EUI WORKING PAPERS
ECO No. 2006/09

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LUCA ONORANTE

EUROPEAN UNIVERSITY INSTITUTE
Department of Economics

EUROPEAN UNIVERSITY INSTITUTE
DEPARTMENT OF ECONOMICS

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EUI Working Paper **ECO** No. 2006/9

ISSN 1725-6704

Printed in Italy
European University Institute
Badia Fiesolana
I – 50016 San Domenico di Fiesole (FI)
Italy

http://www.iue.it/
http://cadmus.iue.it/dspace/index.jsp

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Luca Onorante *
European University Institute

Abstract

Since the Helsinki European Council of December 1999, a process of increased coordination of fiscal policies in the area of the Euro seems to be on its way. In this paper I examine this process from the point of view of the independence of the European central Bank (ECB).

The interaction of the governments and the ECB is addressed in a game theoretical framework. First, the conditions under which in which the national governments are able to put pressure on the ECB are made explicit. Then the main question is addressed: would a greater fiscal coordination reduce or increase the capacity of the monetary authority of targeting long run inflation?

Formal and informal, discretional (positive) and rule-based (negative) coordination and their interactions are examined as possible solutions of the game. I conclude that the main point is not how much fiscal coordination is there, but the form it takes. It turns out that a mix of informal political coordination and binding rules is the one that best preserves the independence of the ECB. For negative coordination, it is shown that a simple change in the definition of "excessive deficit" can at the same time allow more stabilization of output after a shock and a better control of inflation by the ECB.

JEL Classification: C7; E0; E3; E6; H5.

Keywords: European Monetary Union, European Central Bank, game theory, fiscal policy, monetary policy, policy coordination.

*Present address: Department of Economics, European University Institute, Via dei Roccettini 9, I-50016 San Domenico di Fiesole (FI), Italy. E-mail: onorante@iue.it

[0]The author thanks Mike Artis and Pierpaolo Battigalli for supervision, Mirko Wiederholt for an enlightening intuition, Matthias Rau for his comments, and Anna Sanz de Galdeano for reading and correcting the very first version of the paper. All mistakes are mine.

1 Introduction

Since the Helsinki European Council of December 1999, a process of increased coordination of fiscal policies in the area of the Euro seems to be on its way. In this paper I examine this process from the point of view of the independence of the European central Bank (ECB).

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Formal and informal, discretional (positive) and rule-based (negative) coordination and their interactions are examined as possible solutions of the game. I conclude that the main point is not how much fiscal coordination there is, but the form it takes. It turns out that a mix of informal fiscal coordination and binding rules is the one that best preserves the independence of the ECB.

In the present paper I try to determine which kind of coordination would allow the ECB to pursue its statutory goal of price stability. I start from the definition of "best environment" as the one in which the ECB does not need to intervene to counteract exogenous or policy induced shocks. In such an ideal world, the fiscal policy stabilizes national output and unemployment, while the central bank takes care of the common price stability.

In a world hit by shocks, the governments tend to act in order to stabilize the domestic economy. In doing so, it is natural for them to take into account the foreseeable reaction of their central bank[1]. While this strategic interaction has been described in the case of one country, the possible outcome of the interplay of multiple fiscal authorities with a common Central Bank is not completely understood yet. In the rest of the paper I address this issue, and try to answer to the following questions: which is the degree of fiscal coordination that best relieves the ECB from short-run stabilization and allows it to concentrate on long run inflation targeting? And should this coordination be based on binding rules (negative coordination) or discretional common decisions (positive coordination), or both?

[1] In many European countries governments did not limit themselves to taking into account the reaction of their monetary authority to the fiscal policy, but went as far as directly influencing the monetary policy by forcing the central bank to monetize the national debt. Such an explicit pressure is nowadays explicitely ruled out by the statute of the ECB.

1.0.1 The short story of European fiscal coordination

The current policy framework of the EMU presents a strong and unique asymmetry between the management of fiscal and monetary policies. The single monetary policy is run by a unique decision-maker (the European Central Bank) with a clear "primary objective" (price stability); by contrast, the fiscal policies remain in the hand of the Member States, with no objective specified by the Treaty. The only instrument of positive coordination of fiscal policies is the Broad Economic Policy Guidelines (BEPG), non binding recommendations prepared each year by the Commission and adopted by the ECOFIN Council. On the negative coordination side, the Stability and Growth Pact (SGP) is backed by sanctions in the case of "excessive deficits". The SGP allows the ECB to "play on the safe side" by putting a strong limit to the discretional power of the national governments to conduct an independent fiscal policy.

The prospective scenarios The Helsinki European Council of December 1999 adopted the conclusions of an ECOFIN Council Report pleading for a strenghtening of economic policy coordination during Stage Three of Economic and Monetary Union (EMU). Broadly speaking, increased coordination should include 1) a greater sharing of information among the member states, 2) a greater positive coordination and 3) a progressive reduction of the importance of negative (rule-based) coordination.

The principle of informing the other members of the euro area and the Commission before adopting an economic policy measure should form part of a set of "rules of conduct" elaborated by the Commission in consultation with the ECB. Furthermore, regular meetings would be held between the ECB President, the President of the Eurogroup and the representative of the Commission in the Council of Governors of the ECB.

While a literal interpretation of the Treaties impedes the formation of a formal governing body exclusively dedicated to fiscal coordination among the Euro countries, it would be certainly possible to increase the powers of the Eurogroup within the Economic and Financial Committee, by transforming it into a permanent working party and increasing the frequency of its meetings. Short of a Treaty change, the formal power of the Eurogroup could also be strenghtened to the extent allowed by the "closer cooperation" clauses[2].

One should notice, however, that reinforced cooperation would not, even in the opinion of the Commission, determine the end of negative coordination (e.g. the SGP), but only a diminution of its importance.

[2]The reinforced co-operation procedures are based on Articles 43, 44 and 45 of the Treaty of the Union and Article 11 of the EC Treaty.

The terms of the debate Like any other Central bank, the ECB faces the conflicting objectives of long-run price stability and short-run stabilization of the economy in the presence of shocks. Unlike any other Central Bank, the ECB does not face a single fiscal authority, but 12 different ones. In such unprecedented framework the consequences in terms of pressure on the ECB are difficult to assess, and there is no unanimity of opinions. It is then not surprising that the Helsinki Council has revived the existing debate about coordination of fiscal policies, and that no agreement exist.

The first supporter of strong fiscal coordination is the European Commission. The advantage of coordination would be that active fiscal policy is recovered for stabilization. Also, it is perceived by some that there is a need for fiscal coordination to ensure credibility of long-term commitments to macroeconomic stability.

On the other hand, a consistent part of the economic profession tends to be skeptical about the need for such a move. Many economists think that coordinated fiscal policies would place a greater burden on the monetary authority. A more intense coordination could lead to 'Keynesian style' fine-tuning of fiscal policies across the member states, and this would force the ECB to intervene in the policy mix and to pay too much attention to cyclical stabilization, neglecting the objective of long run price stabilization.

The reported declarations by members of the Board of Directors of the European Central Bank (ECB) seem to proceed along both lines of reasoning: on the one hand, a stronger coordination between euro countries could be a potential threat to the independence of the ECB; on the other, it could reduce the level of political uncertainty resulting from a situation where economic policies are pursued independently by a large number of institutions. On this point even the ECB does not seem to dislike the idea of a "credible interlocutor".

It it the opinion of this paper that this question can be addressed only by analyzing the strategic interaction of the various policymakers. The paper is structured as follows: section 2 describes the model and clarifies the hypotheses that underline the idea of "fiscal policies putting pressure on the ECB"; it finally provides a closed form solution for the model. Section 3 examines the consequences of different levels of positive and negative coordination and their interactions. The results are also illustrated via a simulation of a monetary union of 12 countries whose weights are equal to those into the EMU. The conclusions follow. The mathematical appendix provides a more complete characterization of the results of the paper.

Some literature The issue of coordination in a monetary union is explicitly addressed in Dixit and Lambertini (2000), Bosca and Orts (1991), Van Aarle and Huart (1997), Beetsma and Bovenberg (1995) and in a game theory framework by Diaz-Roldan (2000).

Gatti and Van Wijnbergen (2002) examine the conditions for fiscal restraint to emerge as Nash equilibrium in the game between fiscal authorities in a monetary union. Bayoumi and Eichengreen (1993) and the texts of the Optimum Currency Areas in their bibliography are a good starting point for the analysis of the shocks that may hit a monetary union. The conclusions of this paper about the rigidity of the SGP are similar to those in Eichengreen (1996). The legal framework in which coordination must arise is in the Treaty of Maastricht, discussed in Buter, Corsetti and Roubini (1993), Von Hagen and Eichengreen (1996), and of course in European Commission (1991). For fiscal federalism one can look at Oates (1972), Tanzi (1996), Walsh (1992) and Pisani-Ferry (1991).

2 The model

In a simple monetary union hit by exogenous shocks, the single central bank and N national fiscal authorities interact to achieve low inflation and full employment. The interaction between the agents is modeled with a game theory model solvable by backward induction, in which the national governments are able to put pressure on the ECB by running their fiscal policies after an economic shock. The focus is on stabilization after a shock, not on reputational issues of the players, therefore the game is static.

The preferences of national governments differ from those of the central bank because of the greater weight put on smoothing unemployment[3]. The governments in all participating countries have identical preferences. The model is one of short horizon, therefore the effect of fiscal and monetary policy on inflation and unemployment is described by two simple demand equations with fixed expectations of the public.

To keep notation simple, only two governments are explicitly represented. Government j can be seen as the weighted average of all other participating countries as seen by government i. This simplification does not alter the symmetric equilibrium of the model.

In the first section the game is described and solved for the general case. The equilibrium conditions are then used in the second part to analyze some different scenarios.

The first-best monetary policy The ECB has two, conflicting objectives: long-run inflation targeting (primary objective) and short-run stabilization of the Euro area. The more the ECB can neglect stabilization, the better it can concentrate on the other goal. For this reason it is enough to model explicitly the short-run preferences for stabilization. These preferences should be interpreted as the trade-off between inflation and unemployment that

[3] Given the short term characteristics of the model a greater weight on unemployment can also be interpreted as a greater *speed* of desired adjustment.

the ECB considers consistent with long-run price stability. The optimal "working environment" for the ECB is then the one in which it does not have to intervene to correct what are, in terms of its preferences, "errors of the national governments". More specifically:

- it does not need to intervene to offset the inflationary effects of an excessive expenditure of the governments, where "excessive expenditure" is the expenditure that implies more inflation than the ECB would like given the exogenous shock.
- it does not need to intervene because of the lack of action of the national governments. This may seem unlikely in the model, because the preferences of the national fiscal authorities are relatively more concerned about unemployment, but this eventuality may arise in presence of inflexible constraints to fiscal policy such as the ones implemented in the SGP. It will be shown that under some circumstances these constraints can prevent the member states from coping with asymmetric shocks[4] and put the burden of the intervention on the ECB.

