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Coordinating European Monetary Union

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Coordinating European Monetary Union*

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ABSTRACT

This paper explores coordination problems in the transition to European Monetary Union (EMU). If incentives to undertake costly convergence and the benefits of EMU to any individual country depend on other countries' strategies, inefficiencies and multiple equilibria can arise. A multi-speed approach to EMU is advocated as a possible answer to coordination failures. In such a scenario candidate countries would also have the option to spread the costs of convergence over a longer time period.

Keywords: European Monetary Union, policy coordination, convergence

JEL codes: E58, E61, F33, F42

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I. INTRODUCTION

The "strategic view on EMU" proposed in Winkler (1996a) identifies conflicts of interests with respect to the Maastricht transition to Monetary Union. In particular, "credibility countries" with a strong domestic stability tradition are interested in establishing a high degree of convergence in advance of EMU. "Convergence countries" with low domestic credibility, by contrast, prefer an early and unconditional EMU in order to reduce the costs of achieving convergence[1]. These two contrasting views are reflected in the long-standing debate between the "economist" and the "monetarist" approaches to monetary integration. The convergence criteria[2] together with a firm deadline for the start of EMU represent a compromise in the interest of both sides by offering entry into EMU as a reward for prior convergence. Winkler (1996b, 1997c) explores the "vertical" coordination problem between the credibility and the convergence countries, where the Maastricht Treaty, and the convergence criteria in particular, are used to align conflicting interests.

In this paper we address issues of coordination that can arise even in the absence of conflicts of interest. Strategic interdependence between countries with identical objectives here gives rise to "horizontal" coordination problems in the transition to EMU. In the presence of the Maastricht entry conditions an individual country's optimal convergence strategy depends on the behaviour of other countries, as illustrated in section two. If the reward or the cost of convergence is affected by other countries' behaviour, multiple equilibria can arise[3]. Countries also have to make decisions on the timing of their convergence efforts, i.e. whether to adhere to EMU from the start or risk deferring entry until a later date, as discussed in section three. Decisions on EMU-entry of any individual country also depend on other countries' choices. Countries may adopt "bandwagon strategies", i.e. undertake convergence or join EMU only after other

[1] See Garrett (1993) and Sandholtz (1993) on country preferences. Fratianni et al. (1992), Bini-Smaghi et al. (1994), Tavlas (1994) and Winkler (1997b) discuss the Maastricht transition strategy for monetary unification.

[2] The Maastricht criteria call for inflation and interest rates to be within 1.5 percentage points of the the three best performers and for membership of the exchange rate mechanism (ERM) for at least two years without devaluation on own initiative, as preconditions for joining EMU. The fiscal conditions stipulate a deficit of at most 3% and a public debt of at most 60% of GDP, with some qualifiers attached. Countries' eligibility will be decided by qualified majority vote in the Council on the basis of convergence reports prepared by the Commission and the European Monetary Institute.

[3] The logic is similar to the literature on speculative attacks, where the cost of defending an exchange rate depends on market expectations (Obstfeld 1996, Okzan and Sutherland 1994, Eichengreen and Wyplosz 1993).

countries have committed to doing so. This could lead to an inefficient delay of EMU, as explained in section four.

II. THE CONVERGENCE GAME

The strategic view on EMU interprets the Maastricht treaty as a mechanism to address coordination problems that arise from conflicting interests across players and over time. This section looks at strategic interaction of identical players during the convergence process. The basic framework is as in Winkler (1996b, 1997a). The first term in *equation 1* gives the expected payoff from stage three of EMU, where p can be interpreted as a discount factor, the timing of entry into EMU, the probability of entry or, perhaps, even the expected size of EMU (going beyond the simple two-country setting). The probability and timing of accession to EMU are a function of convergence effort (E) in stage two of EMU, because of the Maastricht entrance requirements. In *equation 1* the probability of entering EMU also depends on foreign effort E_f. The net benefits of stage three of EMU are captured by T. The second term in *equation 1* expresses the political and economic costs of convergence measures[4].

$$U(A) = p(E, E_f) \cdot T - C(E) \tag{1}$$

There are several possible channels of externalities in the Maastricht convergence game. Both the size of the expected net benefits from EMU and the costs of convergence could depend on other countries' policies. With respect to the expected benefits of EMU there are three basic possibilities. *First*, benefits of stage three may depend on the degree of convergence undertaken by other countries in stage three. This would be the case if convergence rendered EMU closer to an optimum currency area and thus reduced the costs of centralizing monetary policy. The behaviour of candidate countries in the run-up to EMU, moreover, could also affect the reputation of EMU and thus its performance, at least in the initial period (Winkler 1995).

Second, a country's chances of overcoming the convergence hurdles depend on other countries' efforts. The most obvious reason is that some of the convergence criteria are formulated as a relative standard. In particular the interest rate and inflation criteria are specified with reference to the average of the three best performers. Any increase of convergence effort in the three reference countries, therefore, makes satisfying the criteria more difficult for all other countries.

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[4] See von Hagen and Lutz (1996) and Hughes Hallett and McAdam (1996) for empirical analyses of the costs of meeting the Maastricht criteria.

