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"Credibility, Capital Controls, and the EMS"

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Abstract

A common rationale for EMS membership is that it enhances the credibility of a central bank's commitment to stable monetary growth. In this paper we consider this idea in the light of two features of the system, namely, the existence of exchange rate bands and the prevalence of capital controls. In our model, capital controls themselves affect credibility, reducing it in the absence of exchange-rate bands but enhancing it when there are such bands. We also show that it is difficult to reconcile the non-zero width of the bands with the credibility-based interpretation of the EMS.

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Summary

The European Monetary System (EMS) entails agreement on a set of exchange rate bands that act as a constraint on member central banks' policies. A common rationale for a government's agreeing to such a constraint is that it enhances the credibility of the central bank's commitment to maintaining a low and stable rate of money growth. The importance of central bank credibility is that, without it, the public expects a high inflation rate, and this will increase the cost of any attempt to reduce inflation. Establishing credibility means convincing the public that the central bank will not deviate from its money-supply targets in order to attain the short-term expansionary effects associated with surprise inflation. This therefore requires that the public be convinced that the authorities have some incentive to refrain from introducing monetary surprises.

Accordingly, this paper considers the effects of EMS membership on credibility, defined as the authorities' incentive to refrain from introducing monetary surprises. It considers this issue in the light of two prominent features of the system. One is the existence of exchange rate bands that are wide enough to allow member central banks some degree of flexibility in their short-term monetary policy and that can be realigned by mutual agreement. The other is the capital controls adopted by some member countries; these capital controls are generally thought to limit, but not to eliminate, movements of capital in response to interest rate differentials.

The paper finds that capital controls affect credibility because they alter the relative effect of unanticipated expansionary monetary policy on output and on inflation. This affects both the gains from deviating from money-supply targets and the costs associated with lost reputation. The direction of this effect depends on the exchange rate bands. In the absence of bands (or if the bands are so wide that they do not constrain monetary policy), liberalization of capital controls enhances credibility. If the bands are narrow enough to act as a constraint on monetary policy, liberalization of capital controls reduces credibility.

The analysis also finds that credibility depends on the width of the bands. In the model, there is generally a point beyond which further narrowing the band increases credibility. The model suggests that, if EMS membership is needed to establish credibility, this can only be achieved with bands of zero width. In this light, it is difficult to reconcile the credibility-based rationale for EMS membership with the existence of exchange rate bands of non-zero width.

I. Introduction

The exchange-rate bands established under the European Monetary System act as a constraint on members' monetary policies. Why might a country willingly accept such a constraint by joining the EMS? One explanation that is frequently given is based on the idea of credibility. A central bank that wishes to lower the inflation rate may try to reduce the short-run effect on output associated with contractionary policies by lowering the public's expectations of inflation. In order to do so, it must convince the public that it will not yield to the temptation to raise output temporarily above its natural rate through a surprise monetary expansion. A public with rational expectations will not be so convinced unless the authorities do actually have the incentive to adhere to their rule.

It has been suggested that credibility is an important consideration leading to EMS membership, especially among small high-inflation countries. One way for a government to establish credibility for an anti-inflationary policy is to appoint a conservative central banker, who is highly averse to inflation (Canzoneri (1985), Rogoff (1987)). It has been argued that EMS membership plays an equivalent role: it allows member countries, in effect, to appoint a German central banker, establishing credibility by linking the country's monetary policy to the strong anti-inflationary preferences of the Bundesbank (Giavazzi and Giovannini (1987)).

This argument deserves further scrutiny. The argument implies that, by joining the EMS, member countries surrender their control over monetary policy to the Bundesbank. This ignores an important feature of the system: the EMS exchange-rate mechanism does not fix the exchange rate of those countries, but only limits exchange rate fluctuations within specified bands; members still have some scope for autonomous policy within the bands (Gros (1988b)). The system also allows for periodic realignments, subject to negotiation among the members. According to the logic of the "German central banker" argument, it is hard to account for this remaining degree of flexibility: if only the Bundesbank can establish credibility for a noninflationary policy, why should any remaining flexibility be allowed to the other central banks?

This suggests an important distinction: giving a country's central bank the incentive to behave responsibly is not generally the same thing as limiting an irresponsible central bank's freedom of action. The former concept is compatible with exchange rate bands of non-zero width; the latter suggests that the less flexibility accorded to a central bank, the better, and thus militates in favor of arbitrarily narrow bands. Given the empirical observation that the EMS bands are of nontrivial width, we focus on the former concept of credibility: a rule is credible if it is rational for the public to believe that the authorities have the incentive to adhere to this rule.

Another important feature of the EMS that suggests that the system is not designed simply to curtail member central banks' scope for independent policy is the capital controls that have been imposed by some member countries, including France and Italy. Typically, it has been argued that capital controls are intended to preserve some degree of autonomy for members' monetary policies as well as to avoid massive speculative capital during discrete exchange-rate realignments. Analyses of the EMS also typically assume that existing capital controls completely eliminate international capital flows across those countries' borders (Giavazzi and Pagano (1986), Giavazzi and Giovannini (1987)). Capital controls to preserve autonomy and protect realignments are hard to reconcile with the standard credibility argument, since the logic of that argument suggests that it would be better if autonomy were limited and if realignments were made as difficult as possible. Moreover, the assumption that capital is completely immobilized by the restrictions imposed seems quite implausible: surely, given the many economic interlinkages among the European economies, any capital controls must be imperfect (Gros (1988a)). Furthermore, a potentially important question has thereby been overlooked: what effect do capital controls have on credibility, either inside or outside a system of exchange-rate bands? This question is particularly relevant in the context of the international liberalization of capital markets that is currently being undertaken within the European Community under the 1992 Program. In order to address this question, we shall focus on the case in which capital controls are not sufficiently stringent to result in a complete elimination of capital flows, but only to alter the interest parity relationship.

As mentioned in the previous paragraph, the possibility of occasional exchange rate realignments is an important empirical feature of the system: realignments cannot take place immediately or continuously, but can be negotiated with other members. In this paper, we attempt to capture the flavor of these delayed and infrequent realignments by assuming than an exchange-rate band is given in the current period but that a realignment can take place at the beginning of the following period.

The purpose of this paper is therefore to analyze, in a unified framework, both the "gains in credibility" argument for joining the EMS and the implications of capital controls within the system. Our analysis is in the spirit of the Barro and Gordon (1983a,b) model of reputation and monetary policy. Our analysis explicitly takes into account both the exchange-rate bands and the imperfect restriction of capital movements. We find that liberalization of capital controls may have quite different effects on credibility, depending on the exchange-rate system: in our model liberalization may increase credibility outside the EMS but decreases it inside the EMS exchange-rate bands. We also find that, given the nonzero width of the bands, EMS membership cannot restore credibility to a central bank's monetary rule.

As in the Barro and Gordon framework, the gains from credibility arise in a model in which optimal policy is time-inconsistent (Kydland and

Prescott (1978), Calvo (1978)) in that the central bank may gain by using inflationary surprises to affect real output. The government's attempt to affect real output, however, will not succeed if the public is aware of the government's temptation to deviate from any preannounced monetary commitments; in the resulting consistent equilibrium, the level of output remains at its natural level but the inflation rate is inefficiently high.

