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**Strategic interactions between monetary and
fiscal authorities in a monetary union***

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Abstract

In this paper we extend Nordhaus' (1994) results to an environment which may represent the current European situation, characterised by a single monetary authority and several fiscal bodies. We show that: a) co-operation among national fiscal authorities is welfare improving only if they also co-operate with the central bank; b) when this condition is not satisfied, fiscal rules, as those envisaged in the Maastricht Treaty and in the Stability and Growth Pact, may work as co-ordination devices that improve welfare; c) the relationship between several treasuries and a single central bank makes the fiscal leadership solution collapse to the Nash one, so that, contrary to Nordhaus (1994) and Dixit and Luisa Lambertini (2001), when moving from the Nash to the Stackelberg solution, fiscal discipline no longer obtains. Also in this case we thus argue in favour of fiscal rules in a monetary union.

Key words: Fiscal and monetary policy co-ordination; monetary union; international fiscal issues.

JEL Classification: E61; F42; H87.

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1 Introduction[1]

In this paper we extend Nordhaus' (1994) results to an environment which may represent the current European situation, characterised by a single monetary authority and several fiscal bodies. As a matter of fact, while in the US context the game between the Treasury and the Fed may produce results that are easily interpretable within the Nordhaus' approach, such a model needs to be modified in order to analyse the game between the ECB and the different national treasuries. The recent enlargement of the European Union provides a further justification for our analysis. We consider an open economy and, in particular, the case of a two-country monetary union. Our aim is to provide an analytical framework for the analysis of the monetary and fiscal interactions implied by the clauses of the Maastricht Treaty and of the Stability and Growth Pact.

The starting point is considering macroeconomic policy as conducted through two instruments, monetary and fiscal policy, and defined by three objectives, price and fiscal stability, and full employment. We assume that monetary and fiscal authorities, while sharing the same model of the economy, assign different weights to their objectives: the former cares more about inflation, while the latter is more concerned about unemployment.

Given this background, in this paper we make three distinct points: a) co-operation among national fiscal authorities is welfare improving only if they also co-operate with the central bank; b) when this condition is not satisfied, fiscal rules, as those envisaged in the Maastricht Treaty and in the Stability and Growth Pact, allow to reach a better outcome; c) the relationship between several treasuries and a single central bank makes the fiscal leadership solution collapse to the Nash one, so that, contrary to Nordhaus (1994) and Dixit and Luisa Lambertini (2001), fiscal discipline no longer obtains when moving from the Nash to the Stackelberg solution. Also in this case we thus conclude for the opportunity of fiscal rules in a monetary union.

The paper is organised as follows. First, we present a brief overview of the literature (section 2). Then, the different features of the strategic relationship between monetary and fiscal authorities in the US and in the EU are analysed (section 3). The model and its solutions are derived in section 4, where we consider first the mirror image countries case and then the small country case. Some concluding remarks summarise and end our analysis.

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2 Review of the literature

Nordhaus (1994) considers the strategic relationship between a fiscal and a monetary authority aiming at choosing optimally their respective instruments in order to minimise their loss functions. When a Nash game is played, he finds that the lack of co-operation is responsible for an inefficient policy mix, often observed in reality, resulting in an excessively restrictive monetary and an excessively expansionary fiscal policy[2].

The solution of a Stackelberg game (with the fiscal authority playing as a leader, i.e. taking the central bank's monetary rule into account) Pareto dominates the Nash outcome[3]. This result is explained by the difference in the objectives of the two authorities. The fiscal authority tries to fight unemployment by means of an expansionary policy, but the central bank reacts by means of a contractionary monetary policy to keep inflation under control. The outcome is a too expansionary fiscal policy in the Nash equilibrium. When the fiscal authority plays the role of a Stackelberg leader[4], it will act in a less expansionary way, so as to allow the central bank to follow a more relaxed policy[5].

Several reasons, however, justify some skepticism about this result, so as to support the imposition of fiscal rules. As a matter of fact, many authors

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[2]The same conclusion is reached by Carraro, 1986 and Tabellini, 1987. Hughes Hallet and Petit (1990) also underline the costs deriving from the lack of co-operation between fiscal and monetary policy. They find, however, that the fiscal expansion - monetary restriction policy mix is efficient, and results from a co-operative game in which the government dominates and the central bank is allowed the freedom to fight inflation.

[3]Luca Lambertini and Rovelli (2002) show that the Stackelberg solution always Pareto dominates the Nash one, independently of who is the leader of the game.

[4]Nordhaus (1994) defines such a case as characterised by a monetary rule, arguing that the fiscal authority would be obliged to optimise its utility function, subject to the rules strictly followed by an independent and conservative central bank.

[5]The Stackelberg solution, though being Pareto superior to the Nash one, is worse than the co-operative one. As a matter of fact, co-operation between fiscal and monetary authorities would allow to choose a solution included between their respective bliss points. In opposition to this conclusion, however, Blinder (1983) finds co-ordination (for reasons that will be explained later on, we would find more appropriate to talk about co-operation) between monetary and fiscal policy both difficult to implement and not necessarily conducive to superior outcomes. In his view, the possibility to block each other's options should be preserved, as made clear by the short example quoted in Carraro (1986). The example refers to a car that is used to learn how to drive. While it would seem efficient to endow just one guide with brakes, there might be some situations in which the availability of a second brake might turn out to be particularly useful. The example seems to reflect particularly well the fact that, over the last twenty years, as we will further argue in the next paragraph, the US have never followed both restrictive monetary and fiscal policies: when fiscal policy was expansionary, monetary policy has been restrictive and vice-versa.

would argue that governments always find ways to influence the decisions of a formally independent central bank. This influence may be either direct (sheer political pressure) or indirect (appointment of board members), so that discrepancies between constitutional (or statutory) and actual central bank independence may arise (Beetsma and Bovenberg, 1998; Cuckierman, 1994)[6]. Moreover, even when independence is granted the central bank might not be conservative enough to be able to commit to tight monetary policies that in turn should induce fiscal discipline. This is why most institutional arrangements not only include central bank independence but also conservativeness, the former not necessarily implying the latter.

Central bank conservativeness, however, may still not be enough to induce fiscal discipline. As a matter of fact, Beetsma and Bovenberg (1997), by considering a model in which public debt enters the objective function of the fiscal authorities, show that in the presence of political distortions (the fiscal authority is myopic, i.e. it is more impatient than society) or opportunistic behaviour (the fiscal authority cares less about inflation than society does, and it does not care sufficiently about debt stabilization), a conservative central bank will not be capable to reduce the public debt bias. Moreover, when considering a co-operative equilibrium, central bank conservativeness might not be enough to guarantee fiscal discipline, as proved, among others, by Van Aarle, Bovenberg and Raith (1995). They show that a conservative central bank may exert a perverse effect on the fiscal authority, since the aggregate concern for debt stabilization gets reduced. The arguments above provide, then, some clear justifications for the imposition of fiscal rules.

When considering a monetary union, characterised by a single central bank and several national fiscal authorities, some further arguments justify the introduction of fiscal rules, like those contained both in the Maastricht Treaty and in the Stability and Growth Pact. Bovenberg, Kremers and Masson (1991, quoted in Van Aarle, Bovenberg and Raith, 1997) describe several channels through which monetary unification can make fiscal policy more expansionary. Both the cost of borrowing and the burden of public debt on the domestic economy are not internalised since they are partially shifted to other countries[7]. Country risk is removed, given the implicit insurance result-

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[6]The presence of a high level of public debt provides an additional reason for running expansionary monetary policies in order to reduce its burden (Beetsma and Bovenberg, 1997). Contrary to this conclusion, in Nordhaus' model central bank independence is to be blamed for public debt explosion.

