Status Effects, Public Goods Provision, and the Excess Burden

Wendner, Ronald and Goulder, Lawrence H.

Graz University, Austria, Stanford University, U.S.A.

2008

Status Effects, Public Goods Provision, and the Excess Burden*

Ronald Wendner [a]
Lawrence H. Goulder[b]

[a] *Corresponding Author*
Department of Economics, University of Graz
Universitaetsstrasse 15, RESOWI-F4, A-8010 Graz, Austria

E-mail	ronald.wendner@uni–graz.at
Web	http://www.uni-graz.at/ronald.wendner
Phone	+43 316 380 3458, Fax +43 316 380 9520

[b] Department of Economics, Stanford University
Landau Economics Building, Stanford, CA 94305-6072, U.S.A.

E-mail	goulder@stanford.edu
Web	http://www.stanford.edu/∼goulder
Phone	+1 650-723-3706

Keywords and Phrases: status effects, excess burden, deadweight loss, public goods provision, corrective taxation, consumption externality, first best, second best.

JEL Classification Numbers: D62, H23, H41

*We thank Alan Auerbach, Olof Johansson-Stenman, Claus Thustrup Kreiner, Erzo Luttmer, Ian Parry, Peter Birch Soerensen, Rob Williams and two referees for significant comments on a former version of this paper. We are also grateful to participants of the following workshops and conferences for providing useful suggestions: 7$^{\text{th}}$ International CEPET Workshop, Udine, Italy (June 16–18, 2004), PET05 Meeting, Marseille, France (June 16–18, 2005), 62$^{\text{nd}}$ Congress of the International Institute of Public Finance, Paphos, Cyprus (August 28–31, 2006), EPRU Seminar, University of Copenhagen (May 12, 2007).

Abstract

Most studies of the optimal provision of public goods or the excess burden from taxation assume that individual utility is independent of other individuals' consumption. This paper investigates public good provision and excess burden in a model that allows for interdependence in consumption in the form of status (relative consumption) effects. In the presence of such effects, consumption and labor taxes no longer are pure distortionary taxes but have a corrective tax element that addresses an externality from consumption. As a result, the marginal excess burden of consumption taxes is lower than in the absence of status effects, and will be negative if the consumption tax rate is below the "Pigouvian" rate. Correspondingly, when consumption or labor tax rates are below the Pigouvian rate, the second-best level of public goods provision is above the first-best level, contrary to findings from models without status effects. For plausible functional forms and parameters relating to status effects, the marginal excess burden from existing U.S. labor taxes is substantially lower than in most prior studies, and is negative in some cases.

1 Introduction

Most analyses of optimal provision of public goods or of the excess burden of taxation regard individual utility as depending directly on one's own consumption and leisure. However, utility can depend directly on the consumption or income of others. Several studies have explored the significance of this interdependence in consumption. The earliest work tended to be theoretical. For example, almost 30 years ago Boskin and Sheshinski (1978) and Layard (1980) explored theoretically how optimal redistributive taxation is affected when individual utility depends on one's relative income or consumption. Recently, a number of studies have aimed to assess empirically the extent to which individual utility depends on others' consumption or income. In particular, several studies have sought to determine the strength of a particular form of interdependence here termed the *status effect* – the utility-impact of one's consumption *relative* to others' consumption.[1] Such studies can be divided into two categories: studies based on survey-experimental methods, and studies based on econometric analyses of panel data on individuals' incomes and self reported happiness. Studies falling into the former category include Alpizar et al. (2005), Carlsson *et al.* (2003), Johansson-Stenman *et al.* (2002, 2006), Solnick and Hemenway (1998, 2005). Studies in the latter category include Ferrer-i-Carbonell (2005), Luttmer (2005), McBride (2001), and Neumark *et al.* (1998).

[1]The concern for one's economic status relative to that of others is sometimes termed a "positional concern." (See, for example, Alpizar *et al.* (2005), Brekke and Howarth (2002), Hirsch (1976), Frank (1985, 1999), Solnick and Hemenway (2005).) The status effects discussed in this paper derive from a particular positional concern: namely, the concern for one's own consumption relative to others'.

Prior theoretical and empirical studies have shed important light on the implications of status effects for happiness (Easterlin 1995, Frank 1985, Frank 1999, Scitovsky 1976), economic growth (Abel 2005, Brekke and Howarth 2002, Carroll *et al.* 1997, Liu and Turnovsky 2005), asset pricing (Abel 1990, 1999, Campbell and Cochrane 1999, Dupor and Liu 2003), optimal tax policy over the business cycle (Ljungqvist and Uhlig 2000), and optimal redistributive taxation (Boskin and Sheshinski 1978).

Status effects also have important implications for the excess burden of taxation and the optimal provision of public goods. Although other authors have examined this point[2], we know of no prior study that rigorously analyzes how status effects influence the excess burden and the optimal first-best and second-best levels of public goods provision. This is the focus of the present paper. We develop a theoretical model to examine optimal public goods provision and excess burden in the presence of status effects. In addition, we incorporate recent estimates of status effects in the model to explore their quantitative implications for excess burden.

Status effects imply that an individual's increase in consumption imposes a negative externality on other individuals by reducing others' relative economic position. Under these conditions, a consumption or labor tax functions both as a device for raising revenue and as an instrument for correcting the negative consumption externality. This paper's analytical framework recognizes these two aspects of consumption and labor taxes and demonstrates rigorously the idea, suggested in prior literature, that status effects lower the marginal excess burden from labor and consumption taxes. In addition, the

[2]Important references include Howarth (1996), Ng (1987), Ng and Wang (1993).

paper offers three other main results related to status effects.

First, the sign of the marginal excess burden from a consumption (labor) tax depends on the magnitude of the tax relative to the marginal consumption externality. If the consumption tax rate equals the "Pigouvian" rate (marginal external cost), the marginal excess burden from the tax is zero. The marginal excess burden is negative (positive) if the tax rate is below (above) the Pigouvian rate.

Second, if the second-best optimum involves consumption tax rates above (below) the corrective rate, the marginal excess burden of the tax is positive (negative) and the second-best optimal level of public goods provision is below (above) the first-best level.

Finally, empirical evidence suggests that status effects are large enough to imply a marginal excess burden of consumption (labor) taxes significantly lower than the value obtained in studies that assume no such effects. Indeed, the marginal excess burden is negative in some plausible cases.

Our paper is related as follows to the prior literature on excess burden and public goods provision. Applying a general framework similar to that in Gronberg and Liu (2001), it extends the discussion of the the first-best and second-best levels of optimal public goods provision (Atkinson and Stern (1974), Bartolomé (2001), Batina and Ihori (2005), Chang (2000), Diamond and Mirrlees (1971), Gaube (2000, 2005), Gronberg and Liu (2001), King (1986), Stiglitz and Dasgupta (1971), Wildasin (1984), Wilson (1991a, 1991b)).

These papers demonstrate that in important cases the second-best level of public good provision is below the first-best level, as suggested by Pigou

(1947). However, they show that Pigou's idea was not fully general, as they present exceptions to the classic second-best results, where the second-best level of the public good is greater than the first-best level.

The exceptions center upon three arguments. First, public goods may have desirable consequences for the income distribution (King 1986, Batina 1990, Gaube 2000). Second, complementarities between the public good and a taxed private good may rise public spending beyond the first-best level (Diamond and Mirrlees 1971, Atkinson and Stern 1974, King 1986, Batina 1990). Third, a rise in public goods provision lowers the excess burden, as a larger portion of resources is transferred from the distorted private sector to the undistorted (controlled) public sector (Wilson 1991b).[3]

All of these effects may lower the social marginal cost of a public good. The lowering of the social cost, in turn, potentially gives rise to the case where the second-best level of the public good is greater than the first-best level. Sufficient conditions for such an exception to occur are discussed in Chang (2000)[4] and Gaube (2000, 2005).

Our paper also contributes to the literature on optimal taxation in the presence of externalities. Status effects imply that an individual's consumption generates negative externalities by lowering others' relative consumption. We derive optimal consumption taxes in the presence of this externality, in first-best and second-best settings. In some respects our approach resem-

[3]A different counterexample to the classic second-best ordering is provided by Gronberg and Liu (2001), who present a case where indifference curves exhibit a kink at the equilibrium, and consumers must be taxed to be induced to consume at this kink.

[4]Chang (2000) carefully develops relationships between the *rule issue* (which considers the question whether the social marginal cost of a public good is higher or lower than its production cost) and the *level issue* (which relates to the question whether the second-best level of the public good is lower or greater than the first-best level).

bles the seminal work of Sandmo (1975), who derived the optimal first- and second-best taxes when production or consumption of one of the goods involves an externality. However, in contrast with Sandmo's analysis our paper considers not only optimal tax rates but also the marginal excess burden of a consumption (or labor) tax, and treats the level of public goods provision as endogenous rather than fixed.[5] We show that status effects unambiguously reduce the excess burden relative to what would be the case if such effects were absent. This confirms an idea suggested informally by Ng (2000, p.263).

Section 2 of the paper presents the model. Section 3 considers optimal tax rates in the presence of status effects, first-best, and second-best allocations. Section 4 discusses the impact of status effects on the excess burden. Section 5 establishes the relationship between the level of the consumption tax rate, the sign of the marginal excess burden, and the relation of the first-best to the second-best level of public goods provision. Section 6 incorporates empirical information from other studies on the strength of status effects to suggest the quantitative implications of such effects for public good provision and excess burden. Section 7 offers conclusions. The appendix provides proofs for all propositions.

