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STRUCTURAL DISTORTIONS AND DECENTRALIZED FISCAL POLICIES IN EMU

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Abstract

The combination of discretionary monetary policy, labor-market distortions and nominal wage rigidity yields an inflation bias as monetary policy tries to exploit nominal wage contracts to address labour-market distortions Although an inflation target eliminates this inflation bias, it creates a conflict between monetary policy and discretionary fiscal policy if fiscal policy is set at a higher frequency than nominal wages are. To avoid the associated excessive accumulation of public debt, ceilings on public debt are called for. If countries differ substantially in terms of structural distortions or economic shocks, uniform debt ceilings must be complemented by country-specific debt targets in order to prevent decentralised fiscal authorities from employing debt policy strategically.

JEL Classification: E52, E58, E61, E62.

Keywords: Discretionary monetary policy, wage rigidity, decentralized fiscal policy, monetary union, inflation targets, debt targets.

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1. Introduction

The advent of the European Monetary Union (EMU) has given rise to a lively debate about the appropriate relationship between centralized monetary policy on the one hand and decentralized fiscal and structural policies on the other hand. 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 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 clarifies the constraints on fiscal policy once countries have entered the EMU and specifies sanctions in case these constraints are violated. Finally, the Euro Group (previously called "Euro-11") Council has been set up, in which the finance ministers of the EMU countries informally discusses matters pertaining to fiscal policy on an ongoing basis. Especially France 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).

The starting point of our analysis is that the ECB is not completely immune to pressures to relax 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. In particular governments of countries lacking a tradition of monetary and financial discipline may find ways to influence decisions of the ECB. 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). The vulnerability of the ECB to these pressures provides a rationale for constraints on fiscal policy. In an ideal, but unrealistic, world in which the ECB would be completely committed to price stability, such constraints would not be needed. The constraints on fiscal policy in the Stability and Growth Pact can thus be viewed as a second lock (in addition to the lock of statutory independence) protecting the commitment of the ECB to price stability. However, not only fiscal policy but also structural policies may worsen the commitment problems facing the ECB as high unemployment intensifies pressures on the ECB to relax monetary policy. This is especially important in the European context where serious labor-market distortions give rise to high unemployment rates in several EMU countries.

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 macro-economic policymaking: first, discretion in monetary policymaking, second, discretion in fiscal policymaking and, third, spillovers between decentralized fiscal policies within the union. Lack of monetary policy commitment interacts with nominal wage rigidity and labor-market distortions to yield the familiar "inflation bias" (see Barro and Gordon, 1983, and many subsequent papers, for example Rogoff (1985b), Persson and Tabellini (1993), Walsh (1995) and, most recently, Dixit and Lambertini (2000)): the monetary policymaker engages in (in equilibrium futile) attempts to reduce the real value of nominally fixed wages in order to reduce unemployment below the excessive equilibrium rate. Accordingly, monetary policy is used as an instrument to address the labor-market distortions that push equilibrium employment below the first-best employment level.

Also fiscal policy suffers from time inconsistency if it can be adjusted more frequently than nominal wage contracts. This is indeed the case in many European economies. Fiscal policy is usually decided at a yearly frequency, while wage bargaining often occurs at intervals of more than a year (e.g., Layard et al., 1991; see also Table 1 for a more recent overview). Therefore, in contrast to much of the related literature, this paper assumes that nominal wages and, hence, also inflation expectations are determined for two periods ahead. Fiscal policy can still be adjusted in each period and thus can be adapted more frequently than nominal wage contracts. Just as discretionary monetary policy, discretionary public debt policy thus 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. Another reason why countries differ in their views about monetary policy is that they are hit by different shocks. In that case, the diverging gaps between actual and equilibrium unemployment rates result in conflicts about the common monetary policy. These conflicts among decentralized fiscal authorities yield wasteful strategic interaction in the form of strategic debt accumulation. In particular, countries suffering from serious structural labor-market distortions or adverse shocks accumulate additional public debt in order to encourage the common central bank to relax discretionary monetary policy. Countries featuring only minor structural distortions or enjoying beneficial shocks, in contrast, strategically underaccumulate debt. In the aggregate, these strategic effects cancel out. Accordingly, 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. We focus on inflation targets and debt targets, which are set before the private sector signs nominal wage contracts. These contractual arrangements can be enforced and are thus credible.[1] They thus strengthen the commitment of monetary and fiscal policymakers to not exploit nominal wage contracts in the private sector and to not impose adverse externalities on other policymakers. A tight inflation target, for example, helps to eliminate the inflation bias by making the commitment of the ECB to price stability more credible. At the same time, however, it 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 raise inflation. A ceiling on public debt can resolve this policy conflict. Intuitively, a central bank pursuing tight monetary policies needs to be complemented by tight fiscal policy in order to avoid wasteful conflicts between monetary and fiscal policies. Hence, institutions should strengthen the commitment of not only monetary policy but also fiscal policy. 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.

[1] In practice, enforcement is a contentious issue. In particular, the commitment of countries to the Stability and Growth Pact is often called into question because it is not clear whether the enforcement of this pact is credible.

What is the scope for ex-post fiscal policy coordination, i.e. coordinating fiscal policy *after* nominal wage contracts have been signed?[2] In the absence of inflation targets, ex-post coordination among the fiscal authorities is helpful because it resolves the conflict among the heterogeneous fiscal authorities about the stance of the common monetary policy. In the presence of an inflation target, in contrast, ex-post coordination of fiscal policy may harm welfare, especially if countries are rather homogeneous so that international spillovers are only small. Whereas fiscal coordination resolves the conflict among the heterogenous fiscal authorities, it 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. Indeed, the ECB may rightfully 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 is in doubt. Ex-post coordination of fiscal policy being counterproductive is a typical second-best result: coordination by only a subgroup of players worsens the time-inconsistency problems due to a lack of commitment in fiscal policy.[3]

The remainder of this paper is as follows. Section 2 presents the model. Section 3 explores the second best, which emerges if all policymakers can commit to shock-contingent policy rules. Section 4 analyses the solution under two-period ahead wage setting if policymakers cannot commit and inflation targets and debt targets are absent. Section 5 investigates the role of inflation targets and debt targets as optimal institutional arrangements to strengthen commitment. After Section 6 explores ex-post fiscal coordination, Section 7 concludes the main body of the paper. Finally, the derivations are contained in an appendix which is available upon request.

[2] 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.

[3] A related result showing that coordination among a subset of players can be counterproductive is obtained by Rogoff (1985a). He finds that monetary policy coordination may be counterproductive, because it worsens the credibility problem of central banks vis-à-vis the private sector.

2. The model

The European monetary union (EMU), which is small relative to the rest of the world, is formed by n countries.[4] The European Central Bank (ECB) sets monetary policy for the entire union. There are two periods.

