Monetary Cohabitation in Europe *

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Abstract

How can monetary policy in stage III of European Monetary Union be coordinated between the "ins" and the "outs"? This paper compares alternative institutional mechanisms, and concludes that a generalized system of inflation targets at the European level has several merits. It strengthens domestic credibility of monetary policy. It rules out deliberate attempts to gain competitiveness through devaluations. It forces monetary policy to respond automatically to various macroeconomic shocks which is stabilizing for the real exchange rate. It distributes these shocks symmetrically across countries. On the basis of a simple theoretical model of policy coordination, the paper shows that a system of inflation targets approximates an optimal policy of international cooperation. Preliminary empirical evidence supports these theoretical results.

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1. Introduction

It is still uncertain whether the European Union will have a Single Currency, the Euro, by the end of this century. But two things seem certain about how it would happen. Not all member states would be involved: some members that would like to join are not likely to be accepted, whereas some members that would be accepted are not likely to join. Nor would intensified political integration precede monetary unification. The Single European Currency will remain an international agreement whereby some sovereign states delegate a common monetary policy to an independent supranational agency: the European Central Bank (ECB)[1]

This particular way of achieving monetary unification poses two specific problems. One is how the ECB should pursue its monetary policy. Even though the Maastricht Treaty is very explicit that price stability should be the primary goal of European monetary policy, the operational consequences of that goal have not been spelled out in a specific quantitative mandate to which the ECB can be held accountable. Nor will there be a well-defined political principal for the ECB that can spell out such a mandate. Despite this ambiguity, the ECB is likely to behave as any national central bank: it will give priority to price stability, but will also take into account other considerations, trading off conflicting objectives. Ambiguity over its specific mandate could, however, be detrimental to decision making within the ECB, and could also damage the credibility and the legitimacy of the institution in front of European citizens.[2] An emerging official view—at least among the likely members of the Single Currency—is that the ECB should follow the German model and adopt an intermediate money target. The main advantage

[1] In this paper we do not discuss the desirability of this kind of arrangement but just take its prospective creation and likely properties as given.

[2] The early history of the US Federal Reseve System provides some examples of how difficult decision making can be in an institution without a clear operational mandate, if policymakers regard themselves as representatives of different regions. Describing the ineptitude of the Fed in dealing with the onset of the Great depression, Friedman and Schwartz (1963) write:"A committee of twelwe men, each regarding himself as an equal of all the others and each the chief administrator of an institution established to strengthen regional independence, could much more easily agree on a policy of drift and inaction than on a coordinated policy involving the public assumption of responsibility for decisive and large scale action. There is more than a little element of truth in the jocular description of a committee as a group of people, no one of whom knows what should be done, who jointly decide that nothing can be done. And this is especially likely to be true of a group like the Open Market Policy Conference, consisting of independent persons from widely separated cities, who share none of the common outlook on detailed problems or responsibilities which evolves in the course of long-time collaboration." (pp. 415-6).

of such an arrangement is its continuity with the German way of conducting monetary policy. Continuity is important: the ECB could more easily inherit some of the Bundesbank reputation, and exploit the know how accumulated over a period of successful monetary policy. From a political point of view, however, this way of conducting European monetary policy may not be transparent enough. Europe-wide money targets are a rather technical concept, and European citizens would not easily understand the rationale of possibly unpopular ECB decisions. Moreover, money demand instability and currency substitution are likely to plague the birth of the Single Currency, particularly during the first two years in which parities will be irrevocably fixed, but the Euro will not yet circulate.

The second problem is that of "monetary cohabitation". How will monetary policy be coordinated between the ECB and the member states that have not joined the Single Currency? Absent coordination, exchange rate volatility could undermine the Single Market. Since the breakdown of the EMS in 1992, the Italian Lira has depreciated by 26%, and the Deutsche Mark has appreciated by 16%—both in real effective terms—see **Table 1**. Such wild real exchange rate changes, let alone outright "competitive depreciations", will not be tolerated without eventually introducing some form of trade barrier.[3]

But the coordination of monetary policy with the countries that have not adopted the Euro is not easy. An emerging official view—put forward by the European Monetary Institute (EMI), by the Bundesbank, by Austria, and by the French Finance minister, among others—is that the outside countries should be required to peg to the Euro, in a reformed version of the EMS. But this would be a very risky strategy[4]: a unilateral peg by the outside countries alone is not likely to survive speculative attacks. Moreover, the burden of defending the exchange rate would fall entirely on the outsiders, who would have to destabilize their economies not only to resist speculative attacks, but also in the face of shocks originating in the inside countries. Such an asymmetric arrangement is unlikely to be politically viable, even if it could survive speculative attacks. Why should a country be forced to peg its exchange rate if it decided not to join, or — worse — if it was not admitted to the Single Currency "élite"? Recall that, according to the Maastricht Treaty, the transition to the Single Currency has to be approved by a qualified majority vote in the Council. Hence, the likely outside countries have considerable bargaining power. For instance, the UK, Italy, Spain and Sweden together form a blocking coalition that could prevent a Single

[3]In fact, there are already demands in France that the "compensatory amounts", already in place to protect farmers in the hard currency countries, be extended to other sectors (see Dewatripont et al. 1995)).

[4]Obstfeld and Rogoff (1995) provide an excellent survey of the risks of attempting a unilateral peg of the exchange rate.

Currency among any other subset of countries. A second political problem is that a system based on exchange rate pegging, by focusing on the exchange rate, invites political retaliation if a devaluation cannot be avoided. Special interests in the appreciating "inside" countries could more easily ask for tariff protection, on the grounds that the depreciating country needs to be punished because it did not fulfill its obligations. All of this suggests that, to be viable, any coordination mechanism may have to be symmetric for the countries in and out of the Single Currency. But a symmetric exchange rate peg is also unfeasible. The credibility of the ECB would suffer too much, and Germany would never accept it.

These arguments suggest that any workable solution to the Monetary Cohabitation problem is likely to entail some exchange rate volatility. It is just not feasible to stabilize exchange rates in Europe. The problem is how to mitigate real exchange rate volatility and to avoid extreme disruptions, not to eliminate exchange rate fluctuations altogether.

Based on these considerations, a recent report on European Integration (Dewatripont et al. (1995)) has argued in favor of a generalized system of inflation targeting. The idea is to assign strict and specific (but possibly different) inflation targets both to the ECB and to the other national central banks. This arrangement addresses the political problems mentioned above. For one it is symmetric. For another, an inflation target would clearly increase the accountability of the ECB and, by focusing on a clearly defined and operational goal, would also help decision making inside the ECB. Moreover, if countries not joining the Euro also have an inflation target (possibly different from that of the ECB), the incentives to engage in competitive devaluations would be diminished. The credibility of monetary policy would also be strengthened. Finally, to meet the inflation target all countries would have to automatically respond to a depreciation of their currency in a way that would tend to stabilize the exchange rate itself, even though it would not force any central bank to bet against speculators in the market. All of these factors would help to reduce real exchange rate volatility.[5]

The purpose of this paper is to further elaborate on the economic arguments in favor of inflation targets, by analyzing a specific model of monetary policy coordination. The model, set out in Section 2, combines well-known components of the existing literature. Its equilibrium, in the absence of mechanisms to induce international coordination and to enhance credibility, has excessive average inflation, and suboptimal fluctuations in macroeconomic variables. Section 3 derives a central result: optimally chosen inflation targets remove all these distortions. Inflation biases and incentives to engage in competitive devaluations are offset by

[5] Canzoneri, Nolan and Yates (1995) also discuss inflation targeting in the context of European monetary integration, and compare it to the ERM. Their paper, however, focuses more on the credibility problem in monetary policy than on competitive devaluations.

optimal penalties for missing the inflation target. Section 4 compares alternative nominal targets if inflation targets cannot be optimally enforced, because of lack of information or because of other constraints on institution design. Section 5 discusses some evidence on inflation targeting in a number of countries and on output asymmetries in the EMS. Section 6 concludes.

