Optimal conservatism under fiscal uncertainty

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Abstract

In this paper, we consider a government that faces some uncertainty about its budget estimates. To derive its optimal fiscal policy, it adopts a robust control approach as developed by Hansen and Sargent (2005, 2008). We show that, in the presence of fiscal uncertainty, the resulting policy stance is too aggressive, exacerbating tax distortion, lowering output and increasing inflation. From an institutional point of view, our results suggest that society could be better off by delegating monetary policy to a less conservative central banker when fiscal uncertainty increases.

Keywords: Fiscal uncertainty, robust control, monetary delegation.

JEL classification: E 58 · E 60 · E 62.

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1 Introduction

When setting their fiscal policy, governments have to anticipate lots of indicators influencing their budget. In a context of financial and macroeconomic instability, this task can prove to be highly difficult, rendering budget estimates necessarily imperfect. In this paper, we model the uncertainty that governments may face when estimating their budget components. The objective in this paper is twofold: we first aim to examine the impact of this fiscal uncertainty on economic outcomes ; second, we question whether in the presence of this uncertainty, a conservative central bank may still be optimal.

The literature dealing with uncertainty in setting up economic policies concerns exclusively the monetary policy. As far as we know, no study has dealt with fiscal uncertainty and its impact on macroeconomic outcomes. Our paper aims to fill this gap by defining fiscal uncertainty as the incapacity of the fiscal authority to correctly estimate the structure of its budget. Governments can thus undergo some misspecification in the estimation of their spending and/or taxes. Moreover, we assume that governments are unable to define any probability distribution to their estimation errors. To set an optimal tax level under these circumstances, they adopt a robust control approach as proposed by Hansen and Sargent (2005, 2008) which consists in selecting a fiscal policy that is robust to the worst possible estimation error.[1]

This approach results in fiscal policy becoming excessively aggressive compared to the case of full information. As a consequence, tax distortion is exacerbated, translating into lower output and higher inflation. Indeed, when governments fear misspecification about their estimates, they try to hedge against the possibility of not meeting their budget requirements by setting a higher tax level. From an institutional point of view, our results suggest that society could be better off by delegating monetary policy to a less conservative central banker when the government's confidence in its budget estimates deteriorates.

2 The model

This section presents a model in line with Beetsma and Bovenberg (1998) in which the fiscal authority adopts a robust control approach as introduced by Hansen and Sargent (2005, 2008) to hedge against some uncertainty about the true level of its spending.

We consider a closed economy consisting of three players: the central bank, the government and the private sector. The timing of the game is as

[1]For recent contributions to the robust control literature in general, see for instance Tillmann (2009a) or Tillmann (2014). In Tillmann (2009b) and Sorge (2013), the robust control approach is adapted to determine the optimal degree of conservatism when the social planner faces some uncertainty, respectively, about cost-push shock persistence and central bank preferences.

follows. First, the private sector, rationally determines its inflation expectations through the nominal wage setting process. Then, the government sets taxes and finally the central bank selects the inflation rate. Since in practice monetary policy can be adjusted more quickly than fiscal decisions, we assume that the government, when setting taxes, takes the central bank's expected reaction into account. Accordingly, the government acts as a Stackelberg leader vis-à-vis the central bank.

The output supply function is described by: The output supply function is described by:

$$x = \pi - \pi^e - \tau \tag{1}$$

where π and π^e are the actual and expected inflation rates respectively; τ defines the tax rate. As can be seen from this relation, unexpected inflation, by eroding real wages, induces firms to augment their demand for labor and thus their production. Greater taxation on the firms' revenues, on the contrary, discourages production. Hence, as in Beetsma and Bovenberg (1998, 1999) for instance, fiscal policy has a negative impact on aggregate supply via taxation.

The CB cares about deviations of both, inflation and output from their respective targets. For convenience the latter are assumed to be equal to zero. Its loss function is given by:

$$L^{CB} = I\pi^2 + x^2 \tag{2}$$

where I defines the central bank's degree of conservatism. Minimizing the central bank's loss function with respect to π, we obtain:

$$\pi = \frac{\pi^e + \tau}{1 + I} \tag{3}$$

The government's objectives are summarized in the following loss function:

$$L^G = x^2 + \alpha\,(g - \tilde{g})^2 \tag{4}$$

where g and $\tilde{g}$ respectively denote the actual and targeted levels of public expenditures as shares of output. The government wishes to minimize the deviations of output and public spending from their respective targets. For convenience, we normalize the targeted output level at zero. The public spending target, however, is positive. This implies that the government will tolerate some tax distortions in exchange for a positive amount of public expenditures. Note that the type of expenditures considered here corresponds to public consumption such as public sector wages and other current government spending. The target could thus reflect the government's view on the optimal size of public sector in the economy or political economic aspects such as the government's interest in boosting public expenditures to increase reelection chances (Brender and Drazen 2005). The parameter α measures the weight of the spending objective relative to the weight of the output objective.