The meaning of "pressure on the ECB" The generic worry that the governments can influence the ECB "hides" many other assumption, that is important to make explicit in order to check their likelihood. I shall briefly outline these hypotheses here.

1. Backward induction: the governments must be able to form expectations about the reaction of the ECB and take them into account when formulating fiscal policy. In the jargon of game theory, the governments "move first".
2. The ECB can have preferences that are quite conservative, but they must also to some extent include unemployment. When the ECB is committed to the exclusive targeting of prices[5] there is no scope for putting pressure on it because there is no trade off between prices and unemployment in its best response. The two first years of EMU have clearly shown that employment is a relevant variable in the ECB policy decisions[6].

[4] A relevant problem is when the shocks come from outside or inside the monetary union. It is assumed here that there is consensus among the players on the relevant variables to watch, and the preferences of the players are expressed in terms of these variables. This is not an essential feature of the model and this aspect is therefore assumed away, focusing the attention only on the interaction of the players.

[5] Other solutions may exist. For instance, the Reserve Bank of New Zealand excludes from the targeted inflation the effect of government sales taxes. This can be seen as an attempt to limit the influence of the government.

[6] Employment could be included as a predictor of future inflation. In this case it would appear as if the ECB was concerned by employment.

3. The national fiscal authorities are relatively more concerned about increases in unemployment than the ECB. In absence of this "inflation bias" the problem of pressure on the ECB does not exist. It has been correctly stated that the case for fiscal coordination (and more in general for macroeconomic coordination) is weak when the ECB and the fiscal authorities "keep the house in order" acting on their own. At a closer look, the absence of inflation bias is not realistic. The expression "keep their houses in order" does not only imply that the fiscal authorities do not deviate from "prudent" behavior because of short run political incentives. It also amounts to assuming that the national governments show the same little concern about unemployment than a conservative central bank. This assumption does not seem to be observed in practice in the EU countries[7]. In the rest of the paper, the governments have an inflation bias.

4. Monetary policy is assumed to be relatively more efficient on prices than fiscal policies[8]. This simply means that the institution relatively more concerned about prices (the ECB) has been assigned the instrument that best controls inflation. A situation of misallocation of instruments would lead to the absence of equilibrium.

Other hypotheses of the model are there simply to improve clarity and tractability.

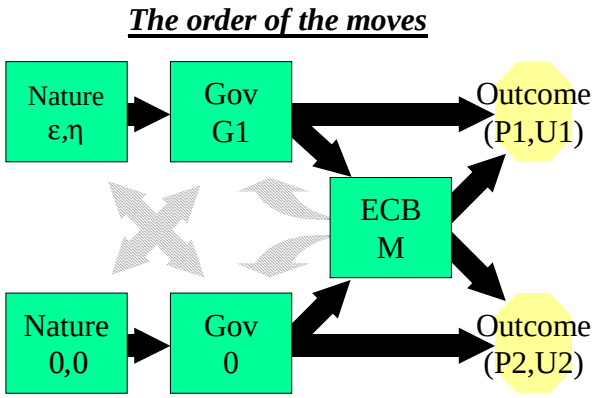
The game aims at describing the interaction among public agents in responding to shocks. Each economy is then described by the same two simple equations of prices and unemployment. The interesting time horizon being the very short period, the expectations of the public are kept fixed. Finally, I want to concentrate on the effects of monetary policy and monetary externalities, therefore I neglect the direct fiscal externalities and assume that the different countries are linked only by the common monetary policy: in other words, each national fiscal policy has direct effects in the domestic market only, and indirect effects abroad through monetary policy. The minimization of these indirect effects is at the center of the attention of the present work.

The sequence of moves At the beginning of the game the market is in *equilibrium*, where equilibrium is defined as the situation where all agents (ECB and Gs) are playing their best responses, the common target values for prices and unemployment are met and

[7] One should notice that a bigger concern for unemployment of the fiscal authorities does not need to arise from corruption or political cycles; while the ECB has a mandate oriented towards price stability, national governments are elected and their preferences should reflect those of the population.

[8] In reality it is enough that the governments believe this when they move, but this would complicate the description of the game. While hypothesis 4 is different from the more commonly used Phillips curve, one can easily show that the latter would not give any incentive to the fiscal authorities to put pressure on the ECB. While this case is perfectly possible, most economists seem to believe that this pressure is a real risk.

there is no shock. The moves are as follows: first, the national market are hit by independent shocks to prices and/or to employment; second, the national governments use the fiscal lever, and finally the central bank sets the monetary policy. The structure of preferences of the agents is common knowledge, therefore the game allows for backward induction, i.e. the national governments take into account the foreseeable reaction of the central bank while setting their optimal policies.



The order of the players has been chosen to reflect both the capacity of influencing each other that is observed in real world and (as argued in the previous section) the only interesting case. In the first two years of EMU, the policy of the ECB has been attentive to both inflation and unemployment levels, while the influence of the ECB on member states was limited to speeches, with the SGP as the only binding institution. If the ECB is not uniquely committed to price stability it is reasonable to assume that, as long as the governments have some freedom in the use of fiscal policy, they can take into account a possible reaction of the ECB[9]. The order of play then reflects the relations of power among agents. A second interpretation could be that the ECB is "faster to react", in the sense that it can change policy much more frequently than the national governments; this greater flexibility allows the ECB to follow any change in fiscal policies with an appropriate response. Under this interpretation, the order of players reflects a sequence in time.

2.1 The national markets

All national markets are identical in structure, but may have different inflation and unemployment levels and different sizes. Each of them is affected by public policies in the following stylized way[10]:

[9] The SGP is a (very imprecise) way to take away such freedom from the governments.

[10] It is important to notice that no single inflation level across the union is imposed.

$$P = p_m M + p_g G + \varepsilon \quad (1)$$

$$U = -u_m M - u_g G + \eta \quad (2)$$

where P, U, M, G indicate the deviations of prices, unemployment, money supply, fiscal expenditure from target values, and ε and η are I.I.D. shocks to prices and to unemployment. The target values are common to the ECB an the national governments, but the former is less inclined to short-run output stabilization (hypothesis 3). All other letters are positive parameters.

Hypothesis 4 implies:

$$\frac{p_m}{u_m} > \frac{p_g}{u_g}$$

This condition simply states that monetary policy has a comparative advantage in controlling prices, and fiscal and monetary instruments have correctly been allocated.

2.2 The ECB

In models solvable by backward induction it is often convenient to start from the player who moves last, in this case the central bank (ECB). The reason is that the strategy of the ECB is taken into account by the governments (G), while the play of G is already known to the ECB when it moves.

The ECB runs the monetary policy for the whole union. The monetary policy is common and has symmetrical effects in all countries (given that they have identical structures).

The preferences of the ECB are defined over union aggregates:

$$L_{ECB}(M, G, \varepsilon, \eta) = [P(M, G, \varepsilon)]^2 + \beta [U(M, G, \eta)]^2 \quad (3)$$

where the variables without a subscript are the weighted average of the N participating countries:

$M = \sum_{i=1}^{N} \lambda_i M_i$

$G = \sum_{i=1}^{N} \lambda_i G_i$

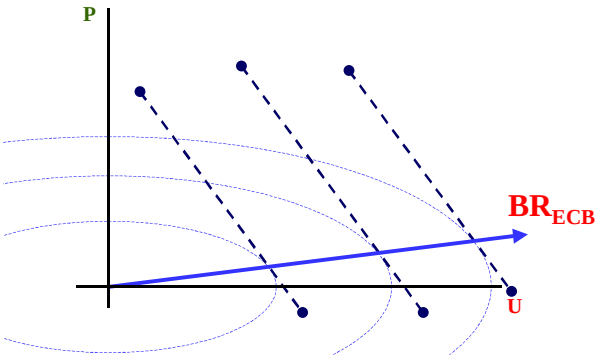
$\varepsilon = \sum_{i=1}^{N} \lambda_i \varepsilon_i$

$\eta = \sum_{i=1}^{N} \lambda_i \eta_i$

with $\sum_{i=1}^{N} \lambda_i = 1$

The parameter β expresses the relative aversion of the ECB to inflation and unemployment.

Preferences and Best Response of CB



The Best response of the ECB can be expressed as follows (see appendix):

$$M\left(G,\varepsilon,\eta\right)=-\mu_g\left(\sum_{i=1}^{N}\lambda_i G_i\right)-\mu_e\left(\sum_{i=1}^{N}\lambda_i\varepsilon_i\right)+\mu_h\left(\sum_{i=1}^{N}\lambda_i\eta_i\right)$$

Or in a condensed representation:

$$M(G,\varepsilon,\eta)=-\mu_g G-\mu_e\varepsilon+\mu_h\eta$$

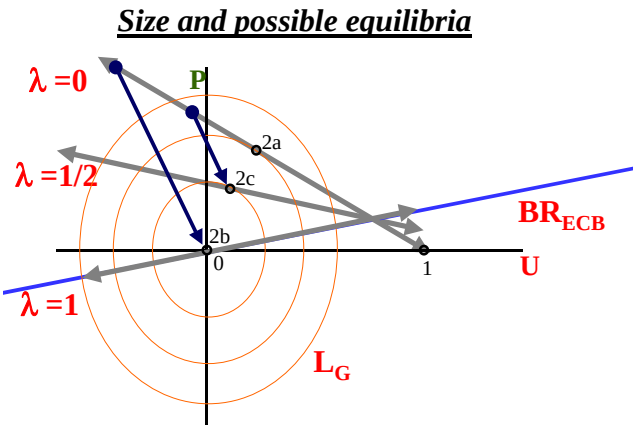
with $\mu_g=-\left[\frac{1}{p_m^2+\beta u_m^2}\right](-\beta u_m u_g-p_g p_m)$

$\mu_e=-\left[\frac{1}{p_m^2+\beta u_m^2}\right](-p_m)$

$\mu_h=+\left[\frac{1}{p_m^2+\beta u_m^2}\right]\beta u_m$ all positive.

The best strategy of the ECB is to deflate in response to an increase of expenditure by the governments (G) and to an exogenous increase of prices ε, and to support employment when a negative shock η hits it.

