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ORIGINAL PAPER

United we stand: on the macroeconomics of a Fiscal union

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Abstract In this paper, we apply dynamic tracking games to macroeconomic policy making in a monetary union. We use a small stylized nonlinear two-country macroeconomic model of a monetary union for analyzing the interactions between two fiscal (governments: "core" and "periphery") and one monetary (central bank) policy makers, assuming different objective functions of these decision makers. Using the OPTGAME algorithm, we calculate numerical solutions for cooperative (Pareto optimal) and non-cooperative games (feedback Nash). We show how the policy makers react to adverse demand shocks. We investigate the consequences of three scenarios: decentralized fiscal policies controlled by independent governments (the present situation), centralized fiscal policy (a fiscal union) with an independent central bank (pure fiscal union), and a fully centralized monetary and fiscal union. For the latter two scenarios, we demonstrate the importance of different assumptions about the joint objective function corresponding to different weights for the two governments in the design of the common fiscal policy. We show that a fiscal union with weights corresponding to the number of states in each of the blocs gives better results than non-cooperative policy making. When one bloc dominates the fiscal union, decentralized policies yield lower overall losses than the pure fiscal union and the monetary and fiscal union.

Keywords Dynamic game · Feedback Nash equilibrium · Pareto solution · Monetary union · Fiscal union · Macroeconomics · Public debt

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1 Introduction

The Great Recession, the financial and economic crisis which started in the United States and spread over most of the world, was the most severe crisis since the Great Depression of the 1930s. While it was over by 2010 in most parts of the world, Europe was hit in a particularly hard way and is still struggling with its consequences. This is due to the specific problems of the European Economic and Monetary Union, in particular the Euro Area. Most observers blame the political architecture of the monetary union for this prolonged crisis. It has at least two dimensions: an asymmetry of competitiveness and an asymmetry of sovereign debt within the union. Both phenomena were acerbated by the initial period of the monetary union, with its equalized interest and inflation rates in spite of these asymmetries and with its consequently distorted price signals. This led to further drifting apart during the Great Recession, when these distortions were noticed by the financial markets. The Greek Crisis is the most obvious manifestation of this development, but several other countries (most explicitly those on the so-called periphery of the union) suffered (and are partly still suffering) from similar problems to Greece.

In this paper we concentrate on the sovereign debt crisis and its macroeconomic consequences. Many observers think that the piling up of public debt in countries like Greece calls for austerity measures to secure the solvency of their governments. However, during periods of low or even negative growth such a policy conflicts with the stabilization function of fiscal policy, which calls for an expansionary policy stance especially in those countries with relatively high public debt. Although there are different estimates about the extent of this trade-off between fiscal prudence and stability requirements on the one hand and stabilization goals for output and employment on the other, there is a lot of evidence that in the short run, debt reductions by restrictive government expenditure and tax policies have adverse effects on aggregate demand and unemployment. Several ways out of this unfortunate situation have been proposed by politicians and economists, especially in the context of the Greek Crisis. Some proposals call for debt reductions through transfers from the countries with sound finances in order to support those countries which are threatened by government insolvency. This may temporarily prevent state bankruptcy in the overindebted countries, but the medium and long run consequences are less clear, and the acceptance of such transfers by taxpayers in the donating countries is certainly limited, in spite of appeals to European solidarity. In a previous paper (Neck and Blueschke 2014), we have shown in a dynamic game model of a monetary union that such a "haircut" for indebted countries may lead to disadvantages, not only for the donors but also for the receiving countries due to their subsequent exclusion from financial markets and increased risk premiums for the interest on their public debt. The development of Greece since the first debt relief seems to corroborate this prediction.

Another remedy for the asymmetry of the government debt situation proposed by many European policy makers is the centralization of fiscal policies in the Euro Area, from a mechanism enforcing prudent government debt policies to the institution of a fiscal union with additional competences for the union-wide

institutions in fiscal matters. Notwithstanding the political obstacles to such a centralizing institutional move, it is of obvious interest to know whether its economic consequences will be advantageous or not. This question will be examined in the present paper. Due to the complexity of the decision mechanisms in the Euro Area, we can only provide a very partial answer. First, we concentrate on macroeconomic effects, abstracting from possible allocative and distributive consequences and from political problems such a massive restriction of national decision-making bodies would possibly create. Moreover, we use a fairly simple model with only two countries (or blocs) in the monetary union to deal with the asymmetry between high and low government debt countries. Policy conclusions must therefore be drawn with a lot of caution.

