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Endogenous fiscal policies, environmental quality, and status-seeking behavior[§]

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Abstract

This paper analyzes endogenous fiscal policy in an endogenous growth model where agents care about social status and environmental quality. The quest for a higher status is assimilated to a preference for capital wealth. The government uses income tax to finance infrastructure and environmental protection. We find that accounting for preferences for social status and environmental quality may lead to an allocation of tax revenue in favor of a cleanup effort to the detriment of infrastructure. It does not necessary have a negative impact on growth. Status seeking can however harm economic growth and environmental quality when its motive is important enough. Finally, we show that economic growth is consistent with environmental preservation but is not necessarily welfare-improving as in the case of absence of status-seeking behavior.

Keywords: Endogenous policy; endogenous growth; environmental quality; status-seeking; public expenditure; Wagner's law

JEL Classification: D9; H31; O41; Q58

1 Introduction

The relationship between growth and environment has been extensively explored in the literature. The emergence of endogenous growth theories in the last two decades has provided a novel framework to address the sustainability issue and especially the role of public policy in improving environmental quality. In this respect, the works of Jones and Manuelli (2001) and Economides and Philippopoulos (2008) are particularly appealing. These authors pleaded for environmental protection policy, which was also recommended by Arrow *et al.* (1995), and suggested that policy choice should be considered as a source of cross-country heterogeneity in terms of economic performance and environmental quality. Economides and Philippopoulos (2008) studied a second-best optimal policy in an endogenous growth model with renewable ressource. The latter is depleted by economic activity but can be maintained by cleanup policy. The government chooses the tax rate and the allocation of tax revenue between infrastructure spending and cleanup effort by maximizing individual welfare. Their results show that the more individuals care about the environment, the more growth-enhancing policy should be chosen.

However, these works used the traditional approach on economic growth, which emphasizes the supply-side of the economy and assumes that individual preferences are exogenous and independent of any social interaction. Accounting for the relative position of individuals in society would lead to considering alternative economic models, including particularly those with endogenous preferences and relative utility. Several recent researches show that individuals care about their relative positions in society and recommend a broader use of these models in environmental studies (van den Bergh *et al.* 2000, Brekke and Howarth 2002). Empirical evidence supporting relative utility can be found in numerous works on subjective well-being (Clark and Oswald 1996, Kapteyn *et al.* 1997, Clark *et al.* 2008). Most of them found that an individual's utility depends not only on her income but also on a reference income.

The conjecture of relative utility dates back to *The Theory of Moral Sentiments* by Smith (1759) and *The Theory of the Leisure Class* by Veblen (1899), and was emphasized by Duesenberry (1949). The latter author postulated that there is a *comparison effect* in the consumption between individuals (see also Rauscher 1997, Alonso-Carréra *et al.* 2008). Human capital accumulation as a motive of status was also suggested by, e.g., Frank (1985) and Fershtman *et al.* (1996). Capital wealth-enhanced social status was incorporated in numerous growth models (Corneo and Jeanne 2001a, b, Long and Shimomura 2004, Pham 2005,, Stark 2006 etc.). This literature emphasizes the role of the demand side as a determinant of growth, i.e. status-seeking behavior leads to a higher growth.

Endogenizing individual preferences can help avoiding the consequences of making wrong decision in valuing environmental externalities and designing public policy (Gowdy 2004). Indeed, status-seeking behavior may have an impact on the level and the structure of optimal tax. For example, the quest for a higher social status raises capital wealth accumulation (recognized as a measure of social status) to the detriment of current consumption and total public expenditure chosen by agents. However, if an individual cares about environmental quality, the cleanup effort will be higher because production degrades the environment. Consumption or wealth-enhanced status may therefore lead to an excessive consumption or an excessive capital wealth accumulation, and an environmental degradation in the market economy (Ng and Wang 1993). This will result in a more agressive policy than in the case without status effects (Howarth 1996, Brekke *et al.* 2003). In line with this research, by studying the optimal tax in an OLG model with consumption that harms the environment, Wendner (2003) concluded that status-seeking raises the optimal tax rate on consumption and reduces that on capital income. In Brekke and Howarth (2002, chapter 9), the assumption that social status is measured by relative capital wealth gives rise to a long-run growth path with excessive capital accumulation and may lead firms to employ polluting technologies inducing excessive pollution in the short-run. Moreover, it is shown that the optimal tax on consumption is set to zero, and capital is taxed at a rate equal to the individual marginal willingness to pay in order to neutralize the status externality related to capital accumulation.

Our paper aims to study how individual behavior impacts public decision on environmental protection and infrastructure spending in an endogenous growth model. As in Economides and Phillipopoulos (2008), we consider that income tax (financing public program) and the allocation of tax revenue between cleanup and infrastructure are welfare-maximizing. Our study differs from this work as we provide an analysis of impacts of endogenous individual preferences on the choice of income tax rate and on the allocation of tax revenue between infrastructure spending and cleanup effort. In particular, we assume that agents care about consumption, environmental quality, and social status. The latter is defined in terms of relative capital wealth (Long and Shimomura 2004, Pham 2005). As underlined previously, the presence of the status-seeking behavior will lead to an excessive capital accumulation and ignoring the influence of social status may therefore yield a long-run equilibrium at which environmental quality is higher (and then it is not a priority), which can generate a higher allocation of tax revenue for infrastructure to the detriment of a cleanup effort.

We show that environmental quality may be considered as a 'luxury good' and that status-seeking behavior may constitute a justification for environmental expenditure, which could be a valid explanation of Wagner's law (following which the ratio of government expenditure to GDP is positively related to GDP per capita). We also show that accounting for preferences for social status and environmental quality may lead to an allocation of tax revenue in favor of a cleanup effort to the detriment of infrastructure. However, this choice is not necessarily harmful for economic growth as the latter is partly explained by a high capital wealth accumulation due to the quest for status. Nevertheless, status concern may be harmful for economic growth and environmental quality when its motive is important enough. Finally, we show that economic growth is consistent with environmental preservation but it is not necessarily welfare-improving as in the case of absence of status-seeking behavior.

