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Mechanisms for Achieving Monetary Stability: Inflation Targeting versus the ERM

First, we modify the Barro-Gordon model so that a credibility-stabilization trade-off will remain, even when a performance contract of the type envisaged by Walsh (1995) is imposed on the central bank governor. We do this by modeling a real interest rate bias along with the inflation bias. Then, we discuss how various inflation penalties might actually be imposed on a central bank, and ask whether "inflation targeting" (supported by one or another of the penalties) is likely to bring a better resolution to the credibility-stabilization trade-off than the ERM.

PRIOR TO THE EXCHANGE RATE CRISES of 1992 and 1993, the inflation credibility of a number of European countries was thought to derive from the ERM and the independence of the Bundesbank. Many feared that a collapse of the ERM, or even a serious questioning of existing parities, would reignite inflationary expectations and take Europe back to the high inflation rates of an earlier decade. The fact that this has not yet happened may cast some doubt on the notion that the ERM was responsible for the monetary stability of the last decade.[1] But in any case, since the widening of the ERM bands, France, the Netherlands, Austria, Belgium, and Denmark seem to have clung to their old policies of pegging to the deutsche mark (DM), while the others have looked elsewhere for a means of determining monetary policy and achieving inflation credibility.

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1. See Giavazzi and Pagano (1988) for a statement of the original notion. It can be argued that longer-term bond rates do exhibit inflationary expectations, and that the weak state of most European economies has kept inflationary pressures at bay. In other words, the new regime has yet to be tested.

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Several countries have joined Canada and New Zealand in adopting the mechanism of inflation targeting.[2] Given the instability of velocity, inflation targeting has an obvious advantage over targeting a money aggregate, but what gives inflation targeting credibility? Recent papers by Walsh (1995) and Persson and Tabellini (1993), along with the earlier papers of Canzoneri (1985) and Rogoff (1985), provide one possible answer. They all suggest that inflation penalties can be imposed upon (or embraced by) a central bank to give it better inflation-fighting credentials.[3] However, the approach of Canzoneri and Rogoff (denoted as C&R in what follows) differs from that of Walsh, Persson and Tabellini (denoted as W&PT) in two potentially important ways: (1) the types of penalties that are imposed, and (2) the methods that are used to impose them.

C&R discuss penalties or restrictions on deviations from the optimal inflation target, while W&PT advocate a linear inflation penalty on any observed inflation, even if it is below target. The difference would appear to be important, in the popular Barro-Gordon model, anyway. C&R argued that there is a fundamental trade-off between commitment to an inflation target and flexibility for stabilization: adding penalties for missing the inflation target will lower the Barro-Gordon inflation bias, but it will also decrease the central bank's incentive to stabilize output. By contrast, W&PT found that their linear penalty on all inflation could eliminate the inflation bias without interfering with the stabilization effort; they argued that there is no fundamental trade-off between credibility and stabilization in the Barro-Gordon model.

C&R suggested that additional penalties could be placed on deviations from the inflation target by delegation (appointing a "conservative" bank governor who placed more weight on the inflation objective) or by legislation (requiring average targeting rules).[4] W&PT envisaged their linear penalties on inflation being written into a performance contract for the central bank governor. The differences here, however, may be more apparent than real. Neither approach has a literal application in the real world, but something like the symmetric penalty suggested by C&R, and something like the linear penalty advocated by W&PT, can be observed in the institutional design of central banks and in the behavior of central bankers. Both approaches have therefore been given generous interpretations. The questions here should be put more operationally: What methods are available for actually instituting the symmetric C&R penalty or the linear W&PT penalty? Is one kind of penalty easier to manufacture than the other? Indeed, is either approach feasible in the real world?

There is, of course, an equivalent question about the ERM: what gave it credibili-

2. The United Kingdom, Sweden, Finland, and (most recently) Spain have announced official inflation targets. See Ammer and Freeman (1994) for a listing of targets and definitions for the first three countries; see the Banco de España's *Economic Bulletin* (January 1995) for Spain. Freedman (1994) discusses the Canadian case, Bowen (1994) discusses the U.K. case, and Svensson (1994) discusses the Swedish case.

3. There is also a literature on first best solutions to the credibility problem. For example, Svensson (1994) discusses controlling the fiscal deficit, issuing indexed (or foreign currency) debt, and making labor markets more flexible. Our lack of attention to first best approaches is not meant to detract from their importance, perhaps in conjunction with an inflation targeting procedure.

4. Lohmann (1992) studied a hybrid solution in which the government delegates policy within certain bounds (that is, provided shocks are not too big).

ty? Put bluntly, if the government can't keep a promise (of low inflation) to its own electorate, then why should it be able to keep a promise (embedded in an exchange rate agreement) with foreigners? The answer usually given is once again "costs," costs for leaving the ERM. But, what exactly are the costs? Are they easier to manufacture than the costs that support inflation targeting? Why did they fail? Can inflation targeting succeed where the (old) ERM did not?

