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Monetary Policy and Public Finances: Inflation Targets in a New Perspective

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Abstract

This paper considers the interaction between the private sector, the monetary authority, and the fiscal authority, and concludes that unrestricted central bank independence may not be an optimal way to collect seigniorage revenues or stabilize supply shocks. Moreover, the paper shows that the implementation of an optimal inflation target results in optimal shares of government finances—seigniorage, taxes, and the spending shortfall—from society's point of view but still involves suboptimal stabilization. Even if price stability is the sole central bank objective, a positive inflation target has important implications for the government's finances, as well as for stabilization.

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I. INTRODUCTION

This paper considers the implications of the interplay between monetary and fiscal policies in an inflation-targeting framework. In this vein, the paper asks the following question: can an inflation target induce an independent central bank to provide the optimal rate of inflation, resulting in optimal seigniorage, taxes, public spending, and output? Does this also lead to optimal stabilization of aggregate supply shocks? The answer to the former is yes, while the answer to the latter is no, and our paper shows why.

These issues have been analyzed in three ways. First, there is a strand of literature that focuses on the interaction between monetary policy and the private sector, and thus on the credibility/flexibility trade-off.² However, this approach fails to take into account the impact of monetary policy on public finances. Second, authors who have explicitly modeled the interaction between monetary and fiscal policy have done so in a deterministic framework. This approach has the weakness of disregarding the implications of aggregate supply shocks.³ Finally the inflation target literature aims at resolving the time inconsistency problem of monetary policy⁴ but tends to overlook the fact that inflation targets could be used as a way of providing the optimal level of seigniorage. Our aim here is to merge these ideas to derive implications for the optimal policy mix and the optimal policy response to a supply shock.

The paper extends the work by Beetsma and Bovenberg (1997) by allowing for an aggregate supply shock and by investigating the merits of inflation targets for public finances when the government interacts with an independent central bank. Beetsma and Bovenberg (1997), following along the lines of Alesina and Tabellini (1987), stress the importance of public debt and assume a constant ratio of real base money holdings to nondistortionary output, that is, the inverse of velocity.⁵ Within this framework, they analyze the implications of alternative institutional arrangements—centralization versus decentralization, Nash versus Stackelberg—for society's welfare. Whichever arrangement is preferable depends on society's preferences for inflation, output and public spending, as well as the structural parameters of the economy, such as real base money holdings and outstanding public debt.

²See, for example, Barro and Gordon (1983), Rogoff (1985), Lohmann (1992) and Alesina and Grilli (1992).

³See, for example, Tabellini (1986 and 1988), Alesina and Tabellini (1987), Jensen (1994), and Beetsma and Bovenberg (1997). Exemptions are Debelle and Fischer (1994), and Beetsma and Bovenberg (forthcoming).

⁴See, for example, Svensson (1995).

⁵This parameter is assumed to be unity in the Alesina and Tabellini (1987) and Debelle and Fischer (1994) models.

This paper extends this analysis in several directions. First, it considers the link between monetary and fiscal policies in a stochastic model, that is, it includes an aggregate supply shock. Second, it provides intuition as to why it makes a difference whether the government faces a constrained optimization problem in which public spending is one of the arguments in the government's objective function, or whether public expenditure is given as a residual by substituting the budget constraint into the policymakers' objective functions. The constrained problem implies that governments are able to choose their optimal level of public spending, which we believe is more realistic. What is more important, it follows that the central bank, when decentralizing its policies, does not automatically internalize the government's budget constraint. Thus it does not make a difference whether the bank cares about public spending, which is in contrast to the existing literature (e.g., Alesina and Tabellini, 1987; and Debelle and Fischer, 1994.⁶ We then show how an inflation target can bring society closer to the second-best equilibrium. This is to say that the inflation target serves as a substitute for the central bank's not taking account of the government's budget constraint. The paper's final extension is to analyze an "extreme" interpretation of the Maastricht proposal of price stability as the main objective of the European Central Bank (ECB) on a national basis. Again, a positive inflation target has interesting implications for smoothing the government's financing requirement over the sources of finance, as well as for stabilization.

Our analysis is formulated as a game between the private sector, the monetary authority and the fiscal authority. The main results can be summarized as follows. A social planner, when in charge of monetary and fiscal policy, can achieve only a second-best equilibrium as we rule out lump-sum taxes.⁷ The social planner then has to use alternative sources of finance—distortionary taxes, seigniorage and the shortfall of public expenditure from its desired target. Aggregate supply shocks causes inflation, taxes, spending, and output to fluctuate (second best) optimally around their respective means. Decentralization then affects the means as well as the stabilization components of the sources of finance in an undesirable way. However, if the central bank is required to implement an optimal inflation target, the central bank can be induced to provide exactly the optimal level of seigniorage although its failure to take account of the government's budget constraint still results in suboptimal stabilization.

The remainder of the paper is organized as follows. Section 2 sets up the basic model. Section 3 considers the social planner's problem as a benchmark case. Section 4 explores the decentralized setting and the implications of inflation targets. Section 5 analyzes an "extreme" form of the Maastricht proposal for monetary policy; a framework, in which the central bank only cares about inflation. Section 6 concludes the paper and gives some ideas of how to extend our model. The appendixes provide derivations in support of our findings.

⁶Except in the case where the central bank would be "Stackelberg" leader with respect to the government.

⁷For an analysis with lump-sum taxes in the deterministic case, see Beetsma and Bovenberg (1997), and, in the stochastic case, Beddies (1997).