The paper is organized as follows. Section 2 presents the model. Section 3 discusses the intertemporal political-economic equilibrium where the fiscal policy is chosen from a two-step decision process: given public policy, the representative household determines her consumption and her private capital, the representative firm chooses its production, and then the altruist government determines the allocation of tax revenue that maximizes the household's utility subject to private decisions. Section 4 presents the impacts of status and environment concerns on fiscal policy, sustainable growth and the relationship between growth and welfare. Section 5 concludes.

2 The model

We assume that the economy has a continuum of infinitely-lived identical households uniformly distributed in $[0, 1]$. Competitive firms produce a consumption good from three inputs: private capital, public capital, and labor. This production degrades environmental quality, which has an externality effect on the household's utility. As in Kempf and Rossignol (2007), Economides and Philippopoulos (2008), we assume that the government uses income tax to finance public capital and environmental protection.

2.1 Individuals' preferences

Each individual has an initial endowment of capital, $k_0 > 0$, and is supposed to supply one unit of labor at each period. Her preferences for consumption, environmental quality, and social status are represented by the following intertemporal utility function:

$$U\left(c_t, k_t, K_t, E_t\right) = \sum_{t=0}^{\infty} \beta^t \left[(1 - s_K - s_E) \ln c_t + s_E \ln E_t + s_K \ln \frac{k_t}{K_t^{\theta}} \right] \tag{1}$$

where $0 < \beta < 1$, $0 < \theta < 1$. The first term of the instantaneous utility function expresses the satisfaction from consumption c_t, the second from environmental quality E_t, and the last from status seeking $\frac{k_t}{K_t^{\theta}}$. Parameter θ may be interpreted as the degree of the individual's social interaction (Jellal and Rajhi 2003).

As underlined previously, status-seeking behavior, which is a way of modeling endogenous preferences, enables us to avoid consequences of making wrong public decisions. In our model, status is expressed in terms of relative wealth ($\frac{k_t}{K_t^{\theta}}$) and the associated coefficient, s_K, represents the relative importance that the individual gives to her status in society. When $s_K = 0$, the utility function has a classical form, i.e. utility is absolute, and individual preferences only depend on consumption and environmental quality as described in Economides and Phillippopoulos (2008). Utility is relative when $s_K > 0$ and $\theta > 0$. We assume that $s_K + s_E \in [0, 1)$ to avoid extreme configurations where consumption is not important at all ($s_K + s_E = 1$) and only social status and environmental quality ensure the household's survival.[1]

[1]The result remains unchanged when using the utility function with the form $s_C \ln c_t + s_E \ln E_t + s_K \ln(k_t/K_t^{\theta})$ with $s_C + s_K + s_E \neq 1$.

2.2 Environmental quality

As in John and Pecchenino (1994) and John *et al.* (1995), environmental quality evolves according to:

$$E_{t+1} = (1-m)E_t + aG_{Et} - by_t, \quad m, a, b > 0 \tag{2}$$

where by_t is environmental degradation relative to production at t, aG_{Et} corresponds to environmental improvement from public pollution abatement. The effectiveness of environmental policy is expressed by the exogenous parameter $a > 0$.

E_t is a public good indicating an index of environmental quality, e.g. soil quality, air quality, groundwater, or some biodiversity index. Without any economic activity, environmental quality has an autonomous level of zero. The parameter $m \in [0,1]$ measures the natural speed of reversion of environmental quality to this level.[2]

2.3 Production technology

The consumption good is produced by a representative firm with a Cobb-Douglas production function

$$y_t = AZ_t^{\alpha} k_t^{1-\alpha} l_t^{\alpha} \tag{3}$$

where A corresponds to the technological level. The aggregate variable Z_t, which is the stock of public capital at t, is assumed to be a pure public good. Variable k_t and l_t

[2]As in John and Pecchenino (1994) and John *et al.* (1995), environmental quality is assumed to be always positive in order to justify the logarithmic form in the utility function. Other forms than in equation (2) were proposed by Aghion and Howitt (1998, chapter 5) where E, measured as the distance between the current environmental quality to its upper limit, is always lower or equal to zero. The zero value corresponds then to the upper limit in the case of absence of human activity. Moreover, when environmental quality is considered as a flow, factors affecting it (consumption, production, capital, pollution abatement, etc.) can be modeled in a nonseparable way, such as the Cobb-Douglas specification (see, e.g., Smulders 2000, and Xepapadeas 2005).

are private capital and labor respectively. For simplicity's sake, we assume that private capital at $t+1$ depends on private investment at t:

$$k_{t+1} = i_t. \tag{4}$$

Our model is a discrete version of Barro's (1990) model with the modification that public capital is introduced into the production process as a stock, instead of a flow variable.[3] We assume that public capital is entirely depreciated at each period, i.e. public capital at $t+1$ is equal to public investment at t:

$$Z_{t+1} = G_{Zt}. \tag{5}$$

2.4 Public sector

The overall public expenditure is financed by income tax:

$$G_t = \tau_t(w_t l_t + r_t k_t) \tag{6}$$

where τ_t is the tax rate at time t. We also assume that a share ϵ of public expenditure is devoted to the provision of public capital and the remaining $1-\epsilon$ to environmental protection. We rewrite (6) as

$$G_t = G_{Zt} + G_{Et} = \epsilon\tau_t\left(w_t l_t + r_t k_t\right) + (1-\epsilon)\tau_t\left(w_t l_t + r_t k_t\right). \tag{7}$$

Equivalently, we can rewrite the above equation as

$$G_t = G_{Zt} + G_{Et} = \left(\gamma_{Zt} + \gamma_{Et}\right)\left(w_t l_t + r_t k_t\right) \tag{8}$$

where γ_{Zt} and γ_{Et} are respectively the ratio of infrastructure expenditure to income and that of environmental expenditure to income. Public policy can be therefore summa-

[3]Similar models, without social status or environment, were proposed by Glomm and Ravikumar (1994, 1995), Lau (1995), etc.

rized by γ_{Zt} and γ_{Et} that we can also call infrastructure and environmental tax rates, respectively.