[7]Aizenman, (1992 and 1993) shows that a monetary union with decentralised fiscal decision making produces both an inflationary bias and excessive public spending (it should be noted that in this case the inefficient policy mix is made of expansionary monetary and fiscal policies).

ing from the participation to a currency union where economic and financial stability is a public good. In addition to that, the elimination of currency risk encourages the residents of other countries to invest in government debt, so that fiscal authorities can easily borrow on the international markets to finance their expenditure. Moreover, since common monetary policy cannot be used to face country-specific shocks, fiscal policy may have to do the job. In other words, the disciplining market mechanism, that might work when a fiscal authority faces its domestic central bank, fails (Papadia and Ruggiero, 1999). Similar considerations are made by Beetsma and Bovenberg (1999), in line with the findings of Chari and Kehoe (1998). In a closed economy, when the credibility of the central bank is assumed to be a public good, in the presence of a non credible central bank the fiscal authority restraints debt accumulation in order to enhance the credibility of future monetary policies. In a monetary union, however, the separate fiscal authorities may not fully internalise the cost of the additional inflation resulting from the need to reduce the real value of the public debt, since part of these costs spills over to other countries. In such a situation, the second best can be achieved by supplementing the central bank with debt targets on the fiscal authorities, so as to alleviate the free rider problem[8].

Dixit (2001) and Dixit and Luisa Lambertini (2001, 2003a, 2003b) provide an additional reason for the introduction of fiscal constraints in a monetary union. Fiscal rules are useful precisely to make the central bank's commitment to low inflation credible[9]. They show that with monetary leadership (i.e. when the monetary authority takes into account the fiscal authorities' reaction function), fiscal discretion may destroy monetary commitment. When fiscal authorities do not care about monetary independence, fiscal policy will keep being expansionary even in the presence of a restrictive monetary policy, so that monetary authorities end up acting in an expansionary way in order to avoid a debt explosion. With fiscal leadership, on the other hand, the fiscal authorities will take into account the monetary authority's reaction function, so that fiscal policy will become more moderate. This result is also obtained, as we have seen, by Nordhaus (1994), when considering the game between national monetary and fiscal authorities.

Van Aarle, Bovenberg and Raith (1997), by extending the model proposed by Tabellini (1986), analyse the strategic game between domestic treasuries and a central bank aiming at reducing public debt. Contrary to the results-

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[8]In line with these results, Casella (1992), Alesina and Grilli (1993) and Bayoumi (1994) show that the attractiveness of entering a currency union decreases with the number of participants.

[9]Similar considerations have been made by Artis and Winkler (1998).

mentioned above, they show that, when considering feedback strategies[10], debt stabilization happens more quickly with a common central bank than with separate ones. The reason for such a conclusion is that any fiscal authority participating to the monetary union knows that, if it does not adjust, the central bank will not react to such an imbalance, since it will only respond to a generalised higher public debt. In other words, in a monetary union the fiscal authority of any single country has a weaker strategic position *vis-à-vis* the central bank compared to the case in which it faces a national central bank. Any national treasury caring about the size of public debt, then, will reduce its fiscal deficit. This effect, however, vanishes as soon as countries co-operate, since this situation replicates the one in which a single treasury faces a single central bank. As long as governments fail to co-operate, then, moving to a monetary union thus improves fiscal discipline and monetary stability, thereby making the need for the imposition of fiscal rules less stringent.[11]

In the model that we present we show on the one hand that when considering the fiscal authorities of two identical countries, co-operation between them is welfare improving only if they also co-operate with the central bank (a result which recalls the one obtained by Van Aarle, Bovenberg and Raith, 1997), and on the other hand that the smaller the single country is with respect to the rest of the monetary union, the smaller its incentive to follow fiscal discipline becomes, thus justifying the introduction of fiscal rules.

3 The strategic game between monetary and fiscal authorities: United States versus Europe

The strategic relationship between monetary and fiscal authorities presents different features in the US and in Europe. As for the US case, it is easy to verify that the Regan-Volcker years have been characterised by an expansionary fiscal policy associated with a strongly contractionary monetary policy[12]. Moving to consider the Clinton Administration, and in particular

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[10]When considering a dynamic game, while in the case of open loop strategies a player takes the opponent's action as given, in the case of a feedback (closed loop) strategy a player takes into account the opponent's reaction function.

[11]A similar conclusion is reached by Beetsma and Bovenberg (1998).

[12]Kishan and Opiela (2000) show that the pre-Reagan/Bush and pre-Volcker/Greenspan eras were characterized by a non co-operative game between monetary and fiscal policy and that the Reagan/Bush and Volcker/Greenspan regimes were consistent, instead, with a co-operative game in which fiscal policy dominates and monetary policy accommodates.

the 1993 legislation aimed at reducing the US structural budget deficit, it is also easy to observe that the policy mix got reversed: a restrictive fiscal policy was accompanied by a relatively expansionary monetary policy[13]. According to Nordhaus, 1994: "This fiscal package was a high-stake gamble that productive investment would indeed rise and that the contractionary effect would be offset either by monetary policy or by strong private investment and consumption" (p. 140)[14].

In particular, the Clinton Administration "hoped that the Fed, which is formally independent of the administration, would endorse the plan's general characteristics and indicate that it would use expansionary monetary policy to offset the contractionary effects of tax increases and spending cuts" (Blanchard, 1997, p. 199)[15]. In Blanchard's view, financial markets believed that the Fed would indeed "offer Bill Clinton easy money for a real swipe of the budget deficit" (The Financial Times, March 13, 1993, quoted in Blanchard, 1997, note 10, p. 199). In our view, the implementation of an expansionary monetary policy clearly indicated the Fed's willingness to help the Clinton Administration in the reduction of the budget deficit.

The present years seem to slightly modify these conclusions, but still show the presence of a coordination between fiscal and monetary policies: in a phase of economic difficulty determined by various reasons (the explosion of the speculative bubble inflated by the perspectives of the 'new economy', the 11th of September 2001 terrorist attack and the wars in Afghanistan and Iraq), the economic policy jointly conducted by the Fed and the Treasury did not fail to show expansionary characteristics aimed at contrasting the danger of recession and crisis.

The attempt to co-ordinate monetary and fiscal policy in order to check for inflation while assuring an adequate output growth, is also common to many OECD countries, where monetary tightening is typically accompanied by fiscal relaxation (Hughes Hallet, 2001). The same was also true for Europe up to 1990[16]. During the years preceding the EMU, however, such a

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[13]Woodward (1995, quotation in Blanchard, 2003) provides an account of the first two years of the Clinton administration, suggesting reading the interaction between the Fed and the US Treasury within the game theoretic approach described above.

[14]Even during the Clinton administration, however, according to Nordhaus (1994) the policy mix was characterised by a not expansionary enough monetary policy (Stiglitz, 2001, also underlines the sluggishness of the monetary authority in responding to the Clinton's Administration consolidation efforts).

[15]It is rather clear that this point is also relevant when discussing the expansionary effects of fiscal contractions (the so-called anti-Keynesian effects of fiscal policy): in other words, the puzzling expansionary effects of fiscal consolidation might well be explained by the expansionary stance followed by the monetary authority.

[16]Also for the European case in the years before 1990, however, there are discording

relationship became less strong, so that monetary policy only reacted in an expansionary way to public debt rather than to public deficit reductions (European Economy, 2001, quoted in Hughes Hallet, 2001). The overall picture did not change when EMU took over. The ECB is committed to pursue price stability and to satisfy self-imposed monetary targets, while the fiscal authorities have to abide by the rigid fiscal rules contained both in the Maastricht Treaty and in the Stability and Growth Pact. In other words, a strategic interaction between the monetary authority and the fiscal treasuries is prevented by the institutional rules to be followed: "We do know that [the ECB] is not going to pay much attention to fiscal policy or to fiscal-monetary co-ordination" (Hughes Hallet, 2001, p. 11).