In this paper, we try to compare the two mechanisms for monetary stability: inflation targeting (cum inflation penalties) versus the ERM. In section 3, we discuss the feasibility of actually implementing either mechanism. We try to identify the "costs" that make it difficult to reverse a previously announced decision, and the methods of imposing them. In the case of inflation targeting, we ask which kind of penalty (the symmetric C&R penalty or the linear W&PT penalty) a given method will accommodate, since the theory suggests the distinction is important. Finally, we give a reason why inflation targeting may be able to survive in an environment where the (old) ERM did not. Section 3 is undoubtedly the most difficult in the paper, and the least rigorous. However, it may also be the most important: feasibility may be the determining factor in a choice between inflation targeting and the ERM, or in a choice between the symmetric and linear inflation penalties.

In section 2, we turn to an easier question. We ask whether inflation targeting (cum inflation penalties) or the ERM would bring a more efficient resolution of the credibility-stabilization trade-off in a variant of the Barro-Gordon model. Both mechanisms eliminate the expected inflation bias; the difference between the two lies in the stabilization effort. After joining the ERM, the home country just imports German monetary policy, and German policy may be responding to current economic conditions in a way that is not appropriate at home. Inflation targeting allows independence from the Bundesbank and the flexibility to respond to economic conditions in a more appropriate manner. If, however, inflation targeting does not provide a very good resolution to the credibility-stabilization trade-off, then the home response may be worse than the imported German policy.

But before going on to this analysis, we need to modify the Barro-Gordon model in a rather significant way. As already mentioned, Walsh (1995) has shown that in standard formulations of the Barro-Gordon model, there is no real trade-off between credibility and stabilization; a linear penalty on observed inflation eliminates the inflation bias without impinging on the discretion of the central bank to respond to shocks an efficient manner. If this is indeed the case, then there is no horse race: inflation targeting is a first best policy that cannot be dominated by the ERM. Those who take this result at face value need read no further. We suspect, however, that the credibility-stabilization trade-off is not so easily eliminated in the real world, and we take the result to be a methodological criticism of the Barro-Gordon model. In section 1, we modify the preferences of the central bank to restore the trade-off, even when a W&PT contract is implemented.[5] Another shortcoming of the Barro-Gordon

5. Walsh (1995) has recently shown that this can also be accomplished by changing the specification of the labor market. We suspect, however, that our modification is more relevant.

model is that political pressures on the central bank are not modeled explicitly. Our modification phrases the credibility problem in terms of political pressures, but this is a poor substitute for a real political economy model.

1. MODIFYING THE BARRO-GORDON MODEL TO RESTORE THE TRADE-OFF

In this section, we show how the Barro-Gordon model can be modified to restore the credibility-stabilization trade-off, even when a W&PT performance contract is imposed on the central bank governor. We start with a very simple framework:

$$y_t = y_t^n + (\pi_t - \pi_{t|t-1}) + x_t \,, \tag{1}$$

$$i_t - \pi_{t+1|t} = r - \delta y_t \,, \tag{2}$$

where p_t is the log of the price level in period t, and $\pi_{t|t-1} \equiv E_{t-1}(p_t - p_{t-1})$ and $\pi_{t+1|t} \equiv E_t(p_{t+1} - p_t)$ are expectations of inflation. Equation (1) is a "Lucas" supply curve, which states that output depends on an inflation prediction error and a productivity shock; x_t is i.i.d. and has expected value zero. Equation (2) is an IS curve, which states that the real rate of interest depends inversely on the level of output. We assume that the central bank sets the inflation rate, π_t, directly each period.[6]

y_t^n is the "natural" rate of output and $r_t^n = r - \delta y_t^n$ is the corresponding "natural" rate of interest; they are the values these variables would take in a full information equilibrium, where agents in the private sector see and respond to all of the shocks. In the "contract" models of Fischer and Gray, and in the "islands" models of Barro and Lucas, the natural rate of output generally depends on the realization of the supply shock; that is why we have given y_t^n and r_t^n time subscripts. We need not be concerned with the details of this in what follows, but we will take y_t^n and r_t^n to be the socially optimal values. We denote the optimal rate of inflation by π_t^n. The loss function of the central bank (or its governor) is

$$L = .5[y_t - (y_t^n + \bar{y})]^2 + .5(\pi_t - \pi_t^n)^2 + \omega\pi + .5\beta[i_t - \pi_{t+1|t} - (r_t^n - \bar{r})]^2 \,, \tag{3}$$

where $\bar{y}$ and $\bar{r}$ are positive constants. We assume that the central bank sees the productivity shock, x_t, before it has to choose the inflation rate, π_t.

Here, it may be useful to review the literature leading up to our discussion. If the loss function were limited to the first two terms, then we would have a typical example of the original Barro-Gordon model. The central bank tries to stabilize the econ-

6. Adding velocity shocks would not matter since they would be fully accommodated in the examples of this section and the next. Adding an LM curve with nominal interest rates would complicate the algebra in this section, and it would add "game" aspects to national policy making in the next. Neither complication would seem to add to the basic insights.

omy against the productivity shock, x_t. It also tries to achieve an inflation target, π_t^n, and a level of output that is higher than the natural rate, y_t^n, which is the equilibrium rate that the private sector is chasing. Thus, $\bar{y}$ represents a distortion.[7] We view it as a political distortion; the central bank is under pressure to create a higher rate of employment than the market will on average allow. The private sector understands this and expects the central bank to try to pump the economy up. More specifically, the private sector expects the central bank to raise the rate of inflation until it conflicts enough with the inflation goal that the bank finally resists any further pressure to raise employment. As is well known, in a rational expectations equilibrium, the central bank is not able to increase the rate of employment on average, and the economy is left with an inflation bias that benefits no one.