II. THE SETUP

The model has three players, namely, the private sector (represented by a trade union), the monetary authority (central bank), and the fiscal authority (government).⁸ The objective of the trade union is to minimize deviations of the real wage rate from a particular target. For convenience and without loss of generality, this real wage target is normalized to zero. Thus, trade unions set the log of the nominal wage rate equal to the expected price level, that is, $w=p^e$. To give the monetary and fiscal authorities an incentive to engage in surprise inflation, nominal wage contracts are assumed to be signed before the policies are selected. Our model is stochastic rather than deterministic, in contrast to Beetsma and Bovenberg (1997) and Alesina and Tabellini (1987). Thus, we allow for the possibility that the economy can be hit by shocks. Given these assumptions, normalized output, y , is given by⁹

$$y = \pi - \pi^e - \tau + \epsilon, \quad (1)$$

where y is the log of real output, π and π^e denote the actual and expected rate of inflation, respectively, τ is the tax rate on output, and ϵ is an aggregate supply shock, distributed normally with zero mean and variance σ_ϵ^2 . From (1), it follows that in a rational expectations equilibrium, where $E_{t-1}(\pi_t) = \pi_t^e$, the long run expected output level, denoted by the unconditional mean $E(y)$, is equal to $-\tau$. To achieve $E(y) = 0$, one has to remove the distortions arising from output taxation. We also allow for nontax distortions, which are measured by $y^* > 0$.¹⁰ Note that y^* represents the first-best level of output in the absence of any distortion. Hence the first best output level y^* can be achieved only by removing both the tax and the nontax distortions. The natural way to achieve the first best and to remove these distortions would be to subsidize output by setting $y^* = -\tau$, whereby the negative tax represents the subsidy on output. This results in $E(y) = y^*$, which offsets the implicit tax on output caused by the nontax distortions.

⁸The basic model uses the framework of Beetsma and Bovenberg (1997). Also, see Beddies (1997).

⁹This is pretty standard in the literature. See, e.g., Debelle and Fischer (1994) and Beddies (1997) for the case with shocks, and Beetsma and Bovenberg (1997) and Alesina and Tabellini (1987) for the case without shocks.

¹⁰This could be labor market union power and/or goods market monopoly power. See Beetsma and Bovenberg (1997), who consider those nontax distortions as an implicit tax on output.

The preferences of the society are specified in a social loss function defined over inflation, output, and public spending.¹¹ The social loss function is given by

$$L_S = \frac{1}{2} \{ \xi_S \pi^2 + (y - y^*)^2 + \mu_S (g - g^*)^2 \}, \xi_S, \mu_S > 0, \quad (2)$$

where ξ_S is the weight that the society places on inflation and μ_S represents the weight that the society places on public spending, both relative to the output objective; π is the rate of inflation; y is the log of real output as defined in (1); y^* represents the first-best nondistortionary level of output; g is public spending; and, finally, g^* denotes the spending target. For simplicity, the target inflation rate is assumed to be zero.¹² The social loss (2) is assumed to be an increasing function of the deviation from targets.

The loss functions of the fiscal and the monetary authority can be defined in a similar way:

$$L_F = \frac{1}{2} \{ \xi_F \pi^2 + (y - y^*)^2 + \mu_F (g - g^*)^2 \}, \xi_F, \mu_F > 0, \quad (3)$$

$$L_M = \frac{1}{2} \{ \xi_M \pi^2 + (y - y^*)^2 + \mu_M (g - g^*)^2 \}, \xi_M, \mu_M > 0. \quad (4)$$

The weights, corresponding to the respective targets in the social, the central bank's, and the government's loss function, may or may not differ.

Within this public finance framework, the government has to choose its policies subject to a budget constraint. This budget constraint in terms of shares of nondistortionary output is given by¹³

$$g + (1+r)b + (1+r+\pi^e - \pi)d = \tau + k\pi, \quad (5)$$

where g denotes government spending, b is the outstanding stock of indexed single-period government debt and d represents the initial real value of nonindexed single-period debt. The

¹¹For an identical treatment of the social loss function, see, for example, Alesina and Tabellini (1987), Jensen (1994), Beetsma and Bovenberg (1997), and Beddies (1997).

¹²In Sections IV and V, we explore the situation where the central bank is allowed to have a positive inflation target.

¹³See Appendix I for details. In deriving this budget constraint, we follow Beetsma and Bovenberg (1997). However, we do not analyze the case of unlimited access to lump-sum taxes. See Beddies (1997) on this issue considered within a stochastic model.

right-hand side of (2) represents the sources of revenue. Thereby τ is the revenue from distortionary taxes and $k\pi$ is the revenue from seigniorage, with $k \geq 0$ as the constant ratio of real money holdings and nondistortionary output. The key assumption underlying this budget constraint is that all debt sold at the end of the previous period has to be repaid, while no new debt is issued in the present period. One can interpret this as a two-period game in which we are interested only in the last period. This assumption has the advantage of simplifying the algebra substantially. Hence we neglect the issue of the intertemporal allocation of tax distortions, inflation, and public spending. In order to ensure that there is a demand for government debt, the return on indexed debt must be at least as high as the real ex ante return on an outside investment opportunity, r . Regarding the nominal debt, investors set expected inflation as a markup on the real ex ante rate r ; thus, the nominal interest rate on nonindexed debt is $r + \pi^e$.¹⁴ To ensure a clear separation between the government's sources of finance and the expenditures that have to be financed by these sources, that is, the government's financing requirement, let us rewrite the budget constraint (5):¹⁵

$$F \equiv g^* + y^* + (1+r)(b+d) = (\tau + y^*) + k\pi + (g^* - g) + (\pi - \pi^e)d. \quad (6)$$

The government has to finance the spending target, the output subsidy to (partly) offset the labor market distortions, y^* , and the repayment and servicing costs of the indexed and the nominal debt. The right-hand side of equation (6) accounts for the source of finance: "revenues" from inflating away nominal debt, $(\pi - \pi^e)d$, revenues via the shortfall of public spending from its target $(g^* - g)$, seigniorage revenues $k\pi$, and, finally, revenues from explicit and implicit taxes on output, $(\tau + y^*)$.¹⁶ Throughout the paper, we assume that the financing requirement does not exceed production. Finally, the private sector's expectations are assumed to be rational and hence satisfy (conditional on the information set available in the previous period, $t-1$, that is, containing all information up to and including period $t-1$) the following:

$$E_{t-1}(\pi_t) = \pi_t^e. \quad (7)$$

¹⁴See, for example, Dornbusch (1996).

¹⁵We simply add the spending and the output target on both sides in (5) and rearrange terms.

¹⁶Labor market distortions are measured by the deviation of the first-best output level, y^* , from the actual output level, y , in the absence of any tax distortions, where $E(y)$ would be zero.