In setting public expenditures, the government faces the following budget constraint:

$$g = \tau + \epsilon \tag{5}$$

This equation can be interpreted as a long-run balanced budget requirement where taxation is the only source of financing public expenditure. Fiscal uncertainty arises as the government is unsure about the exact amount of its spending (and/or taxes). It fears some misspecification ϵ of the estimation of its budget. A crucial assumption here is that the government is unable to assign any probability distribution over alternative outcomes for. To hedge against this form of uncertainty, it adopts a robust control (non-Bayesian) approach which consists in setting its decision so as they are robust to the worst possible realization of ϵ.

This approach can be modeled as a game between the government and a fictitious "evil agent" whose aim is to set the misspecification so as to maximize the government's welfare loss. Following, Hansen and Sargent (2005, 2008), we assume that the government, depending on its preferences for policy robustness, allocates a range of potential values for misspecifications to the evil agent which is constraint by χ.

$$\epsilon^2 \leq \chi \tag{6}$$

Hence, to set its robust fiscal policy, the government solves the following program:

$$\min_{\tau} \max_{\epsilon} L^G = x^2 + \alpha \left(g - \tilde{g}\right)^2 + \theta \epsilon^2 \tag{7}$$

subject to the output supply function (1), the central bank's reaction function (3), the budget constraint (5) and the evil agent's constraint (6). Parameter θ defines the government's preference for policy robustness. It is inversely related to χ, the evil agent's constraint. The higher θ, the smaller the set of potential misspecifications it allocates to the evil agent. Parameter θ can also be interpreted as the level of confidence the government has in its estimate of the budget.[2]

The certainty case corresponds to $\theta \to \infty$ where χ shrinks toward zero, obliging the evil agent to set the misspecification ϵ equal to zero. This is the common case in the literature where it is assumed that governments have a perfect control of their budget. In this paper, we consider the possibility for θ to have a finite value, i.e. that governments face some uncertainty about the exact structure of their budget when setting fiscal decisions.

Solving the government's program, we obtain the following first order conditions:

$$\tau = \frac{\alpha \left(1 + I\right) \tilde{g} + I \left(\pi - \pi^e\right) + \alpha(1 + I)\epsilon}{I + \alpha \left(1 + I\right)} \tag{8}$$

$$\epsilon = \frac{-\alpha \left(\tilde{g} + \tau\right)}{\alpha - \theta} \tag{9}$$

[2]To ensure the consistency of our results, we set $\theta > \alpha$.

Combining these equations, we have:

$$\tau = \frac{\theta\alpha(1+I)\tilde{g} + I(\theta-\alpha)(\pi-\pi^e)}{\theta\alpha(1+I) + I(\theta-\alpha)} \tag{10}$$

$$\epsilon = \frac{\alpha I[\tilde{g} - (\pi-\pi^e)]}{\theta\alpha(1+I) + I(\theta-\alpha)} \tag{11}$$

Combining these expressions with Eq.(3) and taking rational expectations, we obtain the equilibrium values respectively for τ, ϵ and π.

$$\tau = \frac{\theta\alpha(1+I)\tilde{g}}{\theta\alpha(1+I) + I(\theta-\alpha)} \tag{12}$$

$$\epsilon = \frac{\alpha I\tilde{g}}{\theta\alpha(1+I) + I(\theta-\alpha)} \tag{13}$$

$$\pi = \frac{\theta\alpha(1+I)\tilde{g}}{\theta\alpha I(1+I) + I^2(\theta-\alpha)} \tag{14}$$

Integrating these expressions into Eqs. (1) and (5), we have the equilibrium values for output and public expenditure:

$$x = \frac{-\theta\alpha(1+I)\tilde{g}}{\theta\alpha(1+I) + I(\theta-\alpha)} \tag{15}$$

$$g = \frac{\alpha(\theta+\theta I - I)\tilde{g}}{\theta\alpha(1+I) + I(\theta-\alpha)} \tag{16}$$

In this model, there are two types of distortions. The first is due to the presence of a positive spending target which obliges the government to collect taxes, thereby reducing the output level. As a consequence, the central bank implements an expansionary monetary policy which creates inflationary pressures in the economy. The second distortion in our model hinges on the budget uncertainty that faces the government when setting its fiscal decisions.[3] The following result highlights the effects of this uncertainty – inversely related to θ, the government's level of confidence in its estimates – on equilibrium outcomes.