The term in squared brackets is the reciprocal of the responsiveness of the target variables to a policy change and determines the size of the intervention. The ECB intervenes according to the slope of its Phillips curve (u_m/p_m) and to the preferences β. Observe that when only one or some countries of weight λ_i are hit by a shock or adopt a policy change, the ECB will move proportionally from the perceived situation to its BR line. This implies that each governments faces a backward-induction "budget constraint" that does not coincide with the BR of ECB unless $\lambda_i=1$. As an example, the locus of equilibria chosen by a backward inducting government is pictured below for $\lambda=\{0,1/2,1\}$.



2.3 The governments

In this section the best response function of the national governments is calculated in the most general framework. This will lead to some cumbersome notation, but it has the advantage of encompassing all the other situations as special cases.

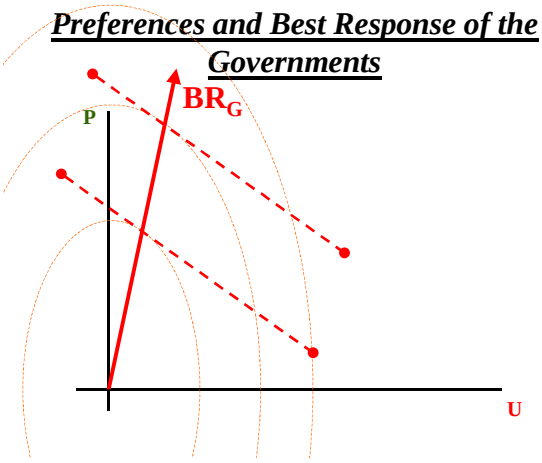
In the general situation (symmetric information) each government is not constrained in the choice of its fiscal stance and is aware of the structure of the model and of the moves of nature (the shocks in all participating countries). Thus, each government is able to form expectations about the moves of its peers and (by backward induction) about the move of the ECB[11], and acts accordingly.

The loss function of each government i is

$$L_{Gi}(M_i, G_i, \varepsilon_i, \eta_i) = [P_i(M_i, G_i, \varepsilon_i)]^2 + \alpha\,[U_i(M_i, G_i, \eta_i)]^2 \tag{4}$$

and (hypothesis 3) the government cares about unemployment more than the ECB, therefore $\alpha > \beta$.

[11] The move of ECB is the only variable of interest for the government because it affects the payoff of its strategy, while the fiscal policies of the other countries do not have direct domestic effects but only indirect externalities coming from the reaction of the ECB.



Solving the FOC for G_i (in appendix), one obtains the BR function of government i:

$$G_i\left(\eta_i,\eta_j,\varepsilon_i,\varepsilon_j,G_j\right) =$$

$$= \Omega * \left\{ \begin{array}{c} +\left[\left(-\lambda_i p_m \mu_h\right)\left(-\lambda_i p_m \mu_g + p_g\right) - \alpha\left(\lambda_i u_m \mu_g - u_g\right)\left(1 - \lambda_i u_m \mu_h\right)\right]\eta_i \\ +\left[\left(-\lambda_j p_m \mu_h\right)\left(-\lambda_i p_m \mu_g + p_g\right) - \alpha\left(\lambda_i u_m \mu_g - u_g\right)\left(-\lambda_j u_m \mu_h\right)\right]\eta_j \\ -\left[\left(1 - \lambda_i p_m \mu_e\right)\left(-\lambda_i p_m \mu_g + p_g\right) - \alpha\left(\lambda_i u_m \mu_g - u_g\right)\left(-\lambda_i u_m \mu_e\right)\right]\varepsilon_i \\ -\left[\left(-\lambda_j p_m \mu_e\right)\left(-\lambda_i p_m \mu_g + p_g\right) - \alpha\left(\lambda_i u_m \mu_g - u_g\right)\left(-\lambda_j u_m \mu_e\right)\right]\varepsilon_j \\ +\left[\left(p_m \mu_g \lambda_j\right)\left(-\lambda_i p_m \mu_g + p_g\right) + \alpha\left(\lambda_i u_m \mu_g - u_g\right)\left(-u_m \mu_g \lambda_j\right)\right] G_j \end{array} \right\}$$

with

$$\Omega = \left[\frac{1}{\left(\lambda_i u_m \mu_g - u_g\right)^2 \alpha + \left(-\lambda_i p_m \mu_g + p_g\right)^2}\right]$$

Fortunately this will be the most complicated expression in the paper. In order to grasp the intuition one has to take into account that the reaction of the ECB is automatically taken into account in the expression above, while those of the other players are not (and they explicitly appear as arguments). This difference in treatment is due to the fact that the governments move simultaneously.

One extreme case ($\alpha = 0$) is ruled out by hypotheses 2 and 3, but it is useful to consider it for the purpose of exposition. If G_i cares only about inflation (that is, if it is even more conservative than the ECB) a fiscal restriction will follow a shock to domestic or foreign unemployment because the comparatively "weak" ECB is going to allow some more inflation. The same is true after a domestic price shock only partially offset by the ECB.

A fiscal expansion follows a foreign price shock simply because the ECB restriction is not welcome.

A government uniquely concerned about the internal level of employment ($\alpha \to \infty$) always increases spending after a shock to unemployment. This reaction is somehow smoothed because the government knows that the ECB will take part of the burden of the intervention ($1 - \lambda_i u_m \mu_h$). If the shock arises in another country, the expected monetary expansion of the ECB ($-\lambda_j u_m \mu_h$) leads to fiscal consolidation. The same is true (with different signs, because the expected reaction of the ECB goes in the other direction) for a shock to prices; the ECB will restrict the quantity of money, and this calls for fiscal expansion.

This coefficient γ_g is the indirect externality reaction to the fiscal expansion of other members. In appendix it is shown that hypothesis 4 implies that this parameter can take values between 0 and 1 (not included)[12]. This conditions ensures the existence of the Subgame Perfect Equilibrium[13].

Finally, a shorter notation is introduced for the complex expenditure function of the generic government i: this function represents the BR of a government free to move, aware of the fact that the ECB will move next and informed about the shocks in all participating countries.

$$G_i = (\gamma_e \varepsilon_i + \gamma_h \eta_i) + \left(\gamma_e^f \varepsilon_j + \gamma_h^f \eta_j\right) + \gamma_g G_j \tag{5}$$

With $\gamma_e < 0, \gamma_h > 0, \gamma_e^f > 0, \gamma_h^f < 0$ and $0 < \gamma_g < 1$ under the hypotheses of the model. The sign of the coefficients is derived analytically in appendix.

3 Five possible scenarios

The proposals for coordination are of two kinds: positive coordination and negative coordination. Positive coordination consists of regular meetings in which the policy responses are coordinated on a case-by-case basis, negative coordination consists of rules laid down at the beginning and then followed throughout. By applying restrictions to the general model solved in section 2, we can analyze the following scenarios, ranked from minimal to maximal positive coordination and contrasted with negative coordination:

[12] In the game the coefficient γ_g represents the (negative) reaction of G_i to the (negative) reaction of ECB to the variation in G_j. This is sometimes referred to as "domino effect" of fiscal policies.

[13] Technically, one has a Nash Equilibium of a reduced form game between governments, with the reaction function of the ECB factored in their objective function. This corresponds to the Subgame Perfect Equilibrium of the original game.

- no coordination and autonomous fiscal policies. The fiscal authorities in the different countries are free to fit their policies to their country's specific needs, and no interaction (neither informal nor formal) is relevant;

- positive coordination via sharing of information (informal cooperation). A loose form of cooperation among fiscal authorities could take the form of periodical informal meetings. Such meetings would foster information exchange, without committing any of the participants to specific policies. The Euro-12 group seems to be a good example of such an institution;

- positive coordination through formal mechanisms. In the context of an increased cooperation, for example within a reinforced version of the BEPG (Broad Economic Policy Guidelines), one could have formal meetings in which the fiscal stance of the participating countries would be decided. The decisions taken in these meetings would then be binding for all Euro members;

- negative coordination: SGP;

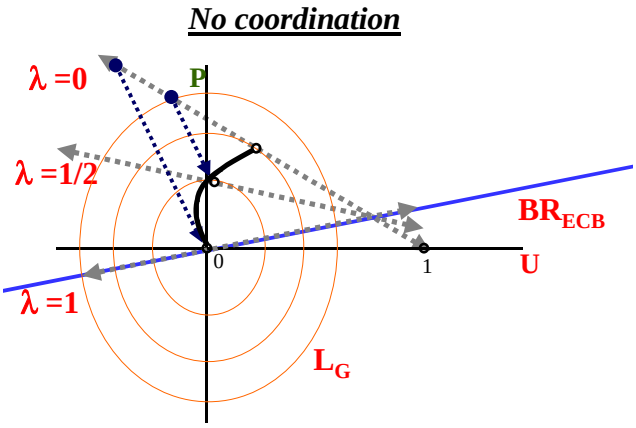
- negative coordination: an ECB-based, alternative SGP. If the ECB has to be free from pressure, it must be able to impose its preferences on the national member states. The proposal is that the "alternative SGP" should be based on the declared preferences of the Central Bank, and the member states should comply with those requirements as they do with the current SGP. Such an arrangement would bring the ECB out of its role of Stackelberg follower and allow it to neglect most of the stabilization issue.

The current framework of the EMU includes the SGP and positive informal cooperation.

3.1 No coordination

When no coordination is possible and the exchange of information is scarce, one government is not able to forecast the policies of the others.

In our model this implies that each government takes the a priori expected value of the shocks for the others, that is zero. Also, when the shocks are not known abroad, all the participating governments can only assume that the others will be inactive. This leads to a very simple behavior: each government reacts as if it was the only one hit by a shock.



