Bureaucratic Choice and Endogenous Growth

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This paper analyzes the effects on the growth rate and economic welfare if the social planner engages in selfish behavior. These effects are displayed in a model of endogenous growth with productive governmental spending. The budget maximizing social planner determines how the public input is to be financed. The integration of selfish behavior by the social planner into a dynamic context combines the endogenous growth theory with the public choice theory. It will be shown that selfish behavior by the planner does not automatically lead to a sub-optimal supply level of the public good with an ensuing welfare loss. Although maximizing his personal utility, the planner may realize an efficient provision. Rather, the consequences of selfish behavior on welfare significantly depend on the formulation of the planner's personal preferences. (JEL: D 90, H 30)

1. Introduction

Within economic theory various investigations on the optimal provision of public goods exist. Aside from this, economic theory seeks economic justifications if sub-optimal provision of public goods is realized. Inefficiencies may be explained by the *public choice theory* according to which public agents primarily tend to maximize their personal utility instead of the utility attained by the private individuals; see Bernholz and Breyer (1994) and Mueller (1989). Following the arguments of Niskanen (1971), the existence of bureaucracies results in an overprovision of public goods, as bureaucrats try to maximize their available budget. This model has been further developed by Migué and Bélanger (1974) to explain how allocative- and X-inefficiencies may occur. The result obtained strongly depends on the bureaucrat's preferences. More arguments for overprovision are mentioned by Orzechowsky (1977), Breton and Wintrobe (1975), Tullock (1965), as well as Romer and Rosenthal (1978).

Recent models of *endogenous growth* explain how an altruistic planner has to engage in the market process to realize an efficient provision of the public good; see Barro (1990), Barro and Sala-i-Martin (1992), Turnovsky (1995).

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The planner possesses perfect information and only becomes active to maximize total welfare. He does not strive for maximum personal utility. This benevolent behavior of the planner is common in the models of endogenous growth theory: the social planner internalizes the external effects that appear, for example, by the accumulation of private capital (Romer, 1986), technological knowledge (Grossman and Helpman, 1991; Aghion and Howitt, 1992) or human capital (Lucas, 1988).

The aim of this paper is to investigate the consequences of selfish behavior by the planner within a dynamic macroeconomic context and thereby to link the endogenous growth theory with the public choice theory. The formal framework is an endogenous growth model in which productive government services, together with private capital, are production inputs. The planner decides how the public input is to be financed. In contrast to the model of Barro (1990), public input is not modeled as a pure public good but has the characteristics of non-rivalry and excludability. Possible applications for this model could be highways financed by tolls or airports. Due to the characteristic of excludability the planner may levy income taxes or charge private individuals user fees; see e.g. Atkinson and Stiglitz (1980) or Cornes and Sandler (1996). Hence, his latitude increases in comparison to models with pure public goods that may only be financed by taxes.

After deriving the optimal and the decentrally chosen growth rate, the financing solution chosen by the *altruistic social planner* is derived along with the consequences for the growth process and welfare. It is proven that the benevolent planner provides an efficient amount of the public input by enforcing exclusion and only charging fees while simultaneously maximizing welfare. In contrast, a *selfish planner* will not automatically only charge fees. In this paper, egoism of the social planner is modeled in analogy to Niskanen (1971), where the public agent maximizes his available budget. As the context is a dynamic model, egoism may be interpreted in two ways: either as a maximization of the budget in relation to total income in each period (e.g. the expenditure ratio), or as a maximization of the total budget in the long run (independent of the amount of total income). This paper links both interpretations of egoism by postulating a planner utility function which contains a weighted ratio of both goals. It is shown that the planner fixes an inefficient mixture consisting of fees and taxes if the level of the expenditure ratio is important to him. The share of taxes increases with the importance the planner attaches to maximizing the expenditure ratio. The income tax distorts intertemporal allocation and leads to an inefficient overprovision of public input. On the other hand, if the planner intends to maximize his total budget, he behaves differently: he chooses a Pareto-optimal provision, as this allows for a maximal budget. Hence, the result strongly depends on the weighted ratio of the planner's goals.

The structure of the paper is as follows: after describing the assumptions of the model in section two, the Pareto-efficient growth rate is derived as a reference. Part 4 analyzes the market equilibrium. The financing solution chosen by an altruistic planner is derived in section 5. Part 6 explains the two dimensions of selfishness of the planner, weights and links them. In the next step, the financing mix (consisting of fees and taxes) chosen by an egoistic planner depending on his preferences is analyzed. The paper closes with a short summary.

