DOMESTIC OR EXTERNAL POLICY TARGETS? THE CASE FOR HAVING IT BOTH WAYS

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Abstract

Monetary policy making has become increasingly dominated by the use of explicit targets. Targeting has been seen as one solution to the Kydland-Precott time inconsistency problem. However, in an environment characterised by uncertainty, targets are only effective if they are credible, and the interplay between targets and reputation is therefore critical. Although early work in the 1980s discussed issues of credibility and reputation when there is uncertainty over policy maker type, few researchers have developed explicit models uncovering the relationship between credibility and reputation within a targeting environment.

Recent work by Cukierman (2000) develops a model of targeting and reputation, using a two-period policy game. However, Cukierman's research is based on a closed economy or an open economy with a flexible exchange rate regime. Many developing countries, particularly those with limited room for textbook monetary policy interventions, have chosen to implement a domestic policy target (monetary or fiscal) in tandem with an external (exchange rate) anchor. This paper extends Cukierman's model to the fixed exchange rate case, utilising insights from the first and second generation exchange rate crisis literature.

The results of the model suggest that a 'dependable' policymaker (one that is committed to implementing declared policy targets) is generally able to deliver a less inflationary policy stance in a fixed exchange rate regime than in a flexible regime. This could account for the increasing use of combined external and domestic policy targets across a diverse range of countries – including Barbados. It may well be that, in the question of domestic versus external policy targets, having it both ways really is the best policy.

[1] This paper represents the views of the author alone and does not necessarily reflect the views of the Caribbean Development Bank.

I. Introduction

Monetary policy making has become increasingly dominated by the use of explicit targets. Targeting has been seen as one solution to the Kydland-Precott time inconsistency problem. However, in an environment characterised by uncertainty, targets are only effective if they are credible, and the interplay between targets and reputation is therefore critical. Although early work in the 1980s discussed issues of credibility and reputation when there is uncertainty over policy maker type, few researchers have developed explicit models uncovering the relationship between credibility and reputation within a targeting environment.

Recent work by Cukierman (2000) develops a model of targeting and reputation, using a two-period policy game. However, Cukierman's research is based on a closed economy or an open economy with a flexible exchange rate regime. Many developing countries, particularly those with limited room for textbook monetary policy interventions, have adopted exchange rate targeting policies as a means of combating inflation, which may involve either an official peg (with or without a currency board) or an unofficial target range for the currency. In this environment, inflation is largely imported, and it is the exchange rate rather than the domestic inflation rate which is the direct concern of the policymaker. However, many countries have chosen to implement a domestic policy target (monetary or fiscal) in tandem with the external anchor. This paper offers a theoretical rationalisation of this choice.

In my model, the policy variable is assumed to represent an amalgam of the fiscal and monetary stance (the two are closely interrelated). On the one hand, unanticipated looser policy has a positive effect on output (if it is anticipated it has no effect because the private sector expect a higher probability of subsequent devaluation and inflation and/or higher taxes). On the other hand, looser policy increases the probability of devaluation, which has inflationary consequences. Policymakers announce a target for policy (such as a target for the fiscal deficit or credit growth)[2]. However, the policymaker is only committed to the target if she is of the 'dependable' type. If she is, instead, a 'weak' policymaker, she does not attempt to meet the target, but rather adopts a discretionary policy.

The choice of policy in the first period impacts on the policymaker's reputation in two ways. Firstly, as in the closed economy model, when the policy choices of the 'weak' and 'dependable' types diverge strongly, there is an increasing probability that the public will be able to discern the policymaker's type and that separation will occur in the second period. This places downwards pressure on the policy choice for both types. Secondly, the occurance of a crisis and devaluation, the probability of which is a function of policy, sends an additional signal to the public concerning the policymaker, since the crisis is more likely to occur under the 'weak' policymaker. It is the impact of this additional signal which the paper aims to uncover.

[2] The target can also be interpreted as an inflation target since expected inflation is a monotonic function of the policy stance.

The results of the model suggest that a 'dependable' policymaker is generally able to deliver a less inflationary policy stance in a fixed exchange rate regime than in a flexible regime. On the other hand, the 'weak' policymaker delivers a policy stance that may be more or less expansionary in the fixed exchange rate regime. This suggests that a fixed exchange rate regime with pre-announced domestic policy targets can act as a more effective anti-inflation tool than the domestic policy targets alone, which may account for the increasing use of multiple policy targets across the globe. Closer to home, it offers a theoretical rationalisation of the use of a fiscal target, combined with an exchange rate target, as part of Barbados's anti-inflation strategy.

The remainder of the paper is structured as follows: the second section of the paper outlines the theoretical debate over credibility, reputation and policy targets with domestic and external policy anchors. The third section discusses the use of dual domestic and external targets in practice. The fourth section outlines the formal model whilst the final section presents the results of the model and some conclusions.

II. Credibility, Reputation and Targets with Domestic and External Anchors

Issues of credibility have long been central to game-theoretic models of monetary policy-making. Kydland-Prescott's (1977) paper demonstrates that optimal (zero inflation) plans are not credible, because the policy-maker has an incentive to exploit the private sector's ex-ante inflationary expectations to deliver a one-off boost to output. Hence, the zero inflation option is not attainable, and the policy-maker's lack of credibility leads to a sub-optimal, inflationary policy stance.

Various theoretical attempts have been made to solve Kydland-Prescott's 'time-inconsistency' problem, all of which involve the introduction of some form of credibility mechanism that allows the policy-maker to commit to a low inflation policy stance. The major theoretical contributions have focussed on the use of domestic policy instruments in overcoming the time inconsistency problem.