The observation made by Hughes Hallet might suggest that it does not make any sense to consider a strategic relationship between the ECB and the national treasuries simply because the ECB Statute does not contain any element allowing to infer that monetary policy would be more expansionary when fiscal policy becomes tight enough. Such a condition, however, is not present in the Fed's Statute either, but the available evidence provides a clear indication of such a strategic relationship, as we have argued above. Moreover, "the aggregate fiscal stance deserves special attention in the EMU context, since it directly affects the policy-mix at the European level, and therefore is one of the elements taken into account in setting monetary policy" (European Economy, 2001, p. 19).

This point of view is strengthened when considering the declarations, reminiscent of the strategic relationship between the Fed and the Treasury in the US, that a couple of years ago accompanied the interest rate reductions by the ECB: "I think that we are credible enough for people to believe that we will deliver what we promise to deliver. And now it is the turn of the governments to do the same thing" (Duisenberg, 5 June 2003, ECB Press Conference).

In the following paragraph we present the model by which we intend to analyse the strategic interaction between the ECB and national fiscal authorities in Europe.

4 The model

We consider a monetary union formed by two countries. In each country the fiscal authority is responsible for fiscal policy, represented by the gov-

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views underlying that central banks, engaged in contractionary policies aimed at reducing the inflation rate, were slow and reluctant to compensate for the consolidation policies followed by fiscal authorities.

ernment surplus/GNP ratio[17], S_i, where subscript $i = 1, 2$ refers to country 1 and 2 respectively. The union's central bank is responsible for monetary policy, conducted by setting interest rate, r. The model is a single-period one. The inflation-unemployment trade off is represented by a standard short-run Phillips curve, as in eq. (1), where p and p^e are the union's actual and expected inflation rate, respectively; u_i and $\bar{u_i}$ is the actual and natural unemployment rate in country i, respectively; δ and ε are the parameters indicating the weight of country 1 and country 2, respectively, in the monetary union, such that $0 \leq \delta \leq 1$, $0 \leq \varepsilon \leq 1$ and $\delta + \varepsilon = 1$:

$$p = -\alpha\prime \left[\delta \left(u_1 - \bar{u_1} \right) + \varepsilon \left(u_2 - \bar{u_2} \right) \right] + p^e. \tag{1}$$

Following Nordhaus (1994), we assume that the expected inflation rate is given by a backward looking component, p^B, i. e. past inflation, and a forward looking one, p, i.e. actual inflation:

$$p^e = \omega p + (1 - \omega)p^B, \tag{2}$$

where ω is a parameter expressing the weight of the forward looking component[18]. By substituting from eq. (2) into eq. (1), for $0 \leq \omega < 1$, we obtain:

$$p = -\alpha \left(\delta u_1 + \varepsilon u_2 \right) + k, \tag{3}$$

where $\alpha = -\frac{\alpha\prime}{(1-\omega)}$ and $k = -\frac{\alpha\prime}{(1-\omega)} \left(\delta \bar{u_1} + \varepsilon \bar{u_2} \right) + p^B$ [19].

Monetary and fiscal policies are assumed to affect aggregate demand and unemployment, as shown in eqs. (4) and (5)[20]:

$$u_1 = \mu_1 S_1 + \nu_2 S_2 + \mu_r r \tag{4}$$

$$u_2 = \mu_2 S_2 + \nu_1 S_1 + \mu_r r, \tag{5}$$

where μ_1 and ν_2 are the multipliers of u_1 with respect to S_1 and S_2; μ_2 and ν_1 are the multipliers of u_2 with respect to S_2 and S_1; and μ_r is the multiplier of both u_1 and u_2 with respect to r.

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[17]For the choice of this (structural) fiscal surplus ratio see Nordhaus (1994).

[18]This formulation encompasses the new classical case for $\omega = 1$.

[19]In the new classical case, with $\omega = 1$, the actual unemployment rate is equal to the natural one.

[20]In the new classical case, instead, unemployment is unaffected by monetary and fiscal policy in the absence of shocks.

By substituting eqs. (4) and (5) into eq. (3), one gets[21]:

$$p = -\alpha \left[\delta \left(\mu_1 + \nu_1 \right) S_1 + \varepsilon \left(\mu_2 + \nu_2 \right) S_2 + 2\mu_r r \right] + k. \tag{6}$$

Authorities are assumed to target unemployment, inflation and government surplus. Their loss functions are assumed to be quadratic and separable:

$$L^{F_1} = \left(u_1 - u_1^* \right)^2 + \beta_1^* \left(p - p_1^* \right)^2 + \gamma_1^* \left(S_1 - S_1^* \right)^2 \tag{7}$$

$$L^{F_2} = \left(u_2 - u_2^* \right)^2 + \beta_2^* \left(p - p_2^* \right)^2 + \gamma_2^* \left(S_2 - S_2^* \right)^2 \tag{8}$$

$$L^M = \left(\delta u_1 + \varepsilon u_2 - u^{**} \right)^2 + \beta^{**} \left(p - p^{**} \right)^2 + \gamma^{**} \left(\delta S_1 + \varepsilon S_2 - S^{**} \right)^2, \tag{9}$$

where β and γ are parameters, the superscripts M, F_1 and F_2 have obvious meanings, and the superscript $*$ ($**$) of a variable denotes the target value for the fiscal (monetary) authorities[22].

4.1 The reaction functions

We can now derive the reaction functions for the monetary and fiscal authorities.

The reaction function of the monetary authority is obtained by substituting into eq. (9) from eqs. (1)-(5), by differentiating with respect to r and by imposing the optimality condition $\frac{\partial L_M}{\partial r} = 0$, which yields:

$$S_1 = -\frac{\left(\varepsilon \mu_2 + \delta \nu_2 \right)}{\left(\delta \mu_1 + \varepsilon \nu_1 \right)} S_2 - \frac{\mu_r}{\left(\delta \mu_1 + \varepsilon \nu_1 \right)} r + \frac{u^{**} + \alpha^2 \beta^{**} (k - p^{**})}{\left(\delta \mu_1 + \varepsilon \nu_1 \right) \left(1 + \alpha^2 \beta^{**} \right)}. \tag{10}$$

As for the fiscal authority of country 1, by substituting into eq. (7) from eqs. (1)-(5) and by setting $\frac{\partial L_{F_1}}{\partial S_1} = 0$, we obtain:

$$S_1 = -\mu_r \frac{\mu_1 + \alpha^2 \beta_1^* \left(\delta \mu_1 + \varepsilon \nu_1 \right)}{\mu_1^2 + \alpha^2 \beta_1^* \left(\delta \mu_1 + \varepsilon \nu_1 \right)^2 + \gamma_1^*} r - \tag{11}$$

$$- \frac{\mu_1 \nu_2 + \alpha^2 \beta_1^* \left(\delta \mu_1 + \varepsilon \nu_1 \right) \left(\varepsilon \mu_2 + \delta \nu_2 \right)}{\mu_1^2 + \alpha^2 \beta_1^* \left(\delta \mu_1 + \varepsilon \nu_1 \right)^2 + \gamma_1^*} S_2 +$$

$$+ \frac{\mu_1 u_1^* + \alpha \beta_1^* \left(\delta \mu_1 + \varepsilon \nu_1 \right) \left(k - p_1^* \right) + \gamma_1^* S_1^*}{\mu_1^2 + \alpha^2 \beta_1^* \left(\delta \mu_1 + \varepsilon \nu_1 \right)^2 + \gamma_1^*}.$$

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[21]In the new classical case inflation is not linked to unemployment in the absence of shocks.

[22]Target unemployment can be different from the natural rate, as, for instance, in the case of monopolistic competition (see Dixit and Lambertini, 2001).