Result 1. *A decrease in θ, the government's confidence level, leads to:*
i) an increase in ϵ, the estimation errors it expects to do.
ii) an increase in τ and π, respectively the tax and inflation rate.
iii) a decrease in the output level x and in public expenditures g.

Proof. Differentiating ϵ, τ, π, x and g with respect to θ respectively leads to:

[3]This distortion disappears when $\theta \to \infty$, which means that the government is fully certain about its budget estimates. By setting $\theta \to \infty$, the equilibrium outcomes corresponds to the standard case in the literature (see for instance Hefeker and Zimmer (2009)).

i) $\frac{\partial \epsilon}{\partial \theta} = \frac{-\alpha I[\alpha(1+I)+I]\tilde{g}}{[\theta\alpha(1+I)+I(\theta-\alpha)]^2} < 0$

ii) $\frac{\partial \tau}{\partial \theta} = \frac{-\alpha^2(1+I)I\tilde{g}}{[\theta\alpha(1+I)+I(\theta-\alpha)]^2} < 0$ and $\frac{\partial \pi}{\partial \theta} = \frac{-\alpha^2(1+I)\tilde{g}}{[\theta\alpha(1+I)+I(\theta-\alpha)]^2} < 0$

iii) $\frac{\partial x}{\partial \theta} = \frac{\alpha^2(1+I)I\tilde{g}}{[\theta\alpha(1+I)+I(\theta-\alpha)]^2} > 0$ and $\frac{\partial g}{\partial \theta} = \frac{\alpha I^2\tilde{g}}{[\theta\alpha(1+I)+I(\theta-\alpha)]^2} > 0.$

When the government faces high uncertainty about its budget (θ low), it expects a large estimation error ϵ. In order to implement a fiscal policy that is robust to this error, it is forced to set a high tax level. This reduces the output level and obliges the central bank to implement an inflationary monetary policy.

In the following result, we also study the effect of I, the central bank's degree of conservatism, on macroeconomic outcomes.

Result 2. *An increase in I, the central bank's degree of conservatism yields:*
i) an increase in ϵ, the estimation error that the government expects to do.
ii) a decrease in τ, π and g, respectively the tax and inflation rate and the level of public spending.
iii) an increase in the output level x.

Proof. Differentiating ϵ, τ, π, x and g with respect to I respectively leads to:

i) $\frac{\partial \epsilon}{\partial I} = \frac{\alpha^2\theta\tilde{g}}{[\theta\alpha(1+I)+I(\theta-\alpha)]^2} > 0$

ii) $\frac{\partial \tau}{\partial I} = \frac{-\alpha\theta(\theta-\alpha)\tilde{g}}{[\theta\alpha(1+I)+I(\theta-\alpha)]^2} < 0$, $\frac{\partial \pi}{\partial I} = \frac{-\alpha\theta\tilde{g}\left[I(\theta-\alpha)(I+2)+\alpha\theta(1+I)^2\right]}{[\theta\alpha I(1+I)+I^2(\theta-\alpha)]^2} < 0$ and $\frac{\partial g}{\partial I} = \frac{-\alpha\theta^2\tilde{g}}{[\theta\alpha(1+I)+I(\theta-\alpha)]^2} < 0.$

iii) $\frac{\partial x}{\partial I} = \frac{\alpha\theta(\theta-\alpha)\tilde{g}}{[\theta\alpha(1+I)+I(\theta-\alpha)]^2} > 0.$

When the degree of CB conservatism increases, the government understands that its tax decisions have a lower impact on inflation and consequently a stronger impact on output. To say it differently, an increase in I exacerbates the output reducing effect of taxes. Knowing this effect, the government is encouraged to reduce fiscal pressure. This in turn helps to improve macroeconomic performances in terms of output and price stability. Moreover, as the government's incentive to increase taxes, and thus to compensate its spending, is refrained when I is high, it anticipates a large budget misspecification.

From these results, we can analyze how the macroeconomic effects of fiscal uncertainty vary with the degree of CBC and vice versa. This is done in the following results:

Result 3. *An increase in I helps to attenuate the deteriorating effect fiscal*

uncertainty exerts on macroeconomic outcomes if α is not too large.

Proof. We observe that: $\frac{\partial^2 \tau}{\partial \theta \partial I} = \frac{-\alpha^2 \tilde{g}[-I\theta+\alpha(I+I\theta+\theta)]}{[\theta\alpha(1+I)+I(\theta-\alpha)]^3}$ is positive for low values of α. In this case, a higher I attenuates the tax increasing effect – and thereby the resulting fiscal distortions – of a lower θ.