Contracting, Reputation and Targeting: the Domestic Policy Anchor Approach

Rogoff (1985) argues for a principal-agent approach, whereby a 'Conservative' (anti-inflation) central banker is able to deliver lower inflation than the discretionary policy-maker. Walsh (1995) introduces side-payments which allow the zero-inflation outcome to be realised.

Other contributions to the literature have focussed on issues of reputation, by placing the policy-maker's choice within a repeated game environment. Barro (1986) and Backus and Driffill (1985) show that when the public is uncertain about the policy-maker's true intentions, a discretionary policy-maker (who would exploit the public's inflationary expectations in a one-period game) mimics for a time the behaviour of a policy-maker who is committed to zero inflation. The reason for this charade is simple- by posing as a committed policy-maker, the discretionary type is able to enhance her reputation, lower inflationary expectations and ultimately achieve a more expansionary policy stance.

One problem with the above work is that it fails to account for the most salient feature of the recent monetary policy debate on the ground, namely the increasing use by monetary authorities of explicit policy targets, and particularly inflation targets, in achieving low and stable rates of inflation (Mahadeva and Sterne, 2000).

The targeting approach, as originally conceived, emerged from the monetarist approach to policy-making. The monetarist view stressed the role of low and constant rates of growth in monetary aggregates in achieving low inflation. Monetary targets were used as a means of committing to and implementing stable monetary growth. In practice, monetary aggregates proved extremely difficult to control, due to wide fluctuations in velocity (as a result of financial liberalisation). As a result, monetary targeting as originally conceived was a conspicuous failure. It was generally unsuccessful in constraining growth in monetary aggregates, and where it did succeed in taming inflation, the cost in terms of output and unemployment tended to be punitive. However, although the adoption of formal rules governing the expansion of the money supply has fallen out of favour, the pre-announcement of target ranges for monetary aggregates or the exchange rate (intermediate tools of inflation management) has continued to play an important role in policymaking. More significantly, a number of countries now announce policy targets for inflation itself, rather than for intermediate policy instruments. Inflation targeting does not fit easily into Kydland-Prescott's 'rules versus discretion' dichotomy, but rather has elements of both approaches, and can be thought of as 'constrained discretion.'

Cukierman (2000) presents the first model to formalise the role of inflation targets within a monetary policy game. In Cukierman's model there are two types of policy-maker but the public is uncertain of the policy-maker's type. The dependable policy-maker (type D) announces a monetary policy target and sticks to it, whereas the weak policy-maker (type W) announces a target but chooses an optimal policy, based on the resulting private sector expectations, which may differ from the announced target. The game has two periods. In the first period, the policy choice impacts on second period expectations and thereby affects the pay-off available in the second period. The public receives a noisy signal of the policy choice (because of asymmetric information neither the policy maker type nor the policy choice is directly observable). As the optimal choices of the D and W types diverge, so the probability that the noisy signal of policy can be attributed to the correct type (i.e. separation takes place) increases.

Because the D type is committed to meeting its policy target whereas the W type exploits existing expectations, the W type's optimal policy is at least as inflationary as the D type's. Hence, the probability of separation (which is a function of the difference between the policies) is increasing in W's policy choice and decreasing in D's. This means that both types of policy-maker choose a less inflationary policy stance in the first period than they would otherwise. For the D type, the motivation is to increase the possibility of separation and thereby reduce inflationary expectations in the second period. For the W type, second-period inflationary expectations are higher in a separating equilibrium, and so the optimal first period policy is lower than in a one-period game in order to reduce the possibility of separation. Hence, the use of monetary targets can enable the committed policy-maker to differentiate herself from the weak, fully discretionary policy-maker. At the very least, even if separation does not occur, the targeting regime delivers lower inflation in the first period whichever policy-maker is actually in charge.

Cukierman's model offers a compelling analysis of the role of inflation targets in policy-making. It illustrates how targets can act as an effective signalling device within an asymmetric information environment. Unlike Rogoff (1985), the difference between the W and D type policy-maker (represented by the government, the principal, and the 'conservative central banker,' the agent, respectively) does not lie in the two types' underlying preferences (the slope of the output/inflation trade-off). That two policy-makers with identical underlying preferences can deliver different rates of inflation is perhaps more interesting than the observation that a policy-maker who is more inflation averse tends to deliver lower inflation. Moving the focus from motivation to procedure is certainly appropriate in today's environment, when the desirability of low inflation is a given, and to that extent most central bankers are 'conservative.'

Nor, unlike Barro (1986), does it come down to a simple choice of 'rules versus discretion'. The failure of simple monetarist rules for governing monetary policy begs the question, what 'rules' can the policy-maker effectively commit to? Furthermore, in Barro's model the zero inflation rule (which is effectively an inflation target) is exogenous and does not allow for the effect of expectations. This is a serious omission. When the private sector anticipates that the policy maker is likely to operate in a discretionary fashion, the non-discretionary policy maker will find it far harder to tame inflationary expectations and is therefore less likely to attempt to implement a zero-inflation policy. This is why countries emerging from high inflation episodes tend to adopt less ambitious targets for monetary growth, inflation or the exchange rate than countries in which low inflation is anticipated. Hence, Cukierman's model, in which the policy target is determined endogenously and is increasing in inflationary expectations, is more realistic.

