Distortionary Taxation and Central Bank Design in a Monetary Union

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Abstract

We consider a monetary union where discretionary monetary policy creates the classical inflation bias. We analyze how the design of the central bank interacts with fiscal policy, under distortionary taxation. We show that when countries share a single currency the central bank has to put more weight on inflation. This result rationalizes the common perception that the European Central Bank is more worried about inflation than the Federal Reserve. Besides, when an economic crisis increases the government spending target in the some member countries (periphery), welfare in the other countries worsens unless the monetary authorities become more conservative.

Keywords: Central Banks, Monetary policy delegation.

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1 Introduction

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

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and stimulate economic growth in the euro zone. Within this debate, the convenience of adopting rules that help discipline fiscal policies of the member states has received a great deal of attention. The need for coordinating fiscal policies in the EMU was highlighted in the Delors Report (1989), which considered it as a prerequisite for a successful monetary integration. Then, after the commitments reached in the Maastricht Treaty (1991), this political process culminated with the signing of the Stability and Growth Pact (SGP) at the Council of Amsterdam in 1997.

Central bankers, politicians and academics often regard fiscal discipline as a prerequisite for a credible monetary policy. Since the appearance of the seminal papers of Kydland and Prescott (1977) and Barro and Gordon (1983) it is widely accepted that, when the natural level of output is suboptimally low, discretionary monetary policy tends to generate an inefficiently high level of inflation with no gain in terms of production. This outcome has been accounted for in a sequential setting where the private sector knows that if expectations on inflation are sufficiently low the policymaker will tend to carry out a monetary surprise with the aim of making output exceed the natural level. Therefore, the private sector will increase its expectations on inflation to the point where such a surprise becomes too costly for the monetary authorities. As a result, the subgame perfect (or time consistent) equilibrium implies that inflation tends to be suboptimally high.

One of strand of this literature has focused attention on tackling this so-called "inflation bias" by proposing different monetary institutions (Rogoff, 1985; Walsh, 1995 and Svensson,1997). This literature assumes that the natural level of output is exogenous but the design of the central bank is endogenous. In contrast, Alesina and Tabellini (1987) consider a setup where the natural level of output is endogeneous, since it is negatively affected by distortionary taxes, but the design of the central is exogeneous.

Our paper blends both approaches since both the design of the central bank and the natural level of output are endogeneous. We study how the optimal design of the monetary institutions interacts with the determination of the de level of taxes. In our framework, taxes create distorsions that reduce the natural level of output but are required to finance government spending. We develop aur analysis in the constext of a monetary union.

The main contributions of our paper to this literature are twofold. Firstly, we analyze how

the degree of conservatism of the central bank exerts an influence on the level of fiscal policy in a monetary union; and, secondly, we show the influence of such fiscal policies on the optimal inflation target of the common central bank. This analysis is especially relevant in the context of the European Monetary Union (EMU) where countries share a common central bank but decisions on fiscal policies belong to the national level; and where a number of member countries have recently increased their government spending in response to the economic crisis. In this respect, our paper is an attempt to shed light on a recent issue in the academic and policy debate. Namely, the extent to which the objectives of the common central bank in the EMU affects the incentives to implement fiscal policies in member countries with different needs as far as government spending is concerned.

We consider a setup where two countries make up a monetary union and where social welfare in one member state is negatively affected when the other country increases its taxed-financed government spending. This is a key element of our analysis.We begin by analyzing an scenario in which a group of countries forms a monetary union but their decisions on fiscal policies belong to the national level. In this setup, we show that if the monetary authorities have the social preferences the creation of the union makes the member countries worse-off. This reduction in social welfare would not occur if countries implemented their fiscal policies in a cooperative way. However, in the latter scenario can be improved if the central bank were made more conservative than society. This analysis provides a strategic argument for making the European Central Bank (ECB) more conservative than the Federal Reserve. The idea is that, if countries form a monetary union but not a fiscal union, the ECB has to put more emphasis on inflation because the above mentioned negative externalies are present.

We also consider the case where, because of an economic crises, some countries within the union (periphery) increase their government spending requirements. We show that this change will make the other countries (core) worse-off unless the common central bank is made more conservative or a commitment technology is put in place that changes the periphery's incentives to increase it fiscal budget.

2 The model

Our framework is based on the standard model widely used in the literature on credibility in monetary policy (Walsh, 2010, ch. 8). However, this setup is extended in two ways. First, we depart from the typical closed-economy assumption and consider a monetary union which is made up of two countries ($i = 1, 2$). Second, the natural level of output is not exogenous but is negatively affected by taxes as in Alesina y Tabellini (1987). Formally, the working of the economy is summarized by the following equations:

$$y_i = \pi - \pi_i^e - \tau_i, \tag{1}$$

$$L_i^S = \lambda\pi^2 + y_i^2 + \delta\left(g_i - \overline{g_i}\right)^2. \tag{2}$$

Expression (1) shows that the economy possesses a Lucas supply function. Expectations are rational which implies that output (y) increases with deviations of inflation (π) from its expected value (π^e) and decreases with the level taxes (τ_i) ,because they are distortionary.

Equation (2) describes each country' social loss function which coincides with its government's.[1] It implies that society dislikes deviations of inflation, output and government spending from their respective target levels. These social targets are normalized to zero for inflation and output. In the case of government spending, this target is positive and equal to $\overline{g_i}$.

