PRUDENT BUDGETARY POLICY

Political economy of precautionary taxation *

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Abstract

The theory of tax smoothing and determination of public debt with uncertain future national income is extended for prudence. A prudent government deliberately underestimates future national income and the tax base, especially if the variance and persistence of shocks hitting the tax base are large and the tax rate and the unemployment benefit are large. As a precaution the tax rate is set higher and the level of public spending lower. As a result, as income and the tax base turn out to be bigger than budgeted, the minister of finance enjoys windfall revenues and is able to gradually reduce debt and debt service over time. This permits, depending on political preferences, either gradual cuts in the tax rate, gradual increases in government spending or a combination of both. It is easy to allow for government assets as well. Finally, political economy justifications are offered of why it is desirable to appoint a strong and pessimistic minister of finance. In particular, we show that prudence is able to offset the *intertemporal* spending, tax and debt biases resulting from the common-pool distortions. If the minister of finance and the prime minister are given as many voting rights as the spending ministers combined, the *intratemporal* common-pool distortions of an excessively large public sector are eliminated as well. A strong and pessimistic minister of finance can thus control the impatient profligacy of squabbling spending ministers. However, if voters care about outcomes on election eve, prudence may be abused for short-run electoral gains. Opportunistic manipulation of election results, however, also dampens the intertemporal common-pool distortions.

Keywords: prudence, pessimism, precautionary taxation, tax smoothing, public debt, income forecasts, public sector assets, common pool, feedback Nash, voting rights, electoral budget cycles, political economy

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*This paper is inspired by my former colleague Gerrit Zalm, who was Minister of Finance during 1994-2007 and initiator of the concept of prudent budgetary policy in the Netherlands. It is also a requiem, since the new administration has abandoned this policy. I thank Lans Bovenberg, Robert Dur, Ferd Crone, Bas Jacobs, Mark Roscam Abbing, Steven Poelhekke, Paul Tang and Sweder van Wijnbergen for helpful comments on an earlier version.

I. INTRODUCTION

The reputation of any good minister of finance is based on prudence and caution. Nobody wants a spend-thrift keeper of the national budget. A good minister of finance will be forgiven if he gets unexpected windfall revenues, but will be scorned if the budget turns out year after year to be worse than expected. Just as the electorate prefers to appoint an ultraconservative central banker as demonstrated by Rogoff (1985), one would rather have a conservative minister of finance. The difference is that a central banker should be curbed as he may try to renege on previous announcements to keep the money supply in check while the minister of finance may be under pressure from his spending ministers to relax budgetary discipline. Intuitively, it thus makes sense to appoint a slightly pessimistic rather than an optimistic minister of finance. This insight underlies the advice of the so-called Studiegroep Begrotingsruimte and inspired the practice in the Netherlands since 1994 of deliberately underestimating future growth in the national income by a say a quarter or half percent in order to err on the safe side and not be surprised by unexpected worsening of the public finances.[1] The main objective of this paper is to formalize this notion of prudent budgetary policy within the context of Barro's (1979) theory of tax smoothing and optimal debt management and to provide a political economy rationale for it.

We thus allow for precautionary behaviour of the minister of finance. The objective is to minimize the expected value of an exponential transformation of the quadratic welfare loss criterion, which itself depends on the sum of tax rates squared. The coefficient of the exponential transformation corresponds to an Arrow-Pratt measure of absolute risk aversion, which we call the degree of prudence. Within the context of a linear model and additive normally distributed errors, the optimal policy rules are linear with reaction coefficients that depend on the variances and covariances of the stochastic processes driving the state variables. Prudence implies that the policy maker plays a min-max game against nature. The policy maker hedges against undesirable outcomes by postulating that shocks damage its objectives even though, from a purely statistical point of view, they do not hurt on average.

Our key insight is that a prudent minister of finance deliberately underestimates future forecasts of national income and the tax base. As a precaution the tax rate is set higher and the level of public spending lower than without prudence. As a result, even though budgeted tax rates are smoothed over time, expected values of the tax rate gradually fall and/or expected levels of governments spending increase over time as the inevitable windfall revenues materialize and the

[1] The new government has in 2007 abandoned prudent forecasts of national income and tax bases. Instead, it claims to be prudent by pursuing a more ambitious target for the final financial surplus.

level of government debt and thus debt service fall over time. We show that the extent to which this happens is greater if the degree of risk aversion (or prudence) of the minister of finance, the variance and persistence of shocks hitting the national income and the tax base, and the level of the tax rate and the unemployment benefit are relatively large. In the very long run the government builds up assets to generate sufficient interest revenue to pay for public spending, so that the expected tax rate asymptotically goes to zero.

Another objective of this paper is to offer insights into *why* a minister of finance wants to implement a *prudent* budgetary policy. One reason is based on the reality of cabinet decision making. If there are unexpected falls in public revenue, spending ministers spend lots of time and energy fighting over who has to implement the spending cuts to balance the budget and the minister of finance is under great pressure to relax the budgetary rules. This is not conducive to good government. Too much time and energy is wasted on squabbling rather than on necessary reforms and cracking necessary tough political decisions. It is therefore desirable to have a prudent budgetary policy, so that on average unexpected windfall revenues are more likely than shortfalls in expected revenues. Another justification of why a minister of finance has more prudent preferences than the electorate is that *ex ante* the minister of finance realizes that *ex post* it will be hard to discipline the spending ministers in his cabinet. Profligate spending ministers and a weak minister of finance give rise to a common-pool problem. This results in an upward bias in public spending claims, a tilt of the government spending profile from the future towards the present and of the tax profile from the present to the future, and thus excessive accumulation of government debt as in Persson and Tabellini (2000, Chapter 13) and Velasco (2000). We show that it is in the interest of society to appoint a relative prudent minister of finance, which can offset the *intertemporal* spending, tax and debt biases resulting from the common-pool problem.[2] If in addition the minister of finance has the unequivocal backing of the prime minister and has at least as many votes in the cabinet as the spending ministers combined, he also has sufficient power to overcome *intratemporal* biases resulting in an excessively large public sector.

Section II sets up the traditional intertemporal theory of tax smoothing and determination of public debt and shows that government borrowing is warranted for temporary increases in government spending and to cover the temporary loss of tax revenues in a recession. Section III extends this framework to allow for a prudent minister of finance and derives our key insight about underestimating the tax base and the principle of precautionary taxation. Section IV allows

[2] We show that prudence offsets the intertemporal distortions caused by wanting public spending now rather than tomorrow and postponing taxation, but not the intratemporal distortions leading to a too large public sector. More precisely, prudence moves the feedback towards the open-loop Nash equilibrium.

for endogenous government spending and unemployment benefits and addresses the question of whether windfall revenues should be used for debt reduction, tax cuts or public spending hikes. The appendix extends prudent budgetary policy for endogenous public investment and public sector assets as well as public debt. Section V offers some political economy justifications of why it is desirable to appoint a pessimistic minister of finance and to give the minister of finance more voting rights in the cabinet. Section V also heeds a warning that prudence may be abused for short-term electoral gains. Section VI concludes and offers suggestions for further research.

II. USING PUBLIC DEBT TO SMOOTH TAX DISTORTIONS

We follow Barro (1979) and abstract from general equilibrium effects. Here we restate the traditional theory of tax smoothing to set the scene for our discussion of prudent budgetary policy rules in section III-V. The government budget constraint is given by:

$$(1) \qquad D_t = (1+r^*)\, D_{t-1} + G_t - \tau_t Y_t, \quad D_0 \text{ given},$$

where D_t, G_t and Y_t of denote, respectively, government debt, government spending and national income at time t, and r^* is the exogenous real interest rate. With γ indicating the trend rate of real economic growth, we rewrite (1) in terms of fractions of the trend level of national income:

$$(1') \qquad d_t = \beta\, d_{t-1} + g_t - \tau_t y_t, \quad d_0 = D_0/Y_0 \text{ given}, \quad \beta \equiv (1+r^*)/(1+\gamma) > 1,$$

where $d_t \equiv D_t/[(1+\gamma)^t Y_0]$, $g_t \equiv G_t/[(1+\gamma)^t Y_0]$, $y_t \equiv Y_t/[(1+\gamma)^t Y_0]$ and β is the (gross) growth-corrected real interest rate. The no-Ponzi condition implies that the present value of future primary surpluses must at least cover the current government debt:[3]

$$(2) \qquad \lim_{s\to\infty} \beta^{-s} d_{t-1+s} = 0 \quad \Rightarrow \quad \sum_{s=t}^{\infty} \beta^{-s} \left(\tau_{t-1+s} y_{t-1+s} - g_{t-1+s}\right) \geq d_{t-1}.$$

Tax distortions are proportional to the square of the tax rate, so the government minimizes:[4]

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[3] See Hamilton and Flavin (1986), Trehan and Walsh (1988), Ahmed and Rogers (1995), Quintos (1995) Bohn (1998) and Afonso (2005) for various unit-root and co-integration tests of whether the no-Ponzi condition and the present-value budget constraint (2) are satisfied, and Bohn (2006) for a critique.