Tying One's Hands: the External Anchor Approach

However, a weakness of Cukierman's model is that the framework for analysis is essentially that of a closed economy, or a large open economy with a flexible exchange rate regime. The policy target is the domestic inflation rate, which is assumed to be directly controllable by the monetary authorities. However, in a small open economy where a significant share of domestic consumption is made up of imported goods, the rate of inflation is basically determined by a combination of world inflation and the rate of currency devaluation. Hence, low inflation is most effectively delivered by fixing the value of the currency against that of a low-inflation country. Moreover, even those with a nominally flexible exchange rate regime cannot ignore the exchange rate in implementing low inflation. This implies that, for such economies the key policy choice is the degree of commitment to a target value for the exchange rate.

This view is central to the so-called 'second generation' currency crisis literature, which analyses the use of fixed currency arrangements as anti-inflation tools. These models are similar in form to the types of closed-economy policy games analysed in the Kydland-Prescott literature. The decision to maintain a fixed exchange rate or to devalue is presented as the result of a maximisation problem with output and inflation as the relevant arguments. More precisely, the decision to devalue in Obstfeld's (1994) model, representative of the second generation literature, is based on an evaluation of the costs and benefits following the realisation of a stochastic shock to output. A shock that is serious enough will cause the costs of maintaining a fixed exchange rate regime to outweigh the one-off costs of devaluation (loss of credibility or political fallout) and trigger a devaluation. However, for less serious output shocks, the one-off cost of devaluation is prohibitive, thus ensuring a conservative policy stance.

One weakness of the traditional second generation model is that the decision to devalue or to maintain the currency anchor is presented as the sole policy choice, and the fixed exchange rate regime is in effect the only relevant policy target. Hence, the government can achieve an inflationary surprise and higher output only if a devaluation occurs, and a monetary or fiscal expansion which does not trigger a devaluation would have no effect. This analysis is consistent with the Mundell-Fleming model of the economy under a fixed exchange rate, in which monetary policy is ineffective. In this view, the primary channel for monetary policy is through the exchange rate and the external sector, and only by causing a deviation from the currency anchor can the authorities achieve an output surprise. However, in practice even countries which maintain a currency anchor have some room for manoeuvre on the monetary side, and there is certainly a role for fiscal policy. Hence, a rationale exists for countries with a fixed exchange rate regime to announce policy targets for inflation or for monetary or fiscal variables. Barbados, with its fiscal deficit to GDP target ratio of 3%, is a case in point.

III. Having it Both Ways: Countries that Utilise External and Domestic Targets

Recent work by researchers at the Bank of England, which presents an extensive and recent (1998) survey of Central Banks across developing, transition and industrial economies, illustrates the extent to which the use of external and domestic targets as complimentary policies has become commonplace. Table One is based on the data from their survey (Mahadeva and Sterne, 2000). It indicates the significant range of economies that utilise both exchange rate targets and domestic policy targets (inflation or money). From a total survey of ninety-three countries for which full data was presented, forty-eight (or 52%) were found to target the exchange rate.[3] Of these forty-eight, twenty-six (listed in table one) also targeted inflation or some monetary aggregate.[4] This represents 54% of the exchange rate targeting countries or 28% of the full sample. Five of the twenty-six countries targeted a monetary variable, twelve targeted inflation and nine targeted both variables, in addition to the external target.

Table One: The Use of External and Domestic Policy Targets

Country	Monetary Target	Inflation Target
Bangladesh	•	•
Belize		•
Botswana		•
Chile		•
Croatia		•
Cyprus	•	
Finland		•
France	•	•
Greece	•	•
Italy	•	•
Jordan	•	
Kuwait	•	
Lebanon		•
Macedonia		•
Malaysia		•
Malta	•	
Mongolia	•	•
Poland		•
Slovakia	•	•
Spain		•
Taiwan	•	•
Tonga	•	
Turkmenistan	•	•
Ukraine	•	•
Uruguay		•
W. African States		•

Source: Mahadeva and Sterne (2000); pp. 145-148

Note that the questionnaire does not allow for a fiscal policy target, so that there may be other countries which, like Barbados, combine an exchange rate target with a fiscal target.

[3] Various definitions of exchange rate targeting are presented in Mahadeva and Sterne (2000) Table A2 (pp.145-148), based on self-identification in the survey or on formal notice of regime from the IMF. For the purposes of this paper, a country is assumed to target the exchange rate if either (a) it is self-identified as targeting the exchange rate either alone or in tandem with other policy targets or (b) it is identified formally as having a fixed exchange rate regime or an explicit target range of less than 30% either side of a fixed value. Countries with an implicit target or engaged in a managed float are not considered to have an exchange rate target.

[4] For the purposes of this paper, a country is identified as targeting inflation or a money or credit variable if either (a) it is self-identified as targeting this variable either alone or in tandem with other policy targets or (b) the country claims to have a published target or target range for this variable.

IV. The Model

An Overview

In the model, the policy stance has an impact on output, to the extent that it is unexpected. As in other rational expectations models, an anticipated monetary or fiscal expansion has no effect. To the extent that any expansion is monetised, the public will anticipate devaluation and higher inflation rather than any real expansion. To the extent that it is fiscal in nature, higher future taxes (be they explicit or implicit- future inflation) will be anticipated and the private sector will reduce their present expenditure accordingly.[5]

Although fiscal or monetary policy can have an impact even within a fixed exchange rate regime, a domestic fiscal or monetary stance that is inconsistent with long-run external balance will have some impact on the viability of the currency anchor, as is explicit from earlier 'first generation' currency crisis models (Flood and Garber, 1984 and Krugman, 1979). A more expansionary policy makes a devaluation in the present period more likely, and, because any external imbalance is more pronounced, a more significant drop in the external value of the currency is likely. Hence, as in Cukierman's model, a more expansionary policy stance increases the anticipated rate of inflation. Unlike Cukierman's model, the effect is not direct, but rather operates indirectly through the probability of, and probable rate of, devaluation.