In order to avoid this consistent equilibrium, the authorities may try to commit themselves to following a preannounced monetary rule. Precommitment can be successful only if the authorities would incur some penalty if they deviate from their rule. One form that this penalty can take is that if the authorities were to deviate from the preannounced rule, the public would not believe their announcements in the following period, so that the economy reverts to the consistent equilibrium (Barro and Gordon (1983a)); this is a variant of the "trigger-strategy" mechanisms found in many dynamic games (Friedman (1986)). In this context, a rule is credible if the temptation to deviate from a monetary rule is less than the discounted value of the "punishment" associated with reversion to the consistent equilibrium: in that case, it is rational for the public to believe that the rule will not be broken.

When examining credibility, therefore, it is important carefully to consider two things: one is the temptation to cheat, the temporary gains from monetary surprises. The other is the punishment, as determined by the onerousness of the consistent equilibrium to which the economy reverts if the authorities lose their reputation. We use the difference between the present value of the punishment and the temptation as a measure of the credibility of a monetary rule.

We follow this approach in analyzing the implications of capital controls and exchange-rate bands. Using a simple model of a small open economy, we examine the influence of capital controls on the impact of monetary surprises on output and inflation. We then trace how this will influence both the government's temptation to cheat and the resulting punishment; the implications for credibility turn out to be different, depending on whether or not policy is constrained by a system of exchange-rate bands associated with the EMS.

Our main results are as follows: first in our model a relaxation of capital controls increases credibility in the absence of exchange-rate bands. In contrast, relaxing capital controls decreases credibility if policy is constrained by a system of exchange rate bands. Second, for a given degree of capital controls, the results of the model suggest that a government's monetary policy does not, in general, achieve credibility by joining the EMS and thereby facing exchange rate bands that constrain policy actions. The only case in which credibility gains might be obtained is one in which, in the absence of bands, the government has a "negative" level of credibility in that private agents realize that the government's welfare gains from deviating from preannounced plans (its temptation) are greater than its welfare losses from such actions (the

punishment). However, even in this case, joining the EMS will not restore a non-negative level of credibility for any finite width of band.

The rest of the paper is organized as follows. Section II develops a simple model of inflation and output for small open economies that face some degree of capital mobility, in order to analyze the economy's response to unanticipated monetary shocks. Section III specifies the government's problem of choosing the optimal monetary policy, depending on whether it keeps or breaks a monetary rule. As in the Barro and Gordon (1983) framework, the authorities minimize a loss function that is quadratic in output and inflation, subject to the behavior of the private sector; in our analysis, however, policy may also be constrained by the exchange-rate bands imposed under the EMS. In this section, we also formally define credibility and analyze the potential effects on credibility of capital controls and of the exchange rate bands. Section IV concludes the paper.

The formulation of the policy problems in this paper implies a hierarchical ordering of policy decisions. It is assumed that decisions pertaining to the design of a system of exchange rate bands, and decisions to retain or liberalize capital controls, are made prior to decisions pertaining to this period's money supply; the former, "structural," decisions are assumed to be encased in international agreements and thus relatively difficult to alter.

II. The Model of Output and Inflation

The model of this section is a variant of the familiar Mundell-Fleming framework under rational expectations (e.g., Kimbrough (1983)). Consider a small open economy that specializes in the production of a single good but consumes both the domestic good and a foreign good which are imperfect substitutes in consumption. The public holds wealth in the form of money and bonds. While economic agents hold only domestic money, they may hold either domestic or foreign bonds. Domestic and foreign bonds are perfect substitutes, so that in the absence of capital controls uncovered interest parity would hold; capital controls are represented as a proportional tax on foreign interest earnings, which leads to a departure from interest parity. 1/

The equations of the model are as follows:

$$(1) \quad y_t^s = \gamma\,(p_t - {}_{t-1}Ep_t)$$

1/ A model such as this often includes random shocks in macroeconomic relationships. Since here our focus is on the economy's response to policy-induced monetary surprises, we consider a limiting case in which the variances of all other unanticipated shocks approach zero.

$$(2)\quad y_t^d = \xi_0 - \xi_1 (i_t - {}_tEp_{t+1}^I + p_t^I) + \xi_2 (s_t + p_t^* - p_t)$$

$$(3)\quad m_t^d = \eta_0 + p_t^I + \eta_1 y_t - \delta i_t$$

$$(4)\quad m_t^s = m^T + z_t$$

$$(5)\quad i_t = (1-\theta)(i_t^* + {}_tEs_{t+1} - s_t)$$

$$(6)\quad p_t^I = \tau p_t + (1-\tau)(p_t^* + s_t)$$

$$(7)\quad y_t^s = y_t^d$$

$$(8)\quad m_t^s = m_t^d$$

where $0 \leq \theta < 1$ and $0 \leq \tau \leq 1$.

Here y_t is the log of domestic output; p_t and p_t^* are the logs of the price levels of the domestic and foreign outputs; s_t is the log of the nominal exchange rate expressed as the domestic currency price of the foreign exchange; p_t^I is the log of the domestic price index; i_t and i_t^* are the nominal domestic and foreign interest rates; m_t is the log of the nominal amount of money; m^T is the target level of the money supply; z_t is a policy-induced shock to the supply of money; θ is a parameter representing the degree of capital mobility and τ is a parameter that represents the share of the domestic price level in the price index. E is the expectations operator.

Equation (1) is a simple aggregate supply equation of the Lucas (1973) and Fisher (1977) type. For convenience, the level of output is normalized such that its natural rate equals zero. Equation (2) indicates that aggregate demand for the domestic good depends on the real interest rate with a negative sign and the domestic relative price of the foreign good with a positive sign. Equation (3) is a semi-log demand for real money balances, where the relevant deflator is the aggregate price index. Equation (4) is the nominal supply of money, which may deviate from a predetermined target level m^T due to a policy-induced monetary shock z_t; this shock is not contemporaneously observed by the private sector.

Equation (5) states that deviations of the domestic interest rate from uncovered interest parity are solely accounted for by the existing capital controls, which are assumed to be binding. In particular, capital

controls are introduced here as a proportional tax on foreign interest earnings. Moreover, in order to be consistent with recent European experience, it is also assumed that this tax is not set at a level high enough to eliminate international capital flows; we assume that some degree of capital mobility remains. Equation (6) defines the domestic price index as a weighted average of the price level of the domestic good and the price level of the foreign good expressed in domestic currency. Equations (7) and (8) are equilibrium conditions in the market for domestic goods and in the money market respectively.

Finally, to close the model, it is necessary to specify the behavior of the world price level and world interest rate, p_t^* and i_t^* respectively. For simplicity, we shall henceforth assume that these variables remain constant at the levels p^* and i^*, respectively. We also assume that the preannounced money-supply target is fixed at m^T. Notice that these assumptions imply that the inflation rate will be zero in the absence of money-supply shocks; rational expectations implies that, if there are no monetary surprises, output will be at its natural level (zero); any departure from this equilibrium is necessarily associated with the monetary shock z_t.