On the other hand, by using a dynamic policy game approach we can capture some of the strategic interactions between high and low public debt countries and between monetary and fiscal policy makers which are often neglected in the literature on the macroeconomics of a monetary union. To do so, we introduce a model of a monetary union with three decision makers: two governments (blocs), named core (bloc 1) and periphery (bloc 2), which differ with respect to their initial debt level and their preferences in the debt-output/employment trade-off, and a central bank responsible for monetary policy in the entire union. While the central bank cares about price stability and other targets in the whole union, the governments are assumed to be only interested in their national targets (and may have preferences about the Phillips curve trade-off which differ from those of the central bank). We calibrate the model so as to mirror some macroeconomic aspects of the Euro Area and calculate (approximate) optimal policies for these policy makers under different assumptions about fiscal-monetary policy interactions. A non-cooperative scenario is compared to several versions of a "pure fiscal union" (without coordination with the central bank) and a "complete monetary and fiscal union" where all policy makers cooperate. One result is that a higher degree of centralization in the institutional setting of the monetary union may but need not necessarily yield better results than non-cooperative decentralized policy making.

2 The dynamic game framework

We consider nonlinear dynamic games in discrete time given in tracking form. The players aim at minimizing quadratic deviations of the equilibrium or optimal values from given desired values. Each player minimizes an objective function (loss function) J^i:

$$\min_{u_1^i,\ldots,u_T^i} J^i = \min_{u_1^i,\ldots,u_T^i} \sum_{t=1}^{T} L_t^i(x_t, u_t^1, \ldots, u_t^N), i = 1, \ldots, N, \tag{1}$$

with

$$L_t^i(x_t, u_t^1, \ldots, u_t^N) = \frac{1}{2}[X_t - \tilde{X}_t^i]' \Omega_t^i [X_t - \tilde{X}_t^i]. \tag{2}$$

The parameter N denotes the number of players (decision makers). T is the finite terminal period of the planning horizon. X_t is an aggregated vector

$$X_t = [x_t \, u_t^1 \, u_t^2 \ldots u_t^N]', \tag{3}$$

consisting of an $(n_x \times 1)$ vector of state variables and N $(n_i \times 1)$ vectors of control variables. The desired levels of the state and the control variables enter (1)–(2) via the terms with a tilde:

$$\tilde{X}_t^i = [\tilde{x}_t^i \, \tilde{u}_t^{i1} \, \tilde{u}_t^{i2} \ldots \tilde{u}_t^{iN}]'. \tag{4}$$

Finally, (2) contains a penalty matrix Ω_t^i weighting the deviations of states and controls from their desired levels at any period t.

The dynamic system constraining the choices of the decision makers is given in state-space form by a first-order system of nonlinear difference equations:

$$x_t = f(x_{t-1}, x_t, u_t^1, \ldots, u_t^N, z_t), \quad x_0 = \bar{x}_0. \tag{5}$$

$\bar{x}_0$ contains the initial values of the states, z_t contains non-controlled exogenous variables. Equations (1), (2) and (5) define a nonlinear dynamic tracking game problem, which can be solved for different solution concepts. In order to solve this game we use the OPTGAME algorithm as described in Blueschke et al. (2013).

3 The MUMOD1 model

We use a dynamic macroeconomic model consisting of two countries (or two blocs of countries) with a common central bank. This model is called MUMOD1 and is essentially the same as the one introduced in Neck and Blueschke (2014). For a similar framework in continuous time, see Aarle et al. (2002). The model is calibrated so as to deal with the problem of public debt targeting in a situation that resembles the one currently prevailing in the European Union.

The model is formulated in terms of deviations from a long-run growth path and includes three decision makers. The common central bank decides on the prime rate R_{Et}, a nominal rate of interest under its direct control. The national governments decide on fiscal policy where g_{it} denotes country i's $(i = 1, 2)$ real fiscal surplus (or, if negative, its fiscal deficit), measured in relation to real GDP.

The model consists of the following equations:

$$y_{it} = \delta_i(\pi_{jt} - \pi_{it}) - \gamma(r_{it} - \theta) + \rho_i y_{jt} \\ - \beta_i \pi_{it} + \kappa_i y_{i,t-1} - \eta_i g_{it} + z d_{it}, \tag{6}$$

$$r_{it} = I_{it} - \pi_{it}^e, \tag{7}$$

$$I_{it} = R_{Et} - \lambda_i g_{it} + \chi_i D_{it}, \tag{8}$$

$$\pi_{it} = \pi_{it}^e + \xi_i y_{it}, \tag{9}$$

$$\pi_{it}^e = \varepsilon_i \pi_{i,t-1} + (1 - \varepsilon_i)\pi_{i,t-1}^e, \quad \varepsilon \in [0, 1], \tag{10}$$

$$y_{Et} = \omega y_{1t} + (1 - \omega)y_{2t}, \quad \omega \in [0, 1], \tag{11}$$

$$\pi_{Et} = \omega \pi_{1t} + (1 - \omega)\pi_{2t}, \quad \omega \in [0, 1], \tag{12}$$

$$D_{it} = (1 + BI_{i,t-1} - \pi_{i,t-1}^e)D_{i,t-1} - g_{it}, \tag{13}$$

$$BI_{it} = \frac{1}{6}\sum_{\tau=t-5}^{t} I_{it}. \tag{14}$$

List of variables	
y_{it}	Real output (deviation from natural output)
π_{it}	Inflation rate
r_{it}	Real interest rate
g_{it}	Real fiscal surplus
I_{it}	Nominal interest rate
π_{it}^e	Expected inflation rate
R_{Et}	Prime rate
D_{it}	Real government debt
B_{it}	Interest rate on public debt

