Fiscal performance in monetary unions: How much austerity should be allowed?

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Summary

The effectiveness of fiscal policy becomes particularly relevant in the case of the member countries of a monetary union facing a sovereign debt crisis. In that environment, fiscal policy is constrained by the need to carry out fiscal consolidation and reduce debt levels. For that reason and with the purpose of anchor fiscal discipline, the adoption of fiscal rules has become a central issue. In this paper we will analyse the management of fiscal policies in monetary unions, when the central bank and the fiscal authorities follow policy rules. The results would be related to the conservativeness of the central bank, the degree of austerity of the fiscal authorities and the initial level of public debt.

Key words: Policy rules, fiscal policy, monetary unions.

JEL codes: E63, H30

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1. Introduction

It is well known that in monetary unions, with an independent monetary authority, fiscal policy turns to be the only available policy demand and, in some cases, monetary policy is insufficient to achieve the required stabilization. Moreover, if monetary authorities are particularly interested in controlling inflation and stabilizing output, the fiscal authorities are expected to ensure sound fiscal policies but also to help guarantee price stability. This question becomes particularly relevant in the case of the member countries of a monetary union facing a sovereign debt crisis, given that fiscal policy is constrained by the need to carry out fiscal consolidation and reduce debt levels.

For that reason and with the purpose of anchor fiscal discipline, in the current economic environment, the adoption of fiscal rules has become a central issue. As for monetary rules, the usefulness of fiscal rules is related to the credibility of stable and announced rules. Even starting from a deficit, if fiscal discipline is credible, a fiscal contraction could have expansionary effects on output. In situations of very high public deficit, a reduction in public spending could lead to greater expansionary effects on aggregate demand than tax increases. And also, fiscal consolidations based on expenditure control, create favourable conditions for economic growth by stimulating tax revenues (Alberto Alesina and Silvia Ardagna, 1998).

Having in mind the case of the European Monetary Union (EMU), the Maastricht Treaty stressed as basic that the Member States of the EMU should avoid excessive deficits; and the reference values for deficit-to-GDP and debt-to-GDP ratios, have worked in practice as an explicit fiscal rule. But, the policy orientation of the Stability and Growth Pact (SGP) was not been fully satisfied. This opened a debate about the utility and effectiveness of fiscal rules in EMU, and on their complementarities with discretionary fiscal policy measures and automatic stabilisers to deal with short-run fluctuations.

From the macroeconomic point of view, the EMU represents a change on the framework of economic policies, resulting in lower variability of the discretionary component of fiscal policy. And the existing national different fiscal frameworks are enforced to be consistent with the requirements of discipline at the European Union (EU) level. To ensure those objectives, in April 2011 *The Pact for the Euro* was signed to strengthen coordination of economic policy and to enforce member states to translate into national legislations the EU budgetary rules established in the SGP.

In an attempt to offer some light on the fiscal performance in EMU, we will develop a simple model for a monetary union to analyse different combinations of policies. We will allow for a more or less conservative governor of the central bank, we will also consider both austere and no austere fiscal policy and, finally, we will take into account the initial level of public debt of the member countries of the union.

The paper is structured as follows: in section 2 we review some related literature; in section 3 we comment some considerations on the issue; next, the macroeconomic model is presented in section 4; section 5 shows the empirical results; and, finally, section 6 concludes.

2. Literature survey

In parallel to the current economic crisis, the debate on the role of economic policies has recovered a renewed interest. It seems to be a consensus on that the success of economic policies depends on the macroeconomic conditions, and that severe fiscal consolidations are needed (See, for instance, Casimir Dadak 2011; and Bradford J. Delong and Lawrence H. Summers, 2012, among others). And as mentioned in the Introduction, the success of fiscal consolidations becomes relevant for monetary unions facing a sovereign debt crisis, since they do not have control over money and they must borrow before they can spend. Particularly, in EMU the problem could be dramatic since the European Central Bank (ECB) does not act as a lender of last resort (see Stephanie Kelton 2011, for details).

At the EU level the fiscal limitations imposed by the Maastricht Treaty and, later, by the SGP, should be interpreted as a way to assure a *Ricardian* regime in terms of the literature on the Fiscal Theory of the Price Level (see Christopher Sims, 1994, and Charles T. Carlstrom and Timothy S. Fuerst, 2000, among others). In such regime monetary policy is "active", being price determination the nominal anchor; while fiscal policy adjusts in a "passive" way, i.e.: the government spending path is endogenous. In this line, Michael Woodford, 1998, 2000, showed that a central bank charged with maintaining price stability cannot be indifferent as to how fiscal policy is determined. And as Lawrence Christiano and Terry J. Fitzgerald, 2000, addressed, "…governments adjust fiscal policy when the debt gets too far… … (and) members of the EU adjust fiscal policy in the event their debts grow too large…"