The inflation bias could of course be eliminated by constraining the central bank to follow a k percent rule for money growth, but this would leave it with no discretion to respond to shocks. Alternatively, the bank could be constrained by a rule that states exactly how it should respond to all of the shocks that might affect the economy, but this is generally thought to be infeasible.[8] Thus, the Barro-Gordon model seemed to provide a useful vehicle for studying the credibility problem that central banks are generally thought to face: the bank needs to find a way of committing itself not to respond to political pressures to inflate while at the same time retaining the flexibility to respond to unforeseen events.

Rogoff (1985) showed that the inflation bias could be reduced by increasing the weight on inflation in the central bank's loss function; however, this would distort the stabilization effort, since the bank would give too little weight to employment when responding to shocks. Canzoneri (1985) showed that targeting rules for money growth would reduce the inflation bias, but again at the expense of flexibility in the stabilization effort. And indeed, a very large literature has developed using the Barro-Gordon model to explore this credibility-stabilization trade-off. Then, Walsh (1995) found a way of eliminating the trade-off altogether. The third term in (3) represents the penalty on observed inflation in the performance contract that W&PT envisage. We will see that an appropriately chosen "price," ω, will induce the central bank to implement the first best policy. As stated in the introduction, we view this result as a methodological criticism of the Barro-Gordon model, rather than a statement about the ease with which the trade-off can be resolved. Thus, we want to modify the model in a way that restores the trade-off, even when a linear penalty on inflation can be imposed.

To do this, we must understand how the performance contract works. Walsh's result rides on a curious feature of the Barro-Gordon model that seems to have gone

7. In some versions of the model, $y_t^n + \bar{y}$ is taken as the socially optimal rate of output; see for example Canzoneri (1985).

8. In the real world, unlike our model, the structure of the economy, and the source and distribution of shocks, are not very well understood. The targeting procedures of New Zealand and Canada do have some rather well-specified escape clauses (see Ammer and Freeman 1994), and a tactful definition of inflation can allow for some contingencies. However, no one would argue that such provisions can constitute a complete contingent contract. To capture this fact in our analysis, we simply rule out contingent contracts.

unnoticed by those of us who have asserted that the model exhibits a fundamental trade-off between credibility and stabilization. In particular, the Barro-Gordon inflation bias is not state contingent. It does not depend on the shocks that cause the stabilization problem; it just depends on the size of the distortion embodied in $\bar{y}$. Or to put it another way, no matter what the state of the economy, at the first best outcome the central bank has a fixed marginal incentive to inflate, related only to the size of $\bar{y}$. The performance contract just imposes an offsetting marginal cost, ω. Having eliminated the marginal incentive to inflate, the central bank can be relied upon to implement the first best stabilization policy, at its own discretion and without any further monitoring.

The way to break up this result is obvious: modify the model so that the inflation bias is state contingent and depends on the shocks that are causing the stabilization problem. But, this is not as straightforward as it may at first seem. The inflation bias is caused by the inflationary expectations of agents on the supply side of the economy. If these agents are to incorporate a shock into their expectations and pass it on to the inflation bias, then they must be able to see the shock, and respond to it. This creates a problem for us, since the stabilization problem is caused by the inability of agents to see and respond to shocks. In our model, for example, if the agents in the supply curve see the productivity shock, then output will always be at its natural rate, y_t^n. We must make the inflation bias state contingent, but we cannot eliminate the stabilization problem in the process.

The way around this difficulty is to shift the credibility problem to other agents in the model. Let them see shocks that agents in the supply side do not, and let them incorporate the information into their actions in a way that creates an inflation bias. The Barro-Gordon model is basically an IS-LM model. The only other agents are savers, and the only other relative price is the real interest rate. If we are to stay within the basic confines of the Barro-Gordon model, we have to shift the credibility problem to savers. Fortunately, it seems reasonable to assume that these agents make their decisions on the basis of more recent information than agents on the supply side. Indeed, the IS-LM model makes exactly that assumption: the interest rate in (2) responds to the productivity shock, x_t, that is not incorporated into the inflation expectations in (1).

This leads us to add the last term in the central bank loss function, which states that the bank tries to keep the real interest rate at a level below the natural rate. Once again, we interpret the distortion embodied in $\bar{r}$ as coming from political pressure, pressure to keep the interest rate low. We do not know of a political economy model that explains this pressure, but we certainly do observe it in practice.[9] Perhaps there is not a political awareness of how high the natural rate of interest is, just as it was difficult for some to accept the rising natural rate of unemployment. Charles Goodhart has suggested to us that the pressure may be due to the dispersion of lenders and the concentration of borrowers, who can form effective lobby groups. In the United

9. We have modeled the pressure in terms of real rates. A focus on nominal rates would produce the same basic results, as long as the nominal interest rate target was inconsistent with the inflation target in the Fisher equation (that is, as long as $\bar{\imath} < r_t^n + \pi_t^n$).