On the other hand, taxes are needed to finance government spending which supports the welfare state. As in Alesina and Tabellini (1987) we assume that the fiscal budget is balanced, i.e., $\tau_i = g_i$.

Notice that, if there were no taxes, the (normalized) natural level of output appearing in (1) would be equal to zero, namely, the society's target. However, a welfare state is financed by taxes, which implies that the natural level of output is lower that the social target. As a result, the classical time consistency problem of discretionary monetary policy is present giving rise to an inflationary bias.

We model the interactions of the central bank and the governments a a multi-stage game. The sequence of events is as follows:

[1] However, our conclusions hold if we consider an scenario in which goverment values its spending differently (e.g. because of the existence of lobbies).

1) Governments decide simultaneously their spending levels (τ_i, g_i).

3) The private sector forms its rational expectations on inflation (π^e).

4) The central bank determines the inflation rate (π).

Throughout the paper, different equilibria will be obtained and evaluated making use of quadratic loss functions as the one in (2), which are standard in the literature on credibility in monetary policy. On the other hand, Dixit and Lambertini (2003) and Woodford (2003, ch. 6) have shown that this type of objective functions builds on microeconomic foundations, since it can be obtained starting from the utility function of a representative agent.[2]

3 A central bank with social preferences

This section analyzes the case where the common central bank minimizes the joint social loss defined as the sum of the objective functions of the countries in the monetary union:

$$L^B = \sum_{i=1}^{2} \left(\lambda \pi^2 + y_i^2 + \delta \left(g_i - \overline{g_i} \right)^2 \right). \tag{3}$$

We refer to this scenario as the one in which the central bank has "the social preferences".[3] In this respect, even though the ECB's chart provides this institution with a high level of formal independence, in practice, governments can always try to exert some influence on the monetary authorities' decisions through different means. To wit, by mobilizing public opinions, appointing board members, the pressure of the ECOFIN, etc. Therefore, we begin by analyzing the benchmark scenario where governments determine the central bank policies and, in the next section, we take up the case in which governmental interference is completely nonexistent.

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

[3] However, assuming that the central bank does not care about the level of government spending would not affect our results. The reason is that the sequence of events outlined in the previous section states that the monetary authorities set their strategic variable (π) in the last stage, that is, after the level of government spending has been chosen.

Now, for the regime where the monetary authorities have the social preferences, we solve the game outlined above by applying backward induction.

In the last stage, once the private sector has set up its rational expectations on inflation, the central bank selects the value for the common inflation rate (π) that solves the following problem (from (1) and (3)):

$$\begin{array}{ll} \underset{\{\pi\}}{Min} & \sum_{i=1}^{2}\left(\lambda\pi^2 + y_i^2 + \delta\left(g_i - \overline{g_i}\right)^2\right) \\ s.t. & y_i = \pi - \pi_i^e - \tau_i. \end{array}$$

The first-order condition yields the monetary authorities' reaction function:

$$\pi = \frac{g_i + g_j + \pi_i^e + \pi_j^e}{2\left(\lambda + 1\right)}, \tag{4}$$

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

This behavior is anticipated by the private sector prior. Therefore, taking expectations in (4) we have:

$$\pi_i^e = \frac{g_i + g_j + \pi_i^e + \pi_j^e}{2\left(\lambda + 1\right)}. \tag{5}$$

Now, setting $\pi_i^e = \pi_j^e$ in (5) (since the inflation rate is common to both countries) yields:

$$\pi_i^e = \frac{1}{2\lambda}\left(g_i + g_j\right). \tag{6}$$

From an inspection of (6) we obtain the following remark:

Remark 1: *If the union central bank has the social preferences, when any member country increases its government spending, the common inflationary bias is exhacerbated making the other country worse-off.*

The explanation of this remark is as follows. When one member country increases government spending more taxes are levied on its citizens to finance it. This, in turn, lowers the country's natural level of output, widening the gap between this output level and the social target for this variable. This increases the central bank's incentives to carry out monetary surprises with the aim narrowing this gap. Therefore, the common inflationary bias is increased. To sum

up, government spending in one country makes the other member worse-off. In other words, such expenditure generates negative externalities.

Now, we proceed to characterize the level of government spending which is the country's best response to the sequence of events just described. In order to do so, first, we need to know the expression for the inflation rate as a function of the the government expenditures in both countries. This is obtained by plugging (6) into (4):

$$\pi = \frac{1}{2\lambda}\left(g_i + g_j\right). \tag{7}$$

Now, in the scenario analyzed in this section we assume that government spending is determined without cooperation between governments. Therefore, each country selects the level of government expenditure that minimizes its own country's expected social loss, taking its counterpart's choice as given. Therefore, each governments faces the following problem (from (1), (2), (6) and (7)):

$$\begin{array}{ll} \underset{\{g_i\}}{Min} & L_i^S = \lambda\pi^2 + y_i^2 + \delta\left(g_i - \overline{g_i}\right)^2 \\ s.t. & \begin{cases} y_i = \pi - \pi_i^e - \tau_i, \\ \pi = \frac{1}{2\lambda}\left(g_i + g_j\right), \\ \pi_i^e = \frac{1}{2\lambda}\left(g_i + g_j\right). \end{cases} \end{array}$$

From the first order conditions, we obtain each government's reaction function:

$$g_i = \frac{2\delta\overline{g_i} - \frac{1}{2\lambda}g_j}{2\delta + \frac{1}{2\lambda} + 2}. \tag{8}$$

This equations lead to the following conclusion:

Remark 2. *If the union central bank has the social preferences and one member country increases its government expenditure the other partner has an incentive to do just the opposite.*

The reason why this happen can be understood by taking into account that when one country increases government spending the common inflationary bias is exhacerbated (see Remark 1). This creates an incentive for the other government to scale back its spending to reduce this bias.

