Bureaucracy, Tax System, and Economic Performance

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Abstract

This paper investigates the consequences for government size, growth and welfare if a selfish bureaucracy provides a congested input. Alternative exogenous tax systems are introduced and numerical analyses are carried out. The welfare optimum is only met under very specific assumptions: proportional congestion, a tax system only consisting of distortionary taxes and a bureaucracy that maximizes the budget's growth rate. Otherwise the relative size of the public sector becomes suboptimally large thus inducing welfare losses. From a welfare economic point of view bureaucratic selfishness is worse than a suboptimal taxing regime that does not (completely) internalize the congestion externalities.

1. Introduction

Within endogenous growth models the government usually eliminates externalities that arise in the context of private economic activity (see Barro and Sala-I-Martin 2004 or Aghion and Howitt 1998 for an overview). Some of the models that are based on the seminal work of Barro (1990) explicitly focus on government provision of congested public inputs (e.g., Barro and Sala-I-Martin 1992, Turnovsky 1997, 1999a, 1999b, Fisher and Turnovsky 1998 or Eicher and Turnovsky 2000). These endogenous growth models assume welfare maximizing behavior of the public agents and the determined policy mix assures that the first-best optimum arises as a consequence of the decentralized decisions. Efficiency requirements within these models are twofold:

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the choice of the optimal financing mode which is independent of the prevailing degree of congestion; and an unique ratio between the private and public sectors. However, these theoretical requirements stand in strong contrast to empirical findings. Firstly, expenditure ratios in most industrialized countries have grown dramatically during the last century (see e.g., Holsey and Borcherding 1997). Second, the growth models mentioned above assume altruistic governmental behavior. Several approaches argue that the growing public sector is the outcome of an increased demand for public services by the citizens. Other approaches analyze the supply side of governmental services and focus on two polar types of public agents. One view is Max Weber's (1947) vision of a bureaucrat who serves the public interest and seeks to maximize utility of the tax payers. In the context of growth models with government expenditure, this type of bureaucrat might be interpreted as an altruistic social planner who wishes to realize the first-best optimum. The other polar view sees civil servants as pursuing personal objectives associated with income and/or career goals. Both objectives are frequently advanced by larger government budgets so that the civil servants have incentives to maximize the size of bureaucracy over which they preside and/or the size of the budget they control (see e.g., Niskanen 1971 or Romer and Rosenthal 1978, 1979, 1982). These models explain the budget's size as consequence of selfish bureaucratic behavior. The personal objectives of the government officials then differ from the taxpayer's goals and therefore creates an environment for excessive public spending.

In this paper we merge the endogenous growth and political economy literature to examine the welfare outcomes of different governmental sizes where that government size is determined by the (exogenously given) preferences of a selfish public agent. The formal framework is an endogenous growth model with private and public capital as production inputs. The bureaucracy determines the amount and provides the public capital. Public capital is financed by government revenues which consists of distortionary and nondistortionary taxes; and the bureaucracy cannot choose the proportion between the two types of taxes. Following Niskanen (1971), the government is modeled as 'bureaucratic leviathan' with no effective political check on its actions. Bureaucratic preferences are assumed to cover a weighted average of the relative size of the public sector and the growth rate of its absolute scale. The bureaucracy is only restricted by the tax system and the governmental budget is assumed to be balanced in each period. With this formulation we follow Brennan and Buchanan (1980) who develop a model in which the government as Leviathan is disciplined by constitutional constraints that are realized by several specifications of the tax system (see e.g., Tanzi and Schuhknecht 2000). We analyze the growth and welfare impact of the public agent's behavior that is interpreted as being a budget maximizing bureaucracy.[1] Given out interest in the dynamics it is important to clarify what

[1]However, we recognize that the tasks of bureaucracies include regulation, the enforcement of private property rights and the provision of public goods. In our model we only analyze

is meant by budget maximization within this model. One interpretation of budget maximization can refer to the public budget in each period. Then the size of the governmental budget compared to the private sector is considered and any outcome can be assessed with respect to static efficiency. Another interpretation stresses a dynamic point of view. Then the focal point is the public budget's growth and the outcome can be evaluated with respect to dynamic efficiency. Budget maximization in the former context implies maximizing the expenditure ratio whereas the latter interpretation implies maximizing the economy's growth rate. However, within our framework it turns out that the growth rate is a function of the expenditure ratio and therefore both cannot be determined independently. As such in our framework we find that the bureaucracy – while fixing the expenditure ratio – also determines the growth rate.

In our paper we compare the decentralized equilibrium to the outcome that depends on the specification of the bureaucracy's preferences. We find that an increase in the income tax unequivocally reduces the growth rate for a given expenditure ratio; whereas the corresponding welfare effect of a transition from a growth neutral to distortionary financing is ambiguous. All things being equal, an increase of the income tax reduces welfare if the public input is nonrival and the opposite applies for proportionally congested inputs. To assess the economic impact of these ambiguous effects numerical simulations are carried out for the special case of a Cobb–Douglas production technology. This allows for explicit calculations of the growth and welfare effects of selfish bureaucratic behavior.

The remainder of the paper is as follows. Section 2 describes the analytical framework. Section 3 gives a brief overview over the first-best optimum, the market equilibrium and the corresponding optimal fiscal policy. Section 4 analyzes the embodiment of the tax system and its effect on government size. Section 5 introduces the bureaucrat's preferences and analyzes the effect of different tax systems on macroeconomic performance. Section 6 provides the specified production technology and numerical simulations are carried out. The paper closes with a short summary, while technical details are relegated to the Appendix.

2. The Analytical Framework

The starting point of the analysis is a model of endogenous growth with a productive governmental input. Each of the identical individuals is facing an infinite planning horizon and maximizes overall utility, W, as given by

the bureaucratic provision of a productive governmental input and the consequences this has, in turn, on welfare. Additionally, to keep the analysis manageable, we abstract from analyzing the implications of electoral rules and alternative forms of governments. All these aspects are discussed e.g., by Persson and Tabellini (2000, 2003) or Mueller (2003). Continuative approaches that explain the evolution and the impact of (inefficient) institutions can be found in Acemoglu et al. (2005) or Acemoglu (2006).

$$W(0) = \int_0^\infty u(c)e^{-\beta t}\,dt. \tag{1}$$

The function $u(c)$ relates the flow of utility to the quantity of individual consumption, c, in each period. The discount factor, $e^{-\beta t}$, involves the constant rate of time preference, where $\beta > 0$. Utility of the representative household in each period is given by the isoelastic function

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma}, \quad \sigma > 0, \quad \sigma \neq 1. \tag{2}$$

Labor supply is assumed to be inelastic and the constant population consists of n individuals. As the feature of congestion is analyzed within this model it is necessary to distinguish between aggregate and individual quantities.

Each firm produces the homogeneous good, y, according to the individual production function

$$y = k \cdot f\left(\frac{G^a}{k}\right), \quad f'(\cdot) > 0, \quad f''(\cdot) < 0, \quad 0 < \frac{G^a}{k} < f(\cdot). \tag{3}$$

The production inputs are individual private capital, k, and the individually available amount of the public input, G^a, while $f(\cdot)$ may be interpreted as a productivity function. The production function is assumed to be homogenous of degree one in the two inputs and satisfies the Inada conditions such that the marginal product of each input is positive but diminishing. Capital is depreciated at the rate δ. The last condition in Equation (3) guarantees that output exceeds the governmental input.