The treatment of the exchange rate policy stance as a probabilistic variable is, on the face of it, rather different from that in the standard second generation model. In the latter, whilst there is a probabilistic element to the process (in that the output shock which can trigger a devaluation is stochastic), the government's policy to devalue or to maintain the fixed currency is made after the shock is realised and is therefore deterministic. However, this deterministic choice to devalue is essentially implicit in the present model, and can be thought of as a game-within-a-game. In this account a more expansionary policy stance, determined before any output shocks occur, places pressure on the currency anchor. For any given subsequent realisation of an output shock, the government is more likely to choose to devalue in the second, embedded game, the more expansionary its policy stance. That is, the government is better placed to maintain the currency anchor in the face of an exogenous shock if its overall monetary and fiscal stance is conservative, whilst in the absence of any notable shock the currency anchor might be safe even with a quite inappropriate policy stance. Since the implicit external shock is not realised until after the policy stance has been determined, the impact on the currency anchor at the time the decision is arrived at is essentially probabilistic.

Although the reasoning is somewhat different from Cukierman's closed-economy model, the models are formally almost identical. However, a critical difference is that in an open economy setting the private sector, although still uncertain about policy-maker type and unable to observe the policy choice directly, now has an additional policy signal. Since the W type policymaker adopts a policy stance which is at least as expansionary as the D type, the probability of devaluation under the W type is at least as high as under the D type. Hence, the occurance or non-occurance of a currency crisis and devaluation imparts additional information concerning the policy-maker's type. If a devaluation occurs in the first period, the private sector's belief that the policy maker is of the W type will increase, and inflationary expectations in the second period will be higher.

This imposes a cost on the policymaker and therefore acts as a disincentive to choosing a more expansionary policy. At the same time, the costs of separation or non-separation will change, which might act to increase or decrease the incentive to adopt a more expansionary stance. The next section of the paper analyses the net effect which this additional signalling opportunity has on the optimal policy stance of the two types in the first and second periods, to illustrate the degree to which a fixed exchange rate regime may reduce the inflationary bias to policymaking through the mechanism of reputation and incentives under uncertainty.

Formal Exposition

As in Cukierman's model, the policy game has two periods and two potential types of player. Both types of player announce a target for the policy variable, denoted $\hat{\theta}$, at the start of each period. However, only the D type is committed to attempting to implement this target, whereas the W type chooses its optimal policy following the private sector's forming of expectations with regard to the likely policy choice. That is, both types choose their policies based on maximisation principles, but whereas the D type takes into account the effect of its choice on the private sector's expectations formation, the W type treats expectations as given.

Formally, the policymaker's optimisation problem is given in (1). The policy variable, $\hat{\theta}$, can be thought of as an amalgam of the fiscal and monetary stance, measured along a continuum from 0 (conservative) to 1 (expansionary). The parameter A represents the slope of the output/ inflation trade-off, and is restricted to the unit interval in order to guarantee an internal solution. As A increases, so the policy-maker attributes a higher weight to its output objectives relative to the control of inflation. Output is a linear function of the difference between the actual and expected policy variable. The parameter δ, the discount rate, measures the degree to which the policy-maker in period one considers the effects of its policy choice on the period two pay-off. A discount rate of 1 indicates equal treatment of the present and the future, whereas at zero the policy-maker does not value the future at all.

As already discussed, a more expansionary policy both increases the probability of devaluation and increases its expected size. Assuming that both the probability and the expected size of the devaluation are equal to $\hat{\theta}$, then the expected rate of devaluation is given as $\hat{\theta}^2$. Assuming purchasing power parity, then the expected rate of inflation is also equal to $\hat{\theta}^2$. As in Cukierman, for simplicity the inflation term is given a weight of ½. The policy variable is not observed perfectly, but a noisy signal is observed. The noise component is represented by a stochastic variable ε. As in Cukierman, this variable

[5] That is, Ricardian equivalence is assumed to hold.

is iid and distributed uniformly. For simplicity, it is assumed to be distributed along the interval (-½, ½). Note that the rate of devaluation in the event of a crisis is equal to the noisy policy signal, so that no additional signal is given if a devaluation occurs, other than the occurance itself.

$$\underset{\hat{\theta}_1,\hat{\theta}_2}{Max}\,\mathrm{E}\left(A(\theta_1-\mathrm{E}\theta_1)-\frac{\theta_1\hat{\theta}_1}{2}+\delta\left(A(\theta_2-\mathrm{E}\theta_2)-\frac{\theta_2\hat{\theta}_2}{2}\right)\right) \quad (1)$$

$$\theta_i=\hat{\theta}_i+\varepsilon_i; \qquad \varepsilon_i \sim iidU\left(-\tfrac{1}{2},\tfrac{1}{2}\right); \qquad i=(1,2)$$

There are three differences between this model and Cukierman's, other than the introduction of the fixed exchange rate regime. The first is that output is a function of the policy surprise rather than the inflation surprise. In Cukierman's model, the two are identical since inflation *is* the policy. However, as discussed above, in a fixed exchange rate environment an expansionary policy is likely to be manifested in declining reserves (with a higher attendant probability of devaluation) first and foremost, and inflation only if the currency anchor is abandoned. Hence, the government may be able to achieve an output surprise through an expansionary policy without causing inflation (although *expected* inflation will be higher) if it is lucky and avoids a currency crisis. Secondly, the objective function is linear in expected inflation rather than quadratic. However, since expected inflation is itself a quadratic function of the policy variable, this linearity does not present a problem when it comes to maximisation. Lastly, the error term is identically distributed for both types, whereas in Cukierman's model the D type exercised more exact control over policy than the W type, and therefore ε has a lower variance under D. The simplification in this model is to ease the exposition, as is the assumption that ε is distributed along (-½,½).