Finally, solving simultaneously the governments' reaction functions (expression (8), where $i, j = 1, 2;\ i \neq j$) we have:

$$g_i = \frac{2\lambda\delta\overline{g_i}}{2\lambda + 2\lambda\delta + 1}. \tag{9}$$

In any case, equation (9) shows that level of government spending is positive which implies that the level of taxes required to financed it is also positive. This implies that the natural level of output is lower than the one which is the social target. Therefore, in equilibrium the central bank has an incentive to try and stimulate output beyond its natural level. This is known by the private sector, which implies that the inflation bias is not removed but takes the following positive value:

$$\pi^e = \frac{2\overline{g_i}\delta}{2\lambda + 2\lambda\delta + 1}. \tag{10}$$

On the other hand, the inflation rate is (substituting (9) into (7)):

$$\pi = \frac{2\overline{g_i}\delta}{2\lambda + 2\lambda\delta + 1}, \tag{11}$$

and the level of output results in (plugging (9), (10) and (11) into (1)):

$$y_i = -\frac{2\lambda\delta\overline{g_i}}{2\lambda + 2\lambda\delta + 1}. \tag{12}$$

Finally, substituting (9), (11) and (12) into (2) and taking expectations in the resulting expression we obtain country i's social loss:

$$L_i^S = \frac{\delta\left(\overline{g_i}\right)^2\left(4\lambda + 4\lambda^2 + 4\lambda\delta + 4\lambda^2\delta + 1\right)}{\left(2\lambda + 2\lambda\delta + 1\right)^2}. \tag{13}$$

Now, one question that arises in the present scenario is whether or not the creation of a monetary union can be counterproductive for the member countries:

Remark 3: *If the monetary authorities have the social preferences and government spending is determined on the national level, the formation of a monetary union makes the member countries worse-off .*

Proof: See Appendix.

This result can be explained as follows. When countries adopt a single currency we have shown that there is a negative spillover, namely, when the government in one country increases its spending it makes the other country worse-off because it exhacerbates the common inflation bias. Therefore, since this prisoner's dilemma type of situation only occurs when countries share

a single currency, the formation of the monetary union is counterproductive. This result makes it necessary to find a mechanism that internalizes this externality.

The first proposal that we consider consists of countries cooperating in the implementation of their fiscal policy. This regime can be modeled by assuming that they delegate their bugget policies to a supranational authority who minimizes the expected joint social loss. In order to analyze this scenario, again, we apply backward induction. The problem to be solved in the first stage by the supranational authority is:

$$\begin{array}{ll} \underset{\{g_i,g_j\}}{Min} & \sum_{i=1}^{2} \lambda\pi^2 + y_i^2 + \delta\left(g_i - \overline{g_i}\right)^2 \\ s.t. & \begin{cases} y_i = \pi - \pi_i^e - \tau_i, \\ \pi = \frac{1}{2\lambda}\left(g_i + g_j\right), \\ \pi_i^e = \frac{1}{2\lambda}\left(g_i + g_j\right), \end{cases} \end{array} \tag{14}$$

The solution to this program yields the following conclusion:

Remark 4: *If the central bank has the social preferences, comparing the scenario where fiscal policy is determined in a cooperative fashion with the one in which this policy belongs to the national level, in the former the level of social welfare is higher and although government spending and the inflationary bias are lower, this bias is not completely eliminated.*

Proof: See Appendix.

The intuition behind this remark can be understood bearing in mind that government spending generate negative externalities, since they increase the common inflationary bias. Therefore, when there exists cooperation fiscal policy, the levels of government spending will be lower than in the noncooperative scenario. As a consequence, in the cooperative regime tax distortions will be reduced, which will increase the natural level of output and social welfare. Therefore, the gap between the natural level of output and its target will narrow. As a result, the incentive to carry out monetary surprises diminishes, lowering the inflation bias. Notice, however, that this bias is not removed completely because (a positive level of) distortinary taxes will be required to finance some government spending since it yields utility to society (reduces its loss).

Remark 5: *If the central bank has the social preferences, when countries belong to a monetary and fiscal union the level of social welfare is the same as the one in the scenario where they have different currencies and fiscal policies. On the other hand, in these two extreme regimes countries are better-off than in the intermediate case where they only share currency but not fiscal policy.*

This result can be rephrased as saying that when the central bank has the social preferences, if economic integration is only partial it will be counterproductive. The reason is that when countries form a monetary union a negative externality in fiscal policy arises which can only be internalized when this policy is determined in a cooperative fashion.

4 Designing the common central bank

In the previous section we have shown that in a monetary union in which the common central bank have the social preferences countries are better-off if government spendings are collectively determined. However, so far the feasibility of this fiscal cooperative scenario has not received empirical support in the case of the EMU. Therefore, another mechanism needs to be found that deals with the externality problem in an appropiate way.