Nominal wage setting takes place as follows. Workers are represented by trade unions who aim for some target real wage rate in each period (e.g. see Alesina and Tabellini, 1987 and Jensen, 1994). For the first period, they set nominal wages 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. This yields $w_1 = \mathrm{E}_0 (p_1)$ so that $w_1 - p_1 = -(\pi_1 - \mathrm{E}_0 \pi_1)$, where π_1 is first-period 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, a share θ of the second-period nominal wages is indexed for inflation incurred over the first period, while a share $1-\theta$ is not indexed. Therefore, the average nominal wage rate in the second period is $w_2 = (1-\theta)\mathrm{E}_0 (p_2) + \theta [p_1 + \mathrm{E}_0 (p_2 - p_1)]$ and, hence, after rewriting, $w_2 - p_2 = -(\pi_2 - \mathrm{E}_0 \pi_2) - (1-\theta)(\pi_1 - \mathrm{E}_0 \pi_1)$. Hence, unless indexation is complete (i.e. $\theta = 1$), higher first-period inflation erodes real wages in *both* periods. However, with complete indexation, the second-period real wage is unaffected by first-period inflation.

Firms face a standard production function exhibiting decreasing returns to scale in labor. Revenues in period t are taxed at a rate τ_{it}. It is straightforward to show that output in country i in periods 1 and 2, respectively, amounts to

$$x_{i1} = \nu (p_1 - w_1 - \tau_{i1}) - \mu - \epsilon_i = \nu (\pi_1 - \mathrm{E}_0 \pi_1 - \tau_{i1}) - \mu - \epsilon_i, \tag{2.1}$$
$$x_{i2} = \nu (p_2 - w_2 - \tau_{i2}) = \nu (\pi_2 - \mathrm{E}_0 \pi_2 - \tau_{i2}) + (1-\theta) \nu (\pi_1 - \mathrm{E}_0 \pi_1), \tag{2.2}$$

where μ represents a common union-wide shock and ϵ_i stands for an idiosyncratic shock that solely hits country i. We assume that $\mathrm{E}[\epsilon_i] = 0, \forall i$; $\mathrm{E}[\mu] = 0$; $\mathrm{E}[\mu \epsilon_i] = 0, \forall i$ and that $\bar{\epsilon} \equiv \frac{1}{n} \sum_{i=1}^{n} \epsilon_i = 0$.[5] The variances of μ and ϵ_i are given by σ_μ^2 and σ_ϵ^2, respectively. We do not allow for shocks in the second period because such

[4] Monetary unification is taken as given. Hence, we do not explore the incentives to join or form a monetary union. However, in order to strengthen the intuition behind our results, we will occasionally explore what happens if the number of union participants becomes infinitely large (i.e., $n \to \infty$).

[5] Without this assumption, the mean $\bar{\epsilon}$ of the ϵ's would play the same role as μ does. In the outcomes given below, μ would then be replaced by $\hat{\mu} \equiv \mu + \bar{\epsilon}$. For convenience, and without any consequences for our results, we assume that $\bar{\epsilon} = 0$.

shocks would not affect debt accumulation and thus would be uninteresting for our purposes. Even in the absence of second-period shocks, the ensuing analysis reveals that π_2 generally differs from $E_0\pi_2$ so that inflation surprises occur in the second period. This is because public debt policy spreads the effects of first-period shocks over both periods, while the expectation of second-period inflation is formed before first-period shocks materialize.

Indexation allows for more complete private contracts that can be made contingent on outcomes in the first period and, hence, reduce nominal wage rigidity. The conventional wisdom is that U.S. wages are rigid in nominal terms, while European wages are rigid in real terms (e.g., Bruno and Sachs, 1985; see also Table 1, which shows that nominal wage contracts in the U.S. last longer than in most European countries, while indexation of nominal wage contracts for price rises is more common in Europe). In the current modelling setup, the U.S. situation corresponds more closely to $\theta = 0$, while the European situation corresponds to $\theta = 1$. Therefore, we assume from now on that $\theta = 1$. This implies that European wages are still nominally rigid, but less so than U.S. wages. In other words, Europe features a mixture of nominal and real wage rigidity.[6] With $\theta = 1$, first-period inflation no longer affects second-period output, as (2.2) makes clear.

Each country features a social welfare function which is shared by the government of that country. In particular, the loss function of government i is defined over inflation, output and public spending:

$$V_{S,i} = \tfrac{1}{2}\sum_{t=1}^{2}\beta^{t-1}\left[\alpha_\pi\pi_t^2 + (x_{it} - \tilde{x}_{it})^2 + \alpha_g\left(g_{it} - \tilde{g}_{it}\right)^2\right], 0 < \beta \leq 1,\ \alpha_\pi, \alpha_g > 0. \tag{2.3}$$

Welfare losses increase in the deviations of inflation, (log) output and government spending (g_{it} is government spending as a share of output in the absence of distortions) 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

[6] 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.

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. Finally, β denotes society's subjective discount factor.

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

$$g_{it} + (1+\rho)\, d_{i,t-1} = \tau_{it} + d_{it}, \tag{2.4}$$

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. 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.[7]

We combine (2.4) with the expression for output, (2.1) or (2.2), to eliminate τ_{it}. The resulting equations can be rewritten to yield the *government financing requirements* (GFR):

$$\begin{aligned} GFR_{i1} &\equiv K_{i1} + (1+\rho)\, d_{i0} - d_{i1} + (\mu + \epsilon_i)/\nu \\ &= [(\tilde{x}_{i1} - x_{i1})/\nu] + (\tilde{g}_{i1} - g_{i1}) + (\pi_1 - \mathrm{E}_0\pi_1), \end{aligned} \tag{2.5}$$

$$\begin{aligned} GFR_{i2} &\equiv K_{i2} + (1+\rho)\, d_{i1} - d_{i2} \\ &= [(\tilde{x}_{i2} - x_{i2})/\nu] + (\tilde{g}_{i2} - g_{i2}) + (\pi_2 - \mathrm{E}_0\pi_2), \end{aligned} \tag{2.6}$$

where

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

will be referred to as *(total) structural distortions* in period t. The government financing requirement, GFR_{it}, consists of three components (see the first right-hand sides of (2.5) and (2.6)). The first component, K_{it}, amounts to the government spending target, $\tilde{g}_{it}$, and an output subsidy aimed at offsetting the implicit output

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

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 final component (in the first period only) is the stochastic shock (scaled by ν), $(\mu + \epsilon_i)/\nu$. The last right-hand sides of (2.5) and (2.6) represent 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 ($d_{i2} = 0, i = 1,..,n$). Under this assumption, while taking the discounted (to period one) sums of the left- and right-hand sides of (2.5) and (2.6) ($t = 1, 2$), we obtain the *intertemporal government financing requirement (*IGFR):

$$
\begin{aligned}
IGFR_i &\equiv F_i + \frac{\mu + \epsilon_i}{\nu} \\
&= \sum_{t=1}^{2} (1+\rho)^{-(t-1)} \left[(\tilde{x}_{it} - x_{it})/\nu + (\tilde{g}_{it} - g_{it}) + (\pi_t - \mathrm{E}_0\pi_t) \right], \qquad (2.7)
\end{aligned}
$$

where

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

stands for the deterministic component of the intertemporal government 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 maximize the following loss function:

$$
V_{ECB} = \tfrac{1}{2} \sum_{t=1}^{2} \beta^{t-1} \left[\alpha_\pi (\pi_t - \pi_t^*)^2 + \tfrac{1}{n} \sum_{i=1}^{n} (x_{it} - \tilde{x}_{it})^2 \right], \qquad (2.8)
$$

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 outcomes would be completely unaltered if we included government spending in the ECB's loss function (2.8). For convenience, and also because it seems more realistic, we do not include government spending in (2.8).