The individual's availability of the public input may be expressed by the congestion function[2]

$$G^a = G \cdot k^{1-\varepsilon} K^{\varepsilon-1}, \quad \varepsilon \in [0, 1], \tag{4}$$

where $K \equiv nk$ denotes the aggregate stock of private capital and ε measures the degree of congestion: the absence of any congestion is represented by $\varepsilon = 1$, in which case the public good is fully available to the representative agent and $\varepsilon = 0$ corresponds to proportional congestion.[3] The parameter G denotes the stock of productive public capital and an increase in G relative to aggregate

[2]This is a typical congestion function as used within the public's good literature (see e.g., Edwards 1990 or Glomm and Ravikumar 1994). Note that within this paper we refer to 'relative' congestion as confined to 'absolute' congestion by Eicher and Turnovsky (2000).
[3](Partially) congested public goods are discussed in Buchanan (1965), Musgrave (1968), Samuelson (1969), Evans (1970) or Oakland (1969, 1972). The seminal work of Barro (1990) has been further developed e.g., by Glomm and Ravikumar (1994), Fisher and Turnovsky (1998), Turnovsky (1999) or Eicher and Turnovsky (2000). The term 'proportional congestion' is borrowed from Fisher and Turnovsky (1998).

capital, K, expands individually available amount of the public input and with this output per capita, y, in Equation (3) for a given amount of individual capital, k. On the other hand, an increase in K for given G lowers the public services available to the individual firms, reduces productivity $f(\cdot)$ and hence individual output. If $0 < \varepsilon < 1$, Equation (4) represents intermediate cases in which the public input is subject to partial congestion.

The government provides the productive input G. Governmental production does not exist in this model. However, the public sector buys a portion of the aggregate private production, $Y \equiv ny$, and makes it available to the individual agents as a public capital input.[4]

The provision of the public input G is financed by duties levied on firms. Since both inputs, private capital as well as the public input, are essential for production the firms cannot renounce on the use of the public input and have to accept any financing scheme chosen by the government. It is assumed that the government levies proportional taxes on income and a lump sum tax. In contrast to the tax on income, the lump sum tax has no distortionary effect on the intertemporal allocation and hence is growth neutral whereas taxing the income reduces the decentralized growth rate.[5] The budget is assumed to be balanced in each period.

3. Optimal Fiscal Policy

Given our analytical framework, the *first-best optimum* is characterized by the welfare maximizing growth rate ϕ^* and an optimal expenditure ratio $(\frac{G}{ny})^*$ that must be realized simultaneously. For our model, an altruistic government, such as a Weberian bureaucracy, can provide such an optimum. The central planning problem therefore would be to maximize the utility of the representative agent as given by Equation (1) and (2) subject to the individual accumulation constraint

$$\dot{k} = kf(\cdot) - c - \frac{G}{n} - \delta k. \tag{5}$$

As the omniscient planner knows that aggregate capital is composed of total individual capital, $K = nk$, the congestion function in Equation (4) simplifies to

$$G^a = \frac{G}{n^{1-\varepsilon}}. \tag{6}$$

[4] It is assumed that the public input G and total output Y may be transformed in a ratio of 1:1. One could also suppose that the government disposes of the same production technology as the private firms and produces G at its own.

[5] Instead of a lump sum tax a tax on consumption could be chosen to close the budget. If labor supply is inelastic the impact of the tax on the intertemporal allocation would be the same.

The optimal amount of the public input is attained if the marginal benefits to productivity equals the unit resource costs of the additional government expenditure. This leads to the necessary condition

$$f'(\cdot)\, n^{\varepsilon} = 1. \tag{7}$$

Maximizing over c and k and using the production function in Equation (3), the congestion function in Equation (6) as well as the optimality condition (7), the first-best growth rate attained by the benevolent government is given by

$$\phi^* = \frac{1}{\sigma}\left[f(\cdot)^* \left(1 - \frac{G}{ny}\right) - \delta - \beta \right], \qquad \frac{\partial \phi^*}{\partial \varepsilon} > 0. \tag{8}$$

As the level of the productivity function, $f(\cdot)$, decreases with an increase in the rivalry, the optimal growth rate depends on the existing degree of congestion, ε, and is the lower the more the public input is characterized by congestion. From (8), growth decreases when the public input is characterized by congestion. Another central feature of ϕ^* is that it depends on the level of the expenditure ratio. Differentiating (8) with respect to $G/(ny)$, we obtain the following relationship between the socially optimal growth rate and the expenditure ratio

$$\frac{\partial \phi^*}{\partial \frac{G}{ny}} = \frac{f(\cdot)}{\sigma(1-\eta)}\left[f'(\cdot)\, n^{\varepsilon} - 1 \right] \gtreqless 0 \quad \Longleftrightarrow \quad \frac{G}{ny} \lesseqgtr \eta \qquad \forall\, \varepsilon \tag{9}$$

with η denoting the partial production elasticity of the public input. Independent of the existing level of congestion the growth rate has a maximum if the expenditure ratio is equal to the partial production elasticity of the public input.[6]

The optimal expenditure ratio may be derived from Equation (7) together with the relation $\frac{G^a}{k} = \frac{G}{ny} f(\cdot)\, n^{\varepsilon}$. If the production function is homogenous the expenditure ratio turns out to be constant and

$$\eta \equiv \frac{f'(\cdot)\frac{G^a}{k}}{f(\cdot)} = \left(\frac{G}{ny}\right)^* \qquad \forall\, \varepsilon. \tag{10}$$

Then, production efficiency of the provision of the input G is realized for all levels of congestion. The first-best optimum thus may be characterized by Equation (8) and Equation (10). There are no transitional dynamics and the economy initially jumps into the steady state. In steady state consumption, capital, output as well as governmental expenditure grow at the same constant rate.

[6]See Figure 1 where the relationship between the optimal growth rates and the expenditure ratio is illustrated for alternative degrees of congestion by the solid curves.

We now turn to the description of the *market equilibrium*. The existence of rivalry is not perceived by the individuals as they do not consider the impact of their own decisions on the economy. That is, the individuals ignore that their individual capital accumulation increases the stock of total capital and thereby, all things being equal, reduces the amount of the public input available to the others. This causes congestion as long as the amount of the public input does not increase to the same extent as private capital. A negative externality of capital accumulation arises. Based on the congestion function (4) the individuals decide on consumption and capital accumulation. Optimizing over c and k and using the relationship $K = nk$ leads to the market equilibrium growth rate

$$\phi^D = \frac{1}{\sigma}\left[(1-\tau)\, f(\cdot)\,(1-\varepsilon\eta) - \delta - \beta\right], \quad \frac{\partial \phi^D}{\partial \varepsilon} < 0, \quad \frac{\partial \phi^D}{\partial \tau} < 0. \quad (11)$$

This equation includes two counteracting effects: all things being equal, an increase in the degree of congestion results in a higher growth rate whereas a higher income tax rate reduces the decentralized growth rate. In a decentralized economy, the first-best optimum may be realized if the government levies taxes in an appropriate way.[7] The *optimal income tax* reduces the decentrally growth rate and with this internalizes the external effect of capital accumulation as long as congestion arises. The lump sum tax then is used in order to close the budget and to provide the efficient amount of the public input.