With this aim, in this section we analyze one institution which achieves this goal. Moreover, we show that it yields a level of social welfare which is even higher than the one obtained in the cooperative regime studied above. This mechanism consists of granting independence to the common central bank whose objective function is collectively chosen by the member countries.

We model this regime by adding a new stage before the first stage of the game studied in the previous section. Namely, in this "stage zero" the design of that monetary institution takes place. We follow the approach adopted by Svensson's (1997) in a closed economy which consists of selecting the level of inflation to be targeted by the central bank (π_0).[4] Namely, in this new

[4]It can be shown that following Walsh's (1995) approach does not change our conclusions; and Rogoff's (1985) monetary institution is dominated by the one we consider.

context, the loss function of the monetary authorities becomes:

$$L^B = \sum_{i=1}^{2} \lambda \left(\pi - \pi_0\right)^2 + y_i^2 + \delta \left(g_i - \overline{g_i}\right)^2 . \tag{15}$$

Once more, we apply backward induction to solve the game. Thus, in the last stage, the central bank chooses the inflation rate that minimizes (15), subject to the supply functions appearing in (1). The solution to this problem yields the monetary authorities's reaction function:

$$\pi = \frac{1}{2\lambda + 2} \left(g_i + g_j + \pi_i^e + \pi_i^e + 2\lambda\pi_0\right), \tag{16}$$

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

Taking expectations we have:

$$\pi_i^e = \frac{1}{2\lambda + 2} \left(g_i + g_j + \pi_i^e + \pi_i^e + 2\lambda\pi_0\right). \tag{17}$$

Thus, expected inflation is (since $\pi_j^e = \pi_i^e$):

$$\pi_i^e = \frac{1}{2\lambda} \left(g_i + g_j + 2\lambda\pi_0\right). \tag{18}$$

Therefore, inflation is (substituting (18) into (16)):

$$\pi = \frac{1}{2\lambda} \left(g_i + g_j + 2\lambda\pi_0\right). \tag{19}$$

Anticipating this process, governments choose their spending. We model the case in which such fiscal policy belongs to the national level by assuming that governments behave as Nash players. Therefore, each of them selects their expenditure (ϕ_i) with the aim of minimizing its own country's expected loss taking the other's choice as given. From the first order condition we obtain the government's reaction function:

$$g_i = \frac{4\lambda\delta\overline{g_i} - 2\lambda\pi_0 - g_j}{4\lambda + 4\lambda\delta + 1}. \tag{20}$$

Applying symmetry one finds:

$$g_i = \frac{2\lambda\delta\overline{g_i} - \lambda\pi_0}{2\lambda + 2\lambda\delta + 1}. \tag{21}$$

From (18), (19) and (21) expected and actual inflation are, respectively:

$$\pi^e = \frac{2\lambda\overline{g_i} + 2\delta\pi_0 + 2\lambda\delta\overline{g_i}}{2\lambda + 2\lambda\delta + 1}. \tag{22}$$

$$\pi = \frac{2\lambda\overline{g_i} + 2\delta\pi_0 + 2\lambda\delta\overline{g_i}}{2\lambda + 2\lambda\delta + 1}. \tag{23}$$

Finally, in stage zero both governments collectively design their common central bank by agreeing on the inflation target to be aimed at by this monetary institution. Therefore this target is designed so that the expected joint social loss is minimized. Formally, the problem to be solved is (from (1), (21), (22) and (23)):

$$\underset{\{\pi_0\}}{Min} \quad \sum_{i=1}^{2} \lambda \left(\pi - \pi_0\right)^2 + y_i^2 + \delta \left(g_i - \overline{g_i}\right)^2$$

$$s.t. \qquad \begin{cases} y_i = \pi - \pi_i^e - \tau_i, \\ g_i = \frac{2\lambda\delta\overline{g_i} - \lambda\pi_0}{2\lambda + 2\lambda\delta + 1}, \\ \pi^e = \frac{2\lambda\overline{g_i} + 2\delta\pi_0 + 2\lambda\delta\overline{g_i}}{2\lambda + 2\lambda\delta + 1}, \\ \pi = \frac{2\lambda\overline{g_i} + 2\delta\pi_0 + 2\lambda\delta\overline{g_i}}{2\lambda + 2\lambda\delta + 1}, \end{cases}$$

whose solution is:

$$\pi_0 = -\frac{\delta\overline{g_i}}{\lambda + \lambda\delta}. \tag{24}$$

Notice that the monetary authorities's inflation target is lower than society's (normalized to zero). In other words, it is optimal to have a central bank more conservative than society.

Now, from (1), (2), (21), (22), (23) and (24) one finds the equilibrium value for goverment spending, expected inflation, actual inflation, output and social loss:

$$g_i = \frac{\delta\overline{g_i}}{\delta + 1}, \tag{25}$$

$$\pi^e = 0, \tag{26}$$

$$\pi = 0, \tag{27}$$

$$y = -\frac{\delta\overline{g_i}}{\delta + 1}, \tag{28}$$

$$L^S = \frac{\left(\overline{g_i}\right)^2 \delta(1 + \delta)}{2\delta + \delta^2 + 1}. \tag{29}$$

Proposition 1: *When the central bank in a monetary union is optimally designed the inflationary bias is eliminated irrespective of whether or not cooperation in fiscal policy takes place. Moreover, all the macroeconomic variables reach the same levels in both scenarios.*

Proof: See Appendix.