2. The Model

The analysis' starting point is a model of endogenous growth with constant returns to scale in the accumulated inputs. The infinitely long living representative individual maximizes his overall utility, U, as given by

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

The function $u(c)$ relates the weighted flow of utility to the quantity of consumption, c, in each period. It increases in c, is concave and satisfies the Inada conditions. The multiplier, $e^{-\rho t}$, involves the constant rate of time preference, $\rho > 0$. The utility of the representative household in each period is given by

$$u(c) = \begin{cases} \dfrac{c^{1-\sigma} - 1}{1-\sigma} & \text{for} \quad \sigma > 0, \quad \sigma \neq 1 \\ \ln c & \text{for} \quad \sigma = 1. \end{cases} \tag{2}$$

Hence, the elasticity of marginal utility equals the constant $-\sigma$. The supply of labor is inelastic, so that the labor-leisure choice is not considered. Additionally, population growth is excluded from the model, and the number of people is normalized to one.

The firms in the model produce the homogeneous good y, which is based on the production function

$$y = f(k, g) = Ak^{\alpha} g^{1-\alpha}, \quad 0 < \alpha < 1. \tag{3}$$

y denotes production per capita, k represents the amount of capital available to the representative firm and equals the sum of capital per capita in relation to the total amount of capital. It is depreciated at the rate δ. The second input, g, is provided by the government and equals the total quantity of the publicly provided good. The marginal product of each input is positive but decreasing ($f_g, f_k > 0; f_{gg}, f_{kk} < 0$). A is a productivity parameter. Since both inputs are essential for production, the firms cannot renounce the use of the public input and have to accept the financing method chosen by the planner.

The government provides the input g, which has the characteristics of non-diminishability while possessing excludability (Musgrave, 1959). Therefore, any individual's consumption of g has no effect on the amount available to other firms. However, the government may levy user fees or exclude non-payers from the use of g. Governmental production does not exist, as the public sector buys a part of private production y and makes it available as public input g[1]. g and y may be exchanged in a ratio of 1:1.

The provision of the public input g is financed by duties of the firms. It is supposed that the government, represented by a social planner, may levy a proportional income tax τ. Due to the possibility of excluding non-payers from the usage of g, the planner may charge the firms a user fee q. Therefore, the government has various possibilities to finance the provision of g: it may choose exclusively taxes or fees respectively, or a mixture of both. Tax revenues then compensate the lower fees.

The budget is balanced in each period, and debts or credits do not exist. Thus, the public budget constraint, which is composed of the aggregate revenues as sum of fees and taxes and aggregate expenditure g, has the form

$$g = \tau y + qg, \quad 0 \leq q, \tau \leq 1, \tag{4}$$

where $\tau = 0$ ($q = 0$) indicates financing solely by taxes (fees), and $\tau \neq 0$, $q \neq 0$ represents mixed financing. The model does not allow for negative fee- or tax rates.

3. First-best Optimum

In this section the welfare maximizing growth rate γ^* is derived as a reference to assess the welfare implications of different financing mixes chosen by the central planner. γ^* is independent of the fiscal parameters and may be realized as consequence of the decentralized decisions, if tax rates and fees are determined adequately.

The optimal growth rate may be derived by utilizing the production function in eq. (3), the utility functions (1) and (2), as well as the following equation that represents the utilization of income

$$y = c + g + \dot{k} + \delta k. \tag{5}$$

1 Alternatively, one could suppose that the government disposes of the same production technology as the private firms and produces g at his own. This assumption would not affect the results.

These equations result in the following Hamiltonian function

$$H = \frac{c^{1-\sigma}-1}{1-\sigma} e^{-\rho t} + \lambda\,[y - \gamma - c - \delta k]. \tag{6}$$

γ^* is identified by choosing the time paths of consumption and capital per capita, c and k, as well as of government expenditures g[2]

$$\gamma^* = \frac{1}{\sigma}\left[\alpha A^{\frac{1}{\alpha}} (1-\alpha)^{\frac{1-\alpha}{\alpha}} - \delta - \rho\right]. \tag{7}$$

The growth rate γ^* determines the optimal consumption path and displays the characteristic that a reallocation of consumption may not increase lifetime utility of the representative individual. Eq. (10) satisfies the Keynes-Ramsey rule, according to which consumption per capita grows at a positive rate if the net marginal product of capital exceeds the rate of time preference. The economy initially jumps onto the steady-state, i.e. no transitional dynamics exist in the model. Within the steady-state, private consumption as well as governmental expenditure and output grow at the same constant rate[3].