4. The Tax System

Benevolent behavior of political agents is generally doubted in the public choice literature (see e.g., Mueller (2003) for a recent overview). To adapt a standard endogenous growth framework to the public choice approach, we need to relax the assumption of long-run welfare maximizing behavior of the government, as represented by the benevolent social planner. As the social planner within endogenous of growth models is not restricted by any electoral constraints he may be interpreted most suitably as a bureaucrat.[8] Usually, the bureaucracy provides services to the public and eliminates, or at least alleviates, any existing external effects. To finance the corresponding expenditures the bureaucrat disposes of revenues out of the tax system.

[7]For a discussion of the impacts of different fiscal instruments and the role of the public sector see e.g., Musgrave (1959), Atkinson and Stiglitz (1980), Stiglitz (1986), Myles (1995) or Cornes and Sandler (1996). A detailed derivation of the level and impact of the income tax rate and the corresponding lump sum tax can be found e.g., by Turnovsky (2000), chapter 13.5 .

[8]Mueller (2003), p. 523 argues that 'governmental bureaucracies are an independent force (·).' Surveys of the bureaucracy literature can be found e.g., by Breton and Wintrobe (1974), Orzechowsky (1977), Moe (1997) and Wintrobe (1997). A recent paper that examines the feature of bureaucratic efficiency is given by Prendergast (2003).

Although the embodiment of the tax system is exogenous to the bureaucracy, the absolute amount of governmental revenues is not. This is the consequence of the assumption of a closed budget on the necessary amount of the public input. The design of the tax system may be interpreted in analogy to the restrictions within the Leviathan model. The central hypothesis is that only constitutional constraints on the source of revenue or the level of expenditure can discipline any selfish government. This might be realized by a tax system that is exogenous to the bureaucracy.[9] In addition, the paper ties up to the literature of optimal taxation as based on the seminal work of Atkinson and Stiglitz (1976) who discuss the optimal direct/indirect tax mix. Another link is given by the recent literature on international fiscal competition in which it is argued that increasing competition might induce changes in the tax mix and motivate politicians to shift taxes from mobile to immobile tax bases – or interpreted in another way as a shift from indirect to direct taxes.[10]

For our model, the constitutional constraints are formalized by the tax system. More specifically this refers to the extent of income tax financing on total revenues. These constraints are characterized by the parameter $\mu = \tau / \frac{G}{ny} \in [0, 1]$ and might be interpreted as *degree of distortion* of the tax system. The degree of distortion is modeled as continuum with $\mu = 0$ representing a situation in which a certain amount of the governmental input is exclusively financed via nondistortionary instruments. The other polar case is reflected by $\mu = 1$, in which case the entire governmental input is exclusively financed by taxing income. Intermediate levels of $0 < \mu < 1$ reflect situations consisting of a mixed financing scheme.[11] It is assumed that the degree of distortion is exogenous to the governmental bureaucracy and is the consequence of the tax payer's votes. Given the utility of the representative agent (1) and (2) together with the production technology (3) and the relationship $\tau = \mu \frac{G}{ny}$, individual optimization over k and c leads to the market equilibrium growth rate[12]

$$\phi^{D\mu} = \frac{1}{\sigma}\left[\left(1 - \mu\frac{G}{ny}\right) f(\cdot)\,(1 - \varepsilon\eta) - \delta - \beta\right], \quad \frac{\partial\phi^{D\mu}}{\partial\varepsilon} < 0, \quad \frac{\partial\phi^{D\mu}}{\partial\mu} < 0. \quad (12)$$

It reflects the relationship between the expenditure ratio and growth rate as perceived by the individuals for all levels of congestion and the exogenous degree of tax distortion, μ. All things being equal, the decentralized growth

9For example, Campbell (1994) provides an application.

10The argumentation within this literature is that increasing globalization is inducing pressure to reduce taxation on mobile factors, as those factors can move to countries having the lowest taxes, thus reducing the tax base and government revenue.

11Tanzi and Schuhknecht (2000) provide empirical background with respect to size and composition of alternative taxes over the last century. They also analyze causes and consequences of these fiscal developments.

12The growth rate is derived for the symmetric equilibrium in which $K = nk$.

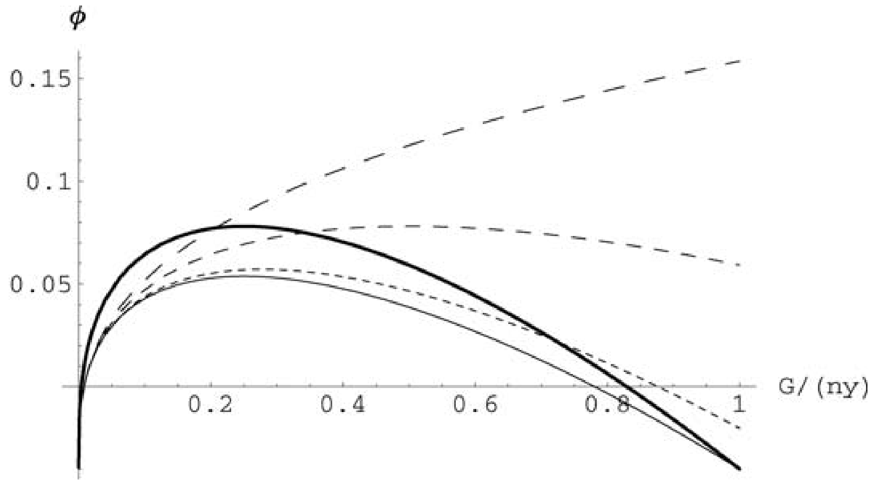

Figure 1: First-best optima and market equilibria for alternative degrees of tax-distortion based on the Cobb–Douglas production function (17), parameter values: $\beta = 0.03$; $\delta = 0.05$; $\eta = 0.25$; $n = 2$; $\sigma = 2$; $A = 0.5$.

rate increases with a rise in the degree of congestion, while it decreases with an increase in tax distortion. This growth rate gains importance with respect to two issues. First, as usual within growth theory together with the first-best growth rate, ϕ^*, it may be used to derive the optimal fiscal policy. Second, it represents individual behavior with respect to alternative environments and thus serves as basis for examining selfish governmental behavior.

A graphical illustration of ϕ^* and $\phi^{D\mu}$ can be found in Figure 1 where the two growth rates are plotted in case of a Cobb–Douglas production function for alternative degrees of congestion and tax distortion. The solid lines represent the relationships between ϕ^* and the expenditure ratio as given in Equation (8) for the benchmark cases of no congestion (upper curve) and proportional congestion (lower curve). In addition, there are three more functions that reflect $\phi^{D\mu}$ for alternative extents of distortionary financing:[13] the upper dashed curve represents the relationship between the growth rate and expenditure ratio if total amount of the revenues is financed via a growth neutral instrument, $\mu = 0$, the middle and lower dashed curves reflect a mixed

[13]Although the functions for the decentralized growth rates (dashed lines) are plotted for the case of proportional congestion, modifications in the degree of congestion would only shift up these relationships, with no qualitative changes in the relative positions of the curves. Note that the upper dashed line crosses the upper solid line in case of an optimally determined expenditure ratio. This reflects the fact that in case of no congestion the optimal amount of the governmental input should be financed through nondistortionary revenues. The parameter value $n = 2$ is chosen to clarify that the runs of the optimal growth rates (represented by the solid lines) depend on the existing level of congestion. If $n = 1$ the two solid lines would coincide.

financing scheme with $\mu = 0.5$ and $\mu = 0.8$, respectively.[14] Qualitatively, these relationships hold for all levels of ε.