III. A BENEVOLENT POLICYMAKER

This section shall serve as a benchmark case against which we can judge alternative outcomes in the decentralized policy setting. Suppose that a committed benevolent policymaker is in charge of setting monetary and fiscal policies. She thus can take account of the private sector's expectations. The optimization problem is characterized by minimizing the loss function (2) subject to the budget constraint (6), to the rational expectations constraint (7) and to the supply function (1). Hence, the Lagrangian is

$$L = \min_{\pi, \pi^e, \tau, g, \lambda, \delta} \frac{1}{2} \{ \xi_S \pi^2 + (\pi - \pi^e - \tau + \varepsilon - y^*)^2 + \mu_S (g - g^*)^2 \} + \lambda [F - (\tau + y^*) - k\pi - (g^* - g) - (\pi - \pi^e)d] + \delta [E_{t-1}(\pi_t) - \pi_t^e], \quad (8)$$

where π , τ , and g are the instruments, λ is the Lagrange multiplier associated with the government's budget constraint, and δ is the Lagrange multiplier associated with the expectations constraint. Minimizing (8) with respect to π , π^e , τ , g , λ , and δ yields the following first-order conditions:

$$\xi_S \pi + (\pi - \pi^e - \tau + \varepsilon - y^*) + \lambda(-k-d) + E(\delta) = 0 \quad (9)$$

$$-(\pi - \pi^e - \tau + \varepsilon - y^*) + \lambda d - \delta = 0 \quad (10)$$

$$-(\pi - \pi^e - \tau + \varepsilon - y^*) - \lambda = 0 \quad (11)$$

$$\mu_S (g - g^*) + \lambda = 0 \quad (12)$$

$$F - (\tau + y^*) - k\pi - (g^* - g) - (\pi - \pi^e)d = 0 \quad (13)$$

$$E_{t-1}(\pi_t) - \pi_t^e = 0. \quad (14)$$

Combining equations (10), (11), and (12) with equation (13), taking expectations (note that $E_{t-1}(\pi_t) = \pi_t^e$, (14)), and using (9), we obtain:

$$E(\delta) = (F - k\pi^e) \left[\frac{\mu_S(1+d)}{1+\mu_S} \right] = F \frac{\mu_S \xi_S (1+d)}{\xi_S + \xi_S \mu_S + \mu_S k^2}, \quad (15)$$

where (15), the expectations of the Lagrange multiplier associated with the expectations constraint, is the (average) marginal cost of expected inflation. Thus, within this commitment

framework, the policymaker understands that the benefit of higher inflation comes at the cost of higher average expected inflation. This cost is reflected in the right-hand side of (15). For example, a higher financing requirement, F , makes seigniorage more valuable but at the same time increases the marginal cost of expected inflation. At the optimum, costs and benefits have to be equal. Substituting (15) into (9), solving the above first-order conditions, and imposing rational expectations (7), we obtain the following equilibrium policy outcomes for seigniorage/inflation, taxes, public spending, and output:

$$k\pi = \frac{k^2 \mu_S F}{\xi_S + \xi_S \mu_S + \mu_S k^2} - \frac{\mu_S k(1+k+d)}{\xi_S + \xi_S \mu_S + \mu_S (1+k+d)^2} \epsilon \quad (16)$$

$$\tau + y^* = \frac{\mu_S \xi_S F}{\xi_S + \xi_S \mu_S + \mu_S k^2} + \frac{\xi_S + \mu_S [(k+d)(1+k+d)]}{\xi_S + \xi_S \mu_S + \mu_S (1+k+d)^2} \epsilon \quad (17)$$

$$g^* - g = \frac{\xi_S F}{\xi_S + \xi_S \mu_S + \mu_S k^2} - \frac{\xi_S}{\xi_S + \xi_S \mu_S + \mu_S (1+k+d)^2} \epsilon \quad (18)$$

$$y^* - y = \frac{\mu_S \xi_S F}{\xi_S + \xi_S \mu_S + \mu_S k^2} - \frac{\mu_S \xi_S}{\xi_S + \xi_S \mu_S + \mu_S (1+k+d)^2} \epsilon. \quad (19)$$

As we abstracted from the unlimited access to lump-sum taxes, the above equilibrium is second best. In contrast to the literature dealing with policy games between the monetary authority and the private sector, our second-best optimal solution here involves optimal positive mean inflation. Depending on the size of k , it appears to be optimal to tax real base money holdings to some extent, in order to finance part of the public expenditures.¹⁷

By inspection of equations (16)–(19), one can verify that a higher government financing requirement results in higher means of inflation and explicit taxes, while reducing the mean of public expenditure. Moreover, output moves further away from its target, because of increased taxes, while the optimal relative variability between inflation, taxes, spending, and output is not affected. Hence, supply-side shocks are smoothed out over output and the three sources of finance, independent of the financing requirement. The social loss necessarily increases with a raise in the financing requirement, as all actual outcomes are further away from their respective targets (see Appendix II on the social loss).

Societies with a lower k (that is, higher velocity) experience a lower optimal mean and a lower variance of seigniorage (16) because the taxable base is smaller. Thus, in these

¹⁷In Andrabi (1997), seigniorage passively adjusts to the budget constraint as a residual tax, while we are treating it as an instrument. However, his setup is purely decentralized.

countries, seigniorage is of less importance than in countries where real base money holdings are higher and, hence, the base for the inflation tax is larger. When regarding output deviations (19) and spending deviations (18) from their respective targets, the opposite is true. Means and variances are higher if k is smaller. Not surprisingly, the mean of implicit and explicit taxes (17) also increases when k becomes smaller, while its variance decreases.¹⁸ The consequence of reduced accessibility to seigniorage is that the government's financing requirement has to be met by less spending and increased taxes, resulting in a larger gap between actual output and its nondistortionary target. The same argument applies to the task of stabilizing supply shocks. In the limit, when k tends to zero, it is no longer optimal to use seigniorage as a source of finance. Hence, inflation responds only to the supply shock to maintain the optimal relative variability between output, inflation, and the remaining financing sources. As a result, F needs to be financed entirely by implicit and explicit output taxes and by the shortfall of spending from its target.