4. Equilibrium in a Decentralized Economy

In a decentralized economy, the optimal growth rate may be reached if the government levies fees and taxes in a suitable way to finance the public production input. Therefore, it is necessary to determine the decentrally set growth rate. Then the optimal and the decentrally set growth rates are compared. The financing mix is then analyzed to identify levels of τ and q which result in the coincidence of both rates.

The representative individual's optimization leads to the decentral optimum. The individual is confronted with the following circumstances: he utilizes his income for consumption, the payment of fees and taxes as well as for the accumulation of private capital. The intertemporal restriction of the private individual is then represented by the following accumulation function

$$\dot{k} = (1-\tau)y - qg - c - \delta k. \tag{8}$$

2 Formally, the necessary conditions for an optimum are obtained by equating the first derivatives of the Hamiltonian function (6) with respect to c and g to zero and setting the first derivative with respect to k to $-\dot{\lambda}$. Additionally, the transversality condition has to be fulfilled.

3 The proof is similar to that presented by Barro and Sala-i-Martin (1995).

As in the case of the Pareto optimum, the decentral optimization may be formally depicted by a Hamiltonian function that covers eq. (1), (2), (3) and (8)

$$\mathcal{H} = \frac{c^{1-\sigma}-1}{1-\sigma} e^{-\rho t} + \lambda\,[(1-\tau)\,y - qg - c - \delta k]. \tag{9}$$

The representative individual chooses the amount of consumption and capital that is accumulated. At the same time it decides about its use of the public input[4]. The result of the optimization problem is the steady-state growth rate of consumption per capita γ that depends on the fiscal parameters of the social planner τ and q,

$$\gamma(\tau,q) = \frac{1}{\sigma}\left[A^{\frac{1}{\alpha}}\,\alpha\,(1-\tau)^{\frac{1}{\alpha}}\left(\frac{1-q}{q}\right)^{\frac{1-\alpha}{\alpha}} - \delta - \rho\right]. \tag{10}$$

By fixing the optimal fee- and tax rates it is possible to realize a coincidence of the growth rates in eq. (7) and (10). Hence, the Pareto optimum may be the result of the individual decisions[5].

The tax- and fee rates may not be determined independently, since a clear connection between both fiscal parameters exists, which may be derived from the governmental budget constraint (4) and the individual decision about the use of the public input

$$\tau(q) = \frac{(1-\alpha)(1-q)}{1-\alpha+\alpha q}, \tag{11}$$

with $\frac{\partial \tau}{\partial q} < 0$. This means that an increase of the fees goes along with a decrease of the tax rate if the budget is to be balanced. Due to the interdependence $\tau(q)$ the growth rate in (10) may be rewritten to depend exclusively on the fee rate[6]

$$\gamma(q) = \frac{1}{\sigma}\left[\alpha\,A^{\frac{1}{\alpha}}\,(1-\alpha)^{\frac{1-\alpha}{\alpha}}\,\frac{q}{(1-\alpha+\alpha q)^{\frac{1}{\alpha}}} - \delta - \rho\right]. \tag{12}$$

4 Again, the necessary conditions for an optimum are obtained by equating the first derivatives of eq. (9) with respect to c and g to zero and setting the first derivative with respect to k to $-\dot{\lambda}$. Aside from this, the transversality condition has to be fulfilled as well.

5 This is a significant difference between this model and the one of Barro (1990), who models the public input as pure public good. Within that model the optimum may only be obtained if the social planner replaces the distortionary income tax by a neutral consumption tax. Either way, the decentral optimization leads to a second-best optimum only.

6 Alternatively, one may choose the presentation of the growth rate of consumption per capita depending on the tax rate τ. Within this model, the dependence of the growth rate in (10) on the fees has been selected to emphasize the characteristic of excludability of g.

5. The Altruistic Social Planner

In this section the consequences of different behavior patterns by the planner on total welfare together with the resulting expenditure ratios are derived. Supplying the public good g is the planner's task. If he acts *benevolently* he will realize the social optimum that corresponds with the optimal amount and financing of g. He chooses a financing solution that results in a coincidence of both growth rates in eq. (7) and (12). This requires the optimal fee rate of $q^* = 1$. Together with (11) the optimal tax rate $\tau^* = 0$ may then be determined. Thus, the optimal financing of the public input is achieved solely by fees and the planner makes use of excludability. This behavior gives rise to an efficient provision of the public input g and is in accordance with the benefit-received principle in a dynamic context.

