ROEL M.W.J. BEETSMA
A. LANS BOVENBERG

Structural Distortions and Decentralized Fiscal Policies in EMU

The combination of discretionary monetary policy, labor-market distortions, and nominal wage rigidity yields excessive inflation as monetary policy tries to exploit nominal wage contracts to address labor-market distortions. An inflation target reduces inflation, but creates a conflict between monetary policy and discretionary fiscal policy if fiscal policy is set at a higher frequency than nominal wages are. Preventing the associated excessive accumulation of public debt calls for debt ceilings. If countries differ substantially in terms of structural distortions, uniform debt ceilings must be complemented by country-specific debt targets in order to prevent decentralized fiscal authorities from employing debt policy strategically.

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The advent of the European Monetary Union (EMU) has given rise to a lively debate about the appropriate relationship between centralized monetary policy, on one hand, and decentralized fiscal and structural policies, on the other. Does the EMU require coordination of fiscal policies and, if so, what form should such coordination take? This paper addresses these questions by investigating how decentralized fiscal policy interacts with centralized monetary policy

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Roel M.W.J. Beetsma *is a professor of economics at the University of Amsterdam and is also affiliated with CEPR* (*E-mail:* R.M.W.J.Beetsma@fee.uva.nl). A. Lans Bovenberg *is a professor at Tilburg University and is also affiliated with CEPR* (*E-mail:* A.L.Bovenberg@uvt.nl)

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and decentralized structural policies in the EMU. We discuss how the appropriate institutional arrangements for fiscal policy should depend on monetary arrangements (e.g. inflation targets), labor-market institutions (e.g. nominal wage rigidity), and labor-market and product-market imperfections (e.g. taxes raising the natural rate of unemployment).

The current institutional arrangements for fiscal policy in the EMU are as follows. The Maastricht Treaty formulates restrictions on public deficits and public debts that countries must meet before they can enter the EMU. In addition, the Stability and Growth Pact constrains fiscal policy once countries have entered the EMU and specifies sanctions in case an EMU country violates these constraints. Finally, the Euro Group is the forum where the finance ministers of the EMU countries informally discuss matters pertaining to fiscal policy on an ongoing basis. France, in particular, desires to endow this council with more formal powers so that, as a European fiscal authority, it can provide some political counterweight to the European Central Bank (ECB) (for example, see The Economist 2000).

Our analysis is conducted in a two-period model of a monetary union where decentralized fiscal authorities determine taxes, public spending, and public debt. The model accounts for labor-market distortions raising the equilibrium unemployment rate above its first-best level. Moreover, it models not only the impact of these distortions on discretionary monetary policy, but also the relationship between labor-market imperfections and fiscal policy by incorporating a direct link between the tax burden and equilibrium unemployment. In this way, it investigates the relationships between three major policy areas (namely, monetary, fiscal, and structural policy) in a monetary union.

The model incorporates three imperfections in macroeconomic policymaking: first, discretion in monetary policymaking; second, discretion in fiscal policymaking; and third, spillovers between decentralized fiscal policies within the union. Discretionary monetary policy is a realistic description of European monetary policy. Although the ECB is one of the most statutorily independent central banks of the world, statutes alone cannot insulate the ECB entirely from political pressures. This influence may be exercised both directly (e.g. by mobilizing public opinion) and indirectly (e.g. through the appointment of ECB Board members or through exchange rate policy, which remains the domain of the ECOFIN Council rather than the ECB). Structural policies worsen the commitment problems facing the ECB, as high unemployment intensifies pressures on the ECB to relax monetary policy. This is especially relevant in the European context, where serious labor-market distortions give rise to high unemployment rates in several EMU countries. Indeed, lack of monetary policy commitment interacts with nominal wage rigidity and labor-market distortions to yield excessive inflation (see Barro and Gordon, 1983, and many subsequent papers—for example, Rogoff, 1985, Persson and Tabellini, 1993, Walsh, 1995 and, more recently, Dixit and Lambertini, 2000).

Discretionary fiscal policy suffers from time inconsistency if it can be adjusted while existing nominal wage and debt contracts remain in force. This is in fact typically the case. To illustrate, whereas fiscal policy is usually set once a year,

the time to maturity of many nominal debt contracts is more than one year. Also nominal wage contracts are fixed for more than a year in several European countries (e.g. Layard, Nickell, and Jackman 1991). Even if nominal contracts are renewed every year, they are typically not renewed at the same time that fiscal policy is set for a new fiscal year. In order to explore the implications of time inconsistency in an analytically tractable fashion, we assume that nominal wages are determined two periods ahead while fiscal policy is adjusted in each period. Since fiscal policy is thus adjusted more frequently than nominal wage contracts are, it faces an incentive to exploit the predetermination of future nominal wages.

The third imperfection (i.e. spillovers between decentralized fiscal policymakers) originates in international conflicts between heterogeneous countries about the common monetary policy. Countries do not agree on the stance of monetary policy if labor-market imperfections differ across union members so that countries perceive different roles for monetary policy in addressing these imperfections. These conflicts among decentralized fiscal authorities yield wasteful strategic interaction in the form of strategic debt accumulation. Countries would be better off if they could all credibly commit to an agreement not to engage in these strategic debt policies.

We explore several institutional arrangements to address these three imperfections in macroeconomic policymaking within a monetary union. In particular, an inflation target lends credibility to the commitment of the ECB to price stability, thereby reducing inflation. Indeed, as part of its monetary policy strategy, the ECB announced a medium-term target range for weighted average inflation of 0–2%. At the same time, however, a tight inflation target causes the preferences of the monetary and fiscal authorities regarding monetary policy to diverge. In the resulting conflict about the stance of monetary policy, the fiscal authorities strategically boost debt accumulation to induce the central bank to relax future monetary policy. A ceiling on public debt can resolve this policy conflict. The conflict between heterogeneous countries about the proper stance of the common monetary policy is addressed through country-specific debt targets. In this way, countries in effect commit to a contractual cooperative agreement not to impose adverse externalities on each other. One can view this solution to international spillovers as ex-ante coordination, i.e. coordinating fiscal policies *before* the private sector commits to nominal wage contracts. Ex-ante coordination of fiscal policy is thus unambiguously beneficial.

