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ABSTRACT

Is Fiscal Policy Coordination in EMU Desirable?*

It is widely argued that Europe's unified monetary policy calls for international coordination at the fiscal level. We survey the issues involved with such coordination of fiscal policy as a demand management tool and we use a simple model to investigate the circumstances under which coordination may be desirable. It turns out that coordination is beneficial when the correlation of the shocks hitting the various economies is low. Given the potentially adverse reaction by the European Central Bank (ECB) as a result of free-riding and/or a conflict on the orientation of the policy mix, fiscal coordination is likely to be counterproductive when demand or supply shocks are highly symmetric across countries and governments are unable to acquire a strategic leadership position vis-à-vis the ECB. Generally, the scope for fiscal coordination is larger under asymmetric shocks, because the ECB remains passive as average inflation in the union is unaffected. This result contrasts with the more widely held view that the case for international fiscal coordination is strongest under common shocks.

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I. INTRODUCTION

The adoption of a common monetary policy in Europe has eliminated the possibility to use monetary policy for the stabilization of country-specific shocks. This is generally considered as the main cost of forming a monetary union. How large this cost actually is depends on what alternative mechanisms are available to ensure economic adjustment to idiosyncratic shocks. With perfectly flexible markets, stabilization policy is actually irrelevant: production factors move instantaneously to that part of the union where under-capacity prevails and, therefore, the effects of asymmetric shocks are dealt with effectively. However, in reality, labor mobility is low, both within and across countries. Hence, not much can be expected from this channel of adjustment (at least not in the near future). In addition, despite the huge international capital flows observed nowadays, cross-border asset holdings still seem to be much smaller than predicted by standard theoretical models (see Gordon and Bovenberg, 1996). Hence, instead of shifting savings to places where the risk-return trade-off is most favorable, agents invest most of their savings locally (Obstfeld and Rogoff, 2000). The findings by Yosha and Sorensen (1998) confirm the negligible role of capital income flows in absorbing the effects of country-specific shocks in Europe. This contrasts with the U.S. where capital markets are found to play a considerable role in diversifying away local shocks (Asdrubali et al., 1996).

If monetary policy can no longer address country-specific shocks and factor markets do not solve the problem either, then other solutions need to be found. One possibility would be a further centralization at the European level of the tax-transfer systems that now mainly operate at the national level[1]. Another possibility, as discussed by some authors (for example, von Hagen and Hammond, 1995, and Beetsma and Bovenberg, 2001a) would be the adoption of a system of cross-border fiscal transfers to countries hit by exceptionally bad shocks. Both options, especially the first one, will be subject to enormous political resistance and cannot be expected to materialize in the foreseeable future. The only remaining instrument in the hands of national authorities and capable to stabilize local macroeconomic conditions is fiscal policy. However, fiscal flexibility is hampered by large public debts and formal institutional constraints: the Maastricht rules and the Stability and Growth Pact (SGP) which forbid public deficits exceeding 3 percent of GDP. It has nevertheless been argued that if countries adhere to a medium term objective of budget balance or budgetary surplus, these restrictions are unlikely to be binding in the event of a recession (Buti, Franco and Ongena, 1998; Eichengreen and Wyplosz, 1998; Pina, 2001).

[1] This way the European Union would follow the example of the U.S. where the tax-transfer system at the federal level is estimated to absorb between 10 percent to 30 percent of the state-level economic shocks, depending on the specific empirical procedure that is followed. For an overview of this literature, see Von Hagen (1999). See also Mélitz and Zumer (1998) for cross-country comparison of the effectiveness of the tax-transfer system at the national level for regional shocks.

This paper discusses the role of national fiscal policies in stabilizing country-specific economic disturbances in the European Monetary Union (EMU). More specifically, we investigate the economic foundations of the case for fiscal policy coordination within the EMU. Because of the international spillovers resulting from such stabilization policies, it is often argued, especially by policymakers, that coordination is required among the EMU participants. A cooperative approach to policy making potentially affects the design of national fiscal policies in two ways. It may limit the discretionary use of fiscal policy but it is expected to increase its effectiveness, in particular if important cross-border spillovers exist.

We formally address the scope for fiscal coordination in the context of a two-country model of EMU, in which the European Central Bank (ECB) trades off price stability against interest rate smoothing, while the fiscal authorities simultaneously target full employment, price stability and structural budget balance. We argue that this policy assignment reflects the current macroeconomic institutions of the EMU. In particular, the specific mandate of the ECB as well as the strict separation of monetary and fiscal powers imply the absence of any ex-ante agreement between the central bank and the governments on their respective policy stances. Based on numerous simulations, the strategic analysis highlights a serious risk of counterproductive fiscal coordination. This is especially the case when shocks are highly correlated between countries. Ironically thus, fiscal coordination is most likely to be undesirable when a set of countries form an optimum currency area (Mundell, 1961).

With demand shocks, the model emphasizes a conflict among the authorities over the share of the “stabilization burden” to be borne by each of them. Fiscal coordination magnifies the “free-riding” behavior of the ECB, so that the governments end up bearing a greater share of the overall burden of stabilizing symmetric demand shocks. The social costs induced by the greater fiscal activism may be large enough to make fiscal coordination counterproductive. With symmetric supply shocks, the free riding problem is paired with a direct conflict over the orientation of the policy mix. The scope for fiscal coordination is the greatest when real shocks are negatively correlated. In that case, the adverse effect of coordination on the ECB's policies vanishes and coordinated fiscal policies are Pareto-optimal. The analysis also investigates the possibility for the governments to engage in binding pre-commitments. By giving the fiscal authorities a first-mover advantage (Stackelberg leadership), this capacity to pre-commit allows them to exploit the free-riding problem at their advantage and shift the burden of stabilization on the ECB. The pre-commitment capacity implies that coordination is in most cases beneficial.

The remainder of this paper is structured as follows. Section II gives a broad overview of the current debate on fiscal policy coordination in the EMU. Section III presents a simple two-country model with direct spillovers stemming from trade linkages and real-exchange rate variations. Section IV explores the reaction of monetary and fiscal policies to demand and supply shocks and establishes the conditions under which fiscal coordination is most likely to be socially desirable. Section V summarizes the main results and concludes. Appendix 1 contains the formal derivations of the model’s solutions.

II. POLICY COORDINATION UNDER EMU

In the context of the European Union, the issue of policy coordination is often addressed in institutional terms, the question being whether decisions about a given policy instrument should be taken at the central level (the Union level) or be decentralized (at the national, regional or local levels). As emphasized by Alesina and Wacziarg (1999), the optimal degree of (de)centralization of policy "prerogatives" generally depends on a trade-off between the specific needs of individual decision-making entities (e.g., because of heterogeneous preferences or constraints) and the extent to which the decentralized manipulation of the policy instrument generates spillovers in areas under the jurisdiction of other decision units.[2] Hence, everything else equal, the larger the cross-border externalities associated with decentralized policy actions, the stronger the case for shifting decision-making powers to a higher level of government, possibly even to a supranational institution able to internalize all externalities and to deliver more efficient policies. This paper focuses on one particular policy prerogative, namely the use of fiscal policy as an aggregate-demand management instrument in the context of the EMU. Subsection A discusses the type of policy decisions under consideration and the likely externalities associated with non-cooperative choices. Then, we discuss the desirability of fiscal coordination (Subsection B) and its feasibility (Subsection C). That discussion highlights potential obstacles to fiscal coordination. Subsection D distinguishes possible forms of policy coordination or centralization. Finally, Subsection E evaluates the existing arguments and mechanisms for policy coordination specifically for the EMU area.

A. Areas of policy coordination

In principle, all national policies generating cross-border spillovers could be subject to some degree of policy coordination or centralization at the supranational level. Potentially important areas for EMU-wide coordination are structural policies (such as labor market regulations, the tax system, goods market liberalization, etc.) and various dimensions of fiscal policy (for example, VAT, capital income taxation, infrastructure expenditure, R&D subsidies and tax exemptions for non-resident investors). In the area of fiscal policy, "tax competition" has received a lot of attention from policymakers and researchers alike. The problem is that national governments have an incentive to reduce taxes on mobile factors, so as to attract economic activity from other countries. As a result, in the absence of coordination, tax rates on mobile factors will be inefficiently low, at the expense of

[2] An overview of the various international spillovers from decentralized fiscal policies is contained in Buti and Sapir (1998).

inefficiently high taxes on less mobile factors like labor (for a recent overview, see Sorensen, 2000).

A second area of fiscal coordination that is attracting more and more attention since the inception of the EMU is the need for national governments to closely coordinate decisions on the overall fiscal stance. As European policymakers become more vocal on the "need" for this type of coordination, it is important to assess whether there is an economic rationale for coordination efforts that go beyond what already exists in the context of the Excessive Deficit Procedure (Article 104 of the Amsterdam Treaty) and the Mutual Surveillance Procedure (Article 99 of the Treaty). This is the aim of our analysis.

The general debate about the merits and costs of coordination is enriched by a series of issues that are specific to monetary unions and that either reinforce or weaken the overall case for fiscal coordination. The first issue dates back to the optimum currency area literature initiated by Mundell (1961) and concerns the stabilization of asymmetric demand shocks. Since monetary unification prevents nominal exchange rate variations to provide a swift and stabilizing adjustment of the real exchange rate to country-specific demand disturbances, aggregate-demand management through fiscal means becomes more important and can be made easier (and globally more efficient) if countries agree to internalize demand externalities so as to adequately "share the burden of adjustment". The argument is reinforced by the fact that monetary integration should foster further trade integration and increase demand-side externalities associated with national fiscal policies.

A second issue specific to monetary unions is that the prevailing policy mix now results from interactions among a large number of players (one central bank and many governments). The risk of a poorly coordinated policy mix is thus potentially greater than in the usual situation in which there is one central bank and only one government. However, even if it reduces the dimension of the fiscal-monetary coordination problem, "horizontal coordination" limited to fiscal authorities only does not necessarily yield better outcomes. Given the relatively narrow mandate of the ECB (which is primary, if not exclusive, focus on price stability), it is conceivable that fiscal coordination amplifies the inconsistency between what fiscal authorities jointly perceive as the appropriate combination of stimuli (and/or contractions) in the various individual countries and the broader assessment made by the ECB for the aggregate level. A related concern is that fiscal coordination increases the strategic weight of the fiscal authorities vis-à-vis the central bank, with potentially adverse consequences on the expansionary bias characterizing time-consistent macroeconomic policies (see e.g., Beetsma and Bovenberg, 1998 and Debrun, 2000). These two elements point towards the risk of counter-productive fiscal coordination (see Subsection B below).

Even though the interaction with the ECB is a key aspect to determine whether coordination is desirable (see Section III), the debate often remains focused on the magnitude and the signs of the fiscal spillovers that could justify a more cooperative approach to demand-side fiscal policies (for example, von Hagen, 1998). The sign of these spillovers is particularly important as it helps to determine whether coordination should lead to a more expansionary or more restrictive fiscal stance in the member states. Should the fiscal

authorities perceive negative externalities, they would interpret non-cooperative ("beggar-thy-neighbor") policies in response to bad economic shocks as too expansionary and agree on a more restrictive stance in all countries. Conversely, if governments perceive positive spillovers, coordination should eliminate free-riding behavior and promote more expansionary policies in response to bad shocks.

The theoretical literature does not provide a clear-cut answer about the sign of fiscal policy spillovers, while, given its short existence, empirical estimates in the context of EMU are not available. In classic analyses of policy coordination (e.g., Mundell, 1968 and Hamada, 1985), ad-hoc fixed-price models generally assume direct, positive demand spillovers. By contrast, more recent, micro-founded models of EMU tend to conclude in favor of negative spillovers. Andersen and Sorensen (1995) and Jensen (1996) emphasize the adverse terms-of-trade effect of a *balanced-budget* foreign fiscal expansion on the domestic economy.[3] The possibility to accumulate public debt adds other sources of negative spillovers through the common real interest rate and the credibility of monetary policy. For instance, Levine and Brociner (1994) propose a model that combines terms-of-trade (negative), real interest rate (negative) and external demand (positive) spillovers and argue that negative spillovers probably dominate. Cohen and Wyplosz (1989) focus on the externality associated with the Union's aggregate balance of payments and insist on the impact of national fiscal policies on the joint real exchange rate. Dixon and Santoni (1997) deviate from the previous papers and demonstrate the possibility of *positive* demand spillovers in a micro-founded model of EMU with monopolistic competition and unionized labor markets leading to excessive unemployment. Important for their result is the assumption that a "specie-flow" mechanism is at work to balance intra-EMU trade. Hence, a domestic fiscal expansion entails a trade deficit financed by a decrease in the net foreign assets of the economy. For a given union-wide money supply, the domestic fiscal expansion thus triggers a redistribution of the money stock in favor of the foreign economy leaving both member states better off.