2. A stylized model

We set out a simple linear-quadratic model to analyze the issues mentioned in the introduction. Our model is a modified and parametrized version of that formulated in Persson and Tabellini (1995), and it is related to Canzoneri and Henderson (1988). It rests on well-known building blocks from the literatures on credibility and policy coordination in monetary policy[6]. There are two countries, each specialized in the production of a single good. Monetary policy is subject to a credibility problem. Because of temporary nominal rigidities, monetary policy can stabilize the economy in the short run, but it is neutral in the long run. Finally, policy has spillover effects abroad and each country has an incentive to engage in competitive devaluations.

All variables are defined as rates of change. The change in the log of the real exchange rate z is defined as:

$$z = s + q^* - q, \tag{1}$$

where s denotes the rate of nominal depreciation of domestic currency. We let letters without an asterisk denote variables in the country outside of the monetary union; the "outside country", for short—and variables with an asterisk denote variables inside the monetary union. Thus q and q^* denote producer price inflation outside and inside the monetary union. We start describing the outside country. CPI-inflation , p, is given by

$$p = q + \beta z, \tag{2}$$

where β is the share of foreign goods in the outside country's consumption basket. Producer price inflation, in turn, satisfies

$$q = m + \nu, \tag{3}$$

where m is the rate of money growth, and ν is a demand, or velocity, shock. The "natural" (or long-run equilibrium) rate of output growth (or employment) is taken

[6] The credibility literature is surveyed in Persson and Tabellini (1990), Cukierman (1992) and Schaling (1995), whereas the policy coordination literature is surveyed in Canzoneri and Henderson (1991) and in Persson and Tabellini (1995).

to be zero. Actual output growth (alternatively employment), x, is determined by an expectations-augmented Phillips-curve:

$$x = \gamma (q - q^e) - \varepsilon, \tag{4}$$

where γ is a parameter, q^e is the rationally expected value of q, and ε is a supply shock. The equilibrium value of z depends on the relative supply of outside goods, $(x - x^*)$ in relation to its relative demand. If the latter is an increasing function of z, the equilibrium real exchange rate satisfies:

$$z = \delta (x - x^*) + \phi, \tag{5}$$

where δ is the inverse (relative) demand elasticity of outside goods. We interpret ϕ as a "speculative shock" to the nominal exchange rate. We assume that the structural shocks ν, ε, ϕ are independently distributed with an expected value of zero.[7]

The policy instrument m is chosen by the outside country's central bank. Policy preferences are given by the loss function

$$L = \frac{1}{2} \left[p^2 + \lambda (x - \theta)^2 + \mu (z - \xi)^2 \right], \tag{6}$$

where λ and μ are positive weights and θ and ξ are stochastic policy targets for employment and the real exchange rate. Assuming $E(\theta) > 0$ creates a systematic "inflation bias," along the lines of the credibility literature. Assuming $E(\xi) > 0$ is a simple way to generate a systematic incentive to engage in competitive devaluations within the context of the model. Informally, we can think of shocks to θ as capturing variations in the difference between the target and the natural rate of unemployment and to ξ as capturing variations in the clout of the export industry, lobbying for higher profitability through a weaker exchange rate. [8]

[7] By (5) and (1), the nominal exchange rate satisfies:

$$s = \delta [x - x^*] + q - q^* + \phi,$$

The shock ϕ thus captures all the forces that move the nominal exchange rate, other than the current output and price fundamentals. In particular, ϕ may reflect expectations of future inflation and devaluations, fear of government defaults, financial crises, or other future events that may induce current capital outflows or inflows. Therefore, it is possible that the shock ϕ is correlated with the variables that determine the systematic incentives to inflate and engage in competitive devaluations, namely (future values of) the parameters θ and ξ in the loss function (6) below. In a less stylized (multiperiod) model, some of these links could be made precise.

[8] An alternative (but perhaps equally ad-hoc) way of modeling the incentive to engage in competitive devaluations would be to let z enter the right hand side of the supply function, (4), with a positive sign: a real depreciation would then lead to faster output growth (see Canzoneri and Gray (1985) and Martin (1995)). Many of the results of this paper would apply to this different specification.

The monetary union is modeled exactly as in equations (2)-(4) and (6), with the exception that z enters with an opposite sign.[9] We assume that all the "structural" parameters, β, γ, λ, and μ, are equal across countries; however, we allow for cross-country differences in the expected value of the targets $(E(\theta) \neq E(\theta^*)$, say), in the variances of all shocks ($\sigma_\varepsilon^2 \neq \sigma_{\varepsilon*}^2$, say) and for arbitrary covariance across pairs of structural shocks $\left(\sigma_{\varepsilon\varepsilon*} \gtreqless 0\text{, say}\right)$.

Events unfold as follows: (i) Policy targets $\tau = (\theta, \theta^*, \xi, \xi^*)$ are revealed, (ii) private expectations (q^e, q^{*e}) are formed, (iii) structural shocks $\omega = (\varepsilon, \varepsilon^*, v, v^*, \phi)$ are revealed, (iv) policies (m, m^*) are simultaneously set, (v) macroeconomic outcomes are realized.

To establish a benchmark for the analysis, we first study the hypothetical situation when the two central banks can commit to cooperate ex ante, before stage (i) above, setting a pair of state-contingent policy rules for m and m^* that minimize their joint losses, subject to the constraint that private expectations are formed rationally, given available information. Concretely, we seek the state-contingent monetary policies $(m(\tau,\omega)), (m^*(\tau,\omega))$ that minimize $E(L+L^*)$ subject to $q^e = E_\tau(q)$and $q^{*^e} = E_\tau(q^*)$. ($E(u)$ denotes the unconditional expectation of u whereas $E_\tau(u)$ denotes the conditional expectation of u, given the realization of τ.) The first-order condition for the optimal choice of $m(\tau,\omega)$, can be expressed as:

$$p(\tau,\omega) + \lambda\gamma x(\tau,\omega) + 2\mu\gamma\delta z(\tau,\omega) + \delta\beta\gamma\left(p(\tau,\omega) - p^*(\tau,\omega)\right) = 0 \qquad (7)$$

The optimal policy rule thus trades off the direct effects of money on domestic prices and employment (the first two terms) and the effect on domestic and foreign losses of induced changes in z, both directly (the third term) and indirectly through CPI-inflation (the fourth term). Given the corresponding set of first-order conditions for $m^*(\tau,\omega)$ and the model structure, we can solve for the optimal policy rule in terms of the underlying shocks. Straightforward, but tedious algebra gives

$$m(\tau,\omega) = c^\varepsilon\varepsilon - \nu + c^{\varepsilon\varepsilon^*}(\varepsilon - \varepsilon^*) - c^\phi\phi, \qquad (8)$$

where the c's are complicated expressions (with likely positive sign) in the model's parameters. In the optimal solution, the outside central bank thus stabilizes the price and output effects of domestic supply shocks somewhat (one can show that $0 < \gamma c^\varepsilon < 1$) and domestic demand shocks completely; it also adopts a more restrictive monetary policy so as to stabilize relative foreign supply shocks, and speculative shocks against its own currency, to partially offset the real depreciation

[9] In the formal analysis, we thus ignore all collective-choice problems in the choice of the ECB's monetary policy. These problems are studied by Alesina and Grilli (1992), Lohman (1994), Tarkka and Åkerholm (1993), and by von Hagen (1995), among others.