In practice, debt ceilings are more difficult to implement than inflation targets, especially in a monetary union with sovereign countries. Indeed, the commitment of EMU countries to the Stability and Growth Pact is often called into question because the sanctions prescribed by the Pact are not so credible in the absence of a European political union. In the absence of credible debt ceilings, optimal inflation targets do not completely eliminate inflation in order to prevent wasteful strategic debt accumulation by the fiscal authorities. Ex-post fiscal policy coordination, i.e. coordinating fiscal policy *after* nominal wage contracts have been signed,[1] resolves

1. For recent work on the coordination of monetary and/or fiscal policies, see e.g. Jensen (1996), Dixon and Santoni (1997), and Debrun (2001). These papers do not investigate how international policy coordination affects public debt accumulation, which is a key issue addressed in this paper.

the conflict among the heterogeneous fiscal authorities about the stance of the common monetary policy. In the presence of an inflation target, however, this coordination worsens the conflict between monetary and fiscal policy by strengthening the strategic position of the fiscal authorities in their conflict with the ECB. Accordingly, strategic debt accumulation aimed at inducing the ECB to relax future monetary policy increases. Ex-post coordination of fiscal policy may therefore harm welfare, especially if countries are rather homogeneous so that international spillovers are only small. The ECB may thus justifiably fear that a more prominent role for the Euro Group Council raises pressures to relax monetary policy, especially if structural unemployment in Europe remains high and the enforcement of the Stability and Growth Pact remains in doubt.

The remainder of this paper is as follows. Section 1 presents the model. We keep the model as simple as possible in order to focus on the strategic interaction between the central monetary policy of the ECB and decentralized fiscal and structural policies. Section 2 explores the second best, which emerges if all policymakers can commit to their policies. Section 3 analyses the solution under two-period ahead wage setting if policymakers cannot commit and inflation targets and debt targets are absent. Section 4 investigates ex-ante (through inflation and debt targets) and ex-post policy coordination, while Section 5 concludes the main body of the paper. Finally, the derivations are contained in an appendices that are available upon request.

1. THE MODEL

The EMU, which is small relative to the rest of the world, is formed by n countries. The ECB sets monetary policy for the entire union. There are two periods.

Nominal wage setting takes place as follows, where we express wages and prices in logs. Workers are represented by trade unions who aim for a target real wage rate of zero in each period (e.g. see Alesina and Tabellini, 1987, Jensen, 1994).[2] For the first period, they set the nominal wage w_1 so as to minimize the expected squared deviation of the realized real wage rate from this target. Hence, they minimize $\mathrm{E}_0(w_1 - p_1)^2$ over w_1 at the start of the first period, where $\mathrm{E}_0(.)$ denotes a (rational) expectation taken at the start of the first period and p_t is the price level in period t. This yields $w_1 = \mathrm{E}_0(p_1)$ so that $w_1 - p_1 = -(\pi_1 - \mathrm{E}_0\pi_1)$, where $\pi_t = p_t - p_{t-1}$ is period-t inflation. Second-period nominal wages w_2 are determined two periods ahead by minimizing $\mathrm{E}_0(w_2 - p_2)^2$ over w_2 at the start of the first period. However, at the start of the second period, the nominal wages for that period are indexed for unexpected inflation incurred over the first period. Therefore, the nominal wage rate in the second period is $w_2 = \mathrm{E}_0(p_2) + p_1 - \mathrm{E}_0(p_1)$, implying that $w_2 - p_2 = -(\pi_2 - \mathrm{E}_0\pi_2)$. Hence, due to the indexation, the second-period real

2. We could allow for a real wage target that deviates from zero and that differs across the two periods (see Appendix A). Non-zero wage targets would then show up in our measure for structural distortions (see below) without affecting the rest of the analysis.

wage is unaffected by first-period inflation. The conventional wisdom is that, compared to the U.S., European wages are relatively rigid in real terms (e.g. Bruno and Sachs 1985). The current model thus features a mixture of nominal and real wage rigidity meant to capture in a stylized way the European situation.[3]

Firms face a standard Cobb–Douglas production function with a fixed capital stock and with decreasing returns to scale in labor. Revenues in period t are taxed at a rate τ_{it}. The demand for labor is determined by equating the real wage rate with the (after-tax) marginal product of labor. Hence, (log) output in country i in periods 1 and 2, respectively, amounts to (see Appendix A):

$$x_{i1} = \nu(p_1 - w_1 - \tau_{i1}) = \nu(\pi_1 - E_0\pi_1 - \tau_{i1}) , \tag{1}$$

$$x_{i2} = \nu(p_2 - w_2 - \tau_{i2}) = \nu(\pi_2 - E_0\pi_2 - \tau_{i2}) , \tag{2}$$

with $\nu > 0$. All union members experience the same inflation rate because the world produces a single, perfectly substitutable good that is traded without barriers. This also implies that the real exchange rate between the union and the rest of the world is constant and can be neglected.

Each country features a benevolent government, which thus shares the social loss function of the public at large. In particular, the social loss function of country i is defined over inflation, output, and public spending:

$$V_{S,i} = \frac{1}{2}\sum_{t=1}^{2}\beta^{t-1}[\alpha_\pi\pi_t^2 + (x_{it} - \tilde{x}_{it})^2 + \alpha_g(g_{it} - \tilde{g}_{it})^2], \quad \alpha_\pi,\alpha_g > 0 . \tag{3}$$

Welfare losses increase in the deviations of inflation, output, and government spending (g_{it} is government spending as a share of *non-distortionary output*, i.e. output in the absence of distortionary taxes, inflation surprises and shocks) from their first-best levels (or "bliss points"). For convenience, the first-best level for inflation corresponds to price stability. The first-best level for output is denoted by $\tilde{x}_{it} > 0$. Two distortions reduce output below this optimal level. First, the output tax τ_{it} drives a wedge between the social and private benefits of additional output. Second, market power enables unions to drive the real wage above its level in the absence of distortions. Hence, even in the absence of taxes, output is below the first-best output level $\tilde{x}_{it} > 0$. A subsidy ($\tau_{it} < 0$) is thus required to arrive at the first-best output level. The first-best level of government spending, $\tilde{g}_{it} > 0$, can be interpreted as the optimal share of non-distortionary output to be spent on public goods if (non-distortionary) lump-sum taxes would have been available. The first-best levels for output and government spending can differ across countries. Parameters α_π and α_g correspond to the weights of the price stability and government spending objectives, respectively, relative to the weight of the output objective. To obtain tractable solutions, we assume that all member countries feature the same relative weights. Finally, $0 < \beta \leq 1$ denotes society's subjective discount factor.

