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MONETARY ANNOUNCEMENTS AND MONETARY POLICY CREDIBILITY

José I. GARCIA DE PASO*
Universidad Complutense de Madrid

This paper models a monetary policy game between the central bank and the agents in an economy in order to analyze the effects of mandatory announcements of intermediate monetary targets. The main result is that if society sets the target, the well-known inflationary bias related to discretionary monetary policy is completely eliminated. Moreover, if the central bank itself sets the target, the inflationary bias remains and money growth over-runs the announced target. This finding is consistent with the empirical evidence on monetary targeting documented by Argy, Brennan and Stevens (1990).

1. Introduction

Central banks have increasingly recognized the importance of maintaining public confidence in the commitment of monetary policymakers to controlling inflation. This recognition has resulted in part from the post-Second World War inflation in most industrial countries. As a result of this experience, economic agents had become skeptical about the ability and willingness of monetary policymakers to maintain a reasonably low rate of inflation.

Recent economic literature on «time-inconsistency» has focused on the implications of such skepticism and what can be done to keep the public's confidence in monetary policy. One conclusion of this literature is that the credibility of a central bank's commitment to price stability is undermined by public perceptions that keeping output at an unrealistically high level is an overriding goal of monetary policy[1]. Moreover, the public's fear of an inflationary policy is particularly acute if the central bank does not conduct policy according to a fixed rule but instead implements a fully discretionary policy.

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[1] It is not necessary that the central bank's lack of credibility does arise from an unrealistic output target. For instance, Waller (1987) distinguishes between fiscal

Therefore, the time-inconsistency literature's principal conclusion is that central banks tend to adopt inflationary policies unless a way can be found to limit their discretion. One proposed solution is for the central bank to adopt a fixed rule. However, a drawback of such a fixed rule is that it prevents the central bank from responding to shocks that disrupt the economy (Canzoneri, 1985). Moreover, the international experience of monetary targeting suggests that no central bank has adhered to strict rules (Argy, Brennan and Stevens, 1990). Both facts suggest an alternative line of research on flexible rules that, on the one hand, do not prevent the central bank from accommodating shocks, and on the other, that guarantee lower rates of inflation than those obtained under a fully discretionary monetary policy.

This paper analyzes the effects of an often implemented flexible rule, namely the mandatory announcement of an intermediate monetary target. The paper provides two key results. First, if the monetary target is chosen by society, the inflationary bias arising from a discretionary monetary policy can be completely eliminated. Second, if the central bank itself sets the monetary target, the inflationary bias remains and actual money growth over-runs the announced target. This finding squares well with the international experience of monetary targeting since mid-70's and constrasts with previous theoretical work on monetary targeting based on the «time-inconsistency» literature –see Cukierman and Meltzer (1986b).

The paper is organized as follows. Section 2 lays down the basic model. Section 3 presents the effects of a fully discretionary monetary policy. Section 4 introduces the mandatory announcement of a monetary target as a limit to the central bank's discretion, and compares the results obtained in two alternative scenarios: in the first, society sets the target, whereas in the second, the central bank itself sets it. Section 5 uses these results to explain some issues related to the theory and practice of monetary targeting. Finally, section 6 summarizes the main conclusions.

2. The basic model

The model used is based on the time-inconsistency literature (Kydland and Prescott, 1977; Barro and Gordon, 1983a,b; Canzoneri, 1985; Rogoff, 1985; Cukierman and Meltzer, 1986a,b).

The output supply function is given by

$$y_t = y_n + (p_t - w_t) \qquad [1]$$

and monetary authorities. If fiscal policy is dominant –i. e. if the central bank cannot influence the size of government's budget deficit– money supply becomes endogenous. If the public is no longer able or willing to absorb additional government debt, the central bank will be forced to finance the deficit by money creation.

where y_t, p_t and w_t are the logs of output, the price level, and the nominal wage, respectively; y_n is the equilibrium rate of output, corresponding to the «natural» rate of employment.

Wage setters set nominal wages in order to minimize employment (and output) deviations from its natural rate. However, the price level is not known when labor contracts are made, so the expected utility maximizing strategy for wage setters is thus:

$$w_t = p_t^e \qquad [2]$$

where p_t^e is the wage setters' expectation of the price level.

