E C O N O M I C S B U L L E T I N

"Macroeconomic stabilization in a heterogeneous monetary union: some insights into the effects of fiscal policy coordination"

Cornel Oros
Université de Poitiers

Abstract

This paper studies the effects the fiscal coordination can have in terms of macroeconomic stabilization in a monetary Union which is heterogeneous at the level of the mechanisms of monetary policy transmission. We will use a static Keynesian model in a closed monetary Union and will prove that the stabilization effectiveness depends mainly on the type and origin of the economic shocks affecting the Union members (demand or supply shocks, domestic or foreign shocks) and on the extent of the Union's structural heterogeneity. In the case of the demand shocks, the fiscal policy coordination proves to be an optimal shock absorber only for the countries to which these shocks are specific. In the case of the supply shocks, it can represent an efficient instrument of stabilization especially if the Union's structural heterogeneity is weak.

I thank Jean-Pierre Berdot and Jacques Léonard for their constructive suggestions and comments on a previous version of this paper.
Citation: Oros, Cornel, (2008) ""Macroeconomic stabilization in a heterogeneous monetary union: some insights into the effects of fiscal policy coordination"." *Economics Bulletin*, Vol. 5, No. 34 pp. 1-12
Submitted: August 18, 2008. **Accepted:** November 14, 2008.
URL: http://economicsbulletin.vanderbilt.edu/2008/volume5/EB-08E60015A.pdf

1. Introduction

The creation of the monetary Union has caused the irrevocable loss of two instruments acting against the specific shocks which affect the Union's members, that is the interest rate and the exchange rate. Within this original framework, a new debate arises: what is the impact of the fiscal policy coordination on the efficiency of the macroeconomic stabilization?

The issue is all the more interesting since the research in this field has yielded contradictory results. For instance, Uhlig (2002) bases his analysis on the idea of a clear specialization between the public authorities (Central bank and governments) concerning the stabilization of economic shocks; he therefore posits that the Stability and Growth Pact as a passive solution of coordination between governments should be reinforced as it ensures the most effective macroeconomic stabilization. Mundschenk and von Hagen (2003), while making the same assumption as Uhlig regarding the specialization between authorities, claim however that the fiscal policies are inefficient being limited exclusively to the use of automatic stabilizers and that the Stability Pact can't guarantee an efficient macroeconomic stabilization. They support the idea of an active coordination of the fiscal policies that can improve the efficiency of the macroeconomic stabilization compared to a non cooperative equilibrium. Lambertini and Rovelli (2003) defend the same idea and show that the informational power plays an essential part in the mechanisms of shock stabilization. Thus, the governments' leadership improves the efficiency of macroeconomic stabilization.

At the same time, the fiscal policy coordination can have different effects according to the type of shocks affecting the economy. Beetsma *et al.* (2001) show that the fiscal policy coordination has positive effects on the stabilization of the asymmetric shocks, but is not apt to stabilize the symmetric shocks. This analysis is confirmed by Laskar (2003) who identifies an optimum degree of shock asymmetry at the level of which the fiscal coordination in a monetary Union begins to be more efficient than in a flexible exchange rate system. However, Villieu (2000) states that on the contrary, with the enlargement of the monetary Union, the fiscal coordination becomes less efficient if the degree of shock asymmetry grows.

These studies, like most of the literature on the subject, have a major drawback: they are based on the hypothesis of a perfect structural homogeneity within the monetary Union. In reality, the EMU members display various and important structural heterogeneities (different sector structures, heterogeneities at the financial structure and at the level of the national labour market organization[1]). With the gradual enlargement of the Euro zone, these heterogeneities will become even more significant and will therefore influence the mechanisms of macroeconomic stabilization.

Under these circumstances, we consider that the structural heterogeneity of the Union affects the mechanisms of monetary policy transmission and will study the efficiency of fiscal coordination in terms of macroeconomic stabilization. More precisely, we will make a distinction between shocks according to their type and origin and will analyse whether the fiscal coordination can improve the national welfare of each country member.

In the second section, we will describe the model while in the third section we will assess, by means of numerical simulations, the relative efficiency of the fiscal coordination compared to a non cooperative game between national governments relative to the stabilization of the different economic shocks. The final section concludes.

2. The model

We use a static Keynesian model within a closed monetary Union with two countries (i, j). The macroeconomic equilibria are described by demand and supply functions and we

[1] See Cadiou *et al.* (1999), Penot *et al.* (2000) for a review of the literature.

consider that the heterogeneity of the Union concerns the mechanisms of monetary policy transmission[2]. All the variables (except the interest rate) are expressed in logarithms. Thus the demand function is represented by a standard IS function, often used in the literature:

$$y_i^d = ag_i + bg_j - \delta_i r + s(\pi - \pi_i) + \varepsilon_i^d \quad \text{where} \quad 0 < a < 1 \;\; ; \;\; |b| < 1 \; ; \;\; \delta, s > 0 \qquad (1)$$

where y_i^d et g_i stand for the output (as deviation from the natural output) and the budget deficit respectively of the country i; g_j represents the budget deficit of the country j; r represents the short-term interest rate; π and π_i the average inflation of the Union and the inflation of the country i respectively; ε_i^d the demand shock specific to the country i with zero mean and finite variance $\sigma^2_{\varepsilon_i^d}$.