3. Burda (1999) argues that real wage rigidity is likely to become less relevant for the Euro area in the future. At the same time, nominal price rigidities may become more important.

Government i's budget constraint can be approximated by (e.g. see Appendix A in Beetsma and Bovenberg, 1999):

$$g_{it} + (1 + \rho)d_{i,t-1} = \tau_{it} + d_{it}\,, \tag{4}$$

where $d_{i,t-1}$ represents the amount of public debt carried over from the previous period into period t, while d_{it} stands for the amount of debt outstanding at the end of period t (both are expressed as a share of non-distortionary output). All public debt is real, matures after one period, and is sold on the world capital market against a real rate of interest of ρ. This interest rate is exogenous because the countries making up the monetary union are assumed to be small relative to the rest of the world. The government budget constraint abstracts from possible seigniorage revenues, which seems realistic, because these revenues currently play an almost negligible role in most EMU countries.[4]

We combine Equation (4) with the expression for output, Equation (1) or (2), to eliminate τ_{it}. The resulting equations can be rewritten to yield the *overall financing requirements* in period t (OFR_{it}), $t = 1, 2$:

$$\begin{aligned}\mathrm{OFR}_{it} &\equiv K_{it} + (1 + \rho)d_{i,t-1} - d_{it} \\ &= [(\tilde{x}_{it} - x_{it})/\nu] + (\tilde{g}_{it} - g_{it}) + (\pi_t - \mathrm{E}_0\pi_t)\,,\end{aligned} \tag{5}$$

where

$$K_{it} \equiv \tilde{g}_{it} + \tilde{x}_{it}/\nu\,,$$

will be referred to as *(total) structural distortions* in period t. The overall financing requirement, OFR_{it}, consists of two components (see the first right-hand side of Equation 5). The first component, K_{it}, amounts to the government spending target, $\tilde{g}_{it}$, and an output subsidy aimed at offsetting the implicit output tax due to labor- or product-market distortions, $\tilde{x}_{it}/\nu$. The second component involves net debt-servicing costs, $(1 + \rho)d_{i,t-1} - d_{it}$. The last right-hand side of Equation (5) represents the financing sources: the shortfall (scaled by ν) of output from its target (henceforth referred to as the *output shortfall*), $(\tilde{x}_{it} - x_{it})/\nu$, the shortfall of government spending from its target (henceforth referred to as the *spending shortfall*), $\tilde{g}_{it} - g_{it}$, and the inflation surprise, $\pi_t - \mathrm{E}_0\pi_t$.

All public debt is paid off at the end of the second period ($d_{i2} = 0$, $i = 1,\ldots, n$). Under this assumption, while taking the discounted (to period 1) sums of the left- and right-hand sides of Equation (5) over t = 1 and 2, we obtain the intertemporal overall financing requirement (F_i):

$$F_i = \sum_{t=1}^{2}(1+\rho)^{-(t-1)}\,[(\tilde{x}_{it} - x_{it})/\nu + (\tilde{g}_{it} - g_{it}) + (\pi_t - \mathrm{E}_0\pi_t)]\,, \tag{6}$$

where

$$F_i \equiv K_{i1} + (1 + \rho)d_{i0} + K_{i2}/(1 + \rho)$$

4. The implicit assumption is that real money holdings, which are the main source of seigniorage revenues, are zero. Indeed, due to efficient payment and transaction systems, real base money holdings are small in advanced economies.

serves as a comprehensive measure of all exogenous factors that result in losses to society. In the sequel, we conveniently express the equilibrium outcomes of the financing sources in terms of this intertemporal overall financing requirement.

Monetary policy is delegated to the ECB, which exercises direct control over the union's inflation rate. One could assume that the ECB features intrinsic preferences regarding policy outcomes. Alternatively, and this is the interpretation we prefer, the ECB can be assigned a loss function by means of an appropriate contractual agreement. More specifically, this agreement shapes the ECB's incentives in such a way (by appropriately specifying its salary and other benefits—for example, possible reappointment—conditional on its performance) that it chooses to minimize the following loss function:[5]

$$V_{\mathrm{ECB}} = \frac{1}{2}\sum_{t=1}^{2}\beta^{t-1}\left[\alpha_{\pi}\left(\pi_t - \pi_t^{*}\right)^2 + \frac{1}{n}\sum_{i=1}^{n}\left(x_{it} - \tilde{x}_{it}\right)^2\right], \tag{7}$$

where π_t^* is the inflation target imposed on the ECB in period t (as in Svensson 1997). It may be different from the first-best inflation rate (which was assumed to be zero). The ECB cares about stabilizing output around its first-best level; the relative weight that the ECB attaches to deviations of inflation from its assigned target coincides with the corresponding relative weight of society and, thus, the fiscal authorities. Credibly delegating monetary policy to a central bank that does not care about fluctuations in output would be difficult in practice. Indeed, in the presence of shocks, society optimally assigns an output objective to the central bank in order to stabilize output. The previous version of this paper (Beetsma and Bovenberg 2001) allowed for supply-side shocks in output (Equation 1). In order to save notation, we abstract from shocks here because all major results continue to hold in the absence of stochastic shocks.

2. THE SECOND-BEST: FULL COMMITMENT

As a benchmark for the remainder of the analysis, this section discusses the equilibrium if all policymakers (monetary and fiscal) are able to commit their policy instruments. The precise timing is as follows. First, at the start of the first period, the ECB announces and commits to inflation *for both periods ahead*. At the same moment, the fiscal authorities announce their commitment to a particular set of debt levels. This eliminates the commitment problem facing fiscal policy described in the introduction and internalizes international spillovers. Second, nominal wage contracts are set for both periods. Third, public spending and taxes are determined, while inflation and debt are set at the announced levels. Then, at the start of the second period, the nominal wage is updated for unexpected inflation incurred in

5. The outcomes would be completely unaltered if we included government spending in the ECB's loss function (Equation 7). For convenience, and because it seems more realistic, we do not include government spending in Equation (7).

the first period. Finally, the second-period policy variables are determined, with inflation set at the originally announced value and public spending and taxes set under the restriction that all debt be paid off. Although the second-period nominal wage is indexed for inflation during the first period, second-period inflation expectations are *not* updated at the start of the second period.