(3) $$\sum_{t=1}^{\infty}\frac{1}{2}(1+r)^{-t}\tau_t^2 Y_t=\sum_{t=1}^{\infty}\frac{1}{2}\beta^{-t}\tau_t^2$$

subject to the present-value budget constraint (2). The optimality conditions imply that tax rates are smoothed over time, i.e., $\tau_t = \tau_{t-1}$.This together with (2) yields the following familiar expressions for the government financial deficit and the tax rate:

(4) $$d_t - d_{t-1} = (g_t - g_t^P) - \tau_t (y_t - y_t^P) \quad \text{and} \quad \tau_t = [g_t^P + (\beta - 1)d_{t-1}] / y_t^P ,$$

where the permanent values of detrended government spending and national income are given by, respectively, $g_t^P \equiv (\beta-1)\sum_{s=t}^{\infty}\beta^{t-s-1} g_s$ and $y_t^P \equiv (\beta-1)\sum_{s=t}^{\infty}\beta^{t-s-1} y_s$.

We thus see that temporary increases in public spending (e.g., caused by a war) are financed by running up a government debt. In contrast, permanent increases in public spending are financed by an increase in the tax rate. Future increases in government spending (e.g., due to graying of the population) imply that the permanent level of public spending exceeds the current level of government spending, so the government brings down debt and debt service to pay for higher public spending in the future. Also, a recession characterized by a temporary fall in national income induces the government to run up public debt. Permanent increases in national income imply sustained increases in the tax base and thus allow for a cut in the tax rate.

III. PRECAUTIONARY TAXATION AND DEBT MANAGEMENT WITH UNCERTAINTY ABOUT FUTURE INCOME AND TAX BASES

To modify the traditional theory of tax smoothing discussed in section II for prudence, the government maximizes the expected value of an exponential transformation of criterion (3):

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[4] Our framework can be given micro foundations if we assume that utility is quasi-linear and the utility of money is constant, labour supply and output are exogenous, production losses resulting from tax collection are proportional to the square of the tax rate, and households cannot accumulate assets. If we also assume that the government can borrow on the world markets against a given interest rate *r*, and the wage follows from the factor price frontier, expression (3) for the social welfare loss corresponds to the aggregate utility loss of households and the present-value budget constraint (2) is justified. One also gets a linear-quadratic framework with no tax collection losses if the disutility of work is quadratic in labour supply.

(3′) $\Phi(\theta) \equiv \ln\left(\mathrm{E}\left[-\exp\left(-\theta\Gamma\right)/d_0, y_0\right]\right)/\theta$, where $\Gamma \equiv -\sum_{t=1}^{\infty}\frac{1}{2}\beta^{-t}\tau_t^2$

and $\theta>0$ indicates the degree of prudence or caution of the policymaker. The risk-neutral case corresponds to $\Phi(\theta)\rightarrow \mathrm{E}\left[-\left(\sum_{t=1}^{\infty}\frac{1}{2}\beta^{-t}\tau_t^2\right)/d_0, y_0\right]$ as $\theta\rightarrow 0$. Two governments may share the same welfare criterion under certainty, but their aversion to risk may differ. To capture this, the government maximizes the expected value of $\mathrm{U}(\Gamma) \equiv -\exp(-\theta\,\Gamma)$. The coefficient of absolute risk aversion with respect to the criterion Γ, i.e., $\theta \equiv -\mathrm{U}''/\mathrm{U}'>0$, also captures prudence in the sense of Kimball (1990), since $\mathrm{U}'''=\theta^3\exp(-\theta\,\Gamma)>0$. Prudence implies the willingness to avoid shocks with *adverse* consequences.

We assume an AR(1) process for deviations of national income from trend where ρ is the autoregressive parameter and the long-run expected value of y_t is rigged to 1:

(4) $y_t = 1-\rho+\rho\, y_{t-1}+\varepsilon_t,\quad \varepsilon_t \sim \mathrm{IN}(0,\sigma_t^2),\quad |\rho|<1.$

Temporary shocks to national income correspond to $\rho = 0$ and permanent shocks to $\rho = 1$. It is straightforward to allow for more general ARMA-processes for national income and the tax base than (4). We work with a first-order Taylor-series expansion of (1′):

(1″) $d_t = \beta\, d_{t-1} + g_t - \tau_t - \tau\,(y_t - 1),\quad d_0 = D_0/Y_0$ given,

where τ indicates the long-run tax rate around which the government budget constraint is linearized. The government maximizes (3) subject to the government budget constraint (1″) and the stochastic process generating deviations of national income from trend (4). We assume that the variance of the stochastic shocks to detrended national income rise with the growth-corrected real interest rate. Hence, we have $\sigma_t^2 = \sigma^2\beta^t$ where σ is the standard deviation of ε_0. This ensures that the feature of time inconsistency occurring in linear-quadratic problems with temporal risk aversion and time discounting (van der Ploeg, 1993; Bommier, 2006) is eliminated. Applying the results on risk-sensitive optimal LQG-control of Speyer, Deyst and Jacobson (1974) or Whittle

(1981, 1990), we see that our framework yields analytically tractable closed-form solutions. The government effectively plays a game against nature and solves:[5]

$$(5) \qquad \underset{\tau_1,\tau_2,\ldots}{\text{Min}} \quad \underset{\varepsilon_1,\varepsilon_2,\ldots}{\text{Max}} \sum_{t=1}^{\infty} \frac{1}{2}\left(\beta^{-t}\tau_t^2 - \varepsilon_t^2/\theta\sigma_t^2\right) \text{ subject to (1″) and (4).}$$

The government thus chooses the tax rate to minimize this min-max criterion and assumes the worst by postulating that the national income disturbances are drawn in a way that maximizes this criterion. The parameter θ thus indicates a degree of pessimism.

The optimality conditions corresponding to the min-max problem (5) from the perspective of time *t* onwards are (see appendix):

$$(6) \qquad \tau_s^B = \tau_{s-1}^B \quad \text{and} \quad \rho\varepsilon_{s+1}^B = \beta\varepsilon_s^B + (\theta\sigma^2\beta^2\tau)\tau_t^B, \quad \forall s \geq t,$$

where the superscript *B* denotes the budgeted rather than mathematically expected outcomes. The second difference equation for the budgeted shocks is unstable, since $|\beta/\rho| > 1$. Given that (6) also requires that the budgeted tax rates are smoothed over time, the budgeted underestimation of the error in the data generating process of the national income and the tax base must be given by:

$$(7) \qquad \varepsilon_s^B = -\left(\frac{\theta\sigma^2\beta\tau}{\beta-\rho}\right)\tau_t^B < 0, \quad \forall s \geq t.$$

It follows from (7) that the extent by which the minister of finance underestimates shocks to the data generating process for the tax base is large if he is relatively prudent, variances and persistence of shocks are large, and the tax rate is high. Our framework deviates from the certainty equivalence principle which sets $\varepsilon_s^B = 0, \forall s \geq t$ and is valid only if $\theta = 0$. Substituting (7) into (4) and solving for the budgeted national income and tax base yields:

$$(8) \qquad y_{t-1+s}^B = 1 + \rho^s(y_{t-1} - 1) + \sum_{s'=1}^{s} \rho^{s-s'}\varepsilon_{t-1+s'}^B = 1 + \rho^s(y_{t-1} - 1) - \left(\frac{\theta\sigma^2\beta\tau}{\beta-\rho}\right)\left(\frac{1-\rho^s}{1-\rho}\right)\tau_t^B, \quad \forall s \geq 1.$$

[5] See section VI for a derivation in a more general setting with endogenous government spending.