(and consequently higher domestic inflation) induced by a relative foreign supply shocks ($\varepsilon - \varepsilon^* < 0$), or by a speculative shock ($\phi > 0$). Notice that none of the stochastic targets in τ enter the solution. This is because τ is observable and because the real variables in the model are neutral to expected policy.

3. Incentive problems and implementation

Suppose now, more realistically, that ex ante commitments are infeasible and that each central bank chooses its policy ex post, in a non-cooperative fashion. The outside central bank thus minimizes L with respect to $m(\tau, \omega)$, taking $m^*(\tau, \omega)$, $E_\tau(q)$ and $E_\tau(q^*)$as given. The first-order condition for $m(\tau, \omega)$ can be written as

$$p(\tau, \omega) + \lambda\gamma x(\tau, \omega) + 2\mu\gamma\delta z(\tau, \omega) + \beta\delta\gamma(p(\tau, \omega) - p^*(\tau, \omega)) = \qquad (9)$$

$$\lambda\gamma\theta + \mu\gamma\delta\xi + \mu\gamma\delta z(\tau, \omega) - \beta\delta\gamma p^*(\tau, \omega)$$

Clearly the LHS of (9) is identical to the LHS of (7). The RHS reflects the two incentive constraints at work under non-cooperative discretionary policy making. First, the "credibility" (ex post optimality) constraint makes the outside central bank ignore the effect of its policy on private expectations formation: the ex post incentive to stimulate growth gives a permanent inflation bias (the first term). Second, the "individual rationality" constraint makes the outside central bank ignore the spillover effects on the monetary union: this gives rise to a permanent competitive depreciation bias (the second term), recall $E(\xi) > 0$. Due to these incentive problems, the observable targets thus enter the solution, in this case. Because the incentives to expand employment and depreciate the real exchange rate are correctly anticipated by the private sector, the equilibrium rate of expected inflation is higher without any effect on real variables. The remaining terms on the RHS of (9) appear because the individual rationality constraint also distorts the stabilization of shocks. Specifically, the outside country does not take into account that it exports inflation abroad if it appreciates its real exchange rate in response to a shock. This externality may be positive or negative: if, for instance, the inside country is hit by an adverse supply shock so that $p^* > 0$, outside monetary policy is too contractionary.

Following the closed economy analyses of Persson and Tabellini (1993) and Walsh (1995), we now show that appropriate institution design can resolve these incentive problems and implement the cooperative ex ante optimum policy rule in (8). Assume that the European Union can impose a performance contract on each of the two central banks. In particular, assume that each central bank is faced with a linear, but state-contingent, performance contract in realized inflation. Consider first the outside central bank. It faces a "penalty"

$$T\left(p\left(\tau,\omega\right);\tau,\omega\right)=t\left(\tau,\omega\right)p\left(\tau,\omega\right) \tag{10 }$$

if it does not achieve its inflation target, which here is equal to zero (by assumption).

Finally, assume that the outside central bank minimizes the sum of the loss function in (6) and the sanction in (10). It is easy to verify that this modifies the first- order condition (9) only at one point: an extra term appears on the RHS, namely: $-\left(1+\beta\delta\gamma\right)t\left(\tau,\omega\right)$. It then follows directly from (7) and (9) that the outside central bank indeed has appropriate incentives to implement the ex ante cooperative policy if the marginal penalty for inflation is set at:

$$t\left(\tau,\omega\right)=\frac{1}{1+\beta\delta\gamma}\left[\lambda\gamma\theta+\mu\gamma\delta\xi+\mu\gamma\delta z\left(\tau,\omega\right)-\beta\delta\gamma p^{*}\left(\tau,\omega\right)\right], \tag{11}$$

where it is understood that z and p^* in (11) are evaluated at the ex ante optimum. Solving for z and p^* in the ex-ante optimum, the marginal penalty can be rewritten in terms of the structural shocks:

$$t\left(\tau,\omega\right)=\frac{1}{1+\beta\delta\gamma}\left[\lambda\theta\gamma+\mu\gamma\delta\xi-t^{\varepsilon*}\varepsilon^{*}-t^{\varepsilon\varepsilon^{*}}\left(\varepsilon-\varepsilon^{*}\right)+t^{\phi}\phi\right] \tag{12}$$

The coefficients $t^{\varepsilon *}, t^{\varepsilon\varepsilon *}$, and t^{ϕ} are, like the c-coefficients in (8), complicated expressions (with a likely positive sign) in the structural parameters.

The marginal penalty defined in (11) and (12) has an intuitive interpretation. The first two terms balance the outside central bank's systematic incentives to expand employment and to depreciate the real exchange rate; the stronger these incentives, the stiffer the optimal penalty. The three final terms correct the stabilization bias that derives from the outside central bank's failure to internalize the spillover effects of its policy on the monetary union; the penalty should be weaker if the union suffers a negative supply shock (ε^* positive), a less severe supply shock ($(\varepsilon-\varepsilon^*)$ positive), or a speculation against its currency (ϕ negative). In these three cases $p^* > 0$ in equilibrium and, as discussed above, outside monetary policy tends to be too contractionary. Offsetting this bias calls for a weaker marginal penalty on inflation.

The incentive scheme for the ECB should be structured in a similar way—the marginal penalty t^* should satisfy

$$t^{*}\left(\tau,\omega\right)=\frac{1}{1+\beta\delta\gamma}\left[\lambda\gamma\theta^{*}+\mu\gamma\delta\xi-t^{\varepsilon}\varepsilon+t^{\varepsilon\varepsilon^{*}}\left(\varepsilon-\varepsilon^{*}\right)-t^{\phi}\phi\right], \tag{13}$$

where $t^{\varepsilon}, t^{\varepsilon\varepsilon^*}, t^{\theta}$ are identical to the expressions that appear in (12). As (12) and (13) reveal, the correction of the stabilization bias is symmetric across the two central banks. Perhaps it is natural to assume that $E(\theta) > E(\theta^*)$ or $E(\xi) > E(\xi^*)$, such that the outside country has a worse credibility problem or a stronger incentive to engage in competitive devaluations than the countries in the union. If so, it should face stronger average penalties for departing from its inflation target.

Consider the special case when the shocks are perfectly correlated (in particular $\varepsilon = \varepsilon^*$), and there are no speculative shocks ($\phi = 0$).[10] Then the optimal penalty consists of only the first three terms on the RHS of (13). The first two terms remove the excessive inflation that results from the credibility problem and the competitive devaluation bias respectively. The third term removes the stabilization bias. With symmetry both countries tend to *underreact* to the common supply shock: monetary policy is not expansionary (contractionary) enough in response to an adverse (favorable) supply shock $\varepsilon > 0$ ($\varepsilon < 0$). The reason is that both countries neglect the effects on foreign prices induced by changes in the real exchange rate. The marginal penalty thus depends on the sign and size of the shock.

