MONETARY UNIONS: THE POLICY COORDINATION ISSUE

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ABSTRACT
In this paper we build a three-country dynamic model of a monetary union (MU), where we focus on how coalitions among policy-makers are formed and what are their effects on the stabilization of output and price. Some preliminary results based on numerical simulations are provided.

KEY WORDS
Macroeconomic stabilization, coalitions, LQ differential games.

1 INTRODUCTION

This paper provides three preliminary numerical simulations derived from the extension to three countries of the dynamic two-country monetary union (MU) model developed by Engwerda *et al.* (2002). Moreover, endogenous coalition formation is studied by using the partitioned game approach. This approach consists in separating the coalition formation process from the rest of the game by reducing a game in normal form to a two-stage game (a partitioned game).[1]

In our context, after having observed an asymmetric shock in a dynamic environment policy-makers try to form coalitions among them by playing non-cooperatively (first stage). Afterwards, the coalitions formed (or the individual policy-makers) play non-cooperatively in setting their macroeconomic stabilization policies (second stage).

We concentrate our attention on the role played by asymmetries (in structural and preference parameters) and externalities, which are the key to endogenously explain the coalition formation. In our model different forms of asymmetry can be investigated: countries may have asymmetric structural model parameters (model asymmetry), policy-makers may have different preferences (preference asymmetry), policy-makers may have different bargaining powers (power asymmetry), and, finally, shocks asymmetrically hit countries (shock asymmetry).

The rest of the paper is organized as follows. The next section briefly describes our stylized model of the MU, section 3 describes the policy regimes (coalition) and the endogenous coalition formation mechanisms, section 4 solves the game recursively by numerical simulations, which are performed using "ad hoc" parameter values as rather usual in the literature.[2] Section 5 concludes.[3]

2 A SIMPLE DYNAMIC MODEL

The MU is described by a simple asymmetric dynamic IS/AS model.

$$\begin{aligned} y_1 &= \eta_1 f_1 \,\mathsf{¡}\, \gamma_1 r_1 + \delta_{12} s_1 + \delta_{13} s_2 + \rho_{12} y_2 + \rho_{13} y_3 \\ y_2 &= \eta_2 f_2 \,\mathsf{¡}\, \gamma_2 r_2 \,\mathsf{¡}\, \delta_{21} s_1 + \delta_{23} s_3 + \rho_{21} y_1 + \rho_{23} y_3 \\ y_3 &= \eta_3 f_3 \,\mathsf{¡}\, \gamma_3 r_3 \,\mathsf{¡}\, \delta_{31} s_2 \,\mathsf{¡}\, \delta_{32} s_3 + \rho_{31} y_1 + \rho_{32} y_2 \\ \dot{p}_i &= \xi_i y_i \quad i \;\mathsf{2}\; \mathsf{f}1,2,3\mathsf{g} \end{aligned}$$

IS curves give the aggregate demand, y, in each of the MU countries as a function of intra-MU competitiveness of a country vis-à-vis the two other countries (i.e. $s_1 := p_2 \,\mathsf{¡}\, p_1$; $s_2 := p_3 \,\mathsf{¡}\, p_1$; $s_3 := p_3 \,\mathsf{¡}\, p_2$), the real interest rate, r, the foreign output and the domestic fiscal deficit f. Competitiveness is defined as the output price differential. Aggregate supplies derived from simple Phillips curves implied by the existence of some rigidities in the labor or good market. In accordance with our short-run stabilization focus, the effectiveness of fiscal policy is limited to its transitory impact on output through the induced stimulus of the aggregate demand.

All variables are functions of time. Moreover, all are expressed in logarithms, except for the interest rate which is in percentages, and denote deviations from their long-run equilibrium that has been normalized to zero, for simplicity. A dot above a variable denotes its time deriva-

[1] See Yi (1997) for a more detailed description of this approach and Kohler (2002) for an application in a context similar to that investigated here.

[2] See e.g., among the others, Neck and Dockner (1995), Widgrèn (1994) and Engwerda *et al.* (2002). A notable exception is Carraro (1997).

[3] This paper focuses on the simulations. Therefore, for more details on the theoretical model, we refer to van Aarle *et al.* (2002).

tive. Moreover, although the nominal interest rate is the same in the whole MU area, expected real interest rates can temporarily diverge among countries if expected inflation rates are different. The expected real interest rate in country $i \in \{1,2,3\}$ is defined as the difference between the nominal interest rate and the expected inflation, i.e. $r_i := i_E - \dot{p}_i^e$. Henceforth, perfect myopic foresight is assumed in this paper, so that, in our deterministic context, $\dot{p}_i^e = \dot{p}_i$.

