Structural reforms and budget deficits in a monetary union: a strategic approach*

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Abstract

This paper explores the interrelations between the implementation of structural reforms and the determination of budget deficits in a monetary union where both policies generate externalities. We characterize a set of rules that achieves the social optimum by penalizing deficits and the non-implementation of reforms. We also consider a scenario where member countries collectively decide their fiscal policies, once structural reforms have been implemented and the realizations of the shocks have been observed**.** We show that this regime can turn out to be counterproductive if countries fail to extend this coordination to the implementation of structural reforms.

Keywords: Structural reforms, Budget deficits,Externalities, Coordination.

1 Introduction

The creation of the European Monetary Union (EMU) has sparked a lively debate on how community institutions should be designed so that they can provide macroeconomic stability

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and stimulate economic growth in the euro zone. Two aspects of this debate have received a great deal of attention due to their special relevance. On the one hand, the convenience of adopting rules that help discipline the fiscal policies implemented by the member states. On the other hand, the design of the right incentives that governments in the union should face so that they implement a sufficient level of structural reforms that make their economies more dynamic and competitive.

The need for coordinating fiscal policies in the EMU was highlighted in the Delors Report (1989), which considered it as a prerequisite for a successful monetary integration. Then, after the commitments reached in the Maastricht Treaty (1991), this political process culminated with the signing of the Stability and Growth Pact (SGP) at the Council of Amsterdam in 1997. This agreement represents the operational response of EU countries to the quest for fiscal coordination in the euro area. It contemplates the possibility of imposing sanctions to the member states whose budget deficits are considered "excessive".

The European Commission has highlighted the need of having an institution as the SGP arguing that when one member country incurs a fiscal deficit it makes the other partners worse-off[1]. The existence of such "negative externalities" has found support in a active line of investigation (see, for instance, Artis and Winkler, 1998; Beetsma and Uhlig, 1999; Casella, 1999; Chalk and Tanzi, 2002; Beestma and Jensen, 2003; and Fatás and Mihow, 2003). First, it has been argued that when one member country's deficit increases interest rates go up in the whole EMU, which will lower investment in the area[2] and, therefore, economic growth. On the other hand, since these fiscal imbalances increase the stock of public debt, they can give rise to a sustainability problem. In this scenario, the monetary authorities would come under political pressure to monetize the debt, which could erode the monetary authorities's credibility for fighting inflation[3].

[1] As HM Treasury (2004) has pointed out if the cost of unsustainable fiscal policies fall entirely within the country that carries them out, they need not be the concern of area-wide rules. However, they can have adverse spillovers in a monetary union and become a concern for other countries.

[2] Jurgen Stark (2001, p. 79), one of the fathers of the SGP, wrote: 'The state's absorption of resources which would otherwise have found their way into private investments results in higher long-term interest rates'.

[3] Germany was a great supporter of the SGP fearing that, without the existence of such a fiscal institution, the incipient monetary institution could not live up to the anti-inflation credibility enjoyed by the Bundesbank (Hancke, 2003).

On the other hand, the fundamental criticism received by the SGP is based on the claim that this institution hampers the national fiscal authorities's ability to stabilize their economies in the face of adverse shocks (see, for instance, Bovenberg *et al.*, 1991; Bayoumi and Eichengreen, 1995; Dornbusch, 1997; Engwerda *et al.*, 2002; De Grauwe, 2003; Enderlein, 2004; and Solow, 2004).

The existence of deep differences in opinion on the relative importance attached to the pros and cons of the pact has not helped build a wide consensus on the desirability of this fiscal institution. On the contrary, the SGP has been a source of political frictions among signing countries. A recent instance of such tensions has taken place after Germany and France escaped the sanctions contemplated under the SGP for incurring an excessive budget deficit. This event created a precedent that damaged the credibility of the rules embedded in the pact. As a consequence, a process of redesign of the pact took place which materialized in the decisions made by the European council at its spring meeting on 22 and 23 March 2005. The council agreed to fundamental changes to the SGP which made the pact's rules more flexible. To wit, even if a country's budget deficit is in violation of the 3 percent rule, the new arrangement allows a wide range of reasons why the member state in question will not be held responsible[4]. This new approach has been criticized (see, for example, Hefeker, 2005; or the Deutsche Bundesbank's Monthly Report of April 2005) on the grounds that it is based on country-specific provisions which make the rules more complex and will result in increasing scope for discretion in their application. In the Bundesbank's view the new rules severely weaken the SGP since they diminish both the incentives to pursue a sound budgetary policy and the binding impact of the rules. By differentiating among countries, the pact will become less transparent, more complex and, therefore, ultimately even more difficult to enforce.

As for the second aspect of the debate on the community institutions referred to above, a wide consensus has emerged on the need to implement structural reforms if the union is to

[4] At a special meeting on 20 March 2005, the Ecofin Council adopted a report to the Heads of State or of Government entitled "Improving the implementation of the Stability and Growth Pact". This document was approved by the European Council at its spring meeting celebrated in Brussels on 22 and 23 March 2005. The only matter that is undecided is the technical implementation of the decisions within the fiscal framework.

achieve the goal stated in the Lisbon Council (2000). Namely, to be the most competitive and dynamic economy in the world[5]. The importance of structural reforms underlies the widespread perception that EMU economies have underperformed in the recent past in comparison with the contemporaneous performance of the United States[6]. It it widely accepted that, since structural reforms eliminate market rigidities and correct market failures, they increase the flexibility of the economy, enhance its resilience against economic shocks and ultimately result in a higher long-term growth potential (see, for example, Trichet, 2004).

The aim of our paper is to explore how such reforms are affected by the way in which national fiscal policies are carried out by member states. With the purpose of focusing on the strategic aspects involved, we have made adopted a game-theoretic approach.

The interrelations between fiscal policy and the implementation of structural reforms, important though they are, have not been considered in the literature. To the best of our knowledge, the only exception is the work of Beetsma and Debrun (2004a). They consider a government with electoral uncertainty which has to choose the level of structural reforms when it faces fiscal restrictions. They show that, insofar as the government is more concerned about the present than the future and reforms give rise to future benefits but present costs, a fiscal pact can help mitigate the deficit bias that arises in this kind of environments. However, this outcome is achieved at the expense of a suboptimal level of structural reforms.