Upon substitution of (8) into the present-value budget constraint (2), we can solve for the tax rate:

$$(9) \qquad \tau_t = \tau_t^B = \frac{(\beta-1)d_{t-1} + g_t^P - \rho\tau\left(\frac{\beta-1}{\beta-\rho}\right)\left(y_{t-1}-1\right)}{1-\theta\sigma^2\tau^2\left(\frac{\beta}{\beta-\rho}\right)^2}.$$

Upon substitution of (9) back into the government budget constraint (1′), we obtain the expected mutation in the debt-GDP ratio (i.e., the expected growth-corrected public sector deficit):

$$(10) \qquad E_{t-1}\left(d_t - d_{t-1}\right) = \left[g_t - g_t^P - \beta\left(\frac{1-\rho}{\beta-\rho}\right)\tau\left(y_{t-1}-1\right)\right] - \theta\sigma^2\tau^2\left(\frac{\beta}{\beta-\rho}\right)^2\tau_t.$$

The key insight is thus that a prudent minister of finance underestimates future GDP and thus underestimates the future tax base and tax revenues. As a consequence, the minister sets a higher tax rate just to be on the safe side. This may be referred to as *precautionary taxation*. The statistically speaking inevitable future windfall revenues permit gradual reductions in public debt and thus also gradual reductions in debt service and the tax rate (on top of any gradual debt reductions necessary to finance efficiently projected increases in government spending). Hence, prudence implies a departure from the principle of tax smoothing.

CASE: TEMPORARY SHOCKS

The case of temporary shocks corresponds to $\rho = 0$ and $y_t = 1 + \varepsilon_t$. It follows that the minister of finance deliberately budgets future levels of national income and the tax base that are lower than the statistically expected value of national income and the tax base:

$$(8') \qquad y_t^B = 1-(\theta\sigma^2\tau)\tau_t^B < 1 \quad \text{if} \quad \theta\sigma^2 > 0.$$

We see that the expected deficit is less than the temporary level of government spending or the expected surplus is greater than is warranted by projected increases in government spending, especially if the degree of prudence and the variance of shocks to the tax base are relatively large:

$$(10') \qquad E_{t-1}(d_t - d_{t-1}) = g_t - g_t^P - \tau(y_{t-1}-1) - \theta\sigma^2\tau^2\tau_t < g_t - g_t^P - \tau(y_{t-1}-1).$$

The optimal tax rate for a prudent minister of finance facing temporary shocks becomes:

$$(9') \qquad \tau_t = \left(\frac{(\beta - 1)d_{t-1} + g_t^P}{1 - \theta\sigma^2\tau^2} \right) > (\beta - 1)d_{t-1} + g_t^P \quad \text{if} \quad \theta\sigma^2 > 0.$$

We note that temporary shocks in national income do not affect the level of taxation, but do affect the deficit. In other words, a temporary fallback in the national income and the tax base is accommodated by a higher deficit, not by a higher tax rate.

CASE: PERMANENT SHOCKS

The tax rate and expected budget deficit for a prudent minister of finance facing permanent shocks ($\rho = 1$) are:

$$(9'') \qquad \tau_t = \left(\frac{(\beta - 1)d_{t-1} + g_t^P - \tau(y_{t-1} - 1)}{1 - \theta\sigma^2\tau^2 \left(\frac{\beta}{\beta - 1} \right)^2} \right) > (\beta - 1)d_{t-1} + g_t^P - \tau(y_{t-1} - 1) \quad \text{if} \quad \theta\sigma^2 > 0.$$

$$(10'') \qquad E_{t-1}(d_t - d_{t-1}) = g_t - g_t^P - \theta\sigma^2\tau^2 \left(\frac{\beta}{\beta - 1} \right)^2 \tau_t < g_t - g_t^P.$$

In contrast to temporary shocks, permanent shocks to the national income and the tax base are accommodated by the tax rate. A permanent fall in national income thus induces a permanent increase in the tax rate and no change in the deficit. The correction for prudence is much greater for permanent than temporary shocks, so that the precautionary level of taxation is higher.

In general, we see from (7) that a higher degree of persistence of stochastic shocks to the national income implies that the budgeted underestimation of the tax base is larger. Persistent shocks thus make a minister of finance more prudent. The higher the degree of persistence of shocks to the national income and the tax base (higher ρ), the higher the extent of precautionary taxation and the higher the resulting reductions in government debt.

IV. PRUDENT BUDGETARY POLICY WITH ENDOGENOUS PUBLIC SPENDING

In practice, ministers of finance must deal with the issue of endogenous government spending and the bill for unemployment benefits. They also have to answer the question of whether windfall revenues arising from a prudent budgetary policy should be used for debt reduction, tax cuts or public spending hikes. We thus replace the government budget constraint (1′) by:

$$(11) \qquad d_t = \beta\, d_{t-1} + g_t + b_t\,[u + \alpha\,(1 - y_t)] - \tau_t\, y_t \approx \beta\, d_{t-1} + g_t + u\, b_t - \tau_t + (\tau + \alpha b)\,(1 - y_t),$$
$$d_0 = D_0/Y_0 \text{ given}, \quad \beta \equiv (1+r)/(1+\gamma) > 1,\ \alpha > 0,$$

where b_t indicates the level of the unemployment benefit, b stands for the long-run value of the unemployment benefit, and u denotes the equilibrium level of unemployment. Okun's law states that $\alpha\,(1 - y_t) + u$ captures the level of unemployment.[6] With a positive effect of pure public goods on social welfare, the criterion that needs to be maximized subject to the (linearized) budget constraint (11) and the data generating process for the national income (4) becomes:

$$(3'') \qquad \Phi(\theta) \equiv \ln\left(\mathrm{E}\left[-\exp\left(\theta \sum_{t=1}^{\infty} \frac{1}{2} \beta^{-t} [\tau_t^2 + \chi(\bar{g}_t - g_t)^2] \right) / d_0, y_0 \right] \right) / \theta,$$

where $\bar{g}_t > g_t > 0$ indicates the bliss level of public spending and $\chi > 0$ denotes the relative priority attached to higher public spending rather than lower tax rates. The optimum min-max outcome is characterized by smoothing of the tax rate as before, by smoothing of shortfalls of public spending from its bliss value, and by a budgeted data generating process for the errors in national income and the tax base (see appendix):

$$(6') \qquad \tau_s^B = \tau_t^B,\ \ \bar{g}_s - g_s^B = \bar{g}_t - g_t^B \quad \text{and} \quad \rho\varepsilon_{s+1}^B = \beta\varepsilon_s^B + [\theta\sigma^2\beta(\tau + b)]\tau_t^B, \quad \forall s \geq t.$$

Using the same arguments as in section 3, we find that the budgeted error in the data generating process for the tax base is larger than before:

[6] We abstract from the effects of the tax rate and unemployment benefit on equilibrium unemployment u.

$$(7') \qquad \varepsilon_s^B = -\left(\frac{\theta\sigma^2\beta(\tau+\alpha b)}{\beta-\rho}\right)\tau_t^B < 0, \quad \forall s \geq t.$$

We thus obtain the budgeted national income and tax base:

$$(8'') \qquad y_t^B = (1-\rho)(1+\rho^{t-1}) + \rho^t y_0 - \left(\frac{\theta\sigma^2\beta(\tau+\alpha b)}{\beta-\rho}\right)\sum_{s=1}^{t}\rho^{t-s}\tau_s^B.$$

The degree of underestimation of the tax base is thus also large if the level of the unemployment benefit is large. The higher the tax rate and the unemployment benefit level, the more sensitive tax revenues are to business cycle variations and thus the more prudent the minister finance has to be. In addition to the dynamic efficiency conditions, the optimum must also satisfy the following static efficiency condition:

$$(12) \qquad \tau_t^B = \chi(\overline{g}_t - g_t^B).$$

The marginal cost of a higher budgeted tax rate must thus equal the marginal benefit of a higher level of public spending. In other words, a high tax rate or cost of public funds implies a low demand for public goods. Upon substituting (8″) and (12) into the present-value government budget constraint and solving for the optimal tax level of public spending and tax rate, we obtain:

