Political shocks, public debt and the design of monetary and fiscal institutions

Beetsma, R.M.W.J.; Bovenberg, A.L.

Political Shocks, Public Debt and the Design of Monetary and Fiscal Institutions

Roel M.W.J. Beetsma
*University of Amsterdam and CEPR**

A. Lans Bovenberg
Tilburg University and CEPR†

November 6, 2002

Abstract

We explore the dynamics of public debt in the presence of political shocks in the form of shocks to preferences for public spending. Under commitment, optimal stabilization is obtained by combining an inflation target that is contingent on the political shock with a debt target that forces the government to fully absorb the political shock in the period in which it occurs. With only a shock-contingent inflation target, the political shock is spread out over time through debt policy. In the absence of any targets, a conservative central bank can enhance stabilization. If we extend the basic two-period model to an infinite horizon, this result is preserved. Moreover, under rather general circumstances the government tends to decumulate debt over time, so that in the long run all targets (for inflation, output and public spending) are attained. A failure to commit monetary policy introduces an additional distortion into the model, which leads the government to decumulate debt at a faster rate.

Keywords: political shocks, public debt, commitment, discretion, inflation targets, debt targets, central bank conservatism.

JEL: E52, E58, E61, E62.

---

* Address: Department of Economics, University of Amsterdam, Roetersstraat 11, 1018 WB Amsterdam, The Netherlands, phone: +31.20.5255280, fax: +31.20.5254254, Beetsma@fee.uva.nl.

† Address: CentER, P.O.Box 90153, 5000 LE Tilburg, The Netherlands, phone: +31.13.4662912, fax: +31.13.4663042, A.L.Bovenberg@uvt.nl.

1 Introduction

Research into political monetary cycles goes back to Nordhaus' (1975) and Hibbs' (1977) work on the relationship between the inflation-unemployment trade off and the political color of the government. Later work includes Alesina (1987), as well as a number of papers that suggest institutional reforms aimed at alleviating politically-induced cycles in monetary policy (see e.g., Alesina and Gatti (1995), Muscatelli (1998) and Al-Nowaihi and Levine (1998)). More recent work on political monetary cycles has linked these cycles to fiscal policy (see, e.g., Demertzis et al. (1999), Ozkan (2000), Drazen (2001) and Pina (2001)).[1]

The current paper extends the work on political monetary cycles and fiscal policy by introducing public debt. The existing literature either employs a single-period setting or assumes a balanced government budget in each period. The introduction of public debt raises a number of issues. First, how should shocks be spread out over time? Does the intertemporal transmission of political shocks (the news associated with the election of a new government) differ from that of standard supply shocks? A second issue is whether the government employs public debt policy strategically to affect the policies of future governments with potentially different preferences. A final issue involves the way public debt affects optimal institutional design, including that of the central bank. Are also fiscal restrictions called for and, if so, how do political shocks affect optimal restrictions?

To explore these issues, we extend the standard Barro and Gordon (1983) framework to include fiscal policy and political shocks arising from electoral uncertainty. In most literature on political monetary cycles, political parties diverge in their views on the relative weight of output versus inflation stabilization. Following Pina (2001), we however assume that political parties differ in their preferences about the level of public spending. Indeed, in reality, political conflicts about public spending seem more important than conflicts about the relative importance of output versus inflation stabilization. We extend Pina (2001) by formulating a dynamic model in which public debt is endogenous.[2]

[1] Electoral cycles in fiscal policy have been studied by Rogoff (1990).

[2] The current model extends Beetsma and Bovenberg (1999, 2001) by including political shocks. Furthermore, Section 5 extends the horizon of the two-period models in Beetsma and Bovenberg (1999, 2001). Finally, Beetsma and Bovenberg (2001) focus on fiscal discretion while nominal wages are determined two periods ahead. Here, we abstract from

We start the analysis with a two-period model assuming that the central bank is able to commit. This yields the following results. As regards the positive results, supply shocks and political shocks affect public debt in different ways. An adverse supply shock boosts public debt. The election of a left government featuring a relatively high spending target, in contrast, is actually likely to reduce debt.[3] Indeed, two forces exert downward pressure on public debt. First, a left government prefers high public spending also in the future. To create the financial room for this additional public spending, public debt accumulation is limited. The second effect is that by financing the spending shock in the period in which it occurs, the government forces the central bank to absorb a larger part of the political shock immediately through an inflation surprise.

Even though the central bank is able to commit, institutional adjustments can still yield welfare gains. We conduct the normative analysis of welfare-enhancing institutional adjustments in several steps. We first consider a rich menu of possible institutional adjustments, which include shock-contingent inflation and debt targets, as well as the possibility to institute a conservative central bank, which attaches more weight to inflation stabilization than society does (à la Rogoff, 1985). The modelling of the inflation target is similar to Svensson (1997). However, whereas Svensson's inflation target alleviates the standard "inflation bias", the role of our inflation target is to better stabilize political shocks. In contrast to Svensson's inflation target, therefore, our inflation target depends on current shocks affecting the economy. In particular, under the optimal combination of institutional adjustments, the inflation target is tightened if a left-wing government assumes power so that the higher spending target of such a government does not cause inflation. Such an inflation target contingent on current political shocks makes central bank conservatism redundant.[4] The optimal debt target ensures that the government must completely absorb the political shock in the period in which it occurs. Intuitively, the inflation and debt targets offset the political distortions associated with political shocks. In particular, these targets reduce the room to finance these shocks through inflation and adjustments in public debt. This forces governments to absorb political shocks through an

this latter complication.

[3] For earlier literature exploring how political conflicts affect public debt accumulation, see, for example, Alesina and Tabellini (1990), Tabellini and Alesina (1990), Cukierman and Edwards and Tabellini (1992).

[4] This contrasts with the findings of some other authors (e.g., Herrendorf and Lockwood, 1998), who establish independent roles for an inflation target and central bank conservatism. However, in these analyses the inflation target is usually imposed in order to alleviate an inflation bias on account of discretionary policymaking.

adjustment of public spending in the direction preferred by society. Hence, relative to its own target, a left-wing government is forced to cut public spending in the period in which it comes to power, while a right-wing government is encouraged to raise spending. Under commitment, inflation and debt targets do not restrict the policy response to supply shocks because the stabilization of these shocks is optimal.

In practice, imposing fiscal restrictions proves to be difficult, especially when these restrictions should be contingent on shocks. When we exclude such debt targets, the optimal inflation target has to trade off combatting intratemporal and intertemporal policy distortions. Still, the central bank does not have to be made conservative. The reason is that the shock-contingent inflation target continues to be a richer instrument to fight political distortions than a conservative central bank. However, inflation targets that are contingent on political shocks may undermine their credibility and may lead to misinterpretations by financial markets (see, e.g., Beetsma and Jensen, 1999). When we exclude not only shock-contingent debt targets but also shock-contingent inflation targets, a conservative central bank becomes optimal.

The latter part of the paper extends the benchmark model into two directions. The first step is to allow for an infinite time horizon. In this setting, public debt becomes a random walk if the real interest rate equals the government's time preference rate. If the real interest rate exceeds the time preference rate, the government decumulates public debt over time. The second extension is to relax the assumption of monetary policy commitment. Recent work by Dixit and Lambertini (1999, 2000) has renewed interest in the modelling of the interactions between discretionary monetary and fiscal policy. We extend the analysis of monetary-fiscal interactions in the absence of commitment by incorporating public debt and allowing for political shocks. Under discretion, the government accumulates assets faster than under commitment in order to alleviate the familiar inflation bias associated with discretionary monetary policy. Restricting ourselves (for the reasons given earlier) to time-invariant institutional adjustments, the normative analysis reveals that a conservative central bank continues to be optimal in the extended model.

The remainder of this paper is structured as follows. Section 2 presents the model. Section 3 explores the equilibrium of the two-period version of the model, assuming that the central bank is able to commit to a pre-announced monetary policy rule. Section 4 analyzes optimal institutional arrangements. Section 5 extends the model to an infinite horizon, first with commitment but later with monetary discretion, which introduces an additional distortion into the model. Finally, Section 6 concludes the main body of the paper. The technicalities and the proofs are relegated to an appendix that is available upon request.[5]

2 The model

The time horizon consists of T periods, possibly with $T = \infty$. Workers are represented by trade unions who aim for some target real wage rate (e.g. see Alesina and Tabellini, 1987, and Jensen, 1994). At the start of each period, and before monetary policy is implemented (i.e., before the inflation rate is determined, see also Barro and Gordon (1983)), they set nominal wages so as to minimize the expected squared deviation of the realized real wage rate from this target. Firms face a standard production function featuring decreasing returns to scale in labor. Output in period t is taxed at a rate τ_t. Therefore, the log of output in period t, x_t, is[6]

$$x_t = \nu \left(\pi_t - \pi_t^e - \tau_t\right) - \mu_t,\ \nu > 0,\ t, .., T, \tag{1}$$

where π_t stands for the inflation rate, $\pi_t^e \equiv \mathrm{E}_{t-1}\pi_t$ denotes period-t inflation as expected at the end of period $t-1$ (that is, after period $t-1, .., 1$ shocks have hit, but before period t shocks materialize) and μ_t represents a standard mean-zero supply-side shock with (constant) variance σ_μ^2. The shocks are uncorrelated over time.