The transition from pure financing by fees to partial or total financing by taxes would cause a break with the optimal financing. In this case the decrease of the fees would automatically result in an increasing tax rate and, therefore, give rise to two countervailing effects. On the one hand, a higher tax rate causes a negative substitution effect because the higher tax rate lowers the marginal product of capital and, hence, raises the price of private capital accumulation. Capital accumulation will be substituted by consumption. Taxation leads to a negative external effect on the growth process. On the other hand, taxation has a positive external effect on productivity. This implies that a higher tax rate leads to a higher amount of the public good, and with this, increases the marginal product of capital and hence the accumulation of private capital and the growth rate. The total consequence of a higher taxation on the growth rate thus depends on which effect predominates. As the growth rate in (12) is maximal at $q^* = 1$, $\tau^* = 0$, an increase of the tax rate within the interval $\tau \in [0, 1]$ results in a decreasing growth rate and a welfare loss, because the negative effect dominates[7].

By assessing the fee- and tax rates, the expenditure ratio $\left(\frac{g}{y}\right)$ is also determined. It may be established by deriving (9) with respect to g,

$$\frac{g}{y}(\tau, q) = \frac{(1-\alpha)(1-\tau)}{q}. \tag{13}$$

The expenditure ratio that results if the optimal fee- and tax rates are assessed is $\left(\frac{g}{y}\right)^* = (1-\alpha)$. It matches the elasticity of production of the public input

7 Another way to illustrate the welfare losses as a consequence of a decreasing growth rate is to prove that the utility function in (1) is concave in γ. Therefore, a maximal growth rate leads to a maximum of total welfare.

and may be interpreted in analogy to the golden rule of accumulation: tax- and fee rates may be determined to maximize per capita consumption.

6. The Egoistic Social Planner

This section analyzes how a selfish planner assesses tax- and fee rates as well as the consequences of this behavior on the realized growth rate and welfare. To that end, selfish behavior is modeled following the budget-maximizing bureaucrat as in Niskanen (1971). The planner's personal utility is positively related to the size of his budget. Unlike the presentation from Niskanen (1971), the formal context is a dynamic model, so that the planner's egoism may be interpreted in two ways: the planner may maximize his budget in relation to total income in each period (i.e. the expenditure ratio) or maximize the budget over time, independent of the income level in each period. In the first case the planner maximizes his relative budget and in the second his absolute budget.

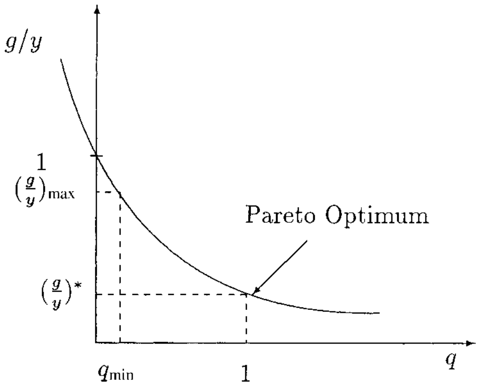
It will be shown that a selfish planner chooses a Pareto-optimal provision of the public input only if his objective is to maximize his total budget. This could be rational if the planner may be voted out of office or is confronted with other sanctions. On the other hand, if he tends to maximize his relative budget, he selects an inefficient financing mix and demands fees that are insufficient to cover the costs. The arising revenue gap is then closed by taxing income. In this case, the planner maximizes his own utility, accepting possible disadvantages for the private individuals. The welfare loss grows with a rising taxation quota. Such behavior is only rational if the time horizon of the public agent is finite. Moreover, it can be shown that a planner may not maximize his absolute and relative budget at the same time. Therefore, the importance of each objective for the planner is essential for the obtained result. However, this paper refrains from a detailed analysis of the emergence of the planner's goals and treats them as exogenous factors. In the following analysis each target segment is analyzed individually. Both are subsequently combined to formulate the planner's utility function.

6.1. Maximization of the Relative Budget

Because the amount of the expenditure ratio is determined by the amounts of taxes and fees, the planner may enforce any expenditure ratio he prefers (compare (13)). Transformation of (13) and (11) leads to an expenditure ratio that only depends on the fee rate

$$\frac{g}{y} = \frac{(1-\alpha)}{1-\alpha+\alpha q}, \tag{14}$$

Figure 1
Expenditure Ratio and Rate of Fees



with $\frac{\partial \frac{g}{y}}{\partial q} < 0$ for all fee rates. Hence, the expenditure ratio increases with a decreasing fee rate. Figure 1 illustrates this connection.