In our linear model, state contingent contracts over *any* pairs of nominal variables can implement the ex ante optimum policies.[11] However, it is unlikely that such complete contracting is feasible, for a number of reasons discussed in Persson and Tabellini (1993,1995). Simplicity and verifiability problems may require the marginal penalties t and t^* to be state-independent. Under this constraint, and given the linearity of the constraints (1) - (5), one can show that the optimal penalties are simply given by the expected values of (12) and (13):

$$t = [\lambda\gamma E(\theta) + \mu\gamma\delta E(\xi)] \,/\, [1 + \beta\gamma\delta] \tag{14}$$

$$t^* = [\lambda\gamma E(\theta^*) + \mu\gamma\delta E(\xi^*)] \,/\, [1 + \beta\gamma\delta]$$

These simplified contracts eliminate the systematic incentives to expand employment and depreciate the real exchange rate, but do not eliminate the suboptimal response to supply shocks and to speculative shocks. Alternative nominal targets continue to be equivalent.

4. Alternative Regimes

In the real world, even a simple linear penalty may be difficult to enact. For instance, if the central bank is risk averse, a linear performance contract would

[10] This symmetric case has figured prominently in the policy-coordination literature.

[11] As discussed in Persson Tabellini (1993) this equivalence remains also in more general settings; however, performance contracts written over variables other than p are more informationally demanding, if there are non-linearities in the constraints describing the economy.

still give rise to a non-linearity. Loss of reputation would also result in a non-linearity. Perhaps a more realistic interpretation of a nominal target would be that the central bank tries to stay as close as possible to the announced target. In this case, alternative targets are certainly non-equivalent, since they impose very different policy responses to the shocks hitting the economy.

The situation immediately after the creation of a Euro may also involve specific constraints. The ECB's attempts to build up a track record and a mode of communicating its intentions to financial markets are likely to be very difficult if it allows for large deviations from its target, or if it follows a complicated state-contingent policy. Similarly if outside central banks are required to peg to the Euro, this could necessitate a tight peg to ever have a chance of becoming credible. Such reputational constraints reinforce the different properties of alternative nominal targets.

To illustrate these differences in the presence of non-linearities, we study three simplified mechanisms aimed at inducing credibility and coordination.

4.1. The ERM

In the first, the "ERM-regime", the ECB can be induced only to pursue alternative non-state-contingent k-percent rules on m^* and the outside central bank can only be induced to peg a constant rate of depreciation s. This regime approximates the one proposed by Germany and also apparently favored by the EMI. For simplicity here we take both the money supply rule and the exchange rate peg to be exact, in that no deviations or escape clauses are allowed.[12] It is straightforward to show that the best such simple rules are $m^* = s = 0$ since these rules remove the permanent inflation and competitive depreciation biases. Escape clauses to allow for realignments could be added, as in Obstfeld (1991), without substantially changing the nature of the results.

When $m^* = s = 0$ for all (τ, ω), the model can easily be solved for the macroeconomic variables of interest:

$$
\begin{aligned}
p(\tau,\omega) &= \nu^* + \frac{\delta(1-\beta)}{1+\delta\gamma}(\varepsilon - \varepsilon^*) - \frac{(1-\beta)}{1+\delta\gamma}\phi \\
p^*(\tau,\omega) &= \nu^* + \frac{\delta\beta}{1+\delta\gamma}(\varepsilon - \varepsilon^*) - \frac{\beta}{1+\delta\gamma}\phi \\
x(\tau,\omega) &= \gamma\nu^* - \varepsilon + \frac{\gamma\delta}{1+\gamma\delta}(\varepsilon - \varepsilon^*) - \frac{\gamma}{1+\delta\gamma}\phi \qquad (15) \\
x^*(\tau,\omega) &= \gamma\nu^* - \varepsilon^*
\end{aligned}
$$

[12] A number of non-linear penalty schemes could implement these simple rules in the context of the model.

$$z(\tau,\omega) = -\frac{\delta}{1+\delta\gamma}(\varepsilon - \varepsilon^*) + \frac{1}{1+\delta\gamma}\phi$$

A few things are worth noting about this solution. First, inside velocity shocks ν^* are not stabilized as in sections 2-3, so both p^* and x^* are subject to an additional source of fluctuations around their average levels. Moreover, these velocity shocks inside the monetary union spill over also on outside macrovariables, particularly p and x, since the outside central bank is targeting s. Second, the arrangement is quite asymmetric: the output fluctuations generated by speculative shocks ϕ are borne exclusively by the outside country. Moreover, supply shocks ε^* inside the monetary union spill over on x, but ε shocks do not spill over on x^*. Thus, if the outside country has the sole responsibility of defending the exchange rate, it bears a disproportionately large cost in terms of output volatility. This cost grows with the variance of the speculative shocks. Third, despite the stability of the nominal exchange rate, there remains some real exchange rate volatility, in response to idiosyncratic supply shocks and speculative shocks. Idiosyncratic supply shocks affect the real exchange rate through the inflation differential. Speculative shocks (a positive realization of ϕ) force the outside central bank to contract the money supply, so as to keep the nominal exchange rate constant. But this contraction causes a reduction of output and prices, and a depreciation of the real exchange rate . The opposite happens with a negative realization of ϕ.

These properties of the equilibrium are quite intuitive and likely to be general. This simplified model, however, misses two important points of how a renewed version of the ERM would work in practice. On the one hand, it is likely to overstate the volatility of the real exchange rate in the absence of realignments. The variance of the speculative shocks ϕ would be dampened by a commitment to peg the nominal exchange rate, even with large fluctuation bands. These shocks are thus likely to vary with the monetary regime, and our assumption that the model is structural is likely to be false. On the other hand, a unilateral peg of the nominal exchange rate cannot be very credible or lasting. Hence, considerable exchange rate risk would remain, even in the absence of observed fluctuations of the nominal exchange rate. This is the well known "peso problem", discussed for instance in Ayuso, Nunez and Perez-Jurado (1995) with reference to Spain. These two omissions of the model tend to offset each other. They suggest that real exchange rate uncertainty would remain in a renewed version of the ERM, even though the form taken need not be the one described by the last equation in (15).

4.2. Money Targeting

The other two arrangements we study are symmetric: both the "ins" and the "outs" are required to target the same variables. Consider first a "money-target regime", where both central banks are induced to implement state-independent rules for m and m^*. Again, we allow no deviations. And again, the best such arrangement sets $m = m^* = 0$. The solution to the model now implies:

$$
\begin{aligned}
p(\tau,\omega) &= \nu + \beta\delta\gamma(\nu-\nu^*) - \beta\delta(\varepsilon-\varepsilon^*) + \beta\phi \\
p^*(\tau,\omega) &= \nu^* - \beta\delta\gamma(\nu-\nu^*) + \beta\delta(\varepsilon-\varepsilon^*) - \beta\phi \\
x(\tau,\omega) &= \gamma\nu - \varepsilon \\
x^*(\tau,\omega) &= \gamma\nu^* - \varepsilon^* \\
z(\tau,\omega) &= \delta\gamma(\nu-\nu^*) - \delta(\varepsilon-\varepsilon^*) + \phi
\end{aligned} \tag{16}
$$

Here, unlike in the previous regime, the solution is completely symmetric. In particular, output in the outside country only responds to own velocity shocks and supply side shocks. However, the real exchange rate is more variable: speculative shocks are not dampened, and idiosyncratic velocity shocks now also affect the real exchange rate. This additional real exchange rate volatility enhances the volatility of inflation rates. Very intuitively, in the ERM-regime the outside country destabilizes its own economy to stabilize the exchange rate. By targeting the money supply, instead, the outside country's output becomes more stable in the face of speculative shocks, but the real exchange rate becomes more unstable.