On the one hand, according to Public Economics and Macroeconomic Theories, fiscal policy is viewed as an effective tool for achieving stabilization. As has been

recently addressed by Philip Arestis and Malcolm Sawyer 2010, Arestis 2011, 2012; Yiannis Kitromilides 2011; Eckhard Hein, Alan Auerbach and Yuriyi Gorodnichenko, 2012, or Achim Truger 2012-2013, for example. Questions such the coordination of fiscal and monetary policy; the deficit and debt reduction, the measurement of output responses to fiscal policies, and a more active role of fiscal policy have been recommended as ways of contributing to improve fiscal policy effectiveness.

On the other hand, the high levels of government deficits and debts have forced to implement austerity-policy packages in most of the developed economies. Arestis and Pelagidis, 2012, Genaro Zezza 2012, and Roberto Perotti, 2013, advise on the potential danger of austerity on economic growth. In a recent study based on fiscal multipliers, Pablo García and Miguel Sebastián, 2013, find that austerity may be counterproductive. From their study, they conclude that policies of deficit reduction may be self-defeating in south-European countries like Spain. On the contrary, for the German case they found that austerity works.

In such environment, where fiscal policies are the only available stabilization tool but the implementation of fiscal measures are constrained by fiscal discipline, fiscal rules have been considered an useful way of combining the achievement of policy aims with discipline and control over economic variables. In academic circles are scarce the studies that have explicitly considered the needed of fiscal rules. Fernando Ballabriga and Carlos Martínez-Mongay, 2003, estimated monetary and fiscal rules for the euro-zone, concluding that monetary policy rules should be accompanied by an explicit public deficit objective. Xavier Debrun *et al.*, 2008, found that fiscal rules lead to more stable budget policies and less pro-cyclical fiscal policies. Michał Brzozowski and Joanna Siwińska-Gorzelak, 2010, analysed the impact of fiscal rules on fiscal policy volatility, concluding that rules based on deficit control are more destabilizing than those based on imposing a limit to public debt. From another point of view, Carmen Díaz-Roldán and Alberto Montero-Soler, 2009, 2011, and more recently Díaz-Roldán, 2013, analyze the convenience of using fiscal rules for different subsets of countries of the EMU. They found that the success of fiscal policy decisions depend on the symmetric or asymmetric nature of the shocks to deal with, and also on the particular economic conditions of each country.

But, recently, after the financial and economic crisis fiscal rules have recovered a new interest due to the potential usefulness that fiscal rules could provide for helping to recover economies. Andrea Schaechter *et.al.* 2012, present details about the rules'

key design elements, particularly in support their enforcement; and conclude that the "next generation" fiscal rules are increasingly complex as they should combine the objectives of sustainability with the need for flexibility in response to shocks, thereby creating new challenges for implementation, communication, and monitoring. From another point of view, and having the EMU debt crisis in mind, Charles Wyplosz, 2013, has addressed that solving the fiscal discipline problem requires adequate institutions or rules, or both.

Having in mind the above considerations along the lines addressed by the literature, in this paper we will study the management of fiscal policies in monetary unions, where the central bank and the fiscal authorities follow policy rules. When analysing different combinations of policies, we will allow for a more or less conservative governor of the central bank, for both austere and no austere fiscal policy measures and, finally, we will also take into account the initial level of public debt of the member countries of the union.

3. Monetary and fiscal policies in a monetary union

The management of fiscal policy becomes an issue of special relevance in monetary unions, given that is not trivial the particular macroeconomic framework that the union represents. The single monetary policy is the exclusive competence of an independent and supranational central bank, whilst other economic policies generally remain the responsibility of the member states. Therefore, the fiscal discipline imposed by the monetary agreements limit the scope of stabilization fiscal policies, and its implications on economic growth. In general, the success of fiscal consolidation depends not only on the improvement of the primary fiscal balances, but also on the macroeconomic conditions such as the monetary policy regime, the exchange rate system, and the external position. In a monetary union, the degree and the mechanism for coordination of national economic policies differ according to how convincing the economic rationale for coordination is in the particular policy area.

Although in principle the renunciation of an independent monetary policy would be a disadvantage for a country, it would be more dangerous the more important were the asymmetric shocks that the economy could suffer. In other words, the member states of a monetary union would face special difficulties when dealing with external shocks. The reason is simply that a common monetary policy is not the appropriate instrument to deal with an asymmetric disturbance, so the cost of the loss of monetary policy would

be the smaller the more integrated are the economies of the countries forming the monetary union. Within integrated countries the evolution of their economies would be much synchronized, and therefore less likely the occurrence of asymmetric shocks. Added to that, a monetary union fiscal represents a novel framework since, in general, a monetary union lacks of a supranational budget of a proper size to incorporate the insurance function of fiscal policy. That is the case of the EMU, where there are no federal taxes at the EU level, and shifting some taxes to the EU is not envisaged, because it would mean to reinforce fiscal competencies at the EU level.