In order that the flexible and fixed exchange rate cases can be made directly comparable, the flexible exchange rate or closed economy model needs to be slightly modified along the same lines. Specifically, output is made a function of the policy surprise rather than the inflation surprise, expected inflation is equal to $\hat{\theta}^2+\sigma^2$, the objective function is linear in expected inflation and ε is uniformly distributed along (-½,½) for both types.[6]

In order to complete the model, the expectations formation process of the private sector needs to be specified. As with Cukierman, the public's ex-ante (period 1) belief concerning the policymaker's type is given exogenously as β_1, representing the probability that the policymaker is of the D type. Hence, $\beta_1=0$ corresponds to the belief that the policymaker is definitely of the W type and $\beta_1=1$ if the public is certain that the policymaker is drawn from the D pool. The belief β_1 is common knowledge. Having observed the noisy signal of the policy variable, separation takes place if the signal differs sufficiently from the expected policy stance of any type. Hence, as in Cukierman, the ex-ante probability of separation is given as:

$$\Pr.(Separation)=\hat{\theta}_{1W}-\hat{\theta}_{1D} \quad (2)$$

Most of the results are similar to Cukierman's, and where the methodology is the same the exposition of this paper is brief. As with Cukierman's model, arriving at the Sub-game Perfect Bayesian Nash equilibrium requires backwards induction. In the second period, the W type maximises her objective function taking the public's expectations as given (although it announces the same target as the D type to avoid identification). Since the game is finished at the end of the second period, she is no longer concerned over her reputation and simply chooses the optimal policy for the one-period game. Hence:

$$\hat{\theta}_{2W}=A \quad (3)$$

The D type, conversely, takes into account the impact of her target announcement on the private sector's expectations, because once it announces its target it has to adhere to it, and hence:

$$\hat{\theta}_{2D}=A(1-\beta_2) \quad (4)$$

Since the anticipated policy stance is a function of both types' equilibrium second period policy stances, then the value of the objective function for each type is a function of the period two belief β_2. Hence, under separation the period two pay-off for W and D is lower and higher respectively. The pay-offs in period two for the W and D types, under separation or non-separation, are given respectively as:[7]

$$V_{W2}(NoSep.)=A^2\left(\beta_2^2-\tfrac{1}{2}\right); \qquad V_{W2}(Sep.)=-\frac{1}{2}A^2 \quad (5)$$
$$V_{D2}(NoSep.)=-\frac{1}{2}A^2\left(1-\beta_2^2\right); \qquad V_{W2}(Sep.)=0$$

As in Cukierman's model, the period one maximisation problem for both types then involves the impact of the period one choice on the probability of separation in period two. However, in the fixed exchange rate environment the policymaker also has to consider the impact of his choice on the probability of devaluation, since the private sector updates its period two belief in response to the signal contained in the occurance or non-occurance of devaluation. With Bayesian updating, the period two belief β_2 under devaluation and non-devaluation respectively is given as:

[6] For the flexible exchange rate case, an expansionary policy stance will lead directly to devaluation and inflation as the foreign exchange market moves to clear the excess supply of domestic currency. Hence, there is no real differentiation between the policy stance and the inflation rate. In this case, the argument that inflation is a quadratic function of the policy stance (which is necessary to ensure both tractability and comparability with the fixed exchange rate case) can be thought of as the introduction of non-linearities in the output response to unanticipated inflation. If no additional signal of the policy stance is to be given, then inflation must be given as $(\hat{\theta}+\varepsilon)^2$, which implies that expected inflation must include the variance term σ^2, representing the variance in ε.

[7] These results are the same as Cukierman's, with the exception that Cukierman's pay-offs also include terms in σ^2. For the flexible exchange rate case, the results are identical to Cukierman's.

$$\beta_2^d = \frac{\beta_1 \hat{\theta}_{1D}}{\beta_1 \hat{\theta}_{1D} + (1-\beta_1)\hat{\theta}_{1W}}; \qquad \beta_2^{nd} = \frac{\beta_1 (1-\hat{\theta}_{1D})}{\beta_1 (1-\hat{\theta}_{1D}) + (1-\beta_1)(1-\hat{\theta}_{1W})} \tag{6}$$

The period one maximisation problem can then be given as in (7) below. In this and preceding equations, the subscript (W,D) refers to the policymaker type, the subscript (1,2) refers to the period and the superscript (d,nd) refers to the occurance or non-occurance of devaluation.