We assume that the fiscal authorities control their fiscal policy instrument such as to minimize the following quadratic loss function which features domestic inflation, output and the fiscal deficit: $J^i(t_0) = \min_{f_i} \frac{1}{2} \int_{t_0}^{\infty} \{\alpha_i \dot{p}_i^2 + \beta_i y_i^2 + \chi_i f_i^2\} e^{-\theta(t-t_0)} dt$ in which θ denotes the rate of time preference and α_i, β_i and χ_i represent preference weights that are attached to the stabilization of inflation, output and fiscal discipline, respectively.

Similarly, we assume that the common central bank CB is confronted with the following optimization problem: $J^E(t_0) = \min_{i_E} \frac{1}{2} \int_{t_0}^{\infty} \{\alpha_E \dot{p}_E^2 + \beta_E y_E^2 + \chi_E i_E^2\} e^{-\theta(t-t_0)} dt$, where $\dot{p}_E := \sum_{i=1}^{3} \varphi_i \dot{p}_i$ and $y_E := \sum_{i=1}^{3} \varphi_i y_i$; φ_i indicates the relative weight of county i's inflation and output in the average considered by the CB.

After some matrix algebra, the policy-makers' losses can be written as: $\frac{d_i}{2} \int_{t_0}^{\infty} \{x^T M_i x\} e^{-\theta(t-t_0)} dt$ for $i \in \{1,2,3,E\}$ where d_E and M_i are appropriate scalars and matrices, $x := [s_1, s_2, s_3, f_1, f_2, f_3, i_E]$, and the dynamics of the model can be represented by the following system of first-order linear differential equations with competitiveness, s_i for $i = \{1,2,3\}$, as the state variables, and the national real fiscal deficits, f_i, and the common interest rate, i_E, as control variables:

$$\begin{bmatrix} \dot{s}_1 \\ \dot{s}_2 \\ \dot{s}_3 \end{bmatrix} = A \begin{bmatrix} s_1 \\ s_2 \\ s_3 \end{bmatrix} + B_1 f_1 + B_2 f_2 + B_3 f_3 + B_E i_E \quad (1)$$

The initial value of the state variables, s_1, s_2 and s_3 measures any initial disequilibrium in competitiveness among the three countries. Such an initial disequilibrium in competitiveness could be the result of differences in fiscal policies in the past or some initial supply side disturbance in some countries.

3 POLICY COORDINATION: A COALITION FORMATION APPROACH

The issue of coalition formation is analyzed by using the partitioned game approach described in the introduction of this paper. To formalize possible coordination behavior among policy-makers, we have to introduce some additional notation. We call a *coalition* any non-empty subset of the policy-makers' set (i.e. the set formed by all policy-makers $\{1,2,3,E\}$). Moreover, we assume that policy-makers in a coalition cooperatively set their instruments in order to minimize a common loss function, i.e. a convex combination of their respective loss functions. A *coalition structure* is then a partition of the policy-makers' set into coalitions. Each coalition structure is associated with a policy regime, i.e. which policy-makers are cooperating and which are not.

Indicating by ω_i a generic element (coalition) of the coalition structure Ω (policy regime), we can formally represent the policy coordination game for each given policy regime as obtaining the (open-loop) Nash equilibrium of the differential game defined by the system (1) of differential equations and by the (system of) loss function(s):

$$J_i = \frac{1}{2} \int_{t_0}^{\infty} \left\{ \sum_{j \in \omega_i} \tau_j d_j x - M_j x \right\} dt \quad (2)$$
$$\forall \omega_i \in \Omega, \forall j \in \omega_i$$

where $J_i$is the loss function of the coalition ω_i and τ_j is the policy-maker j's bargaining weight in the coalition ω_i.[4] The number of coalitions acting in each regime is clearly equal to the cardinality of Ω.

The minimization of the loss function(s) (2) subject to the system of differential equations (1) yields the following optimal controls: $\begin{bmatrix} f_1 \\ f_2 \\ f_3 \\ i_E \end{bmatrix} =: \Psi(\Omega)\, s$where $s := [s_1, s_2, s_3]$ with the initial disequilibrium $s(0) =: s_0 \in \mathbb{R}^3$, and the matrix $\Psi(\Omega)$ is computed via the eigenstructure of a matrix that is determined by the coalition structure Ω (see van Aarle *et al.* (2002)).