Society features the following loss function

$$V_1^S = \tfrac{1}{2}\sum_{t=1}^{T} \beta^{t-1}\left[\alpha_\pi \pi_t^2 + \left(x_t - \tilde{x}_t\right)^2 + \alpha_g \left(g_t - \tilde{g}_t\right)^2\right], 0 < \beta < 1,\ \alpha_\pi, \alpha_g > 0. \tag{2}$$

Society's losses increase in the deviations of inflation, (log) output and public spending from their (possibly time-varying) bliss points. For notational convenience, the ideal level for inflation corresponds to price stability. The blisspoint for output in period t is denoted by $\tilde{x}_t > 0$. Two distortions reduce output below this ideal level. First, the output tax τ_t 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 $\tilde{x}_t > 0$. A subsidy ($\tau_t < 0$) would thus be required to arrive at this ideal, non-distortionary output level. The blisspoint for public spending, $\tilde{g}_t$, can be interpreted as the optimal share of non-distortionary output

[5] It is also available at http://www1.fee.uva.nl/toe/content/people/beetsma.shtm

[6] This output equation is derived in Beetsma and Bovenberg (1999).

to be spent on public goods if (non-distortionary) lump-sum taxes would be available (see Debelle and Fischer, 1994). The parameters α_π and α_g represent the weights of the price stability and public spending objectives, respectively, relative to the output objective. Finally, β denotes society's subjective discount factor.

The assumptions about the political process are based on Pina (2001). There are two political parties: a "left-wing" party, denoted by L, and a "right-wing" party, denoted by R. The parties differ in terms of their public spending targets. In any period t, party L's spending target is $\tilde{g}_t + \eta_L$, while party R's spending target is $\tilde{g}_t + \eta_R$, where $\eta_L > 0$ and $\eta_R < 0$. Apart from public spending targets, the parties share society's preferences. Hence, party P ($P = L$, R) features the following loss function:

$$V_1^P = \frac{1}{2} \sum_{t=1}^{T} \beta^{t-1} \left[\alpha_\pi \pi_t^2 + (x_t - \tilde{x}_t)^2 + \alpha_g \left(g_t - (\tilde{g}_t + \eta_P) \right)^2 \right], 0 < \beta < 1, \ \alpha_\pi, \alpha_g > 0. \tag{3}$$

Each period t, after nominal wage contracts have been signed, an election takes place. In these elections, party L is chosen with probability θ and party R is elected with probability $1-\theta$ so that $\eta_t = \eta_L$ with probability θ and $\eta_t = \eta_R$ with probability $1-\theta$. The election outcomes are uncorrelated over time. Electoral uncertainty may arise from imperfections in the political process, for example, because of uncertainty about voter turnout, which affects the two parties differently. It may also originate from uncertainty about the extent to which the party's leadership appeals to the voters, the occurrence of scandals, and so on. η_t is a mean-zero expected shock when viewed from the perspective of the unions when they set the wage for period t :[7]

$$\theta \eta_L + (1-\theta) \eta_R = 0. \tag{4}$$

Hence, the (constant) variance of η_t is given by $\sigma_\eta^2 \equiv \theta \eta_L^2 + (1-\theta) \eta_R^2$.

The government's budget constraint can be approximated by (see Appendix A in Beetsma and Bovenberg, 1999):

$$g_t + (1+\rho) d_{t-1} = \tau_t + d_t, \ t = 1, .., T, \tag{5}$$

where d_{t-1} represents the amount of public debt carried over from the previous period into period t, while d_t is the amount of debt outstanding at the end of period t. All public debt is real, matures after one period, and is

[7] Assumption (4) is innocent. If the mean of the political shock η_t were non-zero, we could simply redefine $\tilde{g}_t$ to include this mean and reformulate the political shock with its mean subtracted.

sold on the world capital market against an exogenous real rate of interest of $\rho \geq 0$. The government budget constraint abstracts from seigniorage revenues. Indeed, the share of seigniorage in total government revenues is very small in industrial economies with efficient payment systems.

Substituting (1) into (5) to eliminate τ_t, we arrive at the period-t *government financing requirement,* GFR_t:

$$\begin{aligned} GFR_t &\equiv K_t + (1+\rho)\, d_{t-1} - d_t + \mu_t/\nu + \eta_t \\ &= [(\tilde{x}_t - x_t)/\nu] + [(\tilde{g}_t + \eta_t) - g_t] + (\pi_t - \pi_t^e), \end{aligned} \tag{6}$$

where

$$K_t \equiv \tilde{g}_t + \tilde{x}_t/\nu,$$

which will be referred as *(total) structural distortions* in period t. The government financing requirement, GFR_t, provides a comprehensive measure of the factors that result in losses to society. It consists of three components (see the first right-hand side of (6)). The first component, K_t, amounts to the government spending target in the absence of political disagreement, $\tilde{g}_t$, and an output subsidy aimed at offsetting the implicit output tax on account of labor- or product-market distortions, $\tilde{x}_t/\nu$. The second component involves net debt-servicing costs, $(1+\rho)\, d_{t-1} - d_t$. The final component is the composite stochastic shock, $\mu_t/\nu + \eta_t$. The last right-hand side of (6) represents the *financing sources*: the shortfall (scaled by ν) of output from its target (henceforth referred to as the *output shortfall*), $(\tilde{x}_t - x_t)/\nu$, the shortfall of public spending from the *current* government's target (henceforth referred to as the *spending shortfall*), $(\tilde{g}_t + \eta_t) - g_t$, and the inflation surprise, $\pi_t - \pi_t^e$.

We take the present discounted value of (6) for all t to yield the period-t *intertemporal government financing requirement*:

$$\begin{aligned} & F_t + \sum_{\xi=t}^{T} (1+\rho)^{-(\xi-t)} \left(\tfrac{\mu_\xi}{\nu} + \eta_\xi\right) \\ = & \sum_{\xi=t}^{T} (1+\rho)^{-(\xi-t)} \left[(\tilde{x}_\xi - x_\xi)/\nu + \left((\tilde{g}_\xi + \eta_\xi) - g_\xi\right) + \left(\pi_\xi - \pi_\xi^e\right)\right], \end{aligned} \tag{7}$$

where

$$
\begin{aligned}
F_t &\equiv (1+\rho)\, d_{t-1} + G_t, &(8)\\
G_t &\equiv \sum_{\xi=t}^{T} (1+\rho)^{-(\xi-t)} K_\xi. &(9)
\end{aligned}
$$

Here, F_t stands for the *deterministic* (when viewed from the start of period t) component of the intertemporal government financing requirement.

Monetary policy is delegated to an (instrument-)independent central bank (CB), which exercises direct and perfect control over the inflation rate. One could assume that the CB features intrinsic preferences regarding the policy outcomes. Alternatively, and this is the interpretation we prefer, the CB is assigned a loss function by means of an appropriate contractual agreement with the principal (say, the legislature). More specifically, this agreement shapes the CB'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:

$$
V_1^{CB} = \tfrac{1}{2} \sum_{t=1}^{T} \beta^{t-1} \left[\alpha_{\pi M} \left(\pi_t - \pi_t^*\right)^2 + \left(x_t - \tilde{x}_t\right)^2 \right], \tag{10}
$$

where π_t^* is an inflation target imposed in period t (as in Svensson, 1997). This target may differ from the government's blisspoint for inflation (which was assumed to be zero). At several places in the paper, we also allow the inflation target to be a function of the two types of shocks. Moreover, the relative weight the CB attaches to inflation, $\alpha_{\pi M}$, may deviate from society's corresponding weight, α_π. Finally, the central bank does not care about public spending. Indeed, many central banks (in particular, those in the Euro area) are explicitly instructed not to be influenced by the implications of their policies for the government budget.[8]

3 The equilibrium in the two-period model with commitment

This (and the next) section assumes only two periods ($T = 2$). The CB is able to commit to an inflation rule for both periods. This rule is announced at the

[8] Given the structure of the policy game (described below), the results would be unaffected if we included a public spending objective in (10) because inflation has no direct, contemporaneous effect on public spending.

start of the game (i.e., at the end of period 0).[9] Once they materialize, shocks are common knowledge. In each period $t = 1, 2$ the timing is as follows. First, wage setters sign nominal wage contracts. Subsequently, elections take place and supply shocks materialize. Then monetary policy is implemented according to the announced rule, while simultaneously the party taking office selects the tax rate and public debt to be issued. Given the policy choices and the shock realizations, output is determined,[10] while public spending follows residually from the government budget constraint.

The optimal inflation rule is determined by minimizing $\mathrm{E}_0\left[V_1^{CB}\right]$ subject to the constraint that wage-setters' expectations be formed rationally. In contrast to the next section, this section does not allow for an inflation target (i.e. $\pi_t^* = 0$, $t = 1, 2$). However, we allow $\alpha_{\pi M}$ to differ from α_π so that we can use the results derived here in Subsection 4.3.