An asymmetric shock with no coordination The outcome of a shock in country i when there is no coordination or exchange of information is

$$
\begin{aligned}
G_i &= (\gamma_e \varepsilon_i + \gamma_h \eta_i) \\
P_i &= p_m M\left(\lambda_i G_i, \lambda_i \varepsilon_i, \lambda_i \eta_i\right) + p_g G_i + \varepsilon_i \\
&= \left(p_g \gamma_h + p_m \mu_h \lambda_i - \lambda_i p_m \mu_g \gamma_h\right) \eta_i + \left(1 + p_g \gamma_h - p_m \mu_e \lambda_i - \lambda_i p_m \mu_g \gamma_h\right) \varepsilon_i \\
U_i &= -u_m M\left(\lambda_i G_i, \lambda_i \varepsilon_i, \lambda_i \eta_i\right) - u_g G_i + \eta_i = \\
&= \left(u_m \mu_g \lambda_i \gamma_h + 1 - u_m \mu_h \lambda_i - u_g \gamma_h\right) \eta_i + \left(u_m \mu_g \lambda_i \gamma_e - u_g \gamma_e + u_m \mu_e \lambda_i\right) \varepsilon_i \\
G_j &= 0 \\
P_j &= p_m M\left(\lambda_i G_i, \lambda_i \varepsilon_i, \lambda_i \eta_i\right) = \\
&= \left(-\lambda_i p_m \mu_g \gamma_h + p_m \mu_h \lambda_i\right) \eta_i + \left(-p_m \mu_g \lambda_i \gamma_e - p_m \mu_e \lambda_i\right) \varepsilon_i \\
U_j &= -u_m M\left(\lambda_i G_i, \lambda_i \varepsilon_i, \lambda_i \eta_i\right) = \\
&= \left(u_m \mu_g \lambda_i \gamma_h - u_m \mu_h \lambda_i\right) \eta_i + \left(u_m \mu_g \lambda_i \gamma_e + u_m \mu_e \lambda_i\right) \varepsilon_i \\
M^o &= M\left(\lambda_i G_i, \lambda_i \varepsilon_i, \lambda_i \eta_i\right) = \\
&= \left(-\mu_g \lambda_i \gamma_h + \mu_h \lambda_i\right) \eta_i + \left(-\mu_g \lambda_i \gamma_e - \mu_e \lambda_i\right) \varepsilon_i
\end{aligned}
$$

Prices and unemployment outcomes for the union are the weighted average of national values with weights λ_i and $\lambda_j = (1 - \lambda_i)$.

In case of an asymmetric shock in country i, both prices or unemployment raise after intervention of the players[14]; the solution for both $\varepsilon_i > 0, \eta_i > 0$ is, for every $\lambda \in (0, 1)$[15],

[14] The prices are totally smoothed if $\lambda_i = 1$, which can be interpreted as the one country case or a totally common shock. When $\lambda_i = 0$ the result is (trivially) zero as well.

[15] Once again $\lambda_i = 1$ and $\lambda_i = 0$ imply that the shocks have no effect on prices and unemployment.

$(P > 0, P_i > 0, P_j < 0;\ U > 0, U_j > 0;\ M^o < 0)$. One should remark that the sign is not uniquely determined for U_i. This is not surprising: the picture above shows that U_i can be either positive or negative depending on the value of λ_i. Our computer simulations show, however, that for realistic values of the parameters it takes a value of λ_i very close to 1 to have negative values[16].

3.2 Positive coordination

In its strictest definition, positive coordination implies the implementation of a fiscal policy for the EU as a whole by a collegial "decision-making body", whose decisions would be binding for all. This is the typical mode of operation of the common monetary policy in the ECB Council, and it has been suggested as a long-term objective for coordination in the framework of the "closer cooperation" clauses.

As stated before, the likely scenario for the very short term seems to be limited to a greater sharing of information in search for decisions based on consensus. This is the weakest form of positive coordination, and is analyzed first.

3.2.1 Informal cooperation

It has been proposed that cooperation could be informal, in the respect of the existing treaties that impede formal coordination among a subgroup of EU members. This informal cooperation could for example increase the sharing of information about the situation in the different countries, without reaching the point of concertation of policies[17]. In this section it will be clear that, even though the sharing of information is generally perceived to be a positive factor among economists, this need not be the case in a strategic environment.

A shock with informal cooperation The new equilibrium following a shock will be the Nash equilibrium of the reduced form game, where the BRs of the two governments intersect. The complete expression of the Nash equilibrium is reported in appendix. After

[16] In computer simulations with $p_m = 2, p_g = u_g = u_m = 1, \alpha = 1.25, \beta = 0.75$ it takes a value as big as $\lambda_i = 0.85$ to have a negative U_i as consequence of a shock in either η_i or ε_i. The biggest country in Europe is Germany, whose share in the EU GDP is only slightly above 30%.

[17] The macroeconomic data are usually collected by independent statistical agencies, and become known to the public at a later stage (ex post check). It is therefore assumed that the data are truthfully revealed to the partners.

as asymmetric shock in country i, the outcome is for country i

$$
\begin{aligned}
G_i &= \frac{(\gamma_e\varepsilon_i+\gamma_h\eta_i)+\gamma_g\left(\gamma_e^f\varepsilon_i+\gamma_h^f\eta_i\right)}{1-\gamma_g^2}\\
P_i &= \left(p_m\lambda_i\mu_h+\frac{p_g\left(\gamma_h+\gamma_g\gamma_h^f\right)-p_m\mu_g\left[\left(\lambda_i\gamma_h+\lambda_j\gamma_h^f\right)+\left(\lambda_i\gamma_h^f+\lambda_j\gamma_h\right)\gamma_g\right]}{1-\gamma_g^2}\right)\eta_i+\\
&\quad+\left(1-p_m\lambda_i\mu_e+\frac{p_g\left(\gamma_e+\gamma_g\gamma_e^f\right)-p_m\mu_g\left[\left(\lambda_i\gamma_e+\lambda_j\gamma_e^f\right)+\left(\lambda_j\gamma_e+\lambda_i\gamma_e^f\right)\gamma_g\right]}{1-\gamma_g^2}\right)\varepsilon_i\\
U_i &= \left(u_m\lambda_i\mu_e+\frac{u_m\mu_g\left[\left(\lambda_i\gamma_e+\lambda_j\gamma_e^f\right)+\left(\lambda_j\gamma_e+\lambda_i\gamma_e^f\right)\gamma_g\right]-u_g\left(\gamma_e+\gamma_g\gamma_e^f\right)}{1-\gamma_g^2}\right)\varepsilon_i\\
&\quad\left(1-u_m\lambda_i\mu_h+\frac{u_m\mu_g\left[\left(\lambda_i\gamma_h+\lambda_j\gamma_h^f\right)+\left(\lambda_i\gamma_h^f+\lambda_j\gamma_h\right)\gamma_g\right]-u_g\left(\gamma_h+\gamma_g\gamma_h^f\right)}{1-\gamma_g^2}\right)\eta_i
\end{aligned}
$$

and for country j

$$
\begin{aligned}
G_j &= \frac{\left(\gamma_e^f\varepsilon_i+\gamma_h^f\eta_i\right)+\gamma_g\left(\gamma_e\varepsilon_i+\gamma_h\eta_i\right)}{1-\gamma_g^2}\\
P_j &= \left(\frac{p_g\left(\gamma_e^f+\gamma_g\gamma_e\right)-p_m\mu_g\left[\left(\lambda_i\gamma_e+\lambda_j\gamma_e^f\right)+\left(\lambda_j\gamma_e+\lambda_i\gamma_e^f\right)\gamma_g\right]}{1-\gamma_g^2}-p_m\lambda_i\mu_e\right)\varepsilon_i+\\
&\quad\left(p_m\lambda_i\mu_h+\frac{p_g\left(\gamma_h^f+\gamma_g\gamma_h\right)-p_m\mu_g\left[\left(\lambda_i\gamma_h+\lambda_j\gamma_h^f\right)+\left(\lambda_i\gamma_h^f+\lambda_j\gamma_h\right)\gamma_g\right]}{1-\gamma_g^2}\right)\eta_i\\
U_j &= \left(\frac{u_m\mu_g\left[\left(\lambda_i\gamma_e+\lambda_j\gamma_e^f\right)+\left(\lambda_j\gamma_e+\lambda_i\gamma_e^f\right)\gamma_g\right]-u_g\left(\gamma_e^f+\gamma_g\gamma_e\right)}{1-\gamma_g^2}+u_m\lambda_i\mu_e\right)\varepsilon_i\\
&\quad+\left(\frac{u_m\mu_g\left[\left(\lambda_i\gamma_h+\lambda_j\gamma_h^f\right)+\left(\lambda_i\gamma_h^f+\lambda_j\gamma_h\right)\gamma_g\right]-u_g\left(\gamma_h^f+\gamma_g\gamma_h\right)}{1-\gamma_g^2}-u_m\lambda_i\mu_h\right)\eta_i
\end{aligned}
$$

and for the common monetary policy:

$$
\begin{aligned}
M^N &= M\left(\lambda_iG_i+\lambda_jG_j,\lambda_i\varepsilon_i,\lambda_i\eta_i\right)=\\
&= \left(-\frac{1}{1-\gamma_g^2}\left(\left(\lambda_i\gamma_h^f+\lambda_j\gamma_h\right)\gamma_g+\lambda_i\gamma_h+\lambda_j\gamma_h^f\right)\mu_g+\mu_h\lambda_i\right)\eta_i\\
&\quad+\left(-\frac{1}{1-\gamma_g^2}\left(\left(\lambda_j\gamma_e+\lambda_i\gamma_e^f\right)\gamma_g+\lambda_i\gamma_e+\lambda_j\gamma_e^f\right)\mu_g-\mu_e\lambda_i\right)\varepsilon_i
\end{aligned}
$$

This result can be compared with the one of no cooperation. In the previous case, the initial response to the shock $(\gamma_e\varepsilon+\gamma_h\eta)$ was also the final outcome. Here, the initial

shock "spreads around" through monetary externalities. First, each government is informed about the shocks occurring abroad, and keeps them into account $\left(\gamma_e^f \varepsilon_j + \gamma_h^f \eta_j\right)$; then, the reaction of the partners is also considered (square brackets). Finally, the whole numerator is multiplied by $1/\left(1-\gamma_g^2\right)$ because of the interaction of players.

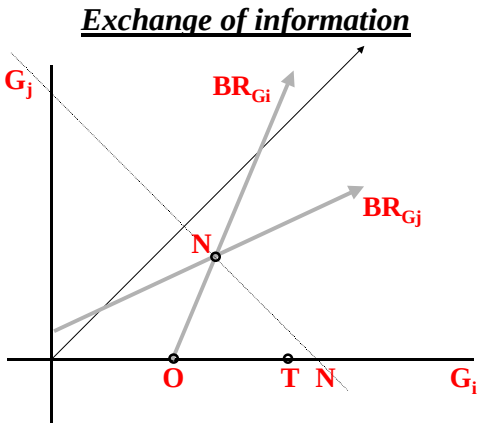
The ECB intervention can also be compared with the one of the precedent case (no exchange of information). For example, in case of an asymmetric unemployment shock in i the difference in intervention is

$$M^N - M^o = -\frac{1}{1-\gamma_g^2}\mu_g \left(\left(\lambda_i \gamma_h^f + \lambda_j \gamma_h\right)\gamma_g + \lambda_i \gamma_h \gamma_g^2 + \lambda_j \gamma_h^f\right)\eta_i$$

which can be shown to be positive for $\lambda_i \in (0,1)$ by substituting in the definitions. A similar conclusion applies to an inflation shock in i. When the different governments are aware of each other's moves but they cannot coordinate, the ECB is forced to show more activism.