2 The Economy

We consider an economy with $N > 0$ consumers (households), two private commodities, and a pure public good. The private commodities, a consump-

[5] Also, we focus on a broad-based consumption (or labor) tax, whereas Sandmo focused on the optimal system of differentiated commodity taxes.

tion good and leisure, are respectively denoted by c and l. The public good is denoted by G. A representative household[6] has preferences over consumption (including relative consumption), leisure, and a pure public good. The public good is strictly separable from private goods in the household's utility function U:

$$U = u(c,\, l,\, r;\, \gamma) + g(G;\, \Psi)\,. \tag{1}$$

Subutility $u(c,\, l,\, r;\, \gamma)$ is a function of one's own absolute consumption, c, of leisure, l, and of relative consumption, r:

$$r \equiv \frac{c}{\bar{c}}\,, \tag{2}$$

where $\bar{c}$ denotes *average* consumption of the society. Status effects here are concerns about relative consumption. In this formulation, a change in given individual's consumption affects his utility both directly and by affecting relative consumption. The parameter $\gamma \in [0, 1)$ measures the strength of the impact of relative consumption on individual utility. In particular, γ is chosen so as to represent the *marginal degree of positionality*, i.e., the fraction of the marginal utility of consumption stemming from increased *relative* consumption.[7] If $\gamma > 0$ utility depends positively on relative consumption. For example, if $\gamma = 0.2$, 20% of marginal utility of consumption comes from increased relative consumption, whereas 80% stems from increased absolute consumption (holding fixed the level of relative consumption).

Various studies indicate that status effects are stronger for consumption goods than for leisure. In particular, Carlsson et al. (2003), Solnick and

[6]The assumption of a representative household implies uniformity of after-tax incomes. Consumption externalities (status effects) arise nevertheless, as discussed below.

[7] The marginal degree of positionality is given by: $\gamma = (\partial\, u(.)/\partial\, r)\,(\partial\, r/\partial\, c)/[(\partial\, u(.)/\partial\, c) + (\partial\, u(.)/\partial\, r)\,(\partial\, r/\partial\, c)]$.

Hemenway (1998), and Solnick and Hemenway (2005), find that leisure time is the least "positional" (that is, has the lowest status effect) of all the goods investigated. As pointed out by Carlsson et al. (2003, p.15), "the marginal degree of positionality for leisure ... is not statistically larger than zero at the 10% levels." In accordance with the empirical evidence, we adopt the simplifying assumption that households care about status with regard to the consumption good, but not with regard to leisure.[8]

The following assumptions are imposed on the subutility function u:[9]

(A.1) $u(c,\, l,\, r;\, \gamma)$ is twice continuously differentiable on $\mathbb{R}^3_+$;

(A.2) $u_i(c,\, l,\, r;\, \gamma) > 0,\ (i = 1,\, 2)$, and $u_3(c,\, l,\, r;\, \gamma) \geq 0$;

(A.3) $u(c,\, l,\, r;\, \gamma)$ and $u(c,\, l,\, 1;\, \gamma)$ are strictly quasiconcave in $(c,\, l)$;

(A.4) $u(c,\, l,\, 1;\, \gamma) = u(c,\, l,\, 1;\, 0)$ is homothetic.

Utility increases in consumption and leisure, according to (A.2). If $\gamma > 0$, utility also rises in relative consumption. Notice that utility grows if in a symmetric allocation ($c = \bar{c}$) both own consumption and average consumption increase by the same amount. That is, $(u_c + u_3\, r_{\bar{c}})|_{c=\bar{c}} = u_1 > 0$. In this situation utility rises by u_1, as relative consumption does not change: $[r_c + r_{\bar{c}}]|_{c=\bar{c}} = 0$.

If $r = 1$, then γ does not affect utility, according to assumption (A.4).

[8] A related concern regards the implicit assumption that all goods generate the *same* status externality per dollar of spending. This is almost certainly not true. However, the general result shown in this paper does not depend on this assumption. The result says that the marginal excess burden is negative when the consumer price of c is below the "corrective" consumer price, in which case the first-best level of the public good is smaller than the second-best level. The relation of first-best to the second-best level of the public goods depends only on the sign of the marginal excess burden, not on the share of consumption activities that yield external effects.

[9] Partial derivatives are denoted as follows: $u_1 \equiv \partial\, u(c,\, l,\, r;\, \gamma)/\partial\, c$ (holding r fixed), $u_2 \equiv \partial\, u(.)/\partial\, l$, $u_3 \equiv \partial\, u(.)/\partial\, r$, $r_c \equiv \partial\, r(.)/\partial\, c$, and $u_c \equiv u_1 + u_3\, r_c$.

This assumption restricts preferences to the class where utility is independent of positional concerns, thereby of γ, only in a *symmetric* allocation ($c = \bar{c}$), in which case the utility function becomes homothetic. The assumption does *not* imply that any equilibrium allocation — not even a *symmetric* equilibrium allocation — is independent of γ. Clearly, any decentralized equilibrium allocation will depend on γ, even if the equilibrium allocation is symmetric, because an individual household considers $\bar{c}$ as given, and has an incentive to consume more than $\bar{c}$ as long as $\gamma > 0$. In a decentralized equilibrium, $r = 1$ (by homogeneity of preferences), thus, demands for c and l, and indirect utility are proportional to income (while necessarily dependent on γ). This allows us to express the excess burden explicitly in terms of indirect utility. Below, we discuss the significance of this assumption further.[10]

The subutility function $g(G;\, \Psi)$ is twice continuously differentiable, increasing, and concave, with $g(G;\, 0) = 0$. The parameter Ψ determines the strength of the household's preference for the public good G. We also assume:

(A.5) $g_{\Psi}(G;\, \Psi) > 0, \;\; g_{G,\Psi}(G;\, \Psi) > 0.$

In Section 5's Figure 1 and in Section 6 we parameterize Ψ as the G-elasticity of utility $g(.)$.

The consumption good as well as the public good are produced by private firms that use labor as the only input. The aggregate production constraint is characterized by a fixed-coefficients transformation function. Without loss of generality, the units of all goods can be normalized such that the marginal

[10] An example satisfying assumptions (A.1) to (A.4) is: $u = [\alpha\, \hat{c}^{\frac{\sigma-1}{\sigma}} + (1-\alpha)\, l^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}}$, where $\hat{c} \equiv c\, r^{\gamma/(1-\gamma)}$.

rates of transformation equal unity:

$$N\,(\omega - l) - C - G = 0\,, \tag{3}$$

where ω is the total amount of time (labor and leisure) available to each household, and C is the total quantity of the consumption good produced.

3 Optimal Tax Rates in the Presence of Status Effects

Here we consider optimal tax rates and first-best and second-best allocations.

3.1 The Planner's Solution

We first use the model to study conditions for social welfare maximization, assuming that social welfare can be evaluated by means of a Benthamite social welfare function:

$$\begin{aligned} W(u^1,\,\cdots,u^N) &= u^1(c,\,l,\,1;\,\gamma) + g^1(G;\,\Psi) + \cdots + u^N(c,\,l,\,1;\,\gamma) + g^N(G;\,\Psi) \\ &= N\,u(c,\,l,\,1;\,\gamma) + N\,g(G;\,\Psi)\,, \end{aligned} \tag{4}$$

where superindex $i \in \{1,...,N\}$ denotes individual households and where the last part of the expression makes use of the assumption of identical utility functions. A social planner, taking fully into account the externality on all households generated by individual consumption — thereby considering $c = \bar{c}$ (or $r = 1$) —, would choose $\{c,\,l,\,G\}$ such as to maximize $W(u^1 \cdots, u^N)$. Since each household has the same preferences, and the welfare function is utilitarian, the optimum will be described by equal treatment: $C = \sum_{i=1}^{N} c_i = N\,c$. Assumption (A.4) implies: $W(u^1 \cdots, u^N) = N\,u(c,\, l,\, 1;\, 0) + N\,g(G;\, \Psi)$. Consumption, leisure, and public goods provision are derived from:

$$\{c,\, l,\, G\} = \arg\max_{c,\, l,\, G} \{W \mid N\,(\omega - l) - N\,c - G = 0\}\,.$$

The *planner's outcome* can be characterized by the following conditions:

$$\frac{u_1}{u_2} = 1\,, \tag{5}$$

$$N\,\frac{g_G(G;\Psi)}{u_2} = 1\,, \tag{6}$$

$$c(\omega - G/N) + l(\omega - G/N) = \omega - G/N\,, \tag{7}$$

where $u_i \equiv u_i(c(\omega - G/N),\, l(\omega - G/N),\, 1; 0)$, $i = 1, 2$. Equation (5) states that the marginal rate of substitution of consumption for leisure equals the marginal rate of transformation (unity). In (5), the social planner takes the consumption externality into account. Equation (6) is the Samuelson rule for optimal public goods supply, requiring the equality between the sum (over all households) of the marginal rate of substitution of the public good for leisure and the marginal rate of transformation (unity). Equation (7) restates the resource constraint.

Notice that assumption (A.4) implies that c and l are independent of γ in the planner's outcome. The planner implements a symmetric allocation, because preferences are assumed to be homogeneous across households. Therefore, by (A.4), the optimal allocation $\{c,\, l,\, G\}$ is not affected by γ. This facilitates the following analysis. The market outcome, however, *is* affected by γ, as individual households assume $\bar{c}$ to be fixed and not to be equal to their individual consumptions, regardless of their respective consumption choice. The distortion from the consumption externality increases in γ and so does the optimal tax, as will be shown below.

3.2 Optimal Taxes in a Market Economy

Next, we characterize market equilibria with taxes and transfers.[11] The wage rate (numeraire) is set equal to one.[12] The consumer price of the private good (in terms of hours of work) is $q = 1/(1-\tau)$, where τ is the consumption tax rate. A lump-sum tax (transfer) is denoted by t.

As the public good enters the individual utility functions in a weakly separable way, the optimization problem can be solved on two levels by embedding a household problem within the government's problem (see, for example, Barten and Boehm 1982, p.400).