Moreover, how strictly the criteria are applied is likely to be influenced by the convergence situation across the board and in key countries like Germany and France in particular. Since the assessment of countries' convergence is subject to a qualified majority vote in the European Council (Krumm and Herz 1996, De Grauwe 1996), voting behaviour (or bargaining strength) may itself be a function of countries' *absolute* or *relative* convergence situation.

Third, the convergence efforts of foreign countries determine their own respective chances for EMU eligibility and thus, to some degree, affect the probability and timing of EMU as well as its expected size. This is most obvious in a two-country model, where EMU only happens if both countries satisfy the criteria simultaneously. It would still hold if the foreign entry probability reflects the likelihood that a critical mass of several countries meet the criteria, and if otherwise EMU would not go ahead. The externality from foreign convergence effort via p or T is likely to be positive. A possible exception can arise if greater convergence effort leads to a larger number of participants in EMU and if this dilutes its credibility.

The political and economic costs of undertaking convergence effort also depend on the intensity of other countries' efforts. Here the externality could be positive or negative. If painful adjustments are undertaken across Europe in the name of Maastricht the political cost to push through convergence measures in any individual country could be lower than if it was acting alone. On the economic side, if convergence proceeds in a synchronized fashion across Europe it may help build systemic confidence, reduce (long-term) interest rates, exchange rate instability and speculative capital flows[5]. In this way aggregate convergence effort could lower the costs of individual convergence measures. In the short-run, however, spillovers are most likely to be negative if convergence efforts depress home demand and therefore also foreign demand. Here the standard literature on international policy coordination applies, both for fiscal and monetary spillovers on the costs of convergence[6].

For illustration, assume two identical Agent countries who maximize *equation 1*, where the strategic interaction operates via the entry probability. The most straightforward interpretation derives from the simple fact that EMU only happens

[5] Winkler (1997a) examines such feedback effects for the case of single country convergence incentives, where an increase in the probability of EMU entry in turn reduces the costs of convergence. In the debt model of Calvo (1988) multiple equilibria arise because interest payments depend on self-fulfilling expectations of default.

[6] See Oudiz and Sachs (1984), Canzoneri and Henderson (1991), Bryson et al. (1993); Buiter et al. (1995, 1996) provide an application to the ERM context.

if at least two countries (often more precisely identified as France and Germany) make the Maastricht appointment. The obvious formalization in a two-country model is to make the total probability of EMU equal to the product of individual chances of meeting the Maastricht requirements. We adopt a functional form for individual entry probability that is concave in effort and naturally bounded between zero and one. We use a quadratic cost function for the disutility of convergence.

$$p(E,E_f) = p(E)\cdot p(E_f) \qquad with \quad p(E) = \frac{E}{1+E} \tag{2}$$

$$C(E) = \frac{\beta}{2}E^2; \qquad E \geq 0; \quad T,\beta > 0; \quad 0 \leq p(E) < 1 \tag{3}$$

In a Nash equilibrium each country maximizes (*1*) taking foreign convergence effort as given, which yields the following individual first order condition (for each country).

$$\frac{\partial U}{\partial E}(\bar{E}_f) = \frac{1}{(1+E)^2}\cdot\frac{E_f}{1+E_f}\cdot T - \beta E \quad \overset{!}{=} \quad 0 \tag{4}$$

We only consider symmetric equilibria where home effort equals foreign effort. Using this assumption we obtain the two Nash equilibria in (*5*), whereas the cooperative solution from maximizing joint welfare is given in (*6*).

$$Nash\ Equilibria\text{:} \quad E_1^{\,NE} = 0, \qquad E_2^{\,NE} = \sqrt[3]{\frac{T}{\beta}} - 1 \qquad \left(for\ \frac{T}{\beta} \geq 1\right) \tag{5}$$

$$Cooperative\ Solution\text{:} \qquad E^{Coop} = \sqrt[3]{\frac{2T}{\beta}} - 1 \qquad \left(for\ \frac{2T}{\beta} \geq 1\right) \tag{6}$$

The Maastricht convergence game has two Pareto-ranked Nash equilibria, which both involve a convergence effort below the efficient, cooperative level[7]. We can therefore distinguish two types of coordination problems. First, how to commit to the cooperative solution and neutralize incentives to deviate from it. If such commitment is not available the second issue becomes how to coordinate on the Pareto-superior Nash equilibrium. Once achieved the latter would be self-enforcing and therefore, unlike the cooperative solution, would not require any commitment technology.

[7] Neither of the Nash equilibria is efficient, since the external effects on other countries' convergence rewards are not taken into account.

The multiplicity result in the Maastricht game arises because the expected reward to convergence (here the probability of EMU) depends on other countries' convergence efforts. A country's best response, if no-one else converges, is to do nothing either. Conversely, the greater foreign effort, the greater is the home incentive to converge. This leads to a second "high convergence" equilibrium. Our formulation takes the Maastricht criteria as fixed and given. The result may also go through if the application of the criteria is subject to qualified majority voting. Then countries will not undertake any convergence if they expect a "political" vote that either lets them in regardless or excludes them irrespectively of their convergence effort. Convergence will only be forthcoming if the voting behaviour, and therefore the chance of admission, is (at least partially) a function of convergence.