The inflationary bias is removed because the central bank's inflation target has been set so low that the private sector expect that inflation will, on average, be zero. Therefore, the

inflationary bias being removed implies that government spending no longer exhacerbates such bias. As a consequence, in this new regime government spending do not generate (negative) spillovers; and with no externalities to be internalized, it does not make any difference whether or not cooperation occurs. That is, in both scenarios macroeconomic variables reach the same levels.

Proposition 2: *In a monetary union, social welfare is maximized when the common central bank is collectively designed irrespective of whether or not government spending is cooperatively implemented. On the other hand, comparing this scenario with the one where monetary authorities have the social preferences and government spending is determined in a cooperative fashion, in the former regime social welfare and the level of government spending are higher and inflation and output are lower.*

Proof: See Appendix.

The intuition behind why social welfare is higher in the scenario where the central bank is designed is as follows. In this regime society has an additional instrument to maximize welfare, namely, the inflation target of the monetary authorities. In fact, since the elimination of the inflationary bias is only achieved when the central bank's inflation target is designed, only in this scenario the externality problem fully disappears.

On the other hand, recall that when the central bank has the social preferences government spending has two disadvantages, namely, it exhacerbates the inflation bias and widens the gap between the effective output and the social target. By contrast, in the former scenario this bias disappears (Proposition 1), namely, inflation is lower, with does away with the first disadvantage of government spending. As a consequence, the level of government spending is increased and, because it is financed by more (distorting) taxes, output is reduced.

Proposition 3: *Comparing the case where countries have different currencies with the scenario in which they share a single currency but they do not form a fiscal union, in the latter the optimally designed central bank is more conservative.*

Proof: See Appendix.

To understand this result, first recall that when the central bank has the social preferences, an inflation bias arises irrespective of whether or not countries share a common currency. However, this bias is higher when countries form a monetary union but do not cooperate in fiscal policy since in this scenario a negative externality arises (each country does not take into account the negative effect that its taxation has on its partner via an increase on the common inflation). Therefore, when countries create a monetary union the central bank has to put more weight on inflation to offset this higher bias. This result rationalizes the common perception that the European Central Bank is more worried about inflation than the Federal Reserve

Proposition 4: *In the context of a monetary union, when countries decide to form a fiscal union their optimally designed central bank has to become less conservative.*

Proof: See Appendix.

The reason is that when countries that share the same currency scale up there integration to form a fiscal union, they internalize the negative externalities on inflation that arise from distortionary taxes.

4.1 An asymmetric monetary union

So far we haved assumed that the desired level of government spending is the same for all the countries in the unión ($\overline{g_1} = \overline{g_2}$ in (2)). In this subsection we explore how the above conclusions are affected when we relax this assumption. We now assume that countries are divided into two groups: core and periphery. Because the periphery country has undergone a deep economic crisis, its unemployment has dramatically increased which calls for a more costly welfare state (more spending on unemployment benefits, etc.). In terms of our model, the periphery country's government spending target increases. To be more specific, in equation (2), $\overline{g_i}$ can now take two different values: $\overline{g_p}$ applies to the periphery and $\overline{g_c}$ to the core, where $\overline{g_p} > \overline{g_c}$.We begin by studying the case in which the central bank's inflation target is not changed after the increase in the government spending target of te periphery country[5]

[5] Our results would not be qualitatively affected if the central bank's objective function puts different weights for the two countries.

Proposition 5: *Consider a monetary union where member countries are divided into two groups; core and periphery. Asume that initially countries in both groups have the same goverment spending target. If only the periphery country increases this target and the central bank's degree of conservatism is not modified, social welfare in the core countries worsens*

Proof: See Appendix.

We now explain the idea behind this result.The economic crisis has increased the cost of sustaining the welfare state in the perpphery. As a result, higher taxes are required in this country which creates a higher distortion on its economy. Therefore, the gap between the social output target and the natural level of output increases. In this new scenario, the monetary authorities have now an incentive to stimulate output by creating monetary surprises. This will be anticipated by the private sector giving rise to an inflationary bias. As a consequence, the governments in the core countries will try to partially offset this bias by decreasing their tax financed spending. Therefore, with a diminished welfare state and an inflationary bias (not completely eradicated now), social welfare in the core countries worsens.

Now, we consider two proposals which, if put into practice would prevent the increase in the periphery's government spending target from making the core countries worse-off. The following proposition refers to the first one:

Proposition 6: *Consider a monetary union where member countries are divided into two groups; core and periphery. Asume that initially all the countries have the same goverment spending target. If only the periphery country increase this target, making the common central bank more conservative can prevent the core coutries' social welfare from being reduced.*

Proof: See Appendix.

The reason why we obtain this result can be understood taking into account the conclusions we have drawn in the previous subsection. We have shown that when the periphery country increases the government spending target, keeping the central bank target unchanged causes an inflationary bias.Therefore, the elimination of this bias calls for a more conservative central bank.

However, the implementation of this proposal is not free of drawbacks. On the one hand, such a change of the common monetary institution would generate coordination costs. Moreover, if an institution such as the central bank is intended to be a credible commitment technology, it cannot be modified very often. It can be argued that this feature is the essence of credibility (Persson and Tabellini, 2000, ch. 17). In this sense, redesigning the central bank because the periphery changes its governement spending target could set a dangerous precedent that would undermined the credibility of the monetary institution.