Currently, the EMU stabilization policies can be broadly described by (i) a monetary policy rule followed by the ECB, aimed to achieve the only objective of price stability (*inflation targeting*); and (ii) the adoption of fiscal rules targeting the budget balance, public debt or government expenditure (including expenditure ceilings). In this environment, the success of a monetary-fiscal policy mix relies on the proper combination of those rules.

Regarding monetary policy, both theoretical and empirical works seem to provide sufficient evidence that the granting of independence to the central bank can reduce inflation without having a negative impact on real economic variables. The independence of the central bank is based on the assumption that the inflationary bias resulting from the application of discretionary monetary policy could be avoided by establishing some kind of strict monetary rule (Robert J. Barro and David B. Gordon, 1983). But the strict rules-based solutions have two serious drawbacks: the credibility of maintenance over time, and the rigidity that monetary rules can introduce in the conduct of monetary policy. According to Kenneth Rogoff, 1985, the delegation of monetary policy to an independent central bank is seen as a way to avoid the limitations of the rules. Under the *discretionary or legislative approach* of central bank independence, reducing the problem of inflationary bias of monetary policy is achieved by the appointment of a governor to the central bank to be more conservative than the rest of society. In terms of a Taylor-type monetary policy rule, a governor would be conservative if the nominal interest rate is sensitive enough to changes on inflation.

When the central bank follows a common monetary rule, fiscal policy would have the same effect as a disturbance that affected goods market. A common fiscal policy (or any real common disturbance) would be only effective in the short term. In other words, the total income of the union would not be altered, but there would be a redistribution of income in each member country of the union.

Taking into account those considerations, the management of fiscal policy within the EMU is constrained basically by two elements: the degree of conservativeness of the ECB and the particular national fiscal frameworks. Given the *inflation targeting* goal of the ECB, European fiscal policy aims not only to fulfil the intertemporal budget constraint, but also to guarantee price stability. Added to this, the current environment of sovereign debt crisis has forced to reconsider the way of fiscal policy adjustments. Therefore, the recent EU reforms are aimed to strength national fiscal frameworks, focusing on the adoption of numerical fiscal rules and the budget coordination between different levels of government (ECB, 2013).

4. A macroeconomic model for a monetary union

Our main purpose is to analyse the management of fiscal policies in monetary unions, where the central bank and the fiscal authorities follow policy rules. To that end, we will develop a simple model for a monetary union to analyse different combinations of monetary and fiscal policies.

Following Díaz-Roldán and Montero-Soler, 2009, our starting point will be a "small" monetary union formed by two symmetric countries, where nominal exchange rate disappears among countries. The monetary authority (the central bank), follows a common Taylor-type monetary rule to achieve the price stabilization goal (*inflation targeting*). Variables are defined as logarithmic deviations from their equilibrium levels (A more detailed description of the model can be found in the Appendix). The aggregate demand and the aggregate supply functions for each country are as follows:

$$y_1 = -a\Delta p_1 \pm b\Delta p_2 \pm cy_2 + hg_1 + v_1 \quad (1)$$

$$y_2 = -a\Delta p_2 \pm b\Delta p_1 \pm cy_1 + hg_2 + v_2 \quad (2)$$

$$y_1 = t\Delta p_1 - s_1 \quad (3)$$

$$y_2 = t\Delta p_2 - s_2 \quad (4)$$

Equations (1) and (2) represent the aggregate demand function for each member country of the monetary union, where y_1, y_2 are the outputs, $\Delta\ p_1$, $\Delta\ p_2$, the inflation rates, g_1, g_2 the budget deficits, i.e., the fiscal policy instrument, and v_1, v_2 capture any kind of expansionary demand shock. Equations (3) and (4) represent the aggregate

supply function for each member country of the monetary union, where s_1, s_2 capture any expansionary supply side shock.