3 Equilibrium

We study in this section the *political-economic equilibrium* which results from a sequential process. In other words, at the beginning of each period, fiscal policy is chosen before consumption, production, and wealth accumulation decisions.[4] Taking fiscal policy and environmental quality as given, the household and the firm will make their own decisions. We have then a two-step decision design. In the first step, the representative firm maximizes its profit by choosing the profile of production factors. The representative household maximizes her utility by choosing her consumption and her saving (private investment) given fiscal policy and environmental quality. A *competitive equilibrium* is therefore defined. In the second step, the altruist government determines the allocation of tax revenue by maximizing the household's utility subject to private decisions at the competitive equilibrium. The *political-economic equilibrium* resulting from this two-step procedure corresponds then to a second-best allocation. This sequential process was often considered as a voting mechanism in a democratic economy as in Glomm and Ravikumar (1995), Krusell *et al.* (1997), Jones and Manuelli (2001), among others. Hereafter, we derive the private decisions at the competitive equilibrium and the allocation of tax revenue determined by the government.

[4] Some authors assumed that the tax rate is fixed at the beginning of time and remains constant subsequently (see, e.g., Lau 1995, and Fiaschi 1999).

3.1 Consumption and investment decisions

At each period, the representative firm employs inputs, k_t and l_t, following the optimization program:

$$\max_{\{k_t,l_t\}} \quad AZ_t^{\alpha}k_t^{1-\alpha}l_t^{\alpha} - w_t l_t - r_t k_t \tag{P1}$$

with $l_t, k_t > 0,\ t = 0, 1, ...$ The price of the consumption good is normalized to unity. Factor prices, fiscal policy, and environmental quality are considered as given. First-order conditions of the optimization program are

$$\begin{aligned} w_t &= \alpha AZ_t^{\alpha}k_t^{1-\alpha}l_t^{\alpha-1} = \frac{\alpha y_t}{l_t}, && (9)\\ r_t &= (1-\alpha)AZ_t^{\alpha}k_t^{-\alpha}l_t^{\alpha} = \frac{(1-\alpha)y_t}{k_t}. && (10)\end{aligned}$$

Given fiscal policy, factor prices, and environmental quality, the representative household determines her consumption, c_t, and her investment, i_t (or private capital k_{t+1}), by maximizing her utility subject to the budget constraint:

$$\max_{\{c_t,k_{t+1}\}} \quad \sum_{t=0}^{\infty}\beta^t\left[(1-s_K-s_E)\ln c_t + s_E\ln E_t + s_K\ln\left(\frac{k_t}{K_t^{\theta}}\right)\right] \tag{P2}$$

subject to

$$\begin{cases} c_t + k_{t+1} = (1-\gamma_{Zt}-\gamma_{Et})(w_t l_t + r_t k_t),\\ c_t,\ k_{t+1} > 0,\\ k_0, Z_0, \{w_t, r_t\}_{t=0}^{\infty}, \{\tau_t, G_t\}_{t=0}^{\infty},\ \{E_t\}_{t=0}^{\infty} \quad \text{given.}\end{cases}$$

First-order conditions from (P2) are

$$\frac{1-s_K-s_E}{c_t} = \beta\left[\frac{(1-s_K-s_E)(1-\tau_{t+1})r_{t+1}}{c_{t+1}} + \frac{s_K}{k_{t+1}}\right],\ \forall t. \tag{11}$$

This relation represents the equality between the marginal cost (in terms of utility) of a reduction of one unit of consumption good at t (left-hand side) and the marginal benefit of an increase of one unit of private capital at $t+1$ (right-hand side). This benefit is composed by two elements: the marginal utility of capital at time $t+1$, s_K/k_{t+1}, and the product between the net marginal return of saving (private investment at t), $(1-\tau_{t+1})r_{t+1}$, and the marginal utility of consumption at $t+1$, $(1-s_K-s_E)/c_{t+1}$.

Definition 1 *Given initial values* $k_0, Z_0, E_0 > 0$ *and sequences* $\{\gamma_{Zt}, \gamma_{Et}, Z_{t+1}, E_{t+1}\}_{t=0}^{\infty}$, *a competitive equilibrium is the sequences* $\{c_t, l_t, k_{t+1}\}_{t=0}^{\infty}$ *and* $\{w_t, r_t\}_{t=0}^{\infty}$ *such that:*
(i) $\{l_t, k_t\}_{t=0}^{\infty}$ *is the solution of the profit-maximization program of the competitive firm (P1),*
(ii) $\{c_t, k_{t+1}\}_{t=0}^{\infty}$ *is the solution of the optimization program of the household (P2),*
(iii) $c_t + k_{t+1} = (1-\gamma_{Et}-\gamma_{Zt})\, y_t$, $l_t = 1$, $k_t = K_t$, $y_t = AZ_t^{\alpha}k_t^{1-\alpha}$ *and* $Z_t = \tau_{Z,t-1}(w_{t-1} + r_{t-1}k_{t-1})$.