If society views inflation as especially important and consequently increases the weight attached to inflation, ξ_s , it can reduce the mean of inflation as well as its variance. However, this "gain" comes at the cost of higher mean distortionary taxes and, hence, less output, and it also moves public spending away from its target. It further induces output and spending to be more variable, and thus transfers the burden of stabilizing shocks from inflation to output and spending. The impact of different inflation weights on the variance of distortionary taxes depends on the parameters but has a likely negative sign, if society cares sufficiently about spending as well.¹⁹

A higher weight on public spending, μ_s , decreases the gap between public spending and its target and reduces its variance. This implies that the means of seigniorage, output and distortionary taxes have to increase in order to meet the financing requirement, because being more concerned about public spending diminishes its value as a financing source. The task of smoothing out the supply shock is increasingly transferred to inflation and output. The tax variance, however, is decreasing in the spending weight, μ_s , in order not to put additional pressure on output.

Higher nominal debt ratios undoubtedly increase the government's financing requirement. As a result, seigniorage/inflation is higher, distortionary taxes increase, and output as well as public expenditures move further away from their respective targets. The fact that the supply shock is positively related to output and thus to taxation implies that debt is positively related to taxes, reducing the impact on output. The same argument holds for public spending. The

¹⁸The effect on the tax variance stems from the reduced inflation variance, which is already putting pressure on output stabilization.

¹⁹More precisely, the tax variance is decreasing in the inflation weight if $\mu_s(k+d) > 1$.

impact of higher nominal debts on inflation is ambiguous but has a likely negative sign.²⁰ This implies that the negative inflation response to the supply shock should be smaller. The economics behind this result is that unanticipated inflation is valuable for decreasing the real value of the nominal debt, which has to be repaid. However, as a positive shock reduces inflation, higher nominal debts imply that this response should be smaller.

IV. THE IMPACT OF CENTRAL BANK INDEPENDENCE ON PUBLIC FINANCES

In this section, we investigate an institutional arrangement in which the central bank is independent of the government. The underlying assumption here is that the monetary and the fiscal authorities move simultaneously; hence, they act in a (noncooperative) Nash fashion. The aim of this section is to investigate the possible advantages of inflation targets in improving society's welfare.

A. Monetary Commitment: No Inflation Target

Many authors have argued that the inflation bias story is overdone. Why should an independent central bank have an incentive to fool the private sector if it does not help anyone?²¹ In this vein, we assume that the central bank is committed to sticking to the ex ante optimal policy. Thus, its optimization problem is characterized by minimizing the loss function (4), subject to the rational expectations constraint (7) and the supply function (1). The Lagrangian is hence given by

$$L = \min_{\pi, \pi^e, \delta} \frac{1}{2} \{ \xi_M \pi^2 + (\pi - \pi^e - \tau + \epsilon - y^*)^2 + \mu_M (g - g^*)^2 \} + \delta [E_{t-1}(\pi_t) - \pi_t^e], \quad (20)$$

where π is the central bank's instrument and δ is the Lagrange multiplier associated with the rational expectations constraint. Minimizing (20) with respect to π , π^e and δ , we obtain the following first-order conditions:

$$\xi_M \pi + (\pi - \pi^e - \tau + \epsilon - y^*) + E(\delta) = 0 \quad (21)$$

$$-(\pi - \pi^e - \tau + \epsilon - y^*) - \delta = 0 \quad (22)$$

²⁰ That is, the effect is negative if $(1+k+d)^2/\xi_S > 1+1/\mu_S$.

²¹ See, for example, McCallum (1995), Clark, Goodhart, and Huang (1996), and Blinder (1997) on this issue.

$$E_{t-1}(\pi_t) - \pi_t^e = 0. \quad (23)$$

Note that the above first-order conditions show that it makes no difference whether the central bank cares about spending or not, that is, it does not matter whether $\mu_M=0$ or not. The government's optimization problem is given by minimizing the loss function (3), subject to the budget constraint (6) and the supply function (1).²² Thus the Lagrangian is

$$L = \min_{\tau, g, \lambda} \frac{1}{2} \{ \xi_F \pi^2 + (\pi - \pi^e - \tau + \epsilon - y^*)^2 + \mu_F (g - g^*)^2 \} \\ + \lambda [F - (\tau + y^*) - k\pi - (g^* - g) - (\pi - \pi^e)d]. \quad (24)$$

By minimizing (24) with respect to τ , g , and λ , we obtain the following first-order conditions:

$$-(\pi - \pi^e - \tau + \epsilon - y^*) - \lambda = 0 \quad (25)$$

$$\mu_F (g - g^*) + \lambda = 0 \quad (26)$$

$$F - (\tau + y^*) - k\pi - (g^* - g) - (\pi - \pi^e)d = 0. \quad (27)$$

The equivalent of (15) in Section III is obtained by combining (22), (25) and (26) with (27), taking expectations (note that $E_{t-1}(\pi_t) = \pi_t^e$, (23)) and using (21):

$$E(\delta) = (F - k\pi^e) \left[\frac{\mu_F}{1 + \mu_F} \right] = F \frac{\mu_F}{1 + \mu_F}, \quad (28)$$

where (28) is the (average) marginal cost of expected inflation. Note that central bank independence implies that the central bank does not internalize the government's budget constraint and thus does not have any temptation to devalue the nonindexed debt d . Technically, the term $(1+d)$ in equation (15) does not appear in (28). Substituting (28) into (21), using (25)–(27) and assuming that $\mu_F = \mu_S$, we can solve for the policy outcomes:

$$k\pi = - \frac{\mu_S k}{\xi_M + \xi_M \mu_S + \mu_S (1 + k + d)} \epsilon \quad (29)$$

²² Note that the government does not choose inflation. Thus it cannot take account of the private sector's rational expectations.

$$\tau + y^* = \frac{\mu_S F}{1 + \mu_S} + \frac{\xi_M + \mu_S(k+d)}{\xi_M + \xi_M \mu_S + \mu_S(1+k+d)} \epsilon \quad (30)$$

$$g^* - g = \frac{F}{1 + \mu_S} - \frac{\xi_M}{\xi_M + \xi_M \mu_S + \mu_S(1+k+d)} \epsilon \quad (31)$$

$$y^* - y = \frac{\mu_S F}{1 + \mu_S} - \frac{\mu_S \xi_M}{\xi_M + \xi_M \mu_S + \mu_S(1+k+d)} \epsilon. \quad (32)$$

Decentralization here has obvious effects. The central bank does not internalize the budget constraint of the government and hence ignores the social value of seigniorage as a source of finance.²³ As is easily seen from (29), inflation—and thus seigniorage—merely fluctuates around a zero mean. Hence, the zero inflation rules, as, for example, studied by Rogoff (1985) and Lohmann (1992), fail to consider that, as long as base money holdings are positive, inflation has some social value as a source of taxation. As a result, the entire burden of meeting the government's financing requirement rests on distortionary taxes, leading to a greater output shortfall, caused by insufficient subsidies, and the spending shortfall.