Solving (1) to (4), we obtain the reduced forms. Looking at the coefficients of the equations of the model (see Appendix), when countries are particularly concerned by *inflation targeting*, the *"beggar-thy-neighbour"* effect prevails (demand shocks are transmitted abroad in an asymmetric way, i.e., with the opposite sign). This would be the case for a monetary union following a monetary policy rule (*inflation targeting*). Given that in our analysis we will focus on stabilization policies aimed to deal with demand shocks, we will neglect supply side shocks hereafter.

$$y_1 = \mathrm{A}\, hg_1 + \mathrm{A}\, v_1 - \mathrm{B}\, hg_2 - \mathrm{B}\, v_2 \qquad (5)$$

$$y_2 = \mathrm{A}\, hg_2 + \mathrm{A} v_2 - \mathrm{B}\, hg_1 - \mathrm{B}\, v_1 \qquad (6)$$

$$\Delta p_1 = \mathrm{A}\, hg_1 + \mathrm{A}\, v_1 + \mathrm{B}\, hg_2 + \mathrm{B}\, v_2 \qquad (7)$$

$$\Delta p_2 = \mathrm{A}\, hg_2 + \mathrm{A}\, v_2 + \mathrm{B}\, hg_1 + \mathrm{B}\, v_1 \qquad (8)$$

Equations (5) to (8) show the economic framework of the monetary union. This particular set of equations will constraint the policy decisions of the authorities, given the economic framework determines the way of transmission of economic policies or any other disturbance. Besides this consideration, we will also include in our model the restriction imposed by the requirement of achieving the fiscal discipline goal. To do that, we will allow the adoption of an explicit fiscal rule to characterize the deficit path followed by fiscal authorities.

To take into account the role of fiscal rules, we will follow Ballabriga and Martínez-Mongay, 2003. And therefore, we will consider a fiscal rule which relates an explicit public deficit target (in terms of the GDP), g^o, with public debt deviations (in terms of the GDP) respect to its optimal level ($d_{-1} - d^o$), and the output level y:

$$g_i^o = -\,[\delta(d_{i,-1} - d_i^o) + \theta y_i] \qquad i = 1, 2 \qquad (9)$$

The public deficit adjusts according to the following path, where $0 \le \rho \le 1$:

$$g_i = (1-\rho) g_i^o + \rho g_{i,-1} \qquad (10)$$

Adding the variables that are given in period 1, we obtain the simplified fiscal rules for each member country of the union:

$$g_1 = k_1 - \lambda y_1 \qquad (11)$$

$$g_2 = k_2 - \lambda y_2 \qquad (12)$$

Notice that if $(d_{i,-1} - d_i^o) > 0$, then $k_i < 0$, indicating a country with a relatively high level of debt. And the opposite holds for $k_i > 0$, indicating a country with a relatively low level of debt.

To solve our model we will assume that fiscal authorities will try to minimize their loss function constrained by the economic framework (given by the reduced form of the macroeconomic model, equations (5) to (8)), and the explicit fiscal rule (equations (11) and (12)). Their goals are to minimize output changes, y_i, with stabilization purposes, and to minimize public deficit changes, g_i, in order to achieve fiscal discipline. Regarding inflation, since our model describes a monetary union, we assume full delegation of prices control to the monetary authority; therefore, public deficit will be the only demand policy instrument available at the national level.

In this framework, among the set of policy makers decisions, we will focus in the case of a coordinated decision allowing for the use of a fiscal rule in both countries. That optimization problem describes the current situation of EU fiscal governance, since European Commission has recently enforced fiscal policy coordination and the use of numerical fiscal rules (See ECB, 2013, for an analysis). Solving the optimization problem, we will obtain the optimal (fiscal) policy, i.e., the optimal level of public deficit compatible with the stabilization goal (see Appendix for details).

The problem of coordinated decision and fiscal rule in both countries is as follows:

$$\min_{g_1, g_2} \quad \ell = \left[\frac{1}{2} L_1 + \frac{1}{2} L_2 \right]$$

s.t. (5), (6), (11) and (12).

where $L_i = y_i^2 + \sigma g_i^2 \quad i = 1,\ 2$ is the loss function of the fiscal authority.

In order to describe the current situation faced by the EMU member states, we will consider the following scenarios:

a) The central bank (CB) could be more conservative or less conservative, i.e.: could be more or less concerned about the inflation goal. We will assume both alternatives giving different values to the coefficient of the inflation objective in

the monetary rule (see Appendix). So we will assign different values to μ, to characterize a more conservative or less conservative CB respectively.

b) Every country could choose a different fiscal rule depending on the initial level of public debt. In order to describe the two alternatives, we will allow for $k > 0$ (low level of debt) and $k < 0$ (high level of debt) in the fiscal rule.

c) Finally, the national fiscal authorities could be more austere or less austere. So, we will assign different values to the weight of public deficit in the loss function, for describing the particular concern on deficit control and, therefore, the degree of austerity of the policy implemented.