States, high interest rates have been criticized by Democratic and Republican administrations for being in conflict with growth policy. In Europe, high interest rates make it difficult for governments to finance their deficits and meet the fiscal convergence criteria specified in the Maastricht Treaty. In any case, political complaints about interest rates have been quite prevalent in recent years. The distortion embodied in $\bar{r}$ would seem to be at least as relevant as the one represented by $\bar{y}$.

The central bank's first-order condition is

$$L_\pi = (\pi_t - \pi_{t|t-1} + x_t - \bar{y}) + (\pi_t - \pi_t^n) + \omega$$
$$- \delta\beta[\bar{r} - \delta(\pi_t - \pi_{t|t-1} + x_t)] = 0 . \tag{4}$$

Since the private sector understands the motives of the central bank, it can use this first-order condition to derive $\pi_{t|t-1}$. Taking expectations of (4), conditional on $t-1$ information, we have

$$\pi_{t|t-1} = \pi_t^n + \bar{y} + \delta\beta\bar{r} - \omega . \tag{5}$$

Using this in (4), we find the *discretionary solution*:

$$\pi_t^d = \pi_t^n + (\bar{y} + \delta\beta\bar{r} - \omega) - (.5 + \beta\Delta)x_t ,$$
$$y_t^d = y_t^n + (.5 - \beta\Delta)x_t ,$$
$$i_t^d - \pi_{t+1}^d = (i_t - \pi_{t+1|t}) - (\pi_{t+1} - \pi_{t+1|t}) = r - \delta y_t^d$$
$$+ (.5 + \beta\Delta)x_{t+1} \tag{6}$$

where $\Delta = .5\delta^2/(2 + \beta\delta^2)$, and therefore $0 < \beta\Delta < .5$.

If there were no political distortions ($\bar{y} = \beta = 0$), the *optimal solution* would be

$$\pi_t^0 = \pi_t^n - .5x_t , \; y_t^0 = y_t^n + .5x_t . \tag{7}$$

(Here, we have set $\omega = 0$, as it is not needed.) Note that it is optimal to accommodate half of the productivity shock. The *inflation bias* is

$$\pi_t^d - \pi_t^0 = (\bar{y} + \delta\beta\bar{r} - \omega) - \beta\Delta x_t . \tag{8}$$

In the discretionary solution, the private sector gets its way on average. Political pressures do not raise output or lower interest rates because the private sector anticipates their effect on the central bank and incorporates inflationary expectations into wage, price and nominal interest rate settings. Political pressures do create an inflation bias, and the interest rate pressure distorts the stabilization effort as well.

Equations (6), (7), and (8) confirm our earlier discussion. Beginning with the original Barro-Gordon Model (by setting $\omega = \beta = 0$), we see that the inflation bias, $\bar{y}$, is independent of the shock that is causing the stabilization problem. However,

the stabilization effort is efficient; that is, the central bank is responding appropriately to the productivity shock in this case. Adding a symmetric C&R penalty for deviations from the inflation target (by putting more weight on the squared inflation term in the loss function) would make the bank respond too little to the shock. However, the linear W&PT penalty can eliminate the inflation bias without distorting the stabilization effort; that is, setting $\omega = \bar{y}$, the discretionary solution reduces to the optimal solution.

Adding political pressure on interest rates (by letting $\beta > 0$), the inflation bias becomes larger (on average) and shock dependent. Moreover, the stabilization effort is distorted; the central bank responds too vigorously to the productivity shock. The linear W&PT penalty can eliminate the expected inflation bias (by setting $\omega = \bar{y} + \delta\beta\bar{r}$), but the stabilization effort is still distorted.[10]

Thus, our modification of the Barro-Gordon model has restored the trade-off between credibility and stabilization. The linear W&PT penalty represents one approach to that trade-off: it eliminates the expected part of the inflation bias. But since the performance contract does not achieve the first best solution, it is quite possible that other approaches will be more attractive. For example, a k percent rule would completely eliminate the inflation bias. The k percent rule would leave no room for stabilization, but it would still be better than the performance contract if interest rate pressures were badly distorting the stabilization effort. The symmetric C&R penalty may also be preferable to the linear W&PT penalty in some circumstances; we have not investigated this possibility.

2. INFLATION TARGETING VERSUS THE ERM

A different mechanism for achieving monetary stability has received more attention in recent years. Giavazzi and Pagano (1988) and many others have argued that by fixing the exchange rate with a low inflation currency, credibility can be simply imported. The basic problem with this approach is that the low-inflation-country's stabilization policy (or lack of one) is imported as well, and this policy may not be appropriate at home. However, in certain circumstances it may provide a better approach to the credibility-stabilization trade-off than a performance contract with the linear W&PT penalty. We turn now to a comparison of these two mechanisms for achieving monetary stability.