By substituting into eq. (8) from eqs. (1)-(5) and by setting $\frac{\partial L_{F2}}{\partial S_2} = 0$, we obtain the reaction function of the fiscal authority of country 2:

$$S_2 = -\mu_r \frac{\mu_2 + \alpha^2 \beta_2^* \left(\delta \nu_2 + \varepsilon \mu_2\right)}{\mu_2^2 + \alpha^2 \beta_2^* \left(\delta \nu_2 + \varepsilon \mu_2\right)^2 + \gamma_2^*} r - \qquad (12)$$

$$\frac{\mu_2 \nu_1 + \alpha^2 \beta_2^* \left(\delta \mu_1 + \varepsilon \nu_1\right)\left(\delta \mu_2 + \varepsilon \nu_2\right)}{\mu_2^2 + \alpha^2 \beta_2^* \left(\delta \nu_2 + \varepsilon \mu_2\right)^2 + \gamma_2^*} S_1 +$$

$$\frac{\mu_2 u_2^* + \alpha \beta_2^* \left(\varepsilon \mu_2 + \delta \nu_2\right)\left(k - p_2^*\right) + \gamma_2^* S_2^*}{\mu_2^2 + \alpha^2 \beta_2^* \left(\delta \nu_2 + \varepsilon \mu_2\right)^2 + \gamma_2^*}.$$

This is a three-player game that we need to simplify in order to obtain easily interpretable results. There are two simple ways for doing this. The first alternative consists in introducing the assumption of perfect symmetry between the two countries, that are thus considered to be mirror images. This is the device we use in this section. The second one, instead, is based on the hypothesis of a strong asymmetry between the two union members, one being a large country, the other a small one. This allows to consider the game between a single country and the central bank. From the perspective of the large country, since the variables and behavior of the small one are virtually irrelevant, the game resembles that of a closed economy, as in Nordhaus (1994). We analyse instead the game between a small country and the union's central bank in section 4.3[23].

4.2 Mirror image countries

Let us consider the case of the two union member countries being mirror images, which implies:

$$\mu_1 = \mu_2 = \mu_s; \ \nu_1 = \nu_2 = \nu_s; \ \delta = \varepsilon = \frac{1}{2}.$$

[23]Note that in the new classical case, since monetary and fiscal policy do not affect the unemployment rate, eq. (4), eq. (5) and eq. (6) are replaced by:

$$p = -\left[\delta \left(\mu_1' + \nu_1'\right) S_1 + \varepsilon \left(\mu_2' + \nu_2'\right) S_2 + 2\mu_r' r\right].$$

Since unemployment is predetermined, its coefficient can be set to zero in the utility function. Solving the utility functions with these new conditions yields that $p = p^{**}$ for the monetary authority, i.e. monetary authority determines the inflation rate. If $p^* = p^{**}$, then $S = S^*$: the fiscal authority determines the surplus and the outcome is efficient. This result reproduces the one by Nordhaus (1994); Dixit and Lambertini (2003a) obtain a similar result, named "symbiosis" of monetary and fiscal policies: if fiscal and monetary authorities agree about the inflation and output targets, these are obtained even with different weights of the objectives in their respective utility functions.

4.2.1 The case of non co-operative fiscal authorities

As for the monetary authority, by using the assumptions above and by setting, without loss of generality, $(\mu_s + \nu_s) = 1$, $u = \frac{u_1 + u_2}{2}$ and $p^{**} = -\alpha u^{++} + k$ (for the last assumption see Nordhaus, 1994), eq. (10) becomes:

$$S_1 = -S_2 - 2\mu_r r + \frac{2(u^{**} + \alpha^2 \beta^{**} u^{++})}{1 + \alpha^2 \beta^{**}}. \tag{13}$$

Since we assume that the two countries are symmetric, we set $S_1 = S_2 = S$, which yields:

$$S = -\mu_r r + \frac{u^{**} + \alpha^2 \beta^{**} u^{++}}{1 + \alpha^2 \beta^{**}}, \tag{14}$$

which is the reaction function for the monetary authority.

As for the fiscal authority, by applying the restrictions above to eq. (11), and by setting $p_1^* = -\alpha u_1^+ + k$, we obtain:

$$S_1 = -\mu_r \frac{2\mu_s + \alpha^2 \beta_1^*}{\left(2\mu_s^2 + \frac{(\alpha^2 \beta_1^*)}{2} + 2\gamma_1^*\right)} r - \frac{2\mu_s \nu_s + \frac{(\alpha^2 \beta_1^*)}{2}}{\left(2\mu_s^2 + \frac{(\alpha^2 \beta_1^*)}{2} + 2\gamma_1^*\right)} S_2 +$$
$$+ \frac{2\mu_s u_1^* + \alpha^2 \beta_1^* u_1^+ + 2\gamma_1^* S_1^*}{\left(2\mu_s^2 + \frac{(\alpha^2 \beta_1^*)}{2} + 2\gamma_1^*\right)}, \tag{15}$$

which is the reaction function for the fiscal authority of country 1; symmetrically, for country 2 eq. (12) becomes:

$$S_2 = -\mu_r \frac{2\mu_s + \alpha^2 \beta_2^*}{\left(2\mu_s^2 + \frac{(\alpha^2 \beta_2^*)}{2} + 2\gamma_2^*\right)} r - \frac{2\mu_s \nu_s + \frac{(\alpha^2 \beta_2^*)}{2}}{\left(2\mu_s^2 + \frac{(\alpha^2 \beta_2^*)}{2} + 2\gamma_2^*\right)} S_1 +$$
$$+ \frac{2\mu_s u_2^* + \alpha^2 \beta_2^* u_2^+ + 2\gamma_2^* S_2^*}{\left(2\mu_s^2 + \frac{(\alpha^2 \beta_2^*)}{2} + 2\gamma_2^*\right)}. \tag{16}$$

Recalling our assumption that the two countries are mirror images so that $S_1 = S_2 = S$, we can derive a unique reaction function for the fiscal authority:

$$S = -\mu_r \frac{(2\mu_s + \alpha^2 \beta^*)}{(2\mu_s + \alpha^2 \beta^* + 2\gamma^*)} r + \frac{2\mu_s u^* + \alpha^2 \beta^* u^+ + 2\gamma^* S^*}{(2\mu_s + \alpha^2 \beta^* + 2\gamma^*)}. \tag{17}$$

The coordinates of the Nash equilibrium (NN) are obtained by considering together eq. (14) and eq. (17):

$$
\begin{aligned}
r &= \frac{2\mu_s + \beta^* \alpha^2 + 2\gamma^*}{2\gamma^*(\mu_s + \beta^{**}\alpha^2)\mu_r} u^{**} - \frac{(2\mu_s + \beta^* \alpha^2 + 2\gamma^*)\beta^{**}\alpha^2}{2\gamma^*(\mu_s + \beta^* \alpha^2)\mu_r} u^{++} + \frac{\mu_s}{\gamma^* \mu_r} u^* + \\
&\quad \frac{\beta^* \alpha^2}{2\gamma^* \mu_r} u^+ + \frac{\mu_s}{\mu_r} S^*
\end{aligned} \tag{18}
$$

$$
S = -\frac{2\mu_s + \beta^* \alpha^2}{2\gamma^*(\mu_s + \beta^* \alpha^2)} u^{**} - \frac{\mu_s + \beta^* \alpha^2}{2\gamma^*(\mu_s + \beta^{**}\alpha^2)} u^{++} - \frac{\mu_s}{\gamma^*} u^* - \frac{\beta^* \alpha^2}{2\gamma^*} u^+ - S^*. \tag{19}
$$

Fiscal leadership generates a result that is Pareto superior to the Nash one, corresponding to a less expansionary monetary stance. Minimizing eq. (7) subject to the constraint of the monetary authority reaction function, eq. (14), one obtains the following coordinates for the Stackelberg equilibrium:

$$
r = \frac{u^{**} + \alpha^2 \beta^{**} u^{++}}{\mu_r \left(1 + \alpha^2 \beta^*\right)} - \frac{S^*}{\mu_r}. \tag{20}
$$

$$
S = S^* \tag{21}
$$

The result is similar to the one obtained in Nordhaus (1994) for a closed economy and in Dixit and Luisa Lambertini (2001) for a monetary union. Fig. 1 represents the situations described above.