At the competitive equilibrium, we have

$$c_t = \frac{\beta(1-\alpha)(1-s_K-s_E)}{(1-s_K-s_E)\frac{k_t}{c_{t-1}} - \beta s_K}(1-\gamma_{Zt}-\gamma_{Et})y_t \tag{12}$$

$$k_{t+1} = \left[1 - \frac{\beta(1-\alpha)(1-s_K-s_E)}{(1-s_K-s_E)\frac{k_t}{c_{t-1}} - \beta s_K}\right](1-\gamma_{Zt}-\gamma_{Et})y_t \tag{13}$$

$$Z_{t+1} = \gamma_{Zt} y_t \tag{14}$$

$$E_{t+1} = (1-m)E_t + (a\gamma_{Et} - b)y_t \tag{15}$$

$$\tau_t = \gamma_{Zt} + \gamma_{Et}. \tag{16}$$

3.2 Economic and environmental policies

We now discuss how the government finances environmental protection and public good provision. We recall that γ_{Zt} is the ratio of infrastructure expenditure to income, and γ_{Et} the ratio of environmental expenditure to income. The altruist government faces a trade-off between costs and benefits of increased γ_{Zt} and γ_{Et}. On the one hand, an increase of γ_{Zt} and γ_{Et} at period t will reduce the after-tax income, causing a drop of consumption and private capital accumulation at the same period. It will reduce current utility and future production (and then future income). On the other hand, higher tax rates at t increase public expenditure devoted to environmental protection and public investment, which will consequently foster the future household's utility.

The government's optimization program is as follows

$$\max_{\{\gamma_{Zt},\gamma_{Et}\}} \quad \sum_{t=0}^{\infty} \beta^t \left[(1-s_K-s_E)\ln c_t + s_E \ln E_t + s_K(1-\theta)\ln k_t\right] \tag{P3}$$

subject to

$$\begin{aligned}
c_t &= \frac{\beta(1-\alpha)(1-s_K-s_E)}{(1-s_K-s_E)\frac{k_t}{c_{t-1}} - \beta s_K}(1-\gamma_{Zt}-\gamma_{Et})y_t \\
k_{t+1} &= \left[1 - \frac{\beta(1-\alpha)(1-s_K-s_E)}{(1-s_K-s_E)\frac{k_t}{c_{t-1}} - \beta s_K}\right](1-\gamma_{Zt}-\gamma_{Et})y_t \\
Z_{t+1} &= \gamma_{Zt} y_t \\
E_{t+1} &= (1-m)E_t + (a\gamma_{Et} - b)y_t \\
y_t &= A Z_t^{\alpha} k_t^{1-\alpha},
\end{aligned}$$

k_0, Z_0 and E_0 taken as given, $\gamma_{Zt}, \gamma_{Et} \in [0,1)$, and $\gamma_{Zt} + \gamma_{Et} \in [0,1)$.

Thanks to the logarithm form and the separability of the utility, the choice of tax rates at t is independent of those at $t-1$ and $t+1$. By plugging the constraints into the utility function, the optimization problem is equivalent to

$$\max_{\{\gamma_{Zt},\gamma_{Et}\}} \quad \Omega\left(\gamma_{Zt}, \gamma_{Et}\right),$$

with

$$\begin{aligned}
\Omega\left(\gamma_{Zt}, \gamma_{Et}\right) &= \left[(1+\beta-\alpha\beta)(1-s_K-s_E) + \beta s_K(1-\theta)\right]\ln(1-\gamma_{Zt}-\gamma_{Et}) + \\
&\quad \alpha\beta(1-s_K-s_E)\ln\gamma_{Zt} + \beta s_E \ln\left[(1-m)E_t + (a\gamma_{Et}-b)y_t\right] + \zeta,
\end{aligned}$$

where ζ contains other variables and parameters independent of γ_{Zt} and γ_{Et}. First-order conditions of this program give the following relationship between γ_{Zt} and γ_{Et}:

$$\gamma_{Et} = \frac{s_E \gamma_{Zt}}{\alpha(1 - s_K - s_E)} + \frac{b}{a} - \frac{(1-m)E_t}{a y_t}. \tag{17}$$

Definition 2 *Given initial values $k_0, Z_0, E_0 > 0$, a politico-economic equilibrium is the sequences $\{c_t, l_t, k_{t+1}\}_{t=0}^{\infty}$, $\{w_t, r_t\}_{t=0}^{\infty}$, $\{\gamma_{Zt}, \gamma_{Et}, Z_{t+1}, E_{t+1}\}_{t=0}^{\infty}$ such that*

(i) $\{l_t, k_t\}_{t=0}^{\infty}$ are the values defined at the competitive equilibrium

(ii) $\{\gamma_{Zt}, \gamma_{Et}\}_{t=0}^{\infty}$ is the solution of the voter's optimization program (P3),

(iii) $c_t + k_{t+1} = (1 - \gamma_{Et} - \gamma_{Zt})\, y_t,\ \ l_t = 1,\ k_t = K_t,$

(iv) $Z_{t+1} = \gamma_{Zt} y_t$ and $E_{t+1} = (1-m)E_t + (a\gamma_{Et} - b)y_t$ where $y_t = A Z_t^{\alpha} k_t^{1-\alpha}$.

Result 1: *At the political-economic equilibrium, the public decision is*

$$\gamma_{Et} = \frac{1}{a(X + \beta s_E)} \left[-(1-m)X\frac{E_t}{y_t} + bX + a\beta s_E \right] \tag{18}$$

$$\gamma_{Zt} = \frac{\alpha\beta(1 - s_K - s_E)}{a(X + \beta s_E)} \left[(1-m)\frac{E_t}{y_t} + a - b \right] \tag{19}$$

where

$$X = (1 - s_K - s_E)(1 + \beta) + \beta s_K (1 - \theta). \tag{20}$$

We observe that the ratio of environmental expenditure to income rises with income whereas the ratio of infrastructure expenditure to income decreases with income:

$$\frac{\partial \gamma_{Et}}{\partial y_t} > 0, \frac{\partial \gamma_{Zt}}{\partial y_t} < 0, \text{ and } \frac{\partial \tau_t}{\partial y_t} > 0. \tag{21}$$

Environmental protection (being more important if γ_{Et} is higher) is not a priority in low income countries where most public expenditure is devoted to economic development to the detriment of environmental protection. This result appears particularly consistent with empirical findings. In particular, Pearce and Palmer (2001) found that public environmental expenditure is positively correlated with GDP and that the elasticity of environmental expenditure with respect to GDP is statistically greater than unity.[5] This result also constitutes a plausible explanation of the Wagner's law which states that the ratio of government expenditure to GDP is positively related to GDP per capita.[6] Indeed, even if the infrastructure expenditure ratio decreases when the economy grows, the total public expenditure ratio continues to expand ($\frac{\partial \tau_t}{\partial y_t} > 0$), due to the increase of environmental protection expenditure ($\frac{\partial \gamma_{Et}}{\partial y_t} > 0$).