$$\begin{aligned}&\underset{\hat{\theta}_1}{Max}\left(A(\hat{\theta}_1 - \mathrm{E}\theta_1) - \frac{\hat{\theta}_1^2}{2}\right) \\ &+ \delta\hat{\theta}_1 \left(V_2^d(Sep.) + \mathrm{Pr}.(NoSep.)\left(V_2^d(NoSep.) - V_2^d(Sep.)\right)\right) \\ &+ \delta(1-\hat{\theta}_1)\left(V_2^{nd}(Sep.) + \mathrm{Pr}.(NoSep.)\left(V_2^{nd}(NoSep.) - V_2^{nd}(Sep.)\right)\right)\end{aligned} \tag{7}$$

As before, the W type mimics D's target announcement but maximises (7) taking expectations concerning the first period policy as given. Conversely, the D type chooses the optimal target taking into consideration the impact on expectations, and sticks to it. Hence, the optimal policy choices for the W and D types are given below. For both types, the optimal policy is dependent upon the choice of the other type in equilibrium, and hence a Nash Equilibrium in the first period sub-game requires that each choice is the optimal choice given the other's optimal policy stance.

$$\begin{aligned}\hat{\theta}_{1W} &= A - \delta A^2 \beta_2^{nd^2} + \delta\left(\mathrm{Pr}.(NoSep.) + \hat{\theta}_{1W}\right)A^2\left(\beta_2^{nd^2} - \beta_2^{d^2}\right) \\ &- 2\delta\,\mathrm{Pr}.(NoSep.)A^2\left(\beta_2^{nd^3} - \beta_2^{d^3}\right)\end{aligned} \tag{8}$$

$$\begin{aligned}\hat{\theta}_{1D} &= A(1-\beta_1) - \frac{\delta A^2\left(1-\beta_2^{nd^2}\right)}{2} - \frac{\delta}{2}\left(3\,\mathrm{Pr}.(NoSep.) + \hat{\theta}_{1D}\right)A^2\left(\beta_2^{nd^2} - \beta_2^{d^2}\right) \\ &+ \delta\,\mathrm{Pr}.(NoSep.)A^2\left(\beta_2^{nd^3} - \beta_2^{d^3}\right)\end{aligned}$$

By comparison, the optimal policy choices under the flexible regime (indicated by an asterisk) are given as:[8]

$$\hat{\theta}_{1W}^* = A - \delta A^2 \beta_1^2 \tag{9}$$

$$\hat{\theta}_{1D}^* = A(1-\beta_1) - \frac{\delta A^2\left(1-\beta_1^2\right)}{2}$$

[8] These results are identical to Cukierman's.

V. Results and Conclusions

Comparison of (8) and (9) indicates that the difference for each type between the optimal policy choice under different exchange rate regimes can be given as:

$$\begin{aligned}\left(\hat{\theta}_{1W} - \hat{\theta}_{1W}^*\right) &= A^2\delta\left(\beta_1^2 - (1-\hat{\theta}_{1W})\beta_2^{nd^2} - \hat{\theta}_{1W}\beta_2^{d^2}\right) \\ &+ A^2\delta\,\mathrm{Pr}.(NoSep.)\left(\beta_2^{nd^2}(1-2\beta_2^{nd}) - \beta_2^{d^2}(1-2\beta_2^d)\right)\end{aligned} \tag{10}$$

$$\begin{aligned}\left(\hat{\theta}_{1D} - \hat{\theta}_{1D}^*\right) &= -\tfrac{1}{2}A^2\delta\left(\beta_1^2 - (1-\hat{\theta}_{1D})\beta_2^{nd^2} - \hat{\theta}_{1D}\beta_2^{d^2}\right) \\ &- \tfrac{1}{2}A^2\delta\,\mathrm{Pr}.(NoSep.)\left(\beta_2^{nd^2}(3-2\beta_2^{nd}) - \beta_2^{d^2}(3-2\beta_2^d)\right)\end{aligned}$$

Some rearranging indicates that the difference for each type is related as:

$$\left(\hat{\theta}_{1D} - \hat{\theta}_{1D}^*\right) = -\tfrac{1}{2}\left(\hat{\theta}_{1W} - \hat{\theta}_{1W}^*\right) - \tfrac{1}{2}A^2\delta\left(2 - 3(\hat{\theta}_{1W} - \hat{\theta}_{1D})\right)\left(\beta_2^{nd^2} - \beta_2^{d^2}\right) \tag{11}$$

It is not immediately obvious from these functions whether the first period policy choice under the fixed exchange rate regime is more or less expansionary than under the flexible regime. Intuitively, since there is an additional signal of type given by the possibility of devaluation, one would expect both types to implement a less expansionary policy. In fact, it can be shown that as long as $(\hat{\theta}_{1W} - \hat{\theta}_{1D}) \leq 2/3$ then $\hat{\theta}_{1D} \leq \hat{\theta}_{1D}^*$ – i.e. the policy stance with the D type policymaker in charge is less inflationary under a fixed exchange rate regime than with a floating exchange rate (Proposition 1: see appendix). A sufficient condition to ensure that $\hat{\theta}_{1D} \leq \hat{\theta}_{1D}^*$ is therefore that $A \leq 2/3$[9]. On the other hand, the first period policy under the W type policymaker with a fixed exchange rate may be higher or lower than under a flexible regime, although simulations of the model under plausible parameter values suggest that $\hat{\theta}_{1W}$ is generally lower than $\hat{\theta}_{1W}^*$.