In order to make an empirical application, we will adopt the following assumptions. The shocks suffered by the countries are identical in size (normalized to 1); in other words, they are perfectly symmetric in size. Although the shocks may differ in the sign: expansive (+) or contractive (–); so they are perfectly asymmetric in their effects. Next, we will give numerical values to the parameters of the reduced form according to the scenarios described above:

a) In the monetary rule: we will assign $\mu = 0.8$ or $\mu = 0.3$, to characterize a more conservative or less conservative CB.

b) In the fiscal rules, the response of the public deficit to changes in output will be neutral ($\lambda = 0.5$) to underline the relevance of the debt level: higher than the target ($k = -0.9$) or lower ($k = 0.9$).

c) In the loss function we would assume that fiscal authorities are more concerned about fiscal discipline ($\sigma = 1.3$) or, in the contrary, they are more concerned about output growth ($\sigma = 0.7$)

For comparability reasons we assign the value 1 to the aggregate supply slope ($t = 1$). The rest of the values can be found in the Appendix.

5. Results

In terms of a macroeconomic model, the current economic crisis, due to the problems of the financial system and the difficult to borrow, has led to increases of the real interest rate decreasing the level of income of the economy. The attempts to deal with the crisis by implementing expansionary demand policies would result in an increase of public

deficit and debt, which are already very high in most advanced countries. Particularly, in EU countries, contractive fiscal policies are being implemented to reduce the size of government deficits and to recover the confidence of financial markets, trying to avoid the risk of debt default. But it is also true that a contractive fiscal policy will tend to cause a drop in activity levels, exacerbating the recession and difficult further deficit reduction.

In Table 1 we offer the realized values of government deficit and public debt for EU-27, the Eurozone, Spain and Germany from the beginning of the EMU. As can be seen, after the current crisis both deficit and debt become higher. And when comparing the Spanish and the German case, in spite of the lower debt level in the former, the Spanish fiscal policy seems to have been less austere allowing for a higher public deficit.

Table 1
Government deficit (-)/surplus (+), and public debt (% of GDP)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
EU27															
Def/sur	-1.0	-0.6	-1.5	-2.6	-3.2	-2.9	-2.5	-1.5	-0.9	-2.4	-6.9	-6.5	-4.4	-4.0	-3.4
Debt	65.8	61.9	61.0	60.5	61.9	62.3	62.8	61.6	59.0	62.2	74.6	80.0	82.5	85.3	86.3
EU17															
Def/sur	-1.3	-0.1	-1.9	-2.6	-3.1	-2.9	-2.5	-1.3	-0.7	-2.1	-6.3	-6.2	-4.1	-3.7	-3.4
Debt	71.6	69.2	68.2	68	69.2	69.6	70.3	68.6	66.4	70.2	80	85.4	87.3	90.6	92.2
SPAIN															
Def/sur	-1.2	-0.9	-0.5	-0.2	-0.3	-0.1	1.3	2.4	1.9	-4.5	-11.2	-9.7	-9.4	-10.6	- 6.7
Debt	62.4	59.4	55.6	52.6	48.8	46.3	43.2	39.7	36.3	40.2	53.9	61.5	69.3	84.2	93.7
GERM.															
Def/sur	-1.6	1.1	-3.1	-3.8	-4.2	-3.8	-3.3	-1.6	0.2	-0.1	-3.1	-4.2	-0.8	0.1	0.2
Debt	61.3	60.2	59.1	60.7	64.4	66.6	68.8	68.0	65.2	66.8	74.5	82.5	80.0	81.0	84.0

Source: Eurostat

- The government deficit (-)/surplus (-) is defined as the difference between the revenue and the expenditure of the general government sector.
- The debt corresponds to the consolidated **general government gross debt** at nominal value, outstanding at the end of the year.

In order to illustrate the current situation faced by EMU countries, and given we are concerned with stabilization, in the empirical application we have computed the values for the case of a common demand contractive shock ($v_1 < 0 + v_2 < 0$), leading to contractive effects on output and prices. Results are reported in Tables 2, 3 and 4.

Tables 2 to 4 distinguish the conservative or not conservative CB attitude in columns. The rows indicate the austerity or no austerity of the fiscal authority, both symmetrically and asymmetrically. Table 2 shows the results for the case of high debt level, and Table 3 for low debt level. In Table 4, asymmetries given by austerity and debt level are combined.

In the cells of each Table, the symbol ℓ indicates the whole monetary union welfare losses (when member countries act in a coordinated way). Given the symmetry of the model, the individual welfare losses of each country, L_1 and L_2, are the same except when the asymmetry in terms of fiscal austerity $\sigma_1 \neq \sigma_2$ is allowed. The tables also report, in absolute value, the decrease in output and inflation due to the contractive demand shock ($v_1 < 0 + v_2 < 0$).