The risk of "coordination failure" (Cooper and John 1988) in the convergence game means that countries could get stuck in the low (here: zero) convergence equilibrium. In order to shift to the better equilibrium an additional coordination and commitment device to initiate and support the transition is required. Therefore our model rejects a purely market led or voluntaristic approach, which advocates proceeding to EMU "when the time is ripe". Our model is in line with the interpretation of the ERM crisis as a response to doubts about the political commitment to EMU (Fratianni and Artis 1996), which knocked countries out of the "high convergence" equilibrium that had prevailed up to 1992.

One possible solution in the Maastricht treaty in order to overcome the "horizontal" (as well as the "vertical") coordination problem of the transition was to set *both* convergence requirements *and* a firm deadline. Without the criteria there would be little incentive to undertake costly convergence. Without the 1999 deadline, doubts about if and when EMU, and therefore the rewards for convergence, would materialize risk coordination failure as in the present model. Fixing a deadline and numerical convergence targets can pick out the superior Nash equilibrium as a "focal point" and coordinate the timing of convergence efforts. Making EMU both state- and time-contingent, however, may not be sufficient if there is a conflict between both starting conditions, i.e. if there is little prospect that the convergence criteria can be met in time for the 1999 deadline by enough countries. On paper, the treaty solves this problem by not imposing a minimum size requirement, i.e. by stipulating that EMU would go ahead even if only two countries satisfied the criteria.

However the coordination problem resurfaces if any one of the three aspects of the treaty itself lacks credibility. First, it is politically unrealistic and economically meaningless to conceive of a mini-EMU, especially one that were to exclude

either France or Germany. Second (and therefore), given convergence conditions as of 1996, either the deadline or the strict interpretation of the criteria have to give, and therefore the "convergence trilemma" undermines the coordination and incentive properties of the treaty in practice. As long as a delay or a failure of EMU or a relaxation of the entry conditions are perceived as possibilities, our model of coordination failure applies as it stands. In particular, it can explain why countries left it until very late, until many years after the signing of the Maastricht treaty, before they initiated meaningful convergence programmes. In the presence of uncertainty about EMU's fate it was rational to sit and wait, as long as other countries did the same.

The convergence trilemma between deadline, criteria and minimum size requirement could be solved if the entry conditions were to be interpreted as relative rather than absolute performance contracts[8]. In terms of our model a country's probability of entry in *equation 1* would become a function of the difference between its own and foreign convergence effort. In fact, the nominal criteria on inflation and interest rates are explicitly formulated in relative terms and the exchange rate by definition is a relative variable. Moreover, given the convergence trilemma, even the absolute fiscal criteria will be subject to a relative interpretation. For example, France is unlikely to try push its deficit below the 3% limit in 1997 if it predicts that Germany will not meet the target either and thus would be in a weak position to insist on a strict application for any country, unless a delay of EMU was an acceptable alternative.

Entry decisions based on relative performance could be superior to absolute criteria for two reasons. They require much less information if convergence effort is not contractible directly. In particular they avoid inefficiencies that arise from absolute criteria which are not state-contingent on (symmetric) shocks outside the countries' control. Second, relative entry criteria avoid the minimum size problem, since the best (relative) performers would be admitted to EMU in any case. As long as there is competition between countries, relative criteria could still provide effective incentives, and more efficiently than rigid absolute conditions.

There are, however, a number of drawbacks. First, under relative performance contracts the absolute level of convergence effort remains indeterminate. In particular, countries will have an incentive to collude in order to minimize the effort needed to join EMU. The danger is particularly acute under the political qualified majority voting on the application of the criteria. Second, to organize effective competition a relative performance contract must limit the number of

[8] As in Shleifer (1985), Mookherjee (1984).

places in EMU that countries compete for, i.e. rule out a large EMU from the start via a "maximum size requirement". Again this may be unrealistic under qualified majority voting, if excluded countries can form a blocking minority (De Grauwe 1996). Relative performance contract are attractive because they make EMU happen for sure, independently of shocks, and thus they solve the coordination problem from the externality via the foreign entry probability. However, now the home country's entry chances will depend directly on foreign effort and therefore the problem of multiple equilibria with respect to convergence effort emerges as before.

To address coordination failures in the convergence game, we can look to the move order, the distribution of authority and contract precommitment as possible answers, as explored in Winkler 1997c for the case of the vertical coordination problem. In a sequential game, pivotal countries could provide leadership by going ahead with convergence unilaterally. Once a critical mass of countries is seen to be likely to satisfy the (absolute) criteria, the other countries will have an incentive to follow suit. An example of this is the acceleration of Italian budget consolidation in the summer of 1996 once it had become clear that the Spanish government was aiming to fulfil the 3% deficit criterion at all costs. Under a relative interpretation of the entry criteria, similarly, individual countries can set the (absolute) performance standard unilaterally. In particular, the fact that the Bundesbank controls monetary conditions in European core countries ensures in practice that the relative inflation and interest rate criteria do not lead to collusion on a bad performance outcome. With respect to the fiscal criteria, however, the German and French difficulties render a relative interpretation more likely. The latter may however, be a sensible response in the face of common adverse shocks.

A second possible solution is to install mechanisms of coordination, communication and authority at the European level (von Hagen and Fratianni 1994). For example the convergence reports by the Commission, EMI, and the EU summit declarations could help invoke the high convergence equilibrium as a focal point, by influencing beliefs about the probability of EMU and by organizing joint convergence. Again, the second half of 1996 provides an illustration, where summit activism, reports from the Commission and the EMI reversed earlier pessimism on EMU and created considerable momentum behind the project.