Note that according to the optimal strategies are a linear feedback rule on the state variables and are moreover depending on the coalition structure in place. The resulting policy-makers' (optimal) losses equal:

$$J^i_{(\omega)} = \frac{d_i}{2} \int_{t_0}^{\infty} s' \left[I, \Psi(\Omega)' \right] M_i \begin{bmatrix} I \\ \Psi(\Omega) \end{bmatrix} s \, dt$$
for $i \in \{1,2,3,E\}$

Using the above policy-makers' optimal costs, we will consider the following policy regimes: (a) The non-cooperative solution $\{1,2,3,E\}$, where no policy coordination exists. (b) The grand coalition $\{(1,2,3,E)\}$, where all policies are set in a cooperative manner. (c) The full fiscal coalition $\{(1,2,3),E\}$ and the partial fiscal coalitions: $\{(1,2),3,E\}$, $\{(1,3),2,E\}$ and $\{1,(2,3),E\}$, where some (or all governments) agree to coordinate the setting of their fiscal policy. Partial coalitions involving the CB and one or two countries are not considered because of the CB is a common institution, and therefore, partial coalitions between the CB and only some countries are, in principle, difficult to justify.

[4] It is trivial that when ω_i is a singleton $\tau_j = 1$ and when equal bargaining powers are assumed τ_j is equal to 1 divided by the cardinality of ω_i.

For the sake of brevity, we mainly restrict our attention to the most common non-cooperative game of coalition formation: the *Coalitional Nash Equilibrium* (CNE). A CNE is an equilibrium characterized by the two following properties:

1. **Profitability property**. *The coalition losses must be lower than or equal to the non-cooperative ones for all coalition members.*

2. **Stability property**: (a) *internal stability: the loss of each coalition member must be lower than or equal to the loss that the same policy-maker faces when she defects from the coalition and the other members do not change their strategies;* (b) *external stability: the losses of each non-coalition member must be lower than the losses that the policy-maker faces when she joins the coalition*.

Profitability assures that the coalition is convenient for its members, while stability guarantees that the equilibrium is self-enforcing. The CNE is based on the following assumption: when leaving (joining) a coalition, each agent assumes that the other agents are not changing their strategies. In other words, this assumption is equivalent to the assumption of the Nash conjectures in a simultaneous oligopoly game where a player assumes no change in the other players' decision variable when she modifies her own decision variable. Under the assumption that non-members can join an existing coalition without the permission of the existing members (open membership assumption), profitability and stability completely characterize the CNE equilibrium.

4 NUMERICAL SIMULATIONS

We consider the three following scenarios. (1) A three-country MU with model and power symmetry. In this case, apart from the shocks, the only form of asymmetry is the different priority placed on output and inflation stabilization by the governments and the CB. (2) A three-country MU with model symmetry but power asymmetry, where at least one fiscal authority participating in a fiscal coalition has a lower bargaining power than one of the other participants. (3) A three-country MU with model asymmetry (degrees of openness and competitiveness), characterized by the CB, two symmetric countries that are more open and more exposed to competitiveness than a third country.

In all the numerical simulations we assume that the governments' priority is real output stabilization while the CB, which equally weights countries, is mainly concerned about price stabilization. In particular, the fiscal policy-makers are assumed to have the same preferences but, in general, policy-makers will have different preferences (preference asymmetry). More in detail, the policy-makers' preferences are assumed to be described by the following values: $\alpha = 0.2$, $\alpha_E = 0.8$, $\beta = 0.4$, $\beta_E = 0.3$, $\chi = 0.15$, $\varphi = \frac{1}{3}$, and $\theta = 0.15$. Moreover, the initial state of the MU area is assumed to be equal to $s_0 = [0.05, 0, ¡ 0.05]$. This initial state corresponds to the case of an asymmetric price shock in the MU (shock asymmetry) where, initially, prices in country 2 are 5% higher than in the two other countries. The other parameters used in the numerical simulations, as well as the results of our experiments, are described in the rest of this section.