Indeed, when the central bank is highly conservative, the government is encouraged to reduce taxes, thereby alleviating the fiscal pressure stemming from its fear of budget misspecification. This is possible if its aversion for public spending deviations is not too important.

Result 4. *An increase in θ, the government's degree of confidence, is associated with a stronger negative effect of I on taxes for high values of α.*

Proof. It appears that: $\frac{\partial^2 \tau}{\partial I \partial \theta} = \frac{-\alpha^2 \tilde{g}[-I\theta+\alpha(I+I\theta+\theta)]}{[\theta\alpha(1+I)+I(\theta-\alpha)]^3}$ is negative for α large.

When the government's fear of budget misspecification is low, it can more easily lower taxes in response to greater CBC.

3 Optimal central bank conservatism under fiscal uncertainty

We here consider a social planner whose objective is to define an optimal design of monetary institutions – and, in particular, of the degree of CBC – by taking account of the government's uncertainty about its budget estimates.

The social planner's loss function is given by:

$$L^S = x^2 + \varphi\pi^2 + \beta\left(g - \tilde{g}\right)^2 \tag{17}$$

where φ and β respectively represent the relative weight the social planner attributes to its inflation and public spending objective. We assume that its public spending target corresponds to $\tilde{g}$, the government's spending target.

Introducing the equilibrium values of output, inflation and public spending into the social planner's loss function and minimizing with respect to I, the central bank's degree of conservatism, yields the following results:

Result 5. *If the social planner is highly concerned about its public spending objective and/or if the government's trust in its budget estimates is low, it can be optimal to delegate monetary policy to a "populist" central banker, i.e. a central banker who is less conservative than the social planner.*

Proof. Introducing the equilibrium values of output, inflation and public

spending into Eq. (17), we obtain:

$$L^S = \frac{\theta^2 \tilde{g}^2 \left[\alpha^2 (1+I)^2 (I^2+\varphi) + \beta I^4\right]}{I^2 \left[\theta\alpha (1+I) + I(\theta-\alpha)\right]^2}.$$

Differentiating this expression with respect to I yields the following first order condition:

$$\frac{\partial L^S}{\partial I} = -\alpha^2\varphi (1+I)^2 \left[\theta\alpha (1+I) + I(\theta-\alpha)\right] - \alpha^2 I (1+I)\left(I^2+\varphi\right)(\theta-\alpha) + \beta I^4 \theta\alpha = 0. \tag{18}$$

Considering the expression $\frac{\partial L^S}{\partial I}$ for the case where $I = \varphi$, we obtain:

$$\frac{\partial L^S}{\partial I}(I=\varphi) = -2\alpha\varphi (1+\varphi)^2 \left(1 - \frac{\alpha}{\theta}\right) - \alpha^2 (1+\varphi)^3 + \beta\varphi^3.$$

This expression becomes positive for relatively high values of β and/or low values of θ. This means that for these values of β and/or θ, the optimal I is lower than φ.

This result can be explained as follows. When the social planner is confronted to a government that is unsure about its budget estimates, it may fear that it sets too low a tax rate, thereby pulling the equilibrium spending level away from its target. The higher the social planner's concern about public spending, the stronger this fear. To alleviate it, it can be optimal to appoint a rather liberal central banker as - according to result 2 - a low degree of CBC encourages the government to harden its fiscal policy, thereby increasing tax revenues.

Result 6. *The optimal degree of central bank conservatism increases with θ, the government's trust in its estimates.*

Proof. From expression (18), we observe that the derivative $\frac{\partial L^S}{\partial I}$ negatively depends on θ, implying that the optimal value of I increases with respect to θ.

Hence, when the government faces high uncertainty about its budget estimates, it is in the interest of society to moderate the degree of central bank conservatism. Indeed, in this case, the government must set a high tax level to ensure that its fiscal policy is robust to a potentially large budget misspecification. Such a decision is optimal only if the government knows that the cost of this tightened fiscal policy – in terms of lower output – can be attenuated by a rather accommodating monetary policy. This implies to appoint not too a conservative central banker.

4 Conclusion

In this paper, we develop a robust control approach to model the governments' tax decision when they face some uncertainty about their budget

estimates. We show that this uncertainty leads to a conflict between monetary and fiscal authorities as it generates an aggressive fiscal policy and, as a response to the exacerbated tax distortion, an inflationary monetary policy. Under these circumstances, it can be in the interest for society to delegate monetary policy to a less conservative central banker when fiscal uncertainty increases.

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