Third, external commitment could help overcome coordination failure and reduce the risk that qualified majority voting undermines the credibility of the convergence criteria. For example the German supreme court ruling (Steinherr 1994) as well as resolutions by the German parliament insisted on a strict interpretation of the Maastricht criteria, thus limiting the scope for collusion on a

low (relative) convergence standard. Conversely, the treaty commitment to the 1999 starting date together with the political stakes in the project reduces the risk of coordination failure under the absolute interpretation of the criteria. In fact, countries did embark on serious convergence programmes when (and only when) the 1999 deadline drew near and EMU was considered very likely to happen.

The analysis of this section suggests a multi-speed EMU as the preferable solution to the convergence trilemma, and as the only possible solution that preserves the credibility of both the starting date and the convergence criteria. In terms of our model it makes (some) foreign entry probability close to one, thus maximizes incentives to catch up with convergence efforts in order to increase one's own chances to join EMU. By relaxing the minimum size constraint, the likelihood increases that EMU can start on time and without compromising absolute convergence standards. By providing a maximum size constraint in the initial phase it reduces the risk of collusion under relative entry conditions and ensures that EMU sets an ambitious standard by rewarding only the best performers. Moreover, once EMU is in existence the incentives to join among those initially outside will become even stronger. However, the cost of convergence for the countries in derogation could increase. We turn to an analysis of single country incentives under a multi-speed EMU in section three.

A Contract for the Convergence Game

Above we have modelled the convergence incentives given the Maastricht criteria, which make the probability of entry a function of convergence effort. As explored in Winkler (1997a), the convergence criteria and other features of the Maastricht game are set such as to achieve the twin objectives of the Treaty, i.e. the realization of EMU and the organization of prior convergence. We have seen that both Nash Equilibria in the convergence game are socially inefficient. Thus a European Principal designing the treaty should not only try to prevent the low effort Nash equilibrium, but possibly provide extra incentives to move towards the cooperative solution. For illustration consider a Principal, perhaps best thought of as Germany or the Bundesbank, who is interested in convergence *per se*, but to whom providing incentives (i.e. conceding EMU) is costly. His objective function is given by *equation 7*, where T represents the net costs of EMU. The latter, therefore, capture the rival features of EMU[9], which shift the costs and benefits

[9] Winkler (1997a, 1997c) considers the distinction between the rival benefits and the non-rival benefits explicitly. Here the rival benefits should be seen as net of any joint benefits of the single currency. Examples of (partially) rival features of EMU are central bank independence, the

between the Principal and the Agent countries, who continue to maximize *equation 1*.

$$\underset{T}{Max} \quad V(P) = -p(E)\cdot p(E_f)\cdot T + \omega E \tag{7}$$

The Principal maximizes (*7*) subject to the (high convergence) Nash equilibrium resulting from the convergence game in *equation 5*. It is convenient to express the Nash equilibrium in terms of T and then substitute into the Principal's objective function, which yields optimal effort and contract reward as below.

$$E^* = -\frac{1}{3} \pm \sqrt{\frac{1}{9} + \frac{\omega}{3\beta}} \tag{8}$$

$$T^* = \beta(1+E^*)^3 \quad = \beta\left(\frac{2}{3} \pm \sqrt{\frac{1}{9} + \frac{\omega}{3\beta}}\right) \tag{9}$$

Here "optimal" refers only to the contract in its restricted form. The Maastricht criteria are taken as given and the Principal cannot contract convergence effort directly. If he had other parameters at his disposal to influence convergence incentives or if he could be compensated for EMU by sidepayments, he may be able to induce the cooperative effort in *equation 10*.

$$E^{coop} = \frac{\omega}{\beta}, \qquad T^{coop} = \beta(1+\frac{\omega}{\beta})^3 \tag{10}$$

A European Principal maximizing the sum of utilities in *equations 1* and *7* only cares about efficient convergence, since the Agent's interest in EMU and the Principal's dislike for it cancel out. The resulting cooperative contract for the convergence game offers more concessions to the Agent on EMU (larger T) and achieves greater convergence than a German Principal would induce. In general, any designer of the Maastricht Treaty who cares about EMU coming about and about convergence will raise T in order to induce greater convergence, which in turn raises the chances of EMU happening. A German Principal, as long as EMU *per se* is a sacrifice, would prefer convergence incentives to be provided via tougher Maastricht criteria $p(E)$.

The issue of providing incentives for efficient convergence across the Principal and Agent countries, however, is a separate issue from the coordination of convergence across Agent countries in the convergence game of *equations 5* and *6*. The latter requires additional measures to coordinate on the preferred Nash

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choice of instruments of monetary policy and the Stability Pact enforcing the deficit criterion inside EMU. All these features will suit some countries while being costly to others.

equilibrium or on the cooperative solution. This requires that countries are offered additional rewards or subsidies for convergence effort, or that perceived rewards from EMU or perceived foreign entry probabilities exceed the actual ones. This might provide a rationale for national leaders to exaggerate the costs of exclusion from EMU and use a "all or nothing" rhetoric in the domestic political arena (raising T). An example is the Italian prime minister's commitment to resign if Italy should fail the EMU objective. Similarly a rhetoric that exaggerates foreign entry probabilities is useful in biasing convergence efforts upwards towards efficient levels. Here the optimistic convergence predictions by the Commission might have a role (raising perceived foreign p) and the anticipation of a large number of participants (in turn raising T), as a "self-fulfilling prophecy".