However, our approach differs from the one adopted in this paper mainly in two respects. On the one hand, our analysis is not developed in a closed economy model. On the contrary, we adopt an open economy framework where the externalities generated by fiscal and reforms policies play a key role. On the other hand, in our work governments have the social preferences (i.e., they are benevolent) which implies that they are not concerned about reelection.

[5] In recognition of the importance of this monitoring, the Lisbon Council mandated the development of a set of comprehensive structural indicators to underpin analysis. Subsequent European Councils at Goteborg, Stockholm and Barcelona have developed and refined the initial set of indicators. To embrace the economic reform agenda there are indicators to cover six broad areas: general economic background, employment, innovation and research, economic reform, social cohesion and environment.

[6] In this respect, the International Monetary Fund (2004) has estimated that if the labor markets in Europe were as flexible as the ones in the US, the European GNP would be 10 percent greater.

In this context, we show that, when fiscal and structural reforms policies are not determined in a cooperative way, budget deficits are excessive from the social welfare point of view and the level of reforms is suboptimally low. Under these circumstances we characterize a set of rules that penalize deficits and the non-implementation of reforms in such a way that the efficient outcome is achieved. However, credibility is a requirement for these arrangements to internalize the externalities involved. Therefore, since the realism of this prerequisite is not supported by recent evidence within the EMU, we then consider an alternative setting where this kind of rules are non-existent or, which is equivalent, cannot be enforced.

In this scenario, and given the emphasis that the European Commission has been putting on the need for strengthening the coordination of fiscal policies among member states, we analyze the case where budgetary objectives are not determined by rigid rules but through cooperative agreements that take account of the structural reforms and the realizations of the shocks. This kind of coordination could be achieved by means of the decisions made within a strengthened Euro Group[7]. However, we show that this type of *ad hoc* coordination, reduces the incentives to implement structural reforms, which may render fiscal cooperation counterproductive. That is, welfare in the member countries could worsen in comparison with the scenario where budget deficits are decided at the national level. This result emphasizes the need to extend policy coordination to the design of structural reforms[8].

The rest of the paper is organized as follows. Section 2 presents the model. Section 3 is devoted to the results. Section 4 concludes. Computations not included in the text are gathered in the Appendix.

[7] The Eurogroup, which had its inaugural meeting in Luxembourg on 5 June 1998, is a subset of ECOFIN. It is made up of finance ministers of the euro states and acts as a forum for coordination within the euro zone.

[8] In this sense, Almunia (2004), European Commissioner for Economic and Financial Affairs has stated: 'it is very clear that we need to coordinate more our actions on structural reforms and our efforts to implement the Lisbon agenda. It is also clear that we cannot rely exclusively on one instrument, the Stability and Growth Pact, to coordinate our economic policies'.

2 The Model

We consider a monetary union, say the EMU, which is made up of two countries $(i = 1, 2)$[9]. The government in each country has the social preferences represented by the following loss function:

$$L_i^S = \sigma \left(\left(\widetilde{\phi} - \phi_i \right) x - d_i \right)^2 + (\alpha d_i + \beta d_j)^2 + \delta \left(\phi_i \right)^2, \tag{1}$$

where $i, j = 1, 2$; $i \neq j$; $\sigma, \widetilde{\phi}, \alpha, \beta > 0$; $\alpha \geq \beta$.

We begin by explaining the first term of expression (1). Country i's economy has an initial level of rigidity inherited from the past, $\widetilde{\phi}$. However, the greater the level of structural reforms implemented in the period of analysis, ϕ_i, the lower the final level of economic rigidity, $\widetilde{\phi} - \phi_i$; and, therefore, the lesser the impact which a common adverse shock , $x > 0$, will have on output and employment[10], $\left(\widetilde{\phi} - \phi_i \right) x$. On the other hand, once governments have carried out their structural reforms and the realization of the shock is observed, they can make use of the budget deficit, d_i, to stabilize the economies[11]. Therefore, to sum up, the first term in (1) represents the reduction in social welfare caused by economic fluctuations[12].

The second term of the loss function in (1) refers to the negative effects that own and foreign deficits have on social welfare. We assume that the social cost of own country's deficit is no lower that the other country's $(\alpha \geq \beta)$. First, when the public sector incurs indebtedness, it

[9] For simplicity, we confine the analysis to a two-country version, but a generalization to more countries is relatively straightforward.

[10] The case where $x < 0$ will not be considered in the paper since, in such scenario governments would have fiscal superavits. This case is not relevant for analyzing the attempts to coordinate fiscal policies within the EMU, since they have never been aimed at preventing superavits in public finances but excessive deficits.

[11] For this purpose, two types of fiscal instruments are available. Namely, the automatic stabilizers, designed prior to the realization of the shock, and the discretional measures implemented after the disturbance is known. It is widely accepted that the countercyclical effect of the automatic stabilizers has an empirical support. However, the stabilizing role of the discretionary component of fiscal policy has generated an active debate. At this respect, see Hemming *et al.* (2002) for a survey of the empirical and theoretical literature on this topic.

[12] An alternative interpretation of this term is as follows. When there is an economic downturn it would be optimal for the private sector to borrow incurring "an individual deficit". However, as Badwin and Wyplosz (2003) pointed out, since in this scenario the financial institutions find it riskier to lend money to a person than to the government, it would be necessary that the latter incurs deficit in its budget. In doing so it would act as a kind of "banker" of the citizens.

passes a financial burden to future generations without their approval. Second, when the deficit increases, it causes interest rates to rise at home and abroad[13], lowering investment and economic growth on the whole currency area. Third, the greater the budget deficit the greater the stock of public debt and the higher the risk of facing a sustainability problem. If this problem arose, the monetary authorities would come under political pressure to monetize the debt, which would erode their anti-inflationary credibility.

The third term of (1) represents the costs associated to the implementations of structural reforms. Some studies have highlighted the existence of such costs on the following grounds (see, for instance Sibert, 1999; and Sibert and Sutherland, 2000). First, the uncertainty associated to the future implementation of reforms is an obstacle which prevents firms and consumers from making efficient decisions. Second, changes in tax laws modify the way in which accountancy is put into practice giving rise to "menu costs". Finally, reforms can cause an undesirable income redistribution and lobbies will struggle to protect their status quo. Notice that the positive parameters σ and δ are, respectively, the weights that the government puts on the costs of output variability and reforms (relative to the costs generated by deficits).