Because q is in the interval $[0, 1]$, the expenditure ratio has its maximum when the corner solution $q = 0$ is realized. In this case, the expenditure ratio is $\left(\frac{g}{y}\right) = 1$. Total production is used to provide the public input. At the same time the corresponding tax rate is $\tau = 1$, as can be seen from (11). If the planner acts in the described manner, he would begin with a pure financing by taxes and at the same time – due to the distortionary effect of the income tax – decrease the levels of both the growth rate and welfare. However, this solution is not feasible because for $q = 0$ the resulting growth rate becomes negative[8]. This implies a shrinking economy which, in the long run, does not need a planner. For that, in the case of maximizing the relative budget, sensible solutions require an expenditure ratio that at least allows for zero growth. In the following presentation this expenditure ratio is called $\left(\frac{g}{y}\right)_{\max}$. To realize $\left(\frac{g}{y}\right)_{\max}$, the planner has to choose q and τ accordingly. He will decide to fix a combination of fee- and tax rates with $q_{\min} > 0$ and $\tau_{\max} < 1$. They are not explicitly determinable but $q_{\min}$ corresponds to the level

8 If the growth rate becomes negative, the accumulation of capital will also be negative because the gross investment is not sufficient to compensate the loss of capital as a consequence of depreciation. The economy then enters recession.

of fees, which solves the following equation and is derived by equating (12) to zero

$$\frac{q}{(1-\alpha+\alpha q)^{1/\alpha}}=\frac{\delta+\rho}{\alpha A^{1/\alpha}\,(1-\alpha)^{(1-\alpha)/\alpha}}\,. \tag{15}$$

This equation, together with (11), also determines $\tau_{\max}$. It is obvious that when maximizing his relative budget the planner will not realize a financing solution consisting of fees only, but settle for an inefficient mixture of fees and taxes. He chooses a higher expenditure ratio than would be optimal, but he is limited by the upper boundary $\left(\frac{g}{y}\right)_{\max}$. The boundaries for the expenditure ratio and the rate of fees are also contained in figure 1.

In order to maximize the expenditure ratio, welfare is also restricted by the determination of sub-optimal fee- and tax rates: because the utility of the representative individual depends positively on the size of the growth rate and a sub-optimal expenditure ratio lowers the growth rate, welfare also declines. In this case, $q<q^*$, the representative individual is not able to realize his optimal plan of intertemporal consumption. However, he still has to accept the fee- and tax rates set by the planner as the public input is necessary for production.

6.2. Maximization of the Absolute Budget

If the planner tends to maximize his total budget in the long run, he will behave in a different way as seen in the case of maximizing the expenditure ratio. As in the steady-state, governmental expenditure grows at the same rate as consumption per capita. Thus, the budget becomes maximal if it grows at the maximum growth rate γ^*. The planner achieves a maximum of his own utility if he chooses a Pareto-optimal provision of the public input with a pure financing by fees and fixing the expenditure ratio at $\left(\frac{g}{y}\right)^*=(1-\alpha)$. At the same time he maximizes welfare of the representative individual, but this fact does not influence his decision.

Moreover, from (12) and (14) it is possible to describe the growth rate depending on the expenditure ratio and hence, to analyze the consequences of a change of the relative budget on the absolute budget

$$\gamma\left(\frac{g}{y}\right)=\frac{1}{\sigma}\left[A^{\frac{1}{\alpha}}\left(\left(\frac{g}{y}\right)^{\frac{1-\alpha}{\alpha}}-\left(\frac{g}{y}\right)^{\frac{1}{\alpha}}\right)-\delta-\rho\right]. \tag{16}$$

The growth rate of the budget, γ, has its maximum at $\left(\frac{g}{y}\right)^* = (1-\alpha)$, and the first derivative is negative for all $(1-\alpha) \leq \frac{g}{y} \leq 1$. Thus, the growth rate declines if the expenditure ratio increases, so that the planner may not maximize both the absolute- and relative budgets at the same time. If the expenditure ratio is at level one, the growth rate becomes negative. The expenditure ratio that allows exactly for zero growth is not explicitly determinable. However, it corresponds to the relative budget $\left(\frac{g}{y}\right)_{\max}$ as previously explained and shown in figure 1.

The social planner's aspiration to maximize his own utility may be concluded in two different ways: firstly, as the realization of a maximum expenditure ratio $\left(\frac{g}{y}\right)_{\max}$ that allows at least for zero growth and, secondly, as a budget growing at the rate γ^*. From (16) it becomes clear that both goals cannot be reached at the same time because an increase of the growth rate γ involves a decreasing expenditure ratio. The following section explores how a planner assesses tax- and fee rates if his utility consists of both goals (maximizing absolute and relative budget) that are weighted in the planner's utility function.