The goods markets are modelled for each country i by the short-run income-expenditure equilibrium relation (IS curve) (6). The natural real rate of output growth, $\theta \in [0, 1]$, is assumed to be equal to the natural real rate of interest. The current real rate of interest r_{it} is given by Eq. (7). The nominal rate of interest I_{it} is given by Eq. (8), where $-\lambda_i$ and χ_i (assumed to be positive) are risk premiums for country i's fiscal deficit and public debt level.

The inflation rates for each country π_{it} are determined in Eq. (9) according to an expectations-augmented Phillips curve. π_{it}^e denotes the rate of inflation expected to prevail during time period t, which is formed according to the hypothesis of adaptive expectations at (the end of) time period $t - 1$ (Eq. 10). $\varepsilon_i \in [0, 1]$ are positive parameters determining the speed of adjustment of expected to actual inflation. The average values of output and inflation in the monetary union are given by Eqs. (11) and (12), where parameter ω expresses the weight of country 1 in the economy of the whole monetary union as defined by its output level.

The government budget constraint is given as Eq. (13) for real government debt D_{it} (measured in relation to GDP). The interest rate on public debt (on bonds) is

denoted by BI_{it}, which assumes an average government bond maturity of 6 years, as estimated in Krause and Moyen (2013).

The parameters of the model are specified for a slightly asymmetric monetary union. Here an attempt has been made to calibrate the model parameters so as to fit for the Euro Area (EA). The data used for calibration include average economic indicators for the (now) 19 countries from EUROSTAT up to the year 2007 (pre-crisis state). Mainly based on their public finance situation, the EA is divided into two blocs: a "core" (country or bloc 1) and a "periphery" (country or bloc 2). The first bloc includes twelve EA countries (Austria, Belgium, Estonia, Finland, France, Germany, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, and Slovakia) with a more solid fiscal situation and inflation performance. This bloc has a weight of 60 % in the entire economy of the monetary union. The second bloc has a weight of 40 % in the economy of the union; in the EA, it consists of seven countries with higher public debt and/or deficits and higher interest and inflation rates on average (Cyprus, Greece, Ireland, Italy, Portugal, Slovenia, and Spain). The weights correspond to their respective shares in EA real GDP (in 2007). For the other parameters of the model, we use values in accordance with econometric studies and plausibility considerations (see Tables 1, 2).

Using the MUMOD1 model we consider an intertemporal nonlinear game in tracking form. The individual objective functions of the national governments ($i = 1, 2$) and of the common central bank (E) are given by

$$J_i = \frac{1}{2} \sum_{t=1}^{T} \left(\frac{1}{1 + \frac{\theta}{100}} \right)^t \{ \alpha_{\pi i}(\pi_{it} - \tilde{\pi}_{it})^2 + \alpha_{yi}(y_{it} - \tilde{y}_{it})^2 + \alpha_{Di}(D_{it} - \tilde{D}_{it})^2 + \alpha_{gi} g_{it}^2 \}$$
(15)

$$J_E = \frac{1}{2} \sum_{t=1}^{T} \left(\frac{1}{1 + \frac{\theta}{100}} \right)^t \{ \alpha_{\pi E}(\pi_{Et} - \tilde{\pi}_{Et})^2 + \alpha_{yE}(y_{Et} - \tilde{y}_{Et})^2 + \alpha_E(R_{Et} - \tilde{R}_{Et})^2 \}$$
(16)

where all α are weights of state variables representing their relative importance to the relevant policy maker (see Table 3). A tilde denotes the desired values of the variable concerned (Table 4).

The joint objective function for calculating the cooperative Pareto-optimal solution is given by the weighted sum of the three objective functions:

Table 1 Initial values of the two-country monetary union

$y_{i,0}$	$\pi_{i,0}$	$\pi_{i,0}^e$	$I_{i,0}$	$D_{1,0}$	$D_{2,0}$	$R_{E,0}$	$g_{1,0}$	$g_{2,0}$
0	2.5	2.5	3	60	80	3	-2	-4

Table 2 Parameter values for an asymmetric monetary union, $i = 1, 2$

T	θ	ω	$\delta_i, \eta_i, \varepsilon_i$	$\beta_i, \gamma_i, \rho_i, \kappa_i, \lambda_i$	ξ_i	χ_i	μ_i, μ_E
30	3	0.6	0.5	0.25	0.1	0.0125	0.333