4.3. Inflation Targeting

A money-targeting regime is not the only symmetric arrangement. An alternative suggested by the previous results on the optimality of inflation contracts is a simple "inflation-target regime", in which both central banks implement state-independent rules for p and p^*. Again, we allow no deviations, and the best arrangement sets $p = p^* = 0$. The solution now implies:

$$
\begin{aligned}
x(\tau,\omega) &= -\varepsilon + \frac{\gamma\beta\delta}{1+2\gamma\beta\delta}(\varepsilon-\varepsilon^*) - \frac{\gamma\beta}{1+2\gamma\beta\delta}\phi \\
x^*(\tau,\omega) &= -\varepsilon^* - \frac{\gamma\beta\delta}{1+2\gamma\beta\delta}(\varepsilon-\varepsilon^*) + \frac{\gamma\beta}{1+2\gamma\beta\delta}\phi \\
z(\tau,\omega) &= -\frac{\delta}{1+2\gamma\beta\delta}(\varepsilon-\varepsilon^*) + \frac{1}{1+2\gamma\beta\delta}\phi
\end{aligned} \tag{17}
$$

In contrast to the ERM- regime, and like in the money-targeting regime, the solution here is completely symmetric. But inflation targeting differs from money targeting in several important respects. First, prices are fully stabilized, by assumption, under inflation targeting.[13] Second, fluctuations due to inside velocity shocks are eliminated. Third, and more importantly, the speculative shock to the exchange rate, ϕ, and the idiosyncratic component of the supply shocks, ε- ε^*, is now partly stabilized by both countries. Hence, the real exchange rate is more stable under inflation targeting than under money targeting. This is achieved by forcing output to absorb some of the shocks that otherwise would only affect the real exchange rate. It is important to understand why the real exchange rate is more stable under inflation targeting than under money targeting. With an inflation target, the authorities react to exchange rate fluctuations so as to prevent them from feeding into prices. This monetary policy response stabilizes the real exchange rate itself.

4.4. Comparisons of expected losses

Given (15) - (17), it is straightforward to compute the expected losses to both countries in these three regimes. Consider first the difference between the expected loss in the ERM and inflation targeting regime. For the outside country, it is given by:

$$E\left(L^s\right) - E\left(L^p\right) = \left(1+\lambda\gamma^2\right)\sigma_{v^*}^2/2 \tag{18}$$

$$+\left[\frac{(1-\beta)^2+\lambda\gamma^2+\mu}{(1+\delta\gamma)^2} - \frac{\lambda\gamma^2\beta^2+\mu}{(1+2\delta\gamma\beta)^2}\right]\left[\delta^2\left(\sigma_\varepsilon^2+\sigma_{\varepsilon^*}^2-2\sigma_{\varepsilon\varepsilon^*}\right)+\sigma_\phi^2\right]/2$$

For the monetary union the corresponding expression is:

$$E\left(L^{*m}\right) - E\left(L^{*p}\right) = \left(1+\lambda\gamma^2\right)\sigma_{v^*}^2/2 \tag{19}$$

$$+\left[\frac{\beta^2+\mu}{(1+\delta\gamma)^2} - \frac{\lambda\gamma^2\beta^2+\mu}{(1+2\delta\gamma\beta)^2}\right]\left[\delta^2\left(\sigma_\varepsilon^2+\sigma_{\varepsilon^*}^2-2\sigma_{\varepsilon\varepsilon^*}\right)+\sigma_\phi^2\right]/2$$

If we assume that β is not too close to zero, it is clear from (18) that the outside country is always better off in the inflation target regime. The monetary union is also likely to be better off, unless λ and γ are very large. The gains can be quite substantial if velocity shocks inside the monetary union, ν^*, and speculative shocks, ϕ, are large. This is precisely what we expect, at least in a transition period, after the creation of the Single Currency. Notice that it is only *asymmetric* supply shocks that produce a pay-off difference: if ε and ε^* are identical

[13] One may perhaps argue that it would be easier to control m (or s) than p. This may be true and could easily be modeled by adding a "control error" to equation (3). However, even if m is easier to hit than p, p does *not* necessarily fluctuate less in an $m-$targeting regime than in a p-targeting regime. For certain correlation structures for the shocks, the opposite may very well happen.

$(\sigma_{\varepsilon}^2 + \sigma_{\varepsilon^*}^2 - 2\sigma_{\varepsilon\varepsilon^*})$ is equal to zero. This term captures the usual argument that a fixed exchange rate does not handle asymmetric shocks very well.

Finally, the difference between the expected loss under money targeting and under inflation targeting for the outside country (the corresponding expression for the monetary union is identical, except that σ_{υ}^2 in the first term is replaced by $\sigma_{\upsilon^*}^2$) is given by:

$$E(L^m) - E(L^p) = \left(1 + \lambda\gamma^2\right)\sigma_{\upsilon}^2/2 + \gamma^2\left(\beta^2\gamma^2 + \lambda + \mu\delta^2\right)\left(\sigma_{\nu}^2 + \sigma_{\nu^*}^2 - 2\sigma_{\nu\nu^*}\right)/2$$
$$+ \left[\left(\beta^2 + \mu\right) - \frac{\lambda\gamma^2\beta^2 + \mu}{(1 + 2\delta\gamma\beta)^2}\right]\left[\delta^2\left(\sigma_{\varepsilon}^2 + \sigma_{\varepsilon^*}^2 - 2\sigma_{\varepsilon\varepsilon^*}\right) + \sigma_{\phi}^2\right]/2 \qquad (20)$$

The first two terms on the right hand side of (20) are always positive, because velocity shocks are fully stabilized under inflation targeting, but not under money targeting. The sign of the last term is ambiguous. On the one hand, prices and the real exchange rate are more stable under inflation than under money targeting. On the other hand, idiosyncratic supply shocks and speculative shocks induce more output volatility under inflation targeting than under money targeting. Unless λ and γ are very large, the first effect is likely to prevail, and both countries are likely to be better off under inflation targeting than under money targeting. The gains from inflation targeting are larger if velocity shocks are large, or if real exchange rate volatility is important (if μ is large).[14]

The main difference between these three regimes can thus be summarized as follows. The ERM regime is highly asymmetric, since only the outside country bears the burden of stabilizing the exchange rate. This burden is more costly the larger is the idiosyncratic component of the supply shocks, and the larger are the speculative exchange rate shocks and the inside velocity shocks. The money targeting and the inflation targeting regime instead are symmetric, in the sense that both countries react to shocks in a similar manner. The money targeting regime however does not offset velocity shocks, and entails more exchange rate

[14] The model abstracts from two features that could affect the comparison of these loss functions. First, money demand (equation (3)) is assumed not to depend on output. If output growth entered the right hand side of equation (3), this would add output variability in the inflation targeting regime compared to money targeting: to prevent a supply shock from destabilizing prices, policy in the inflation targeting regime would have to react to a supply shock in a way that further destabilizes output. For this reason, real world inflation targets often contain contingency clauses in the event of typical supply shocks, such as shocks to commodity prices. The model also abstracts from the possibility of calibrating the inflation target to the nature of the shocks hitting the economy. This points to an important tradeoff in the design of an inflation target as a device to achieve coordination. An inflation target defined over CPI inflation enhances stability properties of the exchange rate, because it forces the central bank to react to it, but makes output more variable. On the other hand, an inflation target defined over the GDP deflator allows more exchange rate variability, but makes output less variable.

instability than the inflation targeting regime. Output volatility could be higher or lower under inflation targeting than under money targeting, depending on the size of velocity shocks and on the parameters of the model. This comparison suggests that the inflation targeting regime may induce a preferable overall response of the macroeconomy to the shocks, even though the precise answer is ambiguous and depends on numerical values of the parameters.