In the following section of the paper, we will want to consider two cases: one is the consistent equilibrium in which the monetary shock z_t is fully anticipated by the public. The other is a discretionary or rule-breaking equilibrium in which the authorities contemplate surprising the public. In order to allow for these cases, we define the unanticipated component of the monetary shock as $\tilde{z}_t = z_t - {}_{t-1}Ez_t$.

This model has a forward-looking solution; for this reason, the model can readily be restated in terms of deviations from expected levels. 1/ Subtracting equations (1) and (2) from the corresponding expressions that would result by taking expectations conditional on the information available at the end of period t-1, and using equations (5), (6), and (7) yields:

$$(9) \quad (\gamma+\xi_1\tau + \xi_2)\ \tilde{p}_t = [\xi_2+\xi_1(1-\theta) - \xi_1(1-\tau)]\tilde{s}_t$$

1/ This solution method requires that current prices and exchange rates have no bearing on expected future values of these variables. This would be consistent with rationality in a model with random shocks to macroeconomic relationships, even though, should the authorities cheat and introduce a positive monetary shock, this would be associated with a higher money supply in the following period, since, in the results to be developed below, cheating occurs with probability zero. Our model must thus be interpreted as a limiting case of such a stochastic framework, where the variances of all the shocks approach zero.

where $\tilde{p}_t$ and $\tilde{s}_t$ stand for the deviation of p_t and s_t from their corresponding expected values; that is: $\tilde{p}_t = p_t - {}_{t-1}Ep_t$ and $\tilde{s}_t = s_t - {}_{t-1}Es_t$.

Similarly, subtracting equations (3) and (4) from their corresponding expected values, and using equations (1), (5), (6) and (8) yields:

$$(10)\quad (\eta_1\gamma + \tau)\tilde{p}_t = -[\delta(1-\theta) + (1-\tau)]\tilde{s}_t + \tilde{z}_t$$

Equations (9) and (10) can now be solved for the equilibrium price level and exchange rate expressed as deviations from their expected values. The resulting solutions are:

$$(11)\quad \tilde{p}_t = \frac{a_2}{a_4a_1+a_3a_2}\,\tilde{z}_t$$

$$(12)\quad \tilde{s}_t = \frac{a_1}{a_4a_1+a_3a_2}\,\tilde{z}_t$$

where: $a_1 = \gamma + \xi_1\tau + \xi_2$

$a_2 = \xi_2 + \xi_1\tau - \xi_1\theta$

$a_3 = \eta_1\gamma + \tau$

$a_4 = \delta(1-\theta) + (1-\tau)$

and a_1, a_2, a_3, $a_4 > 0$.

The restriction that a_2 be positive is a sufficient condition to guarantee that changes in the domestic price level be positively related to changes in the unanticipated component of the money supply.

Substituting equation (11) into equation (1), the reduced form solution for the level of output is obtained:

$$(13)\quad y_t = \frac{a_2\gamma}{a_4a_1+a_3a_2}\,\tilde{z}_t$$

That is, output differs from its natural level only because of unanticipated movements in the money supply.

Since the monetary shock is not contemporaneously observed by the private sector, the public must form expectations on this shock. The unexpected component of the inflation rate equals the unexpected component of the price index, that is

$$\tilde{\pi}_t = \pi_t - {}_{t-1}E\pi_t = (p^I_t - p^I_{t-1}) - ({}_{t-1}Ep^I_t - p^I_{t-1}) = \tilde{p}^I_t$$

Using equations (11) and (12) and taking into account the definition of the price level specified in equation (6), we obtain the reduced-form solution for the unanticipated component of the inflation rate:

$$(14)\quad \tilde{\pi}_t = \frac{\tau a_2 + (1-\tau)a_1}{a_4a_1+a_3a_2}\,\tilde{z}_t$$

We can now analyze the effects of changing the degree of capital restriction on the equilibrium relationship between output and unanticipated inflation. In order to do so, define the partial derivatives of output and inflation with respect to unanticipated money,

$$\psi = (\partial y_t/\partial z_t) = \frac{\gamma a_2}{a_4a_1+a_3a_2} \geq 0$$

and

$$\phi = (\partial \pi_t/\partial z_t) = \frac{(\tau a_2 + (1-\tau)a_1}{a_4a_1 + a_3a_2} \geq 0$$

We define the reduced-form relationship between inflation and output with respect to an unanticipated monetary shock, the ratio of these reduced-form coefficients, as follows:

$$(15)\quad \rho = \frac{dy}{d\pi} = \frac{a_2\gamma}{\tau a_2 + (1-\tau)a_1}$$

$$= \gamma - \frac{\gamma(1-\tau)\ (\gamma+\xi_1\theta)}{\xi_2 + \tau\xi_1(1-\theta) + (1-\tau)\gamma}$$

The second line of equation (15) indicates that the inflation-output relationship given an unanticipated monetary shock, ρ, is less than the slope of the domestic supply curve, γ. The reason is that the inflation rate is the change in the price index, not just in the domestic price. The fact that $\rho < \gamma$ reflects the fact that the exchange rate changes more than the domestic price level in response to an unanticipated monetary shock; a similar result is found in other rational-expectations open-economy models (e.g., Kimbrough (1983)).

Because the degree of capital mobility affects the change in the exchange rate associated with the interest rate required to clear the money market in the face of a given monetary shock, it thereby influences the reduced-form inflation-output relationship ρ:

$$(16)\quad \frac{\partial \rho}{\partial \theta} = - \frac{\gamma(1-\tau)\xi_1(\gamma+\xi_1\tau + \xi_2)}{[\xi_2+\tau\xi_1(1-\theta) + (1-\tau)\gamma]^2} \leq 0$$

That is, restricting capital movements to a greater extent implies that the exchange rate will have to adjust more in response to a given monetary shock; capital controls therefore reduce the ratio of the output to the inflation effect of a monetary surprise. This relationship is illustrated in Figure 1: a higher degree of capital control increases the slope of the equilibrium locus relating output and inflation.

The important result of this section is the following: the higher the level of capital controls, the greater the effect of unanticipated monetary shocks on inflation relative to its effect on output. The intuition behind this result is as follows. Through the demand-for-money equation (3) together with the capital-market equilibrium condition (5), it is clear that the higher the degree of capital controls, the lower the response of the demand for money to a change in the exchange rate. Therefore, in order to restore equilibrium in the money market, there will have to be a larger increase in the exchange rate following a monetary surprise, the more restricted capital movements are. Since the exchange rate is a component of the general price index, the higher the degree of capital controls, the greater the extent to which adjustment will take place via price rather than via output variations. This result will be important in determining the authorities' temptation to introduce monetary surprises, as well as the consequences of reverting to the consistent equilibrium, as analyzed in the following section.

III. The EMS and the Credibility of Monetary Policies

In deciding on the optimal monetary policy, the monetary authorities wish to minimize a loss function that is quadratic in inflation and in deviations of output from the level desired by the authorities. This desired level of output is assumed to be different from the natural level,

due to some distortion in the economy (income taxes or minimum wage laws, for instance); it is this that generates the possibility of activist policy in the model. 1/

What distinguishes the problem of governments inside the EMS from the general case is that they are subject to the constraint imposed by the exchange-rate bands. The government's problem is therefore 2/

$$(17)\quad \underset{z_t}{\mathrm{Min}}\ L = E_t \sum_{t=0}^{\infty} \beta^t [(y_t - \hat{y})^2 + \alpha\pi_t^2]$$

subject to:

$$|s_t - s_t^T| \leq \omega$$

where: $\hat{y}$ is the log of the authorities' desired level of output, s_t^T is the target level of the exchange rate; ω is a constant determining the size of the exchange rate bands and β is a discount factor where $0 \leq \beta \leq 1$.