We model the interactions between fiscal and reforms policies by considering a multi-stage game. The sequence of events is as follows:

1) Governments decide the levels of reforms (ϕ_i).

2) Nature chooses the realization of the shock (x).

3) Fiscal authorities determine the budget deficits (d_i).

Notice that, in the timing, the determination of reforms comes before the selection of the budgets deficits. This is in accordance with the fact that the implementation of reforms is a much more irreversible process than the determination of the fiscal variables. As a result, budget deficits can be adjusted more easily in the face of economic shocks.

Throughout the paper, different equilibria will be obtained and evaluated making use of

[13] This reasoning assumes that the Ricardian Equivalence does not hold. In this sense, it is well known that this hypothesis is based on many restrictive assumptions. Therefore, it is no surprise that this postulate has not received considerable empirical support (see, for example, Bernheim, 1989; Seater, 1993; Kandil, 2001; and Brunila, 2002).

quadratic loss functions as the one in (1), which are standard in the literature on international policy coordination (Obstfeld and Rogoff, 1996, chapter 9). On the other hand, Dixit and Lambertini (2003 a,b) and Woodford (2003, chapter 6) have shown that this type of objective functions builds on microeconomic foundations, since they can be obtained starting from the utility function of a representative agent[14].

This paper considers two different types of coordination, which have been labeled in this literature as *ex-ante* coordination and *ex-post* coordination (see for instance Beetsma *et al.*, 2001). The former, refers to the case where the economic authorities set rules prior to having observed the realizations of the shocks. The SGP in its initial version would had fallen within this category if the fines it contemplated would had been applied to countries whose deficits exceeded the reference level specified in the agreement. If this had been the case, this fiscal institution would had been a credible commitment determined prior to stage 1 (stage 0). By contrast, cooperation ex-post is *ad-hoc* and takes place on the basis of the current state of affairs, that is, taking into account previous decisions and the realization of the shock. In our context, this kind of coordination develops in the third stage. The Eurogroup can be viewed as a vehicle for implementing this regime[15].

Finally, in order to focus on the strategic aspects of the problem we set aside its dynamic elements[16]. In addition, as stated by Agell *et al.* (1996), if the Ricardian Equivalence is not satisfied, the government intertemporal budget constraint is not relevant. Alternatively, they argue that this restriction is not binding in the short run and, therefore, the strategies of the

[14] In addition, the former vice-president of the FED, Alan Blinder (1998), has pointed out that policymakers employ their instruments in such a way that only "small" variations in the economic variables take place and for this type of changes any convex objective function is approximately quadratic.

[15] France has been the main proponent of a strong role for this forum, which some view as the key instrument by which France hopes to regain the share of political power over monetary affairs abdicated to Germany prior to the creation of EMU. Many have noted that France appears to regard the Eurogroup as an "embryonic" economic government for Europe (Mcnamara and Meunier, 2002).

[16] As Beetsma and Debrun (2004b) have pointed out, a strand of the literature, makes abstraction of the dynamic aspects related to the government intertemporal budget restriction with the aim of concentrating its attention on the strategic aspects of monetary and fiscal policies (see, for instance, Agell *et al.*, 1996; Dixit, 2001; and Dixit and Lambertini, 2001; 2003a,b).

players involved can be modelled by a multi-stage game as the one outlined above.

3 The Results

We begin by analyzing the determination of budget deficits and structural reforms when both types of policy decisions are determined at the national level. Then, we compare this regime with the benchmark case where a benevolent social planner sets reforms and deficits in both countries (efficient outcome). Next, we characterize a commitment technology that leads to the implementation of the social optimum in a decentralized way. Finally, considering the scenario in which such mechanism is unfeasible in practice -and, therefore, lacks credibility- we study two alternative regimes. In the first one, fiscal authorities of both countries carry out a fiscal coordination *ex-post*. In the second scenario, countries collectively determine the level of their structural reforms.

3.1 Sovereign policies on budget deficits and structural reforms

In this subsection we consider the regime where decisions on budget deficits and structural reforms belong to the national level. This non-cooperative behavior is modeled by making use of the concept of subgame perfect equilibrium. Therefore, we apply backward induction to the game outlined in section 2.

In the last stage, once the level of structural reforms and the realization of the shocks are known, each government selects the size of its budget deficit with the aim of minimizing its country's social loss, taking its counterpart's as given. Formally, each government faces the following problem:

$$\underset{\{d_i\}}{Min} \quad \sigma \left(\left(\widetilde{\phi} - \phi_i \right) x - d_i \right)^2 + (\alpha d_i + \beta d_j)^2 + \delta \left(\phi_i \right)^2,$$

where $i, j = 1, 2;\ i \neq j$.

From the first-order condition, we obtain the reaction function of the fiscal authorities in each country:

$$d_i = \frac{\sigma x \left(\widetilde{\phi} - \phi_i \right) - \alpha \beta d_j}{\sigma + \alpha^2}. \tag{2}$$

It is worth emphasizing a consequence of expression (2). Namely, when a country raises the level of structural reforms it becomes less vulnerable to adverse shocks. Therefore, when such an event occurs its government's incentive to incur indebtedness is reduced which lowers the level of negative fiscal externalities. In this sense, structural reforms generate positive externalities.

Now, solving simultaneously the reaction functions of the fiscal authorities yields the following Nash equilibrium:

$$d_i = \frac{\sigma\left(\left(\sigma+\alpha^2\right)\left(\widetilde{\phi}-\phi_i\right)-\alpha\beta\left(\widetilde{\phi}-\phi_j\right)\right)x}{\left(\sigma+\alpha^2\right)^2-\alpha^2\beta^2}. \tag{3}$$

Finally, in the first stage, bearing in mind expression (3) and prior to knowing the realization of the shock, governments implement structural reforms without cooperation. That is, the government in country i minimizes the expected value of its country's social loss. Analytically, it solves:

$$\begin{array}{ll} \underset{\{\phi_i\}}{Min} & E\left[\sigma\left(\left(\widetilde{\phi}-\phi_i\right)x-d_i\right)^2+\left(\alpha d_i+\beta d_j\right)^2+\delta\left(\phi_i\right)^2\right] \\ s.t. & d_i=\frac{\sigma\left(\left(\sigma+\alpha^2\right)\left(\widetilde{\phi}-\phi_i\right)-\alpha\beta\left(\widetilde{\phi}-\phi_j\right)\right)x}{\left(\sigma+\alpha^2\right)^2-\alpha^2\beta^2}, \end{array}$$

which implies that the resulting Nash equilibrium is:

$$\phi_i = \frac{\widetilde{\phi}}{1+\frac{\delta(\sigma+\alpha^2-\alpha\beta)(\sigma+\alpha^2+\alpha\beta)^2}{(\alpha+\beta)(\alpha^2+\sigma)\left(\sigma+\alpha^2-\beta^2\right)\sigma E(x^2)\alpha}} > 0. \tag{4}$$