The national demand of the country i depends positively on its national budget deficit according to a sensitivity bellow the unit ($a < 1$) because of the crowding out effect, and depends negatively on the interest rate according to sensitivity δ. At the same time, the national output of the country i is influenced by the budget deficit of the other Union member in a proportion b. The sign of the parameter b can be positive or negative according to whether it is the output channel or the common exchange rate channel respectively that play the major part in the transmission of the fiscal spillovers. The national demand of the country i also depends on price differential relative to the Union average according to a sensitivity s. Finally, the national output is influenced by a specific demand shock.

Since the heterogeneity of the Union concerns the mechanisms of monetary policy transmission, the parameter δ is specific to each country. If we represent the degree of heterogeneity between countries by a coefficient h ($0 < h < 1$), then $\delta_i = (1+h)\delta$ and $\delta_j = (1-h)\delta$, where δ stands for the average impact of the monetary policy on the economic activity of the countries i and j. Therefore, if $h = 0$, the countries will be perfectly homogeneous in terms of monetary policy transmission mechanisms ($\delta_i = \delta_j$), whereas, if $h = 1$, the heterogeneity between the two countries attains its maximum degree, as the monetary policy influences exclusively and with a maximum impact the national demand of the country i ($\delta_i = 2\delta$ et $\delta_j = 0$).

Regarding the supply equation, the production (y_i^s) is described by a Lucas function augmented by the imported inflation. We consider that the expected inflation is zero as we are only investigating the issue of the macroeconomic stabilization and therefore leave aside any questions of credibility.

$$y_i^s = \mu\pi_i - \mu m(\pi - \pi_i) + \varepsilon_i^s \qquad \text{where} \qquad \mu, m > 0 \qquad (2)$$

where ε_i^s represents a supply shock specific to country i with zero mean and variance $\sigma^2_{\varepsilon_i^s}$.

For any variable x, we define the aggregate component, $x = (x_i + x_j)/2$ (the symmetric component of the variable x) and the difference component, $\bar{x} = (x_i - x_j)/2$ (the asymmetric component of the variable x). Regarding shocks, we consider ε^θ et $\bar{\varepsilon}^\theta$ which stand for symmetric and asymmetric shocks respectively, where $\theta = d, s$.

[2] In the Euro zone, this type of structural heterogeneity reflects the important discrepancies at the level of the ways of financing the economy, of the degrees of market capitalization and of banking system concentration (Penot *et al.* (2000), A. Penot (2002)).

Having described the macroeconomic equilibria we will now analyse the behaviour of the policymakers. The Central bank decides on the single monetary policy independently, using its interest rate as a policy instrument to achieve its objectives. The Central bank is mainly interested in price stabilization (with a weight β_0), but also in output stabilization (with a weight β_1) and in interest rate smoothing (with a weight β_2).[3]

$$L^M = \frac{1}{2}\left[\beta_0\pi^2 + \beta_1 y^2 + \beta_2 r^2\right] \qquad \text{where} \qquad \beta_0,\ \beta_1,\ \beta_2 \in (0;1) \tag{3}$$

The governments are in charge with the implementation of the fiscal policies using the budget deficit as a policy instrument. Their aim is to minimize a loss function (L_i^G) which depends on the evolution of national inflation, economic activity and budget deficit (the relative weight of these objectives is α_0, α_1 et de α_2 respectively).

$$L_i^G = \frac{1}{2}\left[\alpha_0\pi_i^2 + \alpha_1 y_i^2 + \alpha_2 g_i^2\right] \qquad \text{where} \qquad \alpha_0,\ \alpha_1,\ \alpha_2 \in (0;1) \tag{4}$$

2. The analysis of the model

We consider a simultaneous decision game between the Central bank and the national governments (Nash equilibrium) and will first of all identify the optimum decisions that can minimize their loss functions. The interest rate writes as follows:

$$r = \frac{1}{\delta}\left[z\left((a+b)g + \varepsilon^d\right) - v\varepsilon^s\right] \qquad \text{where} \quad z = \frac{\frac{\beta_0}{\mu^2} + \beta_1}{\frac{\beta_0}{\mu^2} + \beta_1 + \frac{\beta_2}{\delta^2}} \quad , \quad v = \frac{\frac{\beta_0}{\mu^2}}{\frac{\beta_0}{\mu^2} + \beta_1 + \frac{\beta_2}{\delta^2}} \tag{5}$$

The fiscal instrument will have different values depending on the type of game involving the national governments.