Overall, the validity of the argument in favor of negative spillovers primarily depends on the empirical importance of intra-EMU terms-of-trade effects and on the reaction of the common interest rate to changes in fiscal policy. In most of the theoretical models reviewed above, terms-of-trade effects are significant because they implicitly assume strategic interaction within a group of large countries making up the world economy.[4] However, Europe is better described as a club of small economies open to the rest of the world. More specifically, the goods exchanged among EU member states are also traded at the world level, a level at which individual EU economies can be assumed to be small in the trade-

[3] This spillover effect was originally studied by Turnovsky (1988). Catenaro and Tirelli (2000) and Pina (1999) also rely on this channel in their models.

[4] Countries are large in the trade-theoretic sense, i.e. domestic developments affect the terms of trade.

theoretic sense. It is therefore unclear whether a domestic fiscal impulse in a EU member state could have a significant impact on that country's terms of trade since prices are mostly determined at the world level. The illustrative model described in Section III therefore builds upon the Mundell-Fleming tradition with *positive* demand spillovers resulting from trade linkages and real exchange rate effects. The response of the common interest rate to fiscal impulses will also be taken into account through the *reaction* of the common central bank.

B. The desirability of coordination

The early literature on policy coordination was based on the "two-is-many" principle. Clearly, coordination in a simple two-player game is always beneficial if it can be achieved at no or sufficiently low implementation cost. Following the key contribution of Rogoff (1985a), many authors started to exploit a general result of game theory according to which coordination among a sub-set of players could lead to such an adverse reaction of the outsiders that all players would be better off by not coordinating. Kehoe (1989) provides a first example of counterproductive fiscal coordination in a two-country model of fiscal competition. As in Rogoff (1985a), the third player (the outsider) is a private agent whose action (in Kehoe's case, investment) takes place before the government decides on the capital tax rate. The government thus faces an obvious time-inconsistency problem. Kehoe shows that under full fiscal coordination (i.e., capital cannot escape domestic taxation by relocating to a neighboring country), the time-consistent tax rate on capital is prohibitively high, while under non-coordination it is zero, so that investment will be high. Here, non-coordination acts as a *commitment device* for low capital taxes in each country. However, counterproductive coordination is not necessarily linked to time-consistency problems. Canzoneri and Henderson (1991) provide an example of a three-country Mundell-Fleming model in which monetary coordination between two countries only may be counterproductive.

In our context, the natural "third player" is the common central bank. With the explicit separation of monetary and fiscal powers, conflicts between the central bank and the government about the orientation of the macro-economic policy mix are often inevitable. However, such conflicts are particularly relevant in the European context where the central bank has a mandate to focus primarily on price stability. This is certainly much more narrow than the mandate given to the national governments by their electoral constituencies. A potentially large discrepancy between the objectives of the ECB and those of the national governments is a serious and permanent source of tension, in addition to possible conflicts due to different cyclical or structural conditions. Debrun (2000) illustrates this in a model in which the central bank exclusively targets price stability and consequently has a capacity to pre-commit on inflation. He shows that fiscal coordination may aggravate the fiscal-monetary coordination problem, providing an incentive for the government to appoint excessively "liberal" central bankers at the ECB Board in order to smoothen the conflict. Drawing on the seminal insights of Kehoe (1989), several authors like Agell et al. (1996), Jensen (1996), Beetsma and Bovenberg (1998) and Catenaro and Tirelli (2000) analyze how fiscal coordination may aggravate the time-inconsistency problem of monetary policy by

increasing the strategic weight of the governments vis-à-vis the central bank. To conclude, the existing literature suggests that counterproductive fiscal coordination may occur in the EMU as soon as it triggers a sufficiently strong, adverse reaction of the common central bank. Such a reaction is more likely, the greater the discrepancy between the specific mandates of the fiscal and monetary authorities and the greater the opportunities for the governments to put pressure on the central bank.

C. The feasibility of coordination

A common feature to many theoretical analyses of policy coordination is the assumption that coordination is costless, so that it should be pursued whenever it seems desirable. An extensive review of recent experiences of coordination is unnecessary to convince oneself that coordination is costly. Even if one assumes that the administrative costs of negotiation are negligible, the implementation of a coordination agreement may involve substantial monitoring costs. At a more fundamental level, the implementation of cooperative strategies entails a conflict between individual and collective interests, posing the question of the "commitment technology" able to cope with the natural incentive of individual governments to deviate from the agreement. Real world answers to these problems often take the form of costly institutional adjustments.

Theoretical analyses also take for granted that there is a minimum degree of consensus among governments on the objectives to be pursued and the constraints (i.e., economic model) they face. Disagreement on the objectives makes conflicts harder to solve, while different perceptions of or uncertainty about the "true model" of the economy affect the expected gains from coordination (Ghosh and Masson, 1991). Many analyses focus on simple policy instruments that are perfectly observable and, therefore, subject to easy monitoring. While monetary policy instruments might rather easily pass the tests of simplicity and quick monitoring, fiscal policy is admittedly much more than the textbook "*G*" or "T" (e.g., Mankiw, 2000). A given increase in expenditure will have very different immediate and long-term effects depending on whether it falls on government consumption or investment. This poses the question of the degree of specificity of the coordination agreement. Specific agreements are by nature more tedious to negotiate, harder to monitor and they may create concerns regarding the democratic accountability of the authorities vis-à-vis their domestic constituencies. Another difficulty linked to fiscal policy is that budgetary figures are often subject to creative accounting practices that make the monitoring of general as well as specific agreements extremely difficult (see Milesi-Ferretti, 2000). Finally, the budgetary process is generally complex and characterized by long implementation lags.[5,6]

[5] A good description of the various steps in national budgetary processes is contained in von Hagen and Harden (1996).

[6] The Bonn Agreement of 1978 among the G5 countries is a typical illustration of failed fiscal coordination due to implementation lags. The aim was to give a coordinated fiscal

(continued)

Fiscal coordination thus seems inherently more complicated than monetary policy coordination and, even though welfare gains might be identified, it is not certain to pass the test of an overall cost-benefit analysis.

This brief review of the operational constraints facing policy coordination may explain two empirical regularities. First, existing estimates of the gains from international policy coordination are generally small.[7] Second, most of the existing efforts to coordinate macroeconomic policies have focused on monetary policies and relied on simple and easy-to-monitor exchange rate targets. Does that suggest that fiscal coordination in the EU is wishful thinking? Not necessarily so. However, it draws the attention on the fact that coordination may not be beneficial under all circumstances and that the concrete procedures adopted to organize coordination efforts play an important role in its success. In particular, successful coordination efforts will probably require a stable institutional framework that fosters commitment (see Section IV) and allows orderly renegotiations when circumstances change. Dealing with implementation lags may also require more flexibility in the domestic decision procedures so that the national policy stance can be adjusted more rapidly. However, it remains that the concrete form of coordination and its actual implementation will depend on the governments' political willingness. We discuss further the concrete forms of coordination in the next subsection.

D. Forms of coordination

In general, two types of coordination can be distinguished (e.g., Beetsma and Bovenberg, 2001b): ex-ante coordination and ex-post coordination, depending on the means by which coordination is implemented. Ex-ante coordination operates through formal agreements recognized by the parties as international obligations (pacts, treaties, regulations or any compelling norm of international or supranational law). Widely cited examples are the Treaty on the European Union (the “Maastricht Treaty”) and the Regulation implementing the Excessive Deficit Procedure, better known as the Stability and Growth Pact. Ex-post coordination is ad-hoc and takes place on the basis of the current state of affairs. We can think of the Eurogroup, in which the Finance Ministers of the Euro area discuss fiscal policy

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stimulus to a stagnant world economy without aggravating external imbalances. The plan was finally shattered by the second oil shock and the restrictive monetary policies aimed at fighting inflation.

[7] Early estimates were reported in the seminal article by Oudiz and Sachs (1984), which sparked a substantial amount of subsequent research on the empirical gains from international coordination. Although generally these gains are found to be rather small, they vary across the literature. For example, Holtham and Hughes-Hallett (1987), in their comparison of different macroeconomic models actually find rather large gains. For an overview, see Ghosh and Masson (1994) or Douven (1995).

in an informal way, as a forum for ex-post fiscal coordination. The informal character distinguishes the Eurogroup from the EU-wide ECOFIN to which specific policy prerogatives are delegated by the Maastricht Treaty and whose decisions in those matters are legally binding. However, the distinction between ex-post and ex-ante coordination is not always so clear cut. For example, the concrete procedure leading to the imposition of sanctions in the context of the Stability and Growth Pact leaves room for discretion and ad-hoc adjustments. Ultimately, the important difference between ex-ante and ex-post coordination is that the former implies a much stronger commitment of the parties involved because any violation of the agreement would be public and possibly subject to explicit punishment. Section IV gives theoretical foundations to the potentially beneficial role of a capacity to make credible ex-ante pre-commitment. We show in particular how the pre-commitment capacity can reverse most of the counterproductive-coordination cases identified by our model.

One may expect however that the coordination of fiscal policies as a demand-management tool would primarily be of the ex-post type. In practice, only permanent problems, like a systematic deficit bias, can realistically be addressed by a legally binding text such as the Stability and Growth Pact or the Article 104 of the Amsterdam Treaty. By contrast, highly contingent decisions (like a judgment in a criminal court) fit poorly in clear and stable regulations (the law does not provide a specific sanction for each individual crime) and call for good judgment by the interested parties within the legal frame in place. Coordinated decisions on demand stimuli depend upon many specific circumstances and consequently fall in the category of "contingent" decisions. Only a complete centralization of fiscal decisions could combine commitment and the need for coping with contingencies.

The lack of commitment generally associated with ex-post coordination threatens its effectiveness and calls for organizing it within an institutional frame conducive to the actual implementation of the ad-hoc agreements. Aside full centralization, elements likely to reinforce the degree of commitment of ex-post coordination are the existence of a regular meeting schedule with clear agenda-setting rules (allowing the ministers to focus strictly on the issue of fiscal coordination)[8] and accountability-enhancing mechanisms (allowing appropriate information provision, public scrutiny and assessment by the European Parliament). It should also be possible to schedule emergency meetings if a member state feels that it is affected in its "vital interests" by a lack of fiscal coordination or if a majority of EMU member states desires such a meeting. Formal arrangements and accountability through transparency seem indispensable if one wants to increase the effectiveness of fiscal coordination, prevent free-rider behavior because of the tension between collective and

[8] See also von Hagen (1998). At present, informal Eurogroup meetings take place on the eve of the ECOFIN meeting and, therefore, run the risk that too many issues are discussed at the same time for effective action to be taken on specific issues.

individual interests (commitment) and, finally, ensure that the participation constraints of all member states in the collective game are taken into account.[9]

E. Fiscal policy coordination and the EMU constitution

As indicated in Subsection A, our analysis focuses on the type of policy coordination considered in the mainstream theoretical literature and recently advocated by several EMU Finance Ministers, that is a *joint* (or centralized) decision process on specific policy *actions*, be it discretionary (ad-hoc coordination) or rule-based.[10] However, practical experience seems to point out that international policy coordination often takes looser forms than joint decision-making and rather limits itself to a mere exchange of information or, at best, informal agreements on a set of mutually consistent external objectives. The Plaza and Louvre agreements within the G5/7 in the 1980's, which established informal exchange rate target zones, are widely cited examples witnessing that observation. Another example is the ongoing dialogue organized by the Treaty on the European Union between the monetary and fiscal authorities. According to Article 113 of the Amsterdam Treaty, the President of the ECB is invited to attend ECOFIN (and, *de facto*, Eurogroup) meetings when they discuss matters relating to the objectives and tasks of the ECB. Similarly, the President of the Council and a member of the EU Commission may participate in the meetings of the Governing Council of the ECB. Finally, the President of the ECB reports on the economic and financial situation before the Committee on Economic and Monetary Affairs of the European Parliament every quarter. Such a procedure is nevertheless quite far from joint decision making (i.e., *coordination*) between the monetary and fiscal authorities in the EMU[11]. To make the distinction clear, the literature sometimes labels those mechanisms as international *cooperation* (Canzoneri and Henderson, 1991). They have been described and analyzed extensively in the literature on EMU (e.g., Buti and Sapir, 1998). On the contrary, the way and the circumstances under which fiscal *coordination* among EMU Member States

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[9] Surprisingly, EU Commissioner Solbes recently declared: "Even though the *informal* character of the Eurogroup should be maintained to *permit* an open debate among the participants, more communication with the public about our analyses and about the agreed concrete commitments would doubtless be of use for the functioning of the system" (quoted by Reuters, emphasis added). We would rather argue that the formalization of the procedure whose sole purpose should be to encourage a focused and productive debate on the basis of a clear, publicly-announced agenda would *promote* rather than *prevent* transparency, commitment and accountability.