This result suggests that, unless she weights output significantly higher than inflation in her objective function, a policymaker who is genuinely committed to inflation targeting, or to the targeting of domestic monetary or fiscal policy instruments in pursuit of lower inflation, is able to achieve a lower rate of inflation under a fixed exchange rate regime.[10] This supports a number of 'stylised facts' with respect to exchange rate policy and

[9] In fact under simulations it was found that a value of A approaching unity and a very low discount rate δ were necessary to generate $\hat{\theta}_{1D} > \hat{\theta}_{1D}^*$ in equilibrium. Hence, the result that $\hat{\theta}_{1D} \leq \hat{\theta}_{1D}^*$ in equilibrium is not restricted to the case of $A \leq 2/3$, and does in fact hold for all but the most extreme parameter values.

[10] Since the *expected* rate of inflation under a flexible exchange rate regime includes the variance term σ^2 and the rate under the fixed exchange rate regime does not – because the probability of devaluation excludes the error term ε to ensure that the probability is inside the (0,1) interval – then expected inflation contains an inherent bias under the flexible regime. To remove this bias, which results from a convenient modelling assumption rather than any inherent quality of the model, comparisons of inflation under the fixed and flexible regimes are undertaken at the expected value of ε, i.e. zero, rather than for expected inflation evaluated over the full range of possible realisations for ε.

inflation targeting. For instance, it has been observed that many countries, particularly developing countries, have found a fixed exchange rate to be useful in support of an overall anti-inflationary policy stance. Moreover, as illustrated earlier in the paper, an increasing number of countries have come to use domestic policy targets *in tandem* with a fixed exchange rate regime to combat inflation. Traditional models of exchange rate policy tend to view a fixed exchange rate regime as an anti-inflation tool in itself, and therefore as an *alternative* to inflation or monetary targeting. As Mahadeva and Sterne (2000), analysing the Bank of England's 1998 survey of more than 90 central banks, observe:

> *There has been a long-standing economic literature, which treats [domestic and external policy] targets as alternatives, yet central bank practices in the 1990s confound that treatment. In 1998, nearly half the economies in the sample announced an explicit target (or monitoring range) for more than one of the exchange rate, growth in money or credit, and inflation, compared with only 8% in 1980.* (Mahadeva and Sterne, 2000, p.34)

The model indicates how inflation or other domestic policy targets can be complimentary to, and enhanced by, the adoption of an explicit exchange rate target. This paper therefore offers some support to countries such as Barbados which utilise both domestic and external policy targets in achieving low and stable inflation. It may well be that, in the question of domestic versus external policy targets, having it both ways really is the best policy.

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Appendix

Proof of Proposition 1

Setting $\hat{\theta}_{1D} \geq \hat{\theta}^*_{1D}$ in equation (10) gives us:

$$\left(\hat{\theta}_{1W} - \hat{\theta}_{1D}\right) \geq 1 - \frac{\left(\beta_2^{nd^2} - \beta_1^2\right) - \hat{\theta}_{1D}\left(\beta_2^{nd^2} - \beta_2^{d^2}\right)}{\beta_2^{nd^2}\left(3 - 2\beta_2^{nd}\right) - \beta_2^{d^2}\left(3 - 2\beta_2^{d}\right)} \tag{A1}$$

Utilising the fact that $\left(\beta_2^{nd^2} - \beta_1^2\right) = \left(\beta_2^{nd} - \beta_1\right)\left(\beta_2^{nd} + \beta_1\right)$ and using the expression for β_2^{nd} in (6) gives us:

$$\left(\beta_2^{nd^2} - \beta_1^2\right) = \frac{\left(1 - \beta_2^{nd}\right)\beta_1\left(\beta_1 + \beta_2^{nd}\right)\left(\hat{\theta}_{1W} - \hat{\theta}^*_{1D}\right)}{\left(1 - \hat{\theta}_{1W}\right)} \tag{A2}$$

Similarly, it can be shown that:

$$\hat{\theta}_{1D}\left(\beta_2^{nd^2} - \beta_2^{d^2}\right) = \frac{\left(1 - \beta_2^{nd}\right)\beta_2^{d}\left(\beta_2^{d} + \beta_2^{nd}\right)\left(\hat{\theta}_{1W} - \hat{\theta}_{1D}\right)}{\left(1 - \hat{\theta}_{1W}\right)} \tag{A3}$$

Substituting (A2) and (A3) into (A1) and dividing both the numerator and denominator of the resulting fraction by $\left(\beta_2^{nd^2} - \beta_2^{d^2}\right)$ gives us:

$$\left(\hat{\theta}_{1W} - \hat{\theta}_{1D}\right) \geq 1 - \frac{\hat{\theta}_{1D}\dfrac{\beta_1\left(\beta_1 + \beta_2^{nd}\right) - \beta_2^{d}\left(\beta_2^{d} + \beta_2^{nd}\right)}{\beta_2^{d}\left(\beta_2^{d} + \beta_2^{nd}\right)}}{3 - \left(\beta_2^{d} + \beta_2^{nd}\right) + \dfrac{\left(\beta_2^{d^2} + \beta_2^{nd^2}\right)\left(\beta_2^{nd} - \beta_2^{d}\right)}{\left(\beta_2^{nd^2} - \beta_2^{d^2}\right)}} \tag{A4}$$

Some rearranging yields:

$$\left(\hat{\theta}_{1W} - \hat{\theta}_{1D}\right) \geq 1 - \frac{\left(1 - \beta_1\right)\left(\hat{\theta}_{1W} - \hat{\theta}_{1D}\right)\left(\beta_1 + \beta_2^{d} + \beta_2^{nd}\right)}{3\left(\beta_2^{d} + \beta_2^{nd}\right) - 2\beta_2^{nd}\beta_2^{d}} \tag{A5}$$