Table 3 Weights of the variables in the objective functions

α_{yi}, α_{gi}	$\alpha_{\pi E}$	$\alpha_{yE}, \alpha_{\pi i}$	α_{D1}	α_{D2}	α_{RE}
1	2	0.5	0.01	0.0001	2.5

Table 4 Target values for the asymmetric monetary union

$\tilde{D}_{1t}$	$\tilde{D}_{2t}$	$\tilde{\pi}_{it}$	$\tilde{\pi}_{Et}$	$\tilde{y}_{it}$	$\tilde{y}_{Et}$	$\tilde{g}_{it}$	$\tilde{R}_{Et}$
60	80↘60	2	2	0	0	0	3

$$J = \mu_1 J_1 + \mu_2 J_2 + \mu_E J_E, \quad (\mu_1 + \mu_2 + \mu_3 = 1). \tag{17}$$

The dynamic system is given in state-space form by the MUMOD1 model as presented in Eqs. (6) to (14). Equations (15), (16) and the dynamic system (6)–(14) define a nonlinear dynamic tracking game problem which can be solved for different solution concepts. Using the OPTGAME3 algorithm (see Blueschke et al. 2013) we solve this dynamic tracking game numerically and analyze the effects of different shocks acting on the system. In this study we consider demand-side shocks in the goods markets as represented by the variables (Table 5) zd_{it}. These demand shocks represent both the negative effects of the 2007–2010 economic crisis affecting the whole monetary union and the European sovereign debt crisis affecting the second bloc only.

4 Results of the baseline solution

In this study we investigate the effects of a centralized fiscal policy, which can be interpreted as the working of a fiscal union. To this end we compare the performance of the players based on three scenarios: *Noncoop* (the non-cooperative feedback Nash game with three independent players), *Fiscalun* (a Nash game with two players: fiscal union vs. central bank), and *Monfiscun* (the cooperative Pareto solution where all players act in a coordinated way as one player). First, we present the results of a baseline scenario in which the weights of the fiscal union members correspond to real weights inside the EA. As the weighting criteria we assume that each bloc is assigned one voice, which results in a core/periphery relation of 63–37 %. After that we test two special cases of asymmetric fiscal unions where one member of the fiscal union gets a higher weight (90–10 and 10–90 %). For this

Table 5 Negative demand shocks in the asymmetric monetary union

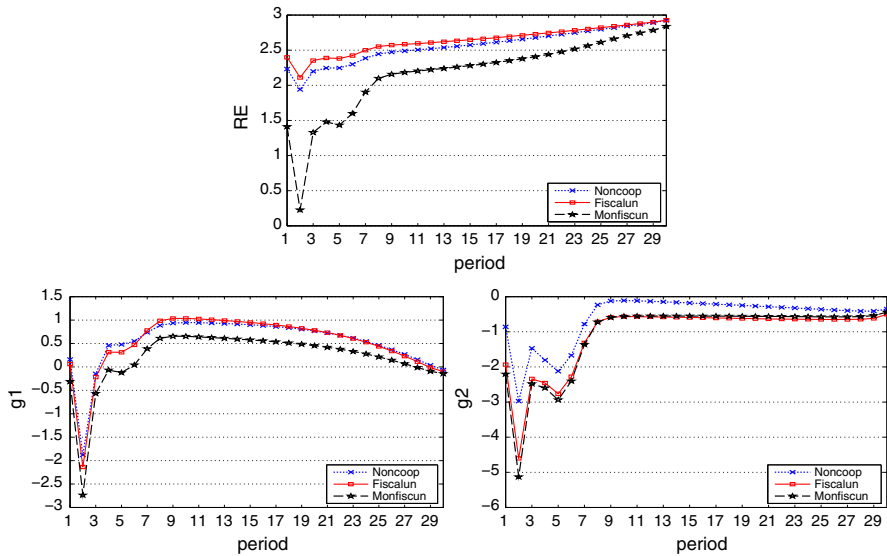| t	1	2	3	4	5	6	7	8	9	...
zd_{1t}	−1	−6	−1	0	0	0	0	0	0	0
zd_{2t}	−1	−6	−1	−3	−4	−3	−1	0	0	0

Fig. 1 Control variables [prime rate (R_{Et}) and fiscal surplus (g_{it})] in the baseline scenario (63-37)

baseline solution, in this section we present the results of the three scenarios (*Noncoop*, *Fiscalun*, and *Monfiscun*).

Figure 1 shows the time paths of the control variables in this experiment. Figure 2 shows the results for the politically most relevant state variables.