The model is solved (see Appendix B.1 – available upon request) under the constraint that the public debt is completely paid off at the end of the second period. Table 1 reports the outcomes for inflation, the output shortfall and the spending shortfall in period t. The first-period outcomes are written as the sum of the responses to the deterministic (when perceived from the beginning of the period) component of the intertemporal government financing requirement in the first period, F_1, the (scaled) supply shock $\frac{\mu_1}{\nu}$, and the political shock η_1. The second-period outcomes, in addition, contain a response to the second-period composite shock, $\frac{\mu_2}{\nu} + \eta_2$. The factor between square brackets in each of the entries of Table 1 reveals how, *within* a given period t, these components are distributed over the financing sources (the output shortfall, the spending shortfall and an inflation surprise – see (6)). Hence, for a given period, the sum over these three financing sources of their terms in square brackets equals unity. (As an example, take the third column in Table 1 and take the sum of the terms in squared brackets in rows 3, 4 and 5.) For each of the outcomes, the term that follows the factor in square brackets regulates the *inter*temporal allocation of the responses to F_1, $\frac{\mu_1}{\nu}$ and η_1.

The solution for public debt can be written as:

$$d_1 = \mathrm{E}_0\left(d_1\right) + d_1^d, \tag{11}$$

[9] The results would not be affected if, instead of announcing an optimal inflation rule at the start of the game, the CB would announce an inflation rule at the start of each period (before inflation expectations are formed). The reason is that inflation responds only to shocks originating in the same period, so that the central bank faces a sequence of one-shot problems.

[10] The choice of the tax rate is not subject to a time-consistency problem because firms determine output after the tax rate has been set.

where

$$\begin{aligned}
\mathrm{E}_0\left(d_1\right) &= \tfrac{K_1+(1+\rho)d_0-\beta^* K_2}{\beta^*(1+\rho)}, &(12)\\
d_1^d &= \left[\tfrac{1}{1+\beta^*(1+\rho)\left(P_M^*/P\right)}\right]\tfrac{\mu_1}{\nu}+\left[\tfrac{1-\beta^*\left(P_M^*/P\right)}{1+\beta^*(1+\rho)\left(P_M^*/P\right)}\right]\eta_1, &(13)
\end{aligned}$$

where the superscript "d" denotes the response to a shock. Furthermore,

$$\begin{aligned}
\beta^* &\equiv \beta\left(1+\rho\right)>0, &(14)\\
P &\equiv 1/\nu^2+1/\alpha_g>0, &(15)\\
P_M^* &\equiv 1/\alpha_{\pi M}+1/\nu^2+1/\alpha_g>0. &(16)
\end{aligned}$$

Public debt is thus written as the sum of a deterministic component, (12), and the responses to the supply and political shocks, (13).

The intuition for these results is as follows. Consider the first-period outcomes first. The coefficients of the shock $\frac{\mu_1}{\nu}$ (in the third column of Table 1, γ_1) differ in two ways from the coefficients of F_1 (in the second column of Table 1, γ_0). The first difference involves the *intra*temporal allocations over the financing sources. The deterministic component F_1 is anticipated and thus incorporated in the inflation expectation. The shock $\frac{\mu_1}{\nu}$, in contrast, is unanticipated and, hence, is not incorporated in π_1^e. The CB exploits the failure of π_1^e to incorporate $\frac{\mu_1}{\nu}$ and absorbs part of this shock with an inflation surprise, $\pi_1-\pi_1^e$. A more liberal CB (exhibiting a smaller $\alpha_{\pi M}$) aborbs more of the shock through such an inflation surprise.

The second difference concerns the *inter*temporal allocations of F_1 and $\frac{\mu_1}{\nu}$ over the financing sources. Part of the temporary shock $\frac{\mu_1}{\nu}$ is transmitted into the future through public debt policy (see (13)). This part is anticipated in the formation of second-period inflation expectations and, for this reason, gives rise to additional future welfare losses. In order to avoid these latter welfare losses, the CB absorbs a relatively large part of $\frac{\mu_1}{\nu}$ in period 1 through an inflation surprise.[11] Since a more liberal CB is less adverse to such an inflation surprise, such a CB allows a larger part of the shock to be absorbed in the period in which it occurs.

[11]To see formally that more of $\frac{\mu_1}{\nu}$ than of F_1 is absorbed in period 1, use Table 1 and take, for period 1, the sum over the financing sources of their responses to F_1, respectively $\frac{\mu_1}{\nu}$. One then observes that the sum associated with F_1 is smaller than the one associated with $\frac{\mu_1}{\nu}$ (i.e. $\psi_0<\psi_1$ since $\beta^*<\beta^*\left(P_M^*/P\right)$ – see Table 1 for the definitions of ψ_0 and ψ_1).

The first-period responses to η_1 differ from the corresponding responses to $\frac{\mu_1}{\nu}$ – see (13)). A government of type L, say, which comes to power in period 1, not only wants spending to be relatively high in period 1, but also in period 2. It thus evaluates future outcomes on the basis of its own preferences rather than those of society. The first-period government thus in fact acts as if the political shock is permanent rather than temporary. As a result, the government will not engage in additional debt accumulation to finance a temporary spending boost in period 1.[12]

If public debt declines in response to the election of a left-wing government in period 1 (i.e., $\beta^* (P_M^*/P) > 1$), then such an election produces larger spending shortfalls in that period. This exerts an offsetting effect on the increase in spending resulting from the political shock itself. One can see this by setting $F_1 = \frac{\mu_1}{\nu} = \frac{\mu_2}{\nu} = \eta_2 = 0$ and using Table 1 to write

$$g_1 = \tilde{g}_1 + \left\{ 1 - \left[\frac{1/\alpha_g}{P_M^*} \right] \left[\frac{2+\rho}{1+\rho} \right] \psi_1 \right\} \eta_1, \tag{17}$$

where $\psi_1 \equiv \frac{\beta^*\left(P_M^*/P\right)(1+\rho)}{1+\beta^*\left(P_M^*/P\right)(1+\rho)} > 0$ and the negative term in the curly brackets represents the offsetting effect arising from the restraint of the public debt.[13]

4 Institutional adjustments

Appropriate institutional adjustments can reduce the additional welfare losses produced by political shocks. This section explores such adjustments. We continue to assume that the central bank can commit to a pre-announced monetary policy rule. As a benchmark, Subsection 4.1 explores a rich menu of institutional adaptations. In particular, we allow for a combination of (1) central bank conservatism (i.e., $\alpha_{\pi M}$ may differ from α_π), (2) shock-contingent inflation targets and (3) a shock-contingent debt target. These institutional adjustments are implemented at the very start of the game, before the central bank announces its monetary policy rule. The remainder of the game is as described in Section 3. One could think of these adjustments as being imposed by the legislature representing society at large. The inflation

[12] The election of party L (i.e., $\eta_1 > 0$) in fact leads to a reduction in public debt if $\beta^* \geq 1$. This may seem unrealistic. In some European countries, however, the downward trend in public debt in recent years has taken place under left-wing governments. Moreover, right-wing governments have sometimes boosted debt. In this connection, the accumulation of public debt under Reagan in the eighties has been explained as an attempt to bind the hands of a future, more left-wing government (e.g., see Persson and Svensson, 1989).

[13] If $\beta^* (P_M^*/P) = 1$ (implying $(2+\rho)\,\psi_1/\,(1+\rho) = 1$), public debt is unaffected by η_1. Political shocks are thus fully absorbed in the periods in which they occur.

target and $\alpha_{\pi M}$ might be part of an appropriate contractual agreement with the central bank. The debt target can be included in a law adopted by the legislature similar to the balanced budget rules adopted by most U.S. states. Subsection 4.2 recognizes that, in practice, fiscal rules are difficult to implement. Hence, it excludes the debt target. Finally, Subsection 4.3 recognizes that also inflation targets that are contingent on shocks suffer from practical drawbacks. That subsection, therefore, limits institutional interventions to changes in the degree of central bank conservatism.

4.1 A full menu of institutional adjustments

We consider a combination of shock-contingent inflation targets,[14]

$$\pi_t^* = \lambda_{0t}\left(\frac{\mu_t}{\nu}\right) + \lambda_{1t}\eta_t, \ t = 1, 2, \tag{18}$$

a shock-contingent debt target,[15]

$$d_1^T = \gamma_0 + \gamma_1 \tfrac{\mu_1}{\nu} + \gamma_2 \eta_1, \tag{19}$$

and an appropriate choice of the degree of central bank conservatism, $\alpha_{\pi M}$. In each period, the targets are adjusted after the shocks have been observed, but before actual policies are conducted.

Appendix B.2 (available upon request) solves the model with the inflation and debt targets and obtains the expression for society's expected loss, conditional on the instutional choice parameters. Minimizing the expected social loss over the institutional parameters (see Appendix C.1 – available upon request), we can establish the following proposition:

[14] Right from the start we exclude the possibility that π_2^* depends on the first-period shocks, because such a complication of the institutional arrangement would not lead to a reduction in welfare losses anyway. Any influence of first-period shocks on second-period inflation would be incorporated in the formation of the second-period inflation expectation. The optimal commitment rule adopted by the central bank would simply eliminate this inflation bias.

[15] We thus consider debt targets that need to be hit exactly. With two periods only, such a debt target translates into a shock-contingent deficit target. In the context of EMU and its "Stability and Growth Pact", the fiscal restrictions are upperbounds on the public debt and the deficit. For work analyzing the Pact or fiscal restrictions more generally, see Beetsma and Uhlig (1999), Debrun (2001), Dixit (2001) and Milesi-Ferretti (2002). More informal discussions can be found in Artis and Winkler (1998) and Brunila et al. (2001).