Table 2: Welfare losses in high debt countries

High debt level $k_1 = k_2 = -0.9$

	Conservative CB $\mu = 0.8$	Not conservative CB $\mu = 0.3$
Austerity $\sigma_1 = \sigma_2 = 1.3$	$l = 1.2075$ $\nabla y_i = 0.8285$ $\nabla p_i = 0.8286$	$l = 0.9133$ $\nabla y_i = 0.8950$ $\nabla p_i = 0.8950$
No austerity $\sigma_1 = \sigma_2 = 0.7$	$l = 0.5222$ $\nabla y_i = 0.8289$ $\nabla p_i = 0.8286$	$l = 0.5464$ $\nabla y_i = 0.8950$ $\nabla p_i = 0.8951$
Austerity $\sigma_1 = 1.3$ No austerity $\sigma_2 = 0.7$	$l = 0.7020$ $L_1 = 0.7022$ $L_2 = 0.7019$ $\nabla y_i = 0.8286$ $\nabla p_i = 0.8285$	$l = 0.6457$ $L_1 = 0.6587$ $L_2 = 0.6327$ $\nabla y_i = 0.8950$ $\nabla p_i = 0.8951$

ℓ, L_1 and L_2, indicate the welfare losses of the monetary union and the member countries, respectively. ∇y_i and ∇p_i indicate the decrease in output and inflation.

Table 3: Welfare losses in low debt countries

Low debt level $k_1 = k_2 = 0.9$

	Conservative CB $\mu = 0.8$	Not conservative CB $\mu = 0.3$
Austerity $\sigma_1 = \sigma_2 = 1.3$	$l = 14.5210$ $\nabla y_i = 0.8285$ $\nabla p_i = 0.8286$	$l = 12.3170$ $\nabla y_i = 0.8951$ $\nabla p_i = 0.8950$
No austerity $\sigma_1 = \sigma_2 = 0.7$	$l = 4.7482$ $\nabla y_i = 0.8285$ $\nabla p_i = 0.8286$	$l = 4.2087$ $\nabla y_i = 0.8951$ $\nabla p_i = 0.8950$
Austerity $\sigma_1 = 1.3$ No austerity $\sigma_2 = 0.7$	$l = 8.8479$ $L_1 = 11.4010$ $L_2 = 6.2948$ $\nabla y_i = 0.8286$ $\nabla p_i = 0.8286$	$l = 7.6509$ $L_1 = 9.8223$ $L_2 = 5.4794$ $\nabla y_i = 0.8950$ $\nabla p_i = 0.8951$

ℓ, L_1 and L_2, indicate the welfare losses of the monetary union and the member countries, respectively. ∇y_i and ∇p_i indicate the decrease in output and inflation.

Table 4: Welfare losses in heterogeneous countries

	Conservative CB $\mu = 0.8$	Not conservative CB $\mu = 0.3$
Country 1 Austerity $\sigma_1 = 1.3$ High debt $k_1 = -0.9$ **Country 2** No austerity $\sigma_2 = 0.7$ Low debt $k_2 = 0.9$	$l = 1.4668$ $L_1 = 1.8235$ $L_2 = 1.1100$ $\nabla y_i = 0.8285$ $\nabla p_i = 0.8286$	$l = 1.3708$ $L_1 = 1.7647$ $L_2 = 0.9768$ $\nabla y_i = 0.8950$ $\nabla p_i = 0.8950$
Country 1 Austerity $\sigma_1 = 1.3$ Low debt $k_1 = 0.9$ **Country 2** No austerity $\sigma_2 = 0.7$ High debt $k_2 = -0.9$	$l = 3.2713$ $L_1 = 4.2520$ $L_2 = 2.2905$ $\nabla y_i = 0.8286$ $\nabla p_i = 0.8285$	$l = 3.0830$ $L_1 = 4.0044$ $L_2 = 2.1615$ $\nabla y_i = 0.8950$ $\nabla p_i = 0.8951$

ℓ, L_1 and L_2, indicate the welfare losses of the monetary union and the member countries, respectively. ∇y_i and ∇p_i indicate the decrease in output and inflation.

According to the results reported in Tables 2 and 3, the monetary union welfare losses will be the minimum when the CB is less conservative, the fiscal authority is less austere and the countries show a relatively high debt level. In other words, expansive fiscal policies would contribute to stabilize without having a negative impact on growth. The results also hold when looking at the individual welfare losses of the member countries. Countries less austere have lower welfare losses. But when we allow for combining asymmetries, in Table 4, the results show that countries with low debt should apply non austere fiscal policies, while countries with high debt should be austere.

This last outcome is independent of the degree of conservativeness of the CB and could illustrate the situation faced by the European countries. In spite of the commitment to use numerical fiscal, countries should not apply identical fiscal rules. The design of the rules should be tightly linked to the values of debt level. This result is in line with those obtained by Díaz-Roldán and Montero-Soler, 2011, who found that the countries interested in adopting a rule would be those with a debt level higher than the objective; although, on the other hand, the fiscal rule could reduce the scope for stabilization. More recently, Díaz-Roldán, 2013, addresses that the member countries of EMU, when deciding whether or not to adopt a fiscal rule, should take into account not only the debt levels but also the specific features of their economies. The reason is that

the characteristics of each member state determine the transmission channels of the shocks and, therefore, the optimal economic policies to deal with them.