This result can also be looked at in a more technical manner. We are dealing with a constrained optimization problem, in which the government chooses its policies subject to a budget constraint. In contrast to this view, some other authors, such as Alesina and Tabellini (1987), Jensen (1994), Debelle and Fischer (1994), and Huang and Padilla (1995), transform the constrained optimization problem into an unconstrained one by substituting the budget constraint into the loss function (via spending). As a result, a central bank has to internalize the government's budget constraint if it cares about public spending ($\mu_M > 0$).²⁴ We believe that public expenditure is an important choice variable and should not be treated as a residual of the choices of inflation and taxes, especially when policies are decentralized. The European Economic and Monetary Union (EMU), for example, leaves public expenditure decisions in the hands of national governments while assigning inflation decisions to an independent ECB.

Assuming that $\xi_M = \xi_S$, we find that stabilization also differs from the second best. With an independent central bank, the variance of inflation/seigniorage is lower, while the output and spending variances are higher (compare (16), (18), and (19) with (29), (31), and (32)). The intuition behind this result is as follows. As the central bank does not internalize the government's budget constraint, it fails to account for the effect of unanticipated inflation on the value of repayable nominal debt. For that reason, inflation responds to a lower extent to the

²³Also, see Beetsma and Bovenberg (1997) and Beddies (1997).

²⁴This argument necessarily disappears in the centralized setting.

supply shock, producing a higher variability of output and spending. Furthermore, the variance of implicit and explicit taxes ($\tau+y^*$) is only lower with the independent central bank if $\mu_s(k+d)>1$ (see (17) and (30)). Thus, it appears that low-debt countries can achieve a lower variability of their tax system by centralizing policies. High-debt countries, however, are better off in terms of the tax variability by decentralizing policies, given that k is equally low.

The impact of a change in the structural parameters of the economy, k and d , and the political parameters, ξ_s and μ_s , on the means and the variances of seigniorage, taxes, the spending shortfall, and the output shortfall are the same as discussed in Section III, except for two important differences. First, the mean sources of finance in the decentralized setting do not depend upon k . However, in the limit, if k tends to zero, that is, seigniorage is of insignificant importance, decentralization “seems” to be attractive. The means of the sources of finance (seigniorage, taxes and the spending shortfall) coincide with those under centralized commitment (compare (16)–(19) with (29)–(32) for $k \rightarrow 0$). Second, the variance of inflation/seigniorage is strictly decreasing in d , no matter how important the society views public spending and output relative to inflation. The reason for this result is that the central bank does not balance the impact of unanticipated inflation on repayable nominal debt against the preferences of society.

Regarding the welfare of the society, we find that within this setup benevolent policymaking strictly dominates central bank independence (see Appendix II for details).

B. Monetary Commitment: An Optimal Inflation Target

In practice, most central banks, at least in the industrialized countries, are more or less independent of the government. Some governments, however, still have the power to set the targets for their national monetary policy, as is the case, for example, in the United Kingdom. We will use this observation to examine whether the finance dilemma analyzed above can be solved by the use of an inflation target. Suppose the central bank would choose its policy subject to the following objective function:

$$L = \frac{1}{2} \{ \xi_M (\pi - \pi^T)^2 + (y - y^*)^2 + \mu_M (g - g^*)^2 \}, \xi_M, \mu_M > 0, \quad (33)$$

where the only difference from (4) is the target inflation rate π^T . Going through the same steps as earlier, we can show that by setting π^T equal to $k\mu_s F / (\xi_s + \xi_s \mu_s + \mu_s k^2)$ and assuming that $\mu_F = \mu_s$ and $\xi_M = \xi_s$, the optimal inflation rate resulting from benevolent policymaking (Section III) can be obtained:

$$k\pi = \frac{k^2 \mu_s F}{\xi_s + \xi_s \mu_s + \mu_s k^2} - \frac{\mu_s k}{\xi_s + \xi_s \mu_s + \mu_s (1+k+d)} \epsilon \quad (34)$$

$$\tau + y^* = \frac{\mu_S \xi_S F}{\xi_S + \xi_S \mu_S + \mu_S k^2} + \frac{\xi_S + \mu_S (k+d)}{\xi_S + \xi_S \mu_S + \mu_S (1+k+d)} \epsilon \quad (35)$$

$$g^* - g = \frac{\xi_S F}{\xi_S + \xi_S \mu_S + \mu_S k^2} - \frac{\xi_S}{\xi_S + \xi_S \mu_S + \mu_S (1+k+d)} \epsilon \quad (36)$$

$$y^* - y = \frac{\mu_S \xi_S F}{\xi_S + \xi_S \mu_S + \mu_S k^2} - \frac{\mu_S \xi_S}{\xi_S + \xi_S \mu_S + \mu_S (1+k+d)} \epsilon. \quad (37)$$

The major drawback of this analysis is that the implementation of a positive inflation target results in the optimal mean shares of finance, as if a benevolent policymaker had chosen monetary and fiscal policies. However, stabilization is still suboptimal compared to the benevolent case.²⁵ The fact that our inflation target is optimal, in the sense that it ensures the optimal share of finances, is best seen by looking at the parameter k . If $k=0$, we have shown in Section III that the optimal inflation rate—and, thus seigniorage—is zero. It is easily verified from the above analysis that, in this scenario, our optimal inflation target becomes zero, resulting in mean shares of finance, as if the benevolent policymaker would have been in charge.

Regarding society's welfare, the targeting regime of this section is still inferior to that of the social planner. However, a comparison between the losses resulting from pure central bank independence and central bank independence with the optimal inflation target shows that the targeting regime dominates the regime without the inflation target (see also Appendix II).