Non cooperative equilibrium – in this case, there is an utter lack of coordination between governments, each of them aiming at minimizing its own loss function. The aggregate component of public deficit is:

$$g^N = \frac{(G^N + H^N)(\delta r - \varepsilon^d) + H^N\varepsilon^s}{\alpha_2 + (G^N + H^N)(a+b)} \tag{6}$$

where $\quad G^N = \alpha_1\left(aN + \frac{P(a+b)}{2}\right) \quad ; \quad H^N = \frac{\alpha_0}{\mu^2(1+m)}\left(aN + \frac{(P+m)(a+b)}{2}\right)$;

$$N = \frac{\mu(1+m)}{\mu(1+m)+s} \quad ; \quad P = \frac{s}{\mu(1+m)+s}$$

Using the equations (5) and (6), the equilibrium values of the public deficit and the interest rate become:

$$g^N = \frac{-(1-z)(G^N + H^N)\varepsilon^d + \left[H^N - v(G^N + H^N)\right]\varepsilon^s}{\alpha_2 + (G^N + H^N)(a+b)(1-z)} \tag{7a}$$

$$r^N = \frac{z\alpha_2\varepsilon^d + \left[z(a+b)H^N - v\left[\alpha_2 + (a+b)(G^N + H^N)\right]\right]\varepsilon^s}{\delta\left[\alpha_2 + (G^N + H^N)(a+b)(1-z)\right]} \tag{7b}$$

[3] The target values of the macroeconomic variables in the policymakers' loss functions are normalized to zero.

The equations (7) allow us to seize the difference between the public authorities' responses according to the type of economic shocks. Thus, the efforts made by the governments and the Central Bank in order to stabilize the symmetric demand shocks converge. For instance, in the case of a negative demand shock, the authorities will adopt an expansionary policy; the public deficit will rise while the interest rate will go down in order to encourage the demand and to boost the activity. On the contrary, when it comes to the symmetric supply shocks, the authorities' reactions become ambiguous. If we take the governments for instance, they will have to carry out two contradictory policies in reaction to an inflationist supply shock: that is on the one hand a restrictive policy consistent with the monetary policy in order to stabilize the inflation (as the governments are concerned with the price evolution) and on the other hand, an expansive policy which would be able to respond to the monetary reaction in order to support the activity (the governments are also concerned with the output stabilization).

On the basis of equation (7), we can identify the equilibrium values of the output and inflation:

$$y^N = \frac{\alpha_2(1-z)\varepsilon^d + \left[\nu\alpha_2 + H^N(a+b)(1-z)\right]\varepsilon^s}{\alpha_2 + (G^N + H^N)(a+b)(1-z)} \tag{8a}$$

$$\pi^N = \frac{\alpha_2(1-z)\varepsilon^d - \left[(1-\nu)\alpha_2 + G^N(a+b)(1-z)\right]\varepsilon^s}{\mu\left[\alpha_2 + (G^N + H^N)(a+b)(1-z)\right]} \tag{8b}$$

Fiscal coordination – in this configuration the governments cooperate and the new collective loss function will correspond to the sum of all the national loss functions:

$$L^C = L_i^G + L_j^G = \frac{1}{2}\left[\alpha_0(\pi_i^2 + \pi_j^2) + \alpha_1(y_i^2 + y_j^2) + \alpha_2(g_i^2 + g_j^2)\right] \tag{9}$$

The aggregate values of the public deficit, output and inflation become:

$$g^C = \frac{-(1-z)(G^C + H^C)\varepsilon^d + \left[H^C - \nu(G^C + H^C)\right]\varepsilon^s}{\alpha_2 + (G^C + H^C)(a+b)(1-z)} \tag{10a}$$

$$y^C = \frac{\alpha_2(1-z)\varepsilon^d + \left[\nu\alpha_2 + H^C(a+b)(1-z)\right]\varepsilon^s}{\alpha_2 + (G^C + H^C)(a+b)(1-z)} \tag{10b}$$

$$\pi^C = \frac{\alpha_2(1-z)\varepsilon^d - \left[(1-\nu)\alpha_2 + G^C(a+b)(1-z)\right]\varepsilon^s}{\mu\left[\alpha_2 + (G^C + H^C)(a+b)(1-z)\right]} \tag{10c}$$

where $G^C = \alpha_1(N+P)(a+b)$, $H^C = \frac{\alpha_0}{\mu^2(1+m)}(N+P+m)(a+b)$

Taking into account the aggregate and difference components[4] of the macroeconomic variables we can identify the equilibrium values of the output, inflation and public deficit at the national level according to the type of fiscal game configuration. If we consider $\phi = \mathrm{N},\ \mathrm{C}$ as the two games liable to take place between the governments, i.e. the Nash equilibrium and the fiscal coordination, any national variable x_i will be written according to the demand and supply shocks specific to the two Union members i and j: $X_i^\phi = f^\phi(\varepsilon_i^d, \varepsilon_j^d, \varepsilon_i^s, \varepsilon_j^s)$[5]. By means of these national equations, we will be able to conceive the loss functions for each

[4] The difference component of the macroeconomic variables is described in the Appendix 1.

[5] The complete equations of the macroeconomic variables at the national level are available upon request.

country and to compare the relative efficiency of the two fiscal games in terms of macroeconomic stabilization.