6.3. Maximization of Absolute and Relative Budget

One may imagine that the planner pursues both objectives and is ready to accept a lower expenditure ratio than $\left(\frac{g}{y}\right)_{\max}$ if, at the same time, his total budget increases. Moreover, he would accept a slower budgetary growth if he strongly preferred a high amount of the expenditure ratio. However, in any case it is necessary to decrease the expenditure ratio in order to get a higher absolute budget and vice versa.

If a planner pursues a mixture of both goals, his preferences may be described by a Cobb-Douglas utility function, in which the relative importance of the goals is expressed by the exponents

$$\mathcal{U}_e\left(\gamma, \frac{g}{y}\right) \equiv \gamma^{\eta} \cdot \left(\frac{g}{y}\right)^{1-\eta}, \quad 0 \leq \eta \leq 1, \tag{17}$$

with γ from eq. (16) and the expenditure ratio from eq. (14). To get an explicit solution for the maximization of (17), in eq. (16) γ will be changed by a linear transformation that is through the addition of $\frac{\rho+\delta}{\sigma}$. From this, a growth rate called γ_0 results that, in contrast to γ, is positive for all expenditure ratios in the interval $[(1-\alpha),1]$

$$\gamma_0 \equiv \frac{1}{\sigma}\left[A^{\frac{1}{\alpha}}\left(\left(\frac{g}{y}\right)^{\frac{1-\alpha}{\alpha}}-\left(\frac{g}{y}\right)^{\frac{1}{\alpha}}\right)\right] \geq 0 . \tag{18}$$

Function (18) has the same formal properties as γ in (16). The only difference is found in the addition of a constant, so that it has its maximum at $\left(\frac{g}{y}\right)^{*}=(1-\alpha)$ and declines if the expenditure ratio increases. At the same time, the transformation of γ into γ_0 indicates an equivalent transformation of the boundaries on the fee- and tax rates and the expenditure ratio: the rate of fees $q_{\min}$ then corresponds to zero, $\tau_{\max}$ as well as $\left(\frac{g}{y}\right)_{\max}$ becomes one. However, the growth rate in eq. (16) is relevant for any real economic development, so that for $\eta=0$ a non-feasible solution results. Consequently, a lower boundary called $\eta_{\min}$ exists that exactly allows for zero growth.

Together with eq. (18), the planner's utility function in (17) may be rewritten to depend only on the level of the expenditure ratio

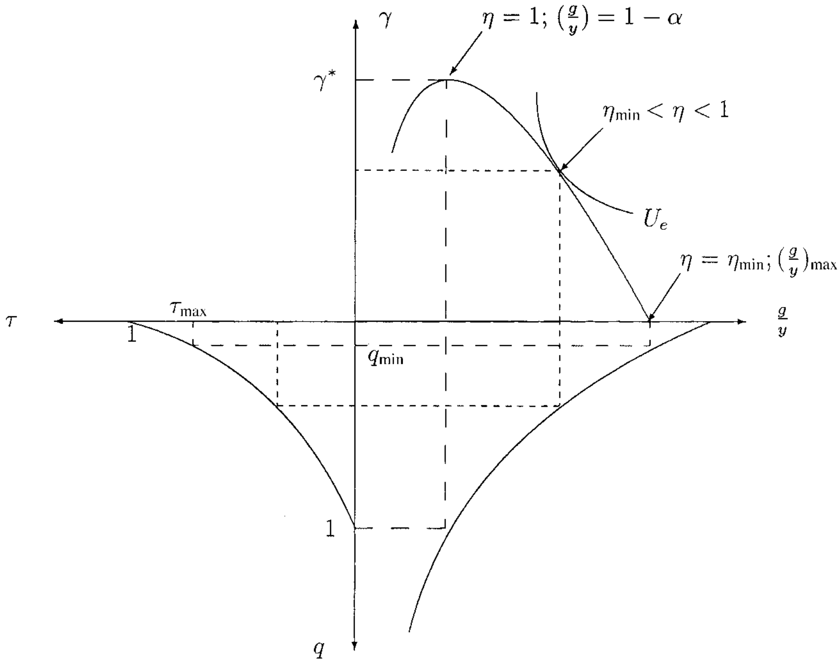
$$\mathcal{U}_e\left(\frac{g}{y}\right)=\left[\frac{1}{\sigma}A^{\frac{1}{\alpha}}\left(\left(\frac{g}{y}\right)^{\frac{1-\alpha}{\alpha}}-\left(\frac{g}{y}\right)^{\frac{1}{\alpha}}\right)\right]^{\eta}\cdot\left(\frac{g}{y}\right)^{1-\eta} . \tag{19}$$

It becomes obvious that the planner chooses different expenditure ratios depending on the weighting of his goals. Additionally, he assesses alternative tax- and fee rates. Through this he influences the realized growth process and thus welfare.