In the sequel, we refer to this equilibrium as the *second-best equilibrium*. In the absence of first-best policies (such as the use of lump-sum taxation and the elimination of product- and labor-market distortions), this equilibrium features the smallest possible expected welfare loss for each individual country in a monetary union (i.e. *given* that inflation is attuned to union-wide circumstances).

The derivation of the second-best equilibrium can be found in Appendix B. Table 1 contains the outcomes for inflation, the output shortfall, and the spending shortfall.[6] The factor between square brackets in each of the outcomes makes clear how, *within* a given period, F_i is distributed over the financing sources (the output shortfall, the spending shortfall, and an inflation surprise), while the factor in round brackets regulates the *inter*temporal allocation of F_i. Indeed, summing over the financing sources for each given period (see the right-hand side of Equation 5, $t = 1, 2$), we find that the factors in square brackets add up to unity. As regards the intertemporal allocation, first-period financing sources together absorb a share of $\beta^*(1 + \rho)/[1 + \beta^*(1 + \rho)]$ of F_i, while second-period financing sources together absorb a share (discounted to the first period) of $1/[1 + \beta^*(1 + \rho)]$. Here, and in the sequel, $\beta^* \equiv \beta(1 + \rho)$.

For later reference, the solution for public debt amounts to

$$d_{i1}^{S} = \frac{[K_{i1} + (1 + \rho)d_{i0} - K_{i2}] + (1 - \beta^*)K_{i2}}{1 + \beta^*(1 + \rho)}, \tag{8}$$

where the superscript "S" stands for "second-best equilibrium". If structural distortions are constant through time (i.e. $K_{i1} = K_{i2}$), initial public debt is absent ($d_{i0} = 0$), and the interest rate equals the discount rate (i.e. $1/\beta = (1 + \rho)$ so that $\beta^* = 1$), public debt remains zero as structural distortions are absorbed in the period in which they occur. Relatively high first-period distortions (i.e. $K_{i1} > K_{i2}$), initial public debt ($d_{i0} > 0$), and the discount rate exceeding the interest rate (i.e. $1/\beta > (1 + \rho)$ so that $\beta^* < 1$) contribute to positive public debt. All these factors encourage governments to shift some of their first-period financing requirements to the second period through public debt policy.

3. PURE DISCRETION

This section explores the case of *pure discretion*, that is, discretionary monetary and fiscal policymaking in the absence of inflation targets ($\pi_1^* = \pi_2^* = 0$) and debt

6. Throughout, we present the outcome for the output shortfall instead of the tax rate. The reason is that, in contrast to the latter, the former directly enters the loss functions.

TABLE 1

SECOND-BEST POLICY OUTCOMES

First period	Second period
$\pi_1 = 0$	$\pi_2 = 0$
$(\tilde{x}_{i1} - x_{i1})/\nu = \left[\frac{1/\nu^2}{S}\right](\beta^* c_0)F_i$	$(\tilde{x}_{i2} - x_{i2})/\nu = \left[\frac{1/\nu^2}{S}\right](c_0)F_i$
$\tilde{g}_{i1} - g_{i1} = \left[\frac{1/\alpha_g}{S}\right](\beta^* c_0)F_i$	$\tilde{g}_{i2} - g_{i2} = \left[\frac{1/\alpha_g}{S}\right](c_0)F_i$
$\pi_1 - E_0\pi_1 = 0$	$\pi_2 - E_0\pi_2 = 0$

NOTES: π_t is the inflation rate in period t, $(\tilde{x}_{it} - x_{it})/\nu$ is the (scaled) shortfall of output from target, $\tilde{g}_{it} - g_{it}$ is the shortfall of spending from target, and F_i is the intertemporal overall financing requirement (Equation 6). Further, ν is the slope of the supply curves (Equations 1 and 2), α_g is the relative weight of the government spending objective in Equation (3), and $\beta^* \equiv \beta(1 + \rho)$, where β is the subjective discount factor and ρ is the real interest rate. Finally, $c_0 \equiv (1 + \rho)/[1 + \beta^*(1 + \rho)]$ and $S \equiv 1/\nu^2 + 1/\alpha_g$.

targets.[7] In contrast to the previous section, therefore, policymakers are no longer able to commit.

The timing of events is now as follows. At the start of the first period ($t = 0$), nominal wages are set (and inflation expectations are determined) *for both periods ahead*. Subsequently, the first-period monetary and fiscal policy instruments are chosen, where each policymaker takes the other players' first-period policy decisions, as well as expectations, as given. Then, the nominal wage for the second period is indexed for unexpected inflation incurred over the first period. Finally, second-period monetary and fiscal policy instruments are chosen, where, again, each policymaker takes the other players' policy decisions, as well as expectations, as given. In other words, within each period, policymakers are involved in a Nash game. Fiscal policy typically has a first-mover advantage vis-à-vis monetary policy because the latter can be changed more easily. However, a monetary union strengthens the strategic position of monetary policy, as the central monetary authority faces many relatively small fiscal authorities. The Nash assumption within each period thus seems a reasonable description of the stronger strategic position of the monetary authorities.[8]

Since they move earlier, first-period governments act as Stackelberg leaders against the second-period policymakers. This gives rise to strategic effects as first-period

7. In much of the literature on fiscal–monetary policy interactions, only monetary policy is discretionary (e.g. Alesina and Tabellini 1987). Exceptions are, for example, Bryson, Jensen, and VanHoose (1993), Agell, Calmfors, and Jonsson (1996), Begg (2000), Debrun (2000), and Dixit and Lambertini (2000).