It becomes obvious that the interaction between growth rate and expenditure ratio is not only influenced by the degree of congestion but also by the design of the tax system. With respect to $\phi^{D\mu}$ in Equation (12), the relationship between the market equilibrium growth rate and expenditure ratio may be summarized as[15]

$$\frac{\partial \phi^{D\mu}}{\partial \frac{G}{ny}} \gtreqless 0 \quad \Longleftrightarrow \quad \frac{G}{ny} \lesseqgtr \frac{\eta}{\mu}. \tag{13}$$

The growth maximizing expenditure ratio thus is given by $\frac{G}{ny} = \frac{\eta}{\mu}$. The ratio increases with the extent to which the public input is financed via a growth neutral instrument, i. e. with a reduction in μ. Since from a point of view of resource availability the maximally possible expenditure ratio is given by $\frac{G}{ny} = 1$, for all $\mu < \eta$ the growth maximizing expenditure ratio is then given by that corner solution where the total output from production is transformed to the government input. This implies that for all $\mu < \eta$ the negative relationship between growth rate and expenditure ratio becomes relaxed over the entire domain as the growth rate and the expenditure ratio are positively linked for all levels of the expenditure ratio. The *economic implication* for this interdependence might be illustrated by the counteracting effects between the intertemporal income and the intertemporal substitution effects that arise if an increase in the level of the public expenditure is income tax financed; that is, an increase in the income tax rate reduces the after tax marginal product of capital thus inducing a negative substitution effect. Capital accumulation becomes less attractive and individuals increase current consumption at the cost of investment. Accordingly, the growth rate decreases. At the same time an increase in the income tax causes an increase of the amount of G thus increasing capital productivity, $f(\cdot)$. Private capital accumulation is stimulated and the growth rate increases. The two effects exactly offset each other for an income tax rate that equals the partial production elasticity of the public input. If now as a consequence of a reduction in tax distortion, μ, the extent of income tax financing is reduced the growth enhancing effect of a higher G is employed, and again the growth rate increases. At the same time this increases the growth maximizing expenditure ratio that equilibrates intertemporal income and substitution effect. These relationships hold for all levels of congestion.

5. Bureaucratic Preferences and Welfare

We now analyze the effect of selfish bureaucratic behavior on growth and welfare maximization. We assume that the bureaucrat disposes of his preferences

[14]Note that the upper dashed curve corresponds to the ‘corner solution’ case and thus does not achieve a maximum value in Figure 1.

[15]A derivation of that result can be found in the Appendix.

as according to Niskanen (1971) or Romer and Rosenthal (1978, 1979, 1982) such that the selfishness of the public agent can be modeled as maximizing the available budget.[16] Within the framework of a growing economy, the bureaucrat might either maximize the relative size of the public sector or the growth rate.[17] In equilibrium the budget's growth rate equals the growth rate of consumption so that the growth rates ϕ^* in Equation (8) and $\phi^{D\mu}$ in Equation (12) will serve as the benchmark budget growth rate. Using these assumptions we will define the bureaucratic utility function and examine the welfare implications under a selfish bureaucracy.

Equation (9) illustrates that for all levels of congestion the *optimal growth rate* is a function of the expenditure ratio and provides the relationship between the relative and the absolute budget size. From Equation (9), we have shown that for suboptimally low levels of the growth rate, the growth rate increases with the expenditure ratio. For expenditure ratios higher than η, an increase of the expenditure ratio goes along with a reduction of the growth rate and the trade-off between relative and absolute budget size becomes negative. The optimal growth rate has a maximum if the public input is efficiently provided with the expenditure ratio being equal to $\frac{G}{ny} = \eta$ from Equation (10). Because $\frac{\partial \phi^*}{\partial \varepsilon} > 0$, the optimal growth rate decreases with a rise in rivalry whereas the growth maximizing expenditure ratio is independent of congestion from Equation (9). Hence, the negative trade-off holds for all levels of congestion whenever $\frac{G}{ny} > \eta$. We can also define a relationship between the relative and absolute budget size for the *decentralized growth rate*, $\phi^{D\mu}$. This relation is influenced by the corresponding tax system. If the input is exclusively financed via an income tax, $\mu = 1$, a negative trade-off results, as in ϕ^* of Equation (8), for all suboptimally high expenditure ratios, $\frac{G}{ny} > \eta$. Generally, the growth maximizing expenditure ratio increases with the extent of the nondistortionary revenues as from Equation (13). Hence the negative trade-off between relative and absolute budgets results in a higher than optimal expenditure ratio if a part of the governmental revenues is neutrally financed by $\mu < 1$. For the bureaucrat therefore, there is always a conflict between maximizing the relative budget size and the budget growth rate if $\frac{G}{ny} > \frac{\eta}{\mu}$. If $\mu \leq \eta$, then the negative trade–off does not apply and the absolute and relative budget may be maximized simultaneously up to $\frac{G}{ny} = 1$.

We now analyze how the budget maximizing bureaucracy uses its own preferences to determine the fiscal instruments. We assume that the

[16]Usually these models argue that the inefficiencies are due to principal-agent problems between bureaucracy, tax payers, politicians, and interest groups. Possibilities to overcome these problems include incentive schemes for the bureaucracies such as contracts between tax payers and bureaucrats or monit, oring of the bureaucracy (see, e.g., Mueller 2003 or Hillman 2003 for an overview).

[17]Ott (2000) provides a similar discussion of a selfish government providing a completely excludable governmental input without congestion and without restrictions on the tax system. Then, to realize a welfare maximum it is sufficient for the bureaucrat to pursue the goal of maximizing the budget in the long run.

bureaucrat has preferences for a high relative budget or a high overall budget or a weighted mixture of both budgets. Consider the first case of maximizing the *overall budget*. In equilibrium the budget will grow at a constant rate and thus the overall budget is maximized in case of a growth-maximizing policy. Here the bureaucrat would fix the expenditure ratio at the level $\frac{G}{ny} = \frac{\eta}{\mu}$ from Equation (13). Independent from the level of congestion the growth rate increases to the extent of the nondistortionary instrument. Alternatively, a bureaucrat can maximize exclusively the *relative budget* size through the expenditure ratio. This implies that the bureaucracy taxes total output and uses the revenue to finance the public input. The expenditure ratio then equals $\frac{G}{ny} = 1$, and the corresponding level of the growth rate is determined by the prevailing degree of distortion, μ. A third option is that the government maximizes a certain *mix of both budget sizes* such that the bureaucracy is willing to accept increases in the budget growth rate and at the same time a lower than the maximally possible expenditure ratio. On the contrary it would accept a slower budgetary growth if it strongly preferred a high level of the relative budget size. Given these trade-offs, we can then formalize the bureaucratic preferences by a Cobb–Douglas utility function in which the relative importance of absolute and relative budget sizes are expressed by the preference parameters φ and $1 - \varphi$. The level of the exponents, $0 < \varphi < 1$, may be interpreted as mixed preferences with an increase in φ reflecting a stronger preference for the overall budget as the budget growth rate becomes more important.