III. MULTI-SPEED EMU

The previous section illustrated the risk of countries failing to move to a superior equilibrium, because painful convergence only pays off if countries act together. Multi-speed EMU was offered as a possible solution to coordination failures in the convergence game. This section introduces the time dimension of the problem explicitly, by giving countries a choice about the allocation of any given required convergence across periods, i.e. between joining EMU in a first or a second wave. If applied to (a single-speed) Europe as a whole, adding a time dimension to the convergence problem opens up the option of taking extra time for convergence and therefore of delaying EMU. In the case of a multi-speed Europe each country has the option individually to join EMU early or late.

Consider a two-period version of objective function (*1*) where the expected net benefits from EMU are collapsed into a single function $T(E)$ for each time period. In principle this function should reflect a combination of the probability of entry and the benefits from EMU, both of which vary with E. In the first case, as before, the Maastricht criteria govern the probability of entry as a function of convergence effort. In the second case convergence reduces the costs from surrendering independent policy instruments. For the present purpose we abstract from uncertainty and assume a fixed EMU benefit for each period. Admission to EMU is conditional on meeting a convergence threshold imposed by the Maastricht criteria (or reflecting the Principal's participation constraint).

$$U(A) = T_1(E_1) + T_2(E_1,E_2) - \frac{\beta_1}{2}E_1^{\,2} - \frac{\beta_2}{2}E_2^{\,2} \tag{11}$$

$$T_1 = \begin{cases} 0 & \text{if} \quad E_1 < \overline{E} \\ 1 & \text{if} \quad E_1 \geq \overline{E} \end{cases}, \qquad T_2 = \begin{cases} 0 & \text{if} \quad E_1 + E_2 < \overline{E} \\ 1 & \text{if} \quad E_1 + E_2 \geq \overline{E} \end{cases} \tag{12}$$

Both the expected benefits from EMU participation (T) and the costs of convergence (β) can differ between time periods. It may be more attractive to aim for EMU in the second period if it comprises a larger group of countries and/or if there is a risk that the start of EMU in the first period may be delayed. An early EMU entry becomes more desirable, the greater are the adverse economic consequences and the loss of political prestige and influence from being excluded. Similarly, the costs of convergence in the second period may be smaller or greater depending on whether the credibility of convergence is enhanced by the formation of multi-speed Europe. Here the design of the exchange rate regime (EMS II) and the entry conditions for countries in derogation become important (Spaventa 1996, Persson and Tabellini 1996).

Maximizing (*11*) a country has three options: joining in the first period, in the second period or not at all. If the country intends to join, it will just supply the minimum convergence effort required for admission, i.e. *equation 12* holds with equality. Using this constraint we can write (*11*) in terms of one decision variable only (ignoring the possibility of no entry for now). If the country joins in the second period it can spread effort optimally across the two periods. This yields optimal period efforts in (*13*), total utility from early and late entry are given in (*14a*).

$$E_1^* = \frac{\beta_2}{\beta_1 + \beta_2}\bar{E}, \qquad E_2^* = \frac{\beta_1}{\beta_1 + \beta_2}\bar{E} \tag{13}$$

$$U_1 = T_1 + T_2 - \frac{\beta_1}{2}\bar{E}^2, \qquad U_2 = T_2 - \frac{\beta_1\beta_2}{2(\beta_1 + \beta_2)}\bar{E}^2 \tag{14a}$$

The optimal distribution of convergence in (*13*) reflects the relative costs of adjustment in the two period. Comparing utilities in (*14*) shows that joining early secures the benefits of EMU from the start but at the expense of compressing all convergence into a single period. *Equation 15a* gives a condition on T_1 for which early entry is preferred to late entry.

$$U_1 \geq U_2 \qquad \Leftrightarrow \qquad T_1 \geq \frac{\beta_1^2}{2(\beta_1 + \beta_2)}\bar{E}^2 \tag{15a}$$

For early entry to be preferred the benefits of EMU in the first period must exceed the extra cost of (suboptimal) convergence. If the aim is to maximize incentives for early convergence and thus a large initial EMU, T_1 should be made high. If one wants to minimize convergence costs and aims at a multi-speed EMU, life outside the single currency should be made attractive for countries in derogation. To complete the analysis for both joining dates the participation

constraint relative to the option of not joining EMU at all must be satisfied in both cases.

$$U_1 \geq 0 \quad \Leftrightarrow \quad \bar{E}_1 \leq \sqrt{\frac{2(T_1+T_2)}{\beta_1}}, \quad U_2 \geq 0 \quad \Leftrightarrow \quad \bar{E}_{1,2} \leq \sqrt{\frac{2T_2(\beta_1+\beta_2)}{\beta_1\beta_2}} \qquad (16a)$$