Substituting [2] into [1] one obtains:

$$y_t = y_n + (\pi_t - \pi_t^e) \qquad [3]$$

where $\pi_t = p_t - p_{t-1}$ and $\pi_t^e = p_t^e - p_{t-1}$.

Equation [3] incorporates the basic properties of an expectational Phillips curve in which only unexpected inflation creates a deviation of output from its natural rate. This is due to the existence in the economy of contracts which are not fully indexed and firms that hire workers according to their marginal productivity (Fischer, 1977).

The following money demand equation determines the equilibrium price level

$$m_t - p_t = y_n - v_t \qquad [4]$$

where m_t and v_t are the logs of the money supply and the velocity of money, respectively. The equilibrium inflation rate is obtained by taking the first difference of [4],

$$\pi_t = g_t - \delta_t \qquad [5]$$

where $\delta_t = (v_{t-1} - v_t)$ and g_t is the growth rate of the money supply, which is the central bank's monetary instrument. Assuming that v_t follows a random walk, δ_t is an independently and identically distributed random variable with zero mean and a finite variance, σ_δ^2. When wages are set, δ_t is not known.

After period-t wages are set, the central bank chooses its policy variable, g_t. In contrast to wage setters, the central bank receives a signal about the disturbance to money demand (δ_t) after wages are set but before policy actions are taken. Specifically, the central bank has a private forecast, e_t, of δ_t when it conducts monetary policy. Such a forecast has a white noise error, ε_t, with finite variance, σ_ε^2, and is uncorrelated with e_t. Hence,

$$\delta_t = e_t + \varepsilon_t, \qquad [6]$$

and $\sigma_\delta^2 = \sigma_e^2 + \sigma_\varepsilon^2 s$.

The model assumes that society as a whole has two goals: high output and an optimal inflation rate. This is reflected in the following social welfare function

$$W_t = z^*(y_t - y_n) - 1/2(\pi_t - \pi^*)^2, \qquad z^* > 0 \qquad [7]$$

The first term in this function indicates that society wants a level of output higher than the natural one (y_n) because of the existence of tax (Barro and Gordon, 1983a) or labor (Canzoneri, 1985) distortions. The second term penalizes deviations from the optimal rate of inflation, π^* [2]. Finally, the parameter z^* is society's marginal rate of substitution between output and inflation. The larger z^*, the more society as a whole cares about output relative to inflation.

Monetary policy is conducted by a particular economic agent –the central bank– whose utility function may differ from the social one. As a matter of fact, there exists a political approach to central bank behavior stressing that monetary policy is not divorced from the political process. Specifically, this approach suggests that monetary policy is affected by institutions, private interest groups, and the legislative and executive branches of government, who respond to organized sectoral pressures and bureaucratic bodies' self-interest (Cukierman, 1986; Havrilesky, 1990). This political theory of monetary policy is motivated by the idea that money growth may be erratic because the formation of effective coalitions determined to change the course of monetary policy is subject to large stochastic elements. As a result, only the central bank knows each period the current compromise that it strikes between advocates of economic stimulation and advocates of price stability. I formalize this notion by modelling an objective function similar to the social one in which the central bank's marginal preference for economic stimulation versus inflation prevention is a random variable (z_t) that varies over time around z^*. Specifically,

$$z_t = z^* + n_t \qquad [8]$$

where n_t is a random variable independently and identically distributed with zero mean, finite variance σ_n^2 and bounded in the interval $(-z^*, \infty)$. Hence, z_t is bounded in the open interval $(0,\infty)$ with $E(z_t) = z^*$, and $E(z_t - z^*)^2 = \sigma_n^2$.

Hence, the central bank's objective function is given by

$$U_t = z_t(y_t - y_n) - 1/2(\pi_t - \pi^*)^2 \qquad [9]$$

[2] The literature on the optimal rate of inflation is a large one. For two comprehensive surveys of this literature, see McCallum (1990) and Woodford (1990). The analysis in our model relies upon the plausible assumption that deviations of inflation from the optimal rate are increasingly costly at the margin. Use of the squared deviation is designed to reflect that condition in a tractable manner.