The utility function of the selfish bureaucrat, $\mathcal{U}_e$, could be described in terms of the growth rate and the expenditure ratio as

$$\mathcal{U}_e\left(\phi_o, \frac{G}{ny}\right) \equiv \phi_o^{\varphi} \cdot \left(\frac{G}{ny}\right)^{1-\varphi}, \quad 0 \leq \varphi \leq 1, \tag{14}$$

with ϕ_o in this function being equal to

$$\phi_o \equiv \frac{1}{\sigma}\left[\left(1 - \mu\frac{G}{ny}\right) f(\cdot)(1 - \varepsilon\eta)\right] \geq 0 \quad \forall \quad \varepsilon. \tag{15}$$

The bureaucratic growth rate is achieved by a linear transformation of the market equilibrium growth rate by adding the constant $\frac{\beta+\delta}{\sigma}$ to Equation (12). This modification allows for an explicit solution of the maximization problem of the selfish government given by Equation (14) while the qualitative interdependencies between absolute and relative budget remain unchanged. The resulting growth rate, ϕ_o, is positive for all expenditure ratios, $\frac{G}{ny} \in [0, 1]$.[18]

[18] The graphical illustrations in Figures 1 and 2 represent the original growth rates and expenditure ratios that are not transformed.

Maximizing the utility function $\mathcal{U}_e$ over $\frac{G}{ny}$ leads to the expenditure ratio chosen by the self-interested civil servant as[19]

$$\left(\frac{G}{ny}\right)_e = \frac{\varphi\eta + (1-\eta)(1-\varphi)}{\mu[(1-\eta)(1-\varphi)+\varphi]} \in \left[\frac{\eta}{\mu}, \frac{1}{\mu}\right], \quad \frac{\partial\left(\frac{G}{ny}\right)_e}{\partial\varphi} < 0, \quad \frac{\partial\left(\frac{G}{ny}\right)_e}{\partial\mu} < 0. \tag{16}$$

Equation (16) is influenced by the bureaucrat's preferences, φ, and the constitutional restriction, μ, but not by the degree of congestion of the public input, ε. For a given level of tax distortion, the governmental official chooses a lower (higher) expenditure ratio for all increases (decreases) of the overall budget's importance. In addition, for a given level of bureaucratic preferences, φ, the expenditure ratio increases with a decrease in the degree of distortion. The independence of the degree of congestion reflects the fact that a selfish bureaucrat is not per se interested in internalizing any external effect but only cares about his budget.

Given Equations (14)–(16) therefore the level of the expenditure ratio and the degree of congestion, ε, becomes crucial for assessing the *welfare implications* of bureaucratic preferences.[20] We can use the first-best optimum given by Equation (8) and (10) to compare the welfare effects against the welfare effects of alternative decisions of the bureaucracy. The optimal expenditure ratio, $\frac{G}{ny} = \eta$, is independent of ε and μ and is realized if the equilibrium amount of the public input is efficiently provided – as marginal revenues equate marginal costs as in Equation (7). A departure from the optimal expenditure ratio induces efficiency losses that increase as $\frac{G}{ny}$ increases. The wedge between marginal revenues and marginal costs increases as the relative budget size (expenditure ratio) becomes more important to the bureaucrat. Note that while the degree of tax distortion influences the resulting growth rate indirectly through the expenditure ratio, the degree of congestion directly enters the growth rate. Given this relationship, the decentralized growth rate is suboptimally high if rivalry arises. Then from an optimal policy point of view a growth reducing income tax rate should be used to internalize the external effect under a selfish bureaucracy. For this model with bureaucratic preferences therefore, the optimal level of the income tax rate should increase with the degree of congestion.

We can now discuss the welfare implications of the interdependence between selfish bureaucratic behavior and congestion on the benchmark case of *pure income tax financing*, $\mu = 1$, and alternative preferences of the selfish bureaucracies. Given the utility function in Equation (14), if the objective

[19]The bureaucracy's optimization problem is unconstrained since the financing constraint, μ, is substituted in ϕ_o

[20]See Table 4 for numerical simulations of the welfare effects depending on the degrees of congestion and distortion under alternative bureaucratic preferences.

of the selfish bureaucrat is to maximize the *overall budget* ($\varphi = 1$) then the bureaucrat will choose the optimal expenditure ratio and the total amount of the government input is financed by the income tax, $\tau = \eta$. As discussed above, this financing mode will reduce the resulting growth rate for all levels of congestion. The welfare effects will depend on the degree of rivalry. In case of proportional congestion, we obtain the welfare maximum because the distortionary income tax $\tau = \eta$ reduces the suboptimally high growth rate and exactly offsets the negative external effect arising from capital accumulation. On the other hand, because the decentralized resulting growth rate is suboptimally low under no congestion, the growth reducing effect of the distortionary income tax reduces welfare. As we discussed above, to induce the optimal growth rate, the optimal income tax rate has to increase with rising congestion. Thus for a fixed level of the income tax rate, $\tau = \eta$, also the wedge between optimal and realized growth rate increases with decreasing congestion and further induces welfare losses. Additionally, these welfare losses increase as the gap between optimal and actual income tax increases. Accordingly, under any mixed budget, $\mu < 1$, we obtain a welfare optimum if, and only if, congestion is proportional, the bureaucrat maximizes the absolute budget size and the income tax is the only source of governmental revenues. The income tax rate then reduces the excess capital accumulation and the revenues out of the tax are sufficient to realize the optimal expenditure ratio.

Given that the government revenue is positively linked to the level of the income tax rate, $G = \tau ny$, and all things being equal, the expenditure ratio increases with the level of the income tax. Given these relationships, maximizing the *relative budget size* is equivalent to ensuring that $\tau > \eta$ holds – that is, the income tax rate exceeds the partial production elasticity of the public input. The maximal expenditure ratio would be realized if total output is transferred to government revenue. Under the assumption $\varphi = 0$, the bureaucrat chooses an expenditure ratio equal to $(\frac{G}{ny})_e = 1$.[21]

The expenditure ratio then departs from production efficiency as for $\frac{G}{ny} > \eta$ the marginal costs of provision exceed the marginal revenues of the governmental input (see Equation (7)). This induces an over–provision of the public input and the public sector becomes suboptimally large. The growth

[21] These parameter combinations result for the transformed growth rate ϕ_0 given in Equation (15). For comparability, the growth rate must be re-transformed by subtracting the constant term given by $\frac{\delta+\beta}{\sigma}$. The corresponding expenditure ratio is smaller than one but cannot be determined explicitly. However, in a dynamic context this is not a feasible solution as this implies a negative growth rate from (11). If the growth rate becomes negative the gross investment is not sufficient to compensate the loss of capital as a consequence of depreciation and the economy contracts permanently. A selfish government that maximizes the relative budget would ensure that the growth rate does not to become negative. For that, sensible solutions require an income tax rate that at least allows for zero growth. Graphically this is given by the intersection of the lower curve with the horizontal axes in Figures 2a–c.