Figure 1 shows that both monetary and fiscal policies react to the negative demand shock in an expansionary and hence countercyclical manner, especially during the periods (to be interpreted as years) of the original Great Recession-like shock. The reaction to the asymmetric part of the shock (modeling the sovereign debt crisis) is stronger in the periphery, as expected. Note that fiscal policies return rather quickly to the long-run desired level of balanced budgets (more so in the core than in the periphery), and monetary policy keeps interest rates low over an extended period. This shows some similarity with the interest rate policy of the European Central Bank, although the rather aggressive expansionary policy stance of the ECB is not an outcome of the game scenarios under consideration. While the core government follows nearly the same fiscal policy in the three versions (non-cooperative, fiscal union, monetary and fiscal union) of this baseline scenario, the non-cooperative solution for the periphery's fiscal policy is less expansionary than in the versions with partial and full cooperation. The central bank is considerably more active (in the expansionary direction) in the full monetary and fiscal union than in the other two games.

Comparing the resulting outcomes of these different games reflecting institutional differences, it is remarkable that the effects on output are very similar for all three games. This is an indication of the low effectiveness of fiscal policies for real sector variables, a result we have already obtained in previous simulations with the same model in spite of its more Keynesian than monetarist features. The
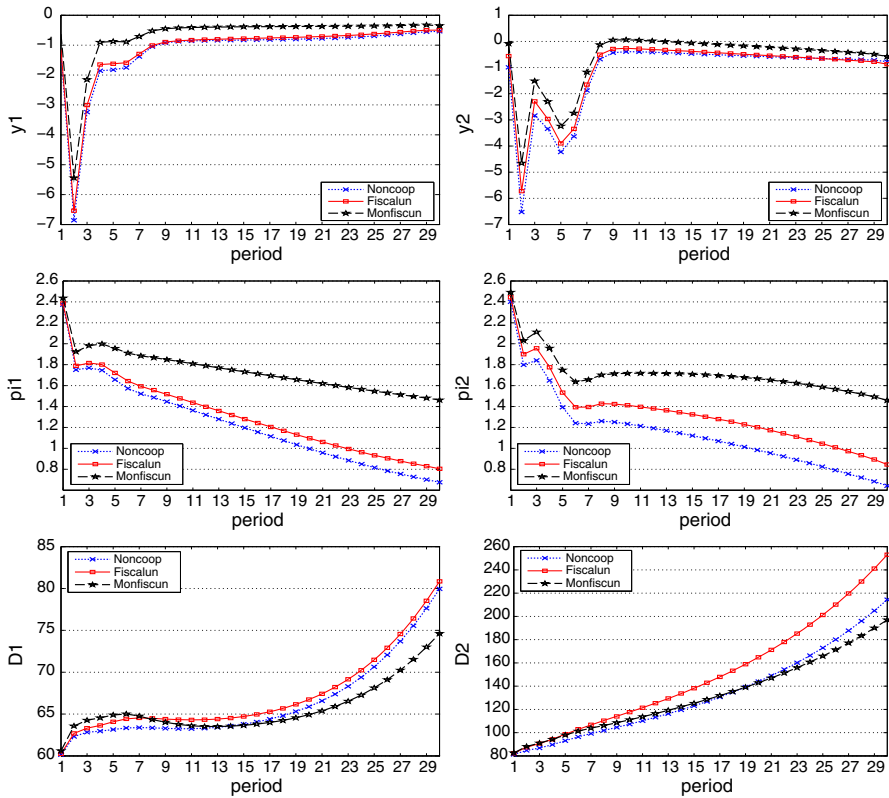
Fig. 2 State variables [output (y_{it}), inflation (π_{it}) and public debt (D_{it})] in the baseline scenario (63-37)

development of the inflation rates differs more, with the active central bank (and, more generally, cooperation) avoiding deflationary tendencies (although not real deflation as the inflation rate always remains positive). The most pronounced differences occur between the three games in the development of government debt, especially in the periphery bloc, where the increase in debt is lowest in the fully cooperative monetary and fiscal union and highest in the pure fiscal union. This latter result is only partly driven by the low weight the government of the periphery attaches to its debt goal; another reason is the more expansionary monetary policy which prevents adverse real interest effects on government debt.

5 Results for asymmetric Fiscal unions

In this section we present the results for two special cases of an asymmetric fiscal union. In these cases one member of the fiscal union is accorded significantly greater importance: core to periphery, 90–10 and 10–90 %, respectively. We may call these scenarios, somewhat ironically, the "Schäuble fiscal union" and the

"Varoufakis fiscal union" respectively to express the dominance of the core on the one hand and the periphery on the other.

5.1 The 90-10 Scenario (Core Dominance)

Figure 3 shows the time paths of the control variables in this experiment while Fig. 4 shows the results for the state variables. In general, the relative effects of the increased weight given to the core government in the fiscal union and in the monetary and fiscal union (the non-cooperative solution remains the same, of course) leads to a less expansionary monetary policy than in the baseline solution, a less expansionary fiscal policy by the core government, and a considerably more expansionary fiscal policy by the periphery (compare Figs. 1, 3). The reason for this is the ability of the more austerity-prone core government to implement its preferred course of actions (less expansion) and the resulting need for the expansion-prone periphery to combat the slump by creating higher budget deficits.