For simplicity, we assume here that the target level of the exchange rate coincides with the central rate. 3/ We also assume that the exchange rate can be realigned, but not instantaneously: if policy drives the exchange rate to the edge of its band this period, then at the beginning of the next period a new band is established whose center is the rate realized this period. This assumption has two important implications: one is that the band may limit the extent to which the exchange rate can change this period; the second is that if the exchange rate depreciates to the boundary of the band this period, this does not preclude further depreciation in the following period, although this further depreciation will be similarly limited by the width of the band.

As in the Barro and Gordon (1983a) framework, if the authorities solve the problem given in equation (17) taking the expectations of the public as given, and if the public's expectations are determined rationally, the resulting consistent equilibrium will entail output at its natural level and a fully-anticipated rate of inflation high enough that the marginal benefit of increasing output through further surprise monetary expansion is equal to the marginal cost of the concomitant additional inflation. If the authorities wish to avoid this consistent

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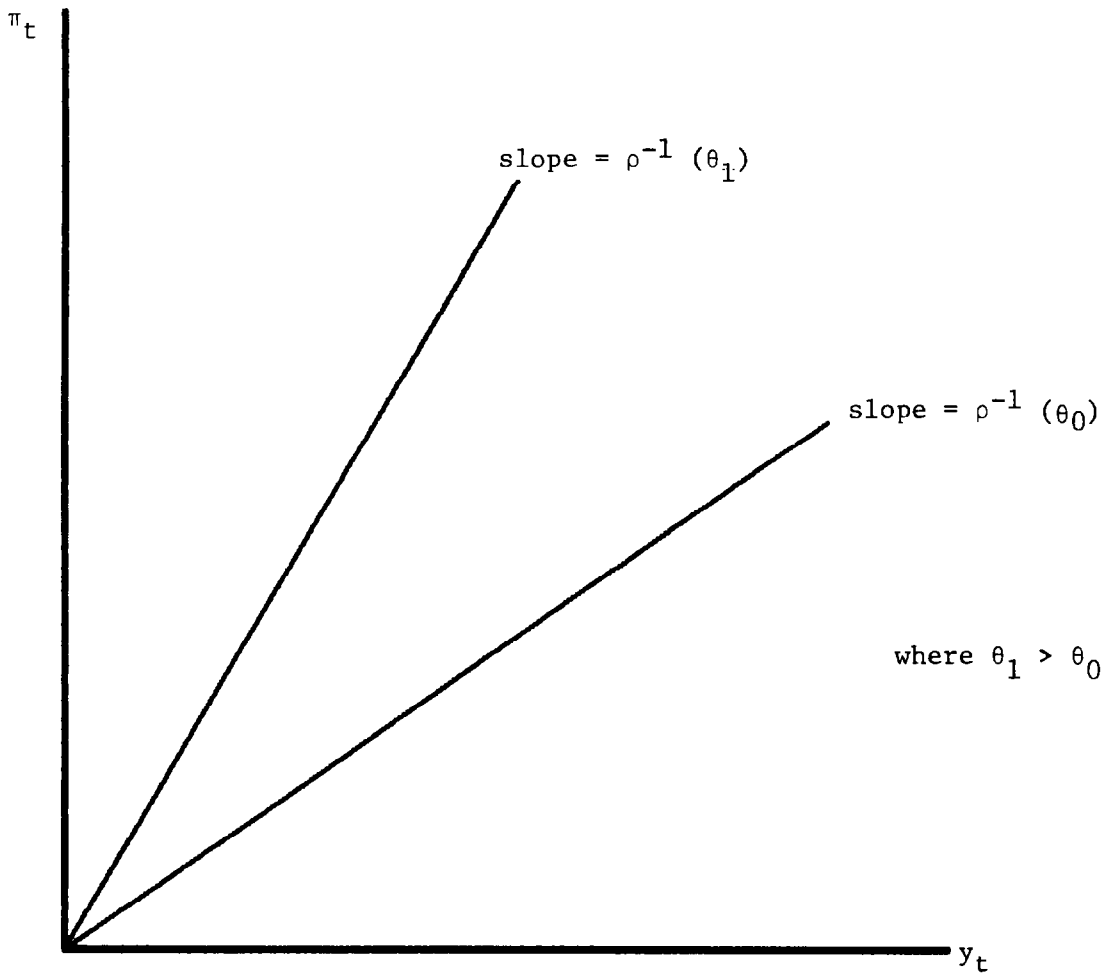
1/ The need to have some distortion in the economy in order to generate activist policy is discussed in Calvo (1978).

2/ The assumption that the loss function is quadratic is obviously quite a specialized one. The implications of alternative loss functions are examined in Fischer and Summers (1988).

3/ For a model of the EMS in which the target level of the exchange rate is allowed to differ from the central rate, see Gros (1988).

Figure 1


π_t
slope = ρ^{-1} (θ_1)
slope = ρ^{-1} (θ_0)
where $\theta_1 > \theta_0$
y_t

equilibrium, they may follow a monetary rule, under which they set the money supply at a preannounced level m^T. A rational public will only believe such an announcement if the authorities actually have the incentive to adhere to the rule; this incentive may exist if the authorities realize that, if they break the rule this period, the public will not believe their announcements next period and they will be trapped in the consistent equilibrium.

Choosing an appropriate policy in the context of a monetary rule therefore entails two stages. First, the authorities must decide whether or not to adhere to their rule. Second, if they depart from the rule by introducing a nonzero monetary shock, they must decide on the optimal size of shock. The optimal size of shock determines the maximum welfare gains obtainable by breaking the rule; these maximum gains must be taken into account in deciding whether or not to break the rule. The authorities will adhere to their rule only if the potential gains from breaking the rule are less than the losses from reverting to the consistent equilibrium; only in this case, therefore, is the rule credible. One measure of credibility is therefore the authorities' incentive to adhere to the rule, that is the difference between the potential welfare losses and gains arising from introducing monetary surprises. In this section, we evaluate the implications for credibility of capital controls and of the pre-specified width of the exchange-rate bands.

To proceed with this exercise, it is necessary to specify precisely what are the authorities' potential welfare gains from deviating from a preannounced monetary rule, i.e., the "temptation," and what are the authorities' potential welfare losses derived from a resulting loss of reputation, i.e., the "punishment." We define

(18) Temptation $= L^R - L^B$

where L^R is the value of the one period loss function that the monetary authority would obtain if they could commit themselves not to depart from the preannounced monetary rule, and L^B is the value that they could obtain by breaking the rule, given that the public believed that they would adhere to the rule--that is, L^B is the value of the loss function obtainable by fooling the public through discretionary policy.

Next, we define

(19) Punishment $= L^C - L^R$

where L^C is the value of the one-period loss function in the consistent equilibrium in which the public does not believe the authorities' announcements and the authorities choose the monetary shock to minimize the loss function given the public's rational expectations.