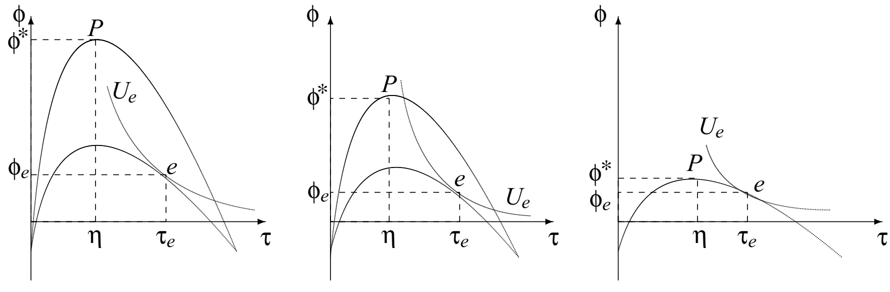

Figure 2: Welfare implications of mixed bureaucratic preferences, $0 < \varphi < 1$ and $\mu = 1$.

rate becomes zero and the economy is stationary. Consequently, welfare declines because the representative agents are not able to realize their optimal intertemporal consumption plans. However, if the bureaucrat's preferences are given by $0 < \varphi < 1$, then the expenditure ratio becomes suboptimally high thus inducing reductions of the growth rate. The welfare optimum cannot be realized but the extent of the welfare loss is less than in the case of pure maximization of the relative budget size, $\varphi = 0$.

Figures 2a–c provide a graphical illustration of the interdependence among the growth rate, the income tax and the bureaucratic preferences.[22] Each figure considers the Pareto optimal relationships between ϕ^* and $\frac{G}{ny}$ (upper curves), the decentralized growth rate, $\phi^{D\mu}$, (lower curves)[23] and an indifference resulting from $\mathcal{U}_e$ of (14), for the mixed bureaucratic preferences, $0 < \varphi < 1$. The point P depicts the first-best optimum including the optimal growth rate, ϕ^*, and the optimal expenditure ratio, $(\frac{G}{ny})^* = \eta$, whereas the point e describes expenditure ratios and the corresponding growth rate given the utility function (14) of the self-interested bureaucrat. If $0 \leq \varphi < 1$, the expenditure ratio $\frac{G}{ny} = \tau_e$ is fixed at a suboptimally high level, $\frac{G}{ny} > \eta$. Figures 2a–c show that under a selfish bureaucracy, welfare losses are sustained as the governmental input is inefficiently provided. All things being equal, the more 'south-east' the point e lies in the quadrant, the more important is the relative budget size to the bureaucracy. For decreasing φ, the wedge between the optimum, P, and the actual values of the growth rate and expenditure ratio, e, increases. We find as well that the gap between the optimal growth rate, ϕ^*, and the maximum of the decentralized growth rate, $\phi^{D\mu}$, increases as the degree of congestion decreases. This growth gap reflects the fact that as

[22] Note that for $\mu = 1$ the income tax rate equals the expenditure ratio. Actually, it is the expenditure ratio that is determined by the bureaucracy and not the income tax rate.
[23] In Figure 2c 'upper' and 'lower' functions coincide and hence are illustrated by one unique function. Note that this holds only for the case of proportional congestion, $\varepsilon = 0$.

the degree of rivalry falls, the income tax becomes less important as a policy tool for offsetting congestion.

6. Cobb–Douglas Production and Numerical Simulations

The welfare losses may be calculated explicitly if the general production function Equation (3) is specified. Consider the Cobb–Douglas technology as given by

$$y = AG^{a^{\eta}} k^{1-\eta}, \quad A > 0, \tag{17}$$

where A indicates the technological level of the considered economy. Using Equation (17), we determine the Pareto optimum and the decentralized growth rate under the assumptions of the individual utility functions (1) and (2) as well as the congestion functions (4) and (6). Assuming as well that the (arbitrarily determined) expenditure ratio is $g \equiv \frac{G}{ny}$, we can express the per capita production function and the resource constraint underlying the first-best optimization problem as

$$y = A^{\frac{1}{1-\eta}} (gn^{\varepsilon})^{\frac{\eta}{1-\eta}} k \tag{18a}$$

$$\dot{k} = (1-g) A^{\frac{1}{1-\eta}} (gn^{\varepsilon})^{\frac{\eta}{1-\eta}} k - c - \delta k \tag{18b}$$

The optimal expenditure ratio equals the constant $g^* = \eta$ and determines the first-best optimum together with the optimal growth rate as given by

$$\phi^* = \frac{1}{\sigma}\left[(1-g^*)\, A^{\frac{1}{1-\eta}}\ (g^* n^{\varepsilon})^{\frac{\eta}{1-\eta}} - \delta - \beta\right]. \tag{19}$$

The decentralized growth rate is based on the individual's production function

$$y = (gn^{\varepsilon})^{\frac{\eta}{1-\eta}} K^{\varepsilon\eta} k^{1-\varepsilon\eta}. \tag{20}$$

Using $\tau = \mu g$, the decentralized growth rate in Equation (11) is then replaced by

$$\phi^{D\mu} = \frac{1}{\sigma}\left[(1-\mu g)(1-\varepsilon\eta)\, A^{\frac{1}{1-\eta}}\ (gn^{\varepsilon})^{\frac{\eta}{1-\eta}} - \delta - \beta\right]. \tag{21}$$

Subtracting the constant $\frac{\beta+\delta}{\sigma}$ and introducing the growth rate rate of Equation (21) in the utility function of the selfish bureaucrat (14) leads to the expenditure ratio given by

$$g_e = \frac{\varphi\eta + (1-\eta)(1-\varphi)}{\mu[(1-\eta)(1-\varphi)+\varphi]}. \tag{22}$$

The expenditure ratio given by (22) equals the expenditure ratio derived for the general production function in Equation (16) except that in Equation (22) the production elasticity of the public input, η, is now constant.

Table 1: Optimal and decentralized growth rates depending on ε and μ if $g = g^*$

	ϕ^*	$\phi^{D\mu}$			
		$\mu = 1$	$\mu = 0.75$	$\mu = 0.5$	$\mu = 0$
$\varepsilon = 0$	0.0538	**0.0538**	0.0616	0.0694	0.0850
$\varepsilon = 0.5$	0.0652	0.0521	0.0598	0.0674	0.0828
$\varepsilon = 1$	0.0781	0.0486	0.0600	0.0634	**0.0781**

To illustrate the economic implications of alternative bureaucratic preferences under different tax systems, numerical simulations based on the Cobb–Douglas production technology (17) were carried out. The simulations are calculated for the parameter values given by: $\beta = 0.03$, $\delta = 0.05$, $\sigma = 2$, $n = 2$, $\eta = 0.25$, and $A = 0.5$. Modifications to the tax system induce changes in the absolute level of the growth rate and also alter the growth maximizing expenditure ratio (see transitions from the solid to the dashed curves in Figure 1); whereas changes in the bureaucracy's preferences reflect movements along a given curve (see transitions of points P to e in Figures 2a–c). The numerical results are summarized in the following Tables 1–4. Bold values imply that decentralized and first-best solutions coincide.