Notice that the equilibrium level of structural reforms do not reach its ceiling $\left(\phi_i < \widetilde{\phi}\right)$ since we have that the denominator of (4) is positive. Therefore, reforms are insufficient to completely eliminate the output variability caused by adverse shocks. On the other hand, taking into account structural reforms (expression (4)), budget deficits will be (substituting (4) into (3)):

$$d_i = \frac{\sigma\left(\left(\sigma+\alpha^2\right)^2-\alpha^2\beta^2\right)\delta\widetilde{\phi}x}{\alpha\sigma E\left(x^2\right)\left(\alpha+\beta\right)\left(\alpha^2+\sigma\right)\left(\sigma+\alpha^2-\beta^2\right)+\delta\left(\sigma+\alpha^2-\alpha\beta\right)\left(\sigma+\alpha^2+\alpha\beta\right)^2} > 0. \tag{5}$$

In order to analyze the optimality of this outcome, we need to determine the levels of structural reforms and budget deficits which would be selected by a benevolent social planner. With this aim, we begin by solving the last stage of this ideal scenario. That is, at the end of the game and knowing the values of the structural reforms and the realization of the shock, the planner would choose the level of the deficits so as to minimize the joint social loss. Formally

the problem faced by this supranational authority would be:

$$\underset{\{d_1,d_2\}}{Min} \quad \sum_{i\neq j}\sigma\left(\left(\widetilde{\phi}-\phi_i\right)x-d_i\right)^2+\left(\alpha d_i+\beta d_j\right)^2+\delta\left(\phi_i\right)^2.$$

The solution yields:

$$d_i=\frac{\sigma\left(\left(\alpha^2+\beta^2+\sigma\right)\left(\widetilde{\phi}-\phi_i\right)-2\alpha\beta\left(\widetilde{\phi}-\phi_j\right)\right)x}{\sigma\left(2\alpha^2+2\beta^2+\sigma\right)+\left(\alpha^2-\beta^2\right)^2}. \tag{6}$$

Now, in the first stage the planner would determine the level of reforms that would minimize the expected joint social loss, bearing in mind (6). Namely, the problem to be solved would be:

$$\begin{array}{ll}\underset{\{\phi_1,\phi_2\}}{Min} & E\left[\sum_{i\neq j}\sigma\left(\left(\widetilde{\phi}-\phi_i\right)x-d_i\right)^2+\left(\alpha d_i+\beta d_j\right)^2+\delta\left(\phi_i\right)^2\right] \\ s.t. & d_i=\frac{\sigma\left(\left(\alpha^2+\beta^2+\sigma\right)\left(\widetilde{\phi}-\phi_i\right)-2\alpha\beta\left(\widetilde{\phi}-\phi_j\right)\right)x}{\sigma\left(2\beta^2+\sigma+2\alpha^2\right)+\left(\alpha^2-\beta^2\right)^2},\end{array}$$

whose result is[17]:

$$\phi_i^o=\frac{\widetilde{\phi}}{1+\frac{\left(\sigma+(\alpha+\beta)^2\right)\delta}{(\alpha+\beta)^2\sigma E(x^2)}}>0. \tag{7}$$

Substituting (7) into (6) we obtain the efficient levels for deficits:

$$d_i^o=\frac{\sigma\delta\widetilde{\phi}x}{E\left(x^2\right)\sigma\left(\alpha+\beta\right)^2+\left(\sigma+\left(\alpha+\beta\right)^2\right)\delta}>0. \tag{8}$$

Result 1: *When decisions on fiscal policy and structural reforms are made at the national level, budget deficits are suboptimally high and the level of reforms is suboptimally low.*

Proof: See Appendix.

The intuition behind this result is as follows. When a policymaker in one country acts without taking into account the other country's welfare the externalities generated by their policy actions cannot be internalized. Therefore, since the budget deficits create negative externalities the absence of cooperation in this field implies that deficits will be excessive from a social welfare point of view. By the same token, the positive sign of the externalities generated by structural reforms will lead to a suboptimally low level of such reforms.

[17] The superscript "o" appearing in (7) and (8) stands for "optimum". On the other hand, notice that since the denominator of (7) is positive then $\phi_i^o<\widetilde{\phi}$. That is, it is not optimal to completely eliminate the rigidity of the economy since that would be too costly for society.

3.2 Optimal commitment technology

We now analyze an scenario in which such externalities are internalized by a coordination *ex-ante*. This type of cooperation is based on agreements among countries that determine a set of "rules of the game". This institutional framework creates the right incentives so that the efficient outcome is achieved, even though national policies are determined in a non-cooperative fashion.

In order to determine such a commitment technology[18], we continue to assume that the sequence of events is the one described in section 2, with the only exception that we now introduce a new stage at the very beginning of the game. In such a "stage 0" (that comes before stage 1) an international principal sets some penalizations on budget deficits (t) and on the non-implementation of reforms (g). More precisely, the objective function of each government becomes:

$$L_i^S = \sigma\left(\left(\widetilde{\phi}-\phi_i\right)x-d_i\right)^2+\left(\alpha d_i+\beta d_j\right)^2+\delta\left(\phi_i\right)^2+t\left(d_i\right)^2+g\left(\widetilde{\phi}-\phi_i\right)^2.$$

Applying backward induction to this enlarged game we obtain the following proposition:

Proposition 1: *When policies are decided at the national level, the efficient outcome is achieved if the penalization rates on deficits and on the non-implementation of structural reforms are, respectively,* $t=\beta\left(\alpha+\beta\right)$ *and* $g=\frac{\beta^2(\alpha+\beta)\sigma^2E\left(x^2\right)\alpha}{\left(\sigma+\beta^2+\alpha^2\right)\left(\sigma+(\alpha+\beta)^2\right)^2}$.

Proof: See Appendix.