In order to analyse analytically the impact the Union's heterogeneity degree has on the national stabilization mechanisms, only the specific demand shocks can be taken into account. Thus, if the degree of heterogeneity between the countries (h) increases, the impact the demand shocks specific to the country i have on the national output and inflation diminishes, which will therefore result in a domestic welfare increase ($\left[\frac{\partial\left[E^{\phi}(L_i^G)\right]}{\partial h}\right]_{\varepsilon_i^d} < 0$). On the contrary, the country j will undergo a decline of the quality of the output and inflation stabilization against the specific demand shocks, which will have a prejudicial impact on its national loss function ($\left[\frac{\partial\left[E^{\phi}(L_j^G)\right]}{\partial h}\right]_{\varepsilon_j^d} > 0$). Such a situation is the direct consequence of the fact that the Central bank and the governments of the countries directly affected by the demand shocks join their efforts in the stabilization process. Indeed, if the heterogeneity of the Union increases (h rises) then the single monetary policy will have a high (low) influence on the country i (j) and the Central bank's stabilization efforts will be more efficiently transmitted to the country i to the detriment of the country j. Moreover the country j will have to make up for the lower impact of the common monetary policy by a more active fiscal response. Its national loss, which is influenced by the evolution of the public deficit, will thus increase. On the contrary, the country i will take advantage of a more fluid transmission of the monetary policy and will thus afford to make less effort for specific demand shock stabilization, with a positive effect on the national welfare.

There is some ambiguity as to the way in which the evolution of the degree of the Union's heterogeneity may influence the stabilization of the non specific demand shocks, because the mechanisms involved here may have contradictory effects. Indeed, the influence of these shocks on the national variables largely depends on the indirect transmission mechanisms, i.e. the foreign fiscal policy channel (the fiscal policies adopted in the countries where the shocks appear carry the impact of these shocks abroad) and the common monetary policy channel.

The analysis of the way in which the degree of structural heterogeneity influences the efficiency of macroeconomic stabilization at the national level is again hindered when dealing with the supply shocks. The reason is that these shocks have opposite effects on the macroeconomic variables: the prices fall down (increase) and the output increases (falls down) at the national level if the asymmetric supply shock is positive (negative).

Since no analytical solution is available to account for all the mechanisms of macroeconomic stabilization against the different types of shocks at the national level, we need to make use of numerical simulation[6] techniques. They will mainly enable us to analyse the relative efficiency of the fiscal coordination game relative to the Nash equilibrium between governments by comparing the values of the national loss functions resulting from these two game configurations.

In order to compare the macroeconomic efficiency at the national level, we have distinguished between the economic shocks according to their type – demand and supply shocks – and to their origin – shocks specific to the country i or j. The Figures bellow describe the evolution of the differences between national losses obtained in the Nash equilibrium relatively to fiscal coordination game. The evolution of the national loss

[6] The simulations were developed using a numerical calibration that is presented in Appendix 2.

differences[7] takes into account the evolution of the structural heterogeneity degree between the countries (h) and the sign of the fiscal spillovers ($b > 0$ or $b < 0$).

Figure 1: Demand shock specific to the country i – relative impact on the national welfare

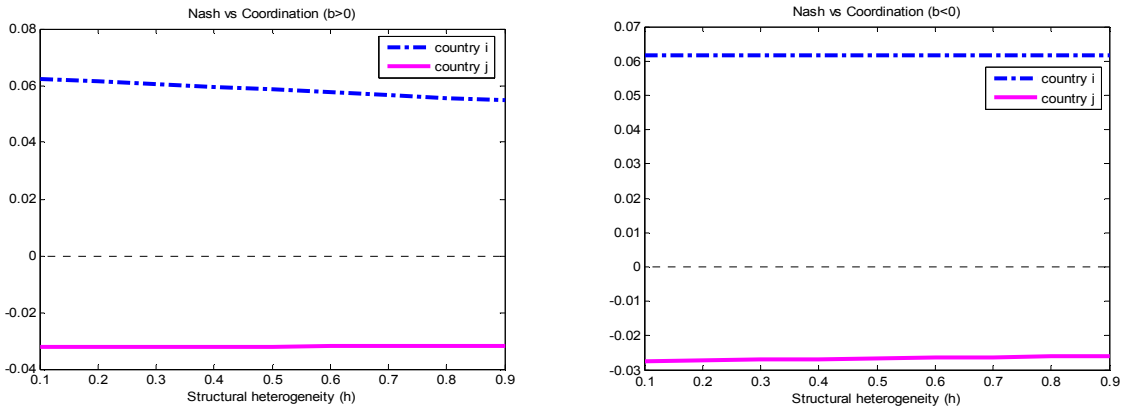
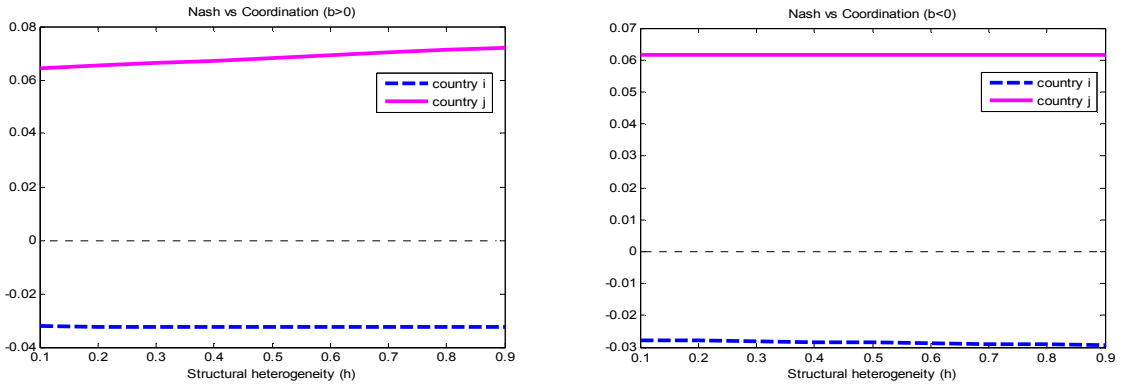