The absolute values of ϕ^* from Equation (19) and of $\phi^{D\mu}$ from Equation (21) for alternative degrees of tax distortion can be found in Table 1. They are based on an optimal expenditure ratio or $g = 0.25$ so that the static efficiency condition for the provision of the governmental input in Equation (7) is satisfied. While the optimal growth rate decreases with a rise in rivalry, the decentralized growth rate increases with congestion and decreases with rising tax distortion. Market equilibrium and first-best growth rate coincide if either the public input is proportionally congested and the provision of the public input is financed by a growth reducing income tax ($\phi^{D\mu} = 0.0538$) or if the public input is a pure public good and the governmental revenues are exclusively growth neutral ($\phi^{D\mu} = 0.0781$). The first case is represented in point P within Figure 2c whereas the latter case can be found in Figure 1 where the upper dashed curve crosses the upper bold curve. If $\varepsilon = 0$ and $\mu < 1$, the optimal growth rate is smaller than the decentralized growth rate whereas the opposite applies if $\varepsilon = 1$ and $\mu > 0$. Then the decentralized growth rate is suboptimally low. If the public input is partially congested, $\varepsilon = 0.5$, the decentralized growth rate might or might not be suboptimally high, depending on the level of μ.

But as already argued, a selfish bureaucracy will determine the expenditure ratio according to Equation (22) and not necessarily choose g^*. The realized levels g_e depend on the bureaucratic preferences (φ) and the embodiment of the tax system (μ) and can be found within Table 2. The optimal expenditure ratio $g^* = 0.25$ is only achieved if the bureaucrat maximizes the budget's growth rate ($\varphi = 1$) and if the entire public input is financed by

Table 2: Expenditure ratios of the selfish bureaucracy depending on μ and φ

		g_e			
	μg_e	$\mu = 1$	$\mu = 0.75$	$\mu = 0.5$	$\mu = 0$
$\varphi = 0$	1	1	–	–	–
$\varphi = 0.5$	0.5714	0.5714	0.7619	–	–
$\varphi = 1$	0.25	**0.25**	0.3333	0.5	1

taxing income ($\mu = 1$). If the relative budget size becomes more important (decreasing φ) or if the tax system is changed to include nondistortionary parts (decreasing μ) the expenditure ratio g_e increases up to a maximum value of $g_e = 1$. Then the corresponding decentralized growth rate would become negative. A suboptimally high expenditure ratio violates the efficiency condition (7) and thus induces welfare losses that are calculated in Table 4. The missing values in Table 2 correspond to expenditure ratios that exceed $g_e = 1$.

Introducing the expenditure ratios from Table 2 in Equation (21) yields the decentralized growth rates, ϕ_e, under the assumption of selfish bureaucratic behavior. Equation 21 shows that the decentralized growth rate depends on the prevailing degrees of congestion, tax–distortion and on the bureaucracy's preference parameters as in Table 3. Due to the growth reducing effect of income taxation and the growth enhancing effect of congestion, all things being equal, ϕ_e decreases with μ and ε. The growth rate ϕ_e equals the optimal growth rate, $\phi^* = 0.0538$, in case of a proportionally congested input ($\varepsilon = 0$) that is solely financed by income taxes ($\mu = 1$) and might only be achieved if the bureaucracy tends to maximize the budget's growth rate ($\varphi = 1$). In our model of bureaucratic preferences, the income tax internalizes the external effect of capital accumulation, while the bureaucracy's goal of maximizing the growth rate determines the growth maximizing expenditure ratio at $g_e = 0.25$.[24] In case of $\varphi = 1$, the same relationships between ϕ^* and ϕ_e apply as discussed in Table 1. On the other hand, the level of ϕ_e is reduced if the bureaucracy focuses more on the relative budget size ($\varphi = 0.5$). Points e in Figures 2a–c provide an illustration of the effect of changes in bureaucratic preferences, φ, on the growth rate ϕ_e. In Table 3, the calculations are suppressed for expenditure ratios $g_e \geq 1$ so that the considered bureaucratic preferences and the tax system are restricted to the values $\varphi = 1$, $\varphi = 0.5$, and $\mu = 1$, $\mu = 0.75$, $\mu = 0.5$, respectively. The welfare losses going along with suboptimal expenditure ratios and/or growth rates are summarized in Table 4. Table 4 also presents the welfare maxima W^* from the utility function in Equation (1) for alternative degrees of congestion. We use these computed welfare levels to assess the welfare of the representative agent, U_e, that arise

[24] Note that $\phi_e = \phi^*$ requires an optimally determined expenditure ratio.

Table 3: Optimal and 'selfish' growth rates depending on ε, μ, and φ

		$\phi_e(\varphi=1)$			$\phi_e(\varphi=0.5)$	
	ϕ^*	$\mu=1$	$\mu=0.75$	$\mu=0.5$	$\mu=1$	$\mu=0.75$
$\varepsilon=0$	0.0538	**0.0538**	0.0632	0.0781	0.0306	0.0377
$\varepsilon=0.5$	0.0652	0.0521	0.0613	0.0760	0.0293	0.0363
$\varepsilon=1$	0.0781	0.0486	0.0570	0.0716	0.0267	0.0334

Table 4: W^* and W_e for alternative combinations of φ, μ, and ε

		$\frac{W_e}{W^*}(\varphi=1)$			$\frac{W_e}{W^*}(\varphi=0.5)$	
	W^*	$\mu=1$	$\mu=0.75$	$\mu=0.5$	$\mu=1$	$\mu=0.75$
$\varepsilon=0$	1	**1**	0.93	0.45	0.52	–
$\varepsilon=0.5$	1	0.98	0.95	0.59	0.51	0.08
$\varepsilon=1$	1	0.93	0.92	0.66	0.49	0.14

if a selfish bureaucracy maximizes its own utility according to Equation (14). Table 4 provides the ratio between the actual welfare in case of a selfish bureaucracy and the maximum welfare, W_e/W^*.[25] Again, the welfare ratios are calculated for alternative bureaucratic preferences, tax systems and degrees of distortions. As already argued, $W_e = W^*$ if $\varphi = 1$, $\varepsilon = 0$, and $\mu = 1$ in which case both the expenditure ratio and the growth rate are set optimally. All things being equal, the welfare ratio increases with the degree of distortion of the tax system, μ, and bureaucratic preferences, φ, whereas the welfare impact of increases in the congestion of the public input, ε, are ambiguous.[26]

Table 4 illustrates that changes in μ and φ have more significant consequences for welfare than changes in ε. These welfare results are illustrated in the different functions for $\phi(g)$ in Figure 1 in which changes in μ alter the growth maximizing expenditure ratio and induce new relationships between ϕ and g. Additionally, modifications to φ induce changes in the growth rate and the expenditure ratio for a given relationship $\phi(e)$ of both parameters (see movements from points P to e in Figures 2a–c).