3. 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 to shock-contingent rules. The precise timing is as follows. First, at the start of the first period, the ECB commits to a shock-contingent inflation rule *for both periods ahead*. At the same moment, a set of shock-contingent debt rules is determined. These rules (which are country-specific because of the presence of idiosyncratic shocks) eliminate the commitment problem facing fiscal policy described in the Introduction and internalize international spillovers. Second, nominal wage contracts are set for both periods. Third, the shocks materialize. Fourth, first-period inflation is determined according to the inflation rule of the ECB, while fiscal policy is implemented according to the adopted debt rules. Then, at the start of the second period, the nominal wage is updated for inflation incurred in the first period. Finally, the second-period policy variables are determined, again taking into account the rules adopted at the start of the game. Although the second-period nominal wage is indexed for inflation incurred during the first period (recall that $\theta = 1$), second-period inflation expectations are *not* updated at the start of the second period. Hence, second-period inflation expectations do not adjust to the shock in the first period and, hence, the second-period real wage may deviate from its original target.

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 is contained in Appendix A.

3.1. Inflation, the output shortfall and the public spending shortfall

Table 2 contains the outcomes for inflation, the output shortfall,[8] $\tilde{x}_{it} - x_{it}$, and the spending shortfall, $\tilde{g}_{it} - g_{it}$. We write each of these outcomes as the sum of two deterministic and two stochastic components. F_i^{Δ} denotes country i's deterministic component of its intertemporal government financing requirement in deviation from the cross-country average of this component, defined by $\bar{F}$. Formally, $\bar{F} \equiv \frac{1}{n}\sum_{j=1}^{n} F_j$ and $F_i^{\Delta} \equiv F_i - \bar{F}$. The factor between square brackets in each of the entries of Table 2 makes clear how, *within* a given period, the intertemporal government financing requirement is distributed over the financing

[8] 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.

sources (the output shortfall, the spending shortfall and an inflation surprise). Indeed, for each period these factors add up to unity, both across the deterministic and across the stochastic components:

$$GFR_{i1} = [(\tilde{x}_{i1} - x_{i1})/\nu] + (\tilde{g}_{i1} - g_{i1}) + (\pi_1 - \mathrm{E}_0\pi_1) = \left[\tfrac{\beta^*(1+\rho)}{1+\beta^*(1+\rho)}\right] IGFR_i, \quad (3.1)$$

and

$$GFR_{i2} = [(\tilde{x}_{i2} - x_{i2})/\nu] + (\tilde{g}_{i2} - g_{i2}) + (\pi_2 - \mathrm{E}_0\pi_2) = \left[\tfrac{1+\rho}{1+\beta^*(1+\rho)}\right] IGFR_i, \quad (3.2)$$

The intratemporal allocation over the financing sources is the same for three components of $IGFR_i$ ($\bar{F}$, F_i^{Δ} and $\frac{\epsilon_i}{\nu}$), but not for $\frac{\mu}{\nu}$ (compare the third column of Table 2, i.e. under the heading "γ_1", with the second, fourth and fifth columns of Table 2). In particular, the *intra*temporal allocation of $\frac{\mu}{\nu}$ differs from that of $\bar{F}$. The intuition is as follows. The deterministic components of the intertemporal government financing requirement are anticipated and thus correctly incorporated in expected inflation. The common shock, in contrast, is unanticipated and, hence, not taken into account when inflation expectations are formed. The predetermination of the inflation expectation is exploited by the policymakers by financing part of this common shock through an inflation surprise. Indeed, whereas the coefficients of $\pi_1 - \mathrm{E}_0\pi_1$ and $\pi_2 - \mathrm{E}_0\pi_2$ are zero in the second column in Table 2, these coefficients are positive in the third column, indicating that part of the common shock is financed through an inflation surprise. With surprise inflation absorbing part of the common shock, the output shortfall and the spending shortfall finance a smaller share of this shock.

3.2. Public debt policy

For each of the outcomes presented in Table 2, the terms that follow the factor in square brackets regulate the *inter*temporal allocation of the different components ($\bar{F}$, F_i^{Δ}, $\frac{\mu}{\nu}$ and $\frac{\epsilon_i}{\nu}$) of the intertemporal government financing requirement. The intertemporal distribution is the same for each of these components: the first-period financing sources together absorb a share $\frac{\beta^*(1+\rho)}{1+\beta^*(1+\rho)}$ of each intertemporal component, while the second-period financing sources together absorb a share (discounted to the first period) $\frac{1}{1+\beta^*(1+\rho)}$ of each intertemporal component.

The solution for debt accumulation in the second-best equilibrium can be written as:

$$d_{i1}^S = \mathrm{E}_0\left(\bar{d}_1^S\right) + \bar{d}_1^{d,S} + \mathrm{E}_0\left(d_{i1}^{\Delta,S}\right) + d_{i1}^{\delta,S}, \quad (3.3)$$

where

$$\mathrm{E}_0\left(\bar{d}_1^S\right) = \frac{\left[\bar{K}_1 + (1+\rho)\,\bar{d}_0 - \bar{K}_2\right] + (1-\beta^*)\,\bar{K}_2}{1+\beta^*(1+\rho)}, \tag{3.4}$$

$$\bar{d}_1^{d,S} = \left[\frac{1}{1+\beta^*(1+\rho)}\right]\frac{\mu}{\nu}, \tag{3.5}$$

$$\mathrm{E}_0\left(d_{i1}^{\Delta,S}\right) = \frac{\left[K_{i1}^{\Delta} + (1+\rho)\,d_{i0}^{\Delta} - K_{i2}^{\Delta}\right] + (1-\beta^*)\,K_{i2}^{\Delta}}{1+\beta^*(1+\rho)},\ n>1, \tag{3.6}$$
$$= 0,\ n=1,$$

$$d_{i1}^{\delta,S} = \left[\frac{1}{1+\beta^*(1+\rho)}\right]\frac{\epsilon_i}{\nu},\ n>1, \tag{3.7}$$
$$= 0,\ n=1,$$

where the superscript "S" stands for "second-best equilibrium", an upperbar above a variable indicates its cross-country average, a superscript "d" denotes the response to a common shock, a superscript "Δ" denotes an idiosyncratic deviation of a deterministic variable from its cross-country average (for example, $K_{i1}^{\Delta} \equiv K_{i1} - \bar{K}_1$), and a superscript "$\delta$" indicates the response to an idiosyncratic shock. Furthermore,

$$\beta^* \equiv \beta(1+\rho). \tag{3.8}$$

Hence, optimal debt accumulation (3.3) is the sum of two deterministic components and two stochastic components. The component $\mathrm{E}_0\left(\bar{d}_1^S\right)$ optimally distributes over time the cross-country averages of the deterministic components of the government financing requirements. Therefore, it is common across countries. The common (across countries) component $\bar{d}_1^{d,S}$ represents the optimal debt response to the common shock μ. The country-specific components $\mathrm{E}_0\left(d_{i1}^{\Delta,S}\right)$ intertemporally distribute the idiosyncratic deterministic components of the government financing requirements, while $d_{i1}^{\delta,S}$ stands for the optimal debt response to the country-specific shock, ϵ_i. If $\beta^* = 1$ (i.e. if the real interest rate equals the rate of time preference), the effects of all distortions and all shocks on the outcomes for inflation and the output and spending shortfalls are perfectly smoothed over the two periods, while, if $\beta^* > 1$, a larger part of the distortions and the shocks is absorbed in the first period.