3. Discretionary scenario

In this scenario, the central bank will choose the rate of growth of the money supply in order to maximize the expected value of [9]. The solution can be found by working backwards through the sequence of decisions that the players of the game have to make. The problem the central bank faces each period is

$$\underset{g_t}{\text{Max}}\ EU_t = E\left[z_t(y_t - y_n) - 1/2(\pi_t - \pi^*)^2\right] \quad [10]$$

Using [3] and [5], [10] can be expressed as

$$\underset{g_t}{\text{Max}}\ EU_t = E\left[z_t(g_t - \delta_t - \pi_t^e) - 1/2(g_t - \delta_t - \pi^*)^2\right] \quad [11]$$

The first-order condition (FOC) is

$$E(z_t) - E(g_t - \delta_t - \pi^*) = 0 \quad [12]$$

Since the information set of the central bank when it chooses the money supply implies $E(\delta_t) = e_t$ and $E(z_t) = z_t$, the FOC can be rearranged to obtain

$$g_t = \pi^* + z_t + e_t \quad [13]$$

Since the information set of the wage setters when they form their inflationary expectations implies $E(\delta_t) = E(e_t) = 0$ and $E(z_t) = z^*$, their utility maximizing action is given by

$$\pi_t^e = E[g_t - \delta_t] = \pi^* + z^* \quad [14]$$

Using [13] and [14], one obtains

$$\pi_t = \pi^* + z_t - \varepsilon_t \quad [15]$$

$$y_t = y_n + n_t - \varepsilon_t \quad [16]$$

$$EW_t = -1/2(z^{*2} + \sigma_n^2 + \sigma_\varepsilon^2) \quad [17]$$

Expression [14] shows the existence of an «intrinsic inflationary bias» (z^*) that coincides with the social marginal rate of substitution between output and inflation. The inflationary bias arises because the monetary authority has an incentive to stimulate the economy in order to raise output above its natural level. As the wage setters recognize this incentive, they rationally expect an inflation rate higher than the optimal one; this forces the central bank actually to inflate by raising monetary growth in order to maintain output at its natural level. The inflation rate is also affected (positive or negatively) by unpredictable shocks is money demand (ε_t). These shocks are not observed by wage setters when they set w_t and therefore they affect output. It should be noted that the central bank fully accommodates predictable money demand disturbances (e_t).

As the central bank's preferences –resulting from the political process– are private information, there is room for the monetary authority to surprise the wage setters: if z_t is lower than z^* ($n_t < 0$), average output is below the natural rate (the opposite holds if z_t exceeds z^*). Henceforth we will refer to the difference ($z_t - z^*$) as the «political bias».

The expected social welfare has three terms: the term related to the intrinsic inflationary bias ($-1/2\ z^{*2}$), the term related to the political bias ($-1/2\ \sigma_n^2$), and the term associated with unpredictable shocks ($-1/2\ \sigma_\varepsilon^2$).

4. Mandatory announcements of monetary targets

Assume, as in Persson and Tabellini (1993), that society and the central bank agree on an explicit or implicit performance-based contract. Specifically, assume that some sanction is imposed on the central bank for missing a prespecified and publicly announced money growth target. Such a sanction could be interpreted literally, as a monetary penalty imposed upon the central bank board or related to the central bank budget. However, it could be interpreted more loosely as involving the central bank prestige as an institution, or the reputation of the individuals with the highest responsibility in that institution. The existence of this type of contract implies a modification in the central bank's objetive function. Now, this function will weigh not only output and inflation, but also deviations between money growth and the announced target. That is, the central bank's new objective function will be

$$U_t = z_t(y_t - y_n) - 1/2(\pi_t - \pi^*)^2 - 1/2\ h(g_t - g^a)^2,\ h > 0 \qquad [18]$$

The parameter h indicates the punishment specified by the contract and imposed on the central bank if the monetary target is not met. A higher h implies that the negative consequences for the central bank from a deviation between the announced target and the actual rate of growth of the money stock are more important. The value of h is common knowledge.

In theory, there may exist several types of monetary announcements, depending on which economic agent sets the monetary target, though just one type has been implemented in practice. Here we study two different types:

1. Society itself (for instance, through the legislative branch of government) sets the monetary target and then such a target is assumed by the central bank. This type has not been implemented in practice and hereafter we will refer to it as the «social setting» scenario.

2. The central bank sets its own target and publicly announces it. Hereafter we will refer to it as the «central bank's setting» scenario. This type has been implemented in practice.

As monetary announcements are made in advance, the information about the shocks affecting the economy that is available to the central bank differs between the time the announcement is publicized and the time the central bank takes the monetary policy decision. Specifically, at the announcement stage there is no information about velocity shocks, whereas at the time the money supply is increased the central bank has already observed a signal of those shocks.