4.2.2 The case of co-operative fiscal authorities

After considering the case in which the two fiscal authorities act non co-operatively, let us consider the case in which they do co-operate. In such a situation they minimise the following joint loss function:

$$
L^F = (u - u^*)^2 + \beta^* (p - p^*)^2 + \gamma^* (S - S^*)^2. \tag{22}
$$

By applying the procedure above and by setting $\frac{\partial L_F}{\partial S} = 0$, one obtains the fiscal reaction function in the co-operative case:

$$
\begin{aligned}
S_C &= -\mu_r \frac{(1 + \alpha^2 \beta^*)}{(1 + \alpha^2 \beta^* + \gamma^*)} r + \frac{1}{(1 + \alpha^2 \beta^* + \gamma^*)} u^* + \frac{\alpha^2 \beta^*}{(1 + \alpha^2 \beta^* + \gamma^*)} u^+ + \\
&\quad + \frac{\gamma^*}{(1 + \alpha^2 \beta^* + \gamma^*)} S^*,
\end{aligned} \tag{23}
$$

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Figure 1: The Nash equilibrium and the Stackelberg equilibrium with fiscal leadership with a negatively sloped central bank's reaction function (mirror image countries)

where S_C indicates the fiscal authorities' optimal surplus response.

Note that the slope of the fiscal authority's reaction function in the co-operative case is higher, in absolute value, than in the non co-operative one, since the effect of a change in r on the other country is also taken into account. The monetary authority's reaction function, instead, remains the same as in the non co-operative case and is always steeper than the fiscal one. This is definitely true if $\nu_s > 0$, which is the case in this two-country setup.

The coordinates of the Nash equilibrium when the fiscal authorities do co-operate with each other (CN) are obtained by solving the system formed by eq. (14) and eq. (23):

$$
r = \frac{1 + \beta^*\alpha^2 + \gamma^*}{\gamma^*(1 + \beta^{**}\alpha^2)\mu_r}u^{**} - \frac{(1 + \beta^*\alpha^2 + \gamma^*)\beta^{**}\alpha^2}{\gamma^*(1 + \beta^{**}\alpha^2)\mu_r}u^{++} + \frac{1}{\gamma^*\mu_r}u^* + \frac{\beta^*\alpha^2}{\gamma^*\mu_r}u^{+} +
$$
$$
+ \frac{1}{\mu_r}S^* \tag{24}
$$

$$
S = -\frac{1}{\gamma^*}u^{**} - \frac{\beta^{**}\alpha^2\left(1 + \beta^*\alpha^2\right)}{\gamma^*(1 + \beta^{**}\alpha^2)}u^{++} - \frac{1}{\gamma^*}u^* - \frac{\beta^*\alpha^2}{\gamma^*}u^{+} - S^*. \tag{25}
$$

As for the Stackelberg equilibrium, it is easy to show that the result is analogous to that obtained in the non co-operative case.

4.2.3 The bliss points

The positions of the bliss points depend upon all parameters. In coherence with our initial assumptions, let us consider the case analysed by Nordhaus (1994). For simplicity, let us assume that the fiscal and monetary authorities' utility functions display equal parameters, except $u^{**} > u^*$. By evaluating the reaction functions at $S = S^*$, from eq. (17) we obtain:

$$r^{BF} = -\frac{S^*}{\mu_r} + \frac{2\mu_s u^* + \alpha^2 \beta^* u^+}{(2\mu_s + \alpha^2 \beta^*)\mu_r}; \tag{26}$$

from eq. (23) we obtain:

$$r^{BFc} = -\frac{S^*}{\mu_r} + \frac{u^* + \alpha^2 \beta^* u^+}{(1 + \alpha^2 \beta^*)\mu_r}, \tag{27}$$

and from eq. (14):

$$r^{BM} = -\frac{S^*}{\mu_r} + \frac{u^{**} + \alpha^2 \beta^* u^+}{(1 + \alpha^2 \beta^*)\mu_r}. \tag{28}$$

r^{BF}, r^{BFc} and r^{BM} indicate, for a given S^*, the level of r at the bliss point for the fiscal authority in the non co-operative and in the co-operative case and for the monetary authority, respectively. The interest rate level depends on the value of the parameters appearing in the equation. For instance, other things being equal, it will be the higher, the higher the unemployment target and its weight in the loss function.

In the non-cooperative case, the difference between r^{BM} and r^{BF} is:

$$r^{BM} - r^{BF} = \frac{1}{(1 + \alpha^2 \beta^*)\mu_r} u^{**} - \frac{2\mu_s}{(2\mu_s + \alpha^2 \beta^*)\mu_r} u^* + \tag{29}$$
$$+ \left[\frac{\alpha^2 \beta^*}{(1 + \alpha^2 \beta^*)\mu_r} - \frac{\alpha^2 \beta^*}{(2\mu_s + \alpha^2 \beta^*)\mu_r} \right] u^+,$$

a higher target for unemployment for the central bank determining a higher level of the interest rate.

In the case of co-operative fiscal authorities, the difference $r^{BM} - r^{BFc}$ is equal to $\frac{1}{(1+\alpha^2\beta^*)\mu_r}(u^{**} - u^*)$; this is still positive, and its size with respect to the previous case depends upon the magnitude of μ_s: it is smaller than the difference $r^{BM} - r^{BF}$ if $\mu_s > 0,5$, while the bliss points coincide if $\mu_s = 0,5$. Recall that, given the assumption $(\mu_s + \nu_s) = 1$, this is equivalent to saying that the bliss points of the fiscal and monetary authorities are closer to each other in the co-operative case than in the non co-operative one if

$\mu_s > \nu_s$, while they coincide if $\mu_s = \nu_s$. Therefore, if the two countries co-operate with each other, co-operation with the central bank is more easily achieved. However, in the lack of co-operation with the central bank, the co-operation between the fiscal authorities leads to a Nash equilibrium in the game played with the monetary authority implying a lower welfare level than that obtained when the fiscal authorities do not co-operate with each other. This situation is represented in Fig. 2, that shows the reaction functions for the case $S^* = S^{**} = 0$ and for $\mu_s = \nu_s$[24]. Given the coordinates of the bliss points for the fiscal and the monetary authority (B^F and B^M) and the slopes of their reaction functions, it is evident that the NN equilibrium lies closer to the bliss points than the CN one, the latter being characterised by a higher level of both the interest rate and the government deficit.

Figure 2: Nash equilibrium in the co-operative (CN) and non co-operative (NN) case.

4.2.4 Discussion of the results in the case of mirror image countries

The explanation of the result according to which, in the lack of co-operation with the central bank, it is preferable that fiscal authorities do not co-operate

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[24]We keep considering the Nordhaus case in which the monetary authority is more concerned with price stability than employment; the opposite is true for the fiscal authority.

between themselves either, lies in the fact that the externalities imposed by each country both on the other one and on the monetary authority partially offset each other. In fact, if they do not co-operate, each fiscal authority does not take into account the positive effect of its action on the employment level in the other union member; therefore, the use of the fiscal instrument would be smaller than optimal. At the same time, the negative effect on the central bank's objective function is also disregarded, which would yield a too large fiscal operation. Being of opposite sign, the two external effects tend to offset each other. If the fiscal authorities do co-operate, instead, a joint loss function is being minimised, with the internalization of the effect of a fiscal action on the other country. As a result, the fiscal authorities' reaction function becomes steeper and the Nash equilibrium implies both a higher budget deficit and a higher interest rate, since the monetary authority follows a more restrictive monetary stance in response to the more expansionary fiscal policy. Only a lack of co-operation between the two fiscal authorities, resulting in a lower fiscal expansion, would allow the central bank not to react[25].