Therefore, it would be optimal for the European Commission to apply rules that influence the course of fiscal policy and the implementation of structural reforms. However, in the case of the EMU, it could be argued that the enforcement of such rules is not credible given the absence of a full-fledged political union. In fact, the final decision on the actions to be taken

[18] The rationalizations of macroeconomic institutions have been most usually based on the existence of a time-inconsistency problem in monetary policy. However, other arguments for providing institutional solutions are the need for coordinating: a) economic policies among countries (Persson and Tabellini, 1995; and Jensen, 2000); and b) monetary and fiscal policy within one economic area (Agell *et al.*, 1996; Beetsma and Bovenberg, 1997; Debrun, 2000; and Dixit and Lambertini, 2003a).

against countries which renege on commitments ultimately depends on councils, some of whose components are representatives of the sovereign states that did not honored the agreements. Therefore, such rules would be more credible if their enforcement were assigned to the European Commission or some independent committee. As a result, in the subsequent subsections we explore other settings in which this kind of rules aimed at achieving a cooperation *ex-ante*, even if they exist, lack credibility which implies that they are not operative.

3.3 Fiscal coordination ex-post

We now consider the case where fiscal cooperation takes place without setting rigid rules as the ones implied by the SGP in its initial version. On the contrary, we assume that this coordination occurs *ex-post,* that is, in the last stage of the game. In that moment, structural reforms have been implemented and the realizations of the shocks have been observed. In the context of the EMU this kind of coordination could be achieved by means of a strengthened Euro Group.

In this case, and considering that cooperation is not extended to the implementation of structural reforms, when deciding the level of such reforms each governments solves in the first stage (bearing in mind (3)):

$$\begin{array}{ll} \underset{\{\phi_i\}}{Min} & E\left[\sigma\left(\left(\widetilde{\phi}-\phi_i\right)x-d_i\right)^2+\left(\alpha d_i+\beta d_j\right)^2+\delta\left(\phi_i\right)^2\right] \\ s.t. & d_i=\frac{\sigma\left(\left(\alpha^2+\beta^2+\sigma\right)\left(\widetilde{\phi}-\phi_i\right)-2\alpha\beta\left(\widetilde{\phi}-\phi_j\right)\right)x}{\sigma\left(2\beta^2+\sigma+2\alpha^2\right)+\left(\alpha^2-\beta^2\right)^2}. \end{array}$$

The solutions yields:

$$\phi_i=\frac{\widetilde{\phi}}{1+\frac{\delta\left(\sigma+(\alpha-\beta)^2\right)\left(\sigma+(\alpha+\beta)^2\right)}{\sigma E(x^2)(\beta+\alpha)\left(\alpha^3-\beta\alpha^2+\sigma\alpha-\beta^2\alpha+\beta^3\right)}}>0. \tag{9}$$

As a consequence, in the third stage budget deficits will take the following value (substituting (9) into (3)):

$$d_i=\frac{\sigma\delta\widetilde{\phi}\left((\alpha-\beta)^2+\sigma\right)x}{\sigma E\left(x^2\right)(\alpha+\beta)\left((\alpha+\beta)(\alpha-\beta)^2+\alpha\sigma\right)+\delta\left(\sigma+(\alpha+\beta)^2\right)\left(\sigma+(\alpha-\beta)^2\right)}>0. \tag{10}$$

Result 2: *In the regime of fiscal coordination ex-post the levels of reforms and budget deficits are, respectively, lower and greater than in the social optimum.*

Proof: See Appendix.

The intuitive explanation of this result is as follows. The only difference between the regime of fiscal cooperation *ex-post* and the one which achieves the social optimum is the way in which the first stage is played. That is, in the former scenario structural reforms are determined in a non-cooperative fashion whereas in the latter such reforms are implemented with cooperation. For this reason, only the former regime will fail to internalize the externalities generated by reforms. As a consequence, since these spillovers are positive, in the regime of fiscal cooperation *ex-post* the level of reforms will be lower than in the social optimum. This means that in the former scenario the level of rigidity of the economy will be higher making it more vulnerable to adverse shocks. That is, if a disturbance creates an economic downturn, the need to incur a budget deficit will be greater in the case in which cooperation is only achieved in the last stage.

Now we compare the regime of fiscal coordination *ex-post* with the scenario where all players act in a non-cooperative fashion.

Result 3: *In the regime of fiscal coordination ex-post, budget deficits and the levels of structural reforms are lower than in the scenario where both policies are determined at the national level.*

Proof: See Appendix.

We obtain this conclusion because the two regimes referred to in Result 3 just differ in the way the last stage develops. That is, when governments forecast that there will be fiscal cooperation in that stage they will realize that deficits will be lower -with the aim of internalizing the negative externalities- than when such cooperation is nonexistent. Therefore, in the former scenario there is less need to carry out costly structural reforms that mitigate the undesirable externalities of budget deficits.

To end up this subsection we present the following proposition which questions the convenience of the regime in which cooperation is carried out just in the last stage of the game:

Proposition 2: *Implementing fiscal coordination ex-post can be counterproductive.*

Proof: See Appendix.

Result 3 and the expression for society's objective function in (1) help understand why we obtain Proposition 2. To wit, comparing the case of fiscal coordination *ex-post* with the scenario in which no stage develops in a cooperative fashion, the former regime has two advantages and one drawback. As for the pros, on the one hand, since in the former case deficits are lower their negative effect on welfare is smaller (second term, $(\alpha d_i + \beta d_j)^2$, in (1)); and, on the other hand, the fact that the structural reforms are implemented to a lesser extent in the cooperation *ex-post* scenario implies that the cost of carrying them out is reduced (third term, $\delta (\phi_i)^2$, in (1)). However, this regime has a clear-cut disadvantage. Namely, output is stabilized to a lesser degree (first term, $(\sigma \left(\left(\widetilde{\phi} - \phi_i \right) x - d_i \right)^2$, in (1)). The reason is twofold: first, the level of reforms is lower, which makes the economies more vulnerable to adverse shocks; and second, deficits are lower, which reduces the anticyclical role of fiscal policy. Therefore the drawback associated to the regime of coordination *ex-post* can more than offset its advantages.