Collecting terms in $\left(\hat{\theta}_{1W} - \hat{\theta}_{1D}\right)$ gives us:

$$\left(\hat{\theta}_{1W} - \hat{\theta}_{1D}\right) \geq \frac{3\left(\beta_2^{d} + \beta_2^{nd}\right) - 2\beta_2^{nd}\beta_2^{d}}{3\left(\beta_2^{d} + \beta_2^{nd}\right) - 2\beta_2^{nd}\beta_2^{d} + \left(\beta_2^{d} + \beta_2^{nd}\right) + \beta_1\left(1 - \beta_1 - \beta_2^{d} - \beta_2^{nd}\right)} \tag{A6}$$

Hence, $\hat{\theta}_{1D} \geq \hat{\theta}^*_{1D}$ implies that $\left(\hat{\theta}_{1W} - \hat{\theta}_{1D}\right) \geq \frac{2}{3}$ if the following condition is met:

$$\left(1 - \beta_1\right)\beta_1 + \beta_2^{nd}\beta_2^{d} \leq \left(\tfrac{1}{2} + \beta_1\right)\left(\beta_2^{d} + \beta_2^{nd}\right) \tag{A7}$$

Returning to equation (A6) and dividing numerator and denominator by β_2^{nd} yields:

$$\left(\hat{\theta}_{1W} - \hat{\theta}_{1D}\right) \geq \frac{x}{x + \left(1 + \frac{\beta_2^{d}}{\beta_2^{nd}}\right) + \frac{\beta_1}{\beta_2^{nd}}\left(1 - \beta_1 - \beta_2^{d} - \beta_2^{nd}\right)}\ ; \quad x \equiv 3\left(1 + \frac{\beta_2^{d}}{\beta_2^{nd}}\right) - 2\beta_2^{d} \tag{A8}$$

From (A8), it is clear that $\left(\hat{\theta}_{1W} - \hat{\theta}_{1D}\right)$ is minimised when x is minimised. The latter is minimised for $\beta_2^d = 0$, and therefore takes on a minimum value of 3. Since $\left(1 + \frac{\beta_2^{d}}{\beta_2^{nd}}\right) \leq 2$ and $\frac{\beta_1}{\beta_2^{nd}}\left(1 - \beta_1 - \beta_2^{d} - \beta_2^{nd}\right) \leq 1$, then it follows that $\left(\hat{\theta}_{1W} - \hat{\theta}_{1D}\right) \geq \frac{1}{2}$.

Substituting for β_2^d and β_2^{nd} in (A7), using (6), and rearranging yields:

$$\text{If } \begin{matrix}\left[\left(1 - \beta_1\right)\beta_1^2\hat{\theta}_{1D} + \left(1 - \beta_1\right)\left(\tfrac{1}{2} + \beta_1^2\right)\hat{\theta}_{1W}\right]\left(1 - \hat{\theta}_{1D}\right) \\ + \left[\left(1 - \beta_1\right)\left(\tfrac{1}{2} + \beta_1^2\right)\hat{\theta}_{1D} - \left(1 - \beta_1\right)^3\hat{\theta}_{1W}\right]\left(1 - \hat{\theta}_{1W}\right) \geq 0\end{matrix} \quad \text{then } \left(\hat{\theta}_{1W} - \hat{\theta}^*_{1D}\right) \geq \tfrac{2}{3} \tag{A9}$$

Note that the first terms inside the both sets of square brackets in (A9) are non-negative. Hence, if the sum of the second terms in both sets of square brackets is non-negative, then (A9) is non-negative. This sum is equal to:

$$\left(1 - \beta_1\right)\hat{\theta}_{1W}\left(\left(1 - \hat{\theta}_{1D}\right)\left(\tfrac{1}{2} + \beta_1^2\right) - \left(1 - \beta_1\right)^2\left(1 - \hat{\theta}_{1W}\right)\right); \tag{A10}$$

which is decreasing in $\hat{\theta}_{1D}$ and increasing in $\hat{\theta}_{1W}$. Since it has already been shown that $\hat{\theta}_{1W} - \hat{\theta}_{1D} \geq \frac{1}{2}$, (A10) is minimised for $\hat{\theta}_{1W} - \hat{\theta}_{1D} = \frac{1}{2}$. Given that $\left(\frac{1}{2} + \beta_1^2\right) > 0$ and $-\left(1 - \beta_1\right)^2 \leq 0$, then (A10) is minimised when the ratio of $\left(1 - \hat{\theta}_{1D}\right):\left(1 - \hat{\theta}_{1W}\right)$ is minimised. Hence, $\hat{\theta}^*_{1D} = 0$ and $\hat{\theta}_{1W} = \frac{1}{2}$ for minimisation. Finally, since $\left(\frac{1}{2} + \beta_1^2\right)$ and $-\left(1 - \beta_1\right)^2$ are both increasing in β_1, then (A10) is minimised at $\beta_1 = 0$. Substituting these values into (A10) gives a value of zero, indicating that the inequality in (A9) is met. Hence, $\left(\hat{\theta}_{1W} - \hat{\theta}_{1D}\right) \geq \frac{2}{3}$ is a necessary condition for $\hat{\theta}_{1D} \geq \hat{\theta}^*_{1D}$. This implies that, as long as $\left(\hat{\theta}_{1W} - \hat{\theta}_{1D}\right) \leq \frac{2}{3}$, then $\hat{\theta}_{1D} \leq \hat{\theta}^*_{1D}$.