First, the model of the last section must be extended to include a second country. For concreteness, we will call the home country Great Britain and the foreign country Germany, and we will assume that the Bundesbank is immune to the political pressures discussed in the last section. The supply curves for Great Britain and Germany are

$$y_t = y_t^n + \pi_t - \pi_{t|t-1} + x_t + z_t\,,\; y_t^* = y_t^{n*} + \pi_t^* - \pi_{t|t-1}^* + x_t^* + z_t\,, \qquad (9)$$

10. Of course, a shock-contingent performance contract could achieve the first best solution. However, we are ruling them out for the reasons given earlier. The strong interest in Walsh's result derived from the fact that the contract could bring about the first best solution without being state contingent.

where z_t is a common productivity shock, and x_t and x_t^* are country-specific shocks. We assume that the goods produced in Great Britain and Germany are perfect substitutes. The aggregate IS curve is

$$i_t - \pi_{t+1|t} = i_t^* - \pi_{t+1|t}^* = r - \delta(y_t + y_t^*) \,. \tag{10}$$

The law of one price and interest rate arbitrage force real interest rates to equalize across countries. The IS curve states that the common real interest rate is inversely related to total output; $r_t^n = r - \delta(y_t^n + y_t^{n*})$ is the natural rate of interest. The central bank loss functions are

$$\begin{aligned} L &= .5[y_t - (y_t^n + \bar{y})]^2 + .5(\pi_t - \pi_t^n)^2 + \omega\pi_t + .5\beta[i_t - \pi_{t+1|t} \\ &\quad - (r_t^n - \bar{r})]^2, \\ L^* &= .5(y_t^* - y_t^{n*})^2 + .5(\pi_t^* - \pi_t^{n*})^2 \,. \end{aligned} \tag{11}$$

Since the Bundesbank is immune to political pressures, it always implements the optimal (from the German point of view) policy:

$$\pi_t^{0*} = \pi_t^{n*} - .5(x_t^* + z_t) \,, \; y_t^{0*} = y_t^{n*} + .5(x_t^* + z_t) \,. \tag{12}$$

This is the outcome for Germany in either the ERM or the flexible rate regime.[11] If Great Britain faced no political pressures ($\bar{y} = \beta = 0$), then its central bank would also implement the *optimal solution*:

$$\pi_t^0 = \pi_t^n - .5(x_t + z_t) \,, \; y_t^0 = y_t^n + .5(x_t + z_t) \,. \tag{13}$$

As in the last section, it is optimal to accommodate half of the productivity shock.

Great Britain's discretionary solution is calculated as before. Expected inflation is

$$\pi_{t|t-1} = \pi_t^n + \bar{y} + \delta\beta\bar{r} - \omega \,, \tag{14}$$

and the performance contract can be used to eliminate the expected inflation bias (by setting $\omega = \bar{y} + \delta\beta\bar{r}$). The *inflation targeting solution* for Great Britain is

$$\begin{aligned} \pi_t^{it} &= \pi_t^n - (.5 + \beta\Delta)(x_t + z_t) + \beta\Delta(x_t^* + z_t) \,, \\ y_t^{it} &= y_t^n + (.5 - \beta\Delta)(x_t + z_t) + \beta\Delta(x_t^* + z_t) \end{aligned} \tag{15}$$

11. We have specified the model so that "game" aspects associated with the productivity shocks are suppressed. In particular, if we had postulated a two-good model, the real exchange rate would become a bone of contention in the flexible rate regime; see for example, Canzoneri and Henderson (1991).

where $\Delta = .5\delta^2/(2 + \beta\delta^2)$. The inflation bias is given by

$$\pi_t^{it} - \pi_t^0 = -\beta\Delta(x_t + z_t) + \beta\Delta(x_t^* + z_t) . \tag{16}$$

As before, the performance contract eliminates the expected inflation bias, but interest rate pressure distorts the stabilization effort. If this pressure is not too great, then inflation targeting does quite well; that is, as β goes to zero, the inflation targeting solution converges on the optimal solution.

If Great Britain fixes its DM exchange rate, then it simply imports the German inflation rate; that is, $\pi_t = \pi_t^*$. The *ERM solution* for Great Britain is

$$\pi_t^{erm} = \pi_t^{n*} - .5(x_t^* + z_t) , \; y_t^{erm} = y_t^n + .5(x_t^* + z_t) + x_t . \tag{17}$$

Here, the inflation bias is given by

$$\pi_t^{erm} - \pi_t^0 = (\pi_t^{n*} - \pi_t^n) + .5(x_t - x_t^*) . \tag{18}$$

The ERM makes British policy immune to domestic political pressures. However, the ERM imposes other costs, most of which are well known. The Bundesbank is pursuing its own objectives, and the policy it exports need not be appropriate for the rest of Europe. It may be aiming at an inflation target that is inappropriate, a problem that has been discussed by Canzoneri and Rogers (1990), and it may be responding inappropriately to shocks. Here, the Bundesbank responds appropriately to the common shock (the global productivity shock, z_t), but it transfers German problems to the British economy (as illustrated by the German productivity shock, x_t^*), and it does not respond at all to British problems (as illustrated by the British productivity shock, x_t). These results are quite familiar from the literature on fixed versus flexible exchange rates, and also the game theory literature: fixed rate regimes work well for global shocks, but flexible rates are better for regional shocks.