Another possibility that would prevent the core countries from being negatively affected by such developments consists of penalizing countries for spending beyong a given limit.. As a consequence, the inflationary bias would not arise and there would be no need to redesign the central bank. However, it can only be a way out of the problem if the periphery were faced with real incentives to limit their government spending. In this sense, as Rotte and Zimmerman (1998) have stated, the convergence criteria agreed in Maastricht which included a limit on governemt spending, were fulfilled by the current members of the EMU because of two reasons. To wit, they were imposed by a supranational authority and the "punishment" implied in the case of not abiding by the "rules of the game" was clear, severe and sure. Namely, staying outside the monetary union. In contrast, the periphery is in a different situation and the incentives to implement reforms that reduce government spending are diminished. The reason is that, because it has already joined in, internal lobbies now have greater leverage and could find it easier to try and stop such austerity reforms since they imply costly decisions. Therefore, EMU institutions could be called for with the aim of convincing lobbies that such a process of reforms is a must. In this sense, one mechanism that has proved successful in stopping this kind of demands made by internal lobbies has been the actions of the European Commission.[6]

[6]For instance, France decided to allow a greater degree of openess in its internal market of electricity just the day after a process had been initiated against this country for not abiding by a rule agreed in the European Union. In the same way, Italy ended seventy years of an active state intervention in industry because of the determination shown by the EU comissioner for competition, Karen van Miert, and its succesor, Mario Monti.

5 Conclusions

This paper considers a monetary union where government spending is financed by distortionary taxes that reduces the natural level of output, giving rise to the classical time-inconsistency problem analysed by Kydland and Prescott (1977) and Barro and Gordon (1983). In this setup, we have explored the influence that the design of the central bank has on the government's incentives to spend and how such spending shapes the optimal inflation target of the central bank. This analysis is relevant in the context of the EMU where countries share a common monetary policy but decisions on government spending belong to the national level.

We have shown that the formation of a monetary union can be counterproductive for the member countries when they have similar preferences on output, inflation and government spending and the monetary authorities aim to maximize joint social welfare. This result will not occur if countries collectively choose their fiscal policy. However, with respect to this cooperative scenario, welfare can further improve if the central bank is designed so that it is more conservative than society which implies a lower inflation target. We also show that when countries create a monetary union the central bank has to put more weight on inflation to offset a higher inflation bias. The reason why the inflation bias is more of a problem in a monetary union is that sharing a single currency creates negative externalities that have to be offset by more conservative central bank. This result rationalizes the common perception that the European Central Bank is more worried about inflation than the Federal Reserve

Finally we have considered the case in which the level of desired government spending of some countries in the union (periphry) is higher than that of the other members (core). This study also applies to the EMU since recently the periphery countries have undergone a deep economic crisis, which has increased unemployment and, in turn, the costs of the safety net associated with their welfare state. We have shown that, in this scenario, the central bank must be made even more conservative in order to prevent this change form making the core countries worse-off. However, changing the monetary institution generates costs in terms of coordination and a loss of credibility. In this sense, an alternative solution that would avoid this unfavorable outcome for the core members consists of encouraging the periphery countries to implement

reforms that lower their government spending. In this respect, one important question that arises is how to find a commitment technology being credible enough to make the periphery countries implement these reforms that diminish their welfare state.

6 Appendix

Proof of Remark 3

When countries do not share the same currency, we apply backward induction to solve the game in the same way used in section 3 (that led into (13)), with the only exception that in the last stage central banks act as Nash players. That is, each of them minimizes its own country's social loss (appearing in (2)), taking its counterpart's behavior as given. As a result, in this scenario country i's social loss is:

$$L_i^S = \frac{(\lambda+1)\,\delta\,(\overline{g_i})^2}{\lambda+\lambda\delta+1}. \tag{A1}$$

Therefore, the difference between country i's social loss with monetary union and without it is ((13) minus $(A1)$):

$$\frac{\delta^2\lambda\,(\overline{g_i})^2}{(\lambda+\lambda\delta+1)\,(2\lambda+2\lambda\delta+1)^2}. \tag{A2}$$

The sign of $(A2)$ is positive. Hence the formation of the monetary union is welfare reducing if the monetary authorities have the social preferences. ∎

Proof of Remark 4:

The solution to the problem appearing in (14) is:

$$g_1 = \frac{\delta\lambda\overline{g_i}}{\lambda+\lambda\delta+1}. \tag{A3}$$

Substituting $(A3)$ in (6), (7) and (1) one finds the values for output and the inflationary bias when countries implement reforms in a cooperative fashion:

$$y_i = -\frac{\delta\lambda\overline{g_i}}{\lambda+\lambda\delta+1}, \tag{A4}$$

$$\pi_i^e = \frac{\delta\overline{g_i}}{\lambda+\lambda\delta+1}. \tag{A5}$$

Working out the (three) respective differences between the values of government spending, output an inflation bias in the cooperative scenario and the corresponding ones obtained in the non-cooperative case, yields (subtracting, respectively, expressions (9), (12) and (10) from equations $(A3)$, $(A4)$ and $(A5)$):

$$-\frac{\delta\lambda\overline{g_i}}{2\lambda^2\delta^2+4\lambda^2\delta+2\lambda^2+3\lambda\delta+3\lambda+1} < 0, \tag{A6}$$

$$\frac{\delta\lambda\overline{g_i}}{2\lambda^2\delta^2+4\lambda^2\delta+2\lambda^2+3\lambda\delta+3\lambda+1} > 0, \tag{A7}$$

$$-\frac{\delta\overline{g_i}}{(\lambda+\lambda\delta+1)(2\lambda+2\lambda\delta+1)} < 0. \tag{A8}$$