4.1. *Social setting*

In this scenario the sequence of events is as follows:

a) Society sets a money growth target (g^a) for the central bank.

b) Wage setters from π_t^e on the basis of their knowledge of g^a.

c) The central bank sets money supply growth in order to maximize its expected utility (EU_t) on the basis of its knowledge of g^a and π_t^e, and of its private signal on the velocity shock (e_t).

As before, the solution is found by working backwards. The problem the central bank faces is

$$\underset{g_t}{\text{Max}}\ EU_t = E\left[z_t(y_t - y_n) - 1/2(\pi_t - \pi^*)^2 - 1/2\ h(g_t - g^a)^2\right] \quad [19]$$

The FOC is

$$E(z_t) - E(g_t - \delta_t - \pi^*) - hE(g_t - g^a) = 0 \quad [20]$$

Rearranging, one obtains

$$g_t = \frac{1}{1 + h}\left[\pi^* + z_t + e_t + hg^a\right] \quad [21]$$

As a consequence, inflation is given by

$$\pi_t = \frac{1}{1 + h}\left[\pi^* + z_t + hg^a - he_t\right] - \varepsilon_t \quad [22]$$

Therefore, the wage setters expect

$$\pi_t^e = \frac{1}{1 + h}\left[\pi^* + z^* + hg^a\right] \quad [23]$$

and output is

$$y_t = y_n + \frac{1}{1 + h}\left[n_t - he_t\right] - \varepsilon_t \quad [24]$$

The problem that society must solve in order to set the money target is

$$\underset{g^a}{\text{Max}}\ EW_t = E\left[z^*(y_t - y_n) - 1/2(\pi_t - \pi^*)^2\right] \quad [25]$$

The FOC is

$$E\left[\frac{1}{1+h}\left[-h\pi^* + z_t + e_t + hg^a\right] - \delta_t\right] = 0 \qquad [26]$$

Since the information set of society when it sets the target g^a implies $E(\delta_t) = E(e_t) = 0$, and $E(z_t) = z^*$, we obtain

$$g^a = \pi^* - z^*/h \qquad [27]$$

Hence we get the following solution

$$g_t = \pi^* + \frac{1}{1+h}\left[n_t + e_t\right] \qquad [28]$$

$$\pi_t = \pi^* + \frac{1}{1+h}\left[n_t - he_t\right] - \varepsilon_t \qquad [29]$$

$$\pi_t^e = \pi^* \qquad [30]$$

$$y_t = y_n + \frac{1}{1+h}\left[n_t - he_t\right] - \varepsilon_t \qquad [31]$$

$$EW_t = -\frac{1}{2}\left\{\frac{\sigma_n^2}{(1+h)^2} + \frac{h^2\sigma_e^2}{(1+h)^2} + \sigma_\epsilon^2\right\} \qquad [32]$$

Several conclusions follow from equations [28] to [32]:

1) The intrinsic inflationary bias completely disappears, contrary to the result obtained in a fully discretionary scenario. This can be seen by comparing [30] and [14]. In the discretionary scenario the wage setters recognize the natural tendency the monetary authority has to surprise them. Hence, they offset this incentive by rationally expecting a high enough inflation. Now, the central bank has an additional restriction (the announcement) and the wage setters –knowing this– generate their inflation expectation taking the announcement into account (see [23]).

Nevertheless, they maintain an inflationary bias in their expectation, although somewhat reduced because of the existence of the announcement. This new inflationary bias is given by the term $(z^*/1+h)$ in [23].

Now, our game has three players and the third one, society, –rationally taking into account the strategies to be followed by the other two players-recognizes that if inflation expectations are not lessened, social welfare will be lower. Thus, the announcement that society sets is deflationary enough so that expectations are equal to the optimal inflation rate.

2) The higher the social preference for output (z^*) and the lower the punishment for deviations from the target (h), the stronger the deflationary bias of the announcement (given by z^*/h). The reason is that in both cases

the central bank's «desire» for surprise inflation is higher and therefore it is necessary to compensate it more strongly via the announcement.

3) However, if the political process produces a z_t higher than z^*, a political inflationary bias is found even in the social setting scenario.[3]

4) Moreover, there exists another random effect arising from the central bank's partial accommodation of its private forecast e_t. This partial stabilization occurs because accommodating a money demand shock generates a higher deviation between g_t and g^a, so that the central bank's utility lowers. This result is interesting because it stresses a weakness of monetary targeting, namely that an anticipated money demand shock (observed only by the central bank) affects both output and inflation.