Thus, the choice between inflation targeting and the ERM involves a number of considerations, and unfortunately the way costs and benefits add up need not be robust across models. However, the basic strengths and weaknesses of the two mechanisms are clear. Inflation targeting works well when political pressures are not too great in the first place, when the Bundesbank is pursuing very different policy goals, or when shocks causing the stabilization problem are primarily regional. The ERM is preferable when domestic political pressures are great, policy preferences are similar, and shocks are Europe wide.

In this section, we have assumed that inflation targeting is supported by the linear W&PT penalty on observed inflation rather than the symmetric C&R penalty for deviating from an announced target, and we have used the language of "performance contracts." We chose to do this because the W&PT approach is new. However, it should be clear that when comparing inflation targeting to the ERM, the C&R penalty would produce much the same results. It would be interesting to com-

pare the two approaches to inflation targeting in an international context, but once again we have left this to future research.

3. CREDIBLE IMPLEMENTATION OF MECHANISMS FOR MONETARY STABILITY

So, what happened in 1992/1993? Why were some countries forced to abandon their tight peg with the DM? And, why did some adopt inflation targeting instead? Conventional wisdom—as expressed by the Committee of Central Bank Governors (1993a, b)—points to fundamental differences with German policy, as explained by the analysis of the last section.[12] According to this view, timely realignments could have addressed these problems and made the old ERM viable. Here we suggest another possibility.

In the last two sections, we simply assumed that either the linear W&PT penalty (on any observed inflation) or the symmetric C&R penalty (for deviations from the inflation target) could be credibly imposed on the central bank. We also assumed that the hard ERM was a viable option. In this section, we discuss the feasibility of actually implementing either of the mechanisms. Indeed, we suspect that feasibility may have been the determining factor in some countries' choice between the two; efficiency in stabilization, which is the focus of most of the academic literature, may just be the icing on the cake.

We begin with the inflation targeting mechanism. Two approaches have been discussed in the literature: Walsh (1995) suggested performance contracts, and Rogoff (1985) suggested delegation to an inflation averse agent. A third approach—simply announcing targets—seems to have been adopted by some countries. In this section, we discuss the strengths and weaknesses of these three approaches.

In principle, a performance contract could be used to impose either the linear W&PT penalty or the symmetric C&R penalty. In practice, the New Zealand "contract" came close to just that: graduated inflation penalties were evidently considered, but not adopted in the end.[13] Instead, the contract implies that the governor can be dismissed if inflation performance does not conform with agreed targets.[14] In addition, the central bank's budget is set in nominal terms for an extended period of time. This may constitute a linear penalty on inflation, but it is doubtful that the amount budgeted was calculated with some marginal inflation cost in mind. Only time will tell how successful the New Zealand model can be.

The basic question here is whether performance contracts are binding. Walsh (1995) asserts that "the legal enforceability of contracts ensures that the government can credibly commit to the (penalty) scheme." We suspect the issue is not so clear-

12. In particular, competitiveness problems and German reunification were the asymmetric shocks that made the ERM in its hard form too costly to continue.

13. See Goodhart and Viñals (1994).

14. Walsh (1995) has reformulated the contract model to show that an optimal dismissal rule can support the first best policy. However, the dismissal rule has to be written in terms of the supply shock, and we have been assuming that contingent contracts are not feasible. New Zealand's "contract" does include some well-defined escape clauses (see Ammer and Freeman 1994), but Walsh finally concludes that "the procedures . . . are time inconsistent."

cut. Contracts can resolve principal-agent problems in the private sector because there is a higher authority, the law courts, that will enforce them. But here, the party charged with monitoring performance and imposing penalties is a sovereign entity; there is (by definition) no higher authority that can force the government to live up to the terms of the contract. As McCallum (1995) has noted, "contracts between governments and central banks do not overcome the motivation for dynamic inconsistency, they merely relocate it."[15] Legal resolutions seem to be ruled out by the very definition of the problem.

A more useful way of proceeding is to look for "costs" that make it difficult for a sovereign entity to reverse a decision once made. There seem to be two possibilities: institutional inertia and political risk. Persson and Tabellini (1993) described the first, saying government commitment "is a reasonable assumption if we view the contract as a statute for the central bank. Clearly, it is possible to change the central bank law, but only according to a preset procedure which requires time." The voluntary shouldering of political risk is another commitment device. A sympathetic (or appreciative?) government might be tempted to be lenient with the bank governor after an inflationary episode, but an open abrogation of the inflation contract would probably be viewed as a blatant political payoff. The government would almost surely be subjected to public criticism by opposition parties.

The New Zealand "contract" would seem to be supported by both institutional inertia and political risk. The EU countries that have adopted inflation targeting seem to be relying on political risk alone. In announcing inflation targets, a central bank (or government) puts its reputation on the line. Moreover, the central bank can choose the degree of risk that it wishes to expose itself to. Some countries (the United States, for example) minimize the risk by only stating their inflation objectives in general terms. Others (like Canada, Finland, Spain, Sweden, New Zealand, and the United Kingdom) go out of their way to increase the risk by adopting official targets. Somewhere in between are countries (like France, Germany, and Switzerland) that allude to numerical goals, but only within context of a broader economic plan.[16] In choosing the degree of risk, the central bank may be able to set the level of the inflation penalty, but fine tuning would presumably be more difficult than with an explicit performance contract.