In accordance with the result obtained by Nordhaus (1994), in the closed economy, co-operation between the monetary authority and both fiscal authorities, instead, allows to reach a point on the contract curve, characterised by a higher S and a lower r, compared to the case above. In fact, as we have already seen, the non co-operative equilibrium is characterised by a lower S and a higher r than desired by either authority because of the conflict between their respective objectives: when the fiscal authority increases the deficit to support employment, it causes a rise in the inflation rate; thus, the central bank reacts by raising r, which increases unemployment. A corollary of this result is that economies with independent central banks (implying non co-operation between central bank and fiscal authorities) will normally face higher interest rates.

Moreover, fiscal leadership would lead to an outcome that is superior to the Nash one, corresponding to a more restrictive fiscal stance, as in Nordhaus (1994). However, in section 4.3 we show how the perspective changes in the case of a small union member country.

These results allow us to interpret the Maastricht Treaty and the Stability and Growth Pact in the light of our model. We can translate their clauses into two elements: a) the central bank is obliged to pursue price stability, which can most easily be represented by a low level of p^{**} (alternatively, or

---

[25]The result that no co-operation at all is preferable to co-operation between some players only is found in several papers on international policy coordination, starting from Rogoff (1985).

in addition to this, by a high value of β^{**}); this induces a rightward shift of the monetary authority's reaction function, making the Nash equilibrium correspond to a higher r and a lower S and the bliss points more distant from each other with respect to the case analysed before (Fig. 3); this would seem to increase the difficulty of co-operating, the bliss points of the two authorities being further apart. However, in this case it is also more likely that, for either authority, the opponent's bliss point allows to reach an indifference curve that is higher than in the Nash case. b) A limit to the level of the deficit, as contemplated in the Maastricht Treaty and in the Stability and Growth Pact, would allow to reach a position that is superior to NN. The fiscal authority's reaction function would become horizontal when reaching it and the new equilibrium would be given by point M in Fig. 3 (r would be higher if also element a) is taken into account - see point M'). Two polar cases would be as follows: i) the central bank chooses this threshold at S^{**}, thus obtaining its bliss (imperialistic solution); ii) since the fiscal authorities might not be able to play Stackelberg for the reasons explained above (myopia and impatience), the threshhold is determined by an outside institution in such a way as to reach such an equilibrium.

Figure 3: Effects of the Stability and Growth Pact

The scenarios sub a) and b) correspond to two alternative interpretations of the Stability and Growth Pact. The first one is centered on the role of the European central bank as the guardian of price stability, according to the

clauses of the Maastricht Treaty. In this view, fiscal discipline reinforces the no bail out clause defending against the risks of an opportunistic behavior of the fiscal authorities. The problem with this attitude is that it ends up with a too restrictive monetary policy.

Alternatively, the limits to government deficit and debt levels can be interpreted as a pre-requirement for a more growth oriented monetary policy. Debt financed fiscal expansions aimed at supporting aggregate demand raise inflation, thus making the central bank increase the interest rate. This would hinder the possibility to expand employment. Conversely, less expansionary fiscal policies would make it possible for the monetary authority to pursue growth oriented policies, according to the discussion presented in section 3.

The case for the imposition of fiscal rules is reinforced if one considers the role played by the number of fiscal authorities in the decision on deficit reduction. If the outcome of the game played by a single monetary authority with several fiscal authorities is much worse than the one resulting from a game played by a central bank and a single treasury, the imposition of strict fiscal rules might be necessary in order to move the economy out of a Pareto inefficient situation, or as a way to impose a co-ordinated action on otherwise short-sighted treasuries (see next section).

4.3   The small country case

A further argument for the introduction of fiscal rules can be found when considering a Stackelberg game with fiscal leadership in which each fiscal authority plays separately against the central bank. In Nordhaus' case (and in Dixit and Luisa Lambertini, 2001) such a game would produce a more restrictive fiscal stance, since the single fiscal authority optimises by taking into account the monetary authority's *reaction function* rather than *action*. In the presence of several fiscal authorities, however, each of them is aware that the monetary authority would react in a limited way to a fiscal consolidation undertaken by just one country: the monetary authority would only react to a co-ordinated fiscal restriction inducing an overall fiscal adjustment. Thus, each single country, especially if small, might face a very steep central bank's reaction function. The latter, in fact, does not directly react to the national fiscal policy stance, but to changes in inflation and unemployment of the whole union. With respect to these variables, however, the single country's fiscal policy operation can be of little relevance (the number of countries, or better, the country economic dimension turns out to be of central importance

in this context)[26].

In the limiting case, then, the monetary authority will not react to changes in the single country's fiscal stance. Thus, it becomes impossible for the single fiscal authority to improve its welfare level by moving away from the Nash equilibrium acting as a leader, since it faces a vertical monetary authority's reaction function (going through the Nash equilibrium point). In this case, the Nash and Stackelberg equilibria coincide, given that the indifference curve of the fiscal authority is tangent to the vertical monetary authority's reaction function exactly where the latter meets the fiscal authority's reaction function.

This situation can be analysed within the general model presented above by imposing the following restrictions: μ_1 is small with respect to ν_2 and μ_r; $\delta \to 0$, $\varepsilon \to 1$ and $\nu_1 = 0$. These assumptions imply that the fiscal stance of the large country can be taken as given. The hypothesis can be justified in the limiting case of a country that is so small with respect to the rest of the union that it cannot influence the unemployment rate of the whole area by using its instrument, so that the rest of the union will not react to changes in its fiscal position.

In order to obtain the Nash equilibrium in the game between the small country and the central bank we need to determine the monetary and fiscal authorities' reaction functions. For the case in which $p^{**} = -\alpha u^{++} + k$, the former is obtained by imposing the above mentioned restrictions to eq. (10), so as to get:

$$r = -\frac{\mu_2}{\mu_r} S_2 + \frac{u^{**} - \alpha^2 u^{++}}{\mu_r (1 + \beta^{**} \alpha^2)}. \tag{30}$$

The latter is obtained by imposing the same restrictions to eq. (11), thus getting:

$$S_1 = -\frac{\mu_1 \nu_2}{\mu_1^2 + \gamma_1^*} S_2 - \frac{\mu_1 \mu_r}{\mu_1^2 + \gamma_1^*} r + \frac{\gamma_1^* S_1^*}{\mu_1^2 + \gamma_1^*}. \tag{31}$$

Given that S_2 is independent of S_1, since the fiscal authority in the large country is not influenced by what takes place in the small one (i.e., $\nu_1 = 0$), country 1 can take such value as exogenous, so that by considering eq. (30) we would conclude that $r = \bar{r}$. More precisely, by applying the restrictions described above to eq. (12) and by letting $p^* = -\alpha u_2^* + k$, we have the following expression for the reaction function of country 2:

---

[26]For the political implications of the participation of small countries to the EMU (Belgium and the Netherlands in particular) see Maes and Verdun (2005).

$$S_2 = -\mu_2 \frac{\mu_r(1 + \alpha^2\beta_2^*)}{\mu_2^2(1 + \alpha^2\beta_2^*) + \gamma_2^*} r + \frac{\mu_2(u_2^* + \alpha^2\beta_2^* u_2^+) + \gamma_2^* S_2^*}{\mu_2^2(1 + \alpha^2\beta_2^*) + \gamma_2^*}. \qquad (32)$$