8. Dixit and Lambertini (2000) explore various leadership assumptions in a one-period model with fiscal–monetary policy interactions. Interestingly, they find that monetary commitment becomes irrelevant for the outcomes if the monetary authority is a Stackelberg leader. With the fiscal reaction function included as a constraint in the monetary authority's optimization problem, the constraint that expectations be rationally formed becomes redundant, thereby eliminating the value to the central bank of having control over private sector expectations. In our model, the outcomes under monetary discretion differ from those under monetary commitment because of two reasons. First, the monetary authorities are not Stackelberg leaders vis-à-vis the fiscal authorities. Second, we consider a dynamic rather than a static game in which fiscal policy affects inflation only indirectly, namely through the ECB's second-period reaction function (see Equation 9 below). Dixit and Lambertini (2000), in contrast, assume that fiscal policy affects inflation directly and instantaneously.

governments exploit the second-period reaction function of the monetary authorities. In particular, by using their debt policy, first-period fiscal policymakers affect the need for tax revenues and thus the tax rate in the second period. This, in turn, impacts output (and employment) and thus the incentive for the ECB to relax or tighten its monetary policy, as is evident from the ECB's second-period reaction function

$$\pi_2 = \left[\frac{\alpha_\pi}{\alpha_\pi + \nu^2}\right]\pi_2^* + \left[\frac{\nu^2}{\alpha_\pi + \nu^2}\right]\left[\pi_2^e + \frac{1}{n}\sum_{i=1}^{n}(\tau_{i2} + \tilde{x}_{i2}/\nu)\right], \tag{9}$$

where for future reference we have allowed for a non-zero inflation target π_2^*. Higher expected inflation and more severe tax and non-tax distortions in any of the countries in the monetary union reduce output below its target level, thereby inducing the ECB to employ unanticipated inflation as an instrument to expand output. The effect on inflation of a unilateral change in the tax rate is only $1/n$-th of the corresponding effect under national monetary policymaking. Accordingly, the reaction of the ECB to an individual country's change in its tax rate decreases with the size of the union. Intuitively, the larger a monetary union becomes, the weaker the strategic position of each individual fiscal player becomes.

Table 2 contains the solutions for the inflation rate, the output shortfall, and the spending shortfall.[9] In contrast to the second best (see Table 1), inflation is no longer zero, owing to the inability to commit to a tight monetary policy. The outcomes deviate from those in the second best also because debt accumulation differs from second-best accumulation if countries are heterogeneous. To clearly show the impact of heterogeneity, we write the solutions (see also Table 2) as the sum of a response to the cross-country average component, $\bar{F}$, of the intertemporal overall financing requirement and a response to its country-specific component, $\hat{F}_i$. Formally, $\bar{F} \equiv (1/n)\Sigma_{j=1}^{n} F_j$ and $\hat{F}_i \equiv F_i - \bar{F}$. In the sequel, any variable with an over bar denotes an average, and any variable with a hat denotes the country-specific component. Government i's debt, for example, can now be written as

$$d_{i1}^{\mathrm{D}} = \bar{d}_1^{\mathrm{D}} + \hat{d}_{i1}^{\mathrm{D}}, \tag{10}$$

where

$$\bar{d}_1^{\mathrm{D}} = \frac{[\bar{K}_1 + (1+\rho)\bar{d}_0 - \bar{K}_2] + (1-\beta^*)\bar{K}_2}{1 + \beta^*(1+\rho)}, \tag{11}$$

$$\hat{d}_{i1}^{\mathrm{D}} = \frac{[\hat{K}_{i1} + (1+\rho)\hat{d}_{i0} - \hat{K}_{i2}] + [1 - \beta^*(P^*/P)]\hat{K}_{i2}}{1 + \beta^*(1+\rho)(P^*/P)}, \tag{12}$$

9. The complete derivation of the equilibrium is contained in Appendix C.

TABLE 2

PURELY DISCRETIONARY POLICY OUTCOMES

First period	Second period
$\pi_1 = \left[\frac{1/\alpha_\pi}{S}\right]\beta^* c_0 \bar{F}$	$\pi_2 = \left[\frac{1/\alpha_\pi}{S}\right] c_0 \bar{F}$
$\frac{\tilde{x}_{i1} - x}{\nu} = \left[\frac{1/\nu^2}{S}\right]\beta^* c_0 \bar{F} + \left[\frac{1/\nu^2}{S}\right]\beta^*\left(\frac{P^*}{P}\right) c_1 \hat{F}_i$	$\frac{\tilde{x}_{i2} - x_{i2}}{\nu} = \left[\frac{1/\nu^2}{S}\right] c_0 \bar{F} + \left[\frac{1/\nu^2}{S}\right] c_1 \hat{F}_i$
$\tilde{g}_{i1} - g_{i1} = \left[\frac{1/\alpha_g}{S}\right]\beta^* c_0 \bar{F} + \left[\frac{1/\alpha_g}{S}\right]\beta^*\left(\frac{P^*}{P}\right) c_1 \hat{F}_i$	$\tilde{g}_{i2} - g_{i2} = \left[\frac{1/\alpha_g}{S}\right] c_0 \bar{F} + \left[\frac{1/\alpha_g}{S}\right] c_1 \hat{F}_i$
$\pi_1 - \mathrm{E}_0\pi_1 = 0$	$\pi_2 - \mathrm{E}_0\pi_2 = 0$

NOTES: $F \equiv (1/n)\Sigma_{j=1}^{n} F_j$ is the cross-country average overall financing requirement and $\hat{F}_i \equiv F_i - F$ is country i's specific component. Further, α_π is the relative weight of the inflation objective in Equations (3) and (7). Finally, $c_1 \equiv (1 + \rho)/[1 + \beta^*(1 + \rho)(P^*/P)]$, $P \equiv 1/\alpha_\pi + 1/\nu^2 + 1/\alpha_g$, and $P^* \equiv [(n - 1)/n](1/\alpha_\pi) + 1/\nu^2 + 1/\alpha_g$. For the other definitions, see Table 1.

and a superscript "D" is used to indicate that this is the purely discretionary solution and where

$$P \equiv 1/\alpha_\pi + 1/\nu^2 + 1/\alpha_g, \;\; P^* \equiv [(n - 1)/n]/\alpha_\pi + 1/\nu^2 + 1/\alpha_g \,. \tag{13}$$