The risk of missing an announced target clearly imposes the symmetric C&R penalty. Could political risk be used to impose the monotonic W&PT penalty as well? The central bank would have to acknowledge an optimal inflation rate, but say that it is embarrassed by any inflation at all. Making such contradictory statements would be difficult in practice.[17]

15. Viewed from this perspective, the literature on central bank independence seems to have come full circle. The original argument for an independent central bank was that the government could not precommit to the optimal policy; now, the new literature on performance contracts asks us to assume that the government can precommit to imposing the penalties that will bring it about.

16. Ammer and Freeman (1994) called them "quantified inflation objectives," and *The Economist* magazine (April 1995 issue) called them "informal targets."

17. Svensson (1995) suggested an approach that might be more promising. He noted that (with quadratic utility) the W&PT penalty can be generated by simply announcing an inflation target that is lower

Rogoff (1985) suggested that the government delegate policy decisions to someone who is perversely inflation conscious. Firing such a person would run the same political risks as abrogating the terms of a performance contract. In practice, however, it would be difficult to find the person with the right degree of perversity. Indeed, we may not even be able to tell whether the linear W&PT penalty or the symmetric C&R penalty is being imposed. Can we know what functional form an individual's perversity might take?

Next, we turn to "costs" that might support a hard ERM. Once again political risk looms large. Having to leave the ERM (or even ask for a realignment) is a highly focussed news event. Here, two factors should be emphasized: (1) With the ERM, a central bank is punished immediately for reneging on a promise of low inflation; the exchange rate is an asset price that renders an immediate verdict on the expected future effect of current policy actions. By contrast, the inflation targeting mechanism has a delay of a year or more between a policy action and the inflationary outcome that would trigger a punishment; this delay may call the mechanism's credibility into question. (2) The exchange rate also renders a verdict on expected future policy actions, actions that the central bank may not even be contemplating. This adds an instability that may have been the ERM's downfall, and that the inflation targeting mechanism does not share.

In particular, some have argued that capital market liberalization has led to the possibility of self-fulfilling speculative attacks.[18] Eichengreen, Rose, and Wyplosz (1994) assert that the 1992 "speculative attacks which forced (governments) to raise interest rates created incipient macroeconomic imbalances rather than the other way around and more generally increased the cost of defending the prevailing currency pegs." This view is in stark contrast to the conventional view of the Committee of Central Bank Governors (1993a, b).

4. SUMMARY AND CONCLUSIONS

In this paper, we studied two mechanisms for achieving monetary stability: inflation targeting (cum inflation penalties) and the ERM. First, in section 1, we modified the Barro-Gordon model by introducing political pressure to keep interest rates low. This modification was necessary, in light of recent work by Walsh (1995), to retain the trade-off between achieving credibility and stabilization. Without such a trade-off, the model loses its usefulness for studying the commitment problem.

Then, in section 2, we compared the efficiency of the two mechanisms in address-

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than the social optimum. To see this, note that

$$L = .5[y_t - (y_t^n + \bar{y})]^2 + .5(\pi_t - \tau_t)^2 = .5[y_t - (y_t^n + \bar{y})]^2 + .5[(\pi_t - \pi_t^n) + (\pi_t^n - \tau_t)]^2$$

$$= .5[y_t - (y_t^n + \bar{y})]^2 + .5(\pi_t - \pi_t^n)^2 + (\pi_t^n - \tau_t)\pi_t - .5(\pi_t^n - \tau_t)(\pi_t^n + \tau_t),$$

and choose the target, τ_t, so that $\pi_t^n - \tau_t = \omega$.

18. See for example Eichengreen and Wyplosz (1993) and Eichengreen, Rose, and Wyplosz (1994), Obstfeld (1994), and Portes (1994).

ing the trade-off. Either can eliminate the expected inflation bias. We found that inflation targeting is better than the ERM when political pressures do not distort the stabilization effort much in the first place, when the Bundesbank is pursuing very different policy objectives, or when shocks causing the stabilization problem are primarily regional in nature.

Finally, in section 3, we identified two "costs"—institutional inertia and political risk—that make it difficult for a sovereign entity to reverse a decision once made. We argued that such costs are necessary for the credible implementation of either mechanism. (In the case of inflation targeting, we also tried to identify methods of actually imposing the linear W&PT penalty or the symmetric C&R penalty.) In comparing the two mechanisms, we noted that inflation targeting requires a delay of a year or more between action and punishment; by contrast, the exchange rate is an asset price that renders an immediate verdict on the effectiveness of both present and (expected) future policy. The exchange rate mechanism may therefore be thought to be more credible, but it is also open to self-fulfilling speculative attacks. This is one reason why inflation targeting might be able to survive in an environment where the (old) ERM could not, but only time will tell. Our discussion in this section was heuristic; clearly, a more formal modeling of these issues would be desirable.