To simplify matters, we assume (following Barro and Gordon (1983a)) that if the monetary authorities decided to "cheat," the public would distrust them for one period thereafter, and thus the economy would stay in the consistent equilibrium for one period; thereafter, credibility may be restored. In effect, this means assuming that the private sector remembers government actions for only one period. Under these assumptions, we define credibility (C) as follows:

$$(20)\quad C = \beta(L^C - L^R) - (L^R - L^B)$$

We now proceed to consider the authorities' choices, given the nature of reputation assumed. First, let us examine the government's choices given that it does not adhere to a rule. In both the consistent solution and in the discretionary solution in which the authorities break a pre-existing rule, the authorities minimize current period losses, taking the public's expectations as given (the difference between these two solutions is in how the public's expectations are formed).

From (16), the one-period government problem becomes:

$$(21)\quad \min_{z_t,\lambda} L = (y_t - \hat{y})^2 + \alpha\pi_t^2 - \lambda\,(\omega - |s_t - s^T|)$$

where λ is a non-negative Lagrange multiplier.

Using the solutions to the model of output and inflation developed in the previous section, the government's optimization problem gives rise to the following first order conditions:

$$(22)\quad 2\,(y_t - \hat{y})\,\psi + 2\alpha\,\pi_t\,\phi + \lambda\zeta = 0$$

$$\lambda(\omega - |s_t - s^T|) = 0$$

$$\lambda \geq 0; \quad (\omega - |s_t - s^T|) \geq 0)$$

$$\text{where:}\quad \zeta = \frac{\partial s_t}{\partial z_t} = \frac{\gamma + \xi_1\tau + \xi_2}{a_4 a_1 + a_3 a_2}$$

and ψ and ϕ are as defined in Section II.

In the rest of this section, we analyze the effects on credibility of relaxing capital controls and of changing the size of the exchange rate

bands under two alternative hypotheses (1) that the width of the bands is such that they are not a binding constraint on monetary policy, that is $\lambda = 0$; and (2) that the exchange rate bands are a binding constraint when deciding on the optimal choice of monetary policy, i.e., that $\lambda > 0$. The first case may represent either an economy that does not belong to the EMS or an economy inside the EMS whose structure and whose authorities' preferences are such that the exchange rate bands are not binding. The second case represents an economy inside the EMS, since in this case, if the authorities did wish to break their rule and revert to the consistent equilibrium, their monetary expansion would be constrained by the exchange rate bands. By comparing the behavior of credibility in these two alternative cases, we aim to re-evaluate some of the arguments suggesting that credibility is an important reason for EMS membership.

1. Credibility under nonbinding exchange rate bands

First, we consider the case in which there are no agreed exchange-rate bands, or in which bands are so wide that they do not constrain member central banks from doing anything that they would choose to do in the absence of bands. To obtain an expression for credibility as defined in (19), it is necessary to obtain the values that the loss function would obtain under alternative solutions: the equilibrium that results if the authorities follow a credible rule, the discretionary solution that would result if they were to break their rule and the consistent solution.

If the authorities could commit themselves never to deviate from the announced monetary rule, the resulting money supply is fully anticipated, and therefore has no effect on output. Moreover, if as in equation (4) the rule specifies a constant money supply, the equilibrium inflation rate is zero. In this context, the government's one-period loss is

$$(23)\quad L^R = \hat{y}^2$$

In the discretionary solution, which would arise if the government were to deviate from its preannounced monetary policy, while the private sector did not anticipate this deviation, the first order condition for the government's optimization problem would require that

$$(24)\quad \pi_t = \frac{\psi\,(\hat{y} - y_t)}{\alpha\,\phi} = \frac{\rho(\hat{y}-y_t)}{\alpha}$$

Using equation (14) to express π_t in terms of the parameters of the model and solving for z_t, yields the optimal discretionary policy:

$$(25)\quad z_t^B = \frac{\rho^2\,(a_4a_1 + a_3a_2)\,\hat{y}}{\gamma a_2(\alpha+\rho^2)}$$

Substituting the optimal value of z_t into the reduced form equations for output and inflation (equations (13) and (14)), the government's one-period loss in this discretionary solution can be expressed as

$$(26)\quad L^B = \frac{(\alpha\rho^2 - \alpha^2)}{(\alpha + \rho^2)^2}\,\hat{y}^2$$

Finally, we may consider the consistent equilibrium, in which the monetary authorities deviate from their preannounced rule by an optimal amount given the public's expectations and in which these expectations are formed rationally taking into account the authorities' incentives to depart from their rule. In this equilibrium, the monetary shock that occurs is fully anticipated and thus has no effect on output; its only effect will be to increase the rate of fully-anticipated inflation. Here, the first-order condition for the government's optimization problem becomes

$$(27)\quad \pi_t = \frac{\psi\,\hat{y}}{\alpha\,\phi} = \frac{\rho}{\alpha}\,\hat{y}$$

and the optimal choice of monetary policy is therefore

$$(28)\quad z_t^C = \frac{\rho}{\alpha}\,\frac{[a_4a_1 + a_3a_2]}{\tau a_2 + (1-\tau)a_1}\,\hat{y}$$

Therefore, the government's one-period loss in the consistent equilibrium is:

$$(29)\quad L^C = \hat{y}^2 + \alpha\,(\frac{\rho}{\alpha})^2\,\hat{y}^2$$

Using equations (23), (26), and (29), we can now analyze the effects of changing the degree of capital controls on the temptation and punishment facing the monetary authorities, and therefore analyze the effects of capital controls on credibility.

The effect of capital controls on the government's temptation to deviate from its monetary rule can be expressed as follows:

$$(30)\quad \frac{\partial(L^R - L^B)}{\partial\theta} = \frac{\delta(L^R - L^B)}{\delta\rho}\left(\frac{\partial\rho}{\partial\theta}\right)$$

$$= \frac{2\alpha\rho\hat{y}^2}{(\alpha + \rho^2)^2} < 0$$

Relaxing capital controls, that is reducing θ, increases the authorities' temptation to use discretionary monetary policy. The reason is that, as discussed in Section II, decreasing capital controls decreases the slope of the equilibrium locus relating output an inflation. This will increase the effect on output and lower the effect on inflation of surprise activist policy. The monetary authorities' temptation to cheat will therefore increase when capital controls are liberalized.

The picture is not complete, however, without considering the effect of capital controls on the punishment associated with losing reputation by breaking a monetary rule:

$$(31)\quad \frac{\partial\ (L^C - L^R)}{\partial\theta} = \frac{2\ \rho}{\alpha}\ \hat{y}^2\ \left(\frac{\partial\rho}{\partial\theta}\right) < 0$$

That is, relaxing capital controls would increase the welfare losses associated with a loss of credibility resulting from deviating from a preannounced rule. This is so because relaxing capital controls make the consistent equilibrium more onerous; this is because it increases the transitory benefits of surprise inflation and thus increases the fully-anticipated inflation rate required to eliminate any marginal net benefit of inflationary surprises. Liberalization of capital flows therefore increases the value of reputation, since it increases the welfare costs of the government's losing its reputation by breaking its monetary rule.