These results are reminiscent of the traditional comparison of fixed versus flexible exchange rates, and of the literature on optimum currency areas. Besides the velocity shocks, the difference among these regimes is entirely due to how they respond to speculative attacks and to idiosyncratic supply shocks. In particular, because of how we model money demand (see footnote 14 above), a common European wide shock would entail the same macroeconomic response in all three regimes. Flexible exchange rates are most valuable when supply shocks are largely uncorrelated across countries (i.e., the idiosyncratic component of the shocks is large) or if there are frequent speculative attacks. This point is also stressed by Canzoneri, Nolan and Yates (1995) in a closely related paper.

Naturally, this comparison focuses only on the aspects captured by our simple model. Several practical but important issues are missing from this comparison. Some of them where mentioned in the Introduction. What we called the ERM regime has the advantage of continuity with the previous monetary history of Europe. It is also consistent with the Maastricht Treaty. A generalized inflation targeting regime would represent more of an innovation for many European countries. Unlike the ERM regime, however, inflation targeting does not force central banks to bet against financial markets in the event of speculative attacks, nor does it give rise to peso problems.

It is difficult to evaluate all these pros and cons and it is unlikely that in the end countries will agree on the evaluation. On the contrary, it is entirely possible that the final choice will be a monetary regime that combines the monetary policy rules considered in this section. A possible outcome, given the arrangements already in place, is one in which the ECB targets money while the outside countries (at least some of them) target inflation. In the model considered here, this regime still gives rise to an asymmetry.[15] First, velocity shocks are stabilized only in the outside country. Hence velocity shocks inside the monetary union affect the real exchange rate and, through this channel, output in the outside country. Second, only the outside country reacts to exchange rate movements, in order to prevent them from affecting inflation. Thus, real exchange rate volatility is higher than in the symmetric inflation targeting regime, but lower than in the symmetric money targeting regime. There is output asymmetry, but it is milder than under the ERM regime.

5. Some Evidence

The theoretical model discussed above suggests two important empirical implications. First, real exchange rate volatility is lower under inflation targeting than in other monetary regimes, including a regime of discretion without any international cooperation. This implication can be confronted with the data of the industrial countries that have recently adopted an inflation target. Second, the ERM - regime entails output asymmetries. The existing literature has convincingly established that the monetary policy in the EMS *de facto* was highly asymmetric, with Germany targeting its own money supply, and other EMS countries unilaterally pegging their exchange rate to the Deutsche Mark (see for instance Giavazzi and Giovannini (1989)). Hence, abstracting from realignment risk, in the 1979-92 period the EMS worked pretty much like the ERM-regime described in the previous section. The implication that German macroeconomic shocks are felt throughout the European countries pegging their exchange rate, but not vice versa, can also be tested empirically. This section finds preliminary support in favor of both of these empirical implications.

5.1. Inflation Targeting in Practice

In the 1990s, two industrial countries experimented successfully with inflation targets for a sufficiently long period of time: New Zealand, which first announced

[15] Output in the two countries and the real exchange rate here are given by the following expressions:

$$x(\tau,\omega) = -\varepsilon + \frac{\gamma\beta\delta}{1+\gamma\beta\delta}(\varepsilon-\varepsilon^*) + \frac{\beta\gamma^2}{1+\beta\gamma\delta}\nu^* - \frac{\gamma\beta}{1+\gamma\beta\delta}\phi$$

$$x^*(\tau,\omega) = \gamma\nu^* - \varepsilon^*$$

$$z(\tau,\omega) = -\frac{\gamma}{1+\beta\gamma\delta}\nu^* - \frac{\delta}{1+\gamma\beta\delta}(\varepsilon-\varepsilon^*) + \frac{1}{1+\gamma\beta\delta}\phi$$

an inflation target in February 1990; and Canada, which announced it for the first time in February 1991. Both countries use the exchange rate as an important (but not exclusive) indicator of future inflation. A depreciation of the exchange rate leads to an upward revision of the inflation forecast and, *ceteris paribus*, calls for a more restrictive monetary policy. The role of the exchange rate as a monetary policy indicator is particularly important in New Zealand, which is a more open economy. It is therefore natural to ask how adopting the inflation target affected the real exchange rate in both countries. The answer is contained in **Figures 1** and **2** and in **Table 2.**

Figures 1 and **2** illustrate the monthly change in the effective real exchange rate before and during the inflation targeting period. A positive number indicates an appreciation. In the case of New Zealand, the short run unconditional volatility of the real exchange rate dropped considerably after the adoption of the inflation target. In Canada, by contrast, nothing seems to have happened. **Table 2** reports some statistics relating to the real exchange rate in these two countries before and during the inflation targeting period. The first column of **Table 2** refers to unconditional short run volatility, measured as the unconditional variance of monthly changes. The second column indicates the average monthly rate of depreciation. The third column provides a measure of long run unconditional volatility, computed as the variance of (the log of) the real exchange rate in proportion to its mean. **Table 2** confirms what is evident to the eye. In New Zealand, both short and long run volatility of the real exchange rate dropped after the adoption of the inflation target. In Canada, the short run volatility is not affected by the monetary regime, while long run volatility and the average rate of depreciation increase during inflation targeting.

Thus, only the experience of New Zealand is in line with the predictions of the model. The experience of Canada may be special, however. First, the 1990s where a period of much higher political instability in Canada than the second half of the 1980s. Second, when Canada started the inflation target, the Canadian dollar was quite overvalued. Finally, in light of this evidence it is interesting to remark that the nominal exchange rate seems to play a bigger role as a monetary policy indicator in New Zealand than in Canada, possibly because of the features of New Zealand economy.

Three European economies — the UK, Sweden and Finland — also adopted inflation targets soon after the speculative attack on the EMS in late 1992. It is therefore interesting to compare them with the other European countries that, during the same period, where floating their exchange rate but did not have an inflation target. In Italy, the central bank does not have any quantitative nominal target since leaving the EMS. Spain adopted an inflation target only in early 1995 and never left the EMS, but with large fluctuations band and rather frequent realignments. The comparison of these European countries cannot be too informative, naturally, because the period is short and because the commitment to the inflation target may be weaker than in New Zealand and Canada.