Proposition 1 *The optimal combination of institutional adjustments is given by:*

$$\begin{aligned}
\alpha_{\pi M} &= \alpha_\pi, \\
\lambda_{01} &= 0,\ \lambda_{11} = -\tfrac{1}{\alpha_\pi}\tfrac{1}{P}, \\
\lambda_{02} &= 0,\ \lambda_{12} = -\tfrac{1}{\alpha_\pi}\tfrac{1}{P}, \\
\gamma_0 &= \tfrac{K_1+(1+\rho)d_0-\beta^* K_2}{1+\beta^*(1+\rho)},\ \gamma_1 = \tfrac{1}{1+\beta^*(1+\rho)(P^*/P)},\ \gamma_2 = 0.
\end{aligned}$$

Hence, if both inflation and debt targets can depend on current shocks, central bank conservatism is redundant. The reason is that the inflation target is a richer instrument than the degree of central bank conservatism. In particular, whereas a conservative central bank provides the same degree of accomodation of both supply and political shocks, a shock-contingent inflation target can respond differently to the two types of shocks (e.g. accomodate only supply shocks while not accomodating political shocks).

The shock-contingent inflation target addresses the intratemporal misallocation of the political shock over the instruments,[16] while the shock contingent debt target deals with the corresponding intertemporal misallocation. In particular, a positive political shock in either one of the periods is met with a tightening of the inflation target. By restricting the use of inflation in this way, the burden of stabilizing the political shock is shifted onto the government itself. As a result, the inflation rate is insulated from the political shock, which, within each period, is absorbed by public spending adjustments and an adjustment in the output shortfall – see Table 2, which contains the outcomes for the financing sources under the optimal institutional arrangement. Furthermore, the first-period government should completely absorb the first-period political shock. This implies that not only first-period inflation but also future policy should be insulated from first-period political shocks. Since neither first-period monetary policy nor debt policy accommodates the political shock, the first-period government is forced to finance the political shock itself by adjusting public spending and taxation (and thus output).

4.2 A limited set of institutional adjustments

In practice, (shock-contingent) debt targets are problematic for several reasons. First of all, relevant contingencies are difficult to foresee. Hence,

[16]The optimal allocation of the supply shock coincides with the allocation in the absence of institutional changes (see (13) with $\alpha_{\pi M} = \alpha_\pi$).

practical shock-contingent debt targets are always to some extent incomplete. Governments may abuse the incomplete nature of these targets to get around them, for example through creative accounting (see Milesi-Ferretti, 2002). Moreover, fiscal policy is at the heart of a political democracy. Hence, binding democratically elected governments through debt targets is difficult. Current discussions about the Stability and Growth Pact illustrate this. Some countries argue that the Pact should be made more flexible, for example by allowing public investment to be excluded from the computation of EU-deficit. Hence, the Pact's credibility is a matter of continuous discussion.

For these reasons, this sub-section explores the optimal combination of institutional adjustments if debt targets are excluded. In that case, the optimal institutional adjustments are given by the following proposition (see Appendix C.2 – available upon request):

Proposition 2 *If debt targets are not feasible, the following combination of institutional adjustments is optimal:*

$$\begin{aligned}\alpha_{\pi M} &= \alpha_{\pi}, \\ \lambda_{01} &= 0,\ \lambda_{11} = -\tfrac{1}{\alpha_{\pi}}\tfrac{1}{P}\left[\tfrac{\beta^{*}(2+\rho)}{1+\beta^{*}(1+\rho)}\right], \\ \lambda_{02} &= 0,\ \lambda_{12} = -\tfrac{1}{\alpha_{\pi}}\tfrac{1}{P}.\end{aligned}$$

The inflation target still dominates central bank conservatism as a way to address political distortions, because it can differentiate between supply and political shocks. Table 3 shows the outcomes for the financing sources under the current arrangement. The responses to the supply shocks and the second-period political shock are the same as those under the optimal arrangement given by Proposition 1. However, the responses to the first-period political shock differ. In the absence of a shock-contingent debt target, second-period output and spending are no longer insulated from the first-period political shock. In particular, if $\beta^{*} < 1$, a positive realization of η_1 is partly absorbed by larger second-period output and spending shortfalls. With η_1 only partly absorbed in the first period, the adjustment of the first-period inflation target to a shock $\eta_1 > 0$ can be loosened (observe that $\frac{\beta^{*}(2+\rho)}{1+\beta^{*}(1+\rho)} < 1$, if $\beta^{*} < 1$). This way, first-period inflation remains insulated from the shock and the government is forced to absorb all of the first-period financing of the shock η_1 (through an adjustment of spending and taxes – and thus output).

With the institutional arrangements proposed in Proposition 2, the outcome for public debt amounts to

$$d_1 = \frac{K_1+(1+\rho)d_0-\beta^{*}K_2}{\beta^{*}(1+\rho)} + \left[\frac{1}{1+\beta^{*}\left(P_M^{*}/P\right)(1+\rho)}\right]\frac{\mu_1}{\nu} + \left[\frac{1-\beta^{*}}{1+\beta^{*}(1+\rho)}\right]\eta_1. \tag{20}$$

Excluding a shock-contingent debt target from the menu of instutional adjustments raises society's welfare loss, unless $\beta^* = 1$. In that case, the inflation targets proposed in Proposition 2 coincide with those in Proposition 1, while public debt does not respond to the first-period political shock η_1.

4.3 The optimal degree of central bank conservatism

The previous subsection explored institutional adjustments that included inflation targets conditional on current shocks. In practice, however, such shock-contingent inflation targets may be difficult to implement if shocks are observed only imperfectly or with lags. Moreover, changing targets in response to shocks may undermine the credibility of these targets, for example, if the market misinterprets these changes as being motivated by political considerations (see Beetsma and Jensen, 1999). This subsection investigates optimal institutional design if not only debt targets but also inflation targets can not be made contingent on shocks. Since a systematic inflation bias is absent under commitment, the inflation targets are set at their optimal constant value of zero (i.e., $\pi_1^* = \pi_2^* = 0$ under all circumstances). In that case, the degree of central bank conservatism, $\alpha_{\pi M}$, is used as an instrument to alleviate political distortions.

The expected loss follows upon substitution of the outcomes reported in Table 1 into (2):

$$\mathrm{E}_0\left[V_1^S\right] = T_1 + T_2 + T_3 + T_4 + T_5, \tag{21}$$

where

$$\begin{aligned}
T_1 &= \tfrac{1}{2}\tfrac{1}{P}\left[\tfrac{\beta^*(1+\rho)}{1+\beta^*(1+\rho)}\right] F_1^2, && (22)\\
T_2 &\equiv \tfrac{1}{2}\left[\tfrac{Q_M}{\left(P_M^*\right)^2} + \tfrac{1}{\beta^*(1+\rho)}\tfrac{P}{\left(P_M^*\right)^2}\right]\psi_1^2\left(\tfrac{\sigma_\mu^2}{\nu^2} + \sigma_\eta^2\right), && (23)\\
T_3 &= \tfrac{1}{2}\beta\tfrac{Q_M}{\left(P_M^*\right)^2}\left(\tfrac{\sigma_\mu^2}{\nu^2} + \sigma_\eta^2\right), && (24)\\
T_4 &= \tfrac{1}{2}\left[\tfrac{\frac{1}{\alpha_{\pi M}}\left(\frac{\alpha_\pi}{\alpha_{\pi M}} - 1\right)}{(1+\rho)\left(P_M^*\right)^2} + \tfrac{Q_M}{(1+\rho)^2\left(P_M^*\right)^2} + \beta\tfrac{1}{P}\right]\psi_1^2\sigma_\eta^2, && (25)\\
T_5 &= T_{51} + T_{52}, && (26)
\end{aligned}$$

and where

$$
\begin{aligned}
T_{51} &\equiv \tfrac{1}{2}\alpha_g \left[1 - 2\left(\tfrac{1/\alpha_g}{P_M^*}\right)\left(\tfrac{2+\rho}{1+\rho}\right)\psi_1\right]\sigma_\eta^2, \\
T_{52} &\equiv \tfrac{1}{2}\beta\alpha_g \left[1 - 2\left(\tfrac{1/\alpha_g}{P_M^*}\right)\right]\sigma_\eta^2, \\
Q_M &\equiv \alpha_\pi/\alpha_{\pi M}^2 + 1/\nu^2 + 1/\alpha_g > 0.
\end{aligned}
$$

The first term, T_1, represents the expected loss associated with the deterministic component of the intertemporal government financing requirement. T_2 and T_3 stand for the expected losses associated with the imperfect stabilization of first- and second period shocks, respectively. The term in square brackets in expression (23) for T_2 consists of two components corresponding to each of the two periods. Indeed, first-period shocks are spread out over two periods and thus cause welfare losses in both periods. The sum of the first three terms, $T_1 + T_2 + T_3$, corresponds to the expected social loss that would arise when the government and society would share the following loss function with random shocks to the public spending target

$$
\tfrac{1}{2}\sum_{t=1}^{2}\beta^{t-1}\left[\alpha_\pi\pi_t^2 + (x_t - \tilde{x}_t)^2 + \alpha_g\left(g_t - (\tilde{g}_t + \eta_t)\right)^2\right]. \tag{27}
$$

The government would select fiscal policy in the two periods so as to minimize this loss function, while society's expected loss associated with the equilibrium outcomes would be evaluated according to this function. The political shock acts like a standard supply shock: it influences the outcomes in exactly the same way (apart from the constant factor $1/\nu$) as the supply shock. As a result, the variances of the two types of shocks enter T_2 and T_3 symmetrically. Whereas T_1 does not depend on $\alpha_{\pi M}$, we can show that:

Lemma 3 *T_2 and T_3 are strictly decreasing (increasing) in $\alpha_{\pi M}$ for $\alpha_{\pi M} < \alpha_\pi$ ($\alpha_{\pi M} > \alpha_\pi$) and thus attain their unique minimum at $\alpha_{\pi M} = \alpha_\pi$.*

The intuition behind Lemma 3 is that non-political distortions disappear at $\alpha_{\pi M} = \alpha_\pi$. Indeed, both policymakers share the social preferences while the central bank can commit to its monetary policy. Hence, the optimality conditions determining the equilibrium coincide with those obtained under a single, benevolent policymaker who exerts control over all policy instruments and is able to commit.