In the first scenario, the structural parameters are assumed to be the same for all the countries (model symmetry) with the following values: the real fiscal deficit elasticity with respect to the aggregate demand η is assumed to be equal to 1, the real interest rate semi-elasticity γ is assumed to be 0.5, the competitiveness elasticity δ is assumed to be 0.2, the foreign output elasticity ρ (degree of openness) is assumed to be 0.4, and the Phillips curve coefficient ξ is assumed to be 0.25. All the policy-makers are assumed to have the same bargaining power when they cooperate (power symmetry). In this scenario, the only form of asymmetry is related to the price shock (shock asymmetry) which makes the (high-price) country 2 different from the other two symmetric (low-price) countries.

Table I presents the results of our first numerical simulation.

Table I - Optimal Costs (multiplied by 1,000)[5]

	NC	C	F	$(1,2)$	$(1,3)$	$(2,3)$
1	0.709	0.491	0.491	0.547	0.807	0.688
2	2.837	1.964	1.964	2.066	2.753	2.066
3	0.709	0.491	0.491	0.688	0.807	0.547
CB	0	0	0	0.003	0.014	0.003

These results widely reflect the model and power symmetries assumed. As in a two-country model (see e.g. van Aarle *et al*. (2001b)), where these kinds of symmetries are considered, there is no difference between the grand coalition C and the full fiscal coalition F. This occurs because of two characteristics of this scenario related to the symmetry assumptions. First, as shown in figures 1 and 2 below, the fiscal policies of the low-price (high-output) countries are exactly offset by the fiscal policy of the other country, due to the model symmetry and the preference symmetry among fiscal authorities. Second, due to the model symmetry, the CB does not affect the dynamics of the competitiveness since changes in the common nominal interest rate equally affect all the prices. Results dramatically change when partial fiscal coalitions are formed, even in this symmetric setting. With partial fiscal coalitions all the players, including the CB, are directly affected in their optimal policies and losses. However, since countries 1 and 3 (low-price countries) face the same shock their optimal losses are the same (or symmetric in the partial coalitions with the country which suffers from high prices).

In all the regimes, the higher-price country suffers from higher optimal costs since it faces a positive price

[5] In all the tables, columns identify policy regimes; rows indicate the policy-makers' (optimal) losses.

shock (increase in price) while the other two countries face a negative price shock. Consequently, the CB will mainly pursue an restrictive monetary policy in order to stabilize the output (prices) in the low-price countries.

Profitable regimes are the fiscal regime F (and the grand coalition C) and the partial coalitions between the high-price country and one of the other two ($(1,2)$ and $(2,3)$), while the coalition between the low-price countries $(1,3)$ is not profitable. This result seems to confirm that fiscal coordination is counter-productive unless asymmetries are present. In fact, in the case of cooperation between two symmetric countries that face the same kind of price shock (fully symmetric countries), cooperation increases the countries' optimal losses. This result, which is often observed for the two-country models, is due to the central bank's action, which offsets that of the fiscal players. Cooperation between countries that face asymmetric shocks (i.e. all the coalitions where the high-price country is included) is profitable. Related to this observation, in a three-country context, cooperation between symmetric countries becomes profitable if they also cooperate with a third asymmetric country.

Regarding the stability property, all the profitable coalitions are internally stable but only the full fiscal coalition (and the grand coalition) is also externally stable. Therefore, the full fiscal and the grand coalition are the CNEs of the game. This result derives from the following two characteristics of the numerical simulation. First, the CB cannot neutralize the cooperation among fiscal players (if they are not all fully symmetric). Second, free-riding behavior is not optimal for the fiscal players since, when they leave the full fiscal coalition, they suffer higher (optimal) costs.

Table II describes the results of our second numerical simulation where we investigate the power distribution among MU policy-makers. We consider the same situation depicted in the previous numerical simulation (model symmetry), but now we assume that country 3 has always a lower bargaining power when it cooperates with the (an) other policy-maker(s) (power asymmetry). More in detail, country 3 (the small country) is assumed to have a bargaining power equal to $\frac{1}{5}$ in the grand coalition regime (while the other players share the rest, i.e. each of them has a bargaining power equal to $\frac{\left(1 \text{ i } \frac{1}{5}\right)}{3}$), the small country's bargaining power is assumed to be equal to $\frac{1}{4}$ in the full fiscal regime (others $\frac{3}{8}$), and it is assumed to be equal to $\frac{1}{3}$ when the small country cooperates with one of the other countries ($\frac{2}{3}$). In this scenario, all the countries are asymmetric through the combination of the power and the shock asymmetries.