Welfare effects of alternative tax systems. Tables 2–4 allow us to consider the welfare impacts of the three levels of budget mixes for financing the public input. Consider firstly the case of pure income tax financing, $\mu = 1$ and no

[25]The underlying consumption–capital ratio to calculate W_e is given by

$$\frac{c}{k} = [(1-\mu g_e) - (1-\mu)g_e]A^{\frac{1}{1-\eta}}(g_e n^{\varepsilon})^{\frac{\eta}{1-\eta}} - \delta - \phi_e.$$

[26]There is no welfare ratio calculated for $\varepsilon = 0$, $\varphi = 0.5$, $\mu = 0.75$ as the underlying consumption level becomes negative.

congestion of the public input, $\varepsilon = 1$. Table 4 shows that the welfare ratio decreases from 1 to 0.93. Since the underlying expenditure ratio is set optimally the welfare losses then are the consequence of the deviation between the optimal and the actual growth rate. Secondly, consider the case of a transition to partially growth neutral financing ($\mu = 0.75$); from Table 2, the growth maximizing expenditure ratio increases to $g_e = 0.33$. Table 4 shows that the welfare ratio first increases from 0.93 to 0.95 and then decreases to 0.92 if congestion is reduced. The ambiguous welfare effect can be found in the growth rate differentials, $\phi^* - \phi_e$, that can be calculated from Table 3. For instance, the absolute differential, $\phi^* - \phi_e = 0.0039$, is smallest if $\varepsilon = 0.5$. Alternatively, this relatively small growth differential can be interpreted that for given values $\varphi = 1$ and $\varepsilon = 0.5$, a transition of $\mu = 1$ to 0.75 modifies the welfare ratio from 0.98 to 0.93. As the underlying growth rates are nearly identical, the welfare loss is mostly due to the efficiency losses from the suboptimal high relative budget and not due to the suboptimal low growth rate. If $\mu = 0.5$ the welfare ratio unequivocally increases with decreasing congestion.

Welfare effects of bureaucratic preferences. The welfare implications might also be analyzed with respect to their sensitivity to changes in bureaucratic preferences. All things being equal, modifications to the bureaucratic preferences, φ, reduce the welfare ratio. Under the assumption of pure income tax financing, $\mu = 1$, a transition from $\varphi = 1$ to mixed bureaucratic preferences reduces the welfare ratios to approximately 0.5. This result is independent of the prevailing degree of distortion and is reinforced if the tax system is changed from $\mu = 1$ to 0.75. The welfare loss occurs since a reduction in φ not only decreases the growth rate which may be welfare enhancing in case of a congested input but also increases the expenditure ratio and violates the production efficiency condition in Equation (7).

These simulations reveal some interesting results. If income taxes are the only source of governmental revenues, i. e. $\mu = 1$, a bureaucracy that seeks to maximize the growth rate of its budget would choose the optimal expenditure ratio independent of the prevalent degree of congestion. Moreover, the financing of the public input exclusively by an income tax reduces the growth rate unequivocally. This goes along with welfare losses whenever the public input is not proportionally congested. In case of a proportionally congested input the welfare maximum results as the income tax, while internalizing the external effect of capital accumulation, reduces the suboptimally high growth rate to the optimal level. At the same time the revenues exactly correspond to the optimal amount of the governmental input. Under the case of pure income tax financing, the static efficiency and also the dynamic efficiency are satisfied.

The results under a *mixed tax system*, $\mu < 1$, are different. Now, the growth maximizing expenditure ratio increases and the self interested bureaucracy determines the public sector's size at a suboptimal high level. The suboptimal budget size violates the static efficiency condition in Equation (7) and induces welfare losses. Now the welfare losses are reinforced as the bureaucracy focuses more on maximizing the relative budget size. Although the failures that are due to congestion could be internalized by modifications of the tax system, selfishness of the bureaucracy unequivocally is accompanied by welfare losses.

7. Conclusions

The paper analyzes the growth and welfare outcomes when a selfish bureaucracy, whose objective is to maximize the governmental budget, provides a congested production input. The bureaucracy is confronted with a tax system that is modeled as an exogenously given ratio between distortionary and nondistortionary governmental tax revenues. It is assumed that the bureaucrat maximizes either the absolute or the relative budget size or some weighted average of both budgets. The relative budget equals the expenditure ratio whereas the overall budget is correlated with the budget's growth rate. We find that there is an intratemporal relationship between both budgets. The first-best optimum, consisting of the optimal growth rate and the optimal expenditure ratio, is derived. We then use this first-best solution as a benchmark to assess the decisions of a selfish government to provide the public input. These decisions include a certain level of the expenditure ratio that: (i) is fixed by the bureaucracy, (ii) determines implicitly the budget's growth rate and (iii) depends crucially on the embodiment of the tax system and the bureaucracy's preference parameters but not on the prevailing degree of congestion.

The main results can be summarized as follows. A welfare optimum in case of a selfinterested bureaucracy results only when very specific assumptions are met simultaneously: a tax system that consists only of income taxes, a productive public input that is proportionally congested, and a bureaucracy that maximizes the budget's growth rate. Under these assumptions the income tax internalizes the negative external effect arising from individual capital accumulation and reduces the excessive growth rate to the optimum. At the same time the government revenue equals the expenditure necessary to provide the optimal amount of the public input. On the other hand, if the tax system is modified to include nondistortionary taxes, the growth maximizing expenditure ratio increases and exceeds the optimal one. This excessive expenditure ratio violates the static efficiency condition for the provision of the public input, and irrespective of the degree of congestion, the public sector becomes suboptimally large relative to the private sector. This result holds even if the congestion externality is internalized by adjusting taxes and the growth rate is determined optimally. As such, our results support the Leviathan hypothesis and modifications to the tax system is not an effective tool for disciplining the bureaucracy.

Appendix

Derivation of Equation (13):

The first derivative of the growth rate $\phi^{D\mu}$ in Equation (12) with respect to the expenditure ratio is given by

$$\frac{\partial \phi^{D\mu}}{\partial \frac{G}{ny}} = \frac{1-\varepsilon\eta}{\sigma}\left[-\mu f(\cdot) + \left(1-\mu\frac{G}{ny}\right)\frac{\partial f(\cdot)}{\partial \frac{G^a}{k}} \cdot \frac{\partial \frac{G^a}{k}}{\partial \frac{G}{ny}}\right]. \tag{A.1}$$

If the productivity function $f(\cdot)$ is homogenous the partial production elasticity of the governmental input may be represented as

$$\eta = \frac{G}{ny} f'(\cdot)\, n^{\varepsilon} \quad . \tag{A.2}$$

For the production function (3) and the congestion function (4) the relationship between the expenditure ratio and the argument in the productivity function, $\frac{G^a}{k}$ is given by

$$\frac{\partial \frac{G}{ny}}{\partial \frac{G^a}{k}} = \frac{1-\eta}{f(\cdot)\, n^{\varepsilon}}. \tag{A.3}$$

Using these relations Equation (A.1) may be rewritten as

$$\frac{\partial \phi^{D\mu}}{\partial \frac{G}{ny}} = \frac{(1-\varepsilon\eta)\, f(\cdot)}{\sigma\,(1-\eta)}\,[\, f'(\cdot)\, n^{\varepsilon} - \mu\,]. \tag{A.4}$$

Introducing the expenditure ratio as given by Equation (A.2) into Equation (A.4) the relationship between growth rate $\phi^{D\mu}$ and the expenditure ratio in Equation (13) results.

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