3.2.1 First-Best Solution

The government can achieve the first-best if it has a lump-sum tax as well as the consumption tax as instruments. A household's budget constraint is $\omega - t - q\,c - l = 0$. Because the public good enters the utility function U in a separable way, the Marshallian demands of c and l are independent of G.

The household's problem consists of choosing respectively c and l:

$$\{c,\, l\} \equiv \arg\max_{c,\, l}\{u(c,\, l,\, r;\, \gamma)\ |\omega - t - q\,c - l = 0\}\,.$$

[11] Denote exogenously given producer prices of c and G by $(p,\, p_G)$. By our normalization, $(p,\, p_G) = (1, 1)$.

[12] The problem can be equivalently restated with a wage tax instead of a consumption tax. Common practice in the literature, however, is to adopt the commodity taxation model in which labor (leisure) is taken to be the numeraire. See, e.g., Atkinson and Stern (1974), Gronberg and Liu (2001), Stiglitz and Dasgupta (1971).

The first-order condition for the market outcome is:

$$\frac{u_c}{u_2} = \frac{u_1 + u_3\, r_c}{u_2} = q\,. \tag{8}$$

Let v denote the indirect utility function. The resulting Marshallian demand and indirect utility functions are:

$$c = c(q,\, \omega - t,\, \bar{c};\, \gamma)\,, \quad l = l(q,\, \omega - t,\, \bar{c};\, \gamma)\,, \quad v = v(q,\, \omega - t,\, \bar{c};\, \gamma)\,,$$

where $(\omega - t)$ is the net full income (after-tax value of the labor endowment) of a household.[13]

Ex post solutions. Since preferences and endowments of all households are equal, the equal treatment property holds ex post (in equilibrium), and $c = \bar{c}$. Note that even though the market outcome will involve equality between $\bar{c}$ and c, the household regards c as its choice variable (and thus endogenous), while considering $\bar{c}$ as exogenous. Let a tilde denote *ex post solutions*: that is, $\tilde{c}(q,\, \omega - t;\, \gamma)$ is the solution to $c - c(q,\, \omega - t,\, c;\, \gamma) = 0$, and $\tilde{l}(q,\, \omega - t;\, \gamma) = l(q,\, \omega - t,\, \tilde{c}(q,\, \omega - t;\, \gamma);\, \gamma)$. Ex post (equilibrium) solutions can then be written as:

$$\tilde{c} = \tilde{c}(q,\, \omega - t;\, \gamma)\,, \quad \tilde{l} = \tilde{l}(q,\, \omega - t;\, \gamma)\,, \quad \tilde{v} = \tilde{v}(q,\, \omega - t;\, \gamma)\,.$$

Let P and M respectively signify the planner's and the market outcome. The corrective (Pigouvian) consumption tax rate, $\hat{\tau}$, is:

$$\hat{\tau} \equiv \frac{u_3\, r_c}{u_1 + u_3\, r_c}|_M = \gamma\,. \tag{9}$$

[13] The demand functions explicitly depend on $\bar{c}$, as $r_c = 1/\bar{c}$ enters the first order condition (8).

Several remarks are in order.[14] First, the corrective tax rate amounts to the marginal social damage of an extra unit of consumption (by a household). To see this, we express the corrective tax rate as:

$$\begin{aligned}\hat{\tau} &= -\sum_{i=1}^{N} \frac{u^i_{\bar{c}}}{u^i_c} \frac{\partial \bar{c}}{\partial c^j}|_{c=\bar{c}} = -\sum_{i=1}^{N} \frac{u^i_{\bar{c}}}{u^i_c} \frac{1}{N}|_{c=\bar{c}} = -\frac{u_{\bar{c}}}{u_c}|_{c=\bar{c}} = -\frac{u_3\, r_{\bar{c}}}{u_c}|_{c=\bar{c}} \\ &= \frac{u_3\, r_c}{u_1 + u_3\, r_c} = \gamma\,,\end{aligned}$$

where i, j are indexes referring to individual households. A marginal increase in household j's consumption implies an increase in $\bar{c}$ by $1/N$ units. The social damage from this increase is equal to the sum over all households of the marginal willingnesses to pay $(u_{\bar{c}}/u_c)$ for avoiding this rise in $\bar{c}$.

Second, the corrective tax rate corresponds to the marginal degree of positionality, γ (see footnote 7). The marginal social damage of a household's rise in consumption is given by $u_3\, r_{\bar{c}}$. In equilibrium, $c = \bar{c}$, and $-r_{\bar{c}}|_{c=\bar{c}} = r_c|_{c=\bar{c}} = 1/c$. Therefore, the numerator of the tax term, $-u_3\, r_{\bar{c}}|_{c=\bar{c}}$, equals the numerator of the term for the marginal degree of positionality, $u_3\, r_c|_{c=\bar{c}}$. As the denominators of both terms are equal as well, $\hat{\tau} = \gamma$.

Third, the corrective consumer price becomes: $\hat{q} \equiv 1/(1-\hat{\tau}) = (u_1 + u_3\, r_c)/(u_1)|_M$. For $\gamma = 0$ we have $u_3 = 0$ (i.e., relative consumption does not affect individual utility), in which case $\hat{\tau} = 0$, and $\hat{q} = 1$. The corrective consumer price is independent of the household's income. From (A.4), $u(\tilde{c}(q, \omega - t; \gamma), \tilde{l}(q, \omega - t; \gamma), 1; \gamma) = (\omega - t)\, u(\tilde{c}(q, 1; \gamma), \tilde{l}(q, 1; \gamma), 1; \gamma)$. Thus, the marginal rate of substitution $u_3(.)/u_1(.)$ is independent of $(\omega - t)$. It is

[14] As pointed out by a referee, it is important to note that the assumption of a unique value of γ across households has significant implications for the Pigouvian tax rate. Suppose there were several groups of households with differing degrees of positionality. Then the first-best commodity tax rate would need to be conditioned on the γ-characteristic of a household. Such a consumption program is not likely to be feasible in practice.

important to note that the Pigouvian tax is also independent of the level of tax revenue. That is, $\hat{q}$ is not a function of q. This simplifies the calculation of the optimal tax program.

In the first-best case (with a lump-sum tax available), the government sets $\tau = \hat{\tau}$: that is, it sets the consumption tax equal to the *corrective consumption tax rate*. The government's problem is to choose optimal values for t and G:

$$\{t,\, G\} \equiv \arg\max_{t,\, G}\{\tilde{v}(\hat{q},\, \omega - t;\, \gamma) + g(G;\, \Psi)\,|N\,t + N\,(\hat{q}-1)\,\tilde{c}(\hat{q},\, \omega - t;\, \gamma) = G\}\,.$$

The resulting Samuelson condition is

$$N\,\frac{g_G(G;\Psi)}{u_2} = 1\,, \tag{10}$$

which, together with the government budget constraint, yields

$$N\,t + N\,(\hat{q}-1)\,\tilde{c}(\hat{q},\, \omega - t;\, \gamma) = G\,, \tag{11}$$

the first best level of public goods provision, G^*, and the optimal lump-sum tax (transfer), t^*.[15] It holds that $N\,t^* + N\,(\hat{q}-1)\,\tilde{c}(\hat{q},\, \omega - t^*;\, \gamma) = G^*$. In the first best case, the government sets the consumption tax rate equal to $\hat{\tau}$, and the level of public goods provision equal to G^*.

Consider the special case where the revenues from corrective consumption taxation exactly equal the necessary revenue to make up for the first-best level of public goods provision. In this case $t^* = 0$ and $G^* = N\,\omega\,(1-\zeta)$, where

[15] First order condition (10), which can equivalently be written as

$$\frac{\tilde{v}(\hat{q},\, 1;\, \gamma)}{N\,[1-(\hat{q}-1)\,\tilde{c}(\hat{q},\, 1;\, \gamma)]} = g_G(G;\Psi)\,, \tag{10'}$$

is derived in the appendix.

$\zeta \equiv [1 - (\hat{q} - 1)\,\tilde{c}(\hat{q}, 1; \gamma)]$ is the share of income net of corrective taxation to full income (ω). More generally, if revenues from corrective consumption taxation fall short of (exceed) the revenue needed for the first-best level of public goods provision, then $t^* > 0$ ($t^* < 0$).

The conditions characterizing the market outcome in the first-best case are the two first order conditions (8), (10), the government budget constraint (11), and the household budget constraint:

$$\hat{q}\,\tilde{c}(\hat{q},\, \omega - t;\, \gamma) + \tilde{l}(\hat{q},\, \omega - t;\, \gamma) = \omega - t\,. \tag{12}$$

Lemma 1 *The market economy can be induced to attain the first-best marginal rate of substitution of consumption for leisure,* (5)*, by implementing the corrective tax* $\hat{\tau}$*.*
By implementing the corrective tax $\hat{\tau}$*,* and *considering the government budget constraint,* $N\,t^* + N\,(\hat{q} - 1)\,\tilde{c}(\hat{q},\, \omega - t^*;\, \gamma) = G^*$*, the market economy can be induced to attain the first-best optimal allocation* $\{c,\, l,\, G\}$*, as characterized by conditions* (5) *to* (7)*.*

Lemma 1, whose proof is given in the appendix, shows that $\{\hat{\tau},\, t^*\}$, as defined for the government's problem above, represents the first-best policy. It is worth noting that Lemma 1 implies:

$$\frac{u_1}{u_2}|_M \lesseqgtr 1 \Leftrightarrow q \lesseqgtr \hat{q}\,.$$

To see this, consider first $q = \hat{q}$. In this case, $(u_1)/(u_2)|_M = (u_1)/(u_2)|_P = 1$, where the first equality follows from Lemma 1 and the second equality is due to first order condition (5). In words: The marginal rate of substitution of consumption for labor equals the marginal rate of transformation. As $q = \hat{q}$, the rates in the market outcome equal those in the planner's outcome. A rise in q lowers the consumption-leisure-ratio, and thereby raises $(u_1)/(u_2)|_M$. Thus, if $q > \hat{q}$, $(u_1)/(u_2)|_M > 1$. Similarly, if $q < \hat{q}$, $(u_1)/(u_2)|_M < 1$.