The signs of the variables in equilibrium are not unique as in the first case, and depend on λ_i. Substitution in the definition leads to the following signs: for $\lambda_i \in (0,1)$ we have $\left(P_i > 0, P_j < 0;\ U_j > 0;\ M^N < M^o < 0\right)$. If the country is the smaller one, $\lambda_i \in (0,1/2)$, then $(P > 0;\ U > 0, U_i > 0)$, for bigger values of λ_i it is true that $(P < 0;\ U < 0)$. As in the previous case, U_i remains indeterminate although generally positive.

A graphic comparison The example of an asymmetric shock in country i is shown in the figure below. The difference in overall fiscal expansion can be seen on a graph (G_i, G_j) by tracing a diagonal line that reports the total expansion on the G_i axis: the distance between the quantities (O) and the point $(N)$is the increase in expenditure above the non cooperation case, which would be realized if the interaction terms (γ_g,γ_e^f and γ_h^f) were zero. The interaction between the two Gs is due to the fact that country j observes the shock in i and anticipates the ECB restriction to the fiscal expansion in i, therefore j expands in order to offset it. This in turn is anticipated by i, and the fiscal expansion is amplified, and so on. The result is an increase in expenditure both in the case of an exogenous increase in prices or unemployment.



3.2.2 Formal coordination

In the context of formal fiscal coordination, the fiscal authorities "act as if they were one", observe the average shocks to the whole union and compute the optimal policy response as if they were a single government[18]. Total coordination leads exactly to the same outcome as the one country case, where the shocks are completely smoothed at the union level. As usual, the complete characterization of the solution is in the appendix. The outcome of an asymmetric shock in country i is:

$$\begin{aligned}
G^T &= \lambda_i \left(\tilde{\gamma}_e \varepsilon_i + \tilde{\gamma}_h \eta_i\right) \\
P &= p_m M + p_g G + \lambda_i \varepsilon_i = 0 \\
U &= -u_m M - u_g G + \lambda_i \eta_i = 0 \\
G_i &= \lambda_i G^T \\
P_i &= -p_g \lambda_j \lambda_i \left(\tilde{\gamma}_e \varepsilon_i + \tilde{\gamma}_h \eta_i\right) + \lambda_j \varepsilon_i \\
U_i &= u_g \lambda_j \lambda_i \left(\tilde{\gamma}_e \varepsilon_i + \tilde{\gamma}_h \eta_i\right) + \lambda_j \eta_i \\
G_j &= \lambda_j G^T \\
P_j &= -p_g \lambda_i^2 \left(\tilde{\gamma}_e \varepsilon_i + \tilde{\gamma}_h \eta_i\right) - \lambda_i \varepsilon_i \\
U_j &= u_g \lambda_i^2 \left(\tilde{\gamma}_e \varepsilon_i + \tilde{\gamma}_h \eta_i\right) - \lambda_i \eta_i \\
M^T &= \left(-\mu_g \tilde{\gamma}_h + \mu_h\right) \lambda_i \eta_i + \left(-\mu_g \tilde{\gamma}_e - \mu_e\right) \lambda_i \varepsilon_i
\end{aligned}$$

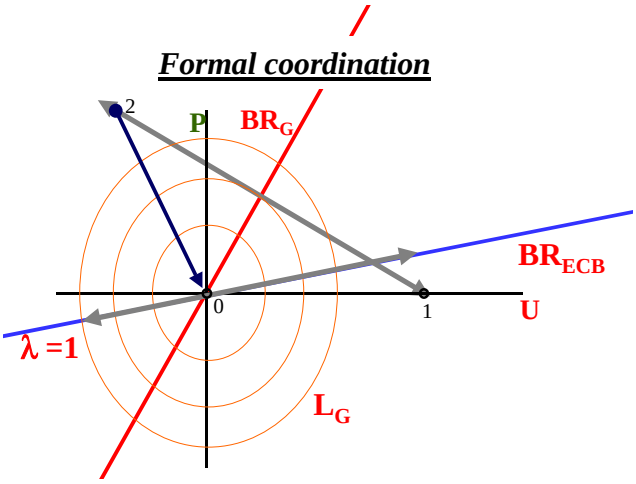
where $\tilde{\gamma}_e, \tilde{\gamma}_h$ are the closed-economy equivalents of γ_e and γ_h[19].

[18] The weights used to calculate the aggregate shocks are assumed to be the same the ECB uses when it has to compute its policy response; this assumption is not unrealistic (the weights could be the national GDPs for example) and allows for a clearer exposition, but it is in no way essential.

[19] The closed economy equivalents can be calculated by setting λ_i to unity. Their analytical expression is

Both in case of a symmetric shock or an asymmetric shock in country i, prices or unemployment remain unaltered at the aggregate level. After a price shock ($\varepsilon_i > 0$) ,for every $\lambda_i \in (0,1)$, then $\left(P = 0, P_i > 0, P_j < 0;\ U = U_i = U_j = 0;\ M^T < 0\right)$. After an increase in unemployment ($\eta_i > 0$) ,for every $\lambda_i \in (0,1)$, then $\left(P = P_i = P_j = 0;\ U = 0, U_i > 0, U_j < 0;\ M^T < 0\right)$. In both cases, the shock is partially translated to the other country, while the consequences on the other variable are zero.

The involvement of the ECB in the stabilization is of the same order of magnitude of informal cooperation. The total smoothing of disturbances is due to the fact that now the response of the ECB is completely internalized, and therefore the joint fiscal authority can decide on which point of the ECB Best Response it wants to be positioned. The following picture shows that the only point in which the BR of G and ECB intersect is the origin.



Subgame Perfect Equilibrium and Nash Equilibrium One obvious objection would be that the backward induction story is not really credible in this case, because a reinforced Eurogroup would evolve in something similar to a equal interlocutor to the ECB. As a matter of fact, when the decision about fiscal policy is taken "as if" there was a single authority, the backward induction solution always coincides with the Nash Equilibrium (NE) between Gs and ECB. In this simple game it does not make a difference whether the ECB moves last (Subgame Perfect Equilibrium) or at the same time (Nash Equilibrium), because in both cases the final outcome is total smoothing of shocks, in the only place where the two BR intersect. For the one country case (or the Eurogroup case) the "order of the moves" is irrelevant.

$\tilde{\gamma}_e = \frac{\left[-p_g\right]}{u_g^2\alpha + p_g^2}$, $\tilde{\gamma}_h = \frac{\alpha u_g}{u_g^2\alpha + p_g^2}$

3.3 Negative coordination

Negative coordination denotes commonly agreed rules to prevent fiscal policy from overburdening the monetary policy. Currently, the Stability and Growth Pact prevents the emergence of large public deficits and the resulting threat to price stability. In the following section the implemented SGP will be compared with a different one to show that it is far from being optimal, both from the point of view of stabilization and from the point of view of the ECB.

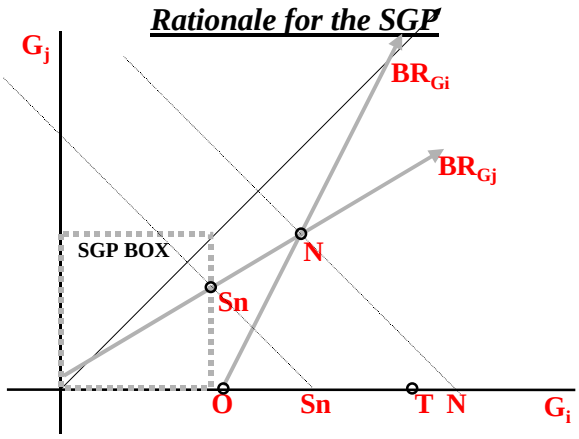
3.3.1 The "Stability and Growth Pact" (SGP)

The SGP implies that the level of fiscal expansion is bounded above by a fixed level, say by $\bar{G}$ for the whole union. When the constraint is not binding the solution is one of those described above. Given that the governments are relatively more concerned about unemployment than the ECB, the result of letting them act freely would always be a restrictive policy by ECB. The rationale of the SGP is to limit the potential involvement of ECB in short run smoothing by putting a cap on the fiscal expansion that governments are allowed to do. In the case of no cooperation[20],

$$\begin{aligned} G_i &= \min\left[\left(\gamma_e\varepsilon_i + \gamma_h\eta_i\right), \bar{G}\right] \\ G_j &= \min\left[\left(\gamma_e\varepsilon_j + \gamma_h\eta_j\right), \bar{G}\right] \\ M^S &= -\mu_g\left(\lambda_i G_i + \lambda_j G_j\right) - \mu_e\left(\lambda_i\varepsilon_i + \lambda_j\varepsilon_j\right) + \mu_h\left(\lambda_i\eta_i + \lambda_j\eta_j\right) \\ &\geq -\mu_g\bar{G} - \mu_e\left(\lambda_i\varepsilon_i + \lambda_j\varepsilon_j\right) + \mu_h\left(\lambda_i\eta_i + \lambda_j\eta_j\right) \end{aligned}$$

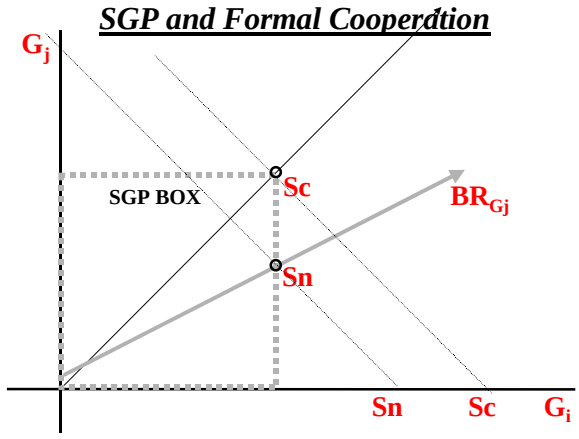
The following picture shows the rationale for the SGP. After a shock in i that leads to O, the interaction among governments would produce N as final outcome. If the SGP limits the expansion of each of them, the total fiscal expansion is limited to S_n (the maximum permitted by the Pact for country i, the BR to i for country j).