3.4 Cooperative implementation of structural reforms

Finally, in this subsection, we consider a context where countries's coordination efforts are concentrated only on structural reforms policy. In this respect, Eichengreen and Wyplosz (1998), Eichengreen (2004) and Pichelmann and Roeger (2004) consider that trying to coordinate fiscal policies is a nuisance since it deviates attention from the most important challenge of the European authorities, namely, coordinating their structural reforms policies[19].

This setting implies, in our framework, that only the first stage develops in a cooperative fashion. Therefore, the problem faced by governments in that stage is:

$$\begin{array}{ll} \underset{\{\phi_1,\phi_2\}}{Min} & E\left[\sum_{i\neq j}\sigma\left(\left(\widetilde{\phi}-\phi_i\right)x-d_i\right)^2+(\alpha d_i+\beta d_j)^2+\delta\left(\phi_i\right)^2\right] \\ s.t. & d_i=\frac{\sigma\left(\left(\sigma+\alpha^2\right)\left(\widetilde{\phi}-\phi_i\right)-\alpha\beta\left(\widetilde{\phi}-\phi_j\right)\right)x}{\left(\sigma+\alpha^2\right)^2-\alpha^2\beta^2}, \end{array}$$

[19] Notwithstanding the progress made in the Amsterdam Council (1999), the main responsibility for carrying out reforms in capital, labor and products markets still lies with the member states. At present, structural policy coordination only relies on the exchange of best practices and on peer pressure.

whose solution is:

$$\phi_i = \frac{\widetilde{\phi}}{1 + \frac{\delta(\sigma+\alpha^2+\alpha\beta)^2}{\sigma E(x^2)(\beta+\alpha)^2(\alpha^2+\sigma)}}. \tag{11}$$

As a consequence substituting (11) into (3) deficits are:

$$d_i = \frac{\sigma\delta\widetilde{\phi}x}{\sigma E\left(x^2\right)\left(\alpha+\beta\right)^2 \frac{\alpha^2+\sigma}{\sigma+\alpha^2+\alpha\beta} + \left(\sigma+\alpha^2+\alpha\beta\right)\delta}. \tag{12}$$

Result 4: *When cooperation applies just to the implementation of structural reforms, not only such reforms but also budget deficits are suboptimally high.*

Proof: See Appendix.

The intuition behind this result is as follows. The social optimum can be interpreted as the regime in which cooperation occurs in the first and final stages of the game. Therefore, if such cooperation does not apply to the last stage, fiscal authorities will not internalize the negative externalities of deficits which, as a result, will be suboptimally high. In this context, if governments collectively determine structural reforms they will aim at creating the appropriate incentives so that this fiscal imbalances are reduced. This will be achieved by implementing a high level of reforms, which will increase beyond the social optimum.

Now we compare the regime in which cooperation only applies to reforms with the scenario where all the stages of the game develop in a non-cooperative way.

Result 5: *Comparing the regime where structural reforms are collectively implemented but fiscal policies are determined at the national level with the scenario in which both policies are determined in a non-cooperative fashion, in the former, social welfare and the level of reforms are higher but budget deficits are lower.*

Proof: See Appendix.

The explanation why we obtain this result is as follows. To begin with, note that since in both regimes the last stage develops in the same (non-cooperative) way, in the case where

structural reforms are collectively implemented, choosing the level of such reforms corresponding to the other scenario is an available option. However, since structural reforms generate positive externalities, their complete internalization in the cooperative regime implies that their level -and, therefore, welfare- will be higher than in the case where reforms are decided at the national level. This higher level of reforms makes economies less rigid and, as a consequence, more resilient to adverse disturbances. Therefore, when such shocks take place the need for making use of budget deficits as a means of stabilizing the economy is less important and, as a result, fiscal imbalances will be smaller. However, social welfare would improve even more if cooperation applied not only to the design of reforms but also to the implementation of fiscal policies since, in this scenario, all the externalities involved would be internalized.

4 Conclusions

The formation of the EMU have prompted a deep interest among academics and practitioners in how fiscal community institutions should be designed so that the negative externalities generated by budget deficits in the member countries are reduced without undermining the stabilizing role of fiscal policy. On the other hand, a wide consensus has emerged on the need to implement to structural reforms if the economies of the union are to increase their competitiveness and dynamism in line with the goals set by the Lisbon Council (2000).

The aim of this paper has been to explore the interrelations between the implementation of structural reforms and determination of fiscal polices in the context of the EMU. With this purpose it has made use of game theory in order to focus on the strategic aspects involved.

In a setup in which budget deficits and structural reforms are decided on a national level, we have characterized a set of rules that achieve the social optimum by penalizing member countries' fiscal imbalances and the non-implementation of their reforms. However, the recent experience of France and Germany which, in spite of not having abided by the pact have not been fined, shows that the enforcement of this type of *ex-ante* coordination is not warranted. Therefore, the credibility of the rules that made up such kind of commitments cannot be taken for granted.

This empirical evidence have led us to consider an alternative setting where fiscal rules are non-existent or, which is equivalent, they do not represent a credible commitment. In this context and bearing in mind the emphasis put by the European Commission on the need to somehow coordinate fiscal policies in the union we have studied a regime where member countries determine their budget deficits by cooperating *ex-post*, that is, taking into account the level of reforms previously implemented and the shocks hitting the economy. In practice, the institution through which this kind of "ad hoc" cooperation would be achieved is the Euro Group. In this sense, we have shown that if fiscal policy is collectively determined in this way and this coordination does not extend to the implementation of structural reforms, incentives to carry out such reforms will decrease. As a result fiscal cooperation *ex-post* can turn out to be counterproductive. That is, social welfare could be lower than in the scenario where deficits

are determined at the national level.

Finally, the search of technologies that guarantee that cooperative commitments are fully met by all member countries is an important challenge which faces the union. However, there is an important aspect that should not be overlooked. To wit, the dangers associated to a coordination which just focuses on the determination of budget deficits. In this sense, this study have shown that this collective action can be counterproductive if member countries fail to extend it to the implementation of structural reforms.

5 Appendix

Proof of Result 1

To begin with, as far the structural reforms are concerned, computing the difference between the denominators in equations (4) and (7) one finds:

$$\frac{\left(\sigma\left(\sigma+2\alpha^2+\alpha\beta\right)+\alpha\left(\alpha+\beta\right)\left(\alpha^2+\beta^2\right)\right)\delta\beta}{\alpha E\left(x^2\right)\left(\alpha+\beta\right)^2\left(\alpha^2+\sigma\right)\left(\sigma+\alpha^2-\beta^2\right)}. \tag{13}$$

The positive sign of expression (13) implies that, when fiscal and structural reforms policies are determined at the national level, the level of such reforms is suboptimally low.