4.2. *Central bank's setting*

The sequence of events is:

a) The central bank sets and publicly announces the target g^a.

b) The wage setters form π_t^e on the basis of their knowledge of g^a.

c) The central bank sets money supply growth in order to maximize its expected utility (EU_t) on the basis of its knowledge of g^a and π_t^e, and of its private signal on the velocity shock (e_t).

We obtain the solution by working backwards. The money supply growth chosen by the central bank is given by [21]. Taking this fact into account, the expected inflation rate chosen by the wage setters is given by [23]. The next problem that the central bank faces is to choose the monetary announcement:

$$\underset{g^a}{\text{Max}}\ EU_t = E\left[z_t(y_t - y_n) - 1/2(\pi_t - \pi^*)^2 - 1/2\ h(g_t - g^a)^2\right] \qquad [33]$$

The FOC is

$$E\left[\frac{1}{1+h}[-h\pi^* + z_t + e_t + hg^a] - \delta_t\right] - E\left[\frac{1}{1+h}[\pi^* + z_t + e_t - g^a] = 0\right] \qquad [34]$$

Using the information set of the central bank at the time it chooses the announcement and rearranging, one obtains

$$g^a = \pi^* \qquad [35]$$

$$g_t = \pi^* + \frac{1}{1+h}\ [z_t + e_t] \qquad [36]$$

[3] Notice that the complete elimination of the intrinsic inflationary bias does not depend on the divergence between z_t and z^*.

$$\pi_t = \pi^* + \frac{1}{1+h}[z_t - he_t] - \varepsilon_t \qquad [37]$$

$$\pi_t^e = \pi^* + z^*/1+h \qquad [38]$$

$$y_t = y_n + \frac{1}{1+h}[n_t - he_t] - \varepsilon_t \qquad [39]$$

$$EW_t = -\frac{1}{2}\left\{\frac{\sigma_n^2 + z^{*2}}{(1+h)^2} + \frac{h^2\sigma_e^2}{(1+h)^2} + \sigma_\varepsilon^2\right\} \qquad [40]$$

In this scenario the central bank itself sets the monetary target. At that stage, it does not know how the political process will affect its preferences about the trade-off between output and inflation (i.e., the value of z_t). Moreover, it has no information about the future shocks in velocity. Due to the central bank's lack of informational advantage at the announcement stage and to its desire of eliminating the inflationary bias in wage setters' expectations, the announcement set by the central bank is equal to π^*.

It can be observed in this scenario that an intrinsic inflationary bias does exist ($z^*/1+h$), although it is lower than that in the discretionary scenario; such a bias is lower the higher the punishment the central bank faces if the target is not met. Moreover, there will be a positive surprise and a level of output higher than the natural one if the political bias (n_t) is positive; just the opposite will occur if the political bias is negative.

At the same time, it is not optimal for the central bank to fully accommodate its private signal e_t, so that there will be an additional effect that will affect output and inflation.

4.3. A comparison of the results

In order to compare the previous results I will label *D* the discretionary scenario, *S* the social setting announcement, and *B* the central bank's setting announcement. Table 1 then summarizes the results obtained.

The expected social welfare under each scenario can be rewritten as

$$EWD_t = -1/2\,(z^{*2} + \sigma_n^2 + \sigma_\varepsilon^2)$$

$$EWS_t = EWD_t + 1/2\, z^{*2} + 1/2\left[1 - \frac{1}{(1+h)^2}\right]\sigma_n^2 - 1/2\frac{h^2\sigma_e^2}{(1+h)^2}$$

$$EWB_t = EWS_t - 1/2\,(z^*/1+h)^2$$

The differences between scenarios *D* and *S* are, to a certain extent, the differences between rules and discretion; the principal advantage of discretion is that it permits the central bank to fully accommodate the money demand shocks; its drawback is the existence of intrinsic and political biases. On the contrary, a flexible rule as the social setting of the monetary target fully eliminates the intrinsic bias (a very important result) and lessens the political bias, at the expense of creating an unavoidable random bias.