[20] The case of informal cooperation is not analytically exposed because the argument follows exactly the same line. The only difference is that the cap on the deficit is more useful because it has the additional effect of limiting the strategic escalation of deficits typical of the NE.



Interaction with positive coordination An important point to stress is that negative coordination (upper bounds to fiscal expansion, like in the SGP) becomes less effective if coupled with *formal* positive coordination. This means that the SGP could be formally maintained but would loose some of its potential should the member states move to a formalized process of fiscal coordination.

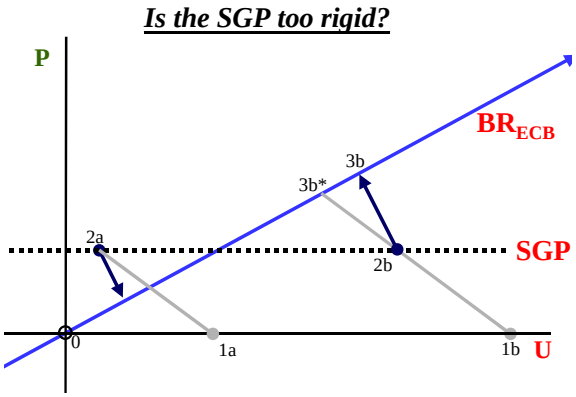
The expected value of the restriction of the SGP is a measure of the potential protection that the ECB can receive from the constraints of the Pact. In appendix it is proved that this value is lower when formal coordination is put into place. The reason is that, in absence of formal cooperation, the limit binds every country separately, while in formal coordination the pact only controls the overall quantity G^T. When the policies are commonly run, all the countries run the same (percentage) deficit, no matter what their private shock can be, and all hit the constraint at the same time or not at all. In other words, the fiscal authorities borrow from each other the unused margins of freedom.



These results are shown analytically in appendix. Here it is important to notice that

the result is extremely general: the power of a negative constraint like the SGP is always and considerably weakened when the fiscal authorities can act together ($S_c > S_n$ always). Positive formal coordination weakens de facto the existing negative coordination.

Perverse effects of the SGP The SGP could (surprisingly) also lead to a greater activism of the ECB: in the case of a big unemployment shock, the ECB could have incentives to increase the quantity of money in presence of insufficient fiscal reaction. The figure below shows that in presence of a strong disturbance in unemployment the ECB could decide to increase the quantity of money ($2b \rightarrow 3b$) because the SGP constrains the national governments. The picture also shows that the fixed cap to fiscal expenditure implemented in the SGP favors those countries which have been hit by a light disturbance over those who really would need to use the fiscal lever even according to the conservative judgement of the ECB. While the more "lucky" countries hit by a small shock are allowed to provoke "unnecessary" inflation ($2a$), those in real need are forced to wait in ($2b$) for an intervention ($2b \rightarrow 3b$) of the ECB. Such intervention cannot be given for granted, because it depends on the overall situation in the union; furthermore, it would be costly because the monetary stance has more effect on prices than on unemployment. Point ($3b$) has more inflation and more unemployment than ($3b^*$).



Given the experience of the national governments before Maastricht became binding, it is certain that the fiscal discipline imposed by the SGP contributes to limit the extent of short run interventions of the ECB. Still, it appears to be an extremely rigid device, first because it imposes arbitrary limits, and then because it has the unpleasant consequence of allowing unnecessary expansion by some while impeding the necessary intervention where this would be necessary.

3.3.2 Comparing the SGP with a "Flexible SGP"

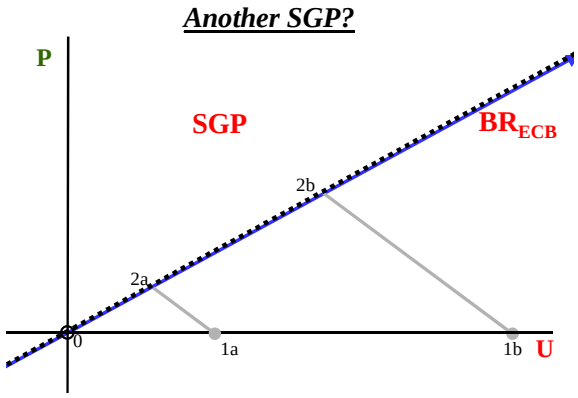
The SGP can be compared with a similar one based on different criteria. Suppose that the ECB communicates its preferences in terms of "maximum inflation allowed for each variation in unemployment" (β). Every member state is then constrained to adopt a fiscal policy that, according to the commonly agreed model, keeps the target variables within the limits announced by the Central Bank. In other words, the limit $\left(G_i = \bar{G}\right)$ on fiscal expansions is replaced by

$$\hat{G}_i \quad s.t. \quad [P_i(G_i, \varepsilon_i, \eta_i) = \beta \cdot U_i(G_i, \varepsilon_i, \eta_i)] \qquad \forall i$$

The excessive deficit procedure can be applied to non complying states exactly as in the current SGP.

The resulting policies follow directly from the setup and do not need calculations. Take as an example a shock that increases prices or unemployment. The national governments, being more prone to accommodate shocks, always use the whole discretionary margin allowed by the Pact. By doing this, they perfectly substitute the ECB in the short-run stabilization function. The ECB then does not need to react to inflationary pressures and is able to concentrate on the long run stability of prices.

From the point of view of equity, this criterion has also the advantage of allowing those countries that are hit by bigger shocks a larger margin of intervention. On the other hand, there is no monetary spillover that can possibly amplify the effects of the original shock and the responses of the governments; the propagation of shocks of the Nash Equilibrium is stopped at the first stage.



3.4 The interaction of positive and negative coordination

In the following section a simulation illustrates how elements of positive and negative coordination interact.

A monetary union of 12 countries is simulated. The countries have weights that corresponds to the GDPs of the countries that participate in the EMU. As in the theoretical part, I focus on the monetary externalities, therefore all the countries have the same structure ($p_m = 2,\ p_g = u_g = u_m = 1$) that respects the required hypothesis of allocation of instruments.

For each country and each period I create a shock to prices and one to employment. All the shocks are drawn from standardized normal distribution and they are I.I.D. A series of Monte Carlo experiments is then run in order to see which framework imposes to the ECB the bigger quantity of short term stabilizing interventions. The results are summarized in the table below where the different levels of positive coordination (rows) interact with more or less binding SGP fixed limits. For every combination the mean and variance of the fiscal activism of a country with weight 0.17 (like Italy) are reported. In the following row the activism of the ECB is described. Finally, where applicable I reported the percentage of cases in which the SGP actually constrained the fiscal policy of the country.

	No SGP		**SGP 2**		**SGP 1**	
Coordination	**Exp**	**Var**	**Exp**	**Var**	**Exp**	**Var**
None						
Fiscal	.02	.50	-.01	.50	-.08	.47
Monetary	0	0	0	0	.01	0
% cut	-		0.4%		6.7%	
Nash						
Fiscal	0	1.65	-.10	1.38	-.31	.96
Monetary	0	.50	.07	.39	.21	.24
% cut	-		3.5%		25%	
Formal						
Fiscal	-.01	.87	0	.97	-.09	.74
Monetary	0	.34	0	.37	.06	.31
% cut	-		3.2%		15.6%	

The main problem is when the ECB feels it has to intervene (to abandon its long run policy) to contrast what it perceives to be an excessive inflation of the Union. A more detailed report (on restrictive monetary policy only) is presented in the table below. The same table (in graphical form) also appears in the conclusions.

	Size of negative inteventions		
	No SGP	SGP2	SGP1
None	19	21	15
Nash	289	231	96
Formal	251	240	210

The overall size of the ECB restrictions in 1000 trials

The first observation is that the theoretical case of no-cooperation no-information produces very small fiscal responses compared to the others. In this case the SGP does not have a role, and one can see that setting the ceiling $\bar{G}$ to 2 and then to 1 changes very little the outcome.

The simulation illustrates the theoretical predictions; in absence of SGP, the fiscal expansions implies an involvement of the ECB in short-run stabilization that is not only one order of magnitude bigger than the no-cooperation case, but also bigger than the case of formal coordination. On the other hand, the SGP effectively constrains the deficit of the member countries in a way that limits the involvement of the central bank (from 289 to 96 in the right table).

The SGP becomes almost irrelevant when the countries can act as it they were one; the ceiling $\bar{G}$ limits the involvement of the ECB from 251 to 210 and cannot do better, because the fiscal authorities are now able to coordinate in a way that allows them to take full advantage of the freedom to spend left by the Pact.

4 Conclusions

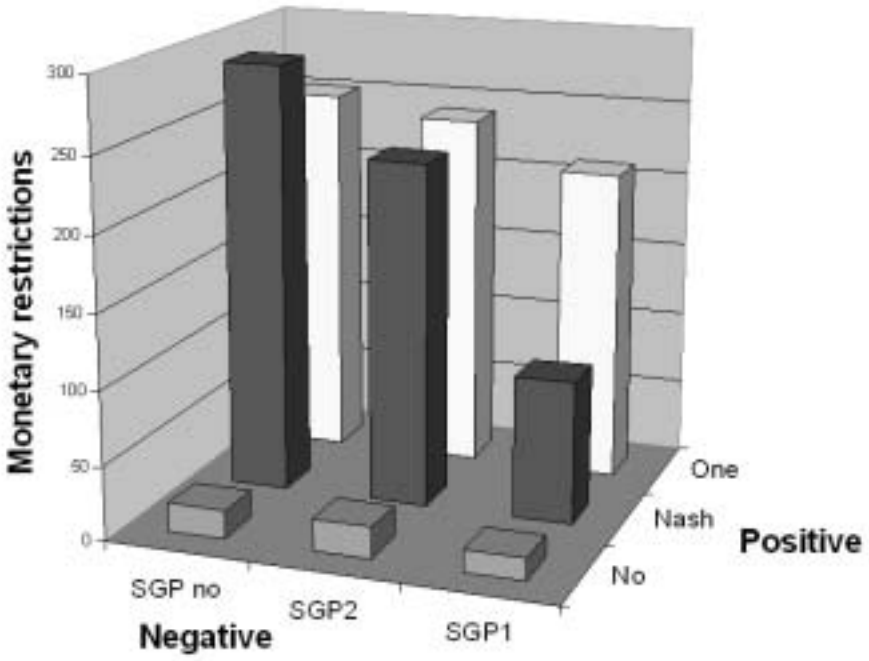
In the present paper the question of which form of fiscal coordination would imply the least stabilizing effort by the ECB has been addressed. From the analytical development of the game, it appears that two main forces enter into play:

- on the one hand, the awareness of the interplay of fiscal policies and monetary policies by the players can start quite complex interactions, that lead to the multiplication of the initial disturbances and to their propagation to the whole union through monetary externalities. Information without coordination leads to policy induced instability.
- on the other hand, a complete coordination would internalize such effects and avoid propagations, while giving back to the fiscal authorities at least one degree of freedom in fiscal policy to counteract common disturbances. The game outlined the risk that complete coordination may weaken the SGP.