This policy mix in the two games with (partial or full) cooperation results in developments in the core which are quite similar to those in the baseline solution (compare the left columns of Figs. 2, 4) but cause a more expansionary development in the periphery: output in both cooperation games is higher, and so is government debt. However, the size of the effect of the more expansionary fiscal policy of the periphery is much larger for government debt than for output. Altogether, the periphery suffers from its low weight in the cooperative agreements assumed for the pure fiscal and the monetary and fiscal union: it pays a high price in terms of (actually not sustainable) increased debt for only modest additional output.
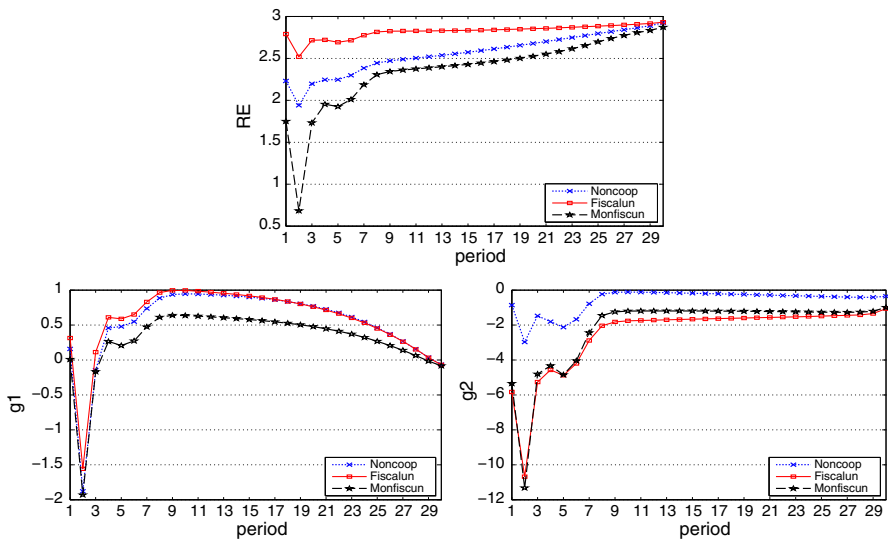

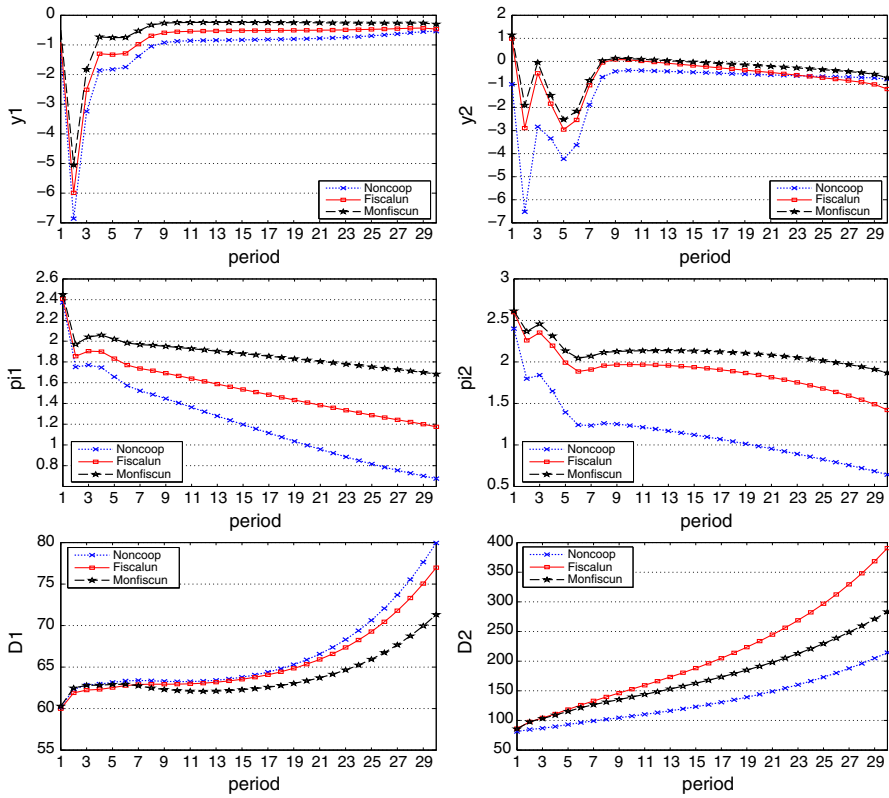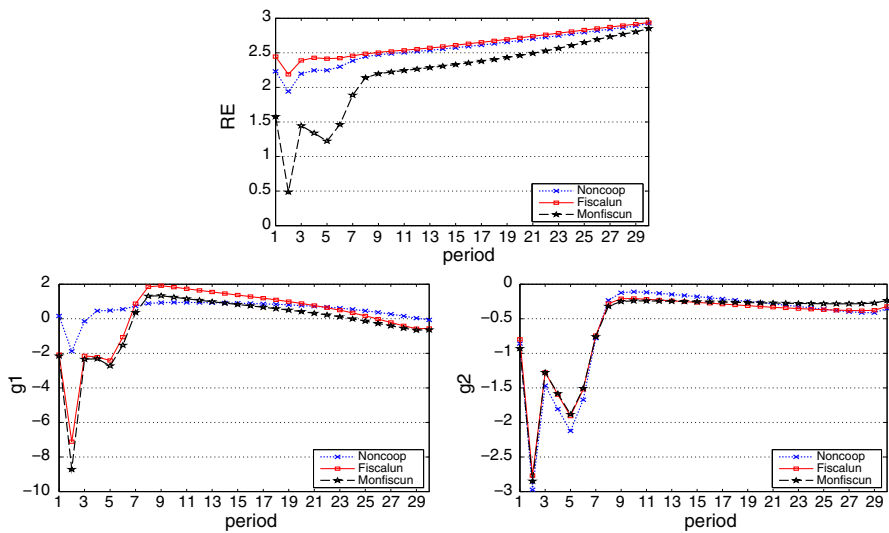**Fig. 3** Control variables [prime rate (R_{Et}) and fiscal surplus (g_{it})] in the 90-10 scenario