By substituting it into the monetary authority reaction function, eq. (30), we get:

$$r = -\frac{\mu_2^2 \left[u_2^* + \alpha^2\beta_2^* u_2^+ + \gamma_2^* S_2^*\right]}{\gamma_2^*} + \frac{(u^{**} + \alpha^2 u^{++})\left[\mu_2^2(1 + \alpha^2\beta_2^*) + \gamma_2^*\right]}{\gamma_2^* \mu_r(1 + \alpha^2\beta^{**})} = \bar{r}. \qquad (33)$$

The same operation can be done for the case in which the small country incorporates the large country's fiscal action into its reaction function rather than taking it as given. By substituting eq. (32) into eq. (31) we obtain:

$$S_1 = -\frac{\mu_1\mu_r[\mu_2(\nu_2 - \mu_2)(1 + \alpha^2\beta_2^*) - \gamma_2^*]}{(\mu_1^2 + \gamma_1^*\mu_2^2)[(1 + \alpha^2\beta_2^*) + \gamma_2^*]} r - \frac{\mu_1\mu_2\nu_2(u_2^* + \alpha^2\beta_2^* u_2^+) + \gamma_2^* S_2^*}{(\mu_1^2 + \gamma_1^*\mu_2^2)[(1 + \alpha^2\beta_2^*) + \gamma_2^*]}$$
$$+ \frac{\gamma_1^* S_1^*}{\mu_1^2 + \gamma_1^*}. \qquad (34)$$

The value of S_1 at the Nash equilibrium point is found by substituting $r = \bar{r}$ into the equation above.

As for the Stackelberg equilibrium, the solution is found by minimizing eq. (7) with respect to S_1 subject to the restrictions for the small country case and to the constraint $r = \bar{r}$, which yields the same result as in the Nash case.

Fig. 1 showed a negatively sloped monetary authority's reaction function. In that case, as in Nordhaus (1994), moving from a Nash to a Stackelberg equilibrium allows a Pareto improvement. On the contrary, in the case we are considering now, a fiscal consolidation would not generate an interest rate reduction, since the reaction function is vertical (or almost vertical): only in the presence of co-ordinated fiscal operations in both countries, a fiscal consolidation undertaken by one country will be accompanied by a similar policy of the other one, thus producing an overall increase in the fiscal surplus and inducing a response from the monetary authority. With a vertical reaction function faced by the small country, instead, a fiscal consolidation would not produce any interest rate reduction, so that the Nash and Stackelberg equilibria coincide (see Fig. 4). It should be observed, therefore, that in the small country case, in the absence of co-ordination between the two fiscal authorities, the result obtained by Lambertini and Rovelli (2003) does not hold any more: the Stackelberg solution is not superior to the Nash one.

Figure 4: The Nash equilibrium and the Stackelberg equilibrium with fiscal leadership with a vertical central bank's reaction function (small country case)

4.3.1 Discussion of the results in the small country case

In the preceding section we have shown that the central bank does not react to the operations undertaken by a small country. This suggests the conclusion that, in a monetary union formed by several small countries, each of them will face a vertical central bank's reaction function, so that none of them will have the incentive to pursue fiscal discipline.

This conclusion, however, might get modified in the case of symmetric countries as assumed in section 4.2: if each of the small countries follows the same action, then the central bank will react to the common fiscal operation. In other words, the monetary authority's reaction function will tend to become flatter with respect to the original vertical slope.

One can thus consider two different possible equilibria. The first one is characterised by the absence of co-ordination between the fiscal authorities of the small countries and obtains if they either ignore the reactions of their partners, taking their actions as given, or know that they will not modify their fiscal stance. The second equilibrium, instead, obtains when fiscal authorities co-ordinate their decisions, aware of the fact that the central bank will respond to a co-ordinated fiscal consolidation.

As we know already, a non co-operative equilibrium between two fiscal authorities (when they also do not co-operate with the monetary authority) is Pareto superior to a co-operative one. While co-operation between the two fiscal authorities worsens the outcome, however, co-ordination between them

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would improve it[27], since a simultaneous decision of the two fiscal authorities to move in the same direction modifies the monetary authority's reaction function, so as to allow its response[28].

Following our previous arguments, the fiscal rules introduced by the Maastricht Treaty find a clear justification in the lack of incentive for each single fiscal authority to operate in a restrictive way. In other words, rules operate as a substitute for co-ordination since the two fiscal authorities might get locked in their initial sub-optimal equilibrium and might not be able to co-ordinate on the "restricts/restricts" equilibrium.

To summarise:

1) The consolidation effort of a fiscal authority might be reduced (or even prevented) by the fear that the monetary authority may not respond in an expansionary way to a fiscal restriction, thereby causing a recession. This would certainly be the case if the central bank were obliged to follow a fixed interest rate rule. In such a case, it could not interact with the fiscal authority(ies) in response to a fiscal adjustment (see Hughes Hallet, 2001). Such an outcome might also result as a consequence of a particular belief by the central bank, for example that inflation is only determined by money: in such an instance, the monetary authority would not respond to a fiscal contraction simply because it does not believe that such a contraction may reduce inflation.

2) The same outcome obtains when the fiscal authority fears that the monetary authority's reaction may be slow. This outcome would arise with a rather conservative central bank that would need to observe a low inflation before agreeing on reducing the interest rate. This point is made extensively by Nordhaus (1994). He shows how a deficit reduction will be very costly in terms of lower aggregate demand and higher unemployment, when monetary policy is "results-oriented" and responds to a fiscal consolidation with a delay.

3) The lack of fiscal consolidation, however, might also emerge in a large union, when each single fiscal authority knows that its behaviour does not affect the interest rate choice made by the central bank. This is the point we make in this paper. The larger the number of countries, the lower the incentive to reduce the fiscal deficit, differently from what happens in the US.

---

[27]It should be underlined that fiscal co-ordination among European countries is strongly advocated in the Maastricht Treaty.

[28]The difference between co-ordination and co-operation is rather subtle and far from univocally accepted (see, for example, Moslechner and Schuerz, 2001). In this paper we refer to co-operation between two players when they optimise a weighted average of their opponent's and of their own utility functions. We refer to co-ordination when, in presence of multiple equilibria, two players that might end up in the sub-optimal one manage to move to the Pareto superior outcome.

A result which is similar to that obtained when one monetary authority faces one fiscal authority might be reached if separate fiscal authorities manage to co-ordinate their policies, rather than co-operate. Since such a co-ordination seems difficult to achieve, however, the imposition of fiscal rules is justified. The imposition of the Maastricht criteria might have also made it common knowledge that everybody will behave in the same way, thereby eliminating the co-ordination problem. The monetary authority will thus be able to respond to the fiscal authorities of the union as if they were a single fiscal authority, like in the US case.

The imposition of fiscal rules finds a further justification when considering that the fiscal authorities may have no incentives to run restrictive policies if the monetary authority has a very limited room for monetary accomodation, as it is the case in the current European context, characterised by low interest rates and a relative expansionary monetary policy. It could be objected that while our paper proves that the incentive to run expansionary policies should be higher for small than for large countries, the opposite is observed in reality. The reason for such and apparent contradiction lies in the fact that the institutional European reality is characterised by the imposition of fiscal rules that apply asymmetrically to European countries. While small countries perceive them as effective and binding, large ones, due to their high voting power, may substantially ignore them. Such a situation can be represented in our model by letting the parameter expressing the cost of fiscal convergence from a given target, γ^*, tend to infinity for small countries, while letting it be very low for large ones.