- In the case of formal coordination, both the SGP and the NE imply pressure on the ECB and the complete smoothing of shocks. This result contradicts the common wisdom according to which policy coordination comprising both fiscal and monetary authorities would imply a lot of pressure on the ECB, while formal fiscal coordination alone would not.

Negative coordination is somewhat simpler, and the rules of the game are decided once and for all, therefore it is easier to apply. For these reason it has probably been chosen to ensure limited liability of the ECB in a strategic context which was not (and probably still isn't) completely understood. The simulations underline both the importance of negative coordination and the danger that an excessive positive coordination could make it ineffective; as on can observe, the SGP is effective in reducing the involvement of the ECB, *unless* the fiscal decisions are formally coordinated.

The present limits stated in the SGP seem somewhat inflexible; to the extent that the SGP is designed to limit the liability of the ECB, it should be also designed according to the preferences of the ECB itself. A simple example showed that more flexibility can be granted in such a way to obtain at the same time more stabilization and more independence of the Central Bank.



4.1 Possible extensions

The goal of the paper was to outline a very specific mechanism that may determine an unforeseen level of pressure on the ECB, along with a larger use of fiscal policy, should stronger fiscal coordination be implemented in the EMU. Many extensions of the model are possible in order to make it more realistic. The first, obvious one, would be to allow for different preferences not only on smoothing, but also on the target level of unemployment. Direct externalities of fiscal policy could be also implemented, and their effect would smooth the skeptical conclusions about positive coordination. We neglected them here for clarity of exposition and because their effect somehow adds up to the one described, without a strong interaction between the two.

Structural differences in the national markets is probably the most interesting extension. This will be the object of a forthcoming paper, in which these differences are built-in in the form of a third category of players, worker's unions.

Many other extensions have been suggested, but they are probably better dealt with in a separate paper.

5 APPENDIX

5.0.1 First order condition for the ECB

By total differentiation of the FOC derived from (3), the locus of the optimal response of the ECB is described by:

$$\left(\sum_{i=1}^{N}\lambda_i P_i\right) = -\beta\frac{\frac{\partial u}{\partial m}}{\frac{\partial p}{\partial m}}\left(\sum_{i=1}^{N}\lambda_i U_i\right) \tag{6}$$

Given that the ECB is the last player, $\frac{\partial u}{\partial m}/\frac{\partial p}{\partial m}$ is simply $\frac{-u_m}{p_m}$.

5.0.2 First order condition for government G_i

The differentiation of the first order condition

$$\begin{aligned}\left(+p_g - \lambda_i\left(p_m\mu_g\right)\right)\left[p_m M\left(G,\varepsilon,\eta\right) + p_g G_i + \varepsilon_i\right] = \\ = -\alpha\left(\lambda_i\left(u_m\mu_g\right) - u_g\right)\left(-u_m M\left(G,\varepsilon,\eta\right) - u_g G_i + \eta_i\right)\end{aligned}$$

for each of the governments leads to:

$$P_i = -\alpha\frac{\frac{\partial u_i}{\partial g_i}}{\frac{\partial p_i}{\partial g_i}}U_i \tag{7}$$

From the definitions of P,U and $M(\cdot)$, and using backward induction:

$$\begin{aligned}\frac{\partial p_i}{\partial g_i} &= \frac{\partial}{\partial g_i}\left(p_m M\left(G,\varepsilon,\eta\right)+p_g G_i+\varepsilon_i\right)=+p_g-\lambda_i p_m\mu_g\\ \frac{\partial u_i}{\partial g_i} &= \frac{\partial}{\partial g_i}\left(-u_m M\left(G,\varepsilon,\eta\right)-u_g G_i+\eta_i\right)=\lambda_i u_m\mu_g-u_g\end{aligned}$$

5.0.3 The symmetric Nash equilibrium

$$\begin{aligned}G_i &= \frac{\left(\gamma_e\varepsilon_i+\gamma_h\eta_i\right)+\left(\gamma_e^f\varepsilon_j+\gamma_h^f\eta_j\right)+\gamma_g\left[\left(\gamma_e\varepsilon_j+\gamma_h\eta_j\right)+\left(\gamma_e^f\varepsilon_i+\gamma_h^f\eta_i\right)\right]}{1-\gamma_g^2}\\ G_j &= \frac{\left(\gamma_e\varepsilon_j+\gamma_h\eta_j\right)+\left(\gamma_e^f\varepsilon_i+\gamma_h^f\eta_i\right)+\gamma_g\left[\left(\gamma_e\varepsilon_i+\gamma_h\eta_i\right)+\left(\gamma_e^f\varepsilon_j+\gamma_h^f\eta_j\right)\right]}{1-\gamma_g^2}\\ M &= M\left(\lambda_i G_i+\lambda_j G_j,\lambda_i\varepsilon_i+\lambda_j\varepsilon_j,\lambda_i\eta_i+\lambda_j\eta_j\right)=\\ &= \left(-\frac{1}{1-\gamma_g^2}\left(\left(\lambda_i\gamma_h+\lambda_j\gamma_h^f\right)\gamma_g+\lambda_i\gamma_h^f+\lambda_j\gamma_h\right)\mu_g+\mu_h\lambda_j\right)\eta_j\\ &\quad+\left(-\frac{1}{1-\gamma_g^2}\left(\left(\lambda_i\gamma_h^f+\lambda_j\gamma_h\right)\gamma_g+\lambda_i\gamma_h+\lambda_j\gamma_h^f\right)\mu_g+\mu_h\lambda_i\right)\eta_i\\ &\quad+\left(-\frac{1}{1-\gamma_g^2}\left(\left(\lambda_i\gamma_e+\lambda_j\gamma_e^f\right)\gamma_g+\lambda_j\gamma_e+\lambda_i\gamma_e^f\right)\mu_g-\mu_e\lambda_j\right)\varepsilon_j\\ &\quad+\left(-\frac{1}{1-\gamma_g^2}\left(\left(\lambda_j\gamma_e+\lambda_i\gamma_e^f\right)\gamma_g+\lambda_i\gamma_e+\lambda_j\gamma_e^f\right)\mu_g-\mu_e\lambda_i\right)\varepsilon_i\end{aligned}$$

5.0.4 Formal coordination

$$\begin{aligned}G^T &= \tilde{\gamma}_e\left(\lambda_i\varepsilon_i+\lambda_j\varepsilon_j\right)+\tilde{\gamma}_h\left(\lambda_i\eta_i+\lambda_j\eta_j\right)\\ M^T &= \left(-\mu_g\tilde{\gamma}_h+\mu_h\right)\left(\lambda_i\eta_i+\lambda_j\eta_j\right)-\left(\mu_e+\mu_g\tilde{\gamma}_e\right)\left(\lambda_i\varepsilon_i+\lambda_j\varepsilon_j\right)\\ P &= p_m M+p_g G+\left(\lambda_i\varepsilon_i+\lambda_j\varepsilon_j\right)=0\\ U &= -u_m M-u_g G+\left(\lambda_i\eta_i+\lambda_j\eta_j\right)=0\\ G_i &= \lambda_i G^T\\ P_i &= -p_g\lambda_j\left[\tilde{\gamma}_e\left(\lambda_i\varepsilon_i+\lambda_j\varepsilon_j\right)+\tilde{\gamma}_h\left(\lambda_i\eta_i+\lambda_j\eta_j\right)\right]+\varepsilon_i-\left(\lambda_i\varepsilon_i+\lambda_j\varepsilon_j\right)\\ U_i &= u_g\lambda_j\left[\tilde{\gamma}_e\left(\lambda_i\varepsilon_i+\lambda_j\varepsilon_j\right)+\tilde{\gamma}_h\left(\lambda_i\eta_i+\lambda_j\eta_j\right)\right]+\eta_i-\left(\lambda_i\eta_i+\lambda_j\eta_j\right)\\ G_j &= \lambda_j G^T\\ P_j &= -p_g\lambda_i\left[\tilde{\gamma}_e\left(\lambda_i\varepsilon_i+\lambda_j\varepsilon_j\right)+\tilde{\gamma}_h\left(\lambda_i\eta_i+\lambda_j\eta_j\right)\right]+\varepsilon_j-\left(\lambda_i\varepsilon_i+\lambda_j\varepsilon_j\right)\\ U_j &= u_g\lambda_i\left[\tilde{\gamma}_e\left(\lambda_i\varepsilon_i+\lambda_j\varepsilon_j\right)+\tilde{\gamma}_h\left(\lambda_i\eta_i+\lambda_j\eta_j\right)\right]+\eta_j-\left(\lambda_i\eta_i+\lambda_j\eta_j\right)\end{aligned}$$

5.1 Calculation of some signs

These signs are important in that they allow more complex calculations later.

Some basic identities The first equation is just a different version of the hypothesis $\frac{p_m}{u_m} > \frac{p_g}{u_g}$; when $z = 0$ the relation holds with equality, when z is positive the hypothesis is true with strict inequality. The other identities are the same seen before.

$p_m = (1+z)\, u_m \frac{p_g}{u_g}$
$\mu_g = -\left[\frac{1}{p_m^2+\beta u_m^2}\right](-\beta u_m u_g - p_g p_m)$
$\mu_e = -\left[\frac{1}{p_m^2+\beta u_m^2}\right](-p_m)$
$\mu_h = +\left[\frac{1}{p_m^2+\beta u_m^2}\right]\beta u_m$
$\lambda_j = 1 - \lambda_i$

Effect of expenditure on prices Sign $\left(-\lambda_i p_m \mu_g + p_g\right) =$
sign $-p_g \frac{\lambda_i u_g^2\beta+\lambda_i p_g^2+2\lambda_i p_g^2 z+\lambda_i z\beta u_g^2+\lambda_i p_g^2 z^2-p_g^2-2p_g^2 z-p_g^2 z^2-\beta u_g^2}{p_g^2+2p_g^2 z+p_g^2 z^2+\beta u_g^2}$.
The numerator of the fraction is $\left(\beta u_g^2 + p_g^2 + 2p_g^2 z + z\beta u_g^2 + p_g^2 z^2\right)(\lambda_i - 1)$ always negative. Therefore the coefficient is always positive.