3.2.2 Second-Best Solution

In the second-best case, no lump-sum taxes (or transfers) are available. The only revenue instrument available to the government is a consumption tax. With a consumption tax in place, the household's problem becomes:

$$\{c,\, l\} \equiv \arg\max_{c,\, l}\{u(c,\, l,\, r;\, \gamma)\ |\omega - q\, c - l = 0\}\,.$$

For a given tax rate τ, the conditions describing a second-best equilibrium are:

$$\frac{u_1 + u_3\, r_c}{u_2} = q\,, \tag{13}$$

$$\omega - q\, c - l = 0\,. \tag{14}$$

The resulting Marshallian *ex post* demand and indirect utility functions are:

$$\tilde{c} = \tilde{c}(q,\, \omega;\, \gamma)\,, \quad \tilde{l} = \tilde{l}(q,\, \omega;\, \gamma)\,, \quad \tilde{v} = \tilde{v}(q,\, \omega;\, \gamma)\,.$$

As the utility function is separable, the demand functions are independent of G.

The government's problem in the second-best case consists of choosing $\{\tau,\, G\}$ or, equivalently, $\{q,\, G\}$:

$$\{q,\, G\} \equiv \arg\max_{q,\, G}\{\tilde{v}(q,\, \omega;\, \gamma) + g(G;\, \Psi)\, |N\, (q-1)\, \tilde{c}(q,\, \omega;\, \gamma) = G\}\,.$$

The resulting second-best level of public goods provision is denoted G^{**}. The level of G^{**} is determined by the following first-order condition:

$$N\, g_G(G^{**}, \Psi)\, R_q(q, \omega; \gamma)\, dq = -\tilde{v}_q(q, \omega; \gamma)\, dq\,, \tag{15}$$

where $R_q(q, \omega; \gamma) = \tilde{c}(q, \omega; \gamma) + (q - 1)\tilde{c}_q(q, \omega; \gamma)$ is the change in revenue due to a marginal increase in the consumption tax rate. To interpret condition (15), note the following. A marginal increase of the tax rate raises revenue (thus the level of public goods) by R_q. Thus the marginal utility of the increase in G financed by a marginal increase of the tax rate is given by $N\, g_G(.)\, R_q(.)$. The right-hand side of (15) represents the loss in utility when the consumption tax rate is marginally raised. The increase of q by dq is equivalent (in terms of utility) to a decline in income by both the tax revenue and the associated excess burden: $dR + dEB$. The excess burden, in turn, will be lower than in models without status effects, for reasons given in the following section. As the public good benefits all households, first-order condition (15) requires the marginal benefit to society of an increase of the public good stemming from a marginal rise of the tax rate to be equal to every household's loss in marginal utility due to the marginal rise of the tax rate.[16]

4 Excess Burden and Status Effects

In this section we show that status effects reduce the excess burden of a consumption tax. Moreover, the marginal excess burden is negative (positive) when $q < \hat{q}$ (when $q > \hat{q}$). Here we consider the excess burden associated

[16]Similar to Sandmo (1975), the second best tax rate on c is equal to $\tau^{**} = (1 - \mu)(-\varepsilon_{qc}^{-1}) + \mu[u_3\, r_c/(u_1 + u_3\, r_c)]$, where $\mu = \lambda/\beta$, λ is the marginal utility of income, and β is the marginal benefit to society of an increase of the public good. The first best and second best levels of τ coincide if and only if $\lambda = \beta = N\, g_G(G; \Psi) \Leftrightarrow u_2 = N\, g_G(G; \Psi)$, which corresponds to (10) above. In this case $\mu = 1$, and $\tau^{**} = \hat{\tau}$.

with a given magnitude of the status effect (as measured by γ) and a given consumption tax rate, τ (or corresponding q). Here we apply arbitrary values for τ: Section 5 will examine optimal second-best levels for τ and the public good.

Definition 1 *The excess burden, EB, of a tax is the difference between the negative of the equivalent variation and the tax revenue collected.*

Thus, the excess burden is the loss to the private sector over and above the revenue collected by the tax.

The marginal excess burden (MEB) measures the change in the excess burden per marginal unit of tax revenue.

Definition 2 *The marginal excess burden is defined as*
$MEB(q,\, \omega;\, \gamma) \equiv d\, EB(q,\, \omega;\, \gamma)/d\, R(q,\, \omega;\, \gamma)$.

Throughout the rest of the paper, we employ the following additional assumption:

(A.6) $d\,R(q,\, \omega;\, \gamma)/d\,q > 0$.

That is, the tax revenue is increasing in q, so we consider the increasing part of the Laffer curve. By (A.6), the sign of the MEB equals the sign of $d\,EB/d\,q$.[17]

In the absence of status effects, the excess burden is implicitly defined by: $v(1, \omega - EB - R; 0) = v(q, \omega; 0)$, where $R = (q-1)\,\tilde{c}(q, \omega; 0)$. With the externality, the excess burden is the difference between the negative of the

[17] As $R_q(q) > 0$, we can express q as a function of R: $q = q(R)$, with $q'(R) = 1/R'(q) > 0$ by the Inverse Function Rule. Thus, $MEB = EB_R = EB_q\, q'(R) = EB_q/R'(q)$.

equivalent variation and the *net* tax revenue collected, *when the Pigouvian tax is initially set to correct for the externality*:

$$\tilde{v}(\hat{q},\, \omega - EB - (R - \hat{R});\, \gamma) = \tilde{v}(q,\, \omega;\, \gamma)\,. \tag{16}$$

Two remarks are in order. First, the excess burden is zero when the tax is set to correct the externality: $q = \hat{q}$. Second, with $q = \hat{q}$, the government receives "corrective" revenue $\hat{R} = (\hat{q} - 1)\tilde{c}(\hat{q}, \omega - EB - (R - \hat{R}); \gamma) \geq 0$. That is, the excess burden at $q > \hat{q}$, is the difference between the equivalent variation and the tax revenue *in excess* of the corrective tax revenue: $(R - \hat{R})$. As shown in the appendix, the excess burden is explicitly given by:

$$\begin{aligned} EB(q,\, \omega;\, \gamma) =& \tilde{v}(q,\, \omega;\, \gamma) \times \\ & [\tilde{c}^h(q, 1;\, \gamma) + \tilde{l}^h(q, 1;\, \gamma) - \tilde{c}^h(\hat{q}, 1;\, \gamma) - \tilde{l}^h(\hat{q}, 1;\, \gamma)]\,, \end{aligned} \tag{17}$$

where superscript h denotes Hicksian (compensated) demands. Clearly, the excess burden is nonnegative: $EB(q,\, \omega;\, \gamma) \geq 0$, and $EB(\hat{q},\, \omega;\, \gamma) = 0$. The equality is seen immediately in (17). The inequality becomes obvious when we consider Lemma 1, which implies $[1 - u_1/u_2] \lesseqqgtr 0 \Leftrightarrow q \gtreqqless \hat{q}$:

$$\begin{aligned} & d/d\,q\,[\tilde{c}^h(q, 1;\, \gamma) + \tilde{l}^h(q, 1;\, \gamma)] = \tilde{c}^h_q + \tilde{l}^h_q = \tilde{c}^h_q - u_1/u_2\, \tilde{c}^h_q \\ & = \tilde{c}^h_q\,(1 - u_1/u_2) \gtreqqless 0 \Leftrightarrow q \gtreqqless \hat{q}\,. \end{aligned}$$

Therefore $EB(q,\, \omega;\, \gamma)$ is nonnegative throughout. Intuitively, if $\tau < \hat{\tau}$, the tax system is characterized by a Pigouvian tax plus a distortionary subsidy. If, however, $\tau > \hat{\tau}$, the tax system is characterized by a Pigouvian tax plus a distortionary tax. In both cases, the distortion leads to a positive excess burden.

Proposition 1 *Holding the consumption tax rate constant and if $q > \hat{q}$, the excess burden is lower, the stronger are status effects.*

Status effects lower the excess burden associated with a given consumption (labor) tax rate. In particular, the excess burden is lower in an economy with status effects ($\gamma > 0$) than in an economy without status effects ($\gamma = 0$). The reason is that the tax corrects for the negative externality associated with consumption, which worsens the relative position of other individuals. The externality-correcting feature of the tax yields an improvement in allocative efficiency. Thus, the tax implies a lower excess burden than would have resulted without status effects.

Proposition 2 *The marginal excess burden is negative (positive) for tax rates below (above) the corrective tax rate, that is, for $q < \hat{q}$ ($q > \hat{q}$).*

(The proof is in the appendix.) The consumption externality introduces the possibility of a negative excess burden. If $q < \hat{q}$, the tax system is characterized by a Pigouvian tax plus a distortionary subsidy. A rise in the consumption tax rate lowers the distortionary subsidy (thus, implying a negative marginal excess burden).[18]

[18]If $q > \hat{q}$, the marginal excess burden is strictly positive. As shown in the proof, differentiability assumption (A.1) plays an important role for demonstrating this result. As a particular case, the marginal excess burden is positive (for $q > \hat{q}$) for the class of CES utility functions, as was previously shown by Wilson (1991a). A counterexample is given by Gronberg and Liu (2001). In their example, however, indifference curves exhibit a kink, that is, $u(.)$ is *not* twice continuously differentiable, as is required by (A.1).

5 Preferences, Excess Burden and Optimal Public Goods Provision

We now examine how preferences for the public good, along with the strength of status effects, influence the second-best consumption tax rate, its excess burden, and the relation of first-best to the second-best level of public goods provision. We proceed in two steps. First, we show that in the second-best setting, the sign of the marginal excess burden of the consumption tax is positive (negative) when the second-best level of public goods provision is below (above) the first-best level. Second, we indicate the effects of the two exogenous preference parameters γ and Ψ on the relation between the first-best and the second-best consumption tax rates.