From another point of view, Pablo García and Miguel Sebastián, 2013, found that austerity may be counterproductive. From their study, based on fiscal multipliers, they conclude that policies of deficit reduction may be self-defeating in south-European countries like Spain. On the contrary, in the German case they found that austerity works. According to data on Table 1, Spanish fiscal policy seems to have been less austere than German fiscal policy. But the effects on real GDP are not conclusive: in Spain the rate of growth has been 0.3% and in German 0.4% in 2013 (source: Eurostat).

6. Summary and conclusions

In this paper we have analysed the management of fiscal policies in monetary unions, when the central bank and the fiscal authorities follow policy rules. To that end, we have developed a simple model for a monetary union to analyse different combinations of policies. We have considered the possibility of a more or less conservative governor of the central bank, both austere and no austere fiscal policy and, finally, we have also taken into account the initial level of public debt of the member countries of the union.

In the empirical application, and in order to illustrate the current situation faced by EMU countries, we have computed the values for the case of a common demand contractive shock, leading to contractive effects on output and prices.

Our results show that the monetary union welfare losses will be the minimum when the CB is less conservative, the fiscal authority is less austere and the all the countries show a relatively high debt level. Under those circumstances, expansive fiscal policies would contribute to stabilize without having a negative impact on growth. But when the countries of the union do not have similar debt levels, the results show that countries with low debt should apply non austere fiscal policies, while countries with high debt should be austere. This outcome is independent of the degree of conservativeness of the CB. In this case, that could be representative of the EMU member countries, the particular fiscal performance should be linked to the initial values of debt level, and they also should take into account the specific features of the involved economies.

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Appendix

The macroeconomic model

DEMAND SIDE

$$y_1 = -\alpha r + \beta(p_2 - p_1) + \gamma y_2 + g_1 \qquad (1.A)$$

$$y_2 = -\alpha r + \beta(p_1 - p_2) + \gamma y_1 + g_2 \qquad (2.A)$$

$$r = \mu\left[\frac{1}{2}\left(\Delta p_1 + \Delta p_2\right) - \Delta p^o\right] \qquad (3.A)$$

From (1.A) to (3.A) we obtain the aggregate demand for each country

$$y_1 = -a\Delta p_1 \pm b\Delta p_2 \pm cy_2 + hg_1 + v_1 \qquad (1)$$

$$y_2 = -a\Delta p_2 \pm b\Delta p_1 \pm cy_1 + hg_2 + v_2 \qquad (2)$$

SUPPLY SIDE

$$\Delta w_1 = \Delta p_{1c}^E - \varphi u_1 + \phi \Delta prod_1 + z_1^w \qquad (4.A)$$

$$\Delta p_1 = \Delta w_1 - \phi \Delta prod_1 + z_1^p \qquad (5.A)$$

$$n_1 = y_1 - prod_1 \qquad (6.A)$$

$$p_{1c}^E = p_{1c,-1} \qquad (7.A)$$

$$p_{1c} = \eta p_1 + (1-\eta) p_2 \qquad (8.A)$$

$$u_1 \equiv l_1 - n_1 \qquad (9.A)$$

From (4.A) to (9.A) we obtain the aggregate supply for each country

$$y_1 = t\Delta p_1 - s_1 \qquad (3)$$

$$y_2 = t\Delta p_2 - s_2 \qquad (4)$$

The "*beggar-thy-neighbour*" effect prevails when countries are particularly concerned by inflation targeting and output stabilization (the coefficient μ, in the monetary rule — equation (3.A) — is high enough).

Aggregate demand coefficients

$$a = \frac{\alpha\mu + 2\beta}{2div} \quad b = \frac{\alpha\mu - 2\beta}{2div} \quad c = \frac{\alpha\varepsilon - 2\gamma}{2div}, \text{ siendo } div = \frac{2+\alpha}{2}, \; h = \frac{1}{div}$$

$$v_i = -\frac{\alpha}{div} r_A + \frac{\alpha\mu}{div}\Delta p^o + \frac{\beta}{div} p_{2,-1} - \frac{\beta}{div} p_{1,-1}$$

Aggregate supply coefficients $t = \frac{1}{\varphi}$

Reduced form

$den = (ct + b)^2 - (a + t)^2 < 0$

$A = -\frac{(a+t)}{den}\, t > 0,\ B = \frac{(b+ct)}{den}\, t > 0$

$A' = -\frac{(a+t)}{den} > 0,\ B' = \frac{(b+ct)}{den} > 0$

Assuming $t = 1$

$den = (c + b)^2 - (a + 1)^2 < 0$ y A = A' y B = B'