[10] In either case, coordination entails the optimization of some joint objective function (see Section III).

[11] The President of the ECB has no voting right in the ECOFIN and the representatives of the Council and the Commission have no voting rights in the ECB Governing Council.

should be organized have received relatively little attention in the literature and are not explicitly addressed by the EMU constitution. This provides a fertile ground for the sometimes heated debate on the potential role of the Eurogroup in that matter.

The Maastricht Treaty and the Stability and Growth Pact provide the legal foundations for organizing fiscal cooperation in the EMU. Following Buti and Sapir (1998, chapter 10), the primary aim of this "budgetary coordination" is to ensure that a broadly balanced policy mix emerges from the decentralized decisions of the twelve national governments and the supranational central bank. For that purpose, the Excessive Deficit Procedure (EDP), reinforced and "clarified" by the SGP, imposes a rule-based convergence towards macroeconomic stability (i.e., stable prices, sustainable fiscal stances and high employment levels). The EDP/SGP is thus expected to help all governments internalize the ultimate objective of the central bank, and choose fiscal and structural policies consistent with the other requirements of macroeconomic stability while preventing the lax-fiscal-tight-monetary policy mix that might result from a conflict between the ECB and the national governments over the desirable orientation of the policy mix. Incidentally, the induced commitment to fiscal discipline gives the fiscal authorities some extra flexibility to let automatic stabilizers accommodate country-specific real disturbances without risking slippages towards an unsustainable fiscal path. Buti and Sapir (1998) also review the benefits accruing from the other cooperation mechanisms included in the Treaty like the regular exchange of views and information between policymakers, the increased predictability of fiscal policies (contributing to a better calibration of the common monetary policy) and a greater weight of Europe in global cooperation forums when the Euro area speaks with one voice.

The scope for fiscal policy *coordination* therefore appears quite limited in the current context. In the first place, no obvious institutional mechanism looks sufficiently flexible to play the role of a formal instrument for joint decision-making on the fiscal stance. The mutual surveillance procedure is limited to the definition and the monitoring of *annual* broad policy guidelines; the EDP is a rule-based mechanism exclusively focused on medium-term discipline and the Eurogroup remains an informal forum, officially to prevent interference with the EU-wide ECOFIN Council. A second reason is that many economists perceive little economic sense for national governments to jointly decide on their fiscal stance. They invoke small spillover effects (Buti and Sapir, 1998, or Eichengreen, 1997), a weakening of the ECB's strategic position (Beetsma and Bovenberg, 1998 and 2001b) or insurmountable practical difficulties to organize efficient coordination (Issing, 2001). Regarding the circumstances under which fiscal coordination could be profitable, Buti and Sapir (1998, p.150) argue that only "in cases of severe *common* shocks or imbalances there may be a role for jointly agreed and announced budgetary policy actions". Issing (2001) excludes the necessity of coordinating national macroeconomic policies under any circumstance because, he claims, "an efficient assignment of objectives and responsibilities will largely substitute the need for coordinated [national] policies later on."

The simple model developed in Section III is designed to address several of these arguments, with the exception of the disciplining argument (i.e., the impact of fiscal coordination on the time-consistent inflation rate) which has already been thoroughly

analyzed elsewhere (e.g., Beetsma and Bovenberg, 1998; Levine and Pearlman, 1998; Beetsma and Uhlig, 1999; Pina, 1999; and Debrun, 2000). Our model sheds a critical light on three key elements in the current debate:

- *Conflicting spillovers*: The conventional argument states that the positive demand spillovers operating through trade flows are mostly offset by the induced effect on common variables like the interest rate or the exchange rate of the Euro so that overall spillovers are small. This may indeed be the case *ex post*, that is once the strategic choices of all authorities (fiscal *and* monetary) have been taken into account. However, *ex ante*, it is not clear why the fiscal authorities should make their choice under the constraint of the induced reactions of these variables since these depend on the strategic choice of the central bank.[12] After all, the latter may choose to accommodate a fiscal impulse. Assuming a non-cooperative Nash game (i.e. simultaneous moves in which each player treats the choices of the others as given), ex ante spillovers of fiscal policies may thus appear bigger and reinforce the traditional case for fiscal coordination.

- The "*Maastricht assignment*": Both the Treaty and the SGP indicate a very clear policy assignment. The ECB receives the primary responsibility for maintaining price stability, implying that the other objectives traditionally assigned to macroeconomic policies (i.e., full employment, fiscal and external sustainability) fall under the responsibility of the national authorities. As indicated above, the current institutional framework stimulates a broad coordination of the policy mix around the core objective of maintaining macroeconomic stability. However, this does not solve the issue of coordinating reactions to temporary macroeconomic disturbances (stabilization policies).[13] Quite to the contrary, by inciting different authorities to focus on specific objectives, a sharp policy assignment may aggravate coordination failures on stabilization policies. This point is clearly illustrated in the model that we analyze below.

- *Counterproductive coordination*: Conventional wisdom tells us that joint fiscal actions should be limited to the case of large *symmetric* shocks, implicitly suggesting that fiscal coordination is more likely to be beneficial the more symmetric the real shocks hitting the EMU Member States. The model developed below is sufficiently tractable to clearly identify the cases of counterproductive fiscal coordination. Counterproductivity might emerge because of the possibly adverse reaction of the ECB to coordinated fiscal actions. Intuitively thus, fiscal coordination is more likely to be beneficial the less intense the central bank's

[12] This would correspond to a Stackelberg game with fiscal leadership (governments playing first).

[13] Therefore, Issing (2001)'s claim reported above is surprising.

reaction to the disturbances. A clear case leading to the ECB's passivity is the presence of *asymmetric* shocks because they have a small impact on the EMU aggregates targeted by the ECB. The model presented below formally establishes this argument and forces us to reconsider the circumstances under which fiscal coordination may be desirable.

III. A SIMPLE MODEL WITH FISCAL POLICY SPILLOVERS

This section presents a highly stylized theoretical framework that will allow us to identify in a systematic way the key determinants of the desirability of fiscal policy coordination in a monetary union. As usual in the relevant literature (e.g., Hamada, 1985 and Canzoneri and Henderson, 1991), the analysis focuses on the welfare implications of adopting a fully cooperative regime against the alternative of a non-cooperative approach. The issues linked to the concrete implementation of hypothetical cooperative outcomes are not formally addressed by the model. The latter is a simple two-good, two-country (Home and Foreign) framework specifically calibrated to capture the short-run stabilization efforts of monetary and fiscal authorities through the aggregate demand. Fiscal policy impulses produce external effects via three channels: a direct aggregate demand effect (through international trade linkages), an indirect interest rate effect (through the reaction of the common monetary policy to the decisions of the individual fiscal authorities) and a real exchange rate effect. The second effect clearly depends on the form of the strategic interaction between the monetary and the fiscal authorities.

The model is an extension of Buti et al. (2001) and is described by the following set of equations, all variables being defined in terms of percentage deviations from their long-run values (except for the interest rate):

$$y^d = -\delta\left(\pi - \pi^*\right) + \phi_1 d - \phi_2\left(i - \pi^e\right) + \gamma y^* + \varepsilon_1, \tag{3.1}$$

$$y^s = \omega\left(\pi - \pi^e\right) + \varepsilon_2, \tag{3.2}$$

$$y^{d*} = \delta\left(\pi - \pi^*\right) + \phi_1 d^* - \phi_2\left(i - \pi^{*e}\right) + \gamma y + \varepsilon_1^*, \tag{3.3}$$

$$y^{s*} = \omega\left(\pi^* - \pi^{*e}\right) + \varepsilon_2^*, \tag{3.4}$$

$$d = d_s - \alpha y, \tag{3.5}$$

$$d^* = d_s^* - \alpha y^*, \tag{3.6}$$

$$y \equiv y^d = y^s, \tag{3.7}$$

$$y^* \equiv y^{d*} = y^{s*}, \tag{3.8}$$

where y^d is the aggregate demand, y^s is the aggregate supply, *y* is the equilibrium output, *d* is the budget deficit, d_s is the cyclically-adjusted budget deficit, *i* is the nominal interest rate, π is the GDP price inflation rate and π^e is its expectation. Finally, ε_1, ε_1^*, ε_2, and ε_2^* are stochastic real disturbances with zero mean and finite variances $\sigma^2_{\varepsilon_1}$, $\sigma^2_{\varepsilon_1^*}$, $\sigma^2_{\varepsilon_2}$, $\sigma^2_{\varepsilon_2^*}$ respectively. Unstarred variables designate domestic variables, while starred variables refer to the foreign country. All the parameters are nonnegative and equal across countries.

Equations (3.1) and (3.3) characterize the aggregate demand in each country. Home aggregate demand depends positively on the fiscal deficit and the Foreign income (through international trade flows) and negatively on the real exchange rate (measured as the GDP price inflation differential) and the real interest rate (measured as $i - \pi^e$ or $i^* - \pi^{*e}$). Equations (3.2) and (3.4) are the standard "Lucas supply" equations, according to which a positive inflation surprise $\pi > \pi^e$ stimulates production. In accordance with our short-run stabilization focus, the effectiveness of fiscal policy is limited to its transitory impact on output through the induced stimulus of the aggregate demand. Equations (3.5) and (3.6) decompose the overall fiscal deficit into a discretionary component (under the control of the government) and an endogenous component which depends on the level of economic activity. For instance, countries with a relatively large government sector and a more generous welfare system are characterized by a relatively high α making their overall fiscal balance *d* more sensitive to economic disturbances. Finally, we do not introduce an explicit government solvency constraint because the implied structural dynamics would make the strategic analysis much more complicated without any obvious gains in terms of insight on the determination of the monetary-fiscal policy mix in the short-run.

In each country, the representative agent cares about the trade-off between fluctuations of output, consumer price inflation (CPI) and the cyclically-adjusted deficit around their preferred levels. This is captured by quadratic loss functions.

$$L_S = \frac{1}{2}\left[\left(d_s - \bar{d}_s\right)^2 + \theta\left(y - \bar{y}\right)^2 + \left(\pi_c - \bar{\pi}_c\right)^2\right], \tag{3.9}$$

$$L_S^* = \frac{1}{2}\left[\left(d_s^* - \bar{d}_s^*\right)^2 + \theta\left(y^* - \bar{y}^*\right)^2 + \left(\pi_c^* - \bar{\pi}_c^*\right)^2\right], \tag{3.10}$$

where an upper bar denotes the preferred levels of the relevant variable. Assuming that the representative agent in each country consumes both Home and Foreign goods according to income shares $(1-\varsigma)$ and ς, respectively, the relevant consumer price index, designated by a subscript *c*, depends on goods prices in both countries. For notational convenience, we define

the relevant CPI inflation as a fraction $(1-\varsigma)$ of the Cobb-Douglas price indices $(1-\varsigma)\pi+\varsigma\pi^*$ (Home) and $(1-\varsigma)\pi^*+\varsigma\pi$ (Foreign):

$$\pi_c = \pi + \eta\pi^*, \tag{3.11}$$

$$\pi_c^* = \pi^* + \eta\pi, \tag{3.12}$$

where $\eta = \varsigma/(1-\varsigma)$. The specification of the loss functions is standard in the related literature. Social losses increase with the deviations of output, CPI and the cyclically-adjusted deficit from their ideal levels. While output and the CPI are standard arguments in the social loss function, the cyclically-adjusted deficit implicitly captures the concern about the future budgetary consequences of current policies. In particular, the aversion to structural deficits may account for the short-run effect of the intertemporal budget constraint or the pressure from the Stability and Growth Pact to strive for budget balance in the medium run.