Another observation is that the environmental expenditure ratio decreases with environmental quality while the infrastructure expenditure ratio rises with environmental quality:

$$\frac{\partial \gamma_{Et}}{\partial E_t} < 0 \text{ and } \frac{\partial \gamma_{Zt}}{\partial E_t} > 0. \tag{22}$$

This is also rather intuitive as one may feel less urgent to improve environmental quality when it is already high. To summarize, an increase of environmental expenditure may be explained either by an increase of income or by an environmental deterioration.

[5] In a similar study, Magnani (2000) found that log of public R&D expenditure per capita is increasing with GDP per capita. However, the author did not compute the elasticity of public R&D expenditure with respect to GDP. Moreover, as underlined by Pearce and Palmer (2001), data used in Magnani (2000) only constitute between 1 and 2 percent of total public environmental expenditure.

[6] Recently, Shelton (2007) looked at cross-country data on public expenditure (defense, education, health care) at different levels (local, central) of government and found a result consistent with Wagner's law. Shelton (2007) explained that Wagner's law may be explained by the redistribution policy in rich countries or by demographic factors. Thus, even if other expenditure declines, richer countries do spend more on social security due to population ageing, resulting in higher total expenditure per capita than in poorer countries.

4 Steady-state analysis

We transform all the variables to make them stationary. From (12) and (13), the ratio capital-consumption is given by:

$$\frac{k_{t+1}}{c_t} = \Psi\left(\frac{k_t}{c_{t-1}}\right).$$

At the steady-state, we obtain

$$\frac{k}{c} = \frac{\beta\left[s_K + (1-\alpha)(1-s_E-s_K)\right]}{(1+\alpha\beta-\beta)}. \tag{23}$$

Current consumption and future private capital can be rewritten as:

$$\begin{aligned} c_t &= \phi(1-\gamma_{Zt}-\tau_{Kt})y_t \\ k_{t+1} &= (1-\phi)(1-\gamma_{Zt}-\tau_{Kt})y_t \end{aligned}$$

where

$$\phi = \frac{(1-s_K-s_E)(1+\alpha\beta-\beta)}{[(1-s_K-s_E)+\beta s_K]}.$$

Now let us consider the following variables

$$T_{t+1} \equiv \frac{Z_{t+1}}{k_{t+1}} = \frac{\gamma_{Zt}}{(1-\gamma_{Zt}-\gamma_{Et})\left[1-\frac{\beta(1-\alpha)(1-s_K-s_E)}{(1-s_K-s_E)\frac{k_t}{c_{t-1}}-s_K\beta}\right]} \tag{24}$$

$$V_{t+1} \equiv \frac{E_{t+1}}{Z_{t+1}} = \frac{(1-m)E_t}{\gamma_{Zt}y_t} + \frac{a\gamma_{Et}-b}{\gamma_{Zt}} \tag{25}$$

with

$$\frac{E_t}{y_t} = \frac{V_t T_t^{1-\alpha}}{A}.$$

¿From expression of γ_{Et} and γ_{Zt} in (18) and (19), it is straightforward to find that

$$V_t = \frac{a s_E}{\alpha(1-s_K-s_E)}, \quad \forall t. \tag{26}$$

Furthermore, from (18) and (19), we obtain

$$\frac{\gamma_{Zt}}{1-\gamma_{Zt}-\gamma_{Et}} = \frac{\alpha\beta(1-s_K-s_E)}{X-\alpha\beta(1-s_K-s_E)}. \tag{27}$$

Combining this expression with (24), it is found that T_{t+1} only depends on k_t/c_{t-1}, which is constant at the steady-state (see equation (23)). Hence, the value of T is

$$T = \frac{\alpha(1 - s_K - s_E)\left[\beta s_K + 1 - s_K - s_E\right]}{\left[X - \alpha\beta(1 - s_K - s_E)\right]\left[(1-\alpha)(1 - s_E) + \alpha s_K\right]}. \tag{28}$$

At the steady-state, all variables (consumption, private capital, public capital, and environmental quality) grow at the same rate. We obtain the following result:

Result 2. *The ratio of infrastructure expenditure to income and the ratio of environmental expenditure to income are respectively given by*

$$\gamma_Z = \frac{\alpha\beta(1 - s_K - s_E)}{a(X + \beta s_E)}\left[(1-m)\frac{VT^{1-\alpha}}{A} + a - b\right], \tag{29}$$

$$\gamma_E = \frac{1}{a(X + \beta s_E)}\left[-(1-m)\frac{XVT^{1-\alpha}}{A} + bX + a\beta s_E\right], \tag{30}$$

where X, V, and T are given in (20), (26), and (28) respectively.

This result can be better understood with a numerical exercise. For this purpose, we use the following parameter values: $\alpha = 0.7$, $A = 5$, $\beta = 0.8$, $\theta = 0.5$, $a = 1$, and $b = 0.2$. The results are displayed in Figures 1 to 3. We analyze how status concern (measured by s_K) and environmental concern (s_E) affect public decisions. Effects of s_K on γ_Z, γ_E, τ, and g are computed by fixing s_E at an arbitrary value, here we choose $s_E = 0.2$. And vice versa, we choose $s_K = 0.2$ when studying the effects of s_E.[7]

We observe that status-seeking behavior (s_K) has two opposite effects on γ_E (Figure 1a). On the one hand, a stronger status concern implies lower total public expenditure (i.e. smaller τ) and then lower environmental protection expenditure. On the other hand, the government is aware that a stronger status concern will foster an excessive capital wealth accumulation and then degrade the environment. Hence, the government will raise environmental expenditure (i.e. higher γ_E) to counterbalance this degradation. This

[7]The results remain very similar when s_E and s_K are fixed at other values.

result is compatible with that found in the previous section concerning the allocation of tax revenue at the competitive equilibrium, according to which a higher public investment will be associated with a higher environmental protection (see equation (17)). When status concern is weak, the positive effect dominates, i.e. γ_E is higher. On the contrary, when status concern becomes sufficiently strong, environmental protection receives a lower priority than wealth accumulation, yielding a smaller γ_E.