Table II - Optimal costs (multiplied by 1,000)

	NC	C	F	$(1,2)$	$(1,3)$	$(2,3)$
1	0.709	0.537	0.435	0.547	0.736	0.456
2	2.837	1.876	2.106	2.066	2.646	2.636
3	0.709	0.537	0.435	0.688	1.247	1.144
CB	0	0	0	0.003	0.075	0.680

As in the previous scenario the coalition between countries 1 and 3 is not profitable. But, differently from table I, the coalition between the large high-price country and the small low-price country $(2,3)$ is not profitable. In fact, due to the different bargaining power distribution, the coalition among the high-price and the small countries does not show the symmetric (optimal) losses of that between the large countries (compare the optimal losses of fiscal coalitions $(1,2)$ and $(2,3)$ in tables I and II).

The coalition between the two large countries $(1,2)$ is internally stable but externally unstable since there is an incentive for the small country to join the coalition. If the CB is not allowed to participate to a coalition, the fiscal regime F is both internally and externally stable, and therefore, it is the CNE of the game since it is also profitable. But if the CB can join the full fiscal coalition, the full fiscal coalition is not externally stable any longer. The equilibrium, in this case, turns out to the non-cooperative equilibrium since if the low-price large country (country 1) leaves the grand coalition, it achieves a lower (optimal) loss (recall that if country 1 leaves the coalition, the CB is also assumed to leave it).[6] Summarizing, the asymmetric distribution of the bargaining power yields two effects: it reduces the willingness to cooperate of the low bargaining power country and it redistributes the (optimal) losses among the coalition members in the different policy regimes. The first effect tends to increase the instability of the coalitions while the second tends to reduce their profitability.

In order to understand the complexity of the policy-makers' interactions, note that if coalition members can block the entry of other policy-makers (exclusive membership assumption), the coalition $(1,2)$ between the two large countries also becomes an equilibrium of the game since the (large) high-price country 2 can prevent that the small country 3 enters this coalition. Similarly, the full fiscal coalition becomes an equilibrium since the fiscal authorities can prevent that the CB enters the coalition. Considering the unanimity assumption (i.e. all profitable coalitions are an equilibrium), the number of equilibria increases since three policy regimes are profitable, i.e. the grand coalition C, the full fiscal coalition F, and the partial fiscal coalition $(1,2)$.

In the third scenario, we remove the assumption of model symmetry. We consider the following changes in the structural (form) parameters presented in our first two scenarios. Countries 2 and 3 are assumed to be subject to a high structural form output elasticity of competitiveness vis-à-vis country 1 ($\delta_{21} = \delta_{31} = 0.4$; other δs are assumed to remain the same at a value of 0.2). Changes in country 1's income are assumed to have a strong impact on the other countries ($\rho_{21} = \rho_{31} = 0.5$) but income changes in countries 2 and 3 are assumed to have marginal effects on country 1 ($\rho_{12} = \rho_{13} = 0.1$). Changes in the income of countries 2 and 3 are assumed to have a moderate effect on the income of the other country ($\rho_{23} = \rho_{32} = 0.3$).

[6] Note that the CNE is the first best for the low-price countries 1 and 3, while the high-price (large) country prefers the grand coalition.

These parameters imply that countries 2 and 3 are (relatively) more open and are more exposed to international competitiveness within MU than country 1. The above parameterization implies several structural externalities because of the changes in the output elasticities of openness and competitiveness. An equal bargaining power (power symmetry) and the same asymmetric price shock (shock asymmetry) as in the previous two numerical simulations are assumed. Therefore, all the countries are asymmetric through the combination of the model and the shock asymmetries.

Table III describes the results of our final numerical simulation.