The determination of the policy mix involves three policymakers: the Home and Foreign fiscal authorities and the ECB. They choose strategies maximizing explicit objective functions under the constraint of the economic environment. We assume that those functions reflect the policy assignment established by the constitution of the monetary union. In that respect, the outstanding feature of the Treaty on the European Union is to assign the primary responsibility for Union-wide price stability to the ECB, leaving the national governments with the "residual" task to stabilize local macroeconomic conditions with fiscal policy. Consequently and in line with the abundant literature on policy delegation, neither the monetary authority nor the national government necessarily shares the preferences of the representative agent of a country. Of course, this presupposes that, for reasons not discussed here (such as monetary discipline), the assignment under consideration delivers greater social welfare than purely representative authorities. Translating the Treaty's assignment into differences between the objective functions of the monetary and the fiscal authorities is inevitably subject to debates and somewhat arbitrary choices. However, the specific nature of the differences matter less than their effect on the strategic interaction: the emergence of conflicts between monetary and fiscal authorities over the orientation of the policy mix.

To model the Treaty's policy assignment, we first assume that output does not enter as an autonomous argument in the ECB objective function. Indeed, the ECB is mandated to stabilize output only when the resulting policy is consistent with price stabilization, suggesting that the ECB is not expected to trade-off inflation and output when supply shocks occur. Second, the ECB mandate might impact on national governments' priorities by distracting them from stabilizing local consumer prices. In fact, national authorities could hardly be held accountable for inflation slippages (even if local) because they have lost the key instrument allowing to control inflation efficiently. Consequently, the EMU constitution might imply that national governments pay relatively less attention to inflation than their

representative inhabitant. The objective function of the national governments is a straightforward generalization of their representative agent's, with governments possibly being more "liberal" (as opposed to "conservative" in the sense of Rogoff, 1985b).

$$L_F = \frac{1}{2}\left[(d_s - \bar{d}_s)^2 + \theta(y - \bar{y})^2 + \xi(\pi_c - \pi_c)^2\right], \tag{3.13}$$

$$L_F^* = \frac{1}{2}\left[(d_s^* - \bar{d}_s^*)^2 + \theta(y^* - \bar{y}^*)^2 + \xi(\pi_c^* - \pi_c^*)^2\right]. \tag{3.14}$$

Hence, $\xi = 1$ characterizes a "representative" government, and while $\xi < 1$ characterizes a relatively "liberal" one.

As discussed above, the ECB makes no trade-off between inflation and output or between inflation and the structural deficit of the member states. However, the ECB shows caution in its decisions by smoothing the nominal interest rate, its policy instrument. Again, a quadratic utility-loss specification is adopted:

$$L_M = \frac{1}{2}\left[(\pi^A - \pi^A)^2 + \beta(i - \bar{i})^2\right], \tag{3.15}$$

where $\pi^A \equiv \frac{1}{2}(\pi + \pi^*)$ is the average union CPI and $\bar{\pi}^A$ is its target[14]. Since both countries are identical, the ECB attaches an equal weight to each of the national inflation rates. The target for the nominal interest rate is given by $\bar{i}$. For the remainder of the analysis we assume that the policymakers have no systematic incentive to deviate from the initial long-run equilibrium so that we abstract from possible deficit biases (i.e., d_s or d_s^* deviate from zero *on average*) or inflation biases (i.e., π_c, π_c^* or π^A deviate from zero *on average*). As a result, $\bar{\pi}_c = \bar{\pi}_c^* = \bar{\pi}^A = \bar{d}_s = \bar{d}_s^* = \bar{y} = \bar{y}^* = \bar{i} = 0$. In other words, we limit the analysis to the stabilization of shocks.

As regards to the strategic interactions among the policymakers, we consider three different regimes. In regime 1, the authorities do not cooperate and simply aim at their individually-optimal policy (best response), taking as given the others' decisions. In game-

[14] By construction, the cross-country average good and CPI inflation rates coincide: $\frac{1}{2}\left[(1-\varsigma)\pi + \varsigma\pi^* + \left[(1-\varsigma)\pi^* + \varsigma\pi\right]\right] = \frac{1}{2}(\pi + \pi^*)$.

theoretic terms, all policymakers "play Nash". In the second and third regimes, national fiscal policies are decided by a supranational institution minimizing the simple sum of the national governments loss functions. This situation corresponds to full ex-ante fiscal coordination. In regime 2, this centralized institution plays Nash against the ECB (simultaneous decisions), while in regime 3 it has a first-mover advantage over the ECB (i.e., it is a Stackelberg leader against the ECB).

Regime 1 is the standard benchmark case where no player has the capacity to pre-commit to a policy stance off its best response schedule. In the "one-shot" game considered here, no deviation from the Nash equilibrium is individually rational ex-post so that a cooperative agreement can only be sustained if the players can make credible pre-game commitments. In games between the monetary and fiscal authorities, it is quite common to assume that the fiscal authority has such a pre-commitment capacity because a generally sluggish budgetary decision process (budget preparation, vote of a binding budget law in Parliament, ex-post monitoring of execution) makes the fiscal stance much harder to reverse than monetary policy (see e.g., Beetsma and Bovenberg, 1997). This embedded pre-commitment technology available to the fiscal authorities may also give them a first-mover advantage. This is why, in addition to the usual benchmark cooperative equilibrium in which the coordinated fiscal policies are set simultaneously to the monetary stance (regime 2), we study a "cooperative-Stackelberg" equilibrium where the coordinated fiscal policies are set before the ECB moves on monetary policy. In practice, that distinction between the two cooperative regimes can be interpreted as follows. Under Stackelberg coordination, governments jointly decide on their respective fiscal stance at the stage of the budget preparation and agree on contingency plans in case of disturbances. Of course, this supposes that joint decisions are properly translated into the national budget laws and that the governments do not exploit the Parliament's veto power to renege on their commitment. Under Nash coordination, joint decisions are made once the disturbances are known and involve amendments to the existing budget law. Buti et al. (2001) also explore the coordination between a single (supranational) fiscal authority and the ECB. However, this would require a pre-commitment technology for the monetary authorities too. Moreover, as discussed in section II, the current institutional setting of the Euro area (including the ECOFIN and the Eurogroup) provides procedures intended to achieve a degree of monetary-fiscal *cooperation* that is very different from the joint decision making a fully cooperative equilibrium would pre-suppose.

Although it is straightforward to solve linear-quadratic games explicitly, the algebra is rather cumbersome and is, therefore, developed in the Appendix. Optimal policies are characterized by the "reaction functions" which can be written as:

$$i = a_1\left(d_s + d_s^*\right) + a_2\left(\varepsilon_1 + \varepsilon_s^*\right) - a_3\left(\varepsilon_2 + \varepsilon_2^*\right), \tag{3.16}$$

$$d_s = b_1^r i - b_2^r d_s^* - b_3^r \varepsilon_1 - b_4^r \varepsilon_1^* - b_5^r \varepsilon_2 - b_6^r \varepsilon_2^*, \tag{3.17}$$

$$d_s^* = b_1^r i - b_2^r d_s - b_3^r \varepsilon_1^* - b_4^r \varepsilon_1 - b_5^r \varepsilon_2^* - b_6^r \varepsilon_2, \tag{3.18}$$

where a_1, a_2, a_3, b_1^r, b_2^r, b_3^r, b_4^r, b_5^r and b_6^r are defined in the Appendix. The superscript "*r*" indicates that the fiscal "slope" coefficients are contingent on the regime under consideration: non-coordination ($r = N$), coordination-Nash ($r = C$) or coordination-Stackelberg ($r = S$). The coefficients a_1, a_2 and a_3 are all positive and the same holds for b_1^r, b_2^r, b_3^r and b_4^r if $r = N$ or $r = C$. Not surprisingly, under non-coordination, all instruments are strategic substitutes as they produce real economic effects through their impact on the aggregate demand. For instance, an autonomous fiscal expansion drives up demand, putting upward pressure on prices and inducing the ECB to contract monetary policy (i.e., to raise the nominal interest rate) - see (3.16). However, in the absence of shocks, *optimal* monetary and fiscal policies are passive (i.e., $i = 0$, $d_s = d_s^* = 0$). When demand or supply disturbances occur, the authorities will adopt active policies aimed at achieving the best trade-off between the deviations of the variables in the objective functions from their targets. For instance, an unfavorable demand shock ($\varepsilon_1 < 0$ and/or $\varepsilon_1^* < 0$) causes a fiscal expansion[15].

However, strategic substitutability implies that the absence of coordination gives rise to free-riding behaviors. Another source of conflict stems from the policy assignment. For instance, a negative supply shock hitting both countries will incite the ECB to contract monetary policy to offset the inflationary effects of the shock. If the national fiscal authorities attach a relatively smaller importance to inflation (ξ is low),they will want to expand fiscal policies to offset the impact on output. Section IV characterizes in detail the conflicts among the policymakers for a variety of shocks and the three policy regimes and establishes conditions under which counterproductive fiscal coordination is likely to arise.

IV. ANALYSIS OF THE MODEL

This section analyzes the policy mix resulting from the strategic interaction among the three policymakers under the three regimes of interest for this paper: decentralized fiscal policies (the non-cooperative regime) and centralized fiscal policies under Nash and under fiscal leadership against the ECB. These are the cooperative solutions[16]. The model is sufficiently flexible to fully recover the intuition, which is convenient to identify and discuss the possibility of counterproductive fiscal coordination. To ease the discussion, we rely on numerical simulations based on a constellation of reasonable parameter values.

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[15] Notice that in the absence of real-exchange-rate effects ($\delta = 0$), "liberal" governments ($\xi = 0$) will not directly react to supply shocks (i.e., $b_5^r = b_6^r = 0$).

[16] Notice that we define cooperative fiscal policies as the set of structural deficits minimizing the simple sum of the national governments' loss functions. When both players are identical, this utilitarian solution concept coincides with the standard Nash bargaining solution.

As we allow for the fiscal authorities' loss functions to deviate from the social loss functions, the circumstances under which fiscal coordination is desirable from a social perspective does not necessarily coincide with the circumstances under which it is desirable from the fiscal authorities' point of view. In a democratic environment where governments are accountable for delivering the highest possible social welfare, such discrepancies should not be worrisome. "Non-representative" authorities that would deliver socially sub-optimal outcomes would ultimately be voted out. However, since an electoral platform is much more than commitments about macroeconomic policies, we take the "types" of the governments as given and evaluate the *social* desirability of fiscal coordination for different types. To keep the discussion focused, we will limit the discussion to representative (or "centrist": $\xi = 1$) and liberal ($\xi = 0$) governments.

Crucial for the desirability of fiscal coordination is the reaction of the ECB to changes in national fiscal policies. Should the optimal monetary policy be completely passive, the strategic interaction would only concern the two national governments and coordination would necessarily benefit both governments. A passive monetary policy (i.e., $i = 0$ in all circumstances) would be optimal in two particular cases: (i) the ECB only targets the interest rate (i.e., $\beta \to \infty$) or (ii) the real interest rate elasticity of aggregate demand is zero in the two countries (i.e., $\phi_2 = 0$), meaning that the ECB's instrument has no effect on inflation. In these cases, the stabilization burden falls entirely on the national fiscal policies and the policy "mix" results from a two-player game as depicted in Figure 1 (Appendix II). The latter shows downward sloping best response schedules (reaction functions), with the Home one steeper than the Foreign one to secure a stable Nash equilibrium in the game (the necessary and sufficient requirement is $b_2^N < 1$, which is fulfilled). Fiscal policies are *strategic substitutes* in the sense that an increase in the Foreign structural deficit induces the Home fiscal authority to reduce its own structural deficit. Since changing the structural deficit entails direct welfare costs for the governments, the absence of coordination leads to free riding and excessively passive reactions to economic disturbances.