The relationship between γ_E and s_E is also non monotonous as described in Figure 1b. Actually, an increase of s_E, representing the weight of environmental preference, has two opposite effects on γ_E. It raises the ratio of environmental expenditure γ_E (direct effect). Simultaneously, it diminishes the ratio of infrastructure expenditure γ_Z, which reduces production and environmental degradation. Consequently, environmental protection becomes less urgent, resulting in a lower value of γ_E (indirect effect). The increasing part of the curve γ_E corresponds to the situation where the direct effect dominates the indirect one.

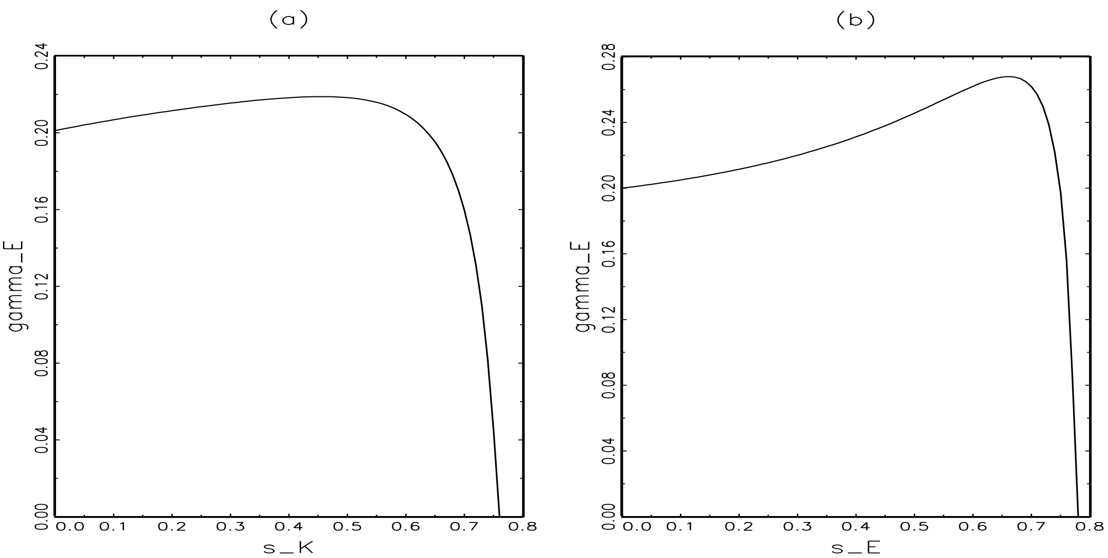

Figure 1: Impacts of status and environmental concerns on environmental expenditure.

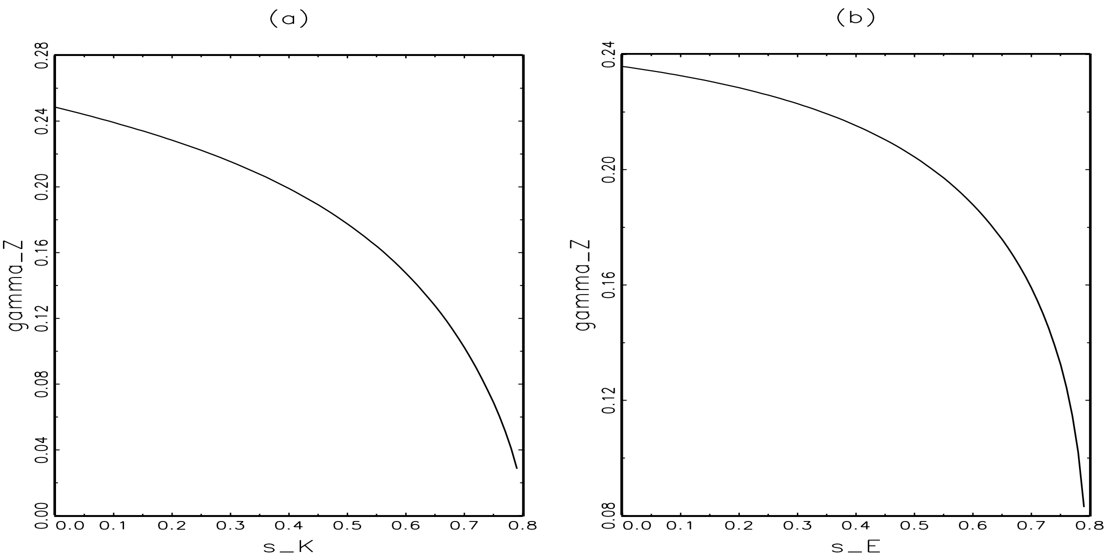

Figure 2: Impacts of status and environmental concerns on infrastructure expenditure.