5   Concluding remarks

A standard result in the literature on monetary and fiscal policy co-ordination is that non co-operative monetary and fiscal policies lead to excessive deficit spending and too high interest rates. When considering a monetary union, characterised by the presence of several fiscal authorities, in the lack of co-operation with the central bank the same result obtains even if the treasuries co-operate with each other. A better outcome is obtained, instead, when, in the lack of co-operation with the central bank, there is no co-operation among themselves either. Fiscal rules, such as those contemplated in the Maastricht Treaty and in the Stability and Growth Pact, can be welfare improving if lower deficit/higher surpluses are accompanied by a more expansionary monetary policy. This is in line with the interpretation of the fiscal requirements as a condition for a growth oriented monetary policy. Another reason for enhancing fiscal rules is that, in the presence of a large number of countries,

fiscal leadership, which would be welfare increasing in a one-country set up, becomes impossible if national treasuries do not act in coordination with each other, so that the central bank will not respond to the behaviour of a single fiscal authority.

It is worth observing that, contrary to Beetsma and Bovenberg (1999), our conclusions do not depend on Central bank's ability to commit to low inflation. The result obtained by van Aarle, Bovenberg and Raith (1997) is symmetric to our own, in that the central bank does not react to a fiscal adjustment undertaken by a single fiscal authority, since such a limited adjustment will not be enough to reduce the union's aggregate demand and inflation rate. In their paper, then, when the number of players in the EMU increases, the strategic power of the Central bank also increases. Such an observation can be reinterpreted in our model, in the sense that, when the number of fiscal players increases, there will be less incentive for fiscal discipline, since the ECB will not reduce interest rates when a single fiscal authority contracts and will not raise them when it expands.

6 References

Aarle, van A., L. Bovenberg, and M. Raith, 1995, "Monetary and Fiscal Policy Interaction and Governement Debt Stabilization", *Journal of Economics*, Vol. 62, pp. 111-140.

Aarle, van A., L. Bovenberg, and M. Raith, 1997, "Is There a Tragedy of a Common Central Bank? A Dynamic Analysis", *Journal of Economic Dynamics and Control*, Vol. 21, pp. 417-447.

Aizenman, J., 1992, "Competitive Externalities and the Optimal Seigniorage", *Journal of Money, Credit and Banking*, Vol. 24, pp. 61-71.

Aizenman, J., 1993, "Soft Budget Constraints, Taxes and the Incentives to Cooperate", *International Economic Review*, Vol. 34, pp. 819-832.

Alesina, A. and V. U. Grilli, 1993, "On the Feasibility of a One or Multi-Speed European Monetary Union", *Economics and Politics*, Vol. 5, pp. 145-166.

Artis, M. and B. Winkler, 1998, "The Stability Pact: Safeguarding the Credibility of the European Central Bank", *National Institute Economic Review*, Vol. 163, pp. 87-98.

Bayoumi, T., 1994, "A Formal Model of Optimum Currency Areas", *CEPR Discussion Paper*, No. 968.

Beetsma, R. and A.L. Bovenberg, 1997, "Central Bank Independence and Public Debt Policy", *Journal of Economic Dynamics and Control*, Vol. 21, pp. 873-894.

Beetsma, R. and A.L. Bovenberg, 1997, "Designing Fiscal and Monetary Institutions in a Second-Best World", *European Journal of Political Economy*, Vol. 13, pp. 53-79.

Beetsma, R. and A.L. Bovenberg, 1998, "Monetary Union Without Fiscal Coordination May Discipline Policymakers", *Journal of International Economics*, Vol. 45, pp. 239-258.

Beetsma, R. and A.L. Bovenberg, 1999, "Does Monetary Unification Lead to Excessive Debt Accumulation?", *Journal of Public Economics*, Vol. 74, pp. 299-325.

Blanchard, O., 1997, *Macroeconomics*, Upper Saddle River (NJ): Prentice-Hall.

Blinder, A., 1983, "Issues in the Coordination of Monetary and Fiscal Policy", in *Monetary Issues in the 1980s*, Federal Reserve Bank of Kansas City, Kansas City, pp. 3-34.

Bovenberg, A.L., J. J. M. Kramer and P. R. Masson, 1991, "Economic and Monetary Union in Europe and Constraints on National Budgetary Policies", *IMF Staff Papers*, Vol. 38, pp. 374-398.

Brociner, A. and P. Levine, 1994, " Fiscal Policy Coordination and EMU", *Journal of Economic Dynamics and Control*, Vol. 18, pp. 699-729.

Carraro, C., 1986, "Teoria dei giochi e il problema della coordinazione tra politica monetaria e fiscale", *Ricerche Economiche*, v. 40, pp. 377-399.

Casella, A., 1992, "Participation in a Currency Union", *American Economic Review*, Vol. 82, pp. 847-863.

Chari, V. V. and P. J. Kehoe, 1998, "On the Need for Fiscal Constraints in a Monetary Union", *Federal Reserve Bank of Minneapolis Working Paper*, n. 589, August.

Cuckierman, A., 1994, "Central Bank Independence and Monetary Control", Mimeo, Federal Reserve Bank of Minneapolis.

Demertzis, M., A. Hughes-Hallet, N. Viegi, "Independently Blue? Accountability and Independence in the New Central Bank for Europe", *CEPR Discussion Paper* n. 1842, March 1998.

Dixit, A., 2001, "Games of Monetary and Fiscal Interactions in the EMU", *European Economic Review,* Vol. 45, pp. 589-613.

Dixit, A. and Luisa Lambertini, 2001, "Monetary-Fiscal Policy Interactions and Commitment versus Discretion in a Monetary Union", *European Economic Review*, Vol. 45, pp. 977-987.

Dixit, A. and Luisa Lambertini, 2003a, "Symbiosis of Monetary and Fiscal Policies in a Monetary Union", *Journal of International Economics*, Vol. 60, pp. 235-247.

Dixit, A. and Luisa Lambertini, 2003b, "Interactions of Commitment and Discretion in Monetary and Fiscal Policies", *American Economic Review*,

Vol. 93, pp. 1522-1542.

European Commission, 2001, *European Economy*, Public Finances in EMU - 2001, Reports and Studies, No. 3.

Hughes-Hallet, A., 2001 "Fiscal Coordination and EMU: Are Monetary and Fiscal Policy Becoming Decoupled?", *New Economy*, March 2001, Vol. 8, pp. 9-13.

Hughes-Hallet, A. and M.L. Petit, 1990, "Cohabitation of Force Marriage? A Study of the Costs of Failing to Co-ordinate Fiscal and Monetary Policy", *Weltwirtschaftliches Archiv*, Vol. 126, pp. 662-690.

Kishan, R. P. and T. P. Opiela, 2000, "Further Evidence on Monetary and Fiscal Policy Co-ordination", *International Advances in Economic Research*, Vol. 6, pp. 672-685.

Lambertini, Luca and R. Rovelli, 2003, "Monetary and Fiscal Policy Coordination and Macroeconomic Stabilization. A Theoretical Analysis", Mimeo.

Maes, I. and A. Verdun, 2005, "Small States and the Creation of EMU: Belgium and the Netherlands, Pace-setters and Gate-keepers", *Journal of Common Market Studies*, Vol. 43, pp. 327-348.

Nordhaus, W. D., 1994, "Policy Games: Coordination and Independence in Monetary and Fiscal Policies", *Brookings Papers on Economic Activity*, no. 2, pp. 139-199.

Papadia, F. and G. P. Ruggiero, 1999, "Central Bank Independence and Budget Constraints for a Stable Euro", *Open Economies Review*, Vol. 10, pp. 63-90.

Rogoff, K., 1985, "The Optimal Degree of Commitment to an Intermediary Monetary Target", *Quarterly Journal of Economics*, Vol. 100, pp. 1169-1189.

Tabellini, G., 1987, "Optimal Monetary Instruments and Policy Games", *Ricerche Economiche*, n. 3-4, pp. 315-325.

Tabellini, G., 1986, "Money, Debt and Deficits in a Dynamic Game", *Journal of Economic Dynamics and Control*, Vol. 10, pp. 427-442.

Woodward, B., 1995, *The Agenda*, New York: Simon & Schuster.