$A = -\frac{(a+1)}{den} > 0,\ B = \frac{(b+c)}{den} > 0$

$A' = -\frac{(a+1)}{den} > 0,\ B' = \frac{(b+c)}{den} > 0$

Solving (1) to (4), we obtain the reduced forms:

$$y_1 = A\, hg_1 + A\, v_1 \pm B\, hg_2 \pm B\, v_2 \qquad (10.A)$$

$$y_2 = A\, hg_2 + Av_2 \pm B\, hg_1 \pm B\, v_1 \qquad (11.A)$$

$$\Delta p_1 = A' hg_1 + A' v_1 + B' hg_2 + B' v_2 \qquad (12.A)$$

$$\Delta p_2 = A' hg_2 + A' v_2 + B' hg_1 + B' v_1 \qquad (13.A)$$

When the "*beggar-thy-neighbour*" effect prevails (*inflation targeting*):

$$y_1 = A\, hg_1 + A\, v_1 - B\, hg_2 - B\, v_2 \qquad (5)$$

$$y_2 = A\, hg_2 + Av_2 - B\, hg_1 - B\, v_1 \qquad (6)$$

$$\Delta p_1 = A\, hg_1 + A\, v_1 + B\, hg_2 + B\, v_2 \qquad (7)$$

$$\Delta p_2 = A\, hg_2 + A\, v_2 + B\, hg_1 + B\, v_1 \qquad (8)$$

Optimization problem

Coordinated decision and fiscal rule in both countries

$$\min_{g_1, g_2} \quad \ell = \left[\frac{1}{2} L_1 + \frac{1}{2} L_2\right]$$

s.t. $y_1 = y_1 (\ldots)$

$y_2 = y_2 (\ldots)$

$g_1 = g_1 (\ldots)$

$g_2 = g_2 (\ldots)$

Reaction functions:

$$g_1^{C,R} = g_1(g_2) = q_1^{C,R} g_2 + q_2^{C,R} v_2 - q_3^{C,R} v_1 - q_6^{C,R}$$

$$q_1^{C,R}, q_2^{C,R}, q_3^{C,R}, q_4^{C,R} > 0, q_5^{C,R}$$

where

$$\left| q_6^{C,R} \right| > 0 \text{ if } (Ak_1 - Bk_2) < 0$$

$$\left| q_6^{C,R} \right| < 0 \quad \text{if} (Ak_1 - Bk_2) > 0$$

$$q_1^{C,R} = \frac{2AB}{(A^2 + B^2)}, \quad q_2^{C,R} = \frac{2AB}{(A^2 + B^2)h}, \quad q_3^{C,R} = \frac{1}{h}, \quad q_4^{C,R} = \frac{(AC - BD)}{(A^2 + B^2)h}$$

$$q_5^{C,R} = \frac{(AD - BC)}{(A^2 + B^2)h}, \quad q_6^{C,R} = \frac{(Ak_1 - Bk_2)\lambda\sigma}{(A^2 + B^2)h(1 + \lambda^2\sigma)}$$

Solving:

$$G_1^{C,R} = -\frac{1}{h} - \frac{(Ak_1 - Bk_2)\sigma_1\lambda}{h(1 + \sigma_1\lambda^2)(A - B)^2} = -\frac{(1 + \sigma\lambda^2)(A - B)^2 + (Ak_1 - Bk_2)\sigma_1\lambda}{h(1 + \sigma_1\lambda^2)(A - B)^2}$$

$$G_2^{C,R} = -\frac{(Ak_1 - Bk_2)\sigma_2\lambda}{h(1 + \sigma_2\lambda^2)(A - B)^2}$$

Solution: $g_1^{C,R} = -G_1^{C,R} v_1 \pm G_2^{C,R} v_2$

(symmetric for g_2)

Values for the empirical application

Austerity $\sigma = 1.3$	Non austerity $\sigma = 0.7$
High debt level $k = -0.9$	Low debt level $k = 0.9$
$\alpha = 0.9$ $\beta = 0.1$ $\gamma = 0.1$ $\varphi = 1$ $\lambda = 0.5$	
Conservative CB $\mu = 0.8$	Not conservative CB $\mu = 0.3$
$a = 0.31724$	$a = 0.16207$
$b = 0.17931$	$b = 2.4138 \times 10^{-2}$
$c = -6.8966 \times 10^{-2}$	$c = 6.8966 \times 10^{-2}$
$h = 0.68966$	$h = 0.68966$
A = 0.76455	A = 0.86181
B = -6.4046×10^{-2}	B = 3.3245×10^{-2}