Since relaxing capital controls has a positive effect on both the temptation and the punishment, it is not clear a priori what the net effect on credibility will be. We can answer this question, however, by using equations (20), (23), (26), and (29):

$$(32)\quad \frac{\partial C}{\partial\theta} = \frac{2\rho[\beta\alpha\rho^2 + \beta\rho^4 - (1-\beta)\alpha^2]}{\alpha\ (\alpha + \rho^2)^2}\ \hat{y}^2\ \left(\frac{\partial\rho}{\partial\theta}\right)$$

This expression is still, in general, ambiguous in sign. However, it seems appropriate to evaluate the effects of capital controls on credibility at the critical point at which credibility equals to zero, that is when the temptation equals the punishment. In this case,

$$\beta^* = \frac{\alpha}{\alpha + \rho^2} < 1$$

where β^* is the critical value of the discount factor such that the temptation to cheat is just equal to the present value of lost reputation. At this critical value of β, relaxing capital controls would increase the credibility of a monetary rule. 1/

This result is of particular importance for small European countries that do not belong to the EMS, but are inside the EC area and therefore plan to continue the process of capital market liberalization under the 1992 Program. This liberalization would, in general, be expected to affect the credibility of these countries' monetary policies; under the assumptions of our analysis, the effect on credibility is favorable.

2. Credibility under binding exchange rate bands

Next, we shall examine the case of countries inside the EMS, for which the exchange-rate bands would be a binding constraint on monetary policy should they decide to depart from a stable-money-growth rule. Again, we are assuming that, should be band edge be reached, there can be a realignment in the following period; that is, the band is a constraint on policy within each period, but the constraint is not fixed from period to period.

Under a monetary rule, the government's loss function has the same value as given in equation (23), regardless of the exchange rate bands, provided that the rule is chosen to be compatible with the bands; since, in this model, the monetary rule entails a fixed money supply, its consequences will not be altered by a system of exchange-rate bands.

Next, we must consider the discretionary solution, in which the authorities contemplate violating an existing credible monetary rule. Here, we must consider the first-order condition for the government's discretionary optimization problem, as given in (22), recalling that if the exchange-rate bands are a binding constraint, the Lagrange multiplier on this constraint, λ, is positive. Using the definitions of ψ, ϕ, and ζ, we may rewrite this first-order condition as

$$(33)\quad 2\,\gamma\, a_2\, y_t + 2\,\alpha\, a_5 \pi_t + a_1 \lambda = 2\gamma a_2 \hat{y}$$

where $a_5 = [a_2 \tau + a_1\,(1-\tau)] = \xi_2 + \tau \xi_1 (1-\theta) + (1-\tau)\gamma$

1/ This result depends, of course, on our use of the common assumption that the authorities' loss function is quadratic.

Also, using equations (13), (14) and the definition of ζ contained in equation (22), we can write:

$$(34)\quad a_5\, y_t - \gamma a_2\, \pi_t = 0$$

and

$$(35)\quad a_1\, y_t - \gamma\, a_2\, s_t = 0$$

Finally, assuming that the exchange rate under the rule equals the target level s^T, the assumption that the exchange rate bands are binding on the discretionary solution implies that

$$(36)\quad s_t = s^T + \omega$$

Totally differentiating the system of equations (33) to (36), and solving simultaneously for the effects of capital controls and of the width of the bands on the equilibrium levels of output and inflation, we obtain:

$$(37)\quad \frac{\partial y_t}{\partial \theta} = \frac{-\gamma\, \xi_1\, s_t}{\gamma + \xi_1 \tau + \xi_2} < 0$$

$$(38)\quad \frac{\partial y_t}{\partial \omega} = \gamma\, \frac{(\xi_2 + \xi_1 \tau - \xi_1 \theta)}{\gamma + \xi_1 \tau + \xi_2} > 0$$

$$(39)\quad \frac{\partial \pi_t}{\partial \theta} = \frac{-\,\tau\, \xi_1\, s_t}{\gamma + \xi_1 \tau + \xi_2} < 0$$

$$(40)\quad \frac{\partial \pi_t}{\partial \omega} = \frac{\xi_2 + \tau\, \xi_1 (1-\theta) + (1-\tau)\gamma}{\gamma + \xi_1\, \tau + \xi_2} > 0$$

To analyze the effects of relaxing capital controls and changing the width of the exchange rate bands on the monetary authorities' temptation, notice that:

$$(41)\ d\,(L^R - L^B) = d\left\{\hat{y}^2 - (y_t - \hat{y})^2 - \alpha\pi_t^2\right\}$$

$$= 2\,(\hat{y} - y_t)dy_t - 2\alpha\pi_t d\pi_t$$

Therefore, using equations (37) and (39), the effect of capital controls on the temptation is

$$(42)\ \frac{\partial(L^R - L^B)}{\partial\theta} = \frac{2\xi_1 s_t}{a_1}\,(-\gamma(\hat{y} - y_t) + \alpha\tau\pi_t)$$

The first order condition (22) guarantees that equation (42) is negative if $\lambda > 0$; that is, for countries inside the EMS, further relaxation of capital controls increases the temptation to break a preannounced monetary rule. Just as in the case in which the bands are not binding, capital liberalization increases the potential output gains associated with surprise inflation, and this increases the temptation to engage in discretionary policy.

Using equations (38) and (40), the implications of the width of the exchange rate bands can be analyzed:

$$(43)\ \frac{\partial(L^R - L^B)}{\partial\omega} = \lambda$$

That is, wider exchange rate bands increase the authorities' temptation to deviate from their policy rule. This result can be explained as follows. The more restrictive the exchange rate bands, the lower the level of activist monetary policy that the government is allowed to undertake since by assumption, the bands are assumed to be binding. Increasing the width of the bands, and thus relaxing this constraint on discretionary policy, increases the authorities' ability to reduce the value of their loss function through discretionary policy, and thus increases their temptation to deviate from a preannounced monetary rule.

In order to analyze the implications for credibility, we need to find the value of the loss function that would obtain in the consistent equilibrium. In this equilibrium, monetary policy is fully anticipated and therefore has no effect on output. In the model, anticipated money is neutral; an anticipated change in the money supply thus results in an equal proportional change in the price level and the exchange rate. Therefore, if the bands are binding, $\pi_t = p_t^I - p_{t-1}^I = s_t - s_{t-1} = s_t - s^T = \omega$. Therefore, the value of the loss function in the consistent equilibrium is

$$(44)\quad L^C = \hat{y}^2 + \alpha\omega^2$$

where it is clear that:

$$\frac{\partial L^C}{\partial \theta} = 0 \quad \text{and} \quad \frac{\partial L^C}{\partial \omega} = 2\alpha$$

From this equation, it can readily be seen that the width of the bands ω affects the inflation rate and the resulting losses associated with the consistent equilibrium, while the capital controls θ have no such influence. Accordingly, the band width affects the punishment associated with losing reputation, but capital controls do not.