So far we have assumed that only total convergence matters for admission into EMU, independently of when it is produced and that the criteria are not readjusted for later entrants. However, the price of entry may be different between periods. For example, some of the Maastricht entry conditions cease to be well defined after the start of EMU (Spaventa 1996), even though one may assume that the reference values for inflation and interest rates could be those of the new Euro instead of the three best performers. Moreover, entry conditions maybe renegotiated or/and convergence undertaken previously may be lost if a country remains outside EMU in the first period. Assume, as an alternative, that the convergence required in the second period does not take into account first period convergence. In other words, countries missing the first round have to start from scratch, either because the fruits of earlier efforts are reversed (not durable) or because the insider countries are able impose additional conditions. Under these circumstances delaying EMU does not offer the benefit of spreading convergence optimally over time. In the "no-commitment" scenario, where either the criteria lack commitment or convergence lacks durability, the choice of the timing of convergence is modified as follows.

$$U_1 = T_1 + T_2 - \frac{\beta_1}{2}\bar{E}_1^2, \qquad U_2 = T_2 - \frac{\beta_2}{2}\bar{E}_2^2 \qquad (14b)$$

$$U_1 \geq U_2 \qquad \Leftrightarrow \qquad T_1 \geq \frac{\beta_1}{2}\bar{E}_1^2 - \frac{\beta_2}{2}\bar{E}_2^2 \qquad (15b)$$

$$U_1 \geq 0 \quad \Leftrightarrow \quad \bar{E}_1 \leq \sqrt{\frac{2(T_1+T_2)}{\beta_1}}, \qquad U_2 \geq 0 \quad \Leftrightarrow \quad \bar{E}_2 \leq \sqrt{\frac{2T_2}{\beta_2}} \qquad (16b)$$

We can see from *equation 15b* that, if the convergence required to catch up in the second period is greater or/and more difficult to achieve, the country will always want to join early, even in the absence of any benefits from EMU.

In order to discuss design issues in a multi-speed EMU, assume that the entry criteria are set by a Principal interested in maximizing total convergence. If he has all the bargaining power he can hold Agents to their participation constraints in *equations 16a,b* for commitment and no-commitment respectively. In each case the Principal will choose to impose the participation constraint that yields the

greater level of convergence. He will prefer an early EMU if the following conditions hold.

$$\bar{E}_1 > \bar{E}_{1,2} \quad \text{iff} \quad \frac{T_1}{T_2} > \frac{\beta_1}{\beta_2} \tag{17a}$$

$$\bar{E}_1 > \bar{E}_2 \quad \text{iff} \quad \frac{T_1}{T_2} > \frac{\beta_1 - \beta_2}{\beta_2} \tag{17b}$$

Under commitment the Principal will extract greater convergence and thus prefer early EMU if the relative rewards from EMU exceed the relative costs of convergence in period one compared to period two. In the absence of commitment (*17b*) the Principal is more likely to prefer early EMU. In fact if convergence is costlier to the Agent in period two the Principal will always choose early EMU. The final question is whether, if given the choice, the Principal would prefer to commit *ex ante* or to be able to extract maximal convergence in period two. Comparing equations *16a* and *16b* the convergence level from an early EMU is the same, while in the case of a late EMU the Principal would always prefer to precommit *ex ante*. However, the Principal has an incentive to deviate from the commitment if the *ex post* convergence he can extract in period two from (*16b*) exceeds the Agent's optimal period two convergence under commitment from (*13*). This will be the case if the condition in ***equation 18*** holds.

$$\bar{E}_2 > E_2^* \quad \text{iff} \quad \frac{T_2}{\beta_2} > \frac{\beta_1}{\beta_1 + \beta_2} \tag{18}$$

The Principal is tempted to exploit the Agent *ex post*, if his "hold-up" power to impose additional convergence exceeds the fraction of convergence originally allocated to period two by the Agent. The commitment not to alter the Maastricht criteria to the detriment of countries in derogation, therefore, must be strong enough to offset the Principal's *ex post* incentive to deviate. This commitment is in the interests of both sides, since in the absence of commitment an Agent aiming for late EMU entry would never undertake any convergence effort in period one. In this case the advantage of multi-speed EMU of spreading effort optimally over time is lost, to the detriment of both parties.

The simple model of multi-speed EMU offered in this section has illustrated under which circumstances countries might opt for a later entry. Such a strategy seemed to be the one pursued by Italy and Spain until the summer of 1996, where government budget forecasts planned a gradual reduction of deficits, with the Maastricht target being hit only in 1998, i.e. one year too late, in the case of Italy. This would have allowed the spreading of adjustment costs over time. However from summer 1996 onwards, apparently either the costs of exclusion were judged

too high, or the costs of immediate convergence less burdensome, such as to justify attempts to make the earlier deadline. The second main conclusion of this section regards the value of pre-commitment to the convergence criteria. Only if the conditions for entry are credibly set in advance can countries reap the advantages of a multi-speed EMU, i.e. spread the adjustment costs without necessarily losing credibility.

IV. SWITCHING TO EMU

Section two has examined coordination problems and section three the timing of convergence. In this section we bring both issues together in the presence of uncertainty about preferences. We return to issues of strategic interaction in the transition to EMU which regard both convergence and individual entry decisions. For the sake of variety here we focus on the choice of EMU as a regime shift. Externalities arise from any individual country's entry decision which affects both the insiders as well as the countries left outside EMU[10]. Therefore, countries' incentives to join EMU are not fixed but depend on how many and which other countries also go ahead with EMU. Here we focus on the positive (network) externalities arising from the size of EMU (Dowd and Greenaway 1993). The microeconomic benefits from a single currency increase with the size of EMU if a single currency has public good qualities and reduces transaction costs for the insiders (Kiyotaki and Wright 1989). Also the macroeconomic net benefits from a zone of exchange rate and price stability should be increasing in its size for a sufficient degree of economic integration (Mélitz 1995, 1996). On the other hand, the larger EMU the greater the (perceived) costs to countries staying outside, who fear to becoming marginalized both politically and economically.

