's announcement, credibility cannot depend on the realized rate of inflation since that is as yet unknown when the announcement is made. One measure of credibility that satisfies this informational requirement is obtained from the impact the announcement has on expected inflation. Cukierman (1992) defines this as marginal credibility. In the present model, marginal credibility is, from (12), equal to A_1^*.[12] This is the effect on expected inflation of a change in announced inflation. Increases in the variance of the central bank's forecasts (σ_f^2)[13] or decreases in the variance of the central bank's preference shocks (σ_s^2), both of which act to increase the ratio $R = \beta^2\sigma_f^2/\sigma_s^2$, serve to raise A_1^*, and raise the level of marginal credibility. Increases in the penalty for target deviations (k) also increases marginal credibility. Since the announced inflation target is decreasing in A_1^* from (14), central banks with higher marginal credibility announce lower targets (for given values of ϕ^f and s).

Faust and Svensson (1998) suggest that credibility should be measured by minus the absolute value of the difference between the expected optimal rate of inflation and the inflation rate the public actually expects the central bank to deliver. In the absence of announcements, the expected optimal rate is just $\underline{\pi}_0$. From (16), the expected inflation prior to any announcement is $\pi_0 + s(1 - A_1^*)$. Faust and Svensson's definition of credibility is then equal to $-s(1 - A_1^*)$. This measure of pre-announcement credibility is affected by the very fact that announcements will be made. In the no-announcement regime, expected inflation is just $\underline{\pi}_0 + s$, and the Faust–Svensson measure of credibility would be lower ($-s < -s(1 - A_1^*)$).

After making its announcement, expected inflation, as well as the public's expectation of optimal inflation, will change as information from the announcement is used to revise expectations about ϕ^f and s. Equations (14) and (16) can be used to find the change in the public's expectation of $\pi^* - \pi$ as a result of the announcement. This is given by

$$(22) \qquad E(\pi^* - \pi | \pi^a) - E(\pi^* - \pi) = -\left[\frac{(1 - A_1)(1 - hA_1)}{Q}\right](\pi^a - E\pi^a),$$

where $Q = R + (1 - hA_1)^2$ and $E\pi^a$ is the unconditional expectation of the central bank's announcement.[14] Let $B \equiv -[(1 - A_1)(1 - hA_1)]/Q > 0$. One measure of the impact of the announcement on credibility is B. An increase in the relative variance term R reduces B. For example, if the variance of supply shock forecasts is large relative to the variance of s around $\underline{s}$, then the announcement of a high inflation target is interpreted as most likely a result of the central bank forecasting a large ϕ. In this case, announcing a high target has less effect on the central bank's credibility than if σ_s^2 is large relative to σ_f^2.

The present model suggests an alternative definition of credibility. The objective in having the central bank announce an inflation target is to allow it to signal to the public its information on the aggregate supply shock, so a natural measure of credibility is the extent to which the announcement causes the public to alter its forecast of the socially optimal rate of inflation.

From (14),

$$E(\pi^* | \pi^a) = \pi_0 + \beta E(\phi | \pi^a) \tag{23}$$

$$= \pi_0 + \left[\frac{R}{Q}\right](\pi^a - E\pi^a).$$

Credibility is then measured by R/Q. If R is large, the public interprets the announcement as providing information mainly about ϕ^f, and announcements are credible. If $\sigma_s^2 \to 0$, then $R \to \infty$ but $R/Q \to 1$ and the central bank has complete credibility. Increased uncertainty about the central bank's preferences results in lower credibility. An increase in k, the penalty for target deviations, raises this measure of credibility.[15]

These alternative definitions of credibility point out the different ways in which inflation targeting affects the central bank's behaviour. A larger penalty on target deviations (an increase in k) increases the credibility of the announced target in the sense that the π^a has a larger impact on the public's expectations about inflation (marginal credibility, A_1^*, increases with k). With deviations from target penalized more heavily, the central bank will want to announce a target that is closer to its planned inflation rate. Consequently, inflation expectations will respond more strongly to the announcement, implying that marginal credibility rises with k. The rise in k also reduces the impact of s on the announcement. (The absolute value of the coefficient on s in (14) falls.) This means that announcements then convey relatively more information about the central bank's forecast of the aggregate supply disturbance.[16] The public's expectations about the socially optimal inflation rate respond more to the announcement, since announcements are more informative about the state of the economy.

IV. Conclusions

When the central bank has private information, it may also have an incentive to misrepresent its information to conceal the inflationary bias of discretionary policy. This incentive arises because the central bank faces an incentive structure that, from society's perspective, is suboptimal. Imposing a targeting requirement with the central bank required to announce a target inflation rate partially corrects this problem; the announcement does not fully reveal the central bank's private information, but it induces the central bank to respond optimally to new information.