Figure 2: Demand shock specific to the country j – relative impact on the national welfare



In the case of the demand shocks specific to the country i, in order to achieve the best stabilization, the two countries need two different game configurations: fiscal coordination for the country i ($E^C(L^G_{i(\sigma_i^d)}) < E^N(L^G_{i(\sigma_i^d)})$ and lack of coordination for its partner j ($E^N(L^G_{j(\sigma_i^d)}) < E^C(L^G_{j(\sigma_i^d)})$, irrespectively of the sign of the fiscal spillovers ($b > 0$ or $b < 0$). In the case of the demand shocks specific to the country j, the same conditions of stabilization apply: the fiscal coordination provides the best stabilization for this country ($E^C(L^G_{j(\sigma_j^d)}) < E^N(L^G_{j(\sigma_j^d)})$, whereas the country i prefers a Nash equilibrium ($E^N(L^G_{i(\sigma_j^d)}) < E^C(L^G_{i(\sigma_j^d)})$). In other words, the specific demand shocks require a fiscal coordination game, while the non specific shocks are better stabilized by a Nash equilibrium between governments. We need to underline the robustness of these results which are not qualitatively changed either by the sign of fiscal spillovers or by the use of different degrees of sensitivity of the public authorities to the evolution of the macroeconomic variables[8]. We

[7] The national losses are developed according to the hypothesis of the independence between the different types of economic shocks.

[8] For instance, when the monetary policy is less reactive to the economic activity evolution ($\beta_0 = 0{,}5;\ \beta_1 = 0{,}2;\ \beta_2 = 0{,}3$) or when the fiscal policies are more flexible and more apt to neutralize the demand and supply shocks ($\alpha_0 = 0{,}6;\ \alpha_1 = 0{,}2;\ \alpha_2 = 0{,}2$).

can therefore conclude that the stabilization of the demand shocks generates a system blockage at the national level because there isn't a single common solution which could ensure an optimum welfare for both Union members simultaneously.

Figure 3: Supply shock specific to the country i – relative impact on the national welfare

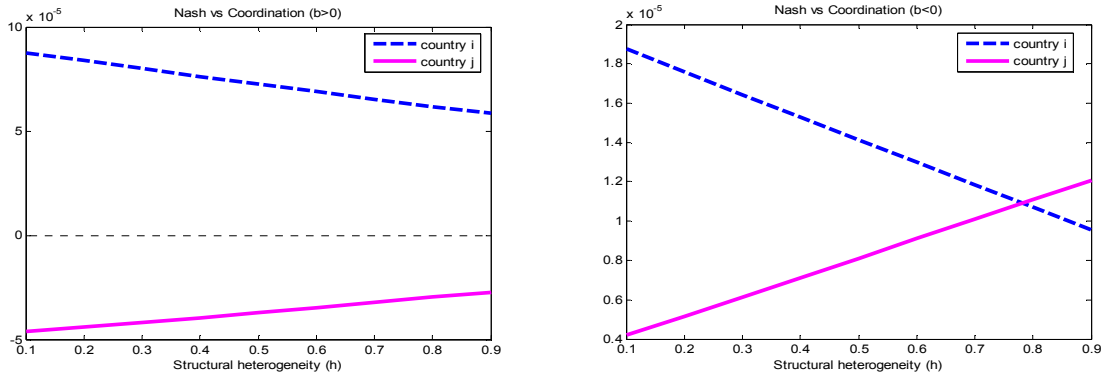
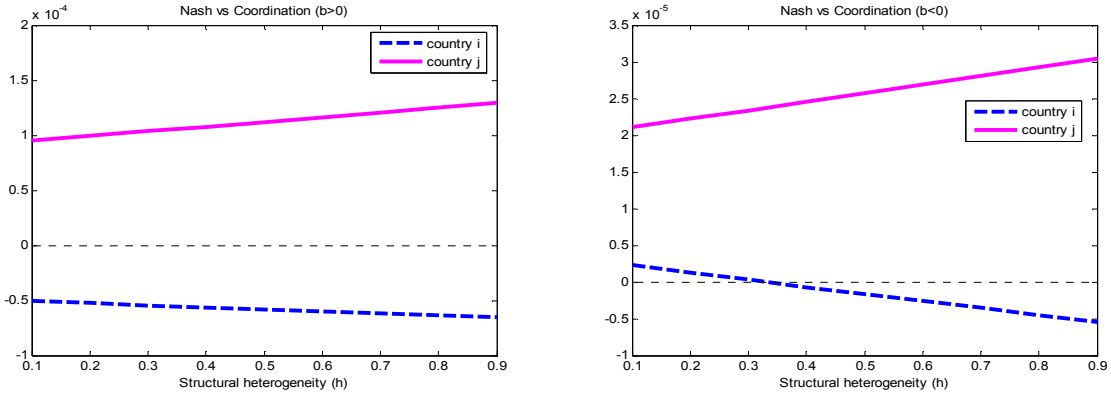