While the debt response to the average components $\bar{K}_1$, $\bar{K}_2$, and $\bar{d}_0$ of the intertemporal overall financing requirement is the same as under the second best (so that $\bar{d}_1^{\mathrm{D}} = \bar{d}_1^{\mathrm{S}}$), the responses to the idiosyncratic components differ, as shown by a comparison between Equations (8) and (12). International heterogeneity, as captured by cross-country differences in the intertemporal overall financing requirement, gives rise to a conflict among the fiscal authorities about the preferred future monetary policy stance. The conflict induces governments to employ debt strategically in order to manipulate future monetary policy to their own advantage. As a result, $\hat{d}_{i1}^{\mathrm{D}}$ differs from $\hat{d}_{i1}^{\mathrm{S}}$. In particular, countries featuring a relatively large intertemporal overall financing requirement (i.e. $\hat{F}_i > 0$) accumulate excessive public debt (i.e. $\hat{d}_{i1}^{\mathrm{D}} > \hat{d}_{i1}^{\mathrm{S}}$). Countries featuring a relatively small intertemporal overall financing requirement (i.e. $\hat{F}_i < 0$), in contrast, do not accumulate enough public debt (i.e. $\hat{d}_{i1}^{\mathrm{D}} < \hat{d}_{i1}^{\mathrm{S}}$).[10]

The intuition for these results is as follows. Countries with a relatively large financing requirement $\hat{F}_i > 0$ need to raise relatively large tax revenues. Their governments realize that raising public debt to shift more of the tax burden to the second period benefits first-period employment, while the adverse impact on second-period employment is only limited, because the higher second-period tax rate induces the ECB to relax monetary policy in that period in order to protect employment (see Equation 9). Hence, these governments perceive a relatively large benefit from exploiting the predetermination (at the start of the first period) of second-period

10. These results follow formally by observing that $\partial \hat{d}_{i1}^{\mathrm{D}}/\partial n$ is positive (negative) if $\hat{F}_i < (>) 0$, while $\hat{d}_{i1}^{\mathrm{D}} \to \hat{d}_{i1}^{\mathrm{S}}$, as $n \to \infty$.

inflation expectations in this way and, therefore, strategically overaccumulate debt (compared to the second best). Through the same mechanism, governments of countries with $\hat{F}_i < 0$ strategically underaccumulate debt in order to encourage the ECB to reduce future inflation. Of course, the combined effect of the conflicting efforts of individual governments to influence the ECB is nil.

If the number of countries, n, increases, $\hat{d}_{i1}^{D}$ tends towards $\hat{d}_{i1}^{S}$. The reason is that, in a larger union, an individual country realizes that it can exert only a small influence on the common inflation rate (see Equation 9). The perceived benefits from using debt strategically are therefore small.

4. EX-ANTE AND EX-POST POLICY COORDINATION

This section explores reforms of monetary and fiscal institutions aimed at improving upon the purely discretionary equilibrium considered in the previous section. In particular, we consider inflation targets (π_1^* and π_2^*) and debt targets, which are determined prior to the setting of nominal wages at the beginning of the first period. These targets can be interpreted as an intermediate step between complete commitment to inflation and debt rules in Section 2 and pure discretion considered in Section 3. They are in fact contractual solutions allowing the policymakers to commit to particular contracts before the private sector takes its decisions. These contracts, which attempt to internalize policy spillovers, can be viewed as *ex-ante coordination* among policymakers.

Throughout this section, we assume that monetary policy is ex-ante coordinated by means of inflation targets. Indeed, various countries, such as the UK, Canada, and New Zealand, have adopted inflation targets. The ECB has announced a target range for inflation of 0–2% for the medium term. These arrangements strengthen the commitment of monetary authorities to not exploit nominal contracts concluded in the private sector. Countries typically find it harder to agree on constraints on fiscal policy than on monetary institutions. Indeed, negotiating the Stability and Growth Pact was considerably more difficult than agreeing on the appropriate design of the ECB. Moreover, the credibility of the Stability and Growth Pact cannot be taken for granted due to serious enforcement problems, especially in a monetary union between sovereign countries. In view of these considerations and our focus on fiscal policy, this section explores three alternative options for fiscal policy, namely (1) ex-ante coordination on the basis of debt targets; (2) ex-post coordination between the fiscal authorities; and (3) the absence of any fiscal coordination. Section 4.1 considers ex-post fiscal coordination, where fiscal authorities bargain about contracts after the private sector has formed expectations and incorporated these expectations into nominal wage contracts. This case clearly isolates the conflict between monetary and fiscal policy authorities. Indeed, ex-post fiscal coordination corresponds to the case of a single country with uncoordinated national fiscal and monetary policies. By abstracting from ex-post fiscal coordination, Section 4.2 explores the case of strategic interaction between one central bank and several

homogeneous decentralized fiscal authorities in a monetary union. Section 4.3 introduces conflicts between the various fiscal authorities by allowing for heterogeneous countries.

4.1 Ex-Post Fiscal Coordination by Homogeneous Countries

Under ex-post coordination, governments jointly select their full set of fiscal policies (tax rates, spending levels, and debt levels) in order to minimize an equally weighted average of the loss functions of the various societies or governments

$$V_U \equiv \frac{1}{n}\sum_{i=1}^{n} V_{S,i}\,, \tag{14}$$

taking private-sector inflation expectations as given. Public debt (see Appendix D for the derivation) is now given by

$$d_{i1}^{F} = \bar{d}_1^{S} - \left[\frac{\beta^*(S/P)}{1+\beta^*(1+\rho)}\right]\pi_2^*, \quad \forall i, \text{ where } S \equiv 1/\nu^2 + 1/\alpha_g\,, \tag{15}$$

where superscript "F" is used to denote ex-post coordination. A tight second-period inflation target (i.e. $\pi_2^* < 0$), which combats inflation, boosts debt accumulation compared to the second best. The reason is that such an inflation target creates a policy conflict between the monetary and the coordinated fiscal authorities, by reducing the preferred inflation rate of the ECB below that of the fiscal authorities. Intuitively, monetary policy is decided at an earlier stage (at the contracting stage via the inflation target) than is discretionary fiscal policy. This conflict between monetary and fiscal policy induces the fiscal authorities to raise public debt strategically.[11] In particular, higher future tax rates required to service a larger public debt reduce output and employment and, with inflation expectations given, encourage the ECB to relax monetary policy (see Equation 9).

In view of these strategic effects, inflation targets alone are not sufficient to ensure the second-best outcome. In order to avoid a debt bias, a tight inflation target needs to be complemented with a ceiling on the public debt. Intuitively, by providing some commitment to not only monetary policy (through credible inflation targets) but also fiscal policy (through credible debt ceilings), one coordinates monetary and fiscal policies by eliminating the conflict between the two. The following proposition (proven in Appendix E) states the sufficient institutional arrangements to reproduce the second best.