Finally, given that it can be checked that the expression for country i's social loss in the cooperative regime coincides with $(A1)$, this scenario yields a higher level of welfare (since the difference between the social loss in the non-cooperative case and the one in the cooperative regime is given by the positive value appearing in $(A2)$). ∎

Proof of Proposition 1:

We apply backward induction to the game in which government spendings are collectively determined. Therefore, we solve it in the same way as we did (in section 4) for the case where these spendings were decided at the national level with just one exception. That is, in the first stage a supranational authority solves (making use of (1), (2), (18) and (19)):

$$\begin{array}{ll} \underset{\{g_i,g_j\}}{Min} & \sum_{i\neq j}^{2}\lambda\pi^2+y_i^2+\delta\left(g_i-\overline{g_i}\right)^2 \\ s.t. & \begin{cases} y_i=\pi-\pi_i^e-\tau_i, \\ \pi=\frac{2\lambda\overline{g_i}+2\delta\pi_0+2\lambda\delta\overline{g_i}}{2\lambda+2\lambda\delta+1}, \\ \pi_i^e=\frac{2\lambda\overline{g_i}+2\delta\pi_0+2\lambda\delta\overline{g_i}}{2\lambda+2\lambda\delta+1}, \end{cases} \end{array} \tag{30}$$

which yields:

$$g_i=-\frac{\lambda\pi_0-\lambda\delta\overline{g_i}}{\lambda+\lambda\delta+1}. \tag{A9}$$

This reforms imply that expected and actual inflation are, respectively:

$$\pi^e = \frac{\pi_0\lambda+\overline{g_i}\delta+\pi_0\lambda\delta}{\lambda+\lambda\delta+1}, \tag{A10}$$

$$\pi = \frac{\pi_0\lambda+\overline{g_i}\delta+\pi_0\lambda\delta}{\lambda+\lambda\delta+1}. \tag{A11}$$

Therefore, in stage zero, the inflation target of the central bank is obtained by solving the following problem:

$$\underset{\{\pi_0\}}{Min} \quad \sum_{i=1}^{2} E\left(\lambda\pi^2 + y_i^2 + \delta\left(g_i - \overline{g_i}\right)^2\right)$$

$$s.t. \quad \begin{cases} y_i = \pi - \pi_i^e - \tau_i, \\ \phi_i = -\frac{\lambda\pi_0 - \lambda\delta\overline{g_i}}{\lambda+\lambda\delta+1}, \\ \pi^e = \frac{\pi_0\lambda+\overline{g_i}\delta+\pi_0\lambda\delta}{\lambda+\lambda\delta+1}, \\ \pi = \frac{\pi_0\lambda+\overline{g_i}\delta+\pi_0\lambda\delta}{\lambda+\lambda\delta+1}, \end{cases}$$

whose solution is:

$$\pi_0 = -\frac{\delta\overline{g_i}}{\lambda + \lambda\delta}, \tag{A12}$$

Notice that $(A12)$ coincides with (24). Now, substituting $(A12)$ into $(A9)$, we obtain the equilibrium value of government spending:

$$g_i = \frac{\delta\overline{g_i}}{\delta + 1}. \tag{A13}$$

Finally, from $(A13)$ one finds the values for expected inflation, actual inflation, output and social loss:

$$\pi^e = 0, \tag{A14}$$

$$\pi = 0, \tag{31}$$

$$y = -\frac{\delta\overline{g_i}}{\delta + 1}, \tag{A16}$$

$$L^S = \frac{\left(\overline{g_i}\right)^2 \delta(1+\delta)}{2\delta + \delta^2 + 1}, \tag{A17}$$

which coincide respectively with the corresponding expressions $(25) - (29)$). ∎

Proof of Propositions 2, 3 and 4:

Claim 1: The first-best is achieved when the common central bank is collectively designed:

Proof:

Following Persson and Tabellini (2000, p. 399) when the objective function is quadratic in the macroeconomic variables, the rule that achieves the first-best is a constant. That is, the rule

takes the following form:

$$\pi = a, \tag{A18}$$

$$g_i = b, \tag{A19}$$

where a and b are two parameters to be determined.

Now we determine the values of a and b. First, plugging $(A18)$ and $(A19)$ into (2), and bearing in mind that $\pi^e = E(a) = a$, we have:

$$b = t\frac{\delta}{\delta + 1}$$
$$L^S = \lambda (a)^2 + (-b)^2 + \delta (b - \overline{g_i})^2 .$$

The first order conditions are:

$$\begin{aligned} \frac{\partial L^S}{\partial a} &= 2\lambda a = 0 \\ \frac{\partial L^S}{\partial b} &= 2b + 2b\delta - 2\delta\overline{g_i} = 0 \end{aligned}$$

Solving simultaneously one finds:

$$\begin{aligned} a &= 0, \\ b &= \frac{\delta\overline{g_i}}{\delta + 1}, \end{aligned}$$

Thus, the first-best is achieved when the inflation and goverment spendings are, respectively: $\pi = 0$ and $g_i = \frac{\delta\overline{g_i}}{\delta+1}$. These two expressions coincide with the ones obtained for these variables in the scenario in which the common central bank is designed ((27) and (25)).