Step 1. We first consider, in the second-best setting, the relation of first-best to the second-best level of public goods provision and the sign of the marginal excess burden (irrespective of the values of the exogenous parameters γ and Ψ).

Proposition 3 *In the model with status effects, the second-best level of provision of a public good falls short of the first-best level if and only if the sign of the marginal excess burden is positive.*

The proof of Proposition 3 (see the appendix) shows the following first order conditions of the government's problems in the first-best and second-best cases:

$$g_G(G^*; \Psi) = \frac{\tilde{v}(\hat{q},\, 1;\, \gamma)}{N\left[1-(\hat{q}-1)\,\tilde{c}(\hat{q},\, 1;\, \gamma)\right]}\,,$$

$$g_G(G^{**}; \Psi) = \frac{\tilde{v}(\hat{q},\, 1;\, \gamma)}{N\left[1-(\hat{q}-1)\,\tilde{c}(\hat{q},\, 1;\, \gamma)\right]}\left[1+MEB(q,\, \omega;\, \gamma)\right].$$

These expressions indicate that the second-best level of provision of public goods *exceeds* the first-best level if the sign of the marginal excess burden is negative.[19] For an economy *with* (status) externalities, Proposition 2 indicates that the second-best level of provision of public goods exceeds the first-best level ($G^{**} > G^{*}$) if $q < \hat{q}$. Likewise, the second-best level of provision of public goods is lower than the first-best level if $q > \hat{q}$ (in case $MEB > 0$).

Step 2. Here, we consider the impact of the two exogenous parameters γ and Ψ on the relation between the first-best and the second-best consumption tax rates. The relation between the first-best and the second-best consumption tax rates determines the sign of the marginal excess burden (Proposition 2), which determines the relationship between the first-best and second-best levels of public goods provision (Proposition 3).

The parameter γ determines the first-best consumption tax rate, $\hat{\tau}$. According to (9), $\hat{\tau}(0) = 0$, and $\hat{\tau}(\gamma)$ is rising in γ and independent of Ψ. That is, every exogenously given value of γ gives rise to a unique $\hat{\tau}(\gamma)$.[20]

The parameter Ψ (strength of preference for G), determines the demand for the public good. The second-best tax rate (tax revenue) needed to finance the public good increases in Ψ. Let $\tau(\Psi)$ stand for the second-best consumption tax rate. Then, $\tau(0) = 0$, and $\tau(\Psi)$ is rising in Ψ.

The key issue is whether Pigouvian taxation generates enough revenue to meet the demand for the public good or not. If, for a given value of Ψ, Pigouvian taxation generates revenue that exactly meets the demand for the

[19] For an economy without externalities, this result was previously shown by Gronberg and Liu (2001).

[20] For the employed preferences in this paper, this is trivially true, as $\hat{\tau} = \gamma$.

public good, the marginal excess burden is zero, and the second-best public good level is equal to the first-best level. However, if, for a given value of Ψ, Pigouvian taxation generates revenue less than (in excess of) the demand for the public good, the marginal excess burden is positive (negative), and the second-best public good level falls short of (exceeds) the first-best level.

In other words, any exogenously given value of γ implies a specific value for $\hat{\tau}(\gamma)$. Given this value for γ, there exists a unique value of Ψ, such that $\tau(\Psi) = \hat{\tau}(\gamma)$. For any lower Ψ, $\tau(\Psi) < \hat{\tau}(\gamma)$; likewise, for any higher Ψ, $\tau(\Psi) > \hat{\tau}(\gamma)$.

The stronger the preference for the public good (the higher the Ψ), the higher is the second-best tax rate (revenue) needed to finance the public good. The stronger the preference for status (the higher the γ), the higher is the Pigouvian tax rate. Clearly, there exist parameter-pairs of γ and Ψ, such that $\tau(\Psi) = \hat{\tau}(\gamma)$, or $q = \hat{q}$. For all such pairs, the marginal excess burden equals zero. In Figure 1 below, all such parameter-pairs are represented by the "$\Psi(\gamma)|_{MEB=0}$-curve" in (γ, Ψ) space.

Proposition 4 *In (γ, Ψ) space, the $\Psi(\gamma)|_{MEB=0}$-curve has a positive slope. Moreover, $\Psi(0)|_{MEB=0} = 0$. Along this curve, $G^* = G^{**}$. For all (γ, Ψ) pairs above this curve, $MEB > 0$, and $G^* > G^{**}$. For all (γ, Ψ) pairs below this curve, $MEB < 0$, and $G^* < G^{**}$.*

[Figure 1 about here]

Figure 1 illustrates the results of this section.[21] It shows that along the $\Psi(\gamma)|_{MEB=0}$-curve, $\tau = \hat{\tau}$, or $q = \hat{q}$ (by Proposition 2), and $G^* = G^{**}$ (by Proposition 3), as the Pigouvian taxation generates revenue that exactly meets the first-best (second-best) level of the public good. The $\Psi(\gamma)|_{MEB=0}$-curve has a positive slope, as a higher γ implies a higher Pigouvian tax rate, and therefore allows for a higher level of revenues (a stronger preference for public goods, Ψ). Thus, the larger the strength of status effects, the larger is the range of tax rates for which the marginal excess burden is negative. In the region above the $\Psi(\gamma)|_{MEB=0}$-curve, $q > \hat{q}$, and the sign of the marginal excess burden is positive. However, by Proposition 1, the excess burden is smaller compared to an economy without status effects. In the region below the $\Psi(\gamma)|_{MEB=0}$-curve, $q < \hat{q}$, and the sign of the marginal excess burden is negative.

If $q < \hat{q}$, according to Proposition 2, $G^{**} > G^*$, which is contrary to Pigou's conjecture that the second-best level of public good would be below the first-best level. If $q > \hat{q}$, Pigou's conjecture holds. Finally, if $q = \hat{q}$, the marginal excess burden equals zero, and $G^{**} = G^*$.

Marginal Excess Burden and Marginal Cost of Public Funds

Thus far, we expressed our results by making use of the marginal excess burden concept. The results can also be expressed in terms of the marginal cost of public funds, as we show here.

The marginal cost of funds (MCF) is the private sector utility loss from

[21] Figure 1 is based on a CES utility function: $u = [\alpha\, \hat{c}^{(\sigma-1)/\sigma} + \beta\, l^{(\sigma-1)/\sigma}]^{\sigma/(\sigma-1)} + G^{\Psi}$, where $\hat{c} \equiv c\,(c/\bar{c})^{\gamma/(1-\gamma)}$. The parameters are assigned the following values: $\omega = 1$, $\alpha = 1$, $\beta = 1.5$, $\sigma = 2$. Numerical experimentation shows that the $\Psi(\gamma)|_{MEB=0}$-curve is not sensitive with respect to changes in these parameter values.

an incremental tax increase, when the revenue is not returned to the private sector. Following Bartolomé (1999), we measure the welfare loss by the compensating variation. We then establish the following relationship between the marginal cost of funds (as measured by the compensating variation) and the marginal excess burden (the derivation is given in the appendix):

$$\frac{\tilde{v}(\hat{q},1;\gamma)}{\tilde{v}(q,1;\gamma)}\,\frac{(1+MEB)}{\zeta} = MCF\,, \tag{18}$$

where $\zeta \equiv [1-(\hat{q}-1)\,\tilde{c}(\hat{q},1;\gamma)]$, $0<\zeta\leq 1$. Specifically, if $\gamma=0$, $\zeta=1$.

Several remarks are in order. First, MCF is not generally equal to $(1+MEB)$. Even if $\gamma=0$, $MCF \neq (1+MEB)$.

Second, if $q=\hat{q}$, $MEB=0$, and $MCF=1/\zeta$. As the marginal excess burden is zero, $G^{**}=G^{*}$, according to Proposition 3. Equation (18) then shows that public projects should be pursued up to the point where the marginal benefit of a public project (MBP) equals $1/\zeta$.

Third, suppose $q>\hat{q}$. Then $MCF>1/\zeta$, as $\tilde{v}(\hat{q},1;\gamma)/\tilde{v}(q,1;\gamma)>1$, and $MEB>0$ (by Proposition 2). That is, MCF is increasing in q, and, for a given MBP schedule[22], fewer projects pass the marginal cost to benefit test. Hence, G must be lower as compared to the case where $q=\hat{q}$. This conclusion corresponds to Proposition 3 that shows that the second-best level of provision of a public good falls short of the first-best level if $MEB>0$. Similar reasoning holds for the case $q<\hat{q}$.

Fourth, the expression for the marginal (efficiency) cost of funds in (36) corresponds to Slemrod and Yitzhaki (2001, p.192). This becomes obvious when applying Roy's identity. For $\gamma=0$, the numerator (at the right hand

[22]Notice that the marginal benefits are given by: $MBP = N\,g_G(G;\Psi)$ and are independent of q and γ.

side) becomes $\tilde{c}(q, \omega; \gamma)$, which yields equation [7] in Slemrod and Yitzhaki (2001). Furthermore, the MCF can be written as: $MCF = [1 - |\varepsilon_{\tilde{c},q}| (q - 1)/q]^{-1}$, where $\varepsilon_{\tilde{c},q}$ represents the price elasticity of consumption demand. An increase in γ lowers the elasticity and, thereby, the marginal cost of funds: $MCF(\gamma) > MCF(\gamma')$, for $\gamma < \gamma'$. As the marginal benefit of public projects is independent of γ (see footnote 22), the second-best optimal level of public goods rises in γ.