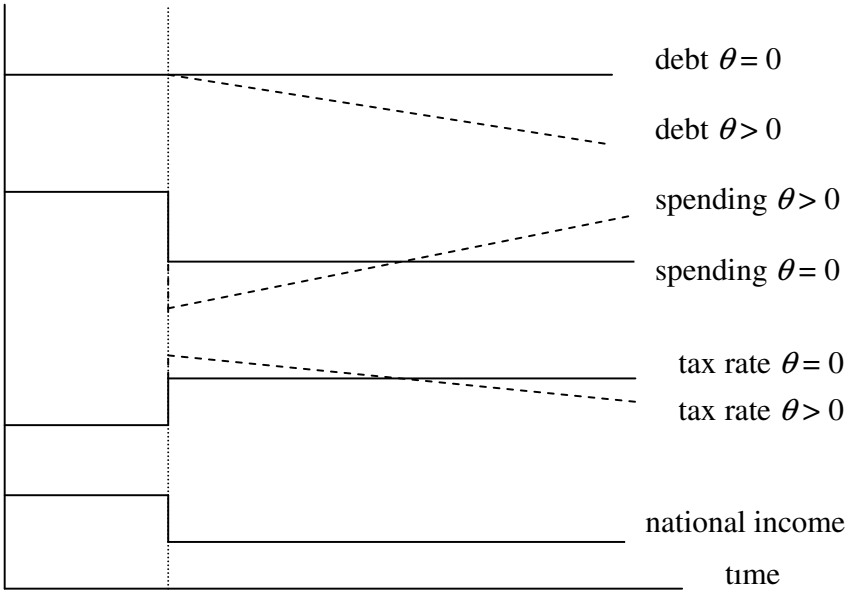
$$(13) \qquad \tau_t = \tau_t^B = \frac{(\beta-1)d_{t-1} + \overline{g}_t^P + ub_t^P - \rho(\tau+\alpha b)\left(\frac{\beta-1}{\beta-\rho}\right)\left(y_{t-1}-1\right)}{1+\chi^{-1}-\theta\sigma^2(\tau+\alpha b)^2\left(\frac{\beta}{\beta-\rho}\right)^2}$$

$$(14) \qquad E_{t-1}\left(d_t - d_{t-1}\right) = \left[\overline{g}_t - \overline{g}_t^P + u(b_t - b_t^P) - \beta\left(\frac{1-\rho}{\beta-\rho}\right)(\tau+\alpha b)\left(y_{t-1}-1\right)\right] - \theta\sigma^2(\tau+\alpha b)^2\left(\frac{\beta}{\beta-\rho}\right)^2\tau_t.$$

where b_t^P indicates the permanent level of the unemployment benefit. If one expects the unemployment benefit rate to be cut in the future, it is optimal to set a relatively low tax rate and

run a temporary deficit. Endogenous government spending does not affect the determination of public debt very much, except that more right-wing governments with a lower value of χ tend to have lower tax rates and thus their correction term for prudence is smaller as well. We see from (12) that now not only do we have as a precaution a higher tax rate, but also a lower level of public spending. Over time the minister of finance will inevitably enjoy windfall revenues, so that the tax rate gradually falls and the level of public spending gradually increases as debt service diminishes. Figure 1 shows what happens with a permanent fall in the level of national income.

FIGURE 1: PRUDENT REACTION TO PERMANENT FALL IN THE TAX BASE



On impact the tax rate is higher and the level of public spending is lower than in the absence of prudence. As a result, on average the government can expect windfall revenues that enable debt to be paid off. The accompanying fall in interest payments permit a gradual rise in public spending and fall in the tax rate. In the very long run the government builds up assets in order to generate just sufficient interest revenue to pay for each period for the long-run level of public spending. This implies, in sharp contrast to the traditional tax smoothing result of Barro (1979), that the tax rate converges asymptotically to zero.

Since many European governments have tried to satisfy the Maastricht norms for the deficit-GDP and the debt-GDP ratios by selling public sector assets, it is interesting to extend our analysis to allow for public sector capital (see appendix). The present-value government budget constraint now states that the net worth of the public sector must be sufficient to cover the excess

of public spending plus losses on public sector capital over tax revenues as in Buiter (1985). Selling public sector capital and using the proceeds to reduce government debt therefore does not necessarily improve the net worth of the public sector. Although the current financial deficit improves, any future income or utility derived from these public sector assets will be forsaken. The key insight is that prudence induces precautionary taxation and underspending of public goods and public sector capital. As a result, the net worth of the public sector increases over time and the government can be expected to gradually lower the tax burden and gradually raise spending on consumption goods and capital.

V. CASE FOR A STRONG AND PESSIMISTIC MINISTER OF FINANCE?

If the electorate itself is prudent, it makes sense for a benevolent government to be prudent as well. In practice, there are also political reasons why a government might want to employ a more prudent budgetary policy than its citizens. Let us therefore assume that household preferences do not display temporal risk aversion and see whether there may nevertheless be a reason for the government to act prudently. Governments want to spend as much of their time and energy on important and necessary economic and political reforms and cannot afford to spend their time and energy on useless matters. However, whenever there are unexpected falls in public revenues, ministers taking care of the spending departments fight over who must implement the spending cuts to balance the budget and the minister of finance is pressurized to relax the budgetary rules. In contrast, if there are windfall revenues, the cabinet members find it easier to agree on what to do with them. The government therefore finds it attractive to have a prudent budgetary policy, so that on average unexpected windfall revenues occur more frequently than shortfalls in expected revenues and more time and energy is left for important political issues.

Another justification highlights why it is attractive to appoint a strong minister of finance with more pessimistic preferences than the electorate and his spending colleagues. *Ex ante* the minister of finance realizes that *ex post* it is tougher to discipline the spending ministers in his cabinet. If the minister of finance is not in firm control, the unfettered claims of the spending ministers give rise to a common-pool problem. This implies an upward bias in public spending and excessive accumulation of government debt as discussed in Persson and Tabellini (2000, Chapter 13.1 and

13.2).[7] It also leads to a departure from tax smoothing, since spending ministers try to defer taxation. Such biases occur as each spending minister is trying to get its hands on scarce public revenue before the other spending ministers get a chance to do so. Given these spending, tax and debt biases, the minister of finance may find it especially advantageous to deliberately underestimate the future tax base and induce precautionary taxation and underspending. More precisely, a minister of finance can strengthen his position in the cabinet by implementing a pessimistic budgetary policy to offset the biases resulting from the common-pool problem. It is thus in the interest of society to appoint a prudent minister of finance.

To make the point, we allow for N spending ministers. To keep matters simple, we abstract from public sector capital and unemployment benefits and assume only two time periods. If there is no inherited debt and the rate of interest and the discount rate are zero, we have $\varepsilon_1 = d_0 = d_2 = 0$ and $\beta = 1$. The present-value government budget constraint is thus given by:

$$(15) \qquad d_1 = \sum_{i=1}^{N} g_{1i} - \tau_1 = \tau_2 + \tau\varepsilon_2 - \sum_{i=1}^{N} g_{2i}, \qquad \varepsilon_2 \sim \mathrm{IN}(0,\sigma^2),$$

where g_{ti} stands for the level of spending by minister i at time t. We focus on symmetric outcomes and assume that priorities and bliss values are time-invariant and the same for each public spending category, so that minister i is concerned with minimizing the expected welfare loss:

$$(16) \qquad L_i \equiv \mathrm{E}\left[\frac{1}{2}\sum_{t=1}^{2}\left(\tau_t^2 + \chi(\overline{g} - g_{ti})^2\right)\right].$$

The minister of finance minimizes the expected value of the sum of the welfare loss functions of each of the spending ministers and also postulates that future disturbances are drawn to hurt social welfare. We first consider the cooperative outcome, where the minister of finance and the spending ministers jointly minimize the expected value of the social welfare loss $L_1 + .. + L_N$ subject to (15) in the absence of prudence. We then contrast this with the non-cooperative