We now proceed to analyze the effects on credibility. First, capital controls have the following influence:

$$(45)\quad \frac{\partial C}{\partial \theta} = \frac{\beta\partial(L^C - L^R)}{\partial \theta} - \frac{\partial(L^R - L^B)}{\partial \theta} = \frac{-\partial(L^R - L^B)}{\partial \theta}$$

$$= \frac{-2\,\xi_1 s_t\,(-\gamma(\hat{y} - y_t) + \alpha\tau\pi_t)}{\gamma + \xi_1\tau + \xi_2}$$

Since, once again, liberalizing capital markets increases the temptation with no effect on the punishment, liberalization unambiguously decreases credibility in this setting. This result contrasts sharply with the one obtained in the case where there are no exchange-rate bands restricting fluctuations in the exchange rate. In fact, what our results suggest is that for countries inside the EMS, the ongoing processes of financial liberalization under the 1992 Program will have an adverse effect on the credibility of their monetary authorities; in fact, this result suggests that liberalization may reduce the potential benefits derived from joining the EMS. One interpretation of this result is that intervention in one market--the foreign exchange market--may create a need for restrictions in another--the international bond market.

Finally, the implication for credibility of the width of the exchange rate band can be examined:

$$(46)\quad \frac{\partial C}{\partial \omega} = \frac{\beta\partial\,(L^c - L^R)}{\partial \omega} - \frac{\partial(L^R - L^B)}{\partial \omega}$$

$$= 2\beta\alpha\omega - \lambda$$

Since a wider band implies both a greater punishment and a greater temptation, the effect on credibility is ambiguous. However, solving for λ, equation (46) can be rewritten in terms of the band width, ω. That is,

$$(46') \quad \frac{\partial C}{\partial \omega} = \frac{-2\ \gamma a_2}{a_1}\ \hat{y} + 2\beta\alpha\omega$$

$$+ \frac{2\gamma^2 a_2^2\ \omega}{a_1^2} + \frac{2\alpha\ a_5^2}{a_1^2}\ \omega$$

Equation (46') implies that the effect on credibility of the width of the bands can be represented in Figure 2. From that figure, it is clear that there is a critical level, ω_0, at which credibility reaches a minimum; credibility increases as the band width is narrowed beyond ω_0. However, the maximum level of credibility that can be obtained by narrowing the bands as ω tends to zero is zero; narrowing the bands beyond ω_0 does not result in a positive level of credibility. The reason that credibility approaches zero as the bands become arbitrarily narrow is that the authorities become more narrowly constrained, so that both the temptation and punishment tend to zero. Of course, as the band width approaches zero, the loss of credibility becomes irrelevant, since the damage that the authorities can do by cheating also tends to zero.

We can also note that there is some width of the bands such that $\lambda = 0$ so that the bands are no longer a constraint on monetary policy and therefore have no effect on credibility; we use ω_1 to represent the band width at which the constraint is just binding. The level of credibility attainable (with a given degree of capital control) outside the EMS is represented by the height of the flat section of the curve in Figure 2; this level of credibility may be positive, zero or negative. These three alternatives are depicted in Figure 3.

Notice that when the initial position of the country is one with positive or zero credibility, joining the EMS has an adverse effect on credibility, an effect whose magnitude depends on the width of the exchange rate bands; credibility is only restored to zero if the exchange-rate bands are made arbitrarily narrow (i.e., by establishing rigidly fixed exchange rates)--although again, in this case the authorities have surrendered all their control over their own money supply so that their credibility is irrelevant. The remaining case is one in which the country starts with a credibility problem, i.e., in which the initial level of credibility is negative. In this case, joining the EMS will increase credibility if the bands are narrowed beyond ω_0, but cannot restore credibility to a non-negative level for any finite width of band. Thus, in this framework it is hard to reconcile the credibility.