3.3. Expected welfare loss

Society's (and the fiscal authority's) expected welfare loss amounts to:

$$\mathrm{E}_0\left[V_{S,i}\right]=\left[\frac{\beta^*\left(1+\rho\right)}{1+\beta^*\left(1+\rho\right)}\right]\left[\frac{1}{2S}F_i^2+\frac{S}{2P^2}\frac{\sigma_\mu^2}{\nu^2}+\frac{1}{2S}\frac{\sigma_\epsilon^2}{\nu^2}\right], \tag{3.9}$$

where

$$\begin{aligned} S &\equiv 1/\nu^2+1/\alpha_g, \\ P &\equiv 1/\alpha_\pi+1/\nu^2+1/\alpha_g. \end{aligned} \tag{3.10}$$

The expected welfare loss is composed of three components: one associated with the deterministic component of the intertemporal government financing requirement, F_i, one associated with the common shock and one associated with the idiosyncratic shock. While the term in the first pair of square brackets on the right-hand side of (3.9) follows from the optimal *inter*temporal distribution of the welfare losses, the coefficients directly in front of F_i^2, $\frac{\sigma_\mu^2}{\nu^2}$ and $\frac{\sigma_\epsilon^2}{\nu^2}$ arise from the optimal *intra*temporal distribution of the deviations of inflation, output and spending from their first-best levels. Since inflation surprises absorb part of the common shock, the coefficient of $\frac{\sigma_\mu^2}{\nu^2}$ is smaller than the coefficient of F_i^2 and $\frac{\sigma_\epsilon^2}{\nu^2}$.

4. 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 targets.[9] In contrast to the previous section, therefore, policymakers are no longer able to commit to a rule.

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. Subsequently, the shocks occur. After this, 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 inflation incurred over the first period. Finally, second-period monetary and fiscal policy instruments are chosen, where each policymaker takes the other players' policy decisions, as well as expectations, as given. In other words, within each period, policymakers are involved in

[9] In much of the literature on fiscal-monetary policy interactions, only monetary policy is discretionary (e.g. Alesina and Tabellini, 1986). Exceptions are, for example, Bryson et al. (1993), Agell et al. (1996), Begg (2000) and Debrun (2000).

a Nash game. However, because they move earlier, first-period governments act as Stackelberg leaders against the second-period policymakers, thereby exploiting their reaction functions. This gives rise to strategic effects. 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:

$$\pi_2 = \left[\frac{\alpha_\pi}{\alpha_\pi + \nu^2}\right]\pi_2^* + \left[\frac{\nu^2}{\alpha_\pi + \nu^2}\right]\left[\pi_2^e + \tfrac{1}{n}\sum_{i=1}^{n}\left(\tau_{i2} + \tilde{x}_{i2}/\nu\right)\right], \tag{4.1}$$

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 in the size of the union. Intuitively, the larger a monetary union becomes, the weaker becomes the strategic position of each individual fiscal player vis-à-vis the ECB.

4.1. Inflation, the output shortfall and the public spending shortfall

Table 3 contains the solutions for the inflation rate, the output shortfall and the spending shortfall.[10] The main difference compared to the outcomes under the second-best equilibrium (see Table 2) is that inflation expectations are higher (compare the term in the second column and the second row of Table 3 with the corresponding term in Table 2). The source of the higher expected inflation rate under pure discretion is the inability to commit to a tight monetary policy, which yields the familiar inflation bias.

The outcomes for the output shortfall and the spending shortfall deviate from the outcomes under the second-best equilibrium also because debt accumulation under pure discretion differs from debt accumulation under the second best if countries are heterogeneous. These differences give rise to conflicts between the fiscal authorities about the preferred future monetary policy which induce these authorities to use debt policy strategically to move future monetary policy to their own advantage. This is discussed in more detail below.

[10] The complete derivation of the equilibrium is contained in Appendix B.

4.2. Public debt policy

Government i's debt can, analogous to (3.3), be written as:

$$d_{i1}^{D} = \mathrm{E}_0\left(\bar{d}_1^{D}\right) + \bar{d}_1^{d,D} + \mathrm{E}_0\left(d_{i1}^{\Delta,D}\right) + d_{i1}^{\delta,D}, \tag{4.2}$$

where

$$\mathrm{E}_0\left(\bar{d}_1^{D}\right) = \frac{\left[\bar{K}_1 + (1+\rho)\,\bar{d}_0 - \bar{K}_2\right] + (1-\beta^*)\,\bar{K}_2}{1+\beta^*\,(1+\rho)}, \tag{4.3}$$

$$\bar{d}_1^{d,D} = \left[\frac{1}{1+\beta^*\,(1+\rho)}\right]\frac{\mu}{\nu}, \tag{4.4}$$

$$\begin{aligned} \mathrm{E}_0\left(d_{i1}^{\Delta,D}\right) &= \frac{\left[K_{i1}^{\Delta} + (1+\rho)\,d_{i0}^{\Delta} - K_{i2}^{\Delta}\right] + \left[1-\beta^*\,(P^*/P)\right]K_{i2}^{\Delta}}{1+\beta^*\,(1+\rho)\,(P^*/P)}, \text{ if } n>1, \\ &= 0, \text{ if } n=1, \end{aligned} \tag{4.5}$$

$$\begin{aligned} d_{i1}^{\delta,D} &= \left[\frac{1}{1+\beta^*\,(1+\rho)\,(P^*/P)}\right]\frac{\epsilon_i}{\nu}, \text{ if } n>1, \\ &= 0, \text{ if } n=1, \end{aligned} \tag{4.6}$$

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

$$P^* \equiv \left[(n-1)/n\right]/\alpha_\pi + 1/\nu^2 + 1/\alpha_g. \tag{4.7}$$

We now discuss each of the components of the debt solution and compare them with the second-best outcomes.

4.2.1. The term $\mathrm{E}_0\left(\bar{d}_1^{D}\right)$

The responses to the common deterministic components of the government financing requirements are the same as under the second best (i.e. $\mathrm{E}_0\left(\bar{d}_1^{D}\right) = \mathrm{E}_0\left(\bar{d}_1^{S}\right)$). The reason is that governments face no incentive to strategically use public debt to affect future inflation expectations because future (second-period) inflation expectations are already determined when debt is set.

4.2.2. The term $\bar{d}_1^{d,D}$

The response of government debt to a common shock is exactly the same as the response to the common deterministic components of the government financing requirement and, therefore, coincides with the corresponding response in the second-best equilibrium. Inflation expectations are fixed for two periods ahead. Hence, governments employ debt optimally by smoothing the effects of the common shock over time.