Society's expected loss would amount to $T_1 + T_2 + T_3 + T_4$, if society would evaluate the actual outcomes for these variables as reported in Table 1 according to (27). The term T_4 thus represents the additional loss that arises because the decision maker (i.e. the party in power) sets policy on the basis of its own loss function (which assumes a permanent preference shift for public goods) rather than (27) (which assumes stochastic preference shifts). Hence, the actual outcomes for inflation and the output and spending shortfalls, as reported in Table 1, do not minimize (27). If $\alpha_{\pi M}$ were equal to α_{π}, the differences between the actual outcomes and the ones minimizing (27) would result entirely from a suboptimal *inter*temporal allocation over the financing sources as the decision maker (i.e. the government) treats preference shocks as permanent while they are in fact temporary. If $\alpha_{\pi M}$ differs from α_{π}, the actual outcomes suffer also from a suboptimal intratemporal allocation. In fact, making the CB more conservative than society (i.e. increasing $\alpha_{\pi M}$ above α_{π}) results in a trade-off between these two sources of suboptimality. This trade off results in the following lemma.

Lemma 4 *T_4 is minimized by making the central bank conservative (i.e., setting $\alpha_{\pi M} > \alpha_{\pi}$).*

Proof. The first term in the square brackets in (25) is strictly decreasing in $\alpha_{\pi M}$ for $\alpha_{\pi M} \leq \alpha_{\pi}$ and is also non-negative over this range. The second term in the square brackets is strictly decreasing (increasing) for $\alpha_{\pi M} < \alpha_{\pi}$ ($\alpha_{\pi M} > \alpha_{\pi}$), while the third term in the square brackets does not depend on $\alpha_{\pi M}$. Furthermore, ψ_1 is strictly decreasing in $\alpha_{\pi M}$. Hence, the derivative of T_4 with respect to $\alpha_{\pi M}$ is negative for $\alpha_{\pi M} \leq \alpha_{\pi}$. ■

The intuition for Lemma 4 is as follows. We know that the intertemporal financing of the political shock is suboptimal. Since the government treats this shock as permanent rather than temporary, it absorbs too much of this shock in the short run. To better smooth the shock, the central bank should be made conservative, so that it absorbs less of the shock in the period in which it occurs. Society can thus employ the central bank's price stability weight to correct for the inefficient intertemporal allocation of the financing requirement. Doing so, however, implies costs since the intratemporal allocation of financing of the shock becomes suboptimal. In particular, compared to inflation surprises, the output and spending shortfalls bear a disproportional share of the adjustment to the shock. These intratemporal losses are only second-order loss if we raise $\alpha_{\pi M}$ only marginally beyond α_{π}. However, these losses outweigh the gains on account of a more efficient intertemporal allocation if $\alpha_{\pi M}$ becomes sufficiently large.[17]

The term T_5 arises because society in fact evaluates the outcomes in Table 1 according to (2) rather than (27), both in the first period (leading to the term T_{51}) and in the second period (leading to the term T_{52}). We have that

[17] Numerical results confirm that minimization of T_4 requires the central bank not to be ultraconservative (i.e., $\alpha_{\pi M} = \infty$). The procedure for computing the numerical results is described below.

Lemma 5 *T_{51} and T_{52} are strictly decreasing in $\alpha_{\pi M}$.*

Appendix C.3 (available upon request) establishes Lemma 5. The intuition for this result is that an inflation surprise accommodates political shocks by bringing public spending closer to the bliss point of the government $\tilde{g}_1 + \eta_1$. This benefits the government in power in period 1 but harms social welfare (2). Society does not want the political shock, which causes political preferences to deviate from from society's preferences, to be accommodated.[18] A conservative central bank ensures that monetary policy does not accommodate political shocks. Hence, $\alpha_{\pi M}$ should be as large as possible in order to contain the welfare loss on account of the divergence between (2) and (27). This is in line with Propositions 1 and 2, which imply that inflation should be insulated from the political shock.

Combining Lemmata 3, 4 and 5, we establish the following proposition (see Appendix C.3 – available upon request):

Proposition 6 *If the central bank can commit, society prefers a conservative central bank (i.e. the optimal weight $\alpha_{\pi M}$ fulfills $\alpha_{\pi M} > \alpha_\pi$).*

We investigate numerically whether the CB should be made ultraconservative (i.e., $\alpha_{\pi M} = \infty$). To this end, we compute for a large set of parameter combinations the value of $\alpha_{\pi M}$ that minimizes (21). In particular, we choose ρ such that $\beta^* = 1$ and fix σ_μ at 1. Furthermore, we select for β the set of values $\{0.5, 0.8, 0.95\}$, for ν we choose $\{0.5, 1, 2\}$ and for each of α_π, α_g and σ_η we select the set $\{0.1, 0.5, 1, 2\}$. We compute the optimal $\alpha_{\pi M}$ for each possible combination $\{\beta, \nu, \alpha_\pi, \alpha_g, \sigma_\eta\}$ formed from these sets of values. In the cases in which we found a solution, an increase in σ_η^2, holding σ_μ^2 constant, raises the optimal inflation weight of the central bank. For some combinations, we were not able to find a finite optimal $\alpha_{\pi M}$. These cases feature relatively large values for σ_η^2 and ν (so that $\sigma_\eta^2 / \left(\sigma_\mu^2/\nu^2\right)$ is large), implying that political shocks are important compared to supply shocks. They also feature low values of β, so that the additional intertemporal welfare gain associated with $\alpha_{\pi M} > \alpha_\pi$ (and thus the potential excessive immediate absorption of the first-period shocks) is relatively small.

[18] Society, however, prefers the central bank to stabilize regular supply shocks (see Lemma 3).

5 Extensions: Infinite Horizon and Monetary Discretion

This section adjusts the model in two directions. After Sub-section 5.1 allows for an infinite horizon, Sub-section 5.2 relaxes the commitment assumption.

5.1 Commitment with an infinite horizon

Appendix A (available upon request) derives the equilibrium. Table 4 contains the solutions for inflation, the output shortfall and the spending shortfall. These outcomes can be written in the format

$$z_t = \gamma_0^C F_t + \gamma_1^C \tfrac{\mu_t}{\nu} + \gamma_2^C \eta_t, \tag{28}$$

where z_t is π_t, $(\tilde{x}_t - x_t)/\nu$ or $(\tilde{g}_t + \eta_t - g_t)$ and the coefficients $\gamma_j^C > 0$, $j = 0, 1, 2$, are defined in Table 4. We present the outcomes in a format that differs somewhat from the presentation of the outcomes in the two-period version of the model (see Table 1), because shocks that occurred before period t are now included in F_t, through the debt responses that took place in the past. Qualitatively speaking, though, the outcomes are similar to the two-period version of the model.

The solution for public debt can now be written as:

$$d_t^C = \mathrm{E}_{t-1}\left(d_t^C\right) + d_t^{d,C}, \tag{29}$$

where

$$\mathrm{E}_{t-1}\left(d_t^C\right) = \tfrac{1}{\beta^*} d_{t-1}^C + \tfrac{(G_t - G_{t+1}) + (1-\beta^*)G_{t+1}}{\beta^*(1+\rho)}, \tag{30}$$

$$d_t^{d,C} = \left[\tfrac{1}{1+\left(P_M^*/P\right)(\beta^*(1+\rho)-1)}\right] \tfrac{\mu_t}{\nu} + \left[\tfrac{1-\beta^*\left(P_M^*/P\right)}{1+\left(P_M^*/P\right)(\beta^*(1+\rho)-1)}\right] \eta_t, \tag{31}$$

and where the superscript "C" indicates that this is the solution under commitment. To guarantee the existence of this solution, we assume $\beta > 1/(1+\rho)^2$ so that $1/\beta^* < 1+\rho$.[19]

We can rewrite (30) as:

$$\mathrm{E}_{t-1}\left(d_t^C + \tfrac{G_{t+1}}{1+\rho}\right) = \tfrac{1}{\beta^*}\left(d_{t-1}^C + \tfrac{G_t}{1+\rho}\right). \tag{32}$$

Using (32), we can establish the following proposition:

[19] A second solution for public debt, with expected debt growing at a rate ρ is ruled out because it violates the usual transversality condition.