[7] Von Hagen and Harden (1995) argue that the spending bias resulting from fiscal illusion (i.e., the overestimation of the benefit of a particular activity) may be contained by appropriate budgetary processes, which depend on what kind of uncertainty dominates the budget process. Another way to constrain profligate spending ministers is to delegate authority to monitor and punish to the minister of finance. Hallerberg and von Hagen (1997) argue that this works better in countries with non-proportional representation and one-party states. Swank (2002) shows that the appointment of a spending-averse minister of finance is better than binding budget targets imposed by the prime minister, because it induces spending ministers to propose less ambitious budgets as well as to appoint less spending-prone bureaucrats.

outcome in the absence of prudence where spending ministers lead in their spending claims and the minister of finance follows in setting the tax rate and public debt. We show that the non-cooperative outcome leads to the following distortions: a tilt towards future rather than present taxation, a tilt towards present rather than future government consumption, excessive accumulation of government debt, and an upward bias in total public spending and the average tax rate. We finally analyze what happens if a strong and pessimistic minister of finance is appointed to control the squabbling spending ministers. A *strong* minister of finance is necessary to overcome the *intratemporal* bias towards excessive public spending while a *pessimistic* minister of finance is necessary to mitigate the *intertemporal* bias of spending too soon and taxing too late. A strong minister of finance effectively has as much power as all his spending colleagues together. Precautionary taxation allows for a gradual reduction in government debt. It also leads on average to expected windfall revenues, so that over time the level of public spending can rise and the tax rate can fall. Prudence is thus able to offset the intertemporal distortions arising from the dynamic common-pool problem.

COOPERATIVE OUTCOME

It is easy to show that the cooperative outcome in the absence of prudence is characterized by:

$$
\begin{aligned}
&g_{1i}^{C} = \mathrm{E}\left(g_{2i}^{C}\right) = \left(\frac{\chi}{\chi + N^2}\right)\overline{g} < \overline{g}, \quad g_{2i}^{C} = g_{1i}^{C} + \left(\frac{N}{\chi + N^2}\right)\tau\varepsilon_2, \quad i = 1,..,N, \quad d_1^{C} = 0, \\
&\tau_1^{C} = \mathrm{E}(\tau_2^{C}) = \left(\frac{\chi}{\chi + N^2}\right)N\overline{g}, \quad \text{and} \quad \tau_2^{C} = \tau_1^{C} - \left(\frac{\chi}{\chi + N^2}\right)\tau\varepsilon_2,
\end{aligned}
\tag{17}
$$

where superscript *C* indicates the cooperative outcome. It is optimal ex ante for the social planner to smooth the levels of public spending and the tax rate over time. Since there are no changes in the targets for government spending or the tax base over time, there is no need for government debt. A bigger priority to public goods χ leads to higher spending and tax rates.

OPEN-LOOP NASH OUTCOME

One way to calculate the non-cooperative outcome is to assume pre-commitment of each spending minister to future spending levels. The resulting open-loop Nash equilibrium is:

$$
g_{1i}^{C} = \mathrm{E}\left(g_{2i}^{C}\right) < g_{1i}^{O} = \mathrm{E}\left(g_{2i}^{O}\right) = \left(\frac{\chi}{\chi + N}\right)\overline{g} < \overline{g}, \quad d_1^{O} = 0, \quad \tau_1^{C} = \mathrm{E}(\tau_2^{C}) < \tau_1^{O} = \mathrm{E}(\tau_2^{O}) = \left(\frac{\chi}{\chi + N}\right)N\overline{g},
\tag{18}
$$

where the superscript *O* indicates the open-loop Nash outcome. In the non-cooperative outcome with pre-commitment, we see that spending and tax rates are higher than in the cooperative outcome. Since spending ministers are only concerned with their own budget, they do not take fully account of the tax distortions caused by the total budget. Tax rates and public spending levels are smoothed, so there is no need for government debt. Hence, there are no *intertemporal* distortions, only *intratemporal* distortions in the open-loop Nash outcome. It is easy to see that, if the minister of finance and the prime minister together get just as much votes as the spending ministers combined, the open-loop Nash outcome becomes the cooperative outcome and the intratemporal distortions leading to an excessively large public sector are eliminated.

FEEDBACK NASH OUTCOME

It is more realistic to assume that there is no pre-commitment in which case the feedback Nash outcome is appropriate. We use dynamic programming to ensure subgame perfection. Working backwards each spending minister takes past government debt and spending plans of his colleagues as given. Minister *i* thus solves in the second period:

$$(19) \qquad L_{2i} \equiv \underset{g_{2i}}{\text{Min}} \frac{1}{2}\left[\tau_2^2 + \chi\left(\bar{g} - g_{2i}\right)^2\right] = \frac{1}{2}\left[\left(d_1 - \tau\varepsilon_2 + \sum_{j=1}^{N} g_{2j}\right)^2 + \chi\left(\bar{g} - g_{2i}\right)^2\right], \quad i = 1,..,N,$$

where we have substituted the second-period budget constraint from (15). The optimal reaction function for minister *i* is thus given by:

$$(20) \qquad g_{2i} = \frac{\chi\bar{g} - d_1 + \tau\varepsilon_2 - \sum_{j\neq i} g_{2j}}{1+\chi}, \quad i = 1,..,N,$$

so that he spends more if there is a small outstanding debt and a positive income shocks. If his colleagues spend more, the cost of funds goes up and he spends less. The resulting symmetric feedback Nash equilibrium for the second-period level of spending and the tax rate is given by:

$$(21) \qquad g_{2i}^N = \frac{\chi\bar{g} - d_1 + \tau\varepsilon_2}{N+\chi}, \ i = 1,..,N \quad \text{and} \quad \tau_2^N = \left(\frac{\chi}{N+\chi}\right)\left(N\bar{g} + d_1 - \tau\varepsilon_2\right),$$

where the superscript N indicates the feedback Nash outcome. Turning to the first period and substituting the first part of (15) and (21) into (16) , we see that minister i chooses first-period spending to minimize its welfare loss:

$$(22) \qquad L_i^N = \underset{g_{1i}}{\text{Min}}\, \text{E}\left(\frac{1}{2}\tau_1^2 + \frac{1}{2}\chi\left(\overline{g} - g_{1i}\right)^2 + \frac{1}{2}\left(\frac{\chi(1+\chi)}{(N+\chi)^2} \right)\left[N\overline{g} + \left(\sum_{j=1}^{N} g_{1j} \right) - \tau_1 - \tau\varepsilon_2 \right]^2 \right),$$

The finance minister chooses the tax rate τ_1 to minimize $L_1 + .. + L_N$. The resulting first-order conditions are:

$$(23) \qquad \chi\left(\overline{g} - g_{1i}\right) = \tau_1 = \left(\frac{\chi(1+\chi)}{(N+\chi)^2} \right)\left(N\overline{g} + Ng_{1i} - \tau_1 \right),$$

This states that the marginal cost of taxation must equal the marginal benefit of public goods in the first period and also equal the marginal cost of public debt (i.e., the marginal cost of lower spending and higher taxes in the future). The resulting symmetric feedback Nash equilibrium outcomes for the first period are:

$$(24) \qquad g_{1i}^N = \left[\frac{(N+\chi)^2 + (\chi - N)(1+\chi)}{(N+\chi)(N+2\chi+1)} \right]\overline{g}, \quad i = 1,..,N, \quad \tau_1^N = \left[\frac{2\chi(1+\chi)}{(N+\chi)(N+2\chi+1)} \right] N\overline{g}$$
$$\text{and} \quad d_1^N = \left[\frac{(N+\chi)^2 - (\chi+N)(1+\chi)}{(N+\chi)(N+2\chi+1)} \right] N\overline{g} > 0.$$

Due to the linear-quadratic-Gaussian nature of the optimization problem and the absence of prudence, certainty equivalence applies so optimal first-period spending and debt can be obtained by setting the future income shock to its expected value of zero. Upon substitution of (24) into (20), we obtain the feedback Nash outcomes for the second period:

$$(21') \qquad g_{2i}^N = \left[\frac{\chi(N+2\chi+1) - N(N-1)}{(N+\chi)(N+2\chi+1)} \right]\overline{g} + \left(\frac{\tau\varepsilon_2}{N+\chi} \right), i = 1,..,N,$$
$$\text{and} \quad \tau_2^N = \left[\frac{2\chi}{(N+\chi)(N+2\chi+1)} \right] N\overline{g} - \left(\frac{\chi}{N+\chi} \right)\tau\varepsilon_2.$$