6 Empirical Evidence

In this Section, we provide some evidence about what location in the (γ, Ψ) plane might represent that of a typical industrialized country. Based on the empirical evidence regarding the magnitude of status effects, we suggest that the marginal excess burden lies well below estimates based on the assumption that households do not derive utility from relative consumption. The strength of status effects from various studies suggests that the corrective Pigouvian tax rate on consumption can be as high as 30% or 40%. Since many actual tax rates[23] are below 40 percent, this suggests that in some instances the marginal excess burden of labor taxes may well be negative.

[23] That is, the consumption tax rates equivalent to existing labor taxes and consumption taxes combined.

6.1 Relative Income and Consumption

Many studies provide empirical evidence supporting the importance of relative consumption (or relative income) for deriving utility.[24] A typical finding is that an increase in neighbors' earnings and a similarly sized decrease in own income each lead to a reduction in happiness of about the same order (Luttmer, 2005). Another aspect pointed out by various studies is that positional concerns (status effects) might be smaller at low income levels than at high income levels. McBride (2001), for example, uses an econometric approach to find significant evidence in support of the importance of relative income, however, the impact of relative income on assessments of subjective well-being is smaller for households with low income levels. While this evidence is supported by Solnick and Hemenway (2005), Johansson-Stenman et al. (2002) do not find evidence for stronger status effects at higher income levels (see Table 1).

6.2 Empirical values for the status parameter

The studies employing survey-experimental methods generally confront an individual with two states of the world, state A, and state R. These states differ with respect to two dimensions: absolute income (consumption) of the individual, and income (consumption) of the individual relative to average income (consumption). In state A, an individual is better off in $a$bsolute terms, compared to the other state. However, relative income (consumption)

[24] Important references include Alpizar et al. (2005), Carlsson et al. (2003), Ferrer-i-Carbonell (2005), Johansson-Stenman et al. (2002), Johansson-Stenman et al. (2006), Luttmer (2005), McBride (2001), Neumark et al. (1998), Solnick and Hemenway (1998, 2005).

is smaller compared to state R. In state R, an individual is better off in $r$elative terms.

The subjects are asked to indicate which of the two states they prefer. Solnick and Hemenway (2005) use the following hypothetical situation. In state R, an individual would earn an annual income of \$ 50,000 while a typical member of society would earn an income of \$ 25,000. In state A, the individual would earn an annual income of \$ 100,000 while a typical member of society would earn an income of \$ 200,000. Everything else would be equal in both states. A similar question was posed for higher income values (state R: \$ 200,000 versus \$ 100,000, and state A: \$ 400,000 versus \$ 800,000). Regarding the low-income (high-income) question, 33% (48%) of the respondents preferred state R over state A.

Given two states of the world that differ in absolute and relative income (consumption), the *implicit degree of positionality*, $\bar{\gamma}$, is defined to be that value of γ for which an individual is indifferent between state A and state R: $u_A(.;\bar{\gamma}) = u_R(.;\bar{\gamma})$. If a respondent prefers state R over state A, it must be the case that $u_A(.;\gamma) < u_R(.;\gamma)$, or equivalently, $\gamma > \bar{\gamma}$. Otherwise, if a respondent prefers state A over state R, $\gamma < \bar{\gamma}$.

Given two states of the world that differ in absolute and relative income (consumption), the value of $\bar{\gamma}$ depends on the specification of the utility function. For the estimations of γ shown below, we use the status formulation offered by Dupor and Liu (2003) and consider the following CES utility function:[25]

$$u = [\alpha\, \hat{c}^{(\sigma-1)/\sigma} + \beta\, l^{(\sigma-1)/\sigma}]^{\sigma/(\sigma-1)} + g(G;\Psi)\,, \quad \hat{c} \equiv c^{1/(1-\gamma)}\, \bar{c}^{-\gamma/(1-\gamma)}\,, \quad (19)$$

[25] $\hat{c} = [(c^{\rho} - \gamma\, \bar{c}^{\rho})/(1-\gamma)]^{1/\rho}$, and $\lim_{\rho\to\infty} \hat{c} = c^{1/(1-\gamma)}\, \bar{c}^{-\gamma/(1-\gamma)}$.

where σ denotes the constant elasticity of substitution between $\hat{c}$ and l. As the whole income is consumed, a respondent is equivalent between states A and R if and only if:

$$\begin{aligned}&[\alpha\,(c_A^{1/(1-\gamma)}\,\bar{c}_A^{-\gamma/(1-\gamma)})^{(\sigma-1)/\sigma}+\beta\,l^{(\sigma-1)/\sigma}]^{\sigma/(\sigma-1)}+g(G;\Psi)\\ =&[\alpha\,(c_R^{1/(1-\gamma)}\,\bar{c}_R^{-\gamma/(1-\gamma)})^{(\sigma-1)/\sigma}+\beta\,l^{(\sigma-1)/\sigma}]^{\sigma/(\sigma-1)}+g(G;\Psi)\,,\end{aligned}\tag{20}$$

where subindexes respectively indicate states R and A, and $\bar{c}$ is average consumption. Notice that G and l is the same (and fixed) in both states, by design of the questions in the survey-experimental studies. Thus, (20) is equivalent to:

$$c_A\left(\frac{c_A}{\bar{c}_A}\right)^{\gamma/(1-\gamma)}=c_R\left(\frac{c_R}{\bar{c}_R}\right)^{\gamma/(1-\gamma)}.\tag{21}$$

In the particular example just provided from Solnick and Hemenway (2005), our assumed utility function implies an implicit degree of positionality (in both the low- and the high-income question) of $\bar{\gamma}=1/3$. Thus, regarding the low-income (high-income) question, for 33% (48%) of the respondents, $\gamma>\bar{\gamma}=1/3$.

Most empirical studies employ several R-states that differ in the respective level of $\bar{\gamma}$. We use this information to infer values for γ. We apply two methods: a parametric method (binary probit analysis), and a non-parametric one (Spearman-Karber method). In what follows we briefly describe both methods and present the estimates in Table 1.

Probit analysis. We formulate a random parameter model (see Carlsson *et al.*, 2003) and introduce a stochastic term, ε, reflecting preference uncertainty and choice errors.[26] Specifically,

$$\gamma = \theta + \varepsilon\,, \tag{22}$$

where $\varepsilon \sim N(0, s^2)$ has a Normal distribution, and $E[\gamma] = \theta$. Given two specific states, A and R, the probability, P, of choosing (preferring) state A equals $P[\gamma < \bar{\gamma}] = P[\theta + \varepsilon < \bar{\gamma}] = P[\varepsilon < \bar{\gamma} - \theta]$. Let $F(.)$ be the cumulative distribution function. Then, $P[\varepsilon < \bar{\gamma} - \theta] = F(\beta_0 + \beta_1\,\bar{\gamma})$, where $\beta_0 \equiv -\theta/s$ and $\beta_1 \equiv 1/s$. Parameters β_0 and β_1 are estimated as maximum likelihood estimators of the associated probit model (method A).[27] The mean value of the strength of the status effect is then given by: $E[\gamma] = -\beta_0/\beta_1$.

Spearman-Karber method. The results obtained from the probit analysis can be questioned for their dependence on a particular distributional assumption; namely, the assumption that γ follows a normal distribution. Our second approach employs a non-parametric method in which the distribution of tastes is determined by the data rather than assumed. In particular, we use the non-parametric Spearman-Karber method, which in many cases has been shown to be more powerful than probit analysis for estimating parameters in psychometric functions (Miller and Ulrich, 2001). In Table 1, we also provide Spearman-Karber estimates for $E[\gamma]$, and associated 95% confidence

[26]This approach is similar to the random utility approach.

[27]As seen in Table 1, for some estimates a similar method (method B) is employed. A few empirical studies consider only states associated with a uniform implicit degree of positionality. For these studies, only one parameter can be identified by the log likelihood function. In these cases, we set β_1 (the absolute of the inverse of the standard error of ε) equal to the mean of all other studies' estimates of β_1, and determine β_0 as maximum likelihood estimate (method B). Specifically, we set $\beta_1 = -1.68$. To consider the sensitivity of this assumption, we provide additional estimates when applying method B. We estimate β_0 again under the assumption that β_1 is equal to the mean of estimated values for β_1 (of -1.68) plus one standard deviation, which amounts to a value of -1.226. The estimated values for γ are lower under the assumption that $\beta_1 = -1.226$, as compared to $\beta_1 = -1.68$.

intervals.[28]

Table 1 reports parametric and non-parametric estimates for γ (following the methods described above), based on data of several studies employing survey-experimental methods. The estimates of the mean of γ vary between 0.20 and 0.65. Standard deviations are calculated by the *multiparameter delta method*. The 95 percent confidence intervals are reported in Table 1 in brackets below the estimates of γ.

[Table 1 about here]

According to the estimates presented in Table 1, we consider $\gamma \in [0.2, 0.4]$, a range for the status parameter that is consistent with the existing survey-experimental evidence.

6.3 Status Effects, Corrective Tax Rate, and the Excess Burden

In the following, we compare the marginal excess burden under the assumption that $\gamma = 0$, with that occurring in a situation where $\gamma > 0$, for four parameter sets, which are calibrated as follows.