Proposition 7 *Assume that the CB follows the optimal commitment rule:*

(a) If $\beta^* > 1$, the expected long-run debt level, $E_{t-1}\left[d_\xi^C\right]$, converges to $-G_{\xi+1}/(1+\rho)$, $\xi \to \infty$. If, in addition, shocks are absent, the government's targets for inflation, output and public spending are attained in the long run.
(b) If $\beta^* = 1$ and $G_t = G_{t+1} = ... = G$, public debt is a random walk.

Recall that $G_{\xi+1}/(1+\rho)$ is the *present discounted sum of all future structural distortions*, see (9). If $\beta^* > 1$, governments are sufficiently forward looking (given ρ) to accumulate sufficient assets in the long run to be able to offset the impact of product- and labor-market distortions on output with appropriate subsidies (i.e., negative taxes: $\tau_\xi = -\tilde{x}_\xi/\nu$ for $\xi \to \infty$).

5.1.1 Institutional adjustments

As we did for the two-period model, we can again consider institutional adjustments in order to reduce the losses from intra- and intertemporal misallocations. As before, any institutional adjustment takes place at the start of the game. For the reasons given earlier, we discard shock-contingent inflation and debt targets. We can then derive the analogue to Proposition 6, which is proven in Appendix E.1 (available upon request):

Proposition 8 *Consider the infinite-horizon version of the model and assume that the central bank is able to commit. In that case, society prefers a conservative central bank, so that $\alpha_{\pi M} > \alpha_\pi$.*

5.2 Discretionary Monetary Policy

This sub-section introduces another distortion in addition to the political shocks. In particular, the CB can no longer commit to a pre-announced inflation rule. Hence, the CB acts under discretion and takes inflation expectations as given when it sets its policy instrument. This is probably the most realistic description of how monetary policy is conducted in practice.

For the moment, we abstract from any institutional adjustments and thus refer to this case as *pure discretion.* The timing within each period is as in Section 3 with the fiscal and monetary authorities playing a Nash game. The equilibrium, which is computed in Appendix D (available upon request), produces the outcomes reported in Table 5. These outcomes are written in the following format:

$$z_t = \gamma_0^P F_t + \gamma_1^P \tfrac{\mu_t}{\nu} + \gamma_2^P \eta_t, \tag{33}$$

where z_t is π_t, $(\tilde{x}_t - x_t)/\nu$ or $(\tilde{g}_t + \eta_t - g_t)$ and the coefficients $\gamma_j^P > 0$, $j = 0, 1, 2$, are defined in Table 5. In analogy of (29), we can write the solution for public debt as:

$$d_t^P = \mathrm{E}_{t-1}\left(d_t^P\right) + d_t^{d,P}, \tag{34}$$

where

$$\mathrm{E}_{t-1}\left(d_t^P + \tfrac{G_{t+1}}{1+\rho}\right) = \tfrac{1}{\beta^*(Q_M/P)}\left(d_{t-1}^P + \tfrac{G_t}{1+\rho}\right), \tag{35}$$

$$d_t^{d,P} = \left[\tfrac{1}{1+\left(P_M^*/P\right)\left[\beta^*(1+\rho)(Q_M/P)-1\right]}\right]\tfrac{\mu_t}{\nu} + \left[\tfrac{1-\beta^*\left(P_M^*/P\right)}{1+\left(P_M^*/P\right)\left[\beta^*(1+\rho)(Q_M/P)-1\right]}\right]\eta_t, \tag{36}$$

and where the superscript "P" indicates the *purely* discretionary equilibrium.

The outcomes for inflation and the output and spending shortfalls differ in several ways from the corresponding outcomes under commitment (compare Table 5 to Table 4). First, the discretionary solutions exhibit an "inflation bias", that is $\mathrm{E}_{t-1}\pi_t > 0$ (see Barro and Gordon, 1983). Second, the terms that regulate the intertemporal allocation of the components of the intertemporal financing requirement differ: $\psi_0^P > \psi_0^C$, $\psi_1^P > \psi_1^C$, and $\psi_2^P < \psi_2^C$ if $\beta^*\left(P_M^*/P\right) > 1$ and $\psi_2^P > \psi_2^C$ if $\beta^*\left(P_M^*/P\right) < 1$.

Compared with commitment, the government absorbs a larger share of F_t using the period-t financing sources, thereby reducing public debt. The reason for smaller debt accumulation under discretion is that a lower stock of debt alleviates the inflation bias in the second period. In the first period, when the authorities take first-period inflation expectations as given, they thus have an additional reason to absorb most of the financing requirement immediately (when inflation expectations are perceived to be given) rather than in the future (when inflation expectations are still to be determined).

For similar reasons, policy makers absorb more of the shock μ_t/ν in period t under discretion than under commitment. By doing so, the authorities in the first period reduce overall inflation variability. Absorbing the shock immediately can be done at a relatively low cost through an inflation surprise. Instead transmitting the shock to the future produces more variable inflation as future inflation expectations adjust. For the same reason, public debt policy transmits a smaller part of the political shock into the future. Indeed, the coefficient of η_t in (36) is smaller in absolute value than the corresponding coefficient in (31). If $\beta^*\left(P_M^*/P\right) < 1$ and, hence, debt rises in response to a shock $\eta_t > 0$, discretion implies more financing of η_t in period t. If $\beta^*\left(P_M^*/P\right) > 1$ and debt declines as a result of $\eta_t > 0$, discretion dampens the fall in public debt by financing a smaller part of η_t in period t.

The following proposition characterizes the behavior of the expected debt level if $\beta^* \geq 1$:

Proposition 9 *Let $\beta^* \geq 1$. Further, assume discretion. Then,*

(a) The expected long-run debt level equals $-\frac{G_{t+1}}{1+\rho}$, $t \to \infty$.

(b) If $\beta^* > 1$, the rate at which the expected debt converges to the long-run level exceeds the corresponding rate under commitment.

In contrast to commitment, even if $\beta^* = 1$, under pure discretion public debt converges to $-G_{t+1}/(1+\rho)$ in the long run (see Part (a) of Proposition 9). Also the second part of the Proposition (which follows from $Q_M/P > 1$) shows that, as explained above, discretion provides additional reasons for speeding up asset accumumation. Discretionary policy authorities, who take current inflation expectations as given but still can affect future inflation expectations, face an incentive to absorb the financing requirement immediately rather than shifting it unto the future. In the long run, the interest receipts on the accumulated assets enable the government to finance an output subsidy that offsets the structural distortion in the labor and product markets so that long-run output is not distorted (in the absence of shocks).[20]

5.2.1 Institutional adjustments

As before, institutional adjustments take place at the start of the game. Moreover, on the basis of our earlier arguments, we discard shock-contingent inflation and debt targets. Appendix E.2 (available upon request) derives the expression for society's expected loss. The expression comprises three components: one for the loss associated with the supply shocks, one for the loss arising from the political shocks and one for the loss on account of the deterministic part of the government financing requirement. In contrast to the commitment case, this last component is no longer independent of $\alpha_{\pi M}$. This is because of the inflation bias. The welfare loss expression is extremely complicated. We therefore resort to numerical computations to evaluate the optimal degree of central bank conservatism. The parameter combinations we consider are the same as those employed earlier: we set ρ such that $\beta^* = 1$ and fix σ_μ at 1. For β we consider the set of values $\{0.5, 0.8, 0.95\}$, for ν we choose $\{0.5, 1, 2\}$ and for each of α_π, α_g and σ_η we select the set $\{0.1, 0.5, 1, 2\}$. We find that for each possible combination $\{\beta, \nu, \alpha_\pi, \alpha_g, \sigma_\eta\}$, a conservative central bank is optimal. In particular, both the loss associated

[20] These results are reminiscent of earlier findings by Obstfeld (1997) and Van der Ploeg (1995) in the context of different models.

with the deterministic part of the government financing requirement and the loss associated with the shocks are each individually minimized by making the central bank conservative.

6 Conclusion

This paper extends existing work on political monetary cycles by including public debt in a model with political disagreement about the level of public spending. This latter way of modelling political disagreement, which follows Pina (2001), is more realistic then the traditional setup in which political disagreements originate in diverging views about the output - inflation trade-off. We derived a number of new results. First, whereas an adverse, temporary supply shock boosts public debt, the election of a left government with a relatively large spending target is actually likely to reduce debt. The latter result originates in two factors. One is that such a government wants to leave enough resources for future spending and, therefore, acts *as if* it will stay in office forever. The other factor is the possibility to finance an unanticipated shock partly through an inflation surprise in the period in which it occurs.

To alleviate the distortions due to the political shocks, society finds it optimal to impose debt and inflation targets that are contingent on the current political shock. These targets insulate monetary policy and debt policy from political shocks, thereby forcing fiscal policy to absorb the political shock in the period in which it occurs. In the absence of such shock-contingent targets, a conservative central bank, which does not fully accommodate political shocks, is optimal.

Extending the analysis to an infinite horizon yields additional results pertaining to the long-run behavior of the public debt. In particular, providing its time preference rate is not too low, the government accumulates assets so that its long-run expected government financing requirement becomes zero. With monetary discretion, the government accelerates asset accumulation in order to faster alleviate the inflation bias. Again, in the absence of shock-contingent targets, a conservative central bank is optimal.