4.2.3. The term $\mathbf{E}_0\left(d_{i1}^{\Delta,D}\right)$

International heterogeneity gives rise to a conflict among the fiscal authorities about the preferred future monetary policy stance. The conflict induces governments to employ debt strategically. As a result, $\mathrm{E}_0\left(d_{i1}^{\Delta,D}\right)$ differs from $\mathrm{E}_0\left(d_{i1}^{\Delta,S}\right)$. In particular, countries featuring a relatively large deterministic component of the intertemporal government financing requirement (i.e. $F_i^{\Delta} > 0$) accumulate excessive public debt (i.e. $\mathrm{E}_0\left(d_{i1}^{\Delta,D}\right) > \mathrm{E}_0\left(d_{i1}^{\Delta,S}\right)$). Countries featuring a relatively small deterministic component of the intertemporal government financing requirement (i.e. $F_i^{\Delta} < 0$), in contrast, do not accumulate enough public debt (i.e. $\mathrm{E}_0\left(d_{i1}^{\Delta,D}\right) < \mathrm{E}_0\left(d_{i1}^{\Delta,S}\right)$).[11]

The intuition for these results is as follows. Countries exhibiting a relatively large deterministic government financing requirement (i.e. $F_i^{\Delta} > 0$) 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 (4.1)). Hence, governments with relatively large deterministic government financing requirements perceive a relatively large benefit from exploiting the predetermination of future inflation expectations in this way and, therefore, strategically overaccumulate debt. Through the same mechanism, governments of countries with a relatively low government financing requirement (i.e. $F_i^{\Delta} < 0$) strategically underaccumulate debt (compared to the second best) 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, $\mathrm{E}_0\left(d_{i1}^{\Delta,D}\right)$ tends towards $\mathrm{E}_0\left(d_{i1}^{\Delta,S}\right)$. 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 (4.1)). The perceived benefits from using debt strategically are therefore small.

[11] These results follow upon observing that

$$\frac{\partial \mathrm{E}_0\left(d_{i1}^{\Delta,D}\right)}{\partial n} = -\left[\frac{\beta^*(1+\rho)}{(1+\beta^*(1+\rho)(P^*/P))^2}\right] F_i^{\Delta}\left[\frac{\partial(P^*/P)}{\partial n}\right],$$

is positive (negative) if $F_i^{\Delta} < (>)\ 0$, while $\mathrm{E}_0\left(d_{i1}^{\Delta,D}\right) \rightarrow \mathrm{E}_0\left(d_{i1}^{\Delta,S}\right)$, as $n \rightarrow \infty$.

4.2.4. The term $\bar{d}_1^{\delta,D}$

Also idiosyncratic shocks cause a conflict between the fiscal authorities about the proper stance of the common future monetary policy and, thus, induce governments to strategically set public debt (note that $d_{i1}^{\delta,D} > d_{i1}^{\delta,S}$ if $\epsilon_i > 0$, while $d_{i1}^{\delta,D} < d_{i1}^{\delta,S}$ if $\epsilon_i < 0$). In particular, in response to a bad (good) idiosyncratic shock ($\epsilon_i > (<)0$), governments increase (decrease) public debt, which produces higher (lower) future tax rates and induces the ECB to relax (tighten) future monetary policy in order to protect employment. Also this strategic debt accumulation disappears if the number of union members tends to infinity (i.e. $\bar{d}_1^{\delta,D} \to \bar{d}_1^{\delta,S}$ if $n \to \infty$).

5. Ex-ante policy coordination

This section explores possible reforms of monetary and fiscal institutions aimed at improving upon the purely discretionary equilibrium considered in the previous section. We consider in particular inflation targets (π_1^* and π_2^*) and debt targets,[12] which are determined prior to the setting of nominal wages at the beginning of the first period. We assume that the targets can be enforced and thus are credible. These institutional constraints can be viewed as 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.

The question arises how detailed these contracts can be. Indeed, the debt and inflation targets we consider in this section can be viewed as an intermediate step between complete commitment to the fully contingent rules in Section 3 and pure discretion considered in Section 4. In practice, inflation targets (as, for example, adopted in the U.K., Canada and New Zealand) usually take the form of a point target or a band for inflation set for one or more years ahead. For example, the ECB has announced a target range for inflation. Projected inflation targets are usually not contingent on unexpected economic circumstances and, if they are, the contingencies are vague (for example, escape clauses under exceptional circumstances). The analysis below keeps both periods' inflation targets unchanged irrespective of any new information that becomes available as the game evolves. Non-contingent inflation targets are likely to be more credible than contingent targets because changing the target in response to unexpected economic developments may open the door for political pressures to relax the target. As another version of the standard "credibility-flexibility trade off", simple rules

[12] The debt targets are point targets to be hit exactly. In Section 5.4 we consider debt ceilings instead of debt targets.

are more credible but less flexible in adjusting to contingencies. The debt targets we consider are slightly more detailed and are allowed to be country specific and contingent on the shocks.

To reproduce the second best analyzed in Section 3, institutional adjustments need to ensure not only an optimal intratemporal allocation among the available instruments (inflation, the output shortfall and the spending shortfall) but also an optimal intertemporal allocation so that public debt coincides with the second-best outcome (i.e. the components $\mathrm{E}_0\left(d_{i1}^{\Delta,D}\right)$ and $d_{i1}^{\delta,D}$ in (4.2) need to be adjusted so that they coincide with their second-best counterparts).

In the absence of debt targets, the introduction of inflation targets impacts the expected average debt position:

$$\mathrm{E}_0\left(\bar{d}_1\right)=\mathrm{E}_0\left(\bar{d}_1^S\right)-\tfrac{1}{n}\beta^*\left[\tfrac{S/P}{1+\beta^*(1+\rho)}\right]\pi_2^*, \tag{5.1}$$

A tight second-period inflation target (i.e., $\pi_2^*<0$) combatting the inflation bias boosts debt accumulation compared to the second best. The reason is that it creates a conflict between the monetary and 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 fiscal policy, which in the absence of debt targets is purely discretionary. This conflict between monetary and fiscal policy induces the fiscal authorities to raise the public debt strategically. In particular, higher future tax rates required to service a larger public debt reduce output and employment and, for given inflation expectations, encourage the ECB to relax monetary policy (see (4.1)).

In a larger monetary union (i.e. n is higher), the effect of a unilateral increase in the public debt on the common inflation rate is perceived to be smaller. Hence, a tight inflation target $\pi_2^*<0$ yields less strategic debt accumulation. Indeed, a larger monetary union weakens the strategic position of each individual fiscal authority vis-à-vis the central bank so that the central bank should be less concerned about pressure from the fiscal authorities in case of a conflict between monetary and fiscal policies.