One way to illustrate the interdependencies between planner's utility, growth rate (welfare), expenditure ratio as well as tax- and fee rates is employed in figure 2. In this illustration it becomes obvious that the planner, while fixing the fee rate at a certain level, automatically provides the size of the corresponding tax rate, the level of the expenditure ratio and the growth rate. Hence, these variables may not be assessed independently. Figure 2 demonstrates these connections: the relationship between tax- and fee rates may be derived from (11), that between expenditure ratio and fee rate from (14). The growth rate γ, depending on the expenditure ratio, is analyzed in (16) and the indifference curve of the planner's utility comes from (17).

In addition to these curves, figure 2 contains three arrows that illustrate points where the indifference curves are tangents to the curve of the growth rate for different weight ratios of the planner's goals. The tangent point is lo-

Figure 2
Relationship between γ, $\frac{g}{y}$, q and τ



cated on the upper left hand side of the curve if the planner tends to maximize his absolute budget. It is on the lower right hand side if he wishes to maximize the expenditure ratio. The pure maximization of the relative budget corresponds to $\eta = \eta_{min}$ and the maximum expenditure ratio $\left(\frac{g}{y}\right)_{max}$.

For $\eta = 1$, the planner's preferences only contain the goal to maximize γ. The corresponding indifference curve is horizontal and the resulting expenditure ratio becomes $\left(\frac{g}{y}\right)^* = (1-\alpha)$. Following the dotted line, the Pareto-optimal growth rate γ^*, fee rate $q^* = 1$ and tax rate $\tau^* = 0$ can be seen. For $\eta_{min} \leq \eta < 1$, a mixed financing solution is realized with a growing share of taxes if η declines. At the same time, growth rate and welfare will decrease and the expenditure ratio is within the interval $\left[(1-\alpha), \left(\frac{g}{y}\right)_{max}\right]$. In the case of $\eta = \eta_{\min}$ the planner chooses $\tau_{\min}$ or $q_{\max}$ respectively and realizes $\left(\frac{g}{y}\right)_{\max}$. Then, the planner's budget grows at a rate γ of zero.

After this graphic explanation of the connections between the tax- and fee rates as well as the corresponding expenditure ratios chosen by an egoistic social planner, these parameters will now be derived analytically. Using the utility function in (19), the expenditure ratio chosen by a selfish planner, who pursues a weighted mix of both goals, may be derived explicitly. As every expenditure ratio can be exactly obtained with one combination of taxes and fees, the level of q and τ may be derived from the realized expenditure ratio. It becomes clear that the expenditure ratio $\left(\frac{g}{y}\right)_e$ which maximizes the utility of the selfish planner in (19), only depends on the elasticities of production of k and g in (3), as well as on the weights of the planner's goals. Maximization of the utility function in (19) leads to the selfish expenditure ratio

$$\left(\frac{g}{y}\right)_e = \frac{\eta(1-\alpha)+\alpha(1-\eta)}{\alpha(1-\eta)+\eta}, \quad \forall\ \eta_{\min} \le \eta \le 1. \tag{20}$$

Here the index e indicates the solution that corresponds to the maximization of (19). The resulting expenditure ratio lies within the interval $\left[(1-\alpha), \left(\frac{g}{y}\right)_{\max}\right]$; the restriction of the upper boundary $\left(\frac{g}{y}\right)_{\max}$ or the restriction of η in (20) correspond to a retransformation of γ_0 to γ. As mentioned before, both, maximization of the expenditure ratio with a minimum growth rate at zero and pure maximization of the growth rate of the budget, are contained in the utility function: $\eta = 1$ means that the planner prefers a maximization of γ, whereas $\eta = \eta_{\min}$ implies a level of the expenditure ratio that allows for zero growth. If $\eta \in (\eta_{\min}, 1)$, the planner wants to realize a mixture of both goals. In this case he chooses a lower expenditure ratio with rising importance of the maximum growing budget. This may be formally derived from $\frac{\partial\left(\frac{g}{y}\right)_e}{\partial\eta} < 0$.