PROPOSITION 1: *Suppose that countries are homogeneous, so that* $K_{i1} = \bar{K}_1$, $K_{i2} = \bar{K}_2$, *and* $d_{i0} = \bar{d}_0$, $\forall i$. *The inflation targets*

11. This conflict occurs also in a single country with uncoordinated national monetary and fiscal authorities. Indeed, ex-post coordination can be interpreted as a monetary authority interacting with a single fiscal authority.

$$\pi_1^{*,\text{opt}} = -\left[\frac{1/\alpha_\pi}{S}\right][\bar{K}_1 + (1+\rho)\bar{d}_0 - \bar{d}_1^S]$$
$$= -\left[\frac{1/\alpha_\pi}{S}\right]\left[\frac{\beta^*(1+\rho)}{1+\beta^*(1+\rho)}\right]\bar{F}, \tag{16}$$

$$\pi_2^{*,\text{opt}} = -\left[\frac{1/\alpha_\pi}{S}\right][\bar{K}_2 + (1+\rho)\bar{d}_1^S] = -\left[\frac{1/\alpha_\pi}{S}\right]\left[\frac{1+\rho}{1+\beta^*(1+\rho)}\right]\bar{F}, \tag{17}$$

combined with a uniform (across countries) debt target $d_{i1}^T = \bar{d}_1^S$, $\forall i$, *ensure that the discretionary equilibrium coincides with the second-best equilibrium.*

Here, and in the sequel, we use a superscript "T " to denote a debt target, which should be hit exactly (but effectively acts as a debt ceiling here). The inflation targets (Equations 16 and 17) ensure that, for given debt policy, the *intra*temporal trade-off among the instruments is optimal. The targets are negative, which may seem unrealistic in the light of actual inflation-targeting experience. The negative targets are the result of our assumption that society's bliss point for inflation is zero. If society's bliss point for inflation is positive, then also the optimal inflation targets can be positive. Moreover, in practice inflation targets are imposed on measured inflation, which tends to exceed actual inflation because it does not properly account for quality improvements of products. Hence, a positive target for measured inflation may correspond to negative actual inflation. In any case, what matters here are the qualitative properties of the optimal inflation targets (Equations 16 and 17). In particular, they eliminate inflation (i.e. $E_0\pi_1 = E_0\pi_2 = 0$). The inflation targets are proportional to the average intertemporal overall financing requirement, $\bar{F}$. A larger value for $\bar{F}$ requires a tighter inflation target to guarantee price stability.

As argued above, debt ceilings are difficult to implement in practice. In the absence of such ceilings, the additional debt accumulation produced by a tight second-period inflation target ($\pi_2^* < 0$—see Equation 15) raises the overall financing requirement in the second period. In order to offset the resulting inflation in the second period, the second-period inflation target has to be tighter than the corresponding inflation target in the presence of optimal debt targets. The optimal inflation target, however, does not completely eliminate second-period inflation (due to more debt accumulation). Marginally relaxing an inflation target that completely eliminates inflation produces a first-order gain in welfare on account of a reduced debt bias. At the same time, it produces only a second-order loss of welfare on account of an emerging inflation bias. The following proposition (proven in Appendix F) makes this precise:

Proposition 2: *Assume homogeneous countries and ex-post fiscal coordination. In the absence of debt targets, the combination of first- and second-period inflation targets that minimizes Equation (14) is, respectively,* $\pi_1^{**} = -[(1/\alpha_\pi)/S][\bar{K}_1 + (1+\rho)\bar{d}_0 - \bar{d}_1^{**}]$ *and* π_2^{**}. *Here,* π_2^{**} *lies between* π_2^{***} *and* $\pi_2^{*,\text{opt}}$ *(Equation 17), where* π_2^{***} $(< \pi_2^{*,\text{opt}})$ *is the second-period inflation target*

that completely eliminates second-period inflation in the absence of debt targets. Finally, $\bar{d}_1^{**}$ *is the right-hand side of Equation (15) obtained after substituting* π_2^{**} *for* π_2^*.

With optimal inflation targets being the only ex-ante arrangement, the second best is not attained. The first-period inflation target, which completely eliminates the first-period inflation bias, needs to be less tight than in the presence of optimal debt targets. The reason is that public debt is higher so that the first-period overall financing requirement (which determines first-period inflation) is lower.

4.2 Homogeneous Countries with Decentralized Fiscal Policies

In this section, fiscal authorities no longer engage in ex-post fiscal coordination, but countries are still homogeneous (i.e. $K_{i1} = \bar{K}_1$, $K_{i2} = \bar{K}_2$, and $d_{i0} = \bar{d}_0$, $\forall i$) so that international fiscal conflicts are absent. Without fiscal coordination, public debt policy is given by

$$\bar{d}_1 = \bar{d}_1^S - \frac{1}{n}\left[\frac{\beta^*(S/P)}{1 + \beta^*(1 + \rho)}\right]\pi_2^*. \tag{18}$$

Decentralization of fiscal policymaking weakens the fiscal authorities in their strategic conflict with the ECB about future monetary policy. Hence, unless $n = 1$ (in which case the solution coincides with that under ex-post fiscal coordination), a tight inflation target ($\pi_2^* < 0$) gives rise to less additional strategic debt accumulation than under ex-post fiscal coordination (compare Equation 18 for $n > 1$ with Equation 15). In the absence of ex-post fiscal coordination, fiscal authorities realize that an individual country boosting public debt exerts only a $1/n$-effect on the common monetary policy. This weakens the incentive to raise public debt when a tight inflation target is imposed. Although strategic debt accumulation is reduced compared to the case with ex-post fiscal coordination, the following proposition (proven in Appendix E) states that the same debt targets are still required to complement tight inflation targets in reproducing the second best.