References

[1] Alesina, A., 1987, Macroeconomic Policy in a Two-Party System as a Repeated Game, *Quarterly Journal of Economics* 102, 651-678.

[2] Alesina, A. and R. Gatti, 1995, Independent Central Banks: Low Inflation at No Cost?, *American Economic Review* 85, 2 (Papers and Proceedings), 196-200.

[3] Alesina, A. and G. Tabellini, 1987, Rules and Discretion with Non-Coordinated Monetary and Fiscal Policies, *Economic Inquiry* 25, 619-630.

[4] Alesina, A. and G. Tabellini, 1990, A Positive Theory of Fiscal Deficits and Government Debt, *Review of Economic Studies*, 57, 3, (July), pp.403-14.

[5] Al-Nowaihi, A. and P. Levine, 1998, Can Political Monetary Cycles be Avoided?, *Journal of Monetary Economics*, 42, 525-545.

[6] Artis, M. and B. Winkler, 1998, The Stability Pact: Safeguarding the Credibility of the European Central Bank, *National Institute Economic Review* 163, 87-98.

[7] Barro, R.J. and D.B. Gordon, 1983, Rules, Discretion and Reputation in a Model of Monetary Policy, *Journal of Monetary Economics* 12, 101-121.

[8] Beetsma, R.M.W.J. and A. L. Bovenberg, 1999, Does Monetary Unification Lead to Excessive Debt Accumulation?, *Journal of Public Economics* 74, 299-325.

[9] Beetsma, R.M.W.J. and A. L. Bovenberg, 2001, When Does an Inflation Target Yield the First Best?, *Scandinavian Journal of Economics* 103, 1, 119-126.

[10] Beetsma, R.M.W.J. and A. L. Bovenberg, 2001, Structural Distortions and Decentralized Fiscal Policies in EMU, *CEPR Discussion Paper*, No.2851.

[11] Beetsma, R.M.W.J. and H. Jensen, 1999, Optimal Inflation Targets, "Conservative" Central Banks, and Linear Inflation Contracts: Comment, *American Economic Review* 89, 1, 342-347.

[12] Beetsma, R.M.W.J. and H. Uhlig, 1999, An Analysis of the Stability and Growth Pact, *Economic Journal* 109, 546-71.

[13] Brunila, A., Buti, M. and D. Franco (eds.), 2001, *The Stability and Growth Pact*, The Palgrave.

[14] Cukierman, A., Edwards, S. and Tabellini, G., 1992, Seignorage and political instability, *American Economic Review*, vol 82, no. 3, (June), pp.537-55.

[15] Debrun, X., 2000, Fiscal Rules in a Monetary Union: a Short Run Analysis', *Open Economies Review* 11, 323-358.

[16] Demertzis, M., Hughes Hallett, A.J. and N. Viegi, 1999, An Independent Central Bank Faced with Elected Governments, *CEPR Discussion Paper*, No.2219.

[17] Dixit, A., 2001, Games of Monetary and Fiscal Interactions in the EMU, *European Economic Review* 45, 589-613.

[18] Dixit, A. and L. Lambertini, 2000, Symbiosis of Monetary and Fiscal Policies in a Monetary Union, *Mimeo*, Princeton University/UCLA.

[19] Dixit, A. and L. Lambertini, 2000, Fiscal Discretion Destroys Monetary Commitment, *Mimeo*, Princeton University/UCLA.

[20] Drazen, A., 2001, The Active Fiscal Passive Monetary Model of the Political Business Cycle, *Mimeo*, Tel Aviv University/University of Maryland.

[21] Herrendorf, B. and B. Lockwood, 1997, Rogoff's "Conservative" Central Banker Restored, *Journal of Money, Credit, and Banking* 29, 476-495.

[22] Hibbs, D.A., Jr., 1977, Political Parties and Macroeconomic Policy, *American Political Science Review* 71, 259-79.

[23] Jensen, H., 1994, Loss of Monetary Discretion in a Simple Dynamic Policy Game, *Journal of Economic Dynamics and Control* 18, 763-779.

[24] Milesi-Ferretti, G. M., 2002, Good, Bad or Ugly? On the Effects of Fiscal Rules with Creative Accounting, forthcoming, *Journal of Public Economics*.

[25] Muscatelli, V.A., 1998, Political Consensus, Uncertain Preferences and Central bank Independence, *Oxford Economic Papers* 50, 412-430.

[26] Nordhaus, W.D., 1975, The Political Business Cycle, *Review of Economic Studies* 42, 169-90.

[27] Obstfeld, M., 1997, Dynamic seigniorage theory: an exploration, *Macroeconomic Dynamics*, vol. 1, no. 3, pp.588-14.

[28] Ozkan, F.G., 2000, Who Wants an Independent Central Bank? Monetary Policy-making and Politics, *Scandinavian Journal of Economics* 102, 4, 621-643.

[29] Persson, T. and L.E.O. Svensson, 1989, Why a Stubborn Conservative Would Run a Deficit: Policy with Time-Inconsistent Preferences, *Quarterly Journal of Economics* 104, 2, 325-345.

[30] Ploeg, F. van der, 1995, Political Economy of Monetary and Budgetary Policy, *International Economic Review* 36, 2, 427-439.

[31] Rogoff, K., 1985, The Optimal Degree of Commitment to an Intermediate Monetary Target, *Quarterly Journal of Economics* 99, 1169-1189.

[32] Rogoff, K., 1990, Equilibrium Political Budget Cycles, *American Economic Review* 80, 1, 21-36.

[33] Svensson, L.E.O., 1997, Optimal Inflation Targets, 'Conservative' Central Banks, and Linear Inflation Contracts, *American Economic Review* 87, 98-114.

Table 1. OUTCOMES FOR THE TWO-PERIOD MODEL WITH MONETARY COMMITMENT

variable	γ_0	γ_1	γ_2	γ_3
π_1	0	$\left[\frac{1/\alpha_{\pi M}}{P_M^*}\right]\psi_1$	$\left[\frac{1/\alpha_{\pi M}}{P_M^*}\right]\frac{2+\rho}{1+\rho}\psi_1$	0
$(\tilde{x}_1 - x_1)/\nu$	$\left[\frac{1/\nu^2}{P}\right]\psi_0$	$\left[\frac{1/\nu^2}{P_M^*}\right]\psi_1$	$\left[\frac{1/\nu^2}{P_M^*}\right]\frac{2+\rho}{1+\rho}\psi_1$	0
$\tilde{g}_1 + \eta_1 - g_1$	$\left[\frac{1/\alpha_g}{P}\right]\psi_0$	$\left[\frac{1/\alpha_g}{P_M^*}\right]\psi_1$	$\left[\frac{1/\alpha_g}{P_M^*}\right]\frac{2+\rho}{1+\rho}\psi_1$	0
$\pi_1 - \pi_1^e$	0	$\left[\frac{1/\alpha_{\pi M}}{P_M^*}\right]\psi_1$	$\left[\frac{1/\alpha_{\pi M}}{P_M^*}\right]\frac{2+\rho}{1+\rho}\psi_1$	0
π_2	0	0	0	$\frac{1/\alpha_{\pi M}}{P_M^*}$
$(\tilde{x}_2 - x_2)/\nu$	$\left[\frac{1/\nu^2}{P}\right]\frac{1}{\beta^*}\psi_0$	$\left[\frac{1/\nu^2}{P}\right]\frac{1}{\beta^*\left(P_M^*/P\right)}\psi_1$	$\left[\frac{1/\nu^2}{P}\right]\frac{1-\beta^*\left(P_M^*/P\right)}{\beta^*\left(P_M^*/P\right)}\psi_1$	$\frac{1/\nu^2}{P_M^*}$
$\tilde{g}_2 + \eta_2 - g_2$	$\left[\frac{1/\alpha_g}{P}\right]\frac{1}{\beta^*}\psi_0$	$\left[\frac{1/\alpha_g}{P}\right]\frac{1}{\beta^*\left(P_M^*/P\right)}\psi_1$	$\left[\frac{1/\alpha_g}{P}\right]\frac{1-\beta^*\left(P_M^*/P\right)}{\beta^*\left(P_M^*/P\right)}\psi_1$	$\frac{1/\alpha_g}{P_M^*}$
$\pi_2 - \pi_2^e$	0	0	0	$\frac{1/\alpha_{\pi M}}{P_M^*}$

Note: for each variable z_t the outcome can be written in the format $z_t = \gamma_0 F_1 + \gamma_1 \frac{\mu_1}{\nu} + \gamma_2 \eta_1 + \gamma_3 \left(\frac{\mu_2}{\nu} + \eta_2\right)$. Further, $\psi_0 \equiv \frac{\beta^*(1+\rho)}{1+\beta^*(1+\rho)}$, $\psi_1 \equiv \frac{\beta^*\left(P_M^*/P\right)(1+\rho)}{1+\beta^*\left(P_M^*/P\right)(1+\rho)}$, $\beta^* \equiv \beta(1+\rho)$, $P \equiv 1/\nu^2 + 1/\alpha_g$ and $P_M^* \equiv 1/\alpha_{\pi M} + 1/\nu^2 + 1/\alpha_g$.