Conventional wisdom about collapse of the (old) ERM—as expressed by the Committee of Central Bank Governors (1993a, b)—follows the line of reasoning found in section 2. So does most of the academic literature. It is just assumed that either mechanism (and any kind of inflation penalty) can be credibly implemented, and efficiency in stabilization becomes the determining factor in regime selection. New worries about capital mobility and self-fulfilling speculative attacks—as expressed by Eichengreen and Wyplosz (1993), Eichengreen, Rose, and Wyplosz (1994), Obstfeld (1994), and Portes (1994)—follow the reasoning found in section 3. The determining factor in regime selection is the feasibility of credible implementation, and efficiency in stabilization is just the icing on the cake.

LITERATURE CITED

Ammer, John, and Richard Freeman. "Inflation Targeting in the 1990s: The Experiences of New Zealand, Canada, and the United Kingdom." IFDP #473, Board of Governors of the Federal Reserve System, 1994.

Barro, Robert, and David Gordon, "Rules, Discretion, and Reputation in a Model of Monetary Policy," *Journal of Monetary Economics* 11 (July 1983), 101–22.

Bowen, Alex. "British Experience with Inflation Targetry." Mimeo, Bank of England, 1994.

Canzoneri, Matthew. "Monetary Policy Games and the Role of Private Information." *American Economic Review* 75 (December 1985), 1056–70.

Canzoneri, Matthew, and Dale Henderson. *Monetary Policy in Independent Economies*. MIT Press, 1991.

Canzoneri, Matthew, and Carol Rogers. "Is the EC an Optimal Currency Area? Optimal Taxation versus the Cost of Multiple Currencies." *American Economic Review* 80 (June 1990), 419–33.

Committee of Governors of the Central Banks of the Members of the European Economic Community. *Annual Report 1992*. Basle: Committee of Governors, 1993. (a)

_____. "The Implications and Lessons to be Drawn from the Recent Exchange Rate Crisis: Report of the Committee of Governors." Processed, 21 April, 1993. (b)

Eichengreen, Barry, and Charles Wyplosz. "The Unstable EMS." *Brookings Papers on Economic Activity* 1 (1993), 51–143.

Eichengreen, Barry, Andrew K. Rose, and Charles Wyplosz. "Speculative Attacks on Pegged Exchange Rates: An Empirical Exploration with Special Reference to the European Monetary System." Mimeo, 1994.

Fischer, Stanley. "Rules versus Discretion in Monetary Policy." In "Handbook of Monetary Economics," vol. 2, edited by Ben Friedman and Frank Hahn, pp. 1156–84. North-Holland, 1990.

Freedman, Charles. "The Canadian Experience with Targets for Reducing and Controlling Inflation." Mimeo, Bank of Canada, 1994.

Giavazzi, Francesco, and Alberto Giovannini. *Limiting Exchange Rate Flexibility*. MIT Press, 1989.

Giavazzi, Francesco, and Marco Pagano. "The Advantage of Tying One's Hands: EMS Discipline and Central Bank Credibility." *European Economic Review* 32 (1988), 1055–82.

Goodhart, Charles, and Jose Viñals. "Strategy and Tactics of Monetary Policy: Examples from Europe and the Antipodes." LSE Financial Markets Group Special Paper no. 61, August 1994.

Lohmann, Suzanne. "Optimal Commitment in Monetary Policy: Credibility versus Flexibility." *American Economic Review* 82 (March 1992), 273–86.

McCallum, Bennett. "Two Fallacies Concerning Central Bank Independence." National Bureau of Economic Research Working Paper no. 5075, March 1995.

Obstfeld, Maurice. "The Logic of Currency Crises." National Bureau of Economic Research Working Paper no. 4640, February 1994.

Persson, Torsten, and Guido Tabellini. "Designing Institutions for Monetary Stability." *Carnegie-Rochester Conference Series on Public Policy* 39 (1993), 53–84.

Portes, Richard. "EMS and EMU after the Fall." *The World Economy* 19 (1993), 1–16.

Rogoff, Kenneth. "The Optimal Degree of Commitment to an Intermediate Monetary Target." *Quarterly Journal of Economics* (November 1985), 1169–90.

Svensson, Lars. "Estimating and Interpreting Forward Interest Rates: Sweden 1992–94." Center for Economic Policy Research discussion paper no. 1051, 1994.

_____. "The Swedish Experience of an Inflation Target." Mimeo, 1994.

_____. "Inflation Targeting Need Not Increase Output Variability: Comment on Rogoff and Walsh." Mimeo, April 1995.

Visco, Ignazio. "Inflation Targeting and Monetary Policy. Notes for Discussion on the Italian Experience." In *Inflation Targets*, edited by Leonardo Leiderman and Lars Svenssen. Center for Economic Policy Research, forthcoming 1995.

Walsh, Carl. "Optimal Contracts for Central Bankers." *American Economic Review* 85 (March 1995), 150–67.

_____. "Is New Zealand's Reserve Bank Act of 1989 an Optimal Central Bank Contract?" *Journal of Money, Credit, and Banking* 27 (November 1995, Part 1), 1179–91.