The analysis becomes much richer when the ECB does react to fiscal policy or to shocks (i.e., $0 < \beta < \infty$). Changes in fiscal policies trigger an offsetting reaction of the ECB to fend off their impact on average inflation in the Euro area. In the two-dimensional representation of the interaction between the fiscal authorities, the ECB's response to fiscal impulses affects the slopes of the governments' best response schedules. In particular, if β is sufficiently low, the reaction of the ECB might be vigorous enough to make national fiscal policies strategic *complements* instead of strategic substitutes because, say, a fiscal expansion in one country would cause a union-wide monetary contraction that could force the other fiscal authority to stimulate the national aggregate demand instead of contracting it. Figure 2 (Appendix II) depicts the fiscal reaction functions for the case in which the monetary reaction function has been substituted out (see the Appendix). For high β (and thus a weak ECB policy response),

the reaction functions are downward sloping (Figure 2a), as before, while for low β they are upward sloping (Figure 2c). The borderline between these two cases is shown in Figure 2b,[17] in which the Home fiscal reaction function is vertical and the Foreign fiscal reaction function is horizontal. This illustrates a situation in which the reaction of the ECB to a fiscal impulse in one country exactly offsets the induced effect on the other country's aggregate demand, in effect neutralizing fiscal externalities. In that case, a Home demand shock shifts the Home fiscal reaction function but has no effect on Foreign fiscal policy because the positive, structural demand externality is exactly compensated by the negative, "strategic" interest rate externality.

In the absence of any systematic bias or time-inconsistency problems, the analysis focuses on the reaction of the policy mix to a variety of shocks. We first distinguish between supply and demand shocks, assuming that they are symmetric across countries (Subsections A and B). This distinction is useful because those two types of shocks lead to different kinds of conflicts between monetary and fiscal authorities. We then assess the sensitivity of the results to the assumption of perfectly asymmetric shocks (Subsection C). Indeed, the effects of asymmetric shocks on average inflation tend to cancel out so that the activism of the ECB, and thereby the conflict with the national fiscal authorities is milder than when shocks are perfectly symmetric. To highlight as clearly as possible the key properties of the model, we limit the investigation to two "polar" cases: perfectly symmetric and perfectly asymmetric shocks (identical in size but opposite in sign). We also assume no correlation between supply and demand disturbances. Intermediate cases can easily be discussed with respect to the benchmark situations analyzed in detail here and the results regarding the desirability of fiscal coordination generally lie between those obtained under the polar cases.

For all these cases, we report numerical results for a common baseline parameter setting: $\beta = 1$, so that the ECB attaches an equal weight to deviations of the interest rate and the union-average inflation rate from their targets, $\theta = 2$, so that the representative agents attach twice as much weight to output than to inflation deviations from their targets. As discussed earlier, numerical results are obtained for two different values of ξ: $\xi = 0$ (liberal government) and $\xi = 1$ (representative government). Further, $\alpha = \phi_1 = \phi_2 = \gamma = \omega = \delta = 0.5$ and $\eta = 0.5$, implying a share of Foreign goods in Home consumption of about 33 percent.

[17] The corresponding value for β is $\beta^* \equiv \phi_2^2 / [2\omega(\gamma\omega + \delta)(1 + \phi_1\alpha - \gamma)]$ if $\eta = 0$. For $\eta > 0$, numerical simulations establish that for sufficiently small β, the fiscal instruments become complements when the monetary policy reaction function is substituted out.

A. Symmetric demand shocks

Table 1a reports, for the baseline parameter combination and for each of the three regimes and two types of governments, the instrument settings and the expected social and government losses under a common adverse demand shock ($\varepsilon_1 = \varepsilon_1^* = -1$). We set $\sigma^2_{\varepsilon_1} = \sigma^2_{\varepsilon_1^*} = 1$, $\sigma^2_{\varepsilon_2} = \sigma^2_{\varepsilon_2^*} = 0$, $Corr(\varepsilon_1, \varepsilon_1^*) = 1$ and all other shock correlations to zero. A common adverse demand shock causes a union-wide fall in output and in prices. To alleviate the consequences of the shock, both the monetary and the fiscal authorities aim at expansionary policies. Hence, the conflict does not take place over the orientation of the policy mix (all agree to stimulate aggregate demand) but over the share of the "stabilization burden" borne by each authority[18]. In general, the decision to coordinate fiscal policies implies that the fiscal authorities will bear a greater share of the overall burden of stabilizing the symmetric demand shocks when compared with non-coordination. The reason is that the solution to the free-riding problem between the fiscal authorities will aggravate the free-riding problem between them and the central bank. The shift of the stabilization burden on the instrument that is *socially* costly to manipulate lowers the welfare gains arising from "pure" fiscal coordination and raises the possibility of counterproductive coordination. The ranking of the three regimes in terms of social utility depends on the type of the governments.

[18] In the case of demand shocks, there is no trade-off between stabilizing prices and output. Expansionary policies can achieve both (see equations (3.2.) and (3.4), with $\varepsilon_2 = 0$ and $\varepsilon_2^* = 0$, respectively. Recall that stabilization is perceived as a "burden" by all players because the use of the stabilization tool under their responsibility is viewed as intrinsically costly.

Table 1a: Policy responses and welfare losses with demand shocks (baseline)

Regime	Structural deficit	Interest rate	Output	Inflation	Government loss	Social loss
Perfectly symmetric shocks and representative governments						
N	0.9796	-0.6531	-0.2449	-0.4898	0.8097	0.8097
C	1.2754	-0.4638	-0.1739	-0.3479	0.9796	0.9796
S	0.7757	-0.7835	-0.2938	-0.5877	0.7757	0.7757
Perfectly symmetric shocks and liberal governments						
N	0.3221	-1.0738	-0.4027	-0.8057	0.2140	0.9437
C	0.4848	-0.9697	-0.3636	-0.7273	0.2498	0.8448
S	0.2066	-1.1478	-0.4304	-0.8608	0.2066	1.0403
Perfectly asymmetric shocks and representative governments						
N	0.3986	0	-0.2135	-0.4270	0.1478	0.1478
C	0.1013	0	-0.2532	-0.5063	0.1013	0.1013
S	0.1013	0	-0.2532	-0.5063	0.1013	0.1013
Perfectly asymmetric shocks and liberal governments						
N	0.1928	0	-0.2410	-0.4819	0.0766	0.1057
C	0.0687	0	-0.2575	-0.5150	0.0687	0.1018
S	0.0687	0	-0.2575	-0.5150	0.0687	0.1018

If governments are *representative*, their expected losses are indeed higher under Nash coordination than under non-coordination. However, when the coordination of fiscal policies is paired with a strategic leadership against the ECB, policymakers can internalize the free-riding behavior of the latter and calibrate their coordination efforts so as to force it to expand more and bear a larger share of the stabilization burden. Under Stackelberg coordination, fiscal policies are thus less expansionary than under Nash coordination, which results in both output and inflation being further away from their targets. However, structural deficits are closer to their preferred levels, making Stackelberg coordination more desirable than non-coordination. This result indicates that the counter-productivity problem is contingent on the

concrete organization of fiscal coordination. If the latter takes the form of irrevocable ex-ante commitments, it may give the fiscal authorities a socially beneficial, strategic advantage over the ECB. In a sense, this exercise underscores the social value attached to the capacity to make ex-ante commitments on fiscal policies. Obviously, the value of fiscal commitment and its power to reverse the counter productivity result crucially depends on the relative importance that governments attribute to the deficit targets and the resulting gains from tilting the policy mix towards monetary activism.

With *liberal* governments, the ranking of the three regimes depends on whether we take the government's or the social loss as the criterion. Not surprisingly and for the same reasons as above, the ranking from the perspective of governments' utility is the same as before: Stackelberg coordination dominates non-coordination which itself dominates Nash coordination. From a social perspective, Nash coordination becomes the best regime, followed by non-coordination and Stackelberg coordination. The intuition goes as follows. Since it does not care about inflation, a liberal government attributes relatively more importance to the deficit target than a representative one. In the absence of a trade-off between inflation and output (i.e., they stabilize demand shocks), abandoning the inflation objective will imply less activist fiscal policies (see Table 1a). Compared to the case of representative governments, the ECB is more activist but the increasing marginal cost of deviating from its interest rate target prevents it from fully compensating for the sub-optimal stabilization efforts of the governments. Consequently, the regime characterized by the strongest fiscal reaction (i.e., Nash coordination) delivers the lowest social welfare loss. Nash coordination is now "productive" because it compensates for an exogenous distortion: the non-representative nature of the governments.

We performed a number of simulations to check the robustness of the baseline results by picking a "low" and a "high" value for each parameter (under the assumption of representative governments).[19] More specifically, we defined a low value of 0.1 and a high value of 0.9 for the elasticity of the actual deficit to output (α), the elasticity of production to unexpected price changes (ω) and the elasticities of demand to the real exchange rate (δ), the deficit (ϕ_1), the real interest rate (ϕ_2) and the other country's income (γ). As regards the interest rate smoothing behavior of the ECB (β), we chose a low value of 0.1 and a high value of 10. These results confirm the risk of observing counterproductive coordination as described above. In particular, Nash coordination is counterproductive and Stackelberg coordination yields almost no benefit when the trade externality (γ) is small or when the elasticity of deficits to output is large. In the former case, the pure gains to fiscal coordination are small. In the latter case, the reason is that large automatic stabilizers lessen the conflict over discretionary responses to shocks, thereby also reducing the pure benefits from coordination. This result suggests that fiscal coordination among "big" governments (in the

[19] To save space, the results are not reported here, but they are available from the authors upon request.

sense of a large public sector with respect to the rest of economy) is more likely to be counterproductive. Coordination is *never* counterproductive in only two cases: a strong incentive to smooth the interest rate and a low real interest rate elasticity of the aggregate demand, two cases characterized by a very passive central bank and therefore, low free riding in the monetary-fiscal interplay.

B. Symmetric supply shocks

We now consider the case of a common adverse supply shock hitting both countries. Specifically, we set $\varepsilon_2 = \varepsilon_2^* = -1$ and assume that $\sigma^2_{\varepsilon_2} = \sigma^2_{\varepsilon_2^*} = 1$, $\sigma^2_{\varepsilon_1} = \sigma^2_{\varepsilon_1^*} = 0$, $Corr(\varepsilon_2, \varepsilon_2^*) = 1$, while all other shock correlations are zero. Table 1b reports the instrument settings and expected losses for the baseline parameter combination. Since adverse supply shocks can only be offset by unexpected inflation, there is now a direct conflict between the fiscal and monetary authorities on the orientation of the policy mix. This conflict combines with the free-riding problem discussed in the previous subsection. According to our policy assignment, the ECB looks at price stability and opts for a contractionary monetary policy, while the governments face a trade-off between avoiding inflation and stimulating activity. That conflict is the most intense with *liberal* governments since the latter disregard inflation and would favor an expansionary policy mix. Despite obvious differences with the case of demand shocks, the present game yields closely related results. First, fiscal coordination makes fiscal policies more activist because fiscal coordination solves the free-riding problem between the governments. Second, this attempt at greater fiscal activism is defeated by the reaction of the ECB, making Nash coordination counterproductive. Under Stackelberg coordination, the governments perfectly anticipate the adverse reaction of the ECB and agree on less expansionary policies than under non-cooperation. This results in a less restrictive monetary stance. A fiscal deficit closer to target and a lower inflation rate allows the social loss under Stackelberg coordination to be lower than under non-coordination. Again, the relative importance attached to deficits is instrumental in the social welfare gain associated with Stackelberg coordination.

The situation is different with *representative* governments because they also aim at containing inflation albeit less than the ECB given their full employment objective. Table 1b indicates that for the baseline parameter settings, monetary *and* fiscal policies are *restrictive*. As usual, Nash cooperation copes with the fiscal free riding problem and now leads to stronger fiscal contractions. The ECB takes full advantage of this (i.e., it free rides) by relaxing its contractionary stance while allowing for lower inflation. The magnified free riding problem between monetary and fiscal authorities implies a deterioration of social welfare with respect to non-coordination. Once again and for the same reasons as in the other scenarios, Stackelberg coordination internalizes the monetary-fiscal free-riding problem and leads to higher social welfare than under non-coordination (i.e., fiscal deficits and unemployment are lower and inflation is slightly higher).