A first remark is that inflation indeed has been lower in the inflation targeting countries: Inflation in UK, Sweden and Finland has varied around 2-3% since 1993, whereas it has remained above 4% in Italy and Spain (see **Table 3**). Here we are, however, mostly interested in comparing the real exchange rate fluctuations. **Table 3** compares these countries for the period 1:1993-9:1995. The table reveals that the most important difference between these two groups of countries is in the average real depreciation rate, which is highest in Italy and Spain, and it is lower in the three inflation targeting countries. Short run volatility is highest in Italy, while "long run" volatility is highest in Finland, which however on average appreciated its exchange rate during this period. These results are not overwhelming, but they do suggest that inflation targets may have had an impact on real exchange rates in Europe, making competitive devaluations more difficult. It is interesting to note that Spain, which belongs to the ERM, devalued its real exchange rate by more than any of the inflation targeting countries in Europe.

5.2. Output Asymmetries during the EMS

To assess the quantitative importance of asymmetries in the output response to shocks during the EMS period, we estimate a VAR model of industrial production in five European economies: Germany, France, the Netherlands, the UK and Italy. We then compute the impulse response functions, analyzing the transmission of innovations across countries. The estimation period is 7:1979- 12:1992, and data are monthly. The VAR includes 6 lags of each variable. Industrial production is filtered with a Hodrick-Prescott filter to remove the trend, and it is measured as percentage deviation from trend.[16]

As stated above, and as suggested by independent evidence, our maintained assumption is that *de facto* the EMS rules were asymmetric: Germany was the center country, that pursued an independent monetary policy, while the other countries were unilaterally pegging their exchange rate to the Mark. In the case of the Netherlands and France, the exchange rate was certainly a key operational variable for monetary policy throughout most of the EMS period. In the case of Italy this is more dubious, as realignments were more frequent until 1987, and the

[16] The simple theoretical model interprets all output variables in deviation from trend. Here the weight λ in the Hodrick-Prescott filter is set to 300 000 (recall that the variables here are monthly). This value of λ was chosen so that our filtered measure of industrial production would mimick as much as possible the observed cyclical behavior of capacity utilization. Similar results are obtained when industrial production is measured in logs, and the VAR is estimated in levels.

fluctuation band was larger than in the other countries until 1990. Finally, the UK was out of the EMS throughout most of this period. Under these assumptions, the equilibrium reduced form for output under the ERM-regime (equation (15)) suggests the following implication. First, an innovation to German industrial production should be transmitted to France and the Netherlands, but not to the UK and to a much weaker extent to Italy. Second, innovations to industrial production in the other European countries should not be transmitted to Germany, nor elsewhere in Europe.

Naturally, industrial production shocks can be transmitted across countries for reasons other than the monetary policy regime. Hence we don't expect that these implications hold exactly. Among countries of equal size, however, these other transmission mechanisms should be symmetric. At least among the four big European countries, it seems reasonable to interpret any evidence of asymmetries as being due to the monetary regime.

The impulse response functions of this VAR are displayed in **Figures 3-4**. Dotted lines indicate the 95% confidence interval. The size of each innovation is one standard deviation and the response of each variable is scaled to its own standard deviation. Thus, the first column of **Figure 3** displays the effect over time of a one-standard-deviation innovation in German output on itself , on French output over time, and so on, where output is always measured in percent of its own standard deviation.

Identification of the shocks is made on the basis of a Choleski decomposition. In **Figure 3**, Germany is the first country. Thus, the identification assumption is that an innovation to, say, French industrial production is the component of the VAR estimated residual for France which is orthogonal to the estimated residual in Germany's equation. This identification assumption is the most favorable to our model, since it assigns the common component of all the shocks to Germany. In **Figure 4**, the ordering is reversed, and Germany is the last country. This identification assumption is the least favorable to our model. Even though the data are monthly, there remains some correlation among the estimated residuals, particularly between France and Germany. Thus, the identification assumption is not innocuous.

The results in **Figure 3** strongly support the theoretical model. Innovations to German output are transmitted to France and the Netherlands, but not to the UK and Italy. Moreover, German output is unaffected by shocks in any other countries. In fact, there is little evidence from this picture that shocks are transmitted across countries, other than shocks originating in Germany. The results in **Figure 4** are less impressive. However in the last column of the Figure evidence remains that German shocks are transmitted to France and the Netherlands, but not to Italy and the UK, even though the spillover effect is now smaller. In this case, French innovations also have a significant effect on German output. This can be interpreted as economic spillovers not relating to the monetary regime. However, the German response to French output in **Figure 4** is considerably smaller than the French response to German output in **Figure 3**. Thus, the transmission mechanism indeed seems asymmetric, as predicted by the model. Even though other interpretations are possible, it seems natural to interpret this asymmetry as due to the monetary regime.[17]

The size of these spillover effects is considerable: at a nine months horizon, an innovation to German industrial production accounts for between 9% and 30% of the variance of French output, and between 30% and 55% of the variance of Dutch output, depending on the identification assumptions, but always less than 1.5% of the variance of Italian output.

6. Concluding Remarks

How should the ECB pursue its monetary policy and how should monetary policy be coordinated with the outside countries after the formation of the Single Currency? Influential policymakers in Europe currently answer these questions as follows: The ECB should adopt an intermediate money target and the outside countries should be required to unilaterally stabilize their exchange rate towards the Single Currency. In this paper, we have tried to show why a system of mandatory inflation targets is a better answer.

One reason is that the inflation targeting regime is more symmetric. The arrangement where the countries not participating in the Single Currency would have to unilaterally peg their exchange rate to the European single currency is highly asymmetric. As shown in section 4, the outside countries would have to destabilize their economy to absorb the speculative shocks to the exchange rate, as well as some of the supply shocks in the inside countries. The evidence from the EMS period suggests that indeed shocks originating from Germany have destabilized output in the other "hard currency" countries in Europe. By contrast, if all countries are required to target inflation, irrespective of whether they participate in Stage III of EMU or not, the burden of coordinating policy is shared more equally.

When it comes to the ECB, an inflation target has two advantages over an intermediate monetary aggregate. First, it automatically offsets velocity shocks. With a strict monetary target instead these shocks are allowed to destabilize

[17] Ballabriga, Sebastian and Valles (1994) also find evidence of asymmetries in Europe, with Germany being the "locomotive", as they say, even though their interpretation is more general. Helg, Manasse, Monacelli and Rovelli (1995) discuss the contemporaneous correlation of innovations across European countries and industrial sectors, focusing on technological spillovers.

prices, output and the real exchange rate. Such shocks are likely to be important inside a newly created monetary union. Second, it also facilitates holding the ECB accountable for its actions, something that may be badly needed for making the institution politically legitimate (this is outside the formal analysis in this paper, though).

A regime with strict and symmetric inflation targets helps solving the problems of monetary cohabitation in three distinct ways. First of all, it removes the incentive to systematically and deliberately engage in competitive devaluations. Since such policies would sooner or later result in higher inflation, they are ruled out under an inflation target.

Second, an inflation targeting regime restores domestic credibility to a low inflation policy. This in turn makes monetary cohabitation easier, because it reduces the volatility of the speculative shocks to the exchange rate. In some European countries, speculative exchange rate attacks have often resulted from the fear that high public debt would eventually be monetized, or more generally from genuine uncertainty about future inflation. Reinforcing the commitment to price stability, making it a responsibility towards other European countries and not just towards domestic citizens, would reduce this uncertainty and could lead to more stable real exchange rates. As discussed in Section 5, the empirical evidence on the European countries that have floated their currencies after 1992 indicates that this may indeed have happened.