As long as N > 1, we can easily establish the following results:.

$$
\begin{aligned}
& g_{1i}^{N} > \mathrm{E}\left(g_{2i}^{N}\right), \quad g_{1i}^{N} > g_{1i}^{O} > g_{1i}^{C} = \mathrm{E}\left(g_{2i}^{C}\right), \quad \mathrm{E}\left(g_{2i}^{N}\right) < \mathrm{E}\left(g_{2i}^{O}\right), \\
& g_{1i}^{N} + \mathrm{E}\left(g_{2i}^{N}\right) = g_{1i}^{O} + \mathrm{E}\left(g_{2i}^{O}\right) > g_{1i}^{C} + \mathrm{E}\left(g_{2i}^{C}\right), \quad L_{i}^{N} > L_{i}^{C} > L_{i}^{C}, \quad i = 1,..,N, \\
& \mathrm{E}(\tau_{2}^{N}) > \tau_{1}^{\mathrm{N}} > \tau_{1}^{\mathrm{C}} = \mathrm{E}(\tau_{2}^{C}) \quad \text{and} \quad d_{1}^{N} > 0.
\end{aligned} \tag{25}
$$

From (25) and (21′) we see that the feedback Nash outcome suffers from two types of distortions. First, the sum of spending levels and of the tax rate over the two periods is the same as in the open-loop Nash equilibrium and thus higher than in the cooperative outcome. This is the familiar *intratemporal* distortion towards an excessive public sector. Second, government consumption is tilted towards the first period, taxation is tilted towards the second period, and, as a consequence, there is excessive government debt. These are the *intertemporal* distortions. In fact, spending in the first period is bigger in the feedback Nash than in the cooperative outcome.[8] Because each spending minister (or group of a coalition) decides part of the budget and nobody controls the aggregate budgetary outcome, ministers spend too much and too soon and postpone taxation with the result that borrowing is too high. These two types of common-pool distortions arise from the lack of a proper definition of property rights to tax revenues.

It is interesting to note that the common-pool distortions worsen when the number of spending ministers increases. More claims on the common budget worsen the biases to spend too much and too soon and postpone taxation. Also, comparing (21′) with (17), a positive shock to national income induces a smaller increase in public spending and the tax rate in the non-cooperative outcome. Finally, the expected welfare loss is obviously greater in the feedback Nash than in the open loop Nash and *a fortiori* than in the cooperative outcome.

PRUDENCE CAN HELP TO CONTROL PROFLIGATE SPENDING MINISTERS

Now we introduce prudence into the feedback Nash outcome and show that this can improve social welfare. This implies that the cabinet deliberately depresses the forecast of future national income and the tax base. The finance minister is pessimistic and solves the min-max problem:

[8] Also, if $\chi(2\chi+N) > N^2$, we establish that $\mathrm{E}(g_{2i}^{N}) > g_{1i}^{C} = g_{2i}^{C}$.

$$(26)\quad \underset{\tau_1}{\text{Min}}\,\underset{\varepsilon_2}{\text{Max}}\,\frac{1}{2}\left[\sum_{i=1}^{N}\left(\tau_1^2+\chi\left(\overline{g}-g_{1i}\right)^2+\left(\frac{\chi(1+\chi)}{(N+\chi)^2}\right)\left[N\overline{g}+\left(\sum_{j=1}^{N}g_{1j}\right)-\tau_1-\tau\varepsilon_2\right]^2\right)-\left(\frac{\varepsilon_2^2}{\theta\sigma^2}\right)\right].$$

This gives rise to the following first-order conditions:

$$(23')\quad -\left(\frac{\varepsilon_2^B}{\theta\sigma^2 N}\right)=\chi\left(\overline{g}-g_{1i}\right)=\tau_1=\left(\frac{\chi(1+\chi)}{(N+\chi)^2}\right)\left(N\overline{g}+Ng_{1i}-\tau_1-\tau\varepsilon_2^B\right).$$

Using (23′) and (21′) to substitute expressions for all variables in terms of τ_1 into the present-value budget constraint yields the following expressions for the first-period tax rate and level of spending, public debt and the future budgeted income shock:

$$(27)\quad \varepsilon_2^B=-\left(\frac{2\theta\sigma^2\tau N\chi(1+\chi)}{(N+\chi)(N+2\chi+1)--\theta\sigma^2\tau^2N\chi(1+\chi)}\right)N\overline{g}<\mathrm{E}(\varepsilon_2)=0,$$

$$g_{1i}^P=\left[\frac{(N+\chi)^2+(\chi-N)(1+\chi)-\theta\sigma^2\tau^2N\chi(1+\chi)}{(N+\chi)(N+2\chi+1)-\theta\sigma^2\tau^2N\chi(1+\chi)}\right]\overline{g},\quad i=1,..,N,$$

$$(24')\quad \tau_1^P=\left[\frac{2\chi(1+\chi)}{(N+\chi)(N+2\chi+1)-\theta\sigma^2\tau^2N\chi(1+\chi)}\right]N\overline{g}>0$$

$$\text{and}\quad d_1^P=\left[\frac{(N+\chi)^2-(\chi+N)(1+\chi)-\theta\sigma^2\tau^2N\chi(1+\chi)}{(N+\chi)(N+2\chi+1)-\theta\sigma^2\tau^2N\chi(1+\chi)}\right]N\overline{g}>0.$$

where superscript *P* indicates the prudent outcome. Expression (27) indicates that the minister of finance deliberately underestimates future income to be on the safe side. Second-period public spending and the tax rate follow readily from the second-period government budget constraint:

$$(28)\quad g_{2i}^P=\left(\frac{\chi\overline{g}-d_1^P+\tau\varepsilon_2}{\chi+N}\right)\quad\text{and}\quad\tau_2^P=\left(\frac{N\overline{g}+d_1^P-\tau\varepsilon_2}{\chi+N}\right).$$

To understand how prudence and a strong minister of finance can offset the intertemporal and intratemporal common-pool distortions, Table 1 calculates feedback Nash outcomes for varying degrees of prudence and compares them with the cooperative and open-loop and feedback Nash

outcomes in the absence of prudence. The open-loop Nash equilibrium only suffers from intratemporal distortions: governments spending and tax rates are higher than in the cooperative outcome, but there is no excessive debt accumulation. To get rid of the bias in the open-loop Nash equilibrium it suffices to give the minister of finance at least as many votes in the cabinet as the spending ministers combined (i.e., reduce χ to χ/N). The feedback Nash outcome gives rise to the intertemporal distortions of spending too soon and taxing too late. It thus leads to excessive debt accumulation. Prudent budgetary policy clearly is able to offset the bias of spending too much and too soon and the resulting debt bias. By deliberately budgeting the future national income and tax revenues too low, the minister of finance forces his spending colleagues to spend later, to not postpone taxation and accumulate less debt. As the degree of prudence θ increases, it is optimal to spend less today and more tomorrow, to borrow less and to have a lower tax rate. If $\theta\sigma^2$ is about 0.35, the debt bias completely disappears and the feedback Nash outcome with prudence has become close to the open-loop Nash outcome. The final rows show that with a strong and even more pessimistic minister of finance it is possible to mitigate all the intratemporal and intertemporal welfare losses arising from the common-pool problem.

TABLE 1: PRUDENCE AND STRONG FINANCE MINISTER
MITIGATE THE COMMON-POOL PROBLEM

	Ng_{1i}	Ng_{2i}	d_1	τ_1	τ_2	ε_2^B	L_i
Cooperative	0.3333	0.3333	0	0.3333	0.3333	0	0.2
Open-loop Nash	0.4286	0.4286	0	0.4286	0.4286	0	0.2204
Feedback Nash	0.4418	0.4154	0.0462	0.3956	0.4615	0	0.2217
Prudent $\theta\sigma^2\tau = 0.1$	0.4386	0.4186	0.0350	0.4036	0.4536	–0.0807	0.2212
Prudent $\theta\sigma^2\tau = 0.2$	0.4352	0.4219	0.0233	0.4119	0.4452	–0.1648	0.2207
Prudent $\theta\sigma^2\tau$=0.35	0.4300	0.4272	0.0050	0.4250	0.4321	–0.2975	0.2204
Prudent $\theta\sigma^2\tau$= 0.4	0.4282	0.4292	–0.0014	0.4296	0.4275	–0.3437	0.2204
Strong and prudent							
$\chi = 2.5$, $\theta\sigma^2\tau$= 0.4	0.3522	0.3145	0.0425	0.3097	0.3569	–0.2478	0.2010
$\chi = 2.5$, $\theta\sigma^2\tau = 0.8$	0.3358	0.3308	0.0057	0.3302	0.3365	–0.5283	0.2000

Parameters: $\tau = \bar{g} = 0.3$, $\chi = 5$ and $N = 2$.