Fig. 4 State variables [output (y_{it}), inflation (π_{it}) and public debt (D_{it})] in the 90-10 scenario

Fig. 5 Control variables [prime rate (R_{Et}) and fiscal surplus (g_{it})] in the 10-90 scenario
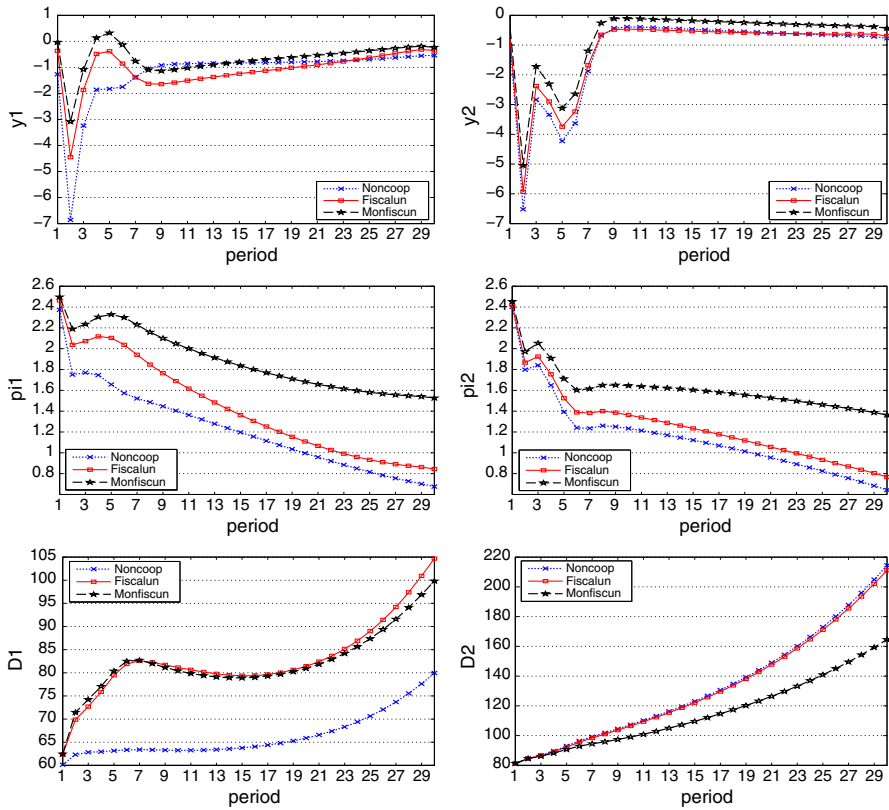
Fig. 6 State variables [output (y_{it}), inflation (π_{it}) and public debt (D_{it})] in the 10-90 scenario

5.2 The 10-90 Scenario (Periphery Dominance)

Figure 5 shows the time paths of the control variables in this experiment while Fig. 6 shows the results for the state variables. The scenario with the dominance of the periphery calls for stronger expansionary reactions by all policy makers to the second (sovereign debt) phase of the shock due to the periphery (which is the only player directly affected by it) having a stronger weight in the cooperative agreements. The most visible effect of the low weight of the core is, however, its considerably more expansionary fiscal policy. As the weak partner in such a fiscal union (with or without the cooperation of the central bank) the core has to shoulder the burden of dealing with the shock to a larger extent than in the two pervious scenarios (Fig. 5 as compared to Figs. 1, 3).