Figure 4: Supply shock specific to the country j – relative impact on the national welfare



In the case of the supply shocks, the system blockage at the national level (i.e. lack of an optimal solution which is common to all the Union members) depends mainly on the sign of the fiscal spillovers and on the extent of the structural heterogeneity of the Union. If the fiscal spillovers are positive ($b > 0$), the stabilization is attained under the same conditions as in the case of the demand shocks and which cause a system blockage : the fiscal coordination improves the stabilization of the specific supply shocks ($(E^C(L^G_{i(j)(\sigma^s_{i(j)})}) < E^N(L^G_{i(j)(\sigma^s_{i(j)})})$), while the non specific supply shocks are better neutralized by a Nash equilibrium between the governments ($E^N(L^G_{j(i)(\sigma^s_{i(j)})}) < E^C(L^G_{j(i)(\sigma^s_{i(j)})})$).

If the fiscal spillovers are negative ($b < 0$), the results change depending on the origin of the supply shocks. Thus, the supply shocks specific to the country i are better stabilized in the two countries by a fiscal coordination game ($E^C(L^G_{i(j)(\sigma^s_i)}) < E^N(L^G_{i(j)(\sigma^s_i)})$), but for the supply shocks specific to the country j, the fiscal coordination improves the welfare of both countries only if the Union's degree of structural heterogeneity is relatively low ($h < 0{,}4$)[9].

[9] For $h > 0{,}3$ the country i prefers a Nash equilibrium ($E^N(L^G_{i(\sigma^s_j)}) < E^C(L^G_{i(\sigma^s_j)})$) ; the system will block because the country j prefers always a fiscal coordination game ($E^C(L^G_{j(\sigma^s_j)}) < E^N(L^G_{j(\sigma^s_j)})$).

We can thus point out that in comparison with the results obtained for the demand shocks, the relative quality of the supply shock stabilization is less robust relative to the parameters chosen. The supply shock stabilization mechanisms are not only influenced by the sensitivity to the sign of spillovers and to the extent of the structural heterogeneity, but also by the relative importance the public authorities place on the different macroeconomic objectives[10]. The relatively low stability of the results is due to the opposite effects of the supply shocks both at the national level and between the two countries. A negative asymmetric supply shock triggers the rise (decrease) of prices (output) at the national level, whereas in the other country these effects are reversed and considerably less important. Moreover, because of these opposite effects, the relative differences between national losses in the case of the supply shocks (the differences concern the loss functions between the Nash and fiscal coordination games) are less strong compared to the relative differences in the case of the demand shocks.

4. Conclusion

In this paper, we have aimed at investigating the advantages of a fiscal coordination as an institutional instrument providing an efficient neutralization of the impact of the economic shocks affecting the members of a heterogeneous monetary Union. Considering the heterogeneity of the Union with respect to the mechanisms of monetary policy transmission, we have distinguished between shocks according to their type and origin, and raised the question whether the fiscal coordination can improve the national welfare of each Union country member.

To sum up our results, we can underline the key elements that influence the mechanisms of macroeconomic stabilization. The first element is the type of shocks affecting the Union members. In the case of the demand shocks, the system is obstructed irrespectively of the various choices of the model's parameters. The specific shocks are better neutralized by a fiscal coordination game while the optimal absorption of the non specific shocks requires the absence of coordination between governments. The analysis of the supply shocks yields more heterogeneous results which are sensitive to the choice of the parameters; we can also mention that for this type of shocks, the fiscal coordination can be, under certain specific conditions, a convenient solution to minimise the national loss functions for all countries.

When analysing the relative differences between the Nash and fiscal coordination games according to the type of economic shocks, we can notice that these differences are by far stronger and more stable in the case of the demand shocks compared to the supply shocks. Consequently, it is more likely to have a system blockage in the case of the demand shocks than to identify an optimum common solution (fiscal coordination) for all the Union members in the case of the supply shocks. To sum up, in a heterogeneous monetary Union each country has specific needs in stabilizing the asymmetric shocks, which may threaten the cohesion of the whole region. Indeed, generally neither the fiscal coordination game nor the Nash equilibrium between governments succeed in providing the optimum national welfare to all the countries of the Union simultaneously. Therefore, since the structural heterogeneity is a fact and is not likely to change (on the contrary, the future Euro zone enlargements is likely to reinforce it), the Euro zone may need to think about reforming its system of economic

[10] For instance, when the monetary flexibility is higher ($\beta_2 = 0{,}1$) and the Central bank is more sensitive to price stability ($\beta_0 = 0{,}7$), the fiscal coordination can represent an optimum solution for both countries in the case of positive spillovers especially if the structural heterogeneity of the Union is high ($h > 0{,}7$). At the same time, the fiscal coordination can improve the welfare of both countries if the Union is particular homogeneous ($h < 0{,}3$), the fiscal flexibility is lower ($\alpha_2 = 0{,}5$) and the fiscal spillovers are positive.

governance. The most reliable solutions could be a variable geometry fiscal coordination or fiscal federalism.