The calibration is based on utility function (19). First, we fix the share

[28] A detailed description of the approach is offered, e.g., in USEPA (1993). Briefly, mean and variance are calculated as follows. Consider k states A and R such that the associated implicit degrees of positionality are $\bar{\gamma}_0, \bar{\gamma}_1, ..., \bar{\gamma}_i, ..., \bar{\gamma}_k$. Let p_i be the proportion of group i individuals that consider $\gamma < \bar{\gamma}_i$. Make sure that $\bar{\gamma}_0$ and $\bar{\gamma}_k$ are such that $p_0 = 0$ and $p_k = 1$. Then, $E[\gamma] = \sum_{i=1}^{k-1} (p_{i+1} - p_i)(\bar{\gamma}_i + \bar{\gamma}_{i+1})/2$. Let n_i be the number of group i individuals. Then, the variance is calculated as $V[E[\gamma]] = \sum_{i=2}^{k-1} p_i(1 - p_i)(\bar{\gamma}_{i+1} - \bar{\gamma}_{i-1})^2/(4(n_i - 1))$.

of labor supply to full-time labor endowment to 40 percent: $(\omega - l)/\omega = 0.4$. We base our calculations on a full-time labor endowment of 5000 hours a year. A household works for about 2000 hours a year, or about 40 hours per week.[29] Second, we develop four different calibrated data sets according to the compensated elasticity of labor supply (ε_{cL}). Sets **I**A and **I**B employ a more conservative estimate of the compensated elasticity of labor supply of $\varepsilon_{cL} = 0.3$. Sets **II**A and **II**B employ an estimate of $\varepsilon_{cL} = 0.7$. These estimates correspond well with the empirical values reported in Blundell (1992). Third, we distinguish data sets according to the base value of γ. Sets I**A** and II**A** employ $\gamma = 0$, and sets I**B** and II**B** employ $\gamma = 0.3$. Normalizing α to unity, we calibrate values for β and σ for all four parameter sets at $\tau = 0.2$. Those values are shown in Table A.1 in Appendix A.8.

For all four parameter sets — given the respective values for α, β, σ — we consider five values for the status parameter ($\gamma = 0$, 0.1, 0.2, 0.3, 0.4), and four values for the tax rate ($\tau = 0.2$, 0.3, 0.4, 0.5) each, and calculate the marginal excess burden.[30]

For $\gamma = 0$, parameter sets IA and IB (low compensated elasticity of labor supply) imply a marginal excess burden of 7 to 27 cents (depending on the marginal tax rate), which corresponds to estimates offered by Hansson and Stuart (1985). These estimates can be viewed as a lower bound for empirical

[29] Among others, this estimate is used by Auerbach and Kotlikoff (1987) for their analyses of dynamic fiscal policy.

[30] For parameter set IA, $\varepsilon_{cL} = 0.3$ and the labor share equals 0.4 (as calibrated) *only* when $\gamma = 0$ and $\tau = 0.2$. The compensated labor elasticity and the labor share attain slightly different values when $\gamma > 0$ or $\tau > 0.2$. This follows from the fact that the same calibrated values of α, β, σ are applied for *all* calculations of the marginal excess burdens (for *all* considered values of τ and γ), based on parameter set IA. Analogue reasoning holds for the other parameter sets.

estimates of the marginal excess burden. For $\gamma = 0$, parameter sets IIA and IIB (high compensated elasticity of labor supply) imply a marginal excess burden of 17 cents to US$ 1.57, which is more in line with estimates given by Browning (1976) that we view as an upper bound on empirical estimates of the marginal excess burden.[31]

Table 2 presents the marginal excess burdens (in US$) per additional dollar of revenue raised, for four tax rates and several levels of γ.

[Table 2 about here.]

Table 2 shows that for all parameter sets, the marginal excess burden decreases substantially in the status parameter γ. Moreover, it becomes negative, when the actual tax rate falls short of the corrective tax rate.[32]

In view of the uncertainties regarding the values for γ and ε_{cL}, it is not possible to pinpoint the excess burden associated with any given tax rate τ. However, in light of our assessment that γ is likely to fall within the range of .2 to .4, Table 2 suggests that status effects have a significant impact on excess burden. In IA, when the consumption tax rate τ is 0.4, the excess burden is 0.14 when there are no status effects, but falls to 0.08 or 0 when γ is 0.2 or 0.4, respectively. Moreover, the possibility of a negative marginal

[31] In between are most other estimates of the marginal excess burden, including Ballard et al. (1985), or Campbell (1975).

[32] The impact of status effects on the percentage change of the marginal excess burden is not very sensitive to the compensated elasticity of labor supply. All percentage changes derived from Table 2 for $\varepsilon_{cL} = 0.3$ are quite similar to those for $\varepsilon_{cL} = 0.7$.

excess burden cannot be ruled out. In this case, "level reversal" occurs: that is, according to Proposition 3, the second-best level of public goods provision exceeds the first best level.

7 Conclusions

This paper addresses analytically and empirically the implications of status effects for the excess burden of a consumption tax and for the optimal levels of public goods provision.

The analytical framework indicates that the excess burden of a consumption tax is reduced by the status externality, because the tax not only serves a revenue-raising purpose but also an externality-correcting purpose. Moreover, for tax rates below the Pigouvian corrective tax rate, the marginal excess burden becomes negative. A negative marginal excess burden implies that the second-best level of optimal public goods provision exceeds the first-best level.

In our empirical investigation we find that a plausible range for the status parameter γ (the marginal degree of positionality) is between 0.2 to 0.4. When γ is in this range and when utility functions have the CES form, even moderate levels of the status parameter substantially reduce the marginal excess burden. From these results, one cannot rule out the possibility that the marginal excess burden is negative.

The model can be extended to account for other potential interdependencies and related externalities, such as network externalities. Moreover, with minor changes in notation, the model can be applied to a wage tax instead of a consumption tax.

These results raise some general philosophical issues. Even if status effects imply much lower (or negative) excess burdens than would be implied by analyses that assume independent preferences, some might question the normative standing of these results. That is, it could be argued that envy and other concerns about relative position should not form a basis for deciding on tax rates and public good levels. This ethical issue is beyond the scope of this paper. However, we would point out that, to the extent that one puts weight on the criterion of economic efficiency, one seems obliged to take these excess burden results seriously.

We note the following limitations in this analysis. First, households are homogeneous. It would be useful to extend the model to consider cases involving heterogeneous households. In addition, while we have taken some steps toward estimating the magnitude of status effects, considerable scope remains for developing better estimates. Our analysis relied on studies in which individuals merely indicated which of two states is preferred. A great deal more information could be obtained – and estimates of the status parameter could be much improved – if households were asked for preferences across a range of states in which relative and absolute consumption (or income) were varied systematically.

A related issue regards differing marginal degrees of positionality across consumption goods, in which case a uniform broad-based consumption tax would not generate a first-best outcome. One question for future research then is to identify the conditions for which the marginal excess burden is negative.

Notwithstanding these limitations, we hope this study clarifies the impact of status effects on excess burden and public good provision, both theoretically and empirically, and can contribute to future discussions of tax reform and public goods evaluation.

Appendix

A.1 Derivation of FOC (10)**.** By homotheticity (ex post) of preferences, we know that $\tilde{c}(\hat{q},\, \omega - t;\, \gamma) = (\omega - t)\, \tilde{c}(\hat{q},\, 1;\, \gamma)$, $\tilde{l}(\hat{q},\, \omega - t;\, \gamma) = (\omega - t)\, \tilde{l}(\hat{q},\, 1;\, \gamma)$, $\tilde{v}(\hat{q},\, \omega - t;\, \gamma) = (\omega - t)\, \tilde{v}(\hat{q},\, 1;\, \gamma)$. Define $\zeta \equiv [1 - (\hat{q} - 1)\, \tilde{c}(\hat{q},\, 1;\, \gamma)]$. Then the government budget constraint can be written as:

$$t(G) = \frac{G}{N\,\zeta} - \frac{(1-\zeta)}{\zeta}\,\omega\,. \tag{11'}$$

Notice that $t_G \equiv (\partial\, t/\partial\, G) = 1/(N\,\zeta)$.
The government chooses G such as to maximize (indirect) utility:

$$\mathcal{V} = \tilde{v}(\hat{q},\, \omega - t(G);\, \gamma) + g(G;\Psi)\,.$$

Notice that $\partial\, \tilde{v}(\hat{q},\, \omega - t(G);\, \gamma)/\partial\, G = \partial\,(\omega - t(G))\tilde{v}(\hat{q},\, 1;\, \gamma)/\partial\, G = -t_G\, \tilde{v}(\hat{q},\, 1;\, \gamma)$.
Obviously, $\partial\,\mathcal{V}/\partial\, G = 0$ implies (10').
Equivalently, $\mathcal{V} = u(\tilde{c}(\hat{q}, \omega - t(G); \gamma), \tilde{l}(\hat{q}, \omega - t(G); \gamma), 1; \gamma) + g(G;\Psi)$. Differentiation with respect to G yields $\partial\,\mathcal{V}/\partial\, G = -t_G\,[u_1(.)\, \tilde{c}(\hat{q}, 1; \gamma) + u_2\, \tilde{l}(\hat{q}, 1; \gamma)] + g_G(G;\Psi)$. Therefore, $\partial\,\mathcal{V}/\partial\, G = 0$ implies:

$$u_2\, \left[\frac{u_1}{u_2}|_{\{M,\, q=\hat{q}\}}\, \tilde{c}(\hat{q},\, 1;\, \gamma) + \tilde{l}(\hat{q},\, 1;\, \gamma)\right]\, \frac{1}{N\,\zeta} = g_G(G;\, \Psi)\,,$$

which, by Lemma 1 (which is stated after equation (12) in the main text), amounts to

$$u_2\, \left[\tilde{c}(\hat{q},\, 1;\, \gamma) + \tilde{l}(\hat{q},\, 1;\, \gamma)\right]\, \frac{1}{N\,\zeta} = g_G(G;\, \Psi)\,.$$

The household budget constraint together with homotheticity of preferences implies: $\hat{q}\,\tilde{c}(\hat{q},\,1;\,\gamma)+\tilde{l}(\hat{q},\,1;\,\gamma)=1$. Add $[1-\hat{q}\,\tilde{c}(\hat{q},\,1;\,\gamma)-\tilde{l}(\hat{q},\,1;\,\gamma)]$, which equals zero, to the expression in square brackets above:

$$u_2\,[1-(\hat{q}-1)\,\tilde{c}(\hat{q},\,1;\,\gamma)]\,\frac{1}{N\,\zeta}=g_G(G;\,\Psi)\,.$$

Consider the definition of ζ. Then,

$$N\,\frac{g_G(G;\,\Psi)}{u_2}=1\,,$$

which is the first order condition (10).