5.1. Homogeneous countries

The following proposition (proven in Appendix C) states the sufficient institutional arrangements to reproduce the second best if countries are homogeneous so that international conflicts are absent (hence, $\mathrm{E}_0\left(d_{i1}^{\Delta,D}\right)+d_{i1}^{\delta,D}=\mathrm{E}_0\left(d_{i1}^{\Delta,S}\right)+d_{i1}^{\delta,S}=0$):

Proposition 1. *Suppose that* $K_{i1} = \bar{K}_1$, $K_{i2} = \bar{K}_2$, $d_{i0} = \bar{d}_0$ *and* $\epsilon_i = 0$, $\forall i$. *In that case, the inflation targets*

$$\pi_1^{*,opt} = -\left[\frac{1/\alpha_\pi}{S}\right]\left[\bar{K}_1 + (1+\rho)\,\bar{d}_0 - \mathrm{E}_0\left(\bar{d}_1^S\right)\right] = -\left[\frac{1/\alpha_\pi}{S}\right]\left[\frac{\beta^*(1+\rho)}{1+\beta^*(1+\rho)}\right]\bar{F}, \qquad (5.2)$$

$$\pi_2^{*,opt} = -\left[\frac{1/\alpha_\pi}{S}\right]\left[\bar{K}_2 + (1+\rho)\,\mathrm{E}_0\left(\bar{d}_1^S\right)\right] = -\left[\frac{1/\alpha_\pi}{S}\right]\left[\frac{1+\rho}{1+\beta^*(1+\rho)}\right]\bar{F}, \qquad (5.3)$$

combined with a uniform (across countries) debt target $d_{i1}^T = \mathrm{E}_0\left(\bar{d}_1^S\right) + \bar{d}_1^{d,S}, \forall i$, *ensures that the decentralized, discretionary equilibrium with two-period ahead wage setting coincides with the second-best equilibrium.*

Here, and in the sequel, we use a superscript "T" to denote a debt target. The inflation targets (5.2) and (5.3) 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. This outcome is 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 target can be positive. In addition, in practice inflation targets are imposed on measured inflation, which tends to exceed actual inflation because it does not properly account for quality improvements. Hence, a positive target for measured inflation may correspond to negative actual inflation. What matters, though, are the qualitative properties of the optimal inflation targets (5.2) and (5.3). In particular, they eliminate the inflation bias (i.e. $\mathrm{E}_0\pi_1 = \mathrm{E}_0\pi_2 = 0$) so that inflation exceeds its socially optimal value of zero only in response to a union-wide bad shock. The inflation targets are proportional to the common deterministic part of the intertemporal government financing requirement, $\bar{F}$. A larger value for $\bar{F}$ requires a tighter inflation target to prevent an inflation bias.

The inflation targets (5.2) and (5.3) alone are not sufficient to ensure the second-best outcome. The reason is that the second-period inflation target gives rise to strategic accumulation of public debt. As explained in connection with the reaction function (5.1), resolving the coordination problem between the monetary authorities and the private sector through the introduction of a tight inflation target ($\pi_2^* < 0$) creates a policy conflict between the monetary and the fiscal authorities. To avoid the resulting 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. In contrast to the inflation target, the debt ceiling is contingent on the common shock μ.

5.2. Heterogeneous countries

If countries are heterogeneous, institutional constraints must address not only the inflation bias but also strategic debt accumulation due to conflicting views of the various governments about the proper stance of monetary policy. This case yields the following proposition (the proof of which is very similar to that of Proposition 1):

Proposition 2. *The set of inflation targets (5.2) and (5.3) combined with a set of country-specific debt targets* $d_{i1}^{T} = d_{i1}^{S}, \forall (i, \epsilon_i, \mu)$ *given by (3.3) ensure that the decentralized, discretionary equilibrium with two-period ahead wage setting coincides with the second-best equilibrium.*

The arrangements proposed in Proposition 2 yield the second-best equilibrium. Accordingly, governments (or societies) would unanimously agree on the targets when they are imposed (i.e. ex ante). The optimal inflation targets again eliminate the inflation bias (i.e. $\mathrm{E}_0\pi_1 = \mathrm{E}_0\pi_2 = 0$). In fact, they coincide with the targets in the case of homogeneous countries and are thus non-stochastic. The optimal debt targets, in contrast, are richer than with homogeneous countries. These targets 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. In order to resolve this latter conflict, the debt targets have to be country specific in that they depend on both the country-specific deterministic components of the government financing requirements and the idiosyncratic shocks.

5.3. Partial ex-ante coordination

The previous proposition investigated institutional constraints on not only monetary policy but also fiscal policy. Countries, however, 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 Stability and Growth Pact cannot be taken for granted due to enforcement problems. In view of these considerations, this sub-section explores the optimal inflation target if constraints on fiscal policy are absent.

Imposing a tight second-period inflation target ($\pi_2^* < 0$) not only alleviates the inflation bias in the second period but also gives rise to strategic debt accumulation (see (5.1)). This additional debt accumulation raises the government financing requirement in the second period. In order to offset the resulting higher inflation bias 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 the increased (due to more debt accumulation) second-period inflation bias. Marginally relaxing the inflation target that completely eliminates the inflation bias produces a first-order gain in welfare on account of a reduced debt bias and only a second-order loss of welfare on account of an emerging inflation bias. All this is made precise in the following proposition (proven in Appendix D):

Proposition 3. *Assume that the objective is to minimize an equally-weighted average of societies' loss functions. In the absence of debt targets, the optimal first-period inflation target is* $\breve{\pi}_1^* = -\left[\frac{1/\alpha_\pi}{S}\right]\left[\bar{K}_1 + (1+\rho)\,\bar{d}_0 - E_0\left(\breve{d}_1\right)\right]$, *while the optimal second-period inflation target is* $\breve{\pi}_2^*$, *which lies between* $\hat{\pi}_2^*$ *and* $\pi_2^{*,opt}$. *Here,* $\hat{\pi}_2^*$ $(< \pi_2^{*,opt})$ *is the second-period inflation target that completely eliminates the second-period inflation bias in the absence of debt targets and* $E_0\left(\breve{d}_1\right)$ *is the right-hand side of (5.1) obtained after substituting* $\breve{\pi}_2^*$ *for* π_2^*.

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 government financing requirement (which determines the first-period inflation bias) is lower. Individual countries agree on the optimal first-period inflation target because they cannot exploit first-period nominal contracts as they take first-period monetary policy as given in the Nash game. On the optimal second-period inflation target, in contrast, countries disagree. In order to resolve this conflict, Proposition 3 takes as the objective a weighted average of the individual societies' loss functions. One can show that a country i featuring relatively severe structural distortions (i.e., $F_i^\Delta > 0$) prefers a relatively lax second-period inflation target (i.e., it prefers $\pi_2^* > \breve{\pi}_2^*$). 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 ($F_i^\Delta < 0$). It prefers a relatively tight target so that it does not need to strategically underaccumulate debt.

5.4. Debt ceilings instead of debt targets

The debt targets considered in sub-section 5.2 act as an upperbound or a lowerbound on debt, depending on the direction in which these constraints are binding. In the presence of a tight second-period inflation target ($\pi_2^* < 0$), the debt targets proposed in Proposition 2 act as upperbounds for countries featuring relatively large structural distortions or for countries hit by relatively bad idiosyncratic shocks. For countries exhibiting only relatively minor structural distortions or for countries hit by good idiosyncratic shocks, however, the target may effectively act as a lower constraint on the public debt.