References

Beetsma, R., X. Debrun and F. Klaassen (2001) "Is Fiscal Policy Coordination in EMU Desirable?" *CEPR Discussion paper* 3035.

Cadiou, L., and S. Guichard (1999) "La diversité des marchés du travail en Europe : quelles conséquences pour l'Union Monétaire (first part) » *Document de travail du CEPII* 10.

Cadiou, L., S. Guichard and M. Maurel (1999) "La diversité des marchés du travail en Europe : quelles conséquences pour l'Union Monétaire (second part) » *Document de travail du CEPII* 11.

Catenaro, M., and P. Tirelli (2000) "Reconsidering the Pros and Cons of Fiscal Policy Co-ordination in a Monetary Union: Should We Set Public Expenditure Targets?" *University of Surrey, Discussion papers* 2.

Creel, J. (2001) « Faut-il contraindre la politique budgétaire en Union Monétaire ? Les enseignements d'une maquette simulée » *Revue de l'OFCE* **77**, 199-250.

Creel, J. (2002) « Asymétries budgétaires dan la zone euro, un essai de modélisation du Pacte de stabilité » *Revue française d'économie* **3**, 91-127.

Engwerda, J. C., J. E. J. Plasmans and B. Van Aarle (2002) "Cooperative and non-cooperative fiscal stabilization policies in the EMU" *Journal of Economic Dynamics and Control* **3**, 451-81.

Lambertini, L., and R. Rovelli (2003) "Monetary and Fiscal Policy Coordination and Macroeconomic Stabilization: A Theoretical Analysis" *Università di Bologna, Working Paper* 464.

Léonard, J., and C. Oros (2007) « Gouvernance économique et élargissement de la zone euro. Les avantages d'une coordination budgétaire à géométrie variable » *Revue du Marché commun et de l'Union européenne* **513**, 621-27.

Menguy, S. (2005) « Hétérogénéité structurelle des pays membres et conflit d'objectifs entre les autorités économiques dans l'UEM » *Économie et Prévision* **169-171**, 41-58.

Mojon, B., and G. Peersman (2001) "A VAR Description of the Effects of Monetary Policy in the Individual Countries of the Euro Area" *ECB Working Paper* 92.

Mundschenk, S., and J. Von Hagen (2003) "Fiscal and Monetary Policy Coordination in EMU" *International Journal of Finance and Economics* **4**, 279-295.

Penot, A. (2002) « Appréciations et conséquences possibles de l'hétérogénéité structurelle dans la zone euro » *Revue d'économie financière* **65**, 153-75.

Penot, A., J.-P. Pollin and V. Seltz (2000) « Hétérogénéité de la zone euro et politique monétaire unique » *XVII*^{èmes} *Journées Internationales d'Économie Monétaire et Bancaire*, Lisbonne, 7-9 juin.

Rogers, J. H. (2001) "Price Level Convergence Relative Prices, and Inflation in Europe" The Board of Governors of the Federal Reserve System, *International Finance Discussion Papers* 699.

Uhlig, H. (2002) "One Money but Many Fiscal Policies in Europe: What Are the Consequences?" *CEPR Discussion Papers* 3296.

Van Aarle, B., J. C. Engwerda and J. E. J. Plasmans (2002) "Monetary and Fiscal Policy Interaction in the EMU: A Dynamic Game Approach" *Annals of Operations Research* **109**, 229-264.

Van Els, P., A. Locarno, J. Morgan and J.-P. Villetelle (2001) "Monetary Policy Transmission in the Euro Area: What do Aggregate and National Structural Models Tell Us?" *ECB Working Paper* 94.

Villieu, P. (2000) « Élargissement de l'Union monétaire et coordination des politiques budgétaires : un point de vue » *Annales d'Économie et de Statistique* **59**, 137-63.

Appendix 1

The difference component of the macroeconomic variables according to the fiscal game configuration is:

- Nash equilibrium:

$$\left.\begin{aligned}
\bar{g}^{N} &= \frac{N\left(G^{N}+\frac{H^{N}}{1+m}\right)(\delta hr-\bar{\varepsilon}^{d})+\left(N\frac{H^{N}}{1+m}-PG^{N}\right)\bar{\varepsilon}^{s}}{\alpha_{2}+N\left(G^{N}+\frac{H^{N}}{1+m}\right)(a-b)} \\
\bar{y}^{N} &= \frac{-\alpha_{2}N(\delta hr^{N}-\bar{\varepsilon}^{d})+\left[P\alpha_{2}+\frac{NH^{N}(a-b)}{1+m}\right]\bar{\varepsilon}^{s}}{\alpha_{2}+(G^{N}+\frac{H^{N}}{1+m})N(a-b)} \\
\bar{\pi}^{N} &= \frac{-\alpha_{2}N(\delta hr^{N}-\bar{\varepsilon}^{d})-N\left[\alpha_{2}+G^{N}(a-b)\right]\bar{\varepsilon}^{s}}{\mu(1+m)\left[\alpha_{2}+(G^{N}+\frac{H^{N}}{1+m})N(a-b)\right]}
\end{aligned}\right\}$$