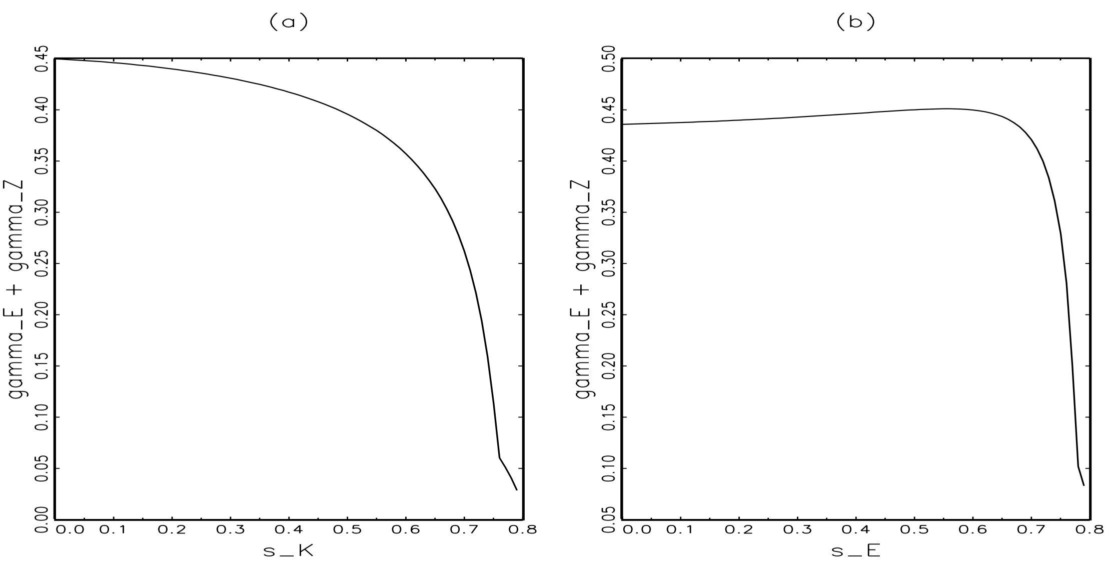

Figure 3: Impacts of status and environmental concerns on the overall public expenditure.

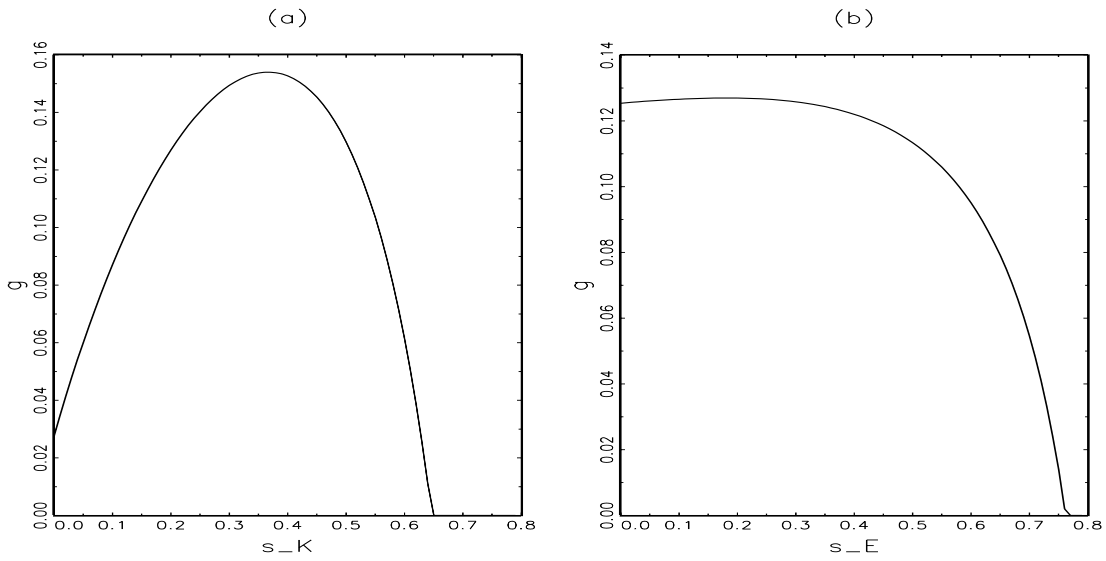

Figure 4: Impacts of status and environmental concerns on the growth rate.

Figures 2 and 3 illustrate the evolution of public expenditure with respect to changes in status and environmental concerns given other parameters. Status-seeking behavior exerts a negative effect on infrastructure expenditure (Figure 2a). Indeed, other things being equal, a higher value of s_K corresponds to a higher utility derived from social status compared to the utility derived from consumption and that from environmental quality. This implies a higher capital wealth accumulation to the detriment of consumption, of overall public expenditure (Figure 3a) and, particularly, of infrastructure expenditure. This explanation is also valid for the negative effect of s_E on infrastructure expenditure (Figure 2b).

While Economides and Philippopoulos (2008) predicted a negative relationship between environmental concern and the ratio of overall expenditure to income, our model provides rather a non-monotonous relationship (Figure 3b). Actually, the impact of environmental concern (s_E) on the overall public expenditure (τ) depends on the positive effect of s_E on γ_E and the negative effect of s_E on γ_Z. It is positive when the former effect dominates the latter.

Result 3. *The long-run growth rate of the economy is*

$$g = \ln A + \ln \gamma_Z - (1-\alpha)\ln T, \tag{31}$$

where T is given in (28).

We observe that the relationship between the growth rate (g) and status motive (s_K) has an inverted-U shaped form. Our finding is different from most existing studies which found that status-seeking exerts a positive effect on the growth rate (see, e.g., Rauscher 1997, Corneo and Jeanne 1997, 2001b). Their result may be explained by the fact that, in their models, status concern is directed toward a producible asset (i.e. capital wealth). Therefore, individuals are encouraged to invest in wealth accumulation in order to acquire a higher social status as in our model. However, our paper adds another effect, i.e. the negative effect on growth of status preferences *via* tax rates. Indeed, when economic policy is welfare-maximizing, a stronger status-seeking motive has a negative effect on public investment ($\partial\gamma_Z/\partial s_K < 0$, see Figure 3b), generating a lower output. This effect will dominate the positive one when the status-seeking motive is strong enough, giving the decreasing part of the curve g in Figure 4a.[8]

Economides and Philippopoulos (2008) underlined that when agents care about the environment, this requires extra revenue for a cleanup policy which can only be achieved by a large tax base and a high growth rate. Our model gives the same prediction when environmental concern is relatively not important. The increasing part of g in Figure 4b may be explained by the fact that an increase of s_E may imply a consumption concern

[8] We note that with exogenous policies, the growth rate of the economy is given by $\bar{g} = \ln A + (1-\alpha)\ln\pi + \alpha\ln\gamma_Z + (1-\alpha)\ln(1-\gamma_Z-\gamma_E)$, where $\pi = \frac{\beta[(1-\alpha)(1-s_E)+\alpha s_K]}{1-s_K-s_E+\beta s_K}$. In this case, the relationship between status preference and growth rate is positive.