The Maastricht Treaty and the Stability and Growth Pact formulate budgetary restrictions in terms of *ceilings* on debts or deficits. Accordingly, this sub-section explores the effects or debt ceilings rather than debt targets. This substantially complicates the analysis. The reason is that the set of countries that are constrained in their debt policy needs to be endogenously determined, taking into account that being constrained may depend on the shocks. At the same time, the unconstrained optimal debt level for the unconstrained countries depends on the average debt level of the constrained countries.

To illustrate this last statement, we simplify matters by assuming that stochastic shocks are absent ($\mu = 0$ and $\epsilon_i = 0$, $\forall i$). An unconstrained country's public debt is given by (see Appendix E):

$$\begin{aligned} d_{i1}^{U} = & -\tfrac{1}{n}\beta^{*}\left[\tfrac{S/P}{1+\beta^{*}(1+\rho)(Q/P)}\right]\pi_{2}^{*} \\ & +\tfrac{\left[\bar{K}_{1}^{U}+(1+\rho)\bar{d}_{0}^{U}-\bar{K}_{2}^{U}\right]+[1-\beta^{*}(Q/P)]\bar{K}_{2}^{U}}{1+\beta^{*}(1+\rho)(Q/P)} \\ & +\tfrac{\left[K_{i1}^{\Delta,U}+(1+\rho)d_{i0}^{\Delta,U}-K_{i2}^{\Delta,U}\right]+[1-\beta^{*}(P^{*}/P)]K_{i2}^{\Delta,U}}{1+\beta^{*}(1+\rho)(P^{*}/P)} \\ & -\beta^{*}\tfrac{1}{n}\left(1-\tfrac{m}{n}\right)\left[\tfrac{1/\alpha_{\pi}}{P}\right]\left[\tfrac{1}{1+\beta^{*}(1+\rho)(Q/P)}\right]\left[\bar{K}_{2}^{R}+(1+\rho)\,\bar{d}_{1}^{R}\right], \end{aligned} \tag{5.4}$$

where m is the number of countries that are not constrained in their debt choice and

$$Q \equiv \left[\tfrac{m}{n^{2}}+\tfrac{n-1}{n}\right]\tfrac{1}{\alpha_{\pi}}+\tfrac{1}{\nu^{2}}+\tfrac{1}{\alpha_{g}}. \tag{5.5}$$

Furthermore, the superscript "U " refers to unconstrained (in debt policy) countries, while the superscript "R " refers to countries constrained in their debt policy. For a generic variable x, $\bar{x}_t^U$ is the average of x_{jt} over all unconstrained countries j, while $\bar{x}_t^R$ is the average of x_{jt} over all constrained countries j and $x_{jt}^{\Delta,U} \equiv x_{jt} - \bar{x}_t^U$.

The first term on the right-hand side of (5.4) reveals that, if the set of unconstrained countries does not change, a tighter second-period inflation target π_2^* boosts public debt (as in (5.1)). However, a tighter inflation target π_2^* may well cause more countries to become constrained. The second and third terms correspond to terms that are familiar from the preceding analysis. However, averages and country-specific deviations from averages are now computed over the set of unconstrained countries only. Moreover, the second term is affected by the number of countries that are constrained (note that, if $m = n$, then $Q = P$). The third term indicates that a new strategic conflict arises among the unconstrained fiscal authorities only: those countries with a larger-than-average (within this group) deterministic component of the intertemporal government financing requirement strategically accumulate additional debt. Finally, the fourth term on the right-hand side of (5.4) indicates that tighter debt ceilings ($\bar{d}_1^R$ falls) induce unconstrained countries to accumulate more debt. The reason is that tighter debt ceilings weaken the strategic debt conflict between countries with relatively large and small structural distortions. Hence, the unconstrained countries, which exhibit relatively small structural distortions, face less incentives to strategically reduce debt accumulation.

6. Ex-post fiscal coordination

Under ex-ante coordination policymakers sign contracts (for example, specifying inflation and debt targets) before the private sector moves. Under ex-post fiscal coordination, in contrast, they bargain about contracts that internalize international spillovers only after the private sector has formed expectations and incorporated these expectations into nominal wage contracts. 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 governments:

$$V_U \equiv \tfrac{1}{n} \sum_{i=1}^{n} V_{S,i},$$

taking private-sector inflation expectations as given. Individual countries' policies affect other countries' losses through the choice of public debt, which impacts the common monetary policy. Public debt – see Appendix F for the derivation – is now given by

$$d_{i1}^C = \mathrm{E}_0\left(\bar{d}_1^C\right) + \bar{d}_1^{d,C} + \mathrm{E}_0\left(d_{i1}^{\Delta,C}\right) + d_{i1}^{\delta,C}, \tag{6.1}$$

where superscript "C" is used to denote coordination and where

$$\begin{aligned} \mathrm{E}_0\left(\bar{d}_1^C\right) &= \mathrm{E}_0\left(\bar{d}_1^S\right) - \beta^* \left[\tfrac{S/P}{1+\beta^*(1+\rho)}\right] \pi_2^*, \\ \bar{d}_1^{d,C} &= \bar{d}_1^{d,S}, \\ \mathrm{E}_0\left(d_{i1}^{\Delta,C}\right) &= \mathrm{E}_0\left(d_{i1}^{\Delta,S}\right), \\ d_{i1}^{\delta,C} &= d_{i1}^{\delta,S}. \end{aligned} \tag{6.2}$$

Ex-post coordination exerts two separate effects on public debt. First, it strengthens the fiscal authorities in their strategic conflict with the ECB about future monetary policy, thereby potentially worsening the policy conflict between monetary and fiscal policymakers. To illustrate, ex-post coordination of fiscal policies worsens strategic debt accumulation in the presence of a tight inflation target, $\pi_2^* < 0$ (compare the first line of (6.2) with (5.1) if $n > 1$). Second, ex-post coordination of fiscal policies implies that individual fiscal authorities internalize the adverse spillovers due to the strategic use of public debt. This eliminates strategic debt accumulation due to international conflicts about monetary policy (compare lines 3 and 4 of (6.2) with (4.5) and (4.6), respectively). In assessing the desirability of the ex-post coordination of fiscal policies, these two effects need to be traded off. In particular, ex-post coordination is harmful if, compared to the international conflict among the various fiscal policymakers, the conflict between the ECB and the fiscal policymakers as a group is especially serious. This is the case if the inflation target π_2^* is tight on account of a large cross-country average of the deterministic component of the intertemporal government financing requirements, while at the same time international differences in the intertemporal government financing requirement are only small.

These findings help to judge France's proposal to strengthen the role of the Euro Group. The Euro Group would be a forum for the ex-post coordination of fiscal policies and act as a political counterweight to the ECB. Given the mandate of the ECB for price stability, our results suggest that giving more powers to the Euro Group may be harmful because it may worsen the policy conflicts between the ECB and the fiscal authorities.