- Fiscal coordination:

$$\left.\begin{aligned}
\bar{g}^{C} &= \frac{N^{2}(a-b)\left(\alpha_{1}+\frac{\alpha_{0}}{\mu^{2}(1+m)^{2}}\right)(\delta hr-\bar{\varepsilon}^{d})+\left(N\frac{\alpha_{0}}{\mu^{2}(1+m)^{2}}-\alpha_{1}P\right)\bar{\varepsilon}^{s}}{\alpha_{2}+N^{2}\left(\alpha_{1}+\frac{\alpha_{0}}{\mu^{2}(1+m)^{2}}\right)(a-b)^{2}} \\
\bar{y}^{C} &= \frac{-N\alpha_{2}(\delta hr-\bar{\varepsilon}^{d})+\left(P\alpha_{2}+\frac{\alpha_{0}N^{2}(a-b)^{2}}{\mu^{2}(1+m)^{2}}\right)\bar{\varepsilon}^{s}}{\alpha_{2}+N^{2}\left(\alpha_{1}+\frac{\alpha_{0}}{\mu^{2}(1+m)^{2}}\right)(a-b)^{2}} \\
\bar{\pi}^{C} &= \frac{-N\alpha_{2}(\delta hr-\bar{\varepsilon}^{d})-N\left(\alpha_{2}+\alpha_{1}N(a-b)^{2}\right)\bar{\varepsilon}^{s}}{\mu(1+m)\left[\alpha_{2}+N^{2}\left(\alpha_{1}+\frac{\alpha_{0}}{\mu^{2}(1+m)^{2}}\right)(a-b)^{2}\right]}
\end{aligned}\right\}$$

Appendix 2

The numerical simulations have been obtained using the Matlab language. In order to analyse the quality of the national macroeconomic stabilization, we have studied the differences between the national losses resulting from the two game configurations in which the governments are involved (Nash equilibrium and fiscal coordination game). The relative differences have been calculated according to the evolution of the degree of structural heterogeneity between the countries (h). For the rest of the parameters, we have used a rich

empirical and theoretical literature in order to choose the values that reflect the average of the Euro zone countries.

For the sensitivity of the demand to the national deficit, we consider an average coefficient of 0,5 ($a = 0{,}5$), (Beetsma *et al.* (2001), Menguy (2005)). The value of fiscal spillovers has been established at 0,2 in absolute value ($b = |0{,}2|$); we consider that the spillovers can't be superior, in absolute value, to the sensitivity of the demand to the national public deficit ($a > |b|$).

We use the sensitivity of the demand to interest rate as identified by Mojon and Peersman (2001) and by Van Els *et al.* (2001) with an average value of 0,2 for the Euro zone ($\delta = 0{,}2$). The sensitivity of the output to the price differential relative to the Union average is 0,1 ($s = 0{,}1$), which is close to the value identified by Creel (2001) and Engwerda *et al.* (2002).

Concerning the sensitivity of the production to the evolution of inflation, the coefficients used in the literature are generally situated around 3 et 4 (Van Aarle *et al.* (2002), Engwerda *et al.* (2002), Rogers (2001)); we have thus chosen the value 3 for this coefficient ($\mu = 3$). The sensitivity of the national inflation to foreign inflation is 0,2 ($m = 0{,}2$) as in Creel (2002).

When identifying the relative preferences of the Central bank, we took into account the ECB's main objective, that is price stabilization. Consequently, the relative importance of this objective ($\beta_0 = 0{,}5$) is higher than the weight of the output stabilization ($\beta_1 = 0{,}3$) and of the interest rate smoothing ($\beta_2 = 0{,}2$). As to the national governments, their priority concerns first of all the output and the public deficit stabilization ($\alpha_1 = \alpha_2 = 0{,}4$), and then the objective of price stabilization ($\alpha_0 = 0{,}2$).

The values of the model's parameters are summed up in the Table bellow:

Table A2: Calibration of the model's parameters

Output sensitivity to national public deficit (a)	0,5
Fiscal spillovers (b)	+/-2
Output sensitivity to interest rate (δ)	0,2
Output sensitivity to price competitiveness relative to the Union average (s)	0,1
Production sensitivity to national inflation (μ)	3
Inflation sensitivity to imported inflation (m)	0,2
The relative importance the Central bank gives to price stabilization (β_0)	0,5
The relative importance the Central bank gives to output stabilization (β_1)	0,3
The relative importance the Central bank gives to interest rate smoothing (β_2)	0,2
The relative importance the national governments give to price stabilization (α_0)	0,2
The relative importance the national governments give to output stabilization (α_1)	0,4
The relative importance the national governments give to public deficit stabilization (α_2)	0,4