$(1 - s_K - s_E)$ relatively lower than the status concern. In this case, agents may be more willing to accumulate capital wealth than to consume, which induces higher growth. Taking preferences for environmental quality into account may yield an allocation of tax revenue in favor of a cleanup policy to the detriment of infrastructure. This choice is not necessarily harmful for economic growth as growth is partly explained by an excessive accumulation of capital wealth for higher status. However, when environmental concern is very high, agents may privilege environmental expenditure rather than infrastructure, providing a lower growth rate (see the decreasing part of curve g in Figure 4b).

We turn now to the link between individual lifetime utility and sustainable growth. This relationship has received particular attention from numerous works in the literature. For example, Ng (2008) proposed an 'environmentally responsible happy nation index' that accounts for a measure of happiness and a global environment impact of the economy. Other authors explored the relationship between proxies of happiness and various measures of sustainable growth and environmental quality (e.g., Bonini 2008, Engelbrecht 2008, Zidanšek 2007). In particular, Zidanšek (2007) suggested a possibility of improving happiness and sustainability simultaneously.[9] Here, we find a similar result when economic growth is not high enough. Let us note that

$$\ln x_t = \ln x_0 + gt, \quad x = c, k, E, \forall\, t > 0,$$

where $c_0 = (1 - \gamma_Z - \gamma_E)y_0 - k_1 = (1 - \gamma_Z - \gamma_E)y_0 - k_0 e^g$ and $y_0 = AZ_0^{\alpha} k_0^{1-\alpha}$. The lifetime

[9]Zidanšek (2007) investigated the relationship between three measures of happiness and two environmental sustainability indicators and found a causal link in both direction, i.e. happier agents care about the environment and a better environment makes them happy.

utility of the household is

$$\begin{aligned} U &= [(1-s_K-s_E)\ln c_0]\sum_{t=0}^{\infty}\beta^t + [s_K(1-\theta)\ln k_0 + s_E \ln E_0]\sum_{t=0}^{\infty}\beta^t + (1-s_K\theta)g\sum_{t=0}^{\infty}\beta^t t \\ &= \frac{(1-s_E-s_K)\ln\left[(1-\gamma_Z-\gamma_E)y_0 - k_0 e^g\right]}{1-\beta} + \frac{(1-s_K\theta)\ln k_0 + s_E \ln E_0}{1-\beta} + \frac{(1-s_K\theta)\,\beta g}{(1-\beta)^2}. \end{aligned}$$

Result 4. *The relationship between the individual's utility and the growth rate has an inverted-U shaped form instead of a monotonous form as in the case without status. In other words, we have*

$$\frac{\partial U}{\partial g} \gtrless 0 \ \Leftrightarrow g \lesseqgtr \hat{g},$$

where

$$\hat{g} = \ln\left[(1-s_K\theta)(1-\gamma_Z-\gamma_E)\beta y_0\right] - \ln\left[(1-\beta)(1-s_E-s_K) + \beta(1-s_K\theta)\right] k_0.$$

Even if economic growth is consistent with environmental preservation, it is not necessarily welfare-improving as in the case of absence of status-seeking behavior. There is a compatibility between environmental preservation, economic growth and individual welfare when the growth rate is smaller than threshold value $\hat{g}$, i.e. growth is only welfare-improving when it is low enough.

Remark that empirical findings in the life satisfaction literature, which underlined the absence of a positive correlation between individual life satisfaction and income (Easterlin 1974, 1995, Oswald 1997, among others) appear consistent with the result above. In particular, Easterlin (1974), based on US data from 1946 to 1970, found that the average level of American well-being did not significantly improve during the post-war decades where rapid economic growth was observed. In another study, Easterlin (1995) took up this question again and gave a negative answer to the question *'Will raising the income* *of all increase the happiness of all?'*, suggesting that individual's utility depends on her relative income, or her social status. As claimed by Earterlin (1974, 1995), this inverted-U shaped feature supports the idea that relative utility constitutes an explanation of the absence of correlation between welfare and income. This explanation was also attained by de la Croix (1998) but in a different theoretical setting where environmental quality is neglected.

5 Concluding remarks

We study in this paper the consequences of status and environmental externalities on public decision regarding environmental protection and infrastructure. We find that accounting for preferences for social status and environmental quality may lead to an allocation of tax revenue in favor of a cleanup effort to the detriment of infrastructure. However, economic growth is not necessarily reduced by this choice as it is partly explained by an excessive accumulation of capital wealth due to the quest for status. Status concern may be harmful for economic growth and environmental quality when its motive is important enough. These results suggest that individual preferences should be considered as a possible explanation of the trade-off between economic and environmental policies. They can also explain the observed cross-country heterogeneity of the government size and of the growth rate. We also show that economic growth is consistent with environmental preservation but it is not necessarily welfare-improving as in the case of absence of status-seeking behavior. This result is consistent with empirical findings in the life satisfaction literature, which underlined the absence of a positive correlation between individual life satisfaction and income.

Our results require some empirical investigation in a future work. The theoretical model deserves further analysis with a more general framework with, for example, a nonseparable utility function. It would be also interesting to address the status-seeking behavior in a model with heterogenous agents where the question of social mobility is included.

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