V. INFLATION AS THE SOLE OBJECTIVE OF MONETARY POLICY

The desire of (some) European countries to establish an ECB that is especially concerned about inflation, that is, concerned about low and stable prices, is our motivation for this section. On a national level, the monetary requirement for participating in EMU is the establishment of an independent central bank whose main concern is seen to be inflation. Following along these lines, we wish to consider a(n) (extreme) central bank that is only concerned about

²⁵The issue here is not that there is an inflationary bias that has to be removed, as in the Svensson (1995) inflation target model, where a negative or a lower inflation target than the optimal one is needed to achieve society's desired inflation rate.

inflation.²⁶ This case is represented by the specification in (38) below.²⁷ Technically, this coincides with the assumption of an infinitely conservative central banker.

A. A General Inflation Target

Let the modified objective function of the (conservative) central bank take the following form:²⁸

$$L_M^C = \frac{1}{2} [\pi - \pi^T]^2, \quad (38)$$

where π^T denotes the central bank's inflation target. Given (38), we can immediately establish the solution to the central bank's problem:

$$\pi = \pi^T, \quad (39)$$

which implies that inflation is always at its target. The government still faces the optimization problem of the previous section. Thus, its first-order conditions are still given by the equations (25)–(27). Solving (39) and (25)–(27) jointly and imposing the condition of rational expectations, (7), we arrive at (assuming that $\mu_F = \mu_S$) the following:

$$k\pi = k\pi^T = k\pi^e \quad (40)$$

$$\tau + y^* = -\frac{\mu_S k\pi^T}{1 + \mu_S} + \frac{\mu_S F}{1 + \mu_S} + \frac{1}{1 + \mu_S} \epsilon \quad (41)$$

$$g^* - g = -\frac{k\pi^T}{1 + \mu_S} + \frac{F}{1 + \mu_S} - \frac{1}{1 + \mu_S} \epsilon \quad (42)$$

$$y^* - y = -\frac{\mu_S \pi^T}{1 + \mu_S} + \frac{\mu_S F}{1 + \mu_S} - \frac{\mu_S}{1 + \mu_S} \epsilon. \quad (43)$$

These results, characterized in equations (40)–(43), have some interesting implications. Whatever target inflation rate the central bank has in mind, inspection of (41) immediately shows that any positive rate of inflation reduces the necessity for distortionary taxes, as long as k is

²⁶Nevertheless, in terms of the loss function, Alesina and Grilli (1992), when examining the (future) ECB, follow Kydland and Prescott (1977), Barro and Gordon (1983), and Rogoff (1985).

²⁷Note that an arrangement such as EMU coincides with one of centralized monetary policy and decentralized fiscal policy. See, for example, Sibert (1994).

²⁸Rankin (1998) also captures the idea of (extreme) conservatism in this way. However, he does not consider the possibility of having a positive inflation target or shocks.

positive. Furthermore, output and public spending are closer to their respective targets ((42) and (43)). However, the above-derived solution also reveals that the entire burden of stabilizing the aggregate supply shock lies on fiscal policy and output. The reason for this is that unanticipated inflation is not available. The central bank does not care about output, given the specified loss function (38). Necessarily a government concerned about meeting fiscal criteria such as those defined in the Maastricht Treaty faces trade-offs among higher taxes, lower expenditures, and lower output subsidies.

B. A Specific Inflation Target

Let us now turn to the central bank's inflation target, π^T . If the government can impose an inflation target that exactly provides the desired level of seigniorage, as specified in the second-best equilibrium of Section III, straightforward calculation reveals that

$$k\pi = \frac{k^2\mu_S F}{\xi_S + \xi_S\mu_S + \mu_S k^2} \quad (44)$$

$$\tau + y^* = \frac{\mu_S \xi_S F}{\xi_S + \xi_S\mu_S + \mu_S k^2} + \frac{1}{1 + \mu_S} \epsilon \quad (45)$$

$$g^* - g = \frac{\xi_S F}{\xi_S + \xi_S\mu_S + \mu_S k^2} - \frac{1}{1 + \mu_S} \epsilon \quad (46)$$

$$y^* - y = \frac{\mu_S \xi_S F}{\xi_S + \xi_S\mu_S + \mu_S k^2} - \frac{\mu_S}{1 + \mu_S} \epsilon, \quad (47)$$

which gives us the same shares of the mean financing sources as in the case where the benevolent policymaker was in charge. However, as the central bank is assumed to care only about inflation, the inflation target cannot achieve optimal stabilization. Thus, extreme forms of central bank independence might not be optimal.²⁹ Depending on the size of k , seigniorage should be a part of finance. The above-specified target ensures that, if $k \rightarrow 0$ in the limit, the seigniorage motive as well as inflation vanishes.³⁰ Thus, the commitment/discretion discussion

²⁹See, for example, Goodhart (1993) for an excellent discussion of the issue of central bank independence.

³⁰The reason for this result is that the optimal inflation target in this scenario is zero. Note that this has nothing to do with the Svensson (1995) approach, where a "negative" inflation target (continued...)

is not an issue as long as the government sticks to the inflation target. If the government cares about staying in office, why should it then try not to act in the interest of the private sector? In that connection, Goodhart (1993) states: "As Lincoln said, you cannot fool all of the people all of the time."³¹ However, the social loss under this arrangement is higher than it would be in the case in which the bank also cares about output stabilization (again, see Appendix II for details).

VI. CONCLUSION

In this paper, we have focused on the interplay between monetary and fiscal policies within a stochastic framework. Our contribution to the literature is the examination of the explicit inclusion of issues of stabilization in a public finance framework and the implications of inflation targets for public finances. We conclude that unrestricted central bank independence may not be optimal from society's point of view, regardless of whether the bank cares only about inflation or about both output and inflation. In terms of society's welfare, we showed that, in the absence of a benevolent policymaker, the most appealing solution is to implement an optimal inflation target for the independent central bank, given that the bank also cares about output.

Given the way we specified the preferences of society and the policymakers, neither a fully independent central bank without the above specified optimal inflation target nor a central bank that cares only about inflation (even if given an optimal inflation target) will generate a preferable outcome from society's point of view, compared with an independent central bank mindful of all arguments in society's loss function and having an optimal inflation target.

In this paper, we assumed that all debt has to be repaid within the current period. In light of EMU our model could be extended to investigate the Maastricht deficit criterion by allowing for debt accumulation. Our model could also be extended to allow for fiscal policy interactions between sovereign fiscal authorities within the union, which together interact with the centralized monetary authority, the ECB. Thus one could focus on the public good character of fiscal policy. Since the European Community lacks a powerful federal government, one could investigate a situation in which the decentralized fiscal authorities can build coalitions to minimize the spillover effects of their fiscal decisions into other union countries. However, these issues are left for future research.