In order to compare budget deficit in both scenarios we rearrange (5) in this way:

$$d_i=\frac{\sigma\delta\widetilde{\phi}x}{\frac{\alpha\sigma E(x^2)(\beta+\alpha)(\alpha^2+\sigma)\left(\sigma+\alpha^2-\beta^2\right)+\delta(\sigma+\alpha^2-\alpha\beta)(\sigma+\alpha^2+\alpha\beta)^2}{\left(\sigma^2+2\sigma\alpha^2+\alpha^4-\alpha^2\beta^2\right)}}. \tag{14}$$

Now, substracting the denominator of (14) from the one in (8) yields:

$$\frac{\left(\delta\left(\sigma+\alpha^2+\alpha\beta\right)\left(\sigma+\alpha^2-\alpha\beta\right)+E\left(x^2\right)\sigma\left(\alpha^4-\alpha^2\beta^2+2\sigma\alpha^2+\sigma\beta\alpha+\sigma^2\right)\right)\beta\left(\alpha+\beta\right)}{\left(\sigma+\alpha^2\right)^2-\alpha^2\beta^2}. \tag{15}$$

Since expression (15) is positive, we conclude that, when decisions on fiscal policies and reforms are decided at a national level, deficits are suboptimally high. ∎

Proof of Proposition 1

In the last stage, each government solves:

$$\underset{\{d_i\}}{Min}\quad \sigma\left(\left(\widetilde{\phi}-\phi_i\right)x-d_i\right)^2+\left(\alpha d_i+\beta d_j\right)^2+\delta\left(\phi_i\right)^2+t\left(d_i\right)^2+g\left(\widetilde{\phi}-\phi_i\right)^2,$$

which yields the following Nash equilibrium:

$$d_i = \frac{\sigma\left(\left(\sigma+\alpha^2+t\right)\left(\widetilde{\phi}-\phi_i\right)-\alpha\beta\left(\widetilde{\phi}-\phi_j\right)\right)x}{\left(\sigma+\alpha^2\right)^2-\left(\alpha\beta\right)^2+t\left(t+2\sigma+2\alpha^2\right)}. \tag{16}$$

Now, since in the first stage reforms will be optimal (expression (7)) the budget deficit will be (substituting (7) into (16)):

$$d_i = \frac{\sigma\left(\sigma+\left(\alpha+\beta\right)^2\right)\delta\widetilde{\phi}x}{\left(\sigma+\alpha^2+t+\alpha\beta\right)\left(\left(\alpha+\beta\right)^2\sigma E\left(x^2\right)+\left(\sigma+\left(\alpha+\beta\right)^2\right)\delta\right)}. \tag{17}$$

Therefore, for deficits are to achieve optimal levels, their "penalizing rate" (t) must be such that the following condition holds (from (8) and (17)):

$$\frac{\sigma\delta\widetilde{\phi}z}{E\left(x^2\right)\sigma\left(\alpha+\beta\right)^2+\left(\sigma+\left(\alpha+\beta\right)^2\right)\delta} = \frac{\sigma\left(\sigma+\left(\alpha+\beta\right)^2\right)\delta\widetilde{\phi}z}{\left(\sigma+\alpha^2+t+\alpha\beta\right)\left(\left(\alpha+\beta\right)^2\sigma E\left(x^2\right)+\left(\sigma+\left(\alpha+\beta\right)^2\right)\delta\right)},$$

whose solution is:

$$t = \beta\left(\alpha+\beta\right). \tag{18}$$

This is precisely the value of t referred to in Proposition 1.

As a consequence, in the first stage, each government faces the following problem:

$$\underset{\{\phi_i\}}{Min} \quad E\left[\sigma\left(\left(\widetilde{\phi}-\phi_i\right)x-d_i\right)^2+\left(\alpha d_i+\beta d_j\right)^2+\delta\left(\phi_i\right)^2+t\left(d_i\right)^2+g\left(\widetilde{\phi}-\phi_i\right)^2\right]$$

$$s.t. \qquad \begin{cases} d_i = \frac{\sigma\left(\left(\sigma+\alpha^2+t\right)\left(\widetilde{\phi}-\phi_i\right)-\alpha\beta\left(\widetilde{\phi}-\phi_j\right)\right)x}{\left(\sigma+\alpha^2\right)^2-\left(\alpha\beta\right)^2+t\left(t+2\sigma+2\alpha^2\right)}, \\ t = \beta\left(\alpha+\beta\right), \end{cases}$$

whose solution leads to the Nash equilibrium:

$$\phi_i = \frac{\widetilde{\phi}}{1+\frac{\delta\left(\beta^2+\alpha^2+\sigma\right)\left(\left(\alpha+\beta\right)^2+\sigma\right)^2}{E\left(x^2\right)\sigma\left(\beta+\alpha\right)Z_1+g\left(\beta^2+\alpha^2+\sigma\right)\left(\left(\alpha+\beta\right)^2+\sigma\right)^2}}, \tag{19}$$

where:

$$Z_1 = \left(\beta^2+\alpha^2\right)\left(\beta+\alpha\right)^3+\sigma\left(\sigma\left(\beta+\alpha\right)+\beta\left(2\beta^2+3\beta\alpha+4\alpha^2\right)+2\alpha^3\right).$$

Therefore, the "penalization rate" g must satisfy (equating (19) and (7)):

$$\frac{\widetilde{\phi}}{1+\frac{\widetilde{\phi}}{1+\frac{\delta\left(\beta^2+\alpha^2+\sigma\right)\left(\left(\alpha+\beta\right)^2+\sigma\right)^2}{E\left(x^2\right)\sigma\left(\beta+\alpha\right)Z_1+g\left(\beta^2+\alpha^2+\sigma\right)\left(\left(\alpha+\beta\right)^2+\sigma\right)^2}}} = \frac{\widetilde{\phi}}{1+\frac{\left(\sigma+\left(\alpha+\beta\right)^2\right)\delta}{\left(\alpha+\beta\right)^2\sigma E\left(x^2\right)}},$$

whose solution is:

$$g = \frac{\beta^2 (\alpha + \beta) \sigma^2 E\left(x^2\right) \alpha}{\left(\sigma + \beta^2 + \alpha^2\right) \left(\sigma + (\alpha + \beta)^2\right)^2}. \tag{20}$$