Table1b: Policy responses and welfare losses with supply shocks (baseline)

Regime	Structural deficit	Interest rate	Output	Inflation	Government loss	Social loss
Perfectly symmetric shocks and representative governments						
N	-0.3265	0.7510	-0.7184	0.5633	0.9263	0.9263
C	-0.4734	0.6570	-0.7536	0.4928	0.9532	0.9532
S	-0.2880	0.7757	-0.7091	0.5818	0.9251	0.9251
Perfectly symmetric shocks and liberal governments						
N	0.4295	1.2349	-0.5369	0.9262	0.3805	1.3455
C	0.6465	1.3737	-0.4848	1.0303	0.4440	1.6383
S	0.2755	1.1363	-0.5739	0.8522	0.3673	1.1844
Perfectly asymmetric shocks and representative governments						
N	-0.0569	0	-0.5409	0.9181	0.3996	0.3996
C	0.0759	0	-0.5232	0.9536	0.3903	0.3903
S	0.0759	0	-0.5232	0.9536	0.3903	0.3903
Perfectly asymmetric shocks and liberal governments						
N	0.3855	0	-0.4819	1.0361	0.3066	0.4408
C	0.1373	0	-0.5150	0.9700	0.2747	0.3923
S	0.1373	0	-0.5150	0.9700	0.2747	0.3923

As in the case of demand shocks, we performed a series of sensitivity analyses for “high” and “low” values of the various parameters (assuming representative governments). In most cases, the ranking that prevails under the baseline scenario remains valid. Exceptions are the two cases for which the monetary-fiscal free-riding problem is mild, that is, when the ECB is highly interested in interest rate smoothing and when the real interest rate elasticity of the aggregate demand is low.

C. Perfectly asymmetric shocks

So far, we have assumed that the real disturbances were perfectly positively correlated. Table 1a shows the outcomes and expected losses when the demand shocks are perfectly negatively correlated (i.e., the correlation between ε_1 and ε_1^* is -1), while all other shock correlations are zero and supply shocks are absent. The instrument settings are based on the realizations $\varepsilon_1 = 1$ and $\varepsilon_1^* = -1$ (one might think of a shock to the relative consumer preferences for the two goods). The output realizations and the chosen values for the fiscal instruments are exactly the opposite for the two countries. As a result, average inflation across the currency area is unaffected by the national fiscal policies and the ECB has no incentive to deviate from its interest rate target.

With a passive central bank, the game reduces to a two-player interaction between the national fiscal authorities, so that fiscal coordination (Nash or Stackelberg) benefits both countries whatever the governments' type. Moreover, the Nash coordination equilibrium coincides with the fiscal leadership coordination equilibrium since there is nothing to obtain from a passive central bank. Without coordination, the country hit by a bad (good) shock would choose an excessively expansionary (contractionary) fiscal stance, in an attempt to offset the spillover effect of the fiscal contraction (expansion) in the other country. Coordinating governments recognize the futility of this behavior and limit activism. The less intensive use of the fiscal instrument causes greater deviations of output and inflation from their targets but deficits are kept much closer to their desirable path. Since average inflation is unaffected, the ECB leaves national inflation rates adjust the intra-EMU real exchange rate to its new equilibrium level. As the ECB keeps the interest rate at zero, the parameters β ands ϕ_2 do not affect the outcome.

In the case of perfectly asymmetric supply shocks (i.e., the correlation between ε_2 and ε_2^* is -1), while demand shocks are absent, fiscal coordination generally benefits both types of governments for the same reason as in the case of perfectly asymmetric demand shocks. Only in the special case in which $\delta = 0$ and $\xi = 0$, local inflation or deflation fully offsets (and without any cost to the fiscal authorities) the effects of the supply shocks on output, so that all the instruments can be kept at their target levels and fiscal coordination is irrelevant for the governments' loss.

V. SUMMARY OF THE MAIN RESULTS

In spite of its stylized structure, the model illustrates some key issues in the discussion about the desirability of fiscal coordination when viewed from the perspective of macroeconomic stabilization. First, we have shown that fiscal coordination efforts not based on a strong pre-commitment capacity of the fiscal authorities (i.e., Nash coordination) are very likely to be counterproductive. Second, if national governments enjoy such a pre-commitment capacity, then coordination is often desirable mainly because they can perfectly

anticipate the adverse reaction of the ECB to their decisions and induce the latter to bear a greater share of the stabilization burden. Clearly, this capacity to strategically exploit the first-mover advantage hinges crucially on the assumption of complete information. Should the governments be uncertain about the ECB's reaction, it is not clear this result would still hold. We leave this important point for future research.

Second, fiscal coordination is most likely to be desirable when the European economy is hit by asymmetric (demand or supply) disturbances. In that case, the area-wide price stability objective is not jeopardized by the reactions of fiscal authorities and the optimal monetary policy is passive. Under coordination, fiscal authorities internalize the fact that their mutual actions partially offset each other and they economize on the use of their instruments.

Both the likelihood of counterproductive coordination and its dependence on specific sets of circumstances seem to call for an ex-post type of coordination. However, the fact that pre-commitment capacities and the associated first-mover advantage makes coordination socially desirable rather calls for a more institutionalized approach that is conducive to credible pre-commitments. This tension between the two results rejoins the informal discussion of section II which emphasized the potential importance of measures aiming to formalize coordination efforts with the idea of strengthening the commitment of the negotiating parties whenever coordination is perceived as desirable.

Obviously, the model can only draw our attention to a few broad sets of circumstances in which the likelihood of counterproductive fiscal coordination could be high. In that respect, it is interesting to note that the conventional wisdom according to which fiscal coordination is called for only when large symmetric shocks occur (see Buti and Sapir, 1998) is at odds with our results. Ironically enough, coordination appears to be the most desirable precisely when it could be the hardest to achieve in practice, that is when shocks are strongly asymmetric. Although the model's simplicity allows for such straightforward conclusions, it leads us to neglect some aspects that may be important in reality. First, we have limited the analysis to a small number of "structural" fiscal externalities pointing to positive spillovers. As indicated in section II, terms-of-trade effects could imply broadly negative spillovers. However, that would only affect the conclusions regarding the orientation of the policy mix in specific circumstances and the exercise could easily be extended to the case of negative externalities without affecting the essential qualitative features of the results. Second, the way fiscal policy affects the economy is modeled in a rather simple way. For instance, a given impulse on the structural deficit most likely hides a whole range of measures that also affect the supply-side of the economy. It is indeed a fact that fiscal policy moves according to other objectives than macro stabilization alone (allocation, redistribution, pork-barrel politics, …). Third, we did not address the dynamic effects of fiscal policy through the intertemporal budget constraint and the possible feedback effect on monetary policy through seigniorage.

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APPENDIX 1: SOLUTION TO THE THEORETICAL MODEL

We set all targets equal to zero: $\bar{\pi}_c = \bar{\pi}_c^* = \bar{\pi}^A = \bar{d}_s = \bar{d}_s^* = \bar{y} = \bar{y}^* = \bar{i} = 0$. The solution to the model, derived below, shows that this rules out any systematic (deterministic) debt or inflation bias. In particular, the absence of such an inflation bias means that the inflation expectations rationally formed by market participants are zero: $\pi^e = \pi^{*e} = 0$, which is confirmed below by the fact that the solutions for π and π^* can always be expressed as linear comninations of the various shocks hitting the economies.

Semi-reduced forms for output and inflation

Using (3.1)–(3.8), one derives the following semi-reduced form equations for output and inflation, conditional on the settings of the policy instruments d_s, d_s^* and i:

$$y = h_1 d_s + h_2 d_s^* + h_3 i + h_4 \varepsilon_1 + h_5 \varepsilon_1^* + h_6(\varepsilon_2 - \varepsilon_2^*), \quad (A.1)$$

$$y^* = h_2 d_s + h_1 d_s^* + h_3 i + h_5 \varepsilon_1 + h_4 \varepsilon_1^* - h_6(\varepsilon_2 - \varepsilon_2^*), \quad (A.2)$$

$$\pi = \frac{h_1}{\omega} d_s + \frac{h_2}{\omega} d_s^* + \frac{h_3}{\omega} i + \frac{h_4}{\omega} \varepsilon_1 + \frac{h_5}{\omega} \varepsilon_1^* + \left(\frac{h_6 - 1}{\omega}\right)\varepsilon_2 - \frac{h_6}{\omega}\varepsilon_2^*, \quad (A.3)$$

$$\pi^* = \frac{h_2}{\omega} d_s + \frac{h_1}{\omega} d_s^* + \frac{h_3}{\omega} i + \frac{h_5}{\omega} \varepsilon_1 + \frac{h_4}{\omega} \varepsilon_1^* - \frac{h_6}{\omega}\varepsilon_2 + \left(\frac{h_6 - 1}{\omega}\right)\varepsilon_2^*, \quad (A.4)$$

where

$$h_1 = \left[\frac{1}{1+\phi_1\alpha+\gamma}\right]\left\{\left[\frac{(1+\phi_1\alpha)\phi_1}{1+\phi_1\alpha-\gamma}\right] - \left[\frac{\phi_1\delta}{\omega(1+\phi_1\alpha+\gamma)+2\delta}\right]\right\} > 0,$$

$$h_2 = \left[\frac{1}{1+\phi_1\alpha+\gamma}\right]\left\{\left[\frac{\gamma\phi_1}{1+\phi_1\alpha-\gamma}\right] + \left[\frac{\phi_1\delta}{\omega(1+\phi_1\alpha+\gamma)+2\delta}\right]\right\} > 0,$$

$$h_3 = -\left[\frac{\phi_2}{1+\phi_1\alpha-\gamma}\right] < 0,$$

$$h_4 = \left[\frac{1}{1+\phi_1\alpha+\gamma}\right]\left\{\left[\frac{1+\phi_1\alpha}{1+\phi_1\alpha-\gamma}\right] - \left[\frac{\delta}{\omega(1+\phi_1\alpha+\gamma)+2\delta}\right]\right\} > 0,$$

$$h_5 = \left[\frac{1}{1+\phi_1\alpha+\gamma}\right]\left\{\left[\frac{\gamma}{1+\phi_1\alpha-\gamma}\right] + \left[\frac{\delta}{\omega(1+\phi_1\alpha+\gamma)+2\delta}\right]\right\} > 0,$$

$$h_6 = \left[\frac{\delta}{\omega(1+\phi_1\alpha+\gamma)+2\delta}\right] > 0.$$

The "format" of these solutions for y, y^*, π and π^*, conditional on the settings of the policy instruments is, of course, valid across the three regimes we consider.

We now derive the ECB's reaction function, which also holds across all the regimes. The first order condition for the monetary authority is

$$\frac{1}{4}(\pi + \pi^*)\left(\frac{\partial \pi}{\partial i} + \frac{\partial \pi^*}{\partial i}\right) + \beta i = 0. \quad (A.5)$$

Using (A.3) and (A.4), some algebra yields:

$$i = a_1(d_s + d_s^*) + a_2(\varepsilon_1 + \varepsilon_1^*) - a_3(\varepsilon_2 + \varepsilon_2^*), \quad (A.6)$$

where

$$a_1 = -\left[\frac{h_3(h_1 + h_2)}{2(h_3^2 + \beta\omega^2)}\right] > 0,$$
$$a_2 = -\left[\frac{h_3(h_4 + h_5)}{2(h_3^2 + \beta\omega^2)}\right] > 0,$$
$$a_3 = -\left[\frac{h_3}{2(h_3^2 + \beta\omega^2)}\right] > 0.$$

We now turn to the computation of the fiscal reaction functions under the three possible regimes. Given the symmetry of the model, we only need to compute the Home fiscal authority's reaction functions.