Effect of expenditure on unemployment Sign $\left(\lambda_i u_m \mu_g - u_g\right) =$
sign $-u_g \frac{-\lambda_i u_g^2\beta-\lambda_i p_g^2-\lambda_i p_g^2 z+p_g^2+2p_g^2 z+p_g^2 z^2+\beta u_g^2}{p_g^2+2p_g^2 z+p_g^2 z^2+\beta u_g^2}$.
The numerator is equal to $(1-\lambda_i)\left(u_g^2\beta + p_g^2 + p_g^2 z\right) + p_g^2 z + p_g^2 z^2$ always positive. Therefore the coefficient is negative

A shock to unemployment less the intervention of the ECB Sign $(1 - \lambda_i u_m \mu_h) =$
$(1-\lambda_i)\beta u_g^2 + p_g^2 + 2p_g^2 z + p_g^2 z^2$ is always positive.

A shock to prices less the intervention of the ECB Sign $(1 - \lambda_i p_m \mu_e) =$
sign $-\frac{-p_g^2-2p_g^2 z-p_g^2 z^2-\beta u_g^2+\lambda_i p_g^2+2\lambda_i p_g^2 z+\lambda_i p_g^2 z^2}{p_g^2+2p_g^2 z+p_g^2 z^2+\beta u_g^2}$.
The numerator of the fraction is $\left(p_g^2 + 2p_g^2 z + p_g^2 z^2\right)(\lambda_i - 1) - \beta u_g^2$ always negative. Therefore the coefficient is always positive.

5.2 Coefficients of government reaction function when the allocation of instruments is indifferent

$$G_i = (\gamma_e \varepsilon_i + \gamma_h \eta_i) + \left(\gamma_e^f \varepsilon_j + \gamma_h^f \eta_j\right) + \gamma_g G_j$$

Sign of the coefficient of η_i : the parameter is always positive
Sign $\left(-\lambda_i p_m \mu_h\right)\left(-\lambda_i p_m \mu_g + p_g\right) - \alpha\left(\lambda_i u_m \mu_g - u_g\right)(1 - \lambda_i u_m \mu_h)$
$=$ sign $-\left(-\lambda_i p_g^2\beta + p_g^2\alpha - \alpha\lambda_i u_g^2\beta + \alpha\beta u_g^2\right)(-1+\lambda_i)\frac{u_g}{p_g^2+\beta u_g^2}$
Knowing that

$\left(-\lambda_i p_g^2\beta + p_g^2\alpha - \alpha\lambda_i u_g^2\beta + \alpha\beta u_g^2\right) = (1-\lambda_i)\,\alpha\beta u_g^2 + p_g^2\,(\alpha - \lambda_i\beta) > 0$ is true, the whole parameter is positive.

Sign of the coefficient of η_j : the parameter is always negative

$\left(-\lambda_j p_m\mu_h\right)\left(-\lambda_i p_m\mu_g + p_g\right) - \alpha\left(\lambda_i u_m\mu_g - u_g\right)\left(-\lambda_j u_m\mu_h\right) =$

$\left(p_g^2 + \alpha u_g^2\right)(\lambda_i - 1)\,\beta u_g \frac{\lambda_j}{p_g^2+\beta u_g^2} < 0$ always.

Sign of the coefficient of ε_i: the sign of the coefficient of $\varepsilon_i$depends on the size of the expected reaction of the ECB to the shock ε_i, that is on λ_i. When the size of the country is small enough the sign is negative.

Sign $-\left[(1-\lambda_i p_m\mu_e)\left(-\lambda_i p_m\mu_g + p_g\right) - \alpha\left(\lambda_i u_m\mu_g - u_g\right)\left(-\lambda_i u_m\mu_e\right)\right] =$

sign $-\left(-p_g^2 - \beta u_g^2 + \lambda_i p_g^2 + \alpha\lambda_i u_g^2\right)(-1+\lambda_i)\frac{p_g}{p_g^2+\beta u_g^2} =$

sign $\left(-p_g^2 - \beta u_g^2 + \lambda_i p_g^2 + \alpha\lambda_i u_g^2\right) = \left(p_g^2 + \alpha u_g^2\right)\lambda_i - \left(p_g^2 + \beta u_g^2\right)$

negative when λ_i is small enough (unless λ_i is very close to one).

Sign of the coefficient of ε_j: the parameter is always positive

$-\left[\left(-\lambda_j p_m\mu_e\right)\left(-\lambda_i p_m\mu_g + p_g\right) - \alpha\left(\lambda_i u_m\mu_g - u_g\right)\left(-\lambda_j u_m\mu_e\right)\right] =$

$= -\left(p_g^2 + \alpha u_g^2\right)(\lambda_i - 1)\,p_g\frac{\lambda_j}{p_g^2+\beta u_g^2} > 0$ always positive.

Sign of the coefficient of G_j: the parameter is always positive

Sign $+\left[\left(p_m\mu_g\lambda_j\right)\left(-\lambda_i p_m\mu_g + p_g\right) + \alpha\left(\lambda_i u_m\mu_g - u_g\right)\left(-u_m\mu_g\lambda_j\right)\right] =$

$= -\left(p_g^2 + \alpha u_g^2\right)(\lambda_i - 1)\,\lambda_j > 0$ always positive

The coefficient of G_j is less than one if $z > 0$. The coefficient of G_j is less than one if and only if the expression below is negative:

$$\left[\left(p_m\mu_g\lambda_j\right)\left(-\lambda_i p_m\mu_g + p_g\right) + \alpha\left(\lambda_i u_m\mu_g - u_g\right)\left(-u_m\mu_g\lambda_j\right)\right]$$
$$-\left(\left(\lambda_i u_m\mu_g - u_g\right)^2\alpha + \left(-\lambda_i p_m\mu_g + p_g\right)^2\right)$$

The lambdas sum up to one, so the expression can be rewritten as

$\left(-\left(\lambda_i u_m\mu_g - u_g\right)\left(u_m\mu_g - u_g\right)\right)\alpha + \left(-\lambda_i p_m\mu_g + p_g\right)\left(p_m\mu_g - p_g\right)$

or

$\left(\lambda_i\beta u_g^2 + \lambda_i p_g^2 + \lambda_i z p_g^2 - p_g^2 - 2zp_g^2 - z^2 p_g^2 - \beta u_g^2\right) zp_g^2\,(1+z)\,\frac{\alpha u_g^2 + p_g^2}{\left(p_g^2 + 2zp_g^2 + z^2 p_g^2 + \beta u_g^2\right)^2}$

When the zeta is zero (the condition on instruments holds only with equality) the whole expression is zero and the coefficient is exactly one. No NE exists.

When zeta is positive, then the relevant term for the sign is

$\left(\lambda_i\beta u_g^2 + \lambda_i p_g^2 + \lambda_i z p_g^2 - p_g^2 - 2zp_g^2 - z^2 p_g^2 - \beta u_g^2\right) =$

$-z^2 p_g^2 + \left(-2p_g^2 + \lambda_i p_g^2\right) z + \left(\beta u_g^2 + p_g^2\right)(\lambda_i - 1)$

this part has negative sign. Therefore the coefficient is strictly less than one, and the NE exists in the case of positive informal cooperation.

5.3 Positive formal coordination weakens the SGP

This appendix shows that negative coordination (upper bounds to fiscal expansion, like in the SGP) becomes less effective if coupled with formal positive coordination.

Suppose the union-wide limit to the deficit is $\bar{G}$, and call the actual deficits G_i and G_j.The density function of (G_i, G_j) is $f(G_i, G_j)$.

In absence of formal cooperation (no cooperation or simple exchange of information) the limit binds every country separately, therefore the national caps are $\left(\lambda_i \bar{G}, \lambda_j \bar{G}\right)$. The restriction imputable to the operation of the SGP is

$\left(G_i - \lambda_i \bar{G}\right)$ if $G_i > \lambda_i \bar{G}$

$\left(G_j - \lambda_j \bar{G}\right)$ if $G_j > \lambda_j \bar{G}$

When there is formal coordination, the pact only controls the overall quantity G^T. This can be seen by observing that in formal coordination $G_i = \lambda_i G^T$ and $G_j = \lambda_j G^T$ always, therefore when $G^T \leq \bar{G}$ it is also verified that $G_i \leq \lambda_i \bar{G}$ and $G_j \leq \lambda_j \bar{G}$.

The restriction imputable to the operation of the SGP is then

$\left(G_i + G_j - \bar{G}\right)$ if $G_i + G_j \leq \bar{G}$.

The expected value of the restriction of the SGP is a measure of the potential protection that the ECB can receive from the constraints of the Pact. This value is lower when formal coordination is put into place.

To show this, the space (G_i, G_j) is partitioned in

$C = \left\{(G_i, G_j) : G_i + G_j \leq \bar{G}\right\}$,

$A = \left\{(G_i, G_j) : G_i > \lambda_i \bar{G}\right\}$,

$B = \left\{(G_i, G_j) : G_j > \lambda_j \bar{G}\right\}$

$D = A \setminus C$

$E = C \setminus B$

$F = A \cup B$

$G = C \setminus A$

$H = B \setminus C$

Then the expected value of the restriction imposed by the Pact is

$$\begin{aligned}
E_{No}\left(G_i+G_j-\bar{G}\right) &= \int_{D\cup E\cup F}\left(G_i-\lambda_i\bar{G}\right)\cdot f()dG_idG_j \\
&\quad +\int_{F\cup G\cup H}\left(G_j-\lambda_j\bar{G}\right)\cdot f()dG_idG_j \\
E_{Formal}\left(G_i+G_j-\bar{G}\right) &= \int_{E\cup F\cup G}\left(G_i+G_j-\bar{G}\right)\cdot f()dG_idG_j \\
&= \int_{E\cup F\cup G}\left[\left(G_i-\lambda_i\bar{G}\right)+\left(G_j-\lambda_j\bar{G}\right)\right]\cdot f()dG_idG_j \\
E_{No}-E_{Formal} &= \int_{D}\left(G_i-\lambda_i\bar{G}\right)\cdot f()dG_idG_j+\int_{H}\left(G_j-\lambda_j\bar{G}\right)\cdot f()dG_idG_j \\
&\quad -\int_{E}\left(G_j-\lambda_j\bar{G}\right)\cdot f()dG_idG_j-\int_{G}\left(G_i-\lambda_i\bar{G}\right)\cdot f()dG_idG_j
\end{aligned}$$

All integrals in the last expression are positive, excepted those defined over E and G and the one defined over F which is zero. Then the sum is always positive.

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