Table III - Optimal costs (multiplied by 1,000)

	NC	C	F	$(1,2)$	$(1,3)$	$(2,3)$
1	0.610	0.699	0.621	0.957	0.774	0.516
2	4.584	3.546	3.771	3.685	4.724	2.031
3	0.549	0.676	0.591	0.756	0.517	1.951
CB	0.016	0.025	0.001	0.018	0.052	0.010

Despite the fact that several asymmetries are present, no coalition is profitable. This means that the unique CNE is the non-cooperative regime, which is not the first best for any of the policy-makers. The effects of cooperation on the policy-makers' (optimal) losses are rather complex. All the cooperative regimes are profitable for the high-price country 2, but all the coalitions including country 2 imply higher (optimal) losses for the other participant(s). The sole profitable coalition for the low-price (open) country 3 is the partial coalition with the other low-price country 1. However, the optimal strategy of country 1 is to free-ride since its optimal strategy is always to avoid cooperation with the other policy-makers.[7]

Taking into account the other endogenous coalition formation mechanisms, the lack of profitability implies that a solution being different from the non-cooperative one will never emerge. Therefore, under this parameterization, the non-cooperative result is quite robust with respect to different specifications of the coalition formation process (e.g. exclusive membership, sequential entry or farsightedness).

5 CONCLUSIONS

This paper focuses on how coalitions among fiscal and monetary authorities are formed and what are their effects on the stabilization of output and inflation. In doing that, we introduce a novelty in the literature by combining the following two aspects of policy coordination:

(a) macroeconomic stabilization policies of individual countries and a common central bank of a monetary union are considered in a three-country dynamic model,

(b) coalition formation among policy-makers to coordinate their policies is explicitly considered by using the recent approach of endogenous coalition formation theory.

More in detail, our paper extends the dynamic two-country model of Engwerda *et al.* (2002) by using the partitioned game approach of the endogenous coalition formation literature. This approach consists in reducing a game in normal form to a two-stage game. In the first stage policy-makers try to form coalitions among them by playing non-cooperatively according to different possible initial assumptions (to which correspond different equilibrium concepts). Afterwards, in the second stage of the game, the coalitions formed (or the individual policy-makers) play non-cooperatively in setting their stabilization policies to face an asymmetric shock in a dynamic environment.

Coordination of (national) fiscal policies and (a common) monetary policy was then investigated through several numerical simulations where we have concentrated our attention on the role played by asymmetries (in structural and preference parameters) and externalities, which are the key to endogenously explain the coalition formation.

We have considered three scenarios for numerical simulations: i) a monetary union composed by three symmetric countries, that face an asymmetric shock, ii) a monetary union where a small country interacts with two large countries, that face an asymmetric shock, and iii) a monetary union composed of two (relatively) open countries that face an asymmetric shock, and interact with a (relatively) closed country. From our numerical simulations five major conclusions can be derived.

1. Regimes different from the grand coalition, the full fiscal coalition, and the non-cooperative regime are never an equilibrium of the game. In fact, the full fiscal coalition is always the equilibrium in the first scenario and it is also so in the second scenario according to some equilibrium concepts only, whereas the grand coalition is an equilibrium only in the first case (where it coincides with the full fiscal coalition because of the symmetries). In the third scenario, the non-cooperative regime is the equilibrium of the game for all equilibrium concepts considered.

2. As for the static two-country models, fiscal coordination seems to be counter-productive unless asymmetries are present. In fact, in the first scenario countries want to cooperate only if they are subject to asymmetric shocks. However, considering three countries, two symmetric countries can benefit from cooperation if they coordinate their fiscal instrument with that of a third asymmetric country.

3. In our benchmark case (the first scenario) cooperation always implies the lowest losses for all fiscal authorities without affecting the optimal cost of the common

[7] The first best policy regime (coalition structure) for country 1 is the fiscal coalition between the fiscal authorities of the other two (more open) countries.

central bank. Therefore, it turns out to be the equilibrium of the game irrespective of the equilibrium concept that is used to solve the game.

4. Under asymmetric bargaining powers (scenario two) the full fiscal coalition differs from the grand coalition and the equilibrium of the game depends on the assumptions considered. However, the grand coalition is never an equilibrium of the game, whereas the full fiscal coalition is an equilibrium (but not unique) under the unanimity and exclusive membership assumptions.

5. In the third scenario, the less open and less exposed to intra-MU competition country always wants to free-ride and does not want to cooperate with the more open and exposed counties. Furthermore, the more open and exposed counties do not want to cooperate with each other. Hence, this scenario, where many asymmetric externalities are present, illustrates that the existence of asymmetries and externalities is a necessary but not sufficient condition for cooperation since the unique equilibrium is the non-cooperative solution.

We think that this latter observation deserves further attention, so that we would like to investigate the impact of the sign and the size of spillovers on coordination in the near future. In addition, we would like to explicitly consider different equilibrium concepts and study how they are related to the institutional setting of a monetary union as the EMU.

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