Nash non-coordination

The first order conditions for the Home fiscal authority are:

$$d_s + \theta y\left(\frac{\partial y}{\partial d_s}\right) + \xi\left(\pi + \eta\pi^*\right)\left(\frac{\partial \pi}{\partial d_s} + \eta\frac{\partial \pi^*}{\partial d_s}\right) = 0. \quad (A.7)$$

Using (A.1), (A.3) and (A.4), some algebra yields the following reaction function for the Home fiscal authority:

$$d_s = b_1^N i - b_2^N d_s^* - b_3^N \varepsilon_1 - b_4^N \varepsilon_1^* - b_5^N \varepsilon_2 - b_6^N \varepsilon_2^*, \quad (A.8)$$

where

$$b_1^N = -\left[\frac{h_1 h_3 \theta + m_1 m_3 \xi / \omega^2}{D^N}\right] > 0, \quad b_2^N = \left[\frac{h_1 h_2 \theta + m_1 m_2 \xi / \omega^2}{D^N}\right] > 0,$$
$$b_3^N = \left[\frac{h_1 h_4 \theta + m_1 m_4 \xi / \omega^2}{D^N}\right] > 0, \quad b_4^N = \left[\frac{h_1 h_5 \theta + m_1 m_5 \xi / \omega^2}{D^N}\right] > 0,$$
$$b_5^N = \left[\frac{h_1 h_6 \theta + m_1 m_6 \xi / \omega^2}{D^N}\right] > 0, \quad b_6^N = \left[\frac{-h_1 h_6 \theta + m_1 m_7 \xi / \omega^2}{D^N}\right] > 0$$

where

$$D^N = 1 + h_1^2 \theta + m_1^2 \xi / \omega^2 > 0,$$

and

$$m_1 = h_1 + \eta h_2 > 0, \quad m_2 = h_2 + \eta h_1 > 0, \quad m_3 = (1+\eta) h_3 < 0,$$
$$m_4 = h_4 + \eta h_5 > 0, \quad m_5 = h_5 + \eta h_4 > 0, \quad m_6 = (1-\eta) h_6 - 1 < 0,$$
$$m_7 = (\eta - 1) h_6 - \eta < 0. \quad (A.9)$$

Check on the stability of the equilibrium

Holding monetary policy fixed, a stable Nash equilibrium in the game between the fiscal authorities is obtained if and only if the reaction function of the Home fiscal authority is steeper than that of the Foreign fiscal authority (assuming that d_s is on the horizontal axis and d_s^* is on the vertical axis). This is the case if and only if $b_2^N < 1$. This condition can be rewritten as

$$\left(h_2 - h_1\right)\left[h_1\theta + \left(h_1 + \eta h_2\right)(1-\eta)\xi/\omega^2\right] < 1.$$

The term in square brackets is positive, while $h_2 - h_1 < 0$. Hence, this condition is fulfilled.

When do fiscal policies become strategic complements?

Now we establish the condition under which the fiscal policies become strategic complements when the ECB's reaction function is taken into account. To keep things manageable, we set $\eta = 0$, only in this subsection. Substitute (A.6) into (A.8) and rewrite to give

$$d_s^N = \left(\frac{b_1^N a_1 - b_2^N}{1 - b_1^N a_1}\right) d_s^{*,N} + \left(\frac{b_1^N a_2 - b_3^N}{1 - b_1^N a_1}\right)\varepsilon_1 + \left(\frac{b_1^N a_2 - b_4^N}{1 - b_1^N a_1}\right)\varepsilon_1^* - \left(\frac{b_1^N a_3 + b_5^N}{1 - b_1^N a_1}\right)\varepsilon_2 - \left(\frac{b_1^N a_3 + b_6^N}{1 - b_1^N a_1}\right)\varepsilon_2^*.$$

The two fiscal policies are strategic substitutes as long as $\frac{b_1^N a_1 - b_2^N}{1 - b_1^N a_1} < 0$ and strategic complements when $\frac{b_1^N a_1 - b_2^N}{1 - b_1^N a_1} > 0$. The borderline case, in which a change in one country's fiscal policy no longer affects the other country's fiscal policy, is obtained when $b_1^N a_1 = b_2^N$, which reduces to $-h_3 a_1 = h_2$. Using the definition of a_1, we find that this is equivalent to

$$\frac{\phi_2^2}{\left(1+\phi_1\alpha-\gamma\right)^2}\left[\frac{\phi_1}{1+\phi_1\alpha+\gamma}\right]\left[1-\frac{2\delta}{\omega\left(1+\phi_1\alpha+\gamma\right)+2\delta}\right]=\left[\frac{2\phi_1\beta\omega^2}{1+\phi_1\alpha+\gamma}\right]\left[\frac{\gamma}{1+\phi_1\alpha-\gamma}+\frac{\delta}{\omega\left(1+\phi_1\alpha+\gamma\right)+2\delta}\right]\Leftrightarrow$$

$$\frac{\phi_2^2}{\left(1+\phi_1\alpha-\gamma\right)^2}\left[\frac{\phi_1\omega\left(1+\phi_1\alpha+\gamma\right)}{\omega\left(1+\phi_1\alpha+\gamma\right)+2\delta}\right]=2\phi_1\beta\omega^2\left[\frac{\gamma\omega\left(1+\phi_1\alpha+\gamma\right)+2\gamma\delta+\left(1+\phi_1\alpha-\gamma\right)\delta}{\left(1+\phi_1\alpha-\gamma\right)\left[\omega\left(1+\phi_1\alpha+\gamma\right)+2\delta\right]}\right]\Leftrightarrow$$

$$\frac{\phi_2^2}{\left(1+\phi_1\alpha-\gamma\right)}=2\beta\omega\left(\gamma\omega+\delta\right)\Leftrightarrow$$

$$\beta=\frac{\phi_2^2}{2\omega\left(\gamma\omega+\delta\right)\left(1+\phi_1\alpha-\gamma\right)}.$$

Nash coordination

The first-order condition for the Home fiscal authority is

$$d_s+\theta y\left(\frac{\partial y}{\partial d_s}\right)+\xi\left(\pi+\eta\pi^*\right)\left(\frac{\partial\pi}{\partial d_s}+\eta\frac{\partial\pi^*}{\partial d_s}\right)+\theta y^*\left(\frac{\partial y^*}{\partial d_s}\right)+$$
$$\xi\left(\pi^*+\eta\pi\right)\left(\frac{\partial\pi^*}{\partial d_s}+\eta\frac{\partial\pi}{\partial d_s}\right)=0. \qquad (A.10)$$

Using (A.1)-(A.4), some algebra yields the following reaction function for the Home fiscal authority:

$$d_s=b_1^C i-b_2^C d_s^*-b_3^C\varepsilon_1-b_4^C\varepsilon_1^*-b_5^C\varepsilon_2-b_6^C\varepsilon_2^*,$$

where

$$b_1^C = -\left[\frac{(h_1+h_2)h_3\theta + (m_1+m_2)m_3\xi/\omega^2}{D^C}\right] > 0,$$

$$b_2^C = \left[\frac{2h_1h_2\theta + 2m_1m_2\xi/\omega^2}{D^C}\right] > 0,$$

$$b_3^C = \left[\frac{(h_1h_4+h_2h_5)\theta + (m_1m_4+m_2m_5)\xi/\omega^2}{D^C}\right] > 0,$$

$$b_4^C = \left[\frac{(h_1h_5+h_2h_4)\theta + (m_1m_5+m_2m_4)\xi/\omega^2}{D^C}\right] > 0,$$

$$b_5^C = \left[\frac{(h_1-h_2)h_6\theta + (m_1m_6+m_2m_7)\xi/\omega^2}{D^C}\right] > 0,$$

$$b_6^C = \left[\frac{(h_2-h_1)h_6\theta + (m_1m_7+m_2m_6)\xi/\omega^2}{D^C}\right] > 0,$$

where

$$D^C = 1 + (h_1^2+h_2^2)\theta + (m_1^2+m_2^2)\xi/\omega^2 > 0.$$

Stackelberg coordination

The first-order condition for the home fiscal authority is of the same format as (A.10), except that now

$$\frac{\partial\pi}{\partial d_s} = h_1 + h_3a_1,$$

$$\frac{\partial\pi}{\partial d_s} + \eta\frac{\partial\pi^*}{\partial d_s} = \frac{h_1}{\omega} + \frac{h_3}{\omega}a_1 + \eta\frac{h_2}{\omega} + \eta\frac{h_3}{\omega}a_1 = \frac{1}{\omega}(m_1 + m_3a_1),$$

$$\frac{\partial y^*}{\partial d_s} = h_2 + h_3a_1,$$

$$\frac{\partial\pi^*}{\partial d_s} + \eta\frac{\partial\pi}{\partial d_s} = \frac{1}{\omega}(m_2 + m_3a_1).$$

Using (A.1)-(A.4), we obtain the following reaction function for the Home fiscal authority:

$$d_s = b_1^S i - b_2^S d_s^* - b_3^S \varepsilon_1 - b_4^S \varepsilon_1^* - b_5^S \varepsilon_2 - b_6^S \varepsilon_2^*.$$

where

$$b_1^S = -\left[\frac{(h_1 + h_2 + 2h_3 a_1)h_3\theta + (m_1 + m_2 + 2m_3 a_1)m_3\xi/\omega^2}{D^S}\right],$$

$$b_2^S = \frac{[(h_1 + h_3 a_1)h_2 + (h_2 + h_3 a_1)h_1]\theta + [(m_1 + m_3 a_1)m_2 + (m_2 + m_3 a_1)m_1]\xi/\omega^2}{D^S},$$

$$b_3^S = \frac{[(h_1 + h_3 a_1)h_4 + (h_2 + h_3 a_1)h_5]\theta + [(m_1 + m_3 a_1)m_4 + (m_2 + m_3 a_1)m_5]\xi/\omega^2}{D^S},$$

$$b_4^S = \frac{[(h_1 + h_3 a_1)h_5 + (h_2 + h_3 a_1)h_4]\theta + [(m_1 + m_3 a_1)m_5 + (m_2 + m_3 a_1)m_4]\xi/\omega^2}{D^S},$$

$$b_5^S = \frac{(h_1 - h_2)h_6\theta + [(m_1 + m_3 a_1)m_6 + (m_2 + m_3 a_1)m_7]\xi/\omega^2}{D^S},$$

$$b_6^S = \frac{(h_2 - h_1)h_6\theta + [(m_1 + m_3 a_1)m_7 + (m_2 + m_3 a_1)m_6]\xi/\omega^2}{D^S},$$

and

$$D^S = 1 + [(h_1 + h_3 a_1)h_1 + (h_2 + h_3 a_1)h_2]\theta + [(m_1 + m_3 a_1)m_1 + (m_2 + m_3 a_1)m_2]\xi/\omega^2.$$

Reduced forms for policy instruments and expected losses

In the preceding subsections of the appendix, we have derived the system (3.16)-(3.18), for each regime r ($r = N$, C and S). Some algebra yields the following syste for each regime r:

$$\begin{aligned} i &= k_1^r(\varepsilon_1 + \varepsilon_1^*) - k_2^r(\varepsilon_2 + \varepsilon_2^*), \\ d_s &= c_1^r i + c_2^r \varepsilon_1 + c_3^r \varepsilon_1^* + c_4^r \varepsilon_2 + c_5^r \varepsilon_2^*, \\ d_s^* &= c_1^r i + c_2^r \varepsilon_1^* + c_3^r \varepsilon_1 + c_4^r \varepsilon_2^* + c_5^r \varepsilon_2, \end{aligned} \tag{A.11}$$

where

$$c_1^r = \frac{b_1^r}{1+b_2^r}, \quad c_2^r = \frac{b_2^r b_4^r - b_3^r}{1-\left(b_2^r\right)^2}, \quad c_3^r = \frac{b_2^r b_3^r - b_4^r}{1-\left(b_2^r\right)^2},$$
$$c_4^r = \frac{b_2^r b_6^r - b_5^r}{1-\left(b_2^r\right)^2}, \quad c_5^r = \frac{b_2^r b_5^r - b_6^r}{1-\left(b_2^r\right)^2},$$
$$k_1^r = \frac{a_2\left(1+b_2^r\right) - a_1\left(b_3^r + b_4^r\right)}{1+b_2^r - 2a_1 b_1^r}, \quad k_2^r = \frac{a_3\left(1+b_2^r\right) + a_1\left(b_5^r + b_6^r\right)}{1+b_2^r - 2a_1 b_1^r}.$$