WARNING: PRUDENCE MAY SOLICIT ELECTORAL BUDGET CYCLES

Many governments adopt a 'first-sour-then-sweet' policy whereby unpopular policies such as raising tax rates and trimming public spending are implemented immediately upon election into office while popular policies of cutting tax rates and boosting public spending occur just before the next election. There may be short-run political benefits from loosening budgetary discipline just before an election, but only if citizens are myopic.[9] Such opportunistic political manipulation is made possible by the assets accumulated from precautionary taxation. By reducing government debt and accumulating assets, the minister of finance builds up a buffer that can be used to cut taxes and boost public spending towards election eve. As long as this is not overdone, electoral cycle motivations may help to offset the intertemporal common-pool distortions of spending too soon and taxing too late. However, there is always the danger that excessively large buffers are accumulated by the minister of finance in order to dish out excessively big tax cuts and spending hikes on election eve for short-run political gains.[10] Short-run political manipulation of election results may thus lead to an excessively prudent budgetary policy. To see this, we change the weight on second-period welfare losses in (16) from 1 to $1+\pi$ with $\pi>0$ and recalculate the outcomes of Table 1. It is easy to show that this induces an electoral business cycle with higher taxes and lower spending upon moving into office and lower taxes and higher spending just before the next election. Clearly, the government has an incentive to build up assets towards election eve in order to dish out favours to the voters. Table 2 confirms these results and indicates that for small values of π it is possible to have a welfare improvement, but for large values of π opportunistic political manipulation is excessive and leads a deterioration of welfare. In other words, if the electorate 'forgets' past outcomes quickly, electoral budget cycles are more likely to reduce welfare. Short-run manipulation of election outcomes ensures, like prudence, more

[9] The pioneering work of Nordhaus (1976) on the political business cycle is based on myopic citizens. Opportunistic, pre-election manipulation of the expectations-augmented Phillips curve creates jobs on election eve while the inflationary effects appear after the election. Apart from not fitting the empirical facts very well as discussed by Drazen (2000), it is unlikely that people are foolish and irrational enough to be manipulated in such a way. Also, electoral cycles seem to be driven more by fiscal policy than monetary policy. Rogoff (1990) rationalized such opportunistic, pre-electoral manipulation by assuming that there is imperfect information about an incumbent's competence. In such a context expansionary policy before an election indicates high competence. Partisan differences about the size of the public sector or the nature of public goods can also induce a pre-election debt bias; e.g., Persson and Tabellini (2000, Chapter 13.3).

[10] Indeed, the 'prudent' finance minister Gerrit Zalm has been accused of being tough in post-election years but exuberant and irresponsible in each pre-election year. Critics such as Jacobs (2007) and Beetsma and van Wijnbergen (2007) argue that under his reign the structural deficit and volatility of output and consumption have increased, but that he was 'saved' by the extra gas revenues resulting from temporary high oil prices. Minister Zalm may thus have abused his 'prudent' budgetary policy for short-run electoral gains. The same critics complain that minister Zalm has in election years immediately converted *temporary* windfall revenues in *permanent* tax cuts (1998, 2005) or public spending hikes (2001).

effective political decision making and makes it possible to control squabbling spending ministers, but not if the reduction of public debt or the accumulated assets induce excessive electoral budget cycles to the detriment of social welfare. If the effective discount rate of the past by the electorate equals 1/1.1666 = 0.857, the opportunistic electoral outcome exactly reproduces the open-loop Nash outcome. In that case, the intertemporal common-pool distortions are exactly offset by opportunistic manipulation of election results.

TABLE 2: OPPORTUNISTIC MANUPILATION OF ELECTION OUTCOMES

	Ng_{1i}	Ng_{2i}	d_1	τ_1	τ_2	L_i
Open loop Nash	0.4286	0.4286	0	0.4286	0.4286	0.2204
Feedback Nash	0.4418	0.4154	0.0462	0.3956	0.4615	0.2217
Electoral $\pi = 0.1$	0.4336	0.4235	0.0176	0.4160	0.4412	0.2206
Electoral $\pi = 0.5$	0.4071	0.4500	–0.0750	0.4821	0.3750	0.2239
Electoral π=0.1666	0.4286	0.4286	0.0000	0.4286	0.4286	0.2204

Parameters: $\tau = \overline{g} = 0.3$, $\chi = 5$ and $N = 2$.

VI. CONCLUDING REMARKS

The principles of sound prudent budgetary policy require that the minister of finance deliberately underestimates the future level of the national income and the tax base. The degree to which this should be done is bigger if the minister of finance is more prudent, the variance and persistence of shocks hitting national income and the tax base are large, and the level of the tax rate and the unemployment benefit are large. The principle of precautionary taxation thus requires that the tax rate is set higher than it would have been done otherwise. Similarly, as a precaution the level of public spending is set lower. As a result, the minister of finance is more likely to enjoy windfall revenues rather than a shortfall of revenues. The government debt is therefore likely to fall over time. The associated reduction in debt service permits, depending on political preferences, either a gradual reduction in the tax rate, an increase in the public spending or a combination of both. In the long run the tax rate converges to zero as public spending is financed by interest income on government assets. This is in sharp contrast to the traditional principles of tax smoothing.

An important advantage of prudent budgetary policy is that it generates peace and quiet in the council of ministers. Without prudent forecasts of national income and the tax base, the likelihood of unexpected falls in tax receipts and consequent budgetary fights is much bigger. The

ministers then waste a lot of time and energy on squabbling to try to offload the costs of further cuts on their colleagues. That time and energy would have been much better spent on important policy issues and reforms. With spending ministers squabbling over a common pool of public revenues, it is attractive to give the minister of finance at least as much voting rights in the cabinet as all the spending ministers combined. This eliminates the *intratemporal* common-pool distortions of an excessively large public sector. The minister of finance should also adopt a prudent budgetary policy to avoid spending too soon and taxing too late. This effectively gets rid of the *intertemporal* common-pool distortions. A strong and pessimistic minister of finance can thus control the claims of his spending colleagues and avoid excessive debt accumulation.

It is straightforward to extend the present framework to allow for uncertainty about future projections in the actual or desired levels of public spending, future returns on public sector capital or future interest on public debt and to allow for more general data generating processes for national income and the tax base. It would then be prudent for the minister of finance to budget for slightly higher levels of future government spending and the market rate of interest and for slightly lower levels of future financial returns on public sector capital than the mathematically expected levels. Again, the minister of finance will on average enjoy less ambitious spending desires and higher returns as well as windfall revenues than budgeted as time proceeds and is thus able to gradually cut debt service and the tax rate. It is also easy to allow for quadratic costs of adjustment for the stock of public sector capital or the level of government spending. It is also interesting to abandon the assumption of an exogenous data generation process for national income and allow for adverse effects of the tax rate on the tax base. The marginal cost of taxation is then likely to increase in recessions and fall during booms. This strengthens the case for a prudent counter-cyclical policy. Also, the structural unemployment rate may be positively affected by taxation. This also strengthens the case for such a prudent policy, because one does not want to increase tax rates in a recession as this would increase unemployment even further.

To allow for a general equilibrium setting with fully specified micro-founded behaviour of households and firms and flexible wages and prices requires numerical approximation algorithms that use linear-quadratic approximations of the model and the welfare function at every iteration. More interesting is to investigate how measurement errors in the national income and the tax base affect the principles of tax smoothing and the optimal determination of public debt. Whittle (1981, 1990) shows that it is possible to decouple the stages of risk-sensitive optimal control and optimal prediction with the aid of a risk-sensitive Kalman-Bucy filter. In future work we will use these techniques to modify our results on prudent budgetary policy.