³⁰(...continued)

(given that society's inflation target is zero) is required in order to remove the inflationary bias. Our positive inflation target is designed to provide the government with optimal seigniorage revenues, as in the previous section.

³¹Goodhart (1993, p. 8).

DERIVATION OF GOVERNMENT BUDGET CONSTRAINT

As in Beetsma and Bovenberg (1997), real money balances in period t are given by $M_t/P_t = kY^*$, where Y^* is the output level in absence of any distortions (the antilog of y^*) and $k \geq 0$ is the constant ratio of real money holdings and nondistortionary output (given by $k = M_t/(P_t Y^*)$). Hence, we have $(M_t - M_{t-1})/M_t = (P_t - P_{t-1})/P_t$.¹ Under the assumption that the tax distortions are not too large, we can approximate revenues from distortionary taxes by $\tau_t P_t Y^*$.² Lump-sum taxes are given by $\theta_t P_t Y^*$. Denoting by G_t the level of government spending, by B_t the amount of indexed single-period debt, by D_t the amount of nonindexed single-period debt sold at the end of the previous period against the price P_{t-1} and interest rates r_{Bt} and r_{Dt} respectively, and, finally, by $(M_t - M_{t-1})$ the increase in the nominal money supply, the nominal government budget constraint is given by³

$$P_t G_t + (1 + r_{Bt}) P_t B_t + (1 + r_{Dt}) P_{t-1} D_t = \tau_t P_t Y^* + \theta_t P_t Y^* + (M_t - M_{t-1}) + P_t (B_{t+1} + D_{t+1}). \quad A1$$

Dividing (A1) by $P_t Y^*$, using the result $\pi_t = (P_t - P_{t-1})/P_t$ and approximating $(1 + r_{Dt}) P_{t-1}/P_t$ by $(1 + r_{Dt} - \pi_t)$, the government budget constraint (A1) can be rewritten in terms of shares of nondistortionary output:

$$g_t + (1 + r_{Bt}) b_t + (1 + r_{Dt} - \pi_t) d_t = \tau_t + \theta_t + k \pi_t + b_{t+1} + d_{t+1}. \quad A2$$

In order to ensure that investors are willing to buy government debt, the interest rate on indexed debt should be as high as the ex ante real rate of return of an outside investment opportunity, r , say. Regarding nominal, nonindexed debt the investor simply sets expected inflation as a markup on this ex ante real rate r to compensate for any expected inflation during the maturity of the debt. Hence, the nominal interest rate on nonindexed government debt is equal to $r + \pi^e$. Thus the government budget constraint stated in (A2), dropping time subscripts and assuming that *no new debt* is issued, satisfies

$$g + (1 + r)b + (1 + r + \pi^e - \pi)d = \tau + \theta + k\pi,$$

which is the budget constraint stated in equation (5) in the text.

¹The requirement for this to hold is that nondistortionary output Y^* is independent of the tax rate τ . Alesina and Tabellini (1987) or Canzoneri (1985) use an identical simplification.

²See, for example, Alesina and Tabellini (1987), who also use the approximation $Y \approx Y^*$.

³ Also, see Jensen (1994).

COMPARISON OF SOCIAL LOSS IN ALTERNATIVE CENTRAL BANKING REGIMES

This appendix compares the social loss (equation 2) under benevolent policymaking (*BP*), central bank independence (*CI*), central bank independence with an optimal inflation target (*CIT*), and central bank independence where the bank is only concerned about inflation (*CCIT*) but has an optimal inflation target. The social loss for the alternative regimes is obtained by substituting the respective policy outcomes into the social loss function (2), assuming that players share the same preferences, that is, $\xi = \xi_S = \xi_F = \xi_M$ and $\mu = \mu_S = \mu_F = \mu_M$. It is then straightforward to show that

$$\begin{aligned} L^{BP} &< L^{CIT} < L^{CI} \\ L^{BP} &< L^{CIT} < L^{CCIT} \\ &\geq \\ L^{CI} &< L^{CCIT} \end{aligned}$$

The proofs for these results are straightforward. The social loss for each regime can be calculated as

$$\begin{aligned} L^{BP} &= \frac{1}{2} \frac{\xi_S \mu_S F^2}{\xi_S + \xi_S \mu_S + \mu_S k^2} + \frac{1}{2} \frac{\xi_S \mu_S \sigma_\epsilon^2}{\xi_S + \xi_S \mu_S + \mu_S (1+k+d)^2} \\ L^{CI} &= \frac{1}{2} \frac{\mu_S F^2}{1 + \mu_S} + \frac{1}{2} \frac{\xi_S \mu_S (\xi_S + \mu_S + \xi_S \mu_S) \sigma_\epsilon^2}{(\xi_S + \xi_S \mu_S + \mu_S (1+k+d))^2} \\ L^{CIT} &= \frac{1}{2} \frac{\xi_S \mu_S F^2}{\xi_S + \xi_S \mu_S + \mu_S k^2} + \frac{1}{2} \frac{\xi_S \mu_S (\xi_S + \mu_S + \xi_S \mu_S) \sigma_\epsilon^2}{(\xi_S + \xi_S \mu_S + \mu_S (1+k+d))^2} \\ L^{CCIT} &= \frac{1}{2} \frac{\xi_S \mu_S F^2}{\xi_S + \xi_S \mu_S + \mu_S k^2} + \frac{1}{2} \frac{\mu_S \sigma_\epsilon^2}{1 + \mu_S} \end{aligned}$$