We can further solve it to yield the reduced forms for the fiscal reaction functions:

$$d_s = \left(c_1^r k_1^r + c_2^r\right)\varepsilon_1 + \left(c_1^r k_1^r + c_3^r\right)\varepsilon_1^* - \left(c_1^r k_2^r - c_4^r\right)\varepsilon_2 - \left(c_1^r k_2^r - c_5^r\right)\varepsilon_2^*, \tag{A.12}$$

$$d_s^* = \left(c_1^r k_1^r + c_2^r\right)\varepsilon_1^* + \left(c_1^r k_1^r + c_3^r\right)\varepsilon_1 - \left(c_1^r k_2^r - c_4^r\right)\varepsilon_2^* - \left(c_1^r k_2^r - c_5^r\right)\varepsilon_2. \tag{A.13}$$

Substitute the reduced forms for the interest rate, (A.11), and the structural deficits, (A.12) and (A.13), into (A.1) and (A.3) to obtain the reduced forms for Home output and inflation, respectively:

$$y = q_1^r\varepsilon_1 + q_2^r\varepsilon_1^* + q_3^r\varepsilon_2 + q_4^r\varepsilon_2^*,$$
$$\pi = \frac{q_1^r}{\omega}\varepsilon_1 + \frac{q_2^r}{\omega}\varepsilon_1^* + \left(\frac{q_3^r - 1}{\omega}\right)\varepsilon_2 + \left(\frac{q_4^r}{\omega}\right)\varepsilon_2^*,$$

where

$$q_1^r = h_1\left(c_1^r k_1^r + c_2^r\right) + h_2\left(c_1^r k_1^r + c_3^r\right) + h_3 k_1^r + h_4,$$
$$q_2^r = h_1\left(c_1^r k_1^r + c_3^r\right) + h_2\left(c_1^r k_1^r + c_2^r\right) + h_3 k_1^r + h_5,$$
$$q_3^r = -h_1\left(c_1^r k_2^r - c_4^r\right) - h_2\left(c_1^r k_2^r - c_5^r\right) - h_3 k_2^r + h_6,$$
$$q_4^r = -h_1\left(c_1^r k_2^r - c_5^r\right) - h_2\left(c_1^r k_2^r - c_4^r\right) - h_3 k_2^r - h_6.$$

Similar expressions can be obtained for Foreign output and inflation. The Home CPI is then given by:

$$\pi_c = \frac{n_1^r}{\omega}\varepsilon_1 + \frac{n_2^r}{\omega}\varepsilon_1^* + \frac{n_3^r}{\omega}\varepsilon_2 + \frac{n_4^r}{\omega}\varepsilon_2^*,$$

where

$$n_1^r = q_1^r + \eta q_2^r, \quad n_2^r = q_2^r + \eta q_1^r,$$
$$n_3^r = q_3^r - 1 + \eta q_4^r, \quad n_4^r = q_4^r + \eta\left(q_3^r - 1\right)$$

The expected social losses and the expected losses of the Home fiscal authority are given by, respectively

$$E[L_s] = \frac{1}{2}\theta E[y^2] + \frac{1}{2}E[\pi_c^2]$$
$$E[L_F] = \frac{1}{2}E[d_s^2] + \frac{1}{2}\theta E[y^2] + \frac{1}{2}\xi E[\pi_c^2],$$

where

$$E[d_s^2] = \left(c_1^r k_1^r + c_2^r\right)^2 \sigma_{\varepsilon_1}^2 + \left(c_1^r k_1^r + c_3^r\right)^2 \sigma_{\varepsilon_1^*}^2 +$$
$$2\left(c_1^r k_1^r + c_2^r\right)\left(c_1^r k_1^r + c_3^r\right)\rho_{\varepsilon_1^*\varepsilon_1}\sigma_{\varepsilon_1^*}\sigma_{\varepsilon_1} +$$
$$\left(c_1^r k_2^r - c_4^r\right)^2 \sigma_{\varepsilon_2}^2 + \left(c_1^r k_2^r - c_5^r\right)^2 \sigma_{\varepsilon_2^*}^2 +$$
$$2\left(c_1^r k_2^r - c_4^r\right)\left(c_1^r k_2^r - c_5^r\right)\rho_{\varepsilon_2^*\varepsilon_2}\sigma_{\varepsilon_2^*}\sigma_{\varepsilon_2},$$

$$E[y^2] = \left(q_1^r\right)^2 \sigma_{\varepsilon_1}^2 + \left(q_2^r\right)^2 \sigma_{\varepsilon_1^*}^2 + 2q_1^r q_2^r \rho_{\varepsilon_1^*\varepsilon_1}\sigma_{\varepsilon_1^*}\sigma_{\varepsilon_1} +$$
$$\left(q_3^r\right)^2 \sigma_{\varepsilon_2}^2 + \left(q_4^r\right)^2 \sigma_{\varepsilon_2^*}^2 + 2q_3^r q_4^r \rho_{\varepsilon_2^*\varepsilon_2}\sigma_{\varepsilon_2^*}\sigma_{\varepsilon_2},$$

$$E[\pi_c^2] = \frac{1}{\omega^2}\begin{bmatrix}\left(n_1^r\right)^2 \sigma_{\varepsilon_1}^2 + \left(n_2^r\right)^2 \sigma_{\varepsilon_1^*}^2 + 2n_1^r n_2^r \rho_{\varepsilon_1^*\varepsilon_1}\sigma_{\varepsilon_1^*}\sigma_{\varepsilon_1} + \\ \left(n_3^r\right)^2 \sigma_{\varepsilon_2}^2 + \left(n_4^r\right)^2 \sigma_{\varepsilon_2^*}^2 + 2n_3^r n_4^r \rho_{\varepsilon_2^*\varepsilon_2}\sigma_{\varepsilon_2^*}\sigma_{\varepsilon_2}\end{bmatrix},$$

and where $\rho_{\varepsilon_1^*\varepsilon_1}$ and $\rho_{\varepsilon_2^*\varepsilon_2}$ are the correlation coefficients between ε_1^* and ε_1 and ε_2^* and ε_2, respectively. We have made the assumption that all the other shock correlations are zero.

APPENDIX II: FIGURES

Figure 1: fiscal reaction functions

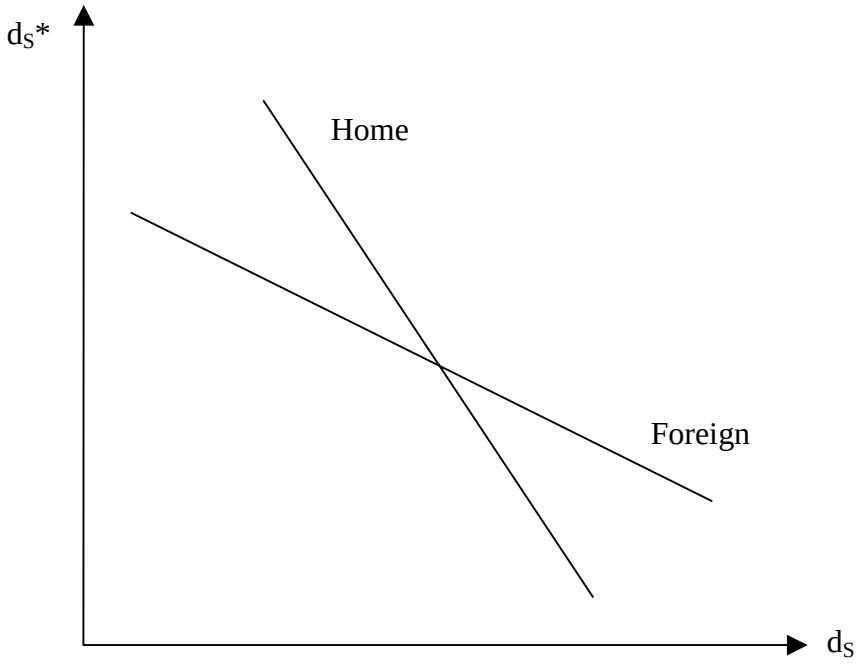

Figure 2a: fiscal reaction functions with the ECB's reaction substituted out: $\beta > \beta^*$

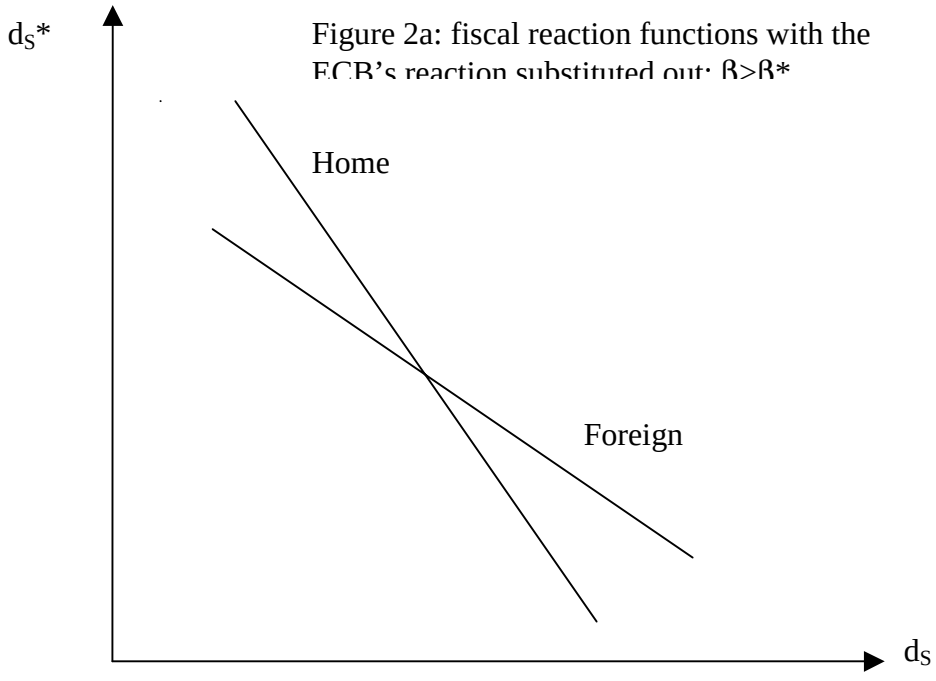

Figure 2b: fiscal reaction functions with the ECB's reaction substituted out: β=β*

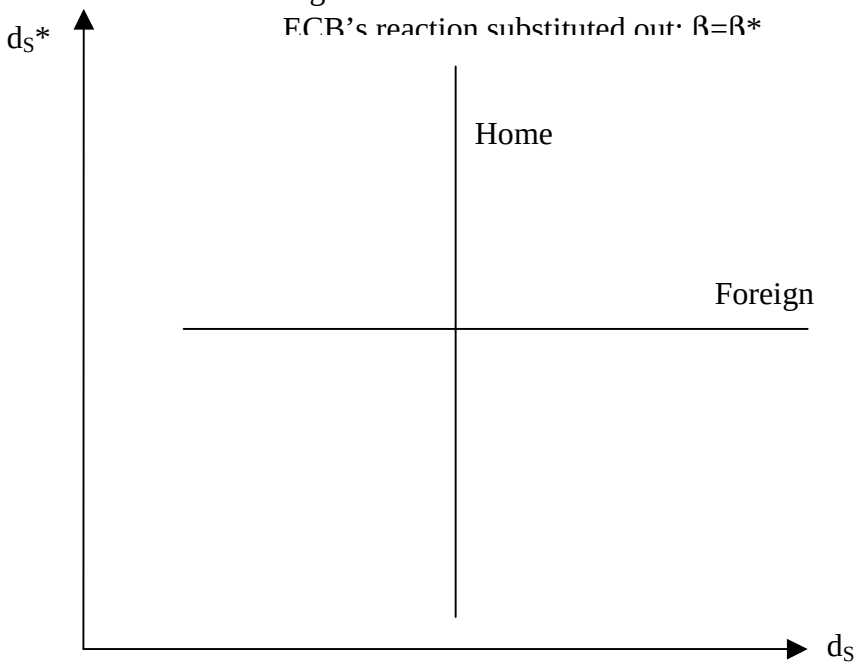

Figure 2c: fiscal reaction functions with the ECB's reaction substituted out: β<β*