These two effects could, in principle, also be achieved in a regime of (symmetric) money targeting. The inflation targeting regime has, however, an advantage when it comes to handling speculative attacks or idiosyncratic supply shocks. An intermediate money target would not require any particular action in the face of such shocks. An inflation target instead requires a stabilizing policy response. We believe this aspect of the model captures an important feature of how an inflation target would work in the real world. In the countries that have moved to inflation targeting, such as New Zealand and Canada, the nominal exchange rate is a closely followed indicator of future inflation: A nominal depreciation thus calls for a more restrictive monetary policy, *ceteris paribus,* to prevent inflation from rising. This response is stabilizing with respect to the exchange rate itself. As discussed in Section 5, the evidence coming from New Zealand, though not that of Canada, supports this argument.

How could a European system of inflation targets be implemented in practice?[18] All countries in the European union would have to participate. They would have to announce precise quantitative targets for a well defined measure of

[18] This question is addressed in more detail in Dewatripont and al. (1995). There is also a rapidly growing literature that describes the recent general experiences with inflation targeting (see for instance Leiderman and Svensson (1995)).

inflation. The targets would not have to be exactly the same, but would have to satisfy certain restrictions. Performance vis-a-vis the target would be monitored by a European institution, most naturally by the European System of Central Banks (i.e. the ECB plus the national central banks not participating in the single currency). The penalties for missing the target would also be recommended by a European Institution; the most natural candidate would be the Council of Ministers, since this is the only body that comes close to a European principal for the member states. In this respect the arrangement would be similar to the "excessive deficit" procedure described in the Maastricht Treaty. Enforcement by a European body, as the Council, also avoids one difficulty that may arise in a national context: ex ante beneficial sanctions may not be enforced ex post, because it may not be in anyone's interest to punish short-run optimal behavior. If enforcement instead is done by a body which includes interests that are damaged by opportunistic behavior — say a competitive depreciation — ex post enforcement becomes much more likely.

Unlike the excessive deficit procedure, the decisions regarding penalties for missing the announced target would have to be addressed to the central banks, and not to the country involved. For strategic delegation to be a workable solution to the incentive problems discussed in this paper, each national central bank would have to be largely independent from government and political interference. Fulfilling the inflation target should hence be a responsibility that falls on the central banks. The penalty for missing the target could take several forms. A mild penalty would be public blame; a harsher penalty would be a recommendation to fire the governor (in this case, national legislation may have to be changed to make this sanction legal).

To what extent is a system of generalized inflation targeting consistent with the Maastricht Treaty? In some ways, the Treaty provides a useful underpinning. Except for the opt-out countries, central banks are required by the Treaty to be independent and to pursue price stability as a goal. Moreover, inflation is one of the convergence criteria and this imposes an implicit penalty for the countries that would like to join the Euro but have excessively high inflation compared to the other EU countries. The idea of imposing accountability for inflation differences is thus already an important ingredient in the Treaty. The system we advocate, can therefore be thought of as strengthening some provisions in the Maastricht Treaty. It makes inflation convergence an overriding objective for monetary policy, it forces each central bank to give that objective operational and quantitative contents and to announce it clearly in advance. It also gives *institutional* contents to the exercise of accountability by making inflation targeting a requirement for *all* central banks, including the ECB and those opting out of the single currency, by spelling out more clearly who is responsible for hitting the target, and by prescribing penalties for poor performance.

The Maastricht Treaty also contains two references to the exchange rate. It says that the exchange rate is a matter of "common interest". And exchange rate stability (in the sense of no realignments) is one of the convergence criteria.[19] The argument presented in this paper suggests that these references to exchange rate stability should be de-emphasized. Ideally, they should be eliminated from the Treaty altogether. That could require opening a Pandora's box and a lengthy process of ratification of a new Treaty. For obvious political reasons, the Maastricht Treaty thus may have to be taken as it is. Under the current EMS, with fluctuation bands of $\pm$ 15%, the exchange rate criterion is almost meaningless, however. We think it should remain meaningless. Any attempt of implementing this part of the Maastricht Treaty by giving the exchange rate criterion a stricter interpretation should be avoided as much as it is legally possible.

Naturally, even with a system of generalized inflation targets, the exchange rate would remain a matter of "common interest". Indeed, a major reason for institutionalizing inflation targets at the EU level rather than at the national level is precisely because of the desirable repercussions of the exchange rate. But exchange rate stability ought to be the *result* of successful monetary policies, rather than the explicit *target* for these policies

In the inflation target regime we advocate monetary policy coordination is achieved by setting up an institution that creates appropriate incentives. Within that institution, national central banks are left free to choose their policy in a decentralized and discretionary fashion. If the incentives are consistently enforced, the decentralized equilibrium approximates the hypothetical ex-ante optimum with policy coordination. Such an approach to policy coordination is more likely to be incentive compatible, and hence to last over time, than ambitious attempts to explicitly target the exchange rate in a world of free capital mobility.

[19] The interpretation of this criterion is still disputed, since the EMS has changed drastically after the Treaty was signed.

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Table 1
Nominal Exchange Rates Since 1992

	Nominal Effective Exchange Rate (Q395-Q392)	Real Effective Exchange Rate (Q395 - Q392)	Exports inside EU	(92-94) outside EU
Belgium -Lux	9.9	10.4	5.8	17.9
Denmark	12.6	12.8	-4.8	7.3
Germany	15.0	16.5	-6.3	6.1
Greece	-14.2	12.7	-11.5	-12.9
Spain	-15.9	-16.0	8.7	17.8
France	11.9	8.7	-2.5	3.6
Ireland	-2.1	-9.0	0.1	23.1
Italy	-26.4	-26.3	2.2	14.2
Netherlands	0.7	4.0	9.3	11.7
Portugal	-7.5	6.8	0.8	0.9
UK	-11.2	-6.8	3.6	12.3

Source: European Commission
A positive number indicates an appreciation
The real rates are computed from unit labor costs

Table 2
Real Exchange Rates in New Zealand and Canada

New Zealand

	V(Δz)	M(Δz)	V(z)/M(z)
Jan 85 - Jan 90	9.34	0.43	2.1E-3
Feb 90 - Apr 95	2.19	-0.05	0.7E-3

Canada

	V(Δz)	M(Δz)	V(z)/M(z)
Jan 85 - Feb 91	1.84	-0.08	0.6E-3
Mar 91 - Aug 95	2.00	-0.42	2.4E-3

Legend:
z= log of real effective exchange rate
Δz = monthly % change in z (computed as 100 times the monthly first difference of z). A positive number indicates an appreciation.
M(z) = mean of z
V(z) = Variance of z

Table 3
Real Exchange Rates in Europe
Jan 93 - Sept 95

	Sweden	UK	Finland	Spain	Italy
V (Δz)	3.348	1.810	2.855	2.777	5.962
M (Δz)	-0.182	-0.112	0.388	-0.324	-0.338
V(z)/M(z)	1.97E-04	0.96E-04	9.92E-04	4.23E-04	7.15E-04
Average inflation rate					
1993	4.54	1.56	2.08	4.47	4.36
1994	2.18	2.45	1.08	4.62	3.97
1995*	2.54	3.44	1.22	4.66	4.99

Legend: See Table 2
* Jan-Sept 1995