Table 2. OUTCOMES UNDER ARRANGEMENT OF PROPOSITION 1

variable	γ_0	γ_1	γ_2	γ_3	γ_4
π_1	0	$\frac{1/\alpha_\pi}{P^*}\hat{\psi}_1$	0	0	0
$(\tilde{x}_1 - x_1)/\nu$	$\frac{1/\nu^2}{P}\psi_0$	$\frac{1/\nu^2}{P^*}\hat{\psi}_1$	$\frac{1/\nu^2}{P}$	0	0
$\tilde{g}_1 + \eta_1 - g_1$	$\frac{1/\alpha_g}{P}\psi_0$	$\frac{1/\alpha_g}{P^*}\hat{\psi}_1$	$\frac{1/\alpha_g}{P}$	0	0
$\pi_1 - \pi_1^e$	0	$\frac{1/\alpha_\pi}{P^*}\hat{\psi}_1$	0	0	0
π_2	0	0	0	$\frac{1/\alpha_\pi}{P^*}$	0
$(\tilde{x}_2 - x_2)/\nu$	$\frac{1/\nu^2}{P}\frac{1}{\beta^*}\psi_0$	$\frac{1/\nu^2}{P}\frac{1}{\beta^*(P^*/P)}\hat{\psi}_1$	0	$\frac{1/\nu^2}{P^*}$	$\frac{1/\nu^2}{P}$
$\tilde{g}_2 + \eta_2 - g_2$	$\frac{1/\alpha_g}{P}\frac{1}{\beta^*}\psi_0$	$\frac{1/\alpha_g}{P}\frac{1}{\beta^*(P^*/P)}\hat{\psi}_1$	0	$\frac{1/\alpha_g}{P^*}$	$\frac{1/\alpha_g}{P}$
$\pi_2 - \pi_2^e$	0	0	0	$\frac{1/\alpha_\pi}{P^*}$	0

Note: for each variable z_t the outcome can be written in the format $z_t = \gamma_0 F_1 + \gamma_1 \frac{\mu_1}{\nu} + \gamma_2 \eta_1 + \gamma_3 \frac{\mu_2}{\nu} + \gamma_4 \eta_2$. Further, $\hat{\psi}_1 \equiv \frac{\beta^*(P^*/P)(1+\rho)}{1+\beta^*(P^*/P)(1+\rho)}$ and $P^* \equiv 1/\alpha_\pi + 1/\nu^2 + 1/\alpha_g$. For other definitions, see Table 1.

Table 3. OUTCOMES UNDER ARRANGEMENT OF PROPOSITION 2

variable	γ_0	γ_1	γ_2	γ_3	γ_4
π_1	0	$\frac{1/\alpha_\pi}{P^*}\hat{\psi}_1$	0	0	0
$(\tilde{x}_1 - x_1)/\nu$	$\frac{1/\nu^2}{P}\psi_0$	$\frac{1/\nu^2}{P^*}\hat{\psi}_1$	$\frac{1/\nu^2}{P}\hat{\psi}_2$	0	0
$\tilde{g}_1 + \eta_1 - g_1$	$\frac{1/\alpha_g}{P}\psi_0$	$\frac{1/\alpha_g}{P^*}\hat{\psi}_1$	$\frac{1/\alpha_g}{P}\hat{\psi}_2$	0	0
$\pi_1 - \pi_1^e$	0	$\frac{1/\alpha_\pi}{P^*}\hat{\psi}_1$	0	0	0
π_2	0	0	0	$\frac{1/\alpha_\pi}{P^*}$	0
$(\tilde{x}_2 - x_2)/\nu$	$\frac{1/\nu^2}{P}\frac{1}{\beta^*}\psi_0$	$\frac{1/\nu^2}{P}\frac{1}{\beta^*(P^*/P)}\hat{\psi}_1$	$\frac{1/\nu^2}{P}(1+\rho)\left(1-\hat{\psi}_2\right)$	$\frac{1/\nu^2}{P^*}$	$\frac{1/\nu^2}{P}$
$\tilde{g}_2 + \eta_2 - g_2$	$\frac{1/\alpha_g}{P}\frac{1}{\beta^*}\psi_0$	$\frac{1/\alpha_g}{P}\frac{1}{\beta^*(P^*/P)}\hat{\psi}_1$	$\frac{1/\alpha_g}{P}(1+\rho)\left(1-\hat{\psi}_2\right)$	$\frac{1/\alpha_g}{P^*}$	$\frac{1/\alpha_g}{P}$
$\pi_2 - \pi_2^e$	0	0	0	$\frac{1/\alpha_\pi}{P^*}$	0

Note: for each variable z_t the outcome can be written in the format $z_t = \gamma_0 F_1 + \gamma_1 \frac{\mu_1}{\nu} + \gamma_2 \eta_1 + \gamma_3 \frac{\mu_2}{\nu} + \gamma_4 \eta_2$. Further, $\hat{\psi}_2 \equiv \frac{\beta^*(2+\rho)}{1+\beta^*(1+\rho)}$, $\hat{\psi}_3 \equiv \frac{(1-\beta^*)(1+\rho)}{1+\beta^*(1+\rho)}$. For other definitions, see Tables 1 and 2.

Table 4. Outcomes for infinite-horizon model with monetary commitment

variable	γ_0^C	γ_1^C	γ_2^C
π_t	0	$\frac{1/\alpha_{\pi M}}{P_M^*}\ \psi_1^C$	$\frac{1/\alpha_{\pi M}}{P_M^*}\ \psi_2^C$
$(\tilde{x}_t - x_t)/\nu$	$\frac{1/\nu^2}{P}\ \psi_0^C$	$\frac{1/\nu^2}{P_M^*}\ \psi_1^C$	$\frac{1/\nu^2}{P_M^*}\ \psi_2^C$
$(\tilde{g}_t + \eta_t) - g_t$	$\frac{1/\alpha_g}{P}\ \psi_0^C$	$\frac{1/\alpha_g}{P_M^*}\ \psi_1^C$	$\frac{1/\alpha_g}{P_M^*}\ \psi_2^C$
$\pi_t - \pi_t^e$	0	$\frac{1/\alpha_{\pi M}}{P_M^*}\ \psi_1^C$	$\frac{1/\alpha_{\pi M}}{P_M^*}\ \psi_2^C$

Note: for each variable z_t the outcome can be written in the format $z_t = \gamma_0^C F_t + \gamma_1^C \frac{\mu_t}{\nu} + \gamma_2^C \eta_t$. Further, $\psi_0^C \equiv \frac{\beta^*(1+\rho)-1}{\beta^*(1+\rho)}$, $\psi_1^C \equiv \frac{\left(P_M^*/P\right)[\beta^*(1+\rho)-1]}{1+\left(P_M^*/P\right)[\beta^*(1+\rho)-1]}$ and $\psi_2^C \equiv \frac{\left(P_M^*/P\right)[\beta^*(2+\rho)-1]}{1+\left(P_M^*/P\right)[\beta^*(1+\rho)-1]}$. For other definitions, see Table 1.

Table 5. Outcomes for infinite-horizon model with pure discretion

variable	γ_0^P	γ_1^P	γ_2^P
π_t	$\frac{1/\alpha_{\pi M}}{P}\ \psi_0^P$	$\frac{1/\alpha_{\pi M}}{P_M^*}\ \psi_1^P$	$\frac{1/\alpha_{\pi M}}{P_M^*}\ \psi_2^P$
$(\tilde{x}_t - x_t)/\nu$	$\frac{1/\nu^2}{P}\ \psi_0^P$	$\frac{1/\nu^2}{P_M^*}\ \psi_1^P$	$\frac{1/\nu^2}{P_M^*}\ \psi_2^P$
$(\tilde{g}_t + \eta_t) - g_t$	$\frac{1/\alpha_g}{P}\ \psi_0^P$	$\frac{1/\alpha_g}{P_M^*}\ \psi_1^P$	$\frac{1/\alpha_g}{P_M^*}\ \psi_2^P$
$\pi_t - \pi_t^e$	0	$\frac{1/\alpha_{\pi M}}{P_M^*}\ \psi_1^P$	$\frac{1/\alpha_{\pi M}}{P_M^*}\ \psi_2^P$

Note: for each variable z_t the outcome can be written in the format $z_{it} = \gamma_0^P F_t + \gamma_1^P \frac{\mu_t}{\nu} + \gamma_2^P \eta_t$. Further, $\psi_0^P \equiv \frac{\beta^*(1+\rho)(Q_M/P)-1}{\beta^*(1+\rho)(Q_M/P)}$, $\psi_1^P \equiv \frac{\left(P_M^*/P\right)[\beta^*(1+\rho)(Q_M/P)-1]}{1+\left(P_M^*/P\right)[\beta^*(1+\rho)(Q_M/P)-1]}$, $\psi_2^P \equiv \frac{\left(P_M^*/P\right)[\beta^*((1+\rho)(Q_M/P)+1)-1]}{1+\left(P_M^*/P\right)[\beta^*(1+\rho)(Q_M/P)-1]}$ and $Q_M \equiv \alpha_\pi/\alpha_{\pi M}^2 + 1/\nu^2 + 1/\alpha_g$. For other definitions, see Table 1.