TABLE 1

	Scenario D	Scenario S	Scenario B
g^a	–	$\pi^* - z^*/h$	π^*
g_t	$\pi^* + e_t + z_t$	$\pi^* + \frac{n_t}{1+h} + \frac{e_t}{1+h}$	$\pi^* + \frac{z_t}{1+h} + \frac{e_t}{1+h}$
π_t	$\pi^* - e_t + z_t$	$\pi^* + \frac{n_t}{1+h} - \frac{he_t}{1+h} - \varepsilon_t$	$\pi^* + \frac{z_t}{1+h} - \frac{he_t}{1+h} - \varepsilon_t$
π_t^e	$\pi^* + z^*$	π^*	$\pi^* + z^*/1+h$
y_t	$y_n + n_t - \varepsilon_t$	$y_n + \frac{n_t}{1+h} - \frac{he_t}{1+h} - \varepsilon_t$	$y_n + \frac{n_t}{1+h} - \frac{he_t}{1+h} - \varepsilon_t$
EW_t	$-\frac{1}{2}(z^{*2} + \sigma_n^2 + \sigma_\varepsilon^2)$	$-\frac{1}{2}\left\{\frac{\sigma_n^2}{(1+h)^2} + \frac{h^2\sigma_e^2}{(1+h)^2} + \sigma_\varepsilon^2\right\}$	$-\frac{1}{2}\left\{\frac{\sigma_n^2+z^{*2}}{(1+h)^2} + \frac{h^2\sigma_e^2}{(1+h)^2} + \sigma_\varepsilon^2\right\}$

Hence, the higher the social preferences for output (z^*) and the variance in the central bank's preferences (σ_n^2), and the lower the variance of the forecasted shocks in money demand (σ_e^2), the higher social welfare generated by the social setting of a monetary target with respect to a discretionary monetary policy.

In fact, it is easy to show that there is an «optimal» –from a social viewpoint– central bank punishment for deviations from the target. This optimal penalty (h^*) under a social setting scenario is found by maximizing EWS_t with respect to h, which gives $h^* = \sigma_n^2/\sigma_e^2$. Hence a k-percent rule ($h=\infty$) is optimal when $\sigma_e^2 = 0$.

At the same time, the expected welfare provided by a social setting with an optimal punishment is higher than the one provided by the discretionary scenario. To see this, the expected social welfare with h^* is

$$EWS_t\,(h^*) = EWD_t + 1/2\ z^{*2} + 1/2\ (h^*/1+h^*)\sigma_n^2$$

Persson and Tabellini (1993) have shown that society can also improve its expected welfare upon the discretionary scenario through a performance-based contract consisting of a linear punishment (denoted by k) on the central bank for any percentage point of realized inflation[4]. In this case, the central bank's objective function is given by

$$U_t = z_t(y_t - y_n) - 1/2(\pi_t - \pi^*)^2 - k\pi_t \quad [41]$$

Maximizing this objective function one obtains

$$g_t = \pi^* + e_t + z_t - k \quad [42]$$

As a consequence, if society chooses a punishment k equal to z^*, the intrinsic inflationary bias completely disappears (a result similar to ours) and at the same time the money demand shocks are fully accommodated. Hence, the results under Persson and Tabellini's (1993) approach will be:

$$\pi_t = \pi^* + n_t - \varepsilon_t \quad [43]$$

$$\pi_t^e = \pi^* \quad [44]$$

$$y_t = y_n + n_t - \varepsilon_t \quad [45]$$

$$EW_t = -1/2(\sigma_n^2 + \sigma_\varepsilon^2) \quad [46]$$

Now, we can compare the «inflation-contract» solution to the time-inconsistency problem proposed by Persson and Tabellini (1993) and our solution based on the social setting of a monetary announcement. This is done by comparing [32] and [46]. The condition under which the social announcement solution is socially preferred to the inflation contract solution is:

$$\sigma_n^2 > \frac{h}{2+h}\sigma_e^2$$

This condition shows that the social announcement is better if the differential benefit from the announcement (lower political bias) exceeds the differential benefit from the inflation contract (full accommodation of money demand shocks). However, if there exists an optimal punishment for deviations from the target, our targeting solution is better –from a social viewpoint– than the inflation contract solution. In this case, the above condition reduces to a condition which always holds:

$$\sigma_n^2 > \frac{\sigma_n^2}{2+h^*}$$

The central bank's setting (scenario *B*) has the drawbacks of scenarios *D* and *S*, although the intrinsic bias is lessened compared to scenario *D* due to the mandatory announcement of the target. Such a reduction will be larger, the higher the punishment for deviations from the announced tar-

[4] It should be clear that this approach is not a targeting procedure because the announcements of inflation or monetary targets do not play any role. In other words, the results are the same whether or not a target exists.

get. Comparing scenarios S and B, the main result is that –if a monetary announcement is to be made– it is better from a social point of view that society itself, rather than the central bank, sets the target to be announced.