The planner does not determine the level of the expenditure ratio but the tax- and fee rates that provide the expenditure ratio. How τ and q depend on the planner's weight ratios may be derived by solving eq. (14) for q and using eq. (20). The planner sets the following fee rate

$$q_e = \frac{\eta(1-\alpha)}{\alpha(1-\eta)+\eta(1-\alpha)}, \quad \forall\ \eta_{\min} \le \eta \le 1. \tag{21}$$

q_e is in the interval $[q_{\min}, 1]$, and, because of $\frac{\partial q_e}{\partial \eta} > 0$, it will increase if the planner wants to realize a maximum budget growth. For all $\eta < 1$ he will provide a mixed financing solution, and the share of fees increases with η. For $\eta = 1$ the public input is solely financed by fees, i.e. the provision is Pareto-optimal.

Moreover, fixing the rate of fees automatically determines the level of τ, so that the selfish planner's tax rate τ_e can be derived from (21) and (11) as

$$\tau_e = \frac{\alpha(1-\eta)}{\alpha(1-\eta)+\eta}, \quad \forall\ \eta_{\min} \leq \eta \leq 1. \tag{22}$$

Again, the restriction of η leads to a restricted tax rate in the interval $[0, \tau_{\max}]$. As with the expenditure ratio in eq. (20) and the fee rate q_e in (21), τ_e only depends on η and α. For each value of α the selfish tax rate τ_e increases while η decreases.

The implications of (22) are analogous to the argumentation with the fee rate: due to $\frac{\partial \tau_e}{\partial \eta} < 0$, the planner will fix a lower tax rate if he prefers a high growth rate of the public budget. If he intends to maximize the expenditure ratio, he will choose a tax rate as high as possible. The planner then departs from the Pareto-optimal provision. He maximizes his own utility at the cost of welfare because the proportional income tax distorts the intertemporal allocation. The results of different behaviors adopted by the planner are summarized in table 1.

7. Summary

This paper analyzes the consequences of alternative behaviors of a social planner on the realized level of welfare. The analysis' starting point is the reflection that the usual so-called benevolent planner within endogenous growth models only illustrates a single part of the whole range of possible behaviors. This consideration neglects the argument that is discussed within the public choice literature: public agents may also tend to maximize their personal utility in the same way as private individuals. In the presented model, altruism of the planner results in maximum social welfare and is chosen as reference to assess the behavior of an egoistic planner. To formalize these thoughts, an endogenous growth model with productive governmental services is chosen. The public in-

Table 1
Consequences of Different Weight Ratios of the Planner's Goals

	$\eta = \eta_{\min}$	$\eta_{\min} < \eta < 1$	$\eta = 1$
$U\left(\gamma, \frac{g}{y}\right) = \gamma^{\eta} \cdot \left(\frac{g}{y}\right)^{1-\eta}$	$\max \frac{g}{y}$ s.t. $\gamma = 0$	$\max \frac{g}{y}, \gamma$	$\max \gamma$
$\left(\frac{g}{y}\right)_e = \frac{(1-\alpha)\,\eta + (1-\eta)\,\alpha}{(1-\eta)\,\alpha + \eta}$	$\left(\frac{g}{y}\right)_{\max}$	$(1-\alpha) < \left(\frac{g}{y}\right) < \left(\frac{g}{y}\right)_{\max}$	$\left(\frac{g}{y}\right)^{*} = (1-\alpha)$
$q_e = \frac{(1-\alpha)\,\eta}{(1-\eta)\,\alpha + \eta\,(1-\alpha)}$	$q_{\min}$	$q_{\min} < q < 1$	$q^{*} = 1$
$\tau_e = \frac{\alpha\,(1-\eta)}{\alpha\,(1-\eta) + \eta}$	$\tau_{\max}$	$0 < \tau < \tau_{\max}$	$\tau^{*} = 0$
$\gamma = \frac{1}{\sigma}\left[A^{\frac{1}{\alpha}}\left(\left(\frac{g}{y}\right)_e^{\frac{1-\alpha}{\alpha}} - \left(\frac{g}{y}\right)_e^{\frac{1}{\alpha}}\right) - \rho - \delta\right]$	0	$0 < \gamma < \gamma^{*}$	γ^{*}

put is non-rival in consumption but the possibility of excluding non-payers from usage does exist. Therefore, the planner may request user fees from the producers. On the other hand, the planner may also impose a proportional income tax to finance his expenditures. After the inference of the Pareto-optimal provision of the public services and the decentrally set growth rate the mixture of fees and taxes chosen by a budget-maximizing planner is analyzed. It is shown that behavior strongly affects the realized level of individual welfare. Furthermore, it could be proven that a selfish planner does not necessarily lower the obtained level of welfare. Hence, the consequences of selfish or altruistic behavior of the social planner on individual welfare significantly depend on the formulation of the social planner's preferences.

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