Imagine a game between two groups of countries, that could perhaps be labelled "North" and "South" or "Europhiles" and "Europhobes". Suppose that the two groups have preferences about four different possible outcomes: First a "large EMU", where both groups join *W(2)*; second, a unilateral, small EMU *W(1)*, where either only the North ("Hard EMU") or only the South ("Soft EMU") embark on a single currency; third, a unilateral, (opt-out) Non-EMU *U(1)*, where the other group goes ahead with EMU; fourth, no EMU at all, *U(2)*. Assume that the preference ordering over the four outcomes satisfies the conditions in (*19*). First, the spillover from choosing the same option ("network externality") is positive. This means that a large EMU is preferred to going it alone and no EMU

[10] As, for example, in Casella (1992), Alesina and Grilli (1993), Martin (1995) and Kohler (1996).

at all is better than having an opt-out. Second, there are benefits from coordination, such that choosing any one option jointly is preferred to pursuing the other option unilaterally. This means that a large EMU and no-EMU are preferable to a division of Europe.

$$U(2) > U(1), \quad W(2) > W(1); \qquad U(2) > W(1), \quad W(2) > U(1) \tag{19}$$

With preferences as above, and under simultaneous choice, there are two equilibria (in pure strategies): either both groups proceed to EMU or none of them. This mirrors the result in the convergence game of section two. However, here in principle the welfare ranking of the two Nash equilibria could go either way. Starting with the status quo of No-EMU, if both sides remain stuck at the status quo, while in fact moving to EMU would be Pareto superior we have the case of "excess inertia". The opposite case can be described as "excess momentum", where countries move into EMU only because other countries do so and even though they would prefer the non-EMU equilibrium.

As before, the coordination problem can be solved by having one side move first (then the other will follow) or by communication or pre-commitment to the superior Nash equilibrium. However, so far we have assumed identical preferences and the coordination problem will re-emerge when countries have conflicting preferences over the four outcomes, as in Farrell and Saloner (1985). Assume that utilities vary with an EMU-preference parameter θ, which is uniformly distributed over the unit interval. The degree to which (joint) EMU is preferred to (unilateral) non-EMU, given in *equation 20*, is increasing in θ. Assume further, that if the preference for EMU is at its maximum, the country would prefer unilateral EMU to the status quo. For "Britannic" preferences (θ=0), by contrast, staying out of EMU unilaterally is preferable to joining the rest of Europe. The introduction of the preference intensity parameter therefore modifies the second set of inequalities in *equation 19*.

$$\frac{\partial\left[W_\theta(2) - U_\theta(1)\right]}{\partial\theta} > 0; \qquad W_{\theta=1}(1) > U_{\theta=1}(2), \quad W_{\theta=0}(2) < U_{\theta=0}(1) \tag{20}$$

Assume that countries are unsure about each other's preferences (i.e. about θ) and play a simultaneous choice game in two periods. In each period the two players have to decide whether to go for EMU or not, where a switch to EMU in period one cannot be reversed in period two. For simplicity only consider the (long-run) payoffs in period two and ignore the temporary payoffs associated with a particular move order in a two speed EMU, of the kind discussed in the previous section. Four strategies can be distinguished in principle. A country can choose never to switch to EMU (strategy I), to switch in the second period if and only if

the other country has switched previously (II), to switch in the first period (III) or to always switch in the second period. However, the last strategy is dominated by the third one. If a country intends to switch, come what may in the second period, it is better off to switch early, since this increases the chance that the other country will also switch. Assuming a symmetric equilibrium *equations 21* and *22* give expressions that define the critical values for the preference parameter for which the three strategies are in equilibrium.

$$U(I) = W(II) \quad \Leftrightarrow \quad U_{\theta^*}(1) = W_{\theta^*}(2) \tag{21}$$

$$W(III) = W(II) \quad \Leftrightarrow$$
$$(1-\theta^*)W_{\theta^{**}}(2) + \theta^* W_{\theta^{**}}(1) = (1-\theta^{**})\cdot W_{\theta^{**}}(2) + \theta^{**}\cdot U_{\theta^{**}}(2) \tag{22}$$

$$\Rightarrow \quad U_{\theta^{**}}(2) > W_{\theta^{**}}(1), \quad W_{\theta^{**}}(2) > U_{\theta^{**}}(2) \qquad \text{from} \quad \theta^{**} > \theta^* \tag{23}$$

From *equation 21* for small enough θ a country will prefer to stay outside EMU even if the other side has switched to EMU (strategy I). In the intermediate region of θ it will switch if (and only if) the other player has switched previously (II). Here joint EMU is preferred to staying out unilaterally, but no-EMU is better than unilateral EMU. For high enough θ it pays even to risk a unilateral EMU since this increases the chances that the other side will also join. The left-hand-side of *equation 22* gives the expected payoff of following strategy III, weighted by the probability that the other country joins EMU or stays out. The right-hand-side is the expected payoff from the "bandwagon strategy" (II), weighted by the probability that the other side has initiated EMU in the first period or has not.