These results show that society faces a trade-off when announcements of monetary targets are to be made. Namely, the higher the punishment for deviations from the target, the lower the intrinsic and political biases, but the higher the random bias (that is, the lower the stabilizing of the economy the central bank can achieve).

5. The theory and practice of monetary targeting

5.1. Monetary targeting: outcomes versus announcements

Argy, Brennan and Stevens (1990) analyze 140 publicly announced annual targets in nine countries over the period 1975 to 1987. The main results obtained are: *a)* less than a half of these targets were achieved (where «achieving» a target is defined as any outcome within the target range, or within one percentage point of a «point» target) and *b)* the «misses» above targets were far more numerous than those on the low side (over-runs outnumbered under-runs by four to one). These authors and some others (Rojo, 1988) suggest that the answer as to why targets were not met more frequently is partly found in technical factors which distorted the demand of money, or rendered control of the money stock difficult. Argy, Brennan and Stevens consider that the other part of the answer is the way in which central banks approached targeting. For these authors, central banks have not seen monetary targets as binding rules to be achieved at all costs. Instead, central banks reserved the discretion to diverge from announced targets if their ultimate goals or other restrictions to monetary policy require it.

The model developed here provides an explanation to the usual misses above announced targets. As central banks themselves set the monetary targets to announce, the central bank's setting scenario accounts for the results documented by Argy, Brennan and Stevens[5].

Specifically, substituting [35] into [36] one obtains

$$g_t = g^a + \frac{1}{1 + h} [z^* + n_t + e_t] \qquad [47]$$

Equation [47] shows that the money stock growth rate depends on: *a)* the announced target (g^a), *b)* an intrinsic and deterministic inflationary bias ($z^*/1+h$), *c)* a random political bias ($n_t/1+h$), and *d)* a random disturbance

[5] Cukierman and Meltzer (1986b) explicitly assume that the difference between the announcement and actual money growth is a white noise innovation. Therefore, they cannot account for the misses above announcements usually observed in practice.

$(e_{t/1+h})$. Hence, in each period of time g_t may exceed g^a or viceversa. However, the expected value of g_t is greater than g^a. This explains why over-runs outnumbered under-runs in the international experience on monetary targeting.

5.2. *The instability in money demand functions*

In most industrial countries there has been a shift or weakening in the established relationship between the original monetary aggregates chosen as intermediate targets and the ultimate goals of monetary policy (through nominal income). In most cases, this instability in money demand has been interpreted as the result of financial innovations and changes in the agents' behavior following deregulation. As a consequence, there have been widespread changes in the targeted aggregate in order to reach a more stable relationship.

Because of the higher instability in money demand and of the changes in the targeted aggregates, some authors have pointed out that the central bank's commitment to monetary targets would be negatively affected so that some of the targeting output, particularly the announcement effects, could be undone (Argy, Brennan and Stevens, 1990; Englander, 1991).

Suppose that as a response to such a higher instability in money demand, the contract between society and the central bank is renegotiated, so that the new contract establishes a smaller punishment h for deviations from the target. In that case, we could explore whether such a renegotiation is welfare improving or not.

In our model, a higher instability in money demand is shown by a higher variance of δ_t which in turn is split into the variances of e_t and ε_t. A rising σ_ε^2 yields a larger random effect and, therefore, a lower social welfare. Moreover, given h, a rising σ_e^2 causes the intrinsic bias to be larger.

In these circumstances, a lower h is not necessarily undesirable from a social point of view, although it amplifies both the intrinsic and political biases.

The reason is that the random effect due to the partial accommodation of the forecasted shocks in money demand is larger the higher σ_e^2 but is smaller the lower h. As a consequence, the effects on social welfare of a rising σ_e^2 –if at the same time h is lowered– are ambiguous. We can see this if we obtain the «optimal» punishment (h*) on the central bank from a social viewpoint. To do so it is necessary to maximize EWS_t and EWB_t with respect to the parameter h.