Figure 2

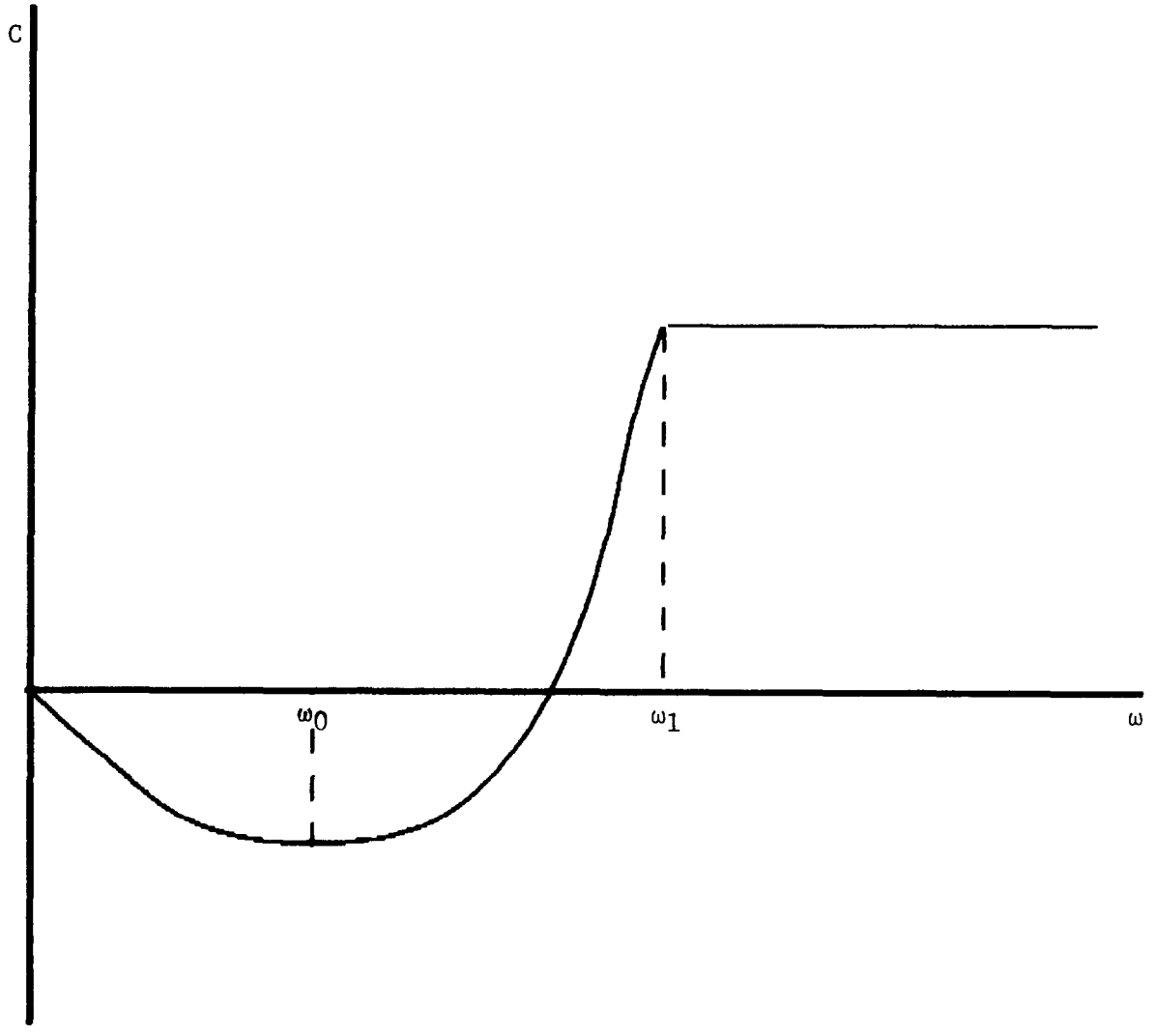
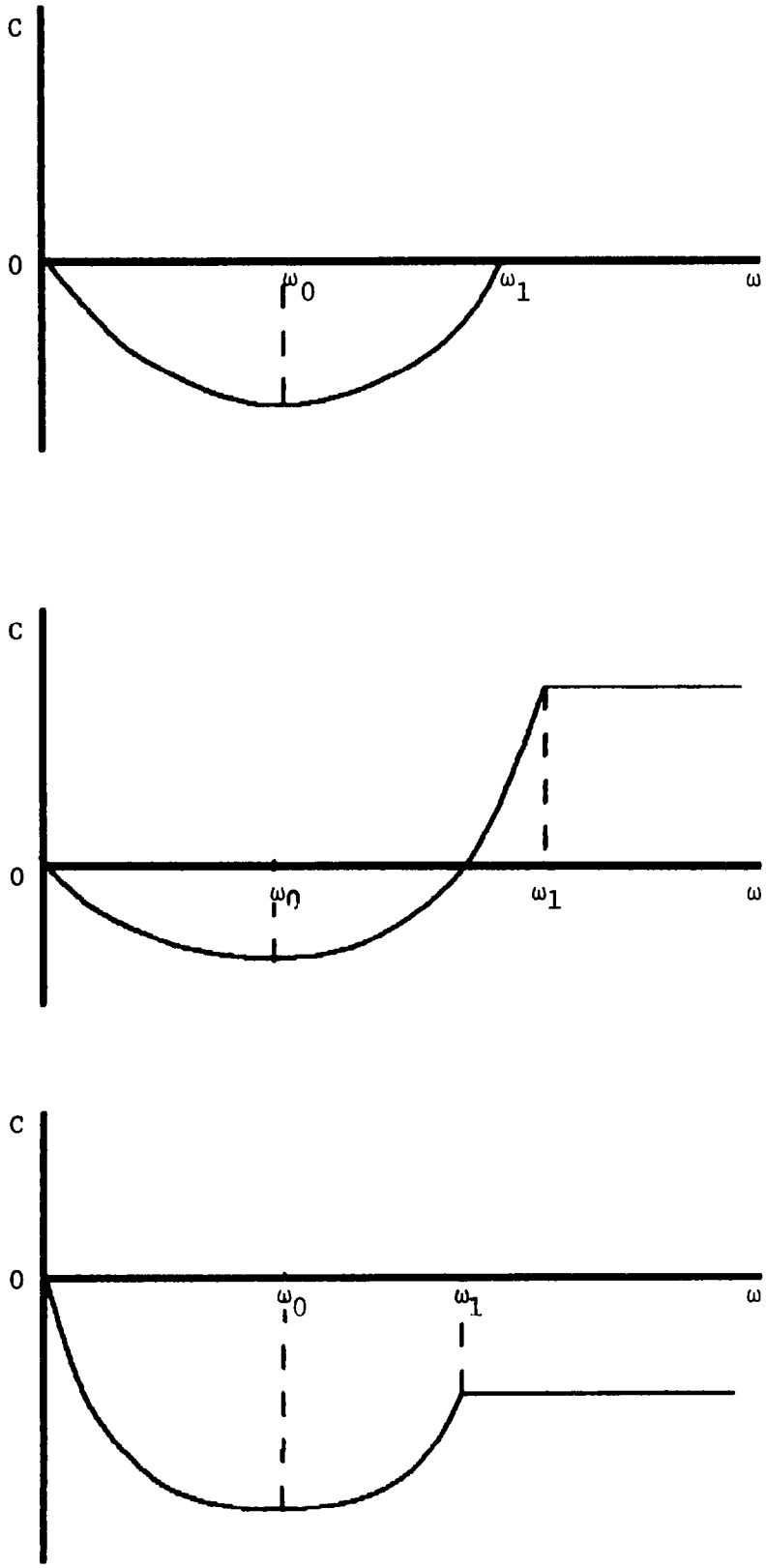


Figure 3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In this section, we have presented a counter-example to the usual presumption that EMS membership restores credibility. We have developed a framework in which, unless exchange rates are rigidly fixed, the governments of small European countries cannot attain a non-negative level of credibility by joining the EMS.

Our other important result pertains to the implications of capital controls. We have shown that monetary policy can gain credibility through liberalization of capital flows in the absence of binding exchange-rate bands. Conversely, within a system of exchange-rate bands, capital-market liberalization reduces credibility. This suggests that EMS countries (or countries contemplating EMS membership) may face particular difficulties in accepting the liberalization of capital flows prescribed under Project 1992.

What, if anything, can be said about welfare in this framework? The welfare conclusions are, unfortunately, too simplistic to be of much interest. In the model, welfare is maximized if the authorities do and are expected to do nothing, and it does not matter whether that is because they have an incentive not to violate a rule or because their policies become irrelevant as the bands become arbitrarily narrow. In order to be able to distinguish, on welfare grounds, between credibility and impotence, it would be necessary to develop a model in which there is some advantage to policy flexibility; an example would be a model in which monetary feedback can offset the effects of shocks affecting the economy. Such considerations were excluded form the present model in order to concentrate on the credibility effects of the EMS; introducing random shocks would have complicated this treatment unduly. A more general analysis, permitting more interesting welfare comparisons, must await further research.

IV. Conclusion

In this paper, we have used a simple but unified framework to examine the interaction of capital controls and the exchange rate bands in influencing the credibility of monetary policy. Our main results suggest that capital controls may have different implications for credibility inside the EMS exchange-rate bands than in the absence of such bands: in our model, liberalization of capital movements enhances the credibility of a monetary rule in the absence of exchange-rate bands, while it undermines credibility when the exchange-rate bands are a binding constraint on monetary policy.

Our other main result pertains to the implications of the width of the exchange-rate band. We find that joining the EMS cannot restore a central bank's credibility, expressed as the authorities' disincentive to break their monetary rule, to non-negative levels for any finite width of band. As the band width approaches zero, the central bank's credibility approaches zero from below--essentially because, as the bands become arbitrarily narrow the central bank loses any remaining freedom of

manoeuvre. This casts doubt on the usual argument that EMS membership can be a way for a central bank to restore credibility to its monetary policies.

Since this framework is highly simplified, there are many possible extensions. The model assumes that, if there are exchange-rate bands, they simply cannot be violated. An alternative would be to model the exchange-rate bands as another form of precommitment, with respect to which a government must also maintain a reputation vis-à-vis the other governments; one could then consider whether the two types of precommitment are likely to reinforce or undermine each other. Another important extension would be to consider the case in which there are random shocks affecting the macroeconomic relationships; in this case, there would be the possibility of designing a rule with feedback designed to offset these shocks, possibly leading to a tradeoff between maintaining credibility and permitting the authorities to respond optimally to such shocks. An additional extension would be to examine a case in which the central bank has superior information about some of these shocks: in this case, the authorities might choose to break a monetary rule sometimes in response to this information, and the public would form expectations taking into account the possibility of such violations.

In all, therefore, we consider this paper to be a step toward a more thorough exploration of the implications of alternative institutional arrangements for the credibility of monetary policies.

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