This is precisely the value of g appearing in Proposition 1. ∎

Proof of Result 2

First, we show that the cooperation fiscal *ex-post* implies that structural reforms are sub-optimally low. The reason is that the difference between the denominator in (9) and (7) is the following positive expression:

$$\frac{\beta \left(\sigma + \beta^2 + 2\alpha\beta + \alpha^2\right) \delta}{E\left(x^2\right) (\beta + \alpha)^2 \left((\beta + \alpha) (\alpha - \beta)^2 + \sigma\alpha\right)}. \tag{21}$$

Second, in order to prove that in this regime deficits are suboptimally high we rewrite expression (10) as:

$$d_i = \frac{\sigma\delta\widetilde{\phi}x}{\frac{\sigma E(x^2)(\alpha+\beta)\left((\alpha+\beta)(\alpha-\beta)^2+\alpha\sigma\right)+\delta\left(\sigma+(\alpha+\beta)^2\right)\left(\sigma+(\alpha-\beta)^2\right)}{\left((\alpha-\beta)^2+\sigma\right)}}. \tag{22}$$

Thus, subtracting the denominator in (22) from the one in (8) one finds:

$$\frac{\sigma^2 E\left(x^2\right) \beta (\alpha + \beta)}{\sigma + (\alpha - \beta)^2}. \tag{23}$$

Since (23) is positive, in the regime of fiscal cooperation *ex-post* deficits are suboptimally high. ∎

Proof of Result 3

First, in the regime of fiscal cooperation *ex-post* the levels of structural reforms are lower than in the scenario where both policies are determined at the national level since, substracting the denominator of (4) from the one in (9) , one finds the following positive expression:

$$\frac{\left(\sigma \left(\sigma (2\alpha - \beta) + 2\alpha (2\alpha + \beta) (\alpha - \beta)\right) + \alpha \left(\alpha^2 - \beta^2\right) \left(\alpha (2\alpha - \beta) + \beta^2\right)\right) \delta\beta^2}{\alpha E\left(x^2\right) (\alpha + \beta) \left(\alpha^2 + \sigma\right) \left(\sigma + \alpha^2 - \beta^2\right) \left((\alpha + \beta) (\beta - \alpha)^2 + \alpha\sigma\right)}. \tag{24}$$

Second, in the former regime deficits are lower since the difference between the denominators in (22) and (14) is the following positive amount:

$$\frac{\beta\left(\delta\left(\alpha+\beta\right)\left(\sigma+\alpha^{2}+\alpha\beta\right)\left(\sigma+\alpha^{2}-\alpha\beta\right)\left(\left(\alpha-\beta\right)^{2}+\sigma\right)+E\left(x^{2}\right)\sigma\left(\alpha+\beta\right)Z_{2}\right)}{\left(\sigma+\alpha^{2}+\alpha\beta\right)\left(\sigma+\alpha^{2}-\alpha\beta\right)\left(\left(\alpha-\beta\right)^{2}+\sigma\right)}, \tag{25}$$

where $Z_{2}=\alpha^{2}\left(\alpha+\beta\right)\left(\alpha-\beta\right)^{3}+\sigma\left(\alpha\left(2\alpha+\beta\right)\left(\alpha-\beta\right)^{2}+\sigma\left(\alpha^{2}-\alpha\beta+\beta^{2}\right)\right)$. ∎

Proof of Proposition 2

The following example proves that this proposition holds. For the case where $\sigma=\beta=\delta=1$ y $\alpha=2$, the difference between the expected values of country i's social loss with coordination *ex-post* (obtained by substituting (9) and (10) into (1)) and without any coordination (calculated by plugging (9) and (10) into (1)) is:

$$\frac{36\left(15z+7\right)\widetilde{\phi}^{2}z\left(225z+287\right)-9\left(185z+238\right)\widetilde{\phi}^{2}z\left(25z+42\right)-325\widetilde{\phi}^{2}z^{2}\left(307+240z\right)}{25\left(3z+4\right)^{2}\left(40z+49\right)^{2}}, \tag{26}$$

where $z=E\left(x^{2}\right)$. The fact that expression (26) is positive when $z>7.438$ implies that the cooperation *ex-post* can be counterproductive. ∎

Proof of Result 4

First, when cooperation applies just to the implementation of structural reforms such reforms are suboptimally high since, substracting the denominator in (11) from the one in (7) , we obtain this positive expression:

$$\frac{\delta\beta^{2}}{E\left(x^{2}\right)\left(\alpha+\beta\right)^{2}\left(\alpha^{2}+\sigma\right)}. \tag{27}$$

Second, in this regime budget deficits are excessive from the social welfare point of view, since the denominator in (8) exceeds the one in (12) by the following amount:

$$\frac{\beta\left(\delta\beta^{2}\alpha+E\left(x^{2}\right)\sigma\beta^{2}\alpha+\sigma\delta\beta+2\delta\beta\alpha^{2}+2\sigma E\left(x^{2}\right)\beta\alpha^{2}+\delta\sigma\alpha+\delta\alpha^{3}+E\left(x^{2}\right)\sigma\alpha^{3}\right)}{\sigma+\alpha^{2}+\alpha\beta}, \tag{28}$$

and expression (28) is positive. ∎

Proof of Result 5

To begin with, when structural reforms are collectively determined their level is higher than in the scenario where both policies are determined at the national level. This is so because the difference between the denominator in (4) and (11) is the following positive expression:

$$\frac{\beta\delta\left(\sigma+\alpha^2+\alpha\beta\right)^2}{\left(\alpha+\beta\right)^2\left(\sigma+\alpha^2\right)\left(\sigma+\alpha^2-\beta^2\right)E\left(x^2\right)\alpha}. \tag{29}$$

Now, deficits in the former regime are lower since, subtracting the denominator of (14) from the one in (12) , one finds this function of the parameters:

$$\frac{\beta\left(\sigma\beta+\alpha^2\beta+\sigma\alpha+\alpha^3\right)\sigma^2E\left(x^2\right)}{\left(\sigma+\alpha^2+\alpha\beta\right)\left(\sigma+\alpha^2-\alpha\beta\right)}, \tag{30}$$

which is positive. ∎

6 References

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