Equation 22 implies the inequalities in *equation 23* holding at the critical value of θ that separates the region where the bandwagon strategy is optimal from the unconditional EMU strategy. For θ (slightly) below the critical value identified by *equation 22* both will choose the bandwagon strategy and EMU will fail to materialize even though it is the outcome preferred by both from (*23*). Each country waits for the other to move first and thus the equilibrium exhibits "excess inertia". Moving first serves as a public good to the second mover who can then be sure to make the right choice in the second period. The model illustrates an intertemporal version of the coordination failure in section two. Here, if EMU entry decisions are left to individual countries EMU may fail to come about even if it is in everybody's interest.

As before, the coordination failure can be remedied by communication or contracts which provide incentives for socially efficient switching. Here multi-speed EMU provides a solution (only) if there are countries with high enough θ, who also would be happy with a small unilateral EMU. Moreover, the Maastricht treaty does not leave the entry decision to individual countries, but obliges them to

join if they satisfy the convergence criteria (with the exception of the opt-out countries Denmark and UK). This should serve to guarantee that EMU happens and the public good of moving first is supplied. However, the logic of the model re-applies if countries are far from fulfilling the criteria initially and bandwagon strategies prevent countries from initiating convergence measures unless they have observed other countries doing so. This can again explain why countries did not initiate serious convergence programmes until long after the signing of the Maastricht treaty, but jumped on the convergence bandwagon once some countries had taken the initiative.

With negative externalities on the countries that remain outside (temporarily or permanently) results can be reversed, i.e. we can also obtain excess momentum. Then Europe would be better off without EMU, but if some countries forge ahead, the others will follow suit, and thus coordination will be on the Pareto inferior equilibrium. The classic mechanism to overcome coordination failure, of course, is to integrate decisionmaking in a joint European body, which however, would also have to be equipped with the capacity to enforce joint decisions, whether on convergence or on the decision to adopt a single currency. This enforcement capacity could perhaps be seen as a proxy for political union as a way to help solving coordination problems in EMU.

V. CONCLUSION

This paper has explored coordination problems in the Maastricht transition to European Monetary Union. Two issues can be distinguished. First, spillovers from the interdependence of utility functions can lead to inefficient equilibria and contract commitment may be necessary to sustain cooperative solutions. Second, externalities combined with strategic complementarity of players' actions (Bulow et al. 1985) can give rise to multiple Pareto-ranked equilibria. This paper has focused mainly on the latter problem of coordination failure in the presence of multiple equilibria in the Maastricht game.

Three aspects of coordination problems have been presented. In the convergence game of section two, countries were willing to undertake convergence only if other countries did the same. A multi-speed approach to EMU was recommended as a way to increase the probability of EMU without undermining the credibility of the convergence criteria. In section three the incentives for joining early or late in a multi-speed set-up were analyzed explicitly. A multi-speed EMU allows the option of spreading adjustment effort more equally over time, provided that there is commitment by the insiders not to raise entry barriers to EMU *ex post*. A multi-speed arrangement can be in the

interest of those who want to maximize convergence prior to EMU admission as well as a way to help countries allocate convergence better across time.

Section three looked at the entry decision in a two-period game model. Here coordination failure arises in the form of excess inertia or excess momentum if countries follow "bandwagon strategies", i.e. are willing to join EMU or undertake convergence only after they have seen other countries do the same. Again a multi-speed EMU can help overcome coordination failure if the Maastricht treaty provides enough commitment to joining EMU and if at least some countries satisfy the convergence criteria. In this way, enough momentum can be created in order to achieve the twin objectives of the Maastricht treaty: the production of convergence and the realization of EMU.

This paper has focused on the "horizontal" coordination problems between identical countries in the transition to EMU with the convergence criteria and Maastricht entry procedures taken as given. The latter primarily reflect the "vertical" coordination problem between "credibility" and "convergence" countries. In practice both dimensions interact, where the most important locus of coordination is the European Council and the Council of ministers. Assume with Krumm and Herz (1996) and De Grauwe (1996) that the application of the convergence criteria and the decisions on EMU starting date and membership will not be a purely technical assessment, but decided politically by qualified majority vote. Then, if convergence countries can outvote credibility countries, EMU will happen for sure and countries have little incentive for convergence. If credibility countries can form a blocking minority, however, they could prevent a large and "soft" EMU. However, in turn, convergence countries can use their blocking minority to prevent a small "hard" EMU.

How this likely situation of cross-vetoes is resolved depends on the ranking and the credibility of the alternative solutions to the convergence trilemma and on the availability of compensating side payments. If convergence countries are willing and able to threaten to block EMU altogether unless they are included, credibility countries may be driven to accept a large EMU as preferable to no EMU. If, on the other hand, credibility countries can credibly threaten delay or failure of EMU, convergence countries may want to accept a small early EMU. In order to avoid coordination failures the procedure governing the birth of EMU must have both a credible deadline *and* be based on (objective) economic criteria in order to provide convergence incentives *ex ante*. In case of conflict, only a multi-speed EMU can salvage the credibility of the time *and* the state-contingency of the Maastricht Treaty. However, the solution to the convergence trilemma must also be a joint and a political decision such as to represent the interests of all parties

involved and to favour the internalization of the externalities of the Maastricht game.

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