7. Conclusion

This paper has explored the scope for policy coordination in EMU. Wasteful strategic accumulation of public debt may arise from conflicts between the ECB and the fiscal authorities and between heterogeneous fiscal authorities themselves about the preferred stance of monetary policy. 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 wage contracts are rigid so that fiscal policy is set more frequently than nominal wage contracts are. The conflicts between the various decentralized governments are most serious if countries are heterogeneous in terms of labor-market distortions and public spending and countries are hit by asymmetric shocks. Also here the length of nominal wage contracts is crucial: governments employ their debt policies to exploit the inflation expectations incorporated in nominal wage contracts. If nominal wage contracts are determined at the same time interval as fiscal policy, conflicts among the fiscal authorities disappear.

Strategic debt accumulation can be alleviated in various complementary ways. One option is to pursue structural policies aimed at cutting high equilibrium unemployment in Europe. Another way 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 accumulation 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. Accordingly, strengthening the role of the Euro Group Council as a political counterweight against the ECB may be undesirable, especially if structural unemployment in Europe remains high and nominal wage contracts are rigid and if the enforcement of the Stability and Growth Pact remains in doubt.

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Tables:

Table 1. CHARACTERISTICS OF NOMINAL WAGE CONTRACTS

Country	contract length (years)	indexation
Belgium	1	1
France	1	–
Spain	1	–
U.K.	1	–
Austria	$1-2$	–
Germany	$1-2$	–
Netherlands	$1-2$	$10-15\%$
Greece	2	1
Luxemburg	2	1
Sweden	2	0
Ireland	3	0
U.S.	3	0

Source: Dutch Ministry for Social Affairs and Employment/European Industrial Relations Review (various issues)

Legend for the column "indexation": "–" = no data available, "0" = no indexation for inflation, "1" = automatic indexation. In the Netherlands, $10-15\%$ of the contracts are automatically indexed for inflation.

Table 2. Second-best policy outcomes

variable	γ_0	γ_1	γ_2	γ_3
π_1	0	$\frac{1/\alpha_\pi}{P}\ \beta^* c_0$	0	0
$\frac{\tilde{x}_{i1}-x_{i1}}{\nu}$	$\frac{1/\nu^2}{S}\ \beta^* c_0$	$\frac{1/\nu^2}{P}\ \beta^* c_0$	$\frac{1/\nu^2}{S}\ \beta^* c_0$	$\frac{1/\nu^2}{S}\ \beta^* c_0$
$\tilde{g}_{i1}-g_{i1}$	$\frac{1/\alpha_g}{S}\ \beta^* c_0$	$\frac{1/\alpha_g}{P}\ \beta^* c_0$	$\frac{1/\alpha_g}{S}\ \beta^* c_0$	$\frac{1/\alpha_g}{S}\ \beta^* c_0$
$\pi_1-\mathrm{E}_0\pi_1$	0	$\frac{1/\alpha_\pi}{P}\ \beta^* c_0$	0	0
π_2	0	$\frac{1/\alpha_\pi}{P}\ c_0$	0	0
$\frac{\tilde{x}_{i2}-x_{i2}}{\nu}$	$\frac{1/\nu^2}{S}\ c_0$	$\frac{1/\nu^2}{P}\ c_0$	$\frac{1/\nu^2}{S}\ c_0$	$\frac{1/\nu^2}{S}\ c_0$
$\tilde{g}_{i2}-g_{i2}$	$\frac{1/\alpha_g}{S}\ c_0$	$\frac{1/\alpha_g}{P}\ c_0$	$\frac{1/\alpha_g}{S}\ c_0$	$\frac{1/\alpha_g}{S}\ c_0$
$\pi_2-\mathrm{E}_0\pi_2$	0	$\frac{1/\alpha_\pi}{P}\ c_0$	0	0

Note: for each variable z_{it} the outcome can be written in the format $z_{it}=\gamma_0\bar{F}+\gamma_1\left(\frac{\mu}{\nu}\right)+\gamma_2 F_i^{\Delta}+\gamma_3\left(\frac{\epsilon_i}{\nu}\right)$. Further, $c_0\equiv\left[\frac{1+\rho}{1+\beta^*(1+\rho)}\right]$, $\beta^*=\beta(1+\rho)$, $S\equiv 1/\nu^2+1/\alpha_g$ and $P\equiv 1/\alpha_\pi+1/\nu^2+1/\alpha_g$.

Table 3. Purely discretionary policy outcomes

variable	γ_0	γ_1	γ_2	γ_3
π_1	$\frac{1/\alpha_\pi}{S}\ \beta^* c_0$	$\frac{1/\alpha_\pi}{P}\ \beta^* c_0$	0	0
$\frac{\tilde{x}_{i1}-x_{i1}}{\nu}$	$\frac{1/\nu^2}{S}\ \beta^* c_0$	$\frac{1/\nu^2}{P}\ \beta^* c_0$	$\frac{1/\nu^2}{S}\ \beta^*\left(\frac{P^*}{P}\right) c_1$	$\frac{1/\nu^2}{S}\ \beta^*\left(\frac{P^*}{P}\right) c_1$
$\tilde{g}_{i1}-g_{i1}$	$\frac{1/\alpha_g}{S}\ \beta^* c_0$	$\frac{1/\alpha_g}{P}\ \beta^* c_0$	$\frac{1/\alpha_g}{S}\ \beta^*\left(\frac{P^*}{P}\right) c_1$	$\frac{1/\alpha_g}{S}\ \beta^*\left(\frac{P^*}{P}\right) c_1$
$\pi_1-\mathrm{E}_0\pi_1$	0	$\frac{1/\alpha_\pi}{P}\ \beta^* c_0$	0	0
π_2	$\frac{1/\alpha_\pi}{S}\ c_0$	$\frac{1/\alpha_\pi}{P}\ c_0$	0	0
$\frac{\tilde{x}_{i2}-x_{i2}}{\nu}$	$\frac{1/\nu^2}{S}\ c_0$	$\frac{1/\nu^2}{P}\ c_0$	$\frac{1/\nu^2}{S}\ c_1$	$\frac{1/\nu^2}{S}\ c_1$
$\tilde{g}_{i2}-g_{i2}$	$\frac{1/\alpha_g}{S}\ c_0$	$\frac{1/\alpha_g}{P}\ c_0$	$\frac{1/\alpha_{gS}}{S}\ c_1$	$\frac{1/\alpha_g}{S}\ c_1$
$\pi_2-\mathrm{E}_0\pi_2$	0	$\frac{1/\alpha_\pi}{P}\ c_0$	0	0

Note: for each variable z_{it} the outcome can be written in the format $z_{it}=\gamma_0\bar{F}+\gamma_1\left(\frac{\mu}{\nu}\right)+\gamma_2 F_i^{\Delta}+\gamma_3\left(\frac{\epsilon_i}{\nu}\right)$. Further, $\beta^*=\beta(1+\rho)$, $c_0\equiv\left[\frac{1+\rho}{1+\beta^*(1+\rho)}\right]$, $c_1\equiv\left[\frac{1+\rho}{1+\beta^*(1+\rho)(P^*/P)}\right]$, $S\equiv 1/\nu^2+1/\alpha_g$, $P\equiv 1/\alpha_\pi+1/\nu^2+1/\alpha_g$ and $P^*\equiv[(n-1)/n](1/\alpha_\pi)+1/\nu^2+1/\alpha_g$.