Prudence favours the accumulation of assets to cope with future risk, but then it is optimal to spend less on actions to prevent risk with adverse consequences (e.g., Eeckhoudt and Collier (2005)). Similarly, a prudent minister of finance who has accumulated a big buffer is less likely to take actions to prevent the tax base from shrinking and is more likely to dish out favours towards election eve. It is therefore interesting to further develop the rationale for a strong and prudent minister of finance within the context of a political business cycle framework with finite election horizons. In practice, newly elected governments adopt a finite horizon, typically the period to the next election, and set themselves a target for the final financial deficit or surplus.[11] The key question is under what conditions prudent budgetary policy improves welfare. We have shown that this occurs if the electorate does not 'forget' too quickly and gives sufficient weight to outcomes immediately upon entering office. If the electorate 'forgets' quickly, the adverse welfare effects of short-run political manipulation will dominate the beneficial welfare effects of offsetting the intertemporal biases of the common-pool problem.

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[11] A lax final target combined with prudent budgeting may then be less cautious than an ambitious final target combined with realistic budgeting.

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APPENDIX

SOLUTION OF THE MIN-MAX PROBLEM

The min-max problem with endogenous government spending can be solved as follows. The case of exogenous public spending corresponds to $\chi \to \infty$, i.e. $g_t = \bar{g}_t$. The Lagrangian is given by:

$$L \equiv \sum_{t=1}^{\infty} \frac{1}{2} \beta^{-t} \left[\tau_t^2 + \chi \left(\bar{g}_t - g_t \right)^2 - (\theta \sigma^2)^{-1} \varepsilon_t^2 \right] - \beta^{-t} \lambda_t \left[d_t - \beta d_{t-1} - g_t + \tau_t - u b_t + (\tau + \alpha b)(y_t - 1) \right]$$
$$+ \sum_{t=1}^{\infty} \beta^{-t} \mu_t \left(y_t - 1 + \rho - \rho y_{t-1} - \varepsilon_t \right),$$

where λ_t and μ_t indicate the (undiscounted) shadow prices of government debt and national income. This yields from the perspective of time 1, the following first-order conditions:

$$\frac{\partial L}{\partial \tau_t} = \beta^{-t} \tau_t - \beta^{-t} \lambda_t = 0 \quad \Rightarrow \quad \tau_t = \lambda_t, \quad \forall t \geq 1$$

$$\frac{\partial L}{\partial g_t} = -\beta^{-t} \chi \left(\bar{g}_t - g_t \right) + \beta^{-t} \lambda_t = 0 \quad \Rightarrow \quad \chi \left(\bar{g}_t - g_t \right) = \tau_t, \quad \forall t \geq 1$$

$$\frac{\partial L}{\partial d_t} = -\beta^{-t} \lambda_t + \beta \beta^{-(t+1)} \lambda_{t+1} = 0 \quad \Rightarrow \quad \lambda_{t+1} = \lambda_t \text{ and } \tau_{t+1} = \tau_t, \quad \forall t \geq 1$$

$$\frac{\partial L}{\partial \varepsilon_t} = -\beta^{-t} \left(\frac{\varepsilon_t}{\theta \sigma^2} \right) - \beta^{-t} \mu_t = 0 \quad \Rightarrow \quad \varepsilon_t = -\theta \sigma^2 \mu_t, \quad \forall t \geq 1 \text{ and}$$

$$\frac{\partial L}{\partial y_t} = -\beta^{-t} (\tau + \alpha b) \lambda_t + \beta^{-t} \mu_t - \rho \beta^{-(t+1)} \mu_{t+1} = 0 \quad \Rightarrow \quad \rho \mu_{t+1} = \beta \mu_t - \beta (\tau + \alpha b) \lambda_t, \quad \forall t \geq 1.$$

Combining the first and last first-order conditions yields:

$$\rho \varepsilon_{t+1} = \beta \varepsilon_t + \theta \sigma^2 \beta (\tau + \alpha b) \tau_t, \quad \forall \tau \geq 1.$$

Given that $\theta > 0$, we can verify that the first-order conditions indeed characterize a min-max solution. Denoting the optimal budgetary outcomes by the superscript *B* and generalizing to the perspective from time *t* rather than time 1 onwards, we see that the first-order conditions give rise to (6′) and (7′) or (6) and (7) in the text.

PRUDENT BUDGETARY POLICY AND PUBLIC SECTOR ASSETS

We introduce public sector investment i_t and public sector capital k_t (both detrended) and modify the government budget constraint as follows:

$$d_t = \beta\, d_{t-1} + g_t + i_t + b_t\, [u + \alpha (1 - y_t)] - \tau_t\, y_t + r\ k_t,\ d_0 = D_0/Y_0 \text{ given},$$

where r indicates the financial return on public sector capital. If δ is the depreciation rate of public sector capital, the dynamics of net worth of the public sector $v_t \equiv k_t - d_t$ can be written as:

$$v_t = \beta\, v_{t-1} + \tau_t\, y_t - g_t - b_t\,[u + \alpha(1 - y_t)] - l_t,\;\; l_t \equiv (\beta + \delta - r)\, k_t,\;\; v_0 = (K_0 - D_0)/Y_0 \text{ given},$$

where losses on public sector capital l_t indicate the amount by which the financial return (net of depreciation) on those assets falls short of the growth-corrected real interest rate. If there are no Ponzi games, the present-value budget constraint of the public sector is:

$$\sum_{s=t}^{\infty} \beta^{t-s-1}\left[g_s + ub_s + (\beta + \delta - r)k_s - \tau_s - (\tau + \alpha b)(y_s - 1)\right] \le k_{t-1} - d_{t-1} = v_{t-1}.$$

If public sector capital earns a market rate of return, losses are zero and public sector capital can be debudgeted from the flow and present-value budget constraints. If the financial return on public sector capital net of depreciation falls short of the market rate of interest, $l_t > 0$. In that case, public sector capital must contribute to social welfare for otherwise there would be no reason to invest in it. We thus assume that the criterion that needs to be minimized is given by:

$$\Phi(\theta) \equiv \ln\left(\mathrm{E}\left[\exp\left(\theta \sum_{t=1}^{\infty} \frac{1}{2}\beta^{-t}[\tau_t^2 + \chi(\bar{g}_t - g_t)^2 + \xi(\bar{k}_t - k_t)^2]\right) / d_0, y_0\right]\right) / \theta,$$

where $\bar{k}_t > k_t > 0$ is the bliss level of public sector capital and $\xi > 0$. The optimality conditions (6′), (7′) and (12) and the equation for the budgeted tax base (8″) are as before. The novel feature is that the optimal capital stock is given by:

$$k_s = \bar{k}_s - \xi^{-1}(\beta + \delta - r)\tau_t, \qquad s \ge t.$$

The optimum public sector capital stock is thus high if the tax rate and the cost of funds are low. It is also high if the return on public sector capital r is high. Upon substitution of this and (6′), (7′) and (12) into the present-value budget constraint, we obtain:

$$\tau_t = \tau_t^B = \frac{\bar{g}_t^P + ub_t^P + (\beta + \delta - r)\bar{k}_t^P - (\beta - 1)(k_{t-1} - d_{t-1}) - \rho(\tau + \alpha b)\left(\dfrac{\beta - 1}{\beta - \rho}\right)(y_{t-1} - 1)}{1 + \chi^{-1} + (\beta + \delta - r)^2 \xi^{-1} - \theta\sigma^2(\tau + \alpha b)^2\left(\dfrac{\beta}{\beta - \rho}\right)^2}$$

$$E_{t-1}(v_t - v_{t-1}) = -(\bar{g}_t - \bar{g}_t^P) - u(b_t - b_t^P) - (\beta + \delta - r)(\bar{k}_t - \bar{k}_t^P)$$
$$+ \beta\left(\frac{1 - \rho}{\beta - \rho}\right)(\tau + \alpha b)(y_{t-1} - 1) + \theta\sigma^2(\tau + \alpha b)^2\left(\frac{\beta}{\beta - \rho}\right)^2 \tau_t.$$

Prudence still requires precautionary taxation. As a result, the expected net wealth of the public sector increases over time. The government is thus able to gradually lower the tax rate and increase spending on consumption goods and capital.