PROPOSITION 3: *Assume homogeneous countries and decentralized fiscal policymaking. Then, imposing the set of inflation targets (Equations 16 and 17) and the set of uniform debt targets* $d_{i1}^T = \bar{d}_1^S$, $\forall i$, *ensures that the discretionary equilibrium coincides with the second-best equilibrium.*

In the realistic case that ex-ante fiscal coordination through debt targets is not feasible, ex-post fiscal coordination is counterproductive. The reason is that the fiscal authorities internalize the mutually beneficial externalities of increasing their debt. This intensifies the conflict between the ECB and the fiscal authorities as a group. Finally, it is easy to show that, without any form of fiscal coordination (ex-ante or ex-post), the optimal inflation targets are given by Proposition 2, where $\bar{d}_1^{**}$ is now the right-hand side of Equation (18) obtained after substituting π_2^{**} for π_2^*.[12]

12. Since π_2^{**} and π_2^{***} depend on n, they differ from their values under ex-post fiscal coordination.

4.3 Heterogeneous Countries with Decentralized Fiscal Policies

If countries are heterogeneous, institutional constraints must not only combat inflation but also address wasteful strategic debt policies due to conflicting views of the various governments about the proper stance of monetary policy. The optimal inflation targets again eliminate inflation (i.e. $E_0\pi_1 = E_0\pi_2 = 0$) and coincide with the targets in the previous two cases. Optimal debt targets must prevent the strategic debt accumulation that arises not only from the conflict between the ECB and the fiscal authorities about the preferred inflation rate but also from the conflict between the various fiscal authorities themselves, as described in Section 3. In order to resolve this latter conflict, the debt targets have to be country specific. Hence, the optimal debt targets must be richer than in the case of homogeneous countries. The following proposition (the proof of which is very similar to that of Proposition 1) makes this precise:

PROPOSITION 4: *Assume decentralized fiscal policy making with heterogeneous countries. The set of inflation targets (Equations 16 and 17) combined with a set of country-specific debt targets* $d_{i1}^{T} = \bar{d}_1^{S}, \forall i$, *given by Equation (8) ensure that the discretionary equilibrium coincides with the second-best equilibrium.*

If debt targets are not practical, debt policy is given by

$$d_{i1} = \left[\bar{d}_1^{S} - \frac{1}{n}\left(\frac{\beta^*(S/P)}{1 + \beta^*(1 + \rho)}\right)\pi_2^*\right] + \hat{d}_{i1}^{D}, \tag{19}$$

while ex-post fiscal coordination among the heterogeneous governments results in

$$d_{i1}^{F} = \left[\bar{d}_1^{S} - \left(\frac{\beta^*(S/P)}{1 + \beta^*(1 + \rho)}\right)\pi_2^*\right] + \hat{d}_{i1}^{S}. \tag{20}$$

Ex-post fiscal coordination eliminates the strategic debt accumulation due to international conflicts between the fiscal authorities about the common monetary policy. The country-specific debt component therefore coincides with its second-best counterpart, as shown by the last term of Equation (20). In assessing the desirability of the ex-post coordination of fiscal policies, this beneficial effect needs to be traded off against the more intense strategic conflict between the ECB and the fiscal authorities as a group, which is reflected in the absence of the $1/n$ term in front of the term in round brackets at the right-hand side of Equation (20). Hence, ex-post coordination is harmful if this conflict is especially serious compared to the international conflict among the various fiscal policymakers. This is the case if the inflation target π_2^* is tight due to a large cross-country average of the intertemporal overall financing requirements on account of serious structural distortions, while at the same time international differences in the intertemporal overall financing requirement are only small (so that the terms $\hat{d}_{i1}^{D}$ and $\hat{d}_{i1}^{S}$ are small in absolute value).

As before, in the absence of any form of fiscal coordination, the optimal inflation targets are given by Proposition 2, where $\bar{d}_1^{**}$ is now the term in square brackets

on the right-hand side of Equation (19) obtained after substituting (the new—see Note 12—value of) π_2^{**} for π_2^*. The optimal second-period inflation target is a compromise, because with heterogeneity, countries differ in their preferred second-period inflation target. In particular, a country i featuring relatively severe structural distortions (i.e. $\hat{F}_i > 0$) prefers a relatively lax second-period inflation target (i.e. it prefers $\pi_2^* > \pi_2^{**}$). The reason is that in the presence of such a lax inflation target the country does not have to engage in costly strategic debt accumulation to encourage the ECB to raise second-period inflation. The opposite holds true for a country i with relatively minor structural distortions ($\hat{F}_i < 0$). It prefers a relatively tight target so that it does not need to strategically underaccumulate debt.

5. CONCLUSION

This paper has explored the scope for policy coordination in the EMU. Wasteful strategic debt policy may arise from conflicts about the preferred stance of monetary policy both between the ECB and the fiscal authorities and between heterogeneous fiscal authorities themselves. How severe these conflicts are depends crucially on monetary institutions and structural distortions. The conflict between the ECB and the fiscal authorities is especially harmful if labor-market rigidities and high distortionary taxes give rise to widespread unemployment, if the ECB pursues tight monetary policies aimed at price stability, and if nominal contracts and fiscal policies are set at different points in time. The conflicts between the various decentralized governments are most serious if countries are heterogeneous in terms of labor-market distortions and public spending. Also, here the fact that nominal contracts and fiscal policy are set at different points in time is crucial. In these circumstances, governments employ their debt policies to exploit the inflation expectations incorporated in nominal contracts.

Strategic debt accumulation can be alleviated in various complementary ways. Of course, one option is to pursue structural policies aimed at cutting high equilibrium unemployment. However, in terms of political feasibility, this option is also most difficult to implement and, therefore, has not been explored in the preceding analysis. Another way to avoid strategic debt accumulation is ex-ante policy coordination among all policy authorities. In particular, commitment to contracts in the form of inflation targets for the ECB and debt targets for the fiscal authorities can eliminate strategic debt policy altogether. Partial ex-ante coordination combined with partial ex-post coordination, however, may be undesirable. In particular, if only the ECB is committed to an ex-ante contract in the form of an inflation target, ex-post coordination among fiscal authorities may be harmful because it exacerbates the conflict between the ECB and the fiscal authorities about the proper stance of monetary policy. From time to time, it is suggested to strengthen the Euro Group as a vehicle for the ex-post coordination of fiscal policies and to act as a political counterweight to the ECB. In the light of our results this may be undesirable, especially if structural unemployment in Europe remains high, nominal wage contracts are rigid, and enforcement of the Stability and Growth Pact remains in doubt.

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