Therefore, it can be shown that

$$L^{BP} - L^{CI} = \frac{1}{2} \frac{\xi_S \mu_S F^2}{\xi_S + \xi_S \mu_S + \mu_S k^2} + \frac{1}{2} \frac{\xi_S \mu_S \sigma_\epsilon^2}{\xi_S + \xi_S \mu_S + \mu_S (1+k+d)^2} - \frac{1}{2} \frac{\mu_S F^2}{1 + \mu_S} - \frac{1}{2} \frac{\xi_S \mu_S (\xi_S + \mu_S + \xi_S \mu_S) \sigma_\epsilon^2}{(\xi_S + \xi_S \mu_S + \mu_S (1+k+d))^2} < 0$$

$$L^{BP} - L^{CIT} = \frac{1}{2} \frac{\xi_S \mu_S F^2}{\xi_S + \xi_S \mu_S + \mu_S k^2} + \frac{1}{2} \frac{\xi_S \mu_S \sigma_\epsilon^2}{\xi_S + \xi_S \mu_S + \mu_S (1+k+d)^2} - \frac{1}{2} \frac{\xi_S \mu_S F^2}{\xi_S + \xi_S \mu_S + \mu_S k^2} - \frac{1}{2} \frac{\xi_S \mu_S (\xi_S + \mu_S + \xi_S \mu_S) \sigma_\epsilon^2}{(\xi_S + \xi_S \mu_S + \mu_S (1+k+d))^2} = - \frac{1}{2} \frac{\xi_S^2 \mu_S^2 (k+d)^2 (1+\mu) \sigma_\epsilon^2}{(\xi_S + \xi_S \mu_S + \mu_S (1+k+d))^2 (\xi_S + \xi_S \mu_S + \mu_S (1+k+d))^2} < 0$$

$$L^{BP} - L^{CCIT} = \frac{1}{2} \frac{\xi_S \mu_S F^2}{\xi_S + \xi_S \mu_S + \mu_S k^2} + \frac{1}{2} \frac{\xi_S \mu_S \sigma_\epsilon^2}{\xi_S + \xi_S \mu_S + \mu_S (1+k+d)^2} - \frac{1}{2} \frac{\xi_S \mu_S F^2}{\xi_S + \xi_S \mu_S + \mu_S k^2} - \frac{1}{2} \frac{\mu_S \sigma_\epsilon^2}{1 + \mu_S} = \frac{1}{2} \frac{\xi_S \mu_S \sigma_\epsilon^2}{\xi_S + \xi_S \mu_S + \mu_S (1+k+d)^2} - \frac{1}{2} \frac{\mu_S \sigma_\epsilon^2}{1 + \mu_S} = - \frac{1}{2} \frac{\xi_S \mu_S (1+k+d)^2 \sigma_\epsilon^2}{(\xi_S + \xi_S \mu_S + \mu_S (1+k+d))^2 (1+\mu)} < 0$$

$$\begin{aligned}
 L^{CI} - L^{CIT} &= \frac{1}{2} \frac{\mu_S F^2}{1 + \mu_S} + \frac{1}{2} \frac{\xi_S \mu_S (\xi_S + \mu_S + \xi_S \mu_S) \sigma_\epsilon^2}{(\xi_S + \xi_S \mu_S + \mu_S (1 + k + d))^2} - \\
 &= \frac{1}{2} \frac{\xi_S \mu_S F^2}{\xi_S + \xi_S \mu_S + \mu_S k^2} - \frac{1}{2} \frac{\xi_S \mu_S (\xi_S + \mu_S + \xi_S \mu_S) \sigma_\epsilon^2}{(\xi_S + \xi_S \mu_S + \mu_S (1 + k + d))^2} = \\
 &= \frac{1}{2} \frac{\mu_S F^2}{1 + \mu_S} - \frac{1}{2} \frac{\xi_S \mu_S F^2}{\xi_S + \xi_S \mu_S + \mu_S k^2} = \frac{1}{2} \frac{\mu_S k^2 F^2}{(\xi_S + \xi_S \mu_S + \mu_S k^2)(1 + \mu)} > 0
 \end{aligned}$$

$$\begin{aligned}
 L^{CI} - L^{CCIT} &= \frac{1}{2} \frac{\mu_S F^2}{1 + \mu_S} + \frac{1}{2} \frac{\xi_S \mu_S (\xi_S + \mu_S + \xi_S \mu_S) \sigma_\epsilon^2}{(\xi_S + \xi_S \mu_S + \mu_S (1 + k + d))^2} - \\
 &= \frac{1}{2} \frac{\xi_S \mu_S F^2}{\xi_S + \xi_S \mu_S + \mu_S k^2} - \frac{1}{2} \frac{\mu_S \sigma_\epsilon^2}{1 + \mu_S} = \\
 &= \left[\frac{1}{2} \frac{\mu_S}{1 + \mu_S} - \frac{1}{2} \frac{\xi_S \mu_S}{\xi_S + \xi_S \mu_S + \mu_S k^2} \right] F^2 + \\
 &= \left[\frac{1}{2} \frac{\xi_S \mu_S (\xi_S + \mu_S + \xi_S \mu_S)}{(\xi_S + \xi_S \mu_S + \mu_S (1 + k + d))^2} - \frac{1}{2} \frac{\mu_S}{1 + \mu_S} \right] \sigma_\epsilon^2 \begin{matrix} > \\ < \end{matrix} 0.
 \end{aligned}$$

Note that the coefficient on F^2 is strictly positive while the coefficient on σ_ϵ^2 is strictly negative. Thus, if the supply shock variance is not too large, central bank independence when the bank has an optimal inflation target but cares only for inflation might be better than a central bank that stabilizes output but does not keep in mind the government's finances.

$$\begin{aligned}
 L^{CIT} - L^{CCIT} &= \frac{1}{2} \frac{\xi_S \mu_S F^2}{\xi_S + \xi_S \mu_S + \mu_S k^2} + \frac{1}{2} \frac{\xi_S \mu_S (\xi_S + \mu_S + \xi_S \mu_S) \sigma_\epsilon^2}{(\xi_S + \xi_S \mu_S + \mu_S (1 + k + d))^2} - \\
 &= \frac{1}{2} \frac{\xi_S \mu_S F^2}{\xi_S + \xi_S \mu_S + \mu_S k^2} - \frac{1}{2} \frac{\mu_S \sigma_\epsilon^2}{1 + \mu_S} = \\
 &= \frac{1}{2} \frac{\xi_S \mu_S (\xi_S + \mu_S + \xi_S \mu_S) \sigma_\epsilon^2}{(\xi_S + \xi_S \mu_S + \mu_S (1 + k + d))^2} - \frac{1}{2} \frac{\mu_S \sigma_\epsilon^2}{1 + \mu_S} < 0
 \end{aligned}$$

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