As has to be expected from this policy mix in the games with cooperation, the effects on the periphery are small compared to the baseline scenario, and the effects on the core are stronger. The output-debt trade-off in the pure fiscal union manifests itself in developments of output and public debt in the periphery which are very close to those in the non-cooperative solution. Now the core has to bear the burden of stabilization policy in the cooperative solutions by accepting higher government

debt over the entire period, with only small gain in terms of higher output. Note that this reinforces the observation that expansionary fiscal policy is not very effective at fulfilling the task of stabilizing output (and employment, although this variable is not explicitly present in our model).

6 Does cooperation pay?

How likely is the advent of an institutional change towards a fiscal union, with or without the cooperation of the central bank? This depends on the possible gains from such a change. In the simplified framework of our model, we can guess an answer from the (equilibrium and optimal) values of the objective functions of the three players under alternative scenarios and for the different types of games. Table 6 shows these values of the individual objective functions and of the fiscal union coalitions (without and with the central bank). Since these are loss functions to be minimized, low numbers are better than large ones. The central bank is abbreviated by "CB". The last column can be interpreted as the overall macroeconomic costs of each game. As has to be expected, the "grand coalition" (monetary and fiscal union) in the baseline scenario is better than the "small coalition" (pure fiscal union), which in turn is better than non-cooperation. However, and this is unexpected, this is not true for the asymmetric unions. The two pure fiscal union games produce the worst outcomes (highest costs), and the non-cooperative solution is even better than the fully cooperative solution when one player dominates in the latter. As the numbers of the individual losses reveal, this is due to the high losses the weaker player incurs in the relevant cooperative game. From a normative point of view we have to conclude from a comparison of the outcomes, therefore, that the desirability of a fiscal union (in this model) depends strongly on the distribution of power within the fiscal policy. An unequal distribution, where one member of the union has to bear most of the costs, will be disadvantageous for the entire cooperative outcome.

Table 6 Objective function values of the MUMOD1 based dynamic game

Scenario/player	CB	Core (C1)	Periphery (C2)	C1 + C2	CB + C1 + C2
Noncoop	41.41	52.55	66.62	119.17	160.58
*Fiscalun*_baseline	31.86	49.41	73.08	122.49	154.35
*Monfiscun*_baseline	43.26	28.54	58.08	86.62	129.88
*Fiscalun*_90-10	13.05	36.45	171.27	207.72	220.76
*Monfiscun*_90-10	24.75	20.93	146.66	167.59	192.35
*Fiscalun*_10-90	27.08	121.00	54.74	175.75	202.82
*Monfiscun*_10-90	37.66	111.07	37.36	148.43	186.09

7 Conclusions and outlook

In this paper, we presented an application of dynamic tracking games to a monetary union. We used a small stylized nonlinear two-country macroeconomic model of a monetary union for analyzing the interactions between two fiscal (governments: "core" and "periphery") and one monetary (common central bank) policy makers, assuming different objective functions of these decision makers. Using the OPTGAME algorithm, we calculated numerical solutions for cooperative (Pareto optimal) and non-cooperative games (feedback Nash). We showed how the policy makers react to demand shocks according to these solution concepts. To this end we introduced a negative asymmetric demand side shock aimed at describing the macroeconomic dynamics within a monetary union in a situation similar to the economic crisis (2007–2010) and the sovereign debt crisis (since 2010) in Europe. We investigated the consequences of three scenarios: decentralized fiscal policies controlled by independent governments (the present situation), centralized fiscal policy (a fiscal union) with an independent central bank (pure fiscal union), and a fully centralized fiscal and monetary union. For the latter two scenarios, we investigated the effects of different assumptions about the joint objective function corresponding to different weights for the two governments in the bargaining process assumed to precede the design of the common fiscal policy. We showed the importance of these weights and, hence, of the regulations contained in the fiscal constitution of the union for the macroeconomic outcomes of the resulting games in terms of the sustainability of fiscal policies and the main objective variables of the policy makers. We showed that a fiscal union with weights corresponding to the number of states in the respective bloc gave better results (in terms of the overall objective function) than non-cooperative decentralized policy making, especially if the fiscal union cooperates with monetary policy by the joint central bank. When one bloc dominates the fiscal union, however, decentralized policies yield lower overall losses than the pure fiscal union and the monetary and fiscal union.

Applying these results to the current situation in the Euro Area must be done very cautiously. The model used is relatively simple and does not contain some important macroeconomic relations such as, for instance, differences in competitiveness between the blocs. Forward-looking expectations could possibly imply another modification to the results. Differences within the blocs are neglected, which would give rise to additional strategic possibilities such as coalitions between several countries against the rest. The model aims at short-run effects only and does not consider the long-run growth effects of different policy regimes. These and other extensions to the framework seem worthwhile examining and will be subjects for further research. We think, however, that even within the simple framework considered here, the usefulness of the dynamic game approach has been demonstrated for the analysis of macroeconomic policy making in a monetary union.

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