Claim 2: Comparing the case in which the central bank has been designed with the regime where governments cooperate in the implementation of fiscal policies and the central bank has the social preferences, in the former scenario reforms, inflation output and social loss reach lower level.

Proof:

Working out the (four) respective differences between the values of govenment spendings, output, inflationary bias and social loss for the scenario where the central bank has been design

and the corresponding values obtained in the case where the monetary authorities have the social preferences and there is cooperation in fiscal policies yields (subtracting, respectively, expressions $(A3)$, $(A4)$, $(A5)$ and $(A1)$ from equations $(A13)$, $(A16)$, $(A14)$ and $(A17)$):

$$\frac{\delta\overline{g_i}}{(\delta+1)(\lambda+\lambda\delta+1)} > 0, \tag{A20}$$

$$-\frac{\delta\overline{g_i}}{(\delta+1)(\lambda+\lambda\delta+1)} < 0, \tag{A21}$$

$$-\frac{\delta\overline{g_i}}{\lambda+\lambda\delta+1} < 0, \tag{A22}$$

$$-\frac{(\lambda+1)\,\delta\overline{g_i}^2}{\lambda+\lambda\delta+1} < 0, \tag{A23}$$

The signs of the previous four expressions prove claim 2. ∎

Proof of the Proposition 5

The levels of government spendings implemented after the crisis takes place ($\overline{g_p} > \overline{g_c}$) is obtained by solving the game as in the previous scenarios but keeping the inflation target at the level selected prior to the crisis (expression (24)):

$$g_c = \frac{\delta\overline{g_c}-\delta\overline{g_p}+4\lambda\delta^2\overline{g_c}+4\lambda\delta\overline{g_c}}{4\lambda+2\delta+8\lambda\delta+4\lambda\delta^2+2}, \tag{A24}$$

$$g_p = \frac{-\delta\overline{g_c}+\delta\overline{g_p}+4\lambda\delta^2\overline{g_p}+4\lambda\delta\overline{g_p}}{4\lambda+2\delta+8\lambda\delta+4\lambda\delta^2+2}. \tag{A25}$$

The difference between the level of country 1's reforms after and before enlargement ($(A24)$ minus $(A13)$) is:

$$-\frac{1}{2}\frac{\delta}{\delta+1}\frac{\overline{g_c}+\overline{g_p}}{2\lambda+2\lambda\delta+1} < 0.$$

The negative sign of this expression implies that country 1 (core) carries out less government spending after the crisis occurs.

The equilibrium values for country'1 expected inflation, actual inflation and output are, respectively:

$$\pi^e = -\delta\frac{\overline{g_c}+\lambda\overline{g_c}-\lambda\overline{g_p}+\lambda\delta\overline{g_c}-\lambda\delta\overline{g_p}}{\lambda(\delta+1)(2\lambda+2\lambda\delta+1)}, \tag{A26}$$

$$\pi = -\delta\frac{\overline{g_p}+\lambda\overline{g_p}-\lambda\overline{g_p}+\lambda\delta\overline{g_p}-\lambda\delta\overline{g_p}}{\lambda(\delta+1)(2\lambda+2\lambda\delta+1)}, \tag{A27}$$

$$y_c = -\frac{\delta\overline{g_c}-\delta\overline{g_p}+4\lambda\delta^2\overline{g_c}+4\lambda\delta\overline{g_c}}{4\lambda+2\delta+8\lambda\delta+4\lambda\delta^2+2}. \tag{A28}$$

Taking into account equations $(A24)-(A28)$, the value of country 1's social loss after the crisis differs from the one obtained prior to this event (expression $(A17)$) in the following amount:

$$\frac{1}{4}\delta^2\left(\overline{g_c}+\overline{g_p}\right)^2\frac{4\lambda+4\lambda\delta+1}{(\delta+1)\left(2\lambda+2\lambda\delta+1\right)^2}.$$

Since this expression is positive, the crisis makes country 1 (initial block) worse-off, provided that the central bank's inflation target remains unchanged. ∎

Proof of Proposition 6

Following the same procedure followed to obtain (24) , one finds that, when the crisis occurs, the redesigned inflation target of the central bank is:

$$\pi_0=-\frac{(\delta\overline{g_c}+\delta\overline{g_p})}{2\lambda+2\lambda\delta}. \tag{A29}$$

The difference between this value and the one appearing (24) is:

$$\frac{1}{2}\delta\frac{\overline{g_c}-\overline{g_p}}{\lambda\left(\delta+1\right)}<0.$$

Hence the central bank becomes more conservative after the enlargement. Taking account of $(A29)$, the inflationary bias is eliminated ($\pi^e=0$) and the social loss is:

$$L^S=\frac{\left(\overline{g_c}\right)^2\delta(1+\delta)}{2\delta+\delta^2+1}, \tag{A30}$$

which coincides with the one appearing in $(A17)$. ∎

7 References

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