The incentive to misrepresent private information is partially offset by the role the announcement plays in establishing a benchmark against which the central bank's performance will be measured. Holding the central bank accountable on the basis of its announcements serves to raise the central bank's credibility and to solve some of the difficulties associated with designing an optimal state-contingent targeting rule.

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NOTES

1. For a survey of this literature, see Cukierman (1992) or Walsh (1988, ch. 8).
2. Garcıa de Paso (1993, 1995) allows the central bank to announce a target growth rate for the money supply, but the announcement is made after the public has formed its expectations.
3. I wish to thank the referee for bringing this paper to my attention. As Muscatelli notes (see his fn. 13), our approaches are complementary since we compare alternative regimes.
4. The Cukierman–Meltzer model has also been used by Lewis (1991) and, most recently, by Faust and Svensson (1998). In Cukierman and Meltzer (1986), and in Faust and Svensson (1998), the serially correlated properties of the random variables are important in allowing private agents to learn about the central bank's preferences. Since the focus in this paper is on the informational content of announcements, shocks are assumed to be serially uncorrelated. When announcements are not fully revealing and preference shocks are serially correlated, private agents will base their expectations about the central bank's preferences on both their announcements and the past realizations of money growth and inflation.
5. For a discussion of the enforcement of such a requirement and the nature of the penalties that might be used, see Rogoff (1985), Garfinkel and Oh (1993), Persson and Tabellini (1993) and Walsh (1995a, b).
6. Rogoff (1985) analyses targeting rules by appending them to the loss function as in (7). An alternative approach to modelling inflation targets is employed by Svensson (1997) and Muscatelli (1996, 1998). They assume that the central bank's only concern with inflation is to minimize fluctuations of inflation around the target; the central bank does not care directly about the socially optimal inflation rate π^*. Ignoring irrelevant constants, this implies that the objective function of the central bank is equal to $V - b\pi$ where b is a constant whose value depends on the inflation target. In this case, an inflation target can mimic a linear inflation contract through suitable choice of b. Svensson and Muscatelli show that the target inflation rate should be set below π^*.
7. This follows Cukierman and Meltzer (1986).
8. This ignores the non-negativity constraint on the distribution of the preference parameter s. Following Cukierman and Meltzer (1986), I treat s as normally distributed with a variance around s that is sufficiently small to ensure the probability that a negative realization of s is arbitrarily small.
9. See also Cukierman (1992).
10. During the period of monetary targeting in the United States, actual money growth rates consistently overshot the Fed's announced targets; see Broaddus and Goodfriend (1984) or Walsh (1986). The conclusion that announcements will understate planned inflation is also reached by Garcıa de Paso (1993) and Cosimano and van Huyck (1993).
11. Muscatelli (1998) reaches a slightly different conclusion about the inflation bias when the central bank has goal independence and can announce its own target. He compares the outcome with announcements to the case in which the government sets a fixed inflation target that is below the average social optimum; that is, the target is set below π_0. As Svensson (1997) shows, such a target mimics an optimal linear inflation contract and eliminates the average inflation bias (see also Muscatelli 1996). In that case, as Muscatelli shows, the inflation bias is higher when the central bank announces the target, since a positive bias equal to $s(1 - A_1^*)$ remains. When the inflation bias is constant, Svensson (1997) and Muscatelli (1996) show that a flexible target regime with a fixed inflation target can mimic the optimal inflation contract, thereby also eliminating any trade-off between flexibility and bias.
12. Cukierman focuses on credibility in terms of money growth rather than inflation; in his framework, the announcement is a noisy measure of planned money growth, but he does not study the strategic aspects of the central bank's choice of what to announce.
13. Equivalently, decreases in the variance of central bank forecast errors for a given variance of the true shocks.
14. From (14), $E\pi^a$ is equal to $\pi_0 + \bar{s}(1 - hA_1^*)$.
15. An increase in k will increase R/Q if, and only if, $\partial Q/\partial k < 0$ since R is independent of k. From the definition of Q, $\partial Q/\partial k = 2(1 - hA_1^*)A_1^*(1 + \varepsilon)/k^2$ where ε is the elasticity of A_1^* with respect to h. Since $hA_1^* > 1$, $\partial Q/\partial k$ is negative if, and only if, $1 + \varepsilon > 0$. Using the definition of $f(A_1)$ in (18), $1 + \varepsilon = (1 + R - hA_1^*)/A_1^* f'(A_1^*)$; since $f' > 0$, the sign of $1 + \varepsilon$ is the same as that of $1 + R - hA_1^*$. To sign this expression, use (18) to write $1 - hA_1^*$ as equal to

$(1-h)(1+R-hA_1^*)/Q$. Since $1-hA_1^*$ and $1-h$ are both negative while Q is positive, it follows that $1+R-hA_1^*$, and therefore $1+\varepsilon$, must be positive.

16. Interpreting ϕ^f as the signal and s as the noise, the signal-to-noise ratio rises as k increases.

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