The optimal h^* in a social setting scenario is σ_n^2/σ_e^2. This expression shows that when σ_e^2 rises, it is welfare improving to reduce the punishment for deviations from the announced target. This is so because a lower h will increase the latitude for stabilization. Moreover, the above expression shows that the higher σ_n^2, the more welfare improving –from a social viewpoint– will be a higher punishment. The reason is that a higher h prevents an excessive divergence between the economic outcomes preferred by society and the outcomes preferred by the central bank[6]. Similarly, we can explain the optimal $h^* = (z^{*2} + \sigma_n^2)/\sigma_e^2$ corresponding to the central bank's setting scenario. The only caveat here is that the existence of an intrinsic bias makes optimal to increase the punishment.

5.3. On the independence of central banks

The independence of central banks is an important issue in the light of the post-Second World War inflation bias in most industrial countries (McCallum, 1990) and the results recently obtained by some authors, who show a negative correlation between the central bank's degree of independence and inflation –see, for instance, Alesina (1989), Grilli, Masciandaro and Tabellini (1991) and De Haan and Sturm (1992).

One of the major benefits of central bank independence is that it probably weakens the influence that social and political interest groups put into monetary policy (Waller, 1989; Masciandaro, 1990).

In our model, a higher independence in this sense would yield smaller deviations between z_t and z^* (i.e., a lower variance of n_t), because the central bank will be less influenced by pressure groups. As a lower σ_n^2 creates smaller deviations between π_t and π^*, the expected social welfare rises with central bank's independence.

However, our model presents an additional device to evaluate central bank's independence, namely the identity of the agent that sets the intermediate target (society or the central bank itself). Therefore, we must compare EWS_t and EWB_t. It is clear that a higher independence in this second sense (the central bank itself sets the target) reduces social welfare.

6. Conclusions

Our model considers an economy where *a*) deviations of output from its natural level are positively related to unanticipated inflation; *b*) society as a whole has a welfare function that gives a negative weight to inflation and a positive weight to output; *c*) the monetary authority is influenced by the general political process; *d*) the central bank chooses its operational target in order to maximize its own objective function; and *e*) the wage setters understand the central bank's behavior and form their inflationary expectations accordingly. In this economy an intrinsic inflationary bias arises because the central bank is not credibly committed to a money growth rate equal to the optimal inflation rate.

[6] At first sight, it would seem that the expression for h^* should equal zero if $\sigma_n = 0$; that is, the optimal punishment ought to be zero. However, it should be noted that if $h = 0$, the monetary target is not determined because its existence would not provide any monetary discipline. In other words, if $h = 0$, our model reduces to the discretionary model. This can be seen in equation [21] which shows how if $h = 0$, g_t does not depend on g^a, and $g_t = \pi^* + z_t + e_t$. Accordingly, g^a cannot be determined.

A possible solution to this problem is for the central bank to adhere to a strict rule. However, such a strict rule does not allow the central bank to stabilize the economy. Therefore, it is convenient to study flexible rules that do not prevent the central bank from stabilizing and that provide some degree of commitment to non inflationary policies.

Along this line, we have seen that mandatory announcements of intermediate monetary targets completely eliminate the intrinsic inflationary bias if society sets the target to be announced.

Our theory of monetary targeting provides over-runs of targets as a result when the central bank itself sets the target. This theoretical finding is consistent with the empirical evidence documented by Argy, Brennan and Stevens (1990).

Moreover, if as a response to a more unstable money demand, the punishment on the central bank for deviations from the target is lowered, it does not necessarily reduce social welfare because there will be more latitude for the central bank to accommodate money demand shocks.

Finally, a more independent central bank generates a smaller political bias, so that social welfare improves. However, if more independence means that the central bank sets the targets to meet, a more independent central bank reduces social welfare.

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Resumen

En este trabajo se utiliza un juego de política monetaria entre el banco central y los agentes de una economía para analizar los efectos de anuncios formales de objetivos monetarios intermedios. El resultado principal es que si la sociedad fija el objetivo, desaparece completamente el sesgo inflacionista asociado a una política monetaria discrecional. Si el objetivo lo escoge el propio banco central, el sesgo inflacionista persiste y el objetivo monetario se desborda. Este último resultado es consistente con la evidencia empírica sobre las políticas de objetivos monetarios aportada por Argy, Brennan y Stevens (1990).

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