A.2 Proof of Lemma 1.

The first part of Lemma 1 follows directly from (5), (8), and (9).

Second part of Lemma 1. Conditions (5) – (7) characterize the planner's outcome. We have to show that (8) and (10) – (12) imply (5) – (7). Consider $q=\hat{q}$, and $t=t^*$. Then, we have to prove that the government budget constraint together with the household budget constraint (both at $\tau=\hat{\tau}$ and $t=t^*$) imply the resource constraint. That is[33],

$$\begin{aligned}
&[\omega-t^*=\hat{q}\,\tilde{c}(\hat{q},\,\omega-t^*;\,\gamma)+\tilde{l}(\hat{q},\,\omega-t^*;\,\gamma)] \quad \wedge\\
&[t^*+(\hat{q}-1)\,\tilde{c}(\hat{q},\,\omega-t^*;\,\gamma)=G^*/N] \Rightarrow\\
&[\omega-G^*/N=c(1,\,\omega-G^*/N;\,\gamma)+l(1,\,\omega-G^*/N;\,\gamma)]\,.
\end{aligned}$$

In the household budget constraint, substitute for the first t^*: $t^*=G^*/N-(\hat{q}-1)(\omega-t^*)\,\tilde{c}(\hat{q},\,1;\,\gamma)$. The household budget constraint becomes:

$$\omega-G^*/N=\tilde{c}(\hat{q},\,\omega-t^*;\,\gamma)+\tilde{l}(\hat{q},\,\omega-t^*;\,\gamma)\,.$$

It remains to show that

$$\tilde{c}(\hat{q},\,\omega-t^*;\,\gamma)+\tilde{l}(\hat{q},\,\omega-t^*;\,\gamma)=c(1,\,\omega-G^*/N;\,\gamma)+l(1,\,\omega-G^*/N;\,\gamma)\,.$$

[33] Indeed $c(1,\,\omega-G^*/N;\,\gamma)=c(1,\,\omega-G^*/N;\,0)$, and $l(1,\,\omega-G^*/N;\,\gamma)=l(1,\,\omega-G^*/N;\,0)$, as the planner takes into account that $c=\bar{c}$, prior to calculating optimal demands.

The government budget constraint implies: $\omega - t^* = (\omega - G^*/N)/\zeta$. Therefore, the household budget constraint becomes:

$$\begin{aligned} &\tilde{c}(\hat{q},\, \omega - t^*;\, \gamma) + \tilde{l}(\hat{q},\, \omega - t^*;\, \gamma) = \omega - G^*/N = \zeta\,(\omega - t^*)\,, \quad \text{thus,} \\ &\tilde{c}(\hat{q},\, 1;\, \gamma) + \tilde{l}(\hat{q},\, 1;\, \gamma) = \zeta\,. \end{aligned} \tag{23}$$

Monotonicity assumption (A.2) implies that for all prices and incomes, the budget constraint binds:

$$c(1,\, \zeta;\, \gamma) + l(1,\, \zeta;\, \gamma) = \zeta\,. \tag{24}$$

Equations (23) and (24) together:

$$\begin{aligned} &\tilde{c}(\hat{q},\, 1;\, \gamma) + \tilde{l}(\hat{q},\, 1;\, \gamma) = c(1,\, \zeta;\, \gamma) + l(1,\, \zeta;\, \gamma)\,, \quad \text{or,} \\ &\tilde{c}(\hat{q},\, \omega - t^*;\, \gamma) + \tilde{l}(\hat{q},\, \omega - t^*;\, \gamma) = c(1,\, \zeta\,(\omega - t^*);\, \gamma) + l(1,\, \zeta\,(\omega - t^*);\, \gamma)\,. \end{aligned}$$

As $\zeta\,(\omega - t^*) = (\omega - G^*/N)$:

$$\tilde{c}(\hat{q},\, \omega - t^*;\, \gamma) + \tilde{l}(\hat{q},\, \omega - t^*;\, \gamma) = c(1,\, \omega - G^*/N;\, \gamma) + l(1,\, \omega - G^*/N;\, \gamma)\,.$$

Q.E.D.

A.3 Derivation of the Excess Burden and Expenditure Function. We can (implicitly) define the excess burden by: $\tilde{v}(\hat{q},\, \omega - EB - R^n;\, \gamma) = \tilde{v}(q,\, \omega;\, \gamma)$, where R is consumption tax revenue, R^n (net revenue) denotes the consumption tax revenue collected *in excess* of "corrective tax revenue", $\hat{R}$. Formally, $R^n \equiv R - \hat{R} = (q-1)\,\tilde{c}(q,\, \omega;\, \gamma) - \hat{R}$, where we define $\hat{R}$ as the solution to $\hat{R} - (\hat{q}-1)\,\tilde{c}(\hat{q},\, \omega - R^n - EB;\, \gamma) = 0$.[34] Denote the expenditure function by $e(.)$. Then: $e(\hat{q},\, \tilde{v}(\hat{q},\, \omega - EB - R^n;\, \gamma);\, \gamma) = \omega - EB - R^n$ (important properties of the expenditure function are given below). Taking (16) into consideration,

$$EB(q,\, \omega;\, \gamma) = \omega - e(\hat{q},\, \tilde{v}(q,\, \omega;\, \gamma);\, \gamma) - R^n(q,\, \omega;\, \gamma)\,. \tag{25}$$

[34] It is important to note that the corrective tax revenue, $\hat{R}$ is not independent of q. A rise in q lowers $\tilde{c}(.)$ and thereby the tax revenue collected by the Pigouvian tax.

Next, we rewrite (25), useing the fact that $\tilde{v}(q,\omega;\gamma) = \tilde{v}(\hat{q},\omega - EB - (R - \hat{R});\gamma)$:

$$EB = e(q,\tilde{v}(q,\omega;\gamma);\gamma) - e(\hat{q},\tilde{v}(\hat{q},\omega - EB - R^n;\gamma);\gamma) - (R - \hat{R})\,.$$

Surely, $e(q,\tilde{v}(q,\omega;\gamma);\gamma) = \tilde{v}(q,\omega;\gamma)e(q,1;\gamma) = \tilde{v}(q,\omega;\gamma)[q\,\tilde{c}^h(q,1;\gamma)+\tilde{l}^h(q,1;\gamma)]$, and $e(\hat{q},\tilde{v}(q,\omega;\gamma);\gamma) = \tilde{v}(q,\omega;\gamma)[\hat{q}\,\tilde{c}^h(\hat{q},1;\gamma) + \tilde{l}^h(\hat{q},1;\gamma)]$. Also,

$$\begin{aligned}
&R - \hat{R} = (q-1)\tilde{c}(q,\omega;\gamma) - (\hat{q}-1)\tilde{c}(\hat{q},\omega - EB - (R-\hat{R});\gamma)\\
&= (q-1)\tilde{c}^h(q,\tilde{v}(q,\omega;\gamma);\gamma) - (\hat{q}-1)\tilde{c}^h(\hat{q},\tilde{v}(\hat{q},\omega - EB - (R-\hat{R});\gamma);\gamma)\\
&= \tilde{v}(q,\omega;\gamma)\left[(q-1)\tilde{c}^h(q,1;\gamma) - (\hat{q}-1)\tilde{c}^h(\hat{q},1;\gamma)\right]\,,
\end{aligned}$$

where the last equality uses homogeneity and the relationship $\tilde{v}(q,\omega;\gamma) = \tilde{v}(\hat{q},\omega - EB - (R-\hat{R});\gamma)$. Putting the expressions for $e(q,\tilde{v}(q,\omega;\gamma);\gamma)$, $e(\hat{q},\tilde{v}(q,\omega;\gamma);\gamma)$, and $(R-\hat{R})$ together, yields equation (17).

Lemma 2 (Expenditure Function) *The expenditure function* $e(q,u;\gamma)$ *is:*

(i) *strictly increasing in* u *and* q*,*

(ii) *concave in* q*,*

(iii) *strictly increasing in* γ*.*

Properties (i) and (ii) of the expenditure function are standard properties and they can be derived following the usual approaches in microeconomics textbooks.

Property (iii). Indirect utility decreases in q: $\tilde{v}_q(q,\omega;\gamma) < 0$. Consider $\gamma' > \gamma$. As γ indexes the strength of a *negative* consumption externality: $\tilde{v}(q,\omega;\gamma') < \tilde{v}(q,\omega;\gamma)$. As $\tilde{v}(.)$ is continuous, we can find $q^- < q < q^+$ such that: $\tilde{v}(q,\omega;\gamma') < \tilde{v}(q^-,\omega;\gamma') = \tilde{v}(q^+,\omega;\gamma) < \tilde{v}(q,\omega;\gamma)$. We also observe that $e(q^-, \tilde{v}(q^-, \omega; \gamma'); \gamma') = e(q^+, \tilde{v}(q^+, \omega; \gamma); \gamma) = \omega$. Let $\bar{v} \equiv \tilde{v}(q^-, \omega; \gamma') = \tilde{v}(q^+, \omega; \gamma)$. Then: $e(q, \bar{v}; \gamma') > e(q^-, \bar{v}; \gamma') = e(q^+, \bar{v}; \gamma) > e(q, \bar{v}; \gamma)$. Thus, $e(q, \bar{v}; \gamma') > e(q, \bar{v}; \gamma)$. Q.E.D.

A.4 Proof of Proposition 1. Define $\Delta \equiv [\tilde{c}^h(q, 1; \gamma) + \tilde{l}^h(q, 1; \gamma) - \tilde{c}^h(\hat{q}, 1; \gamma) - \tilde{l}^h(\hat{q}, 1; \gamma)]$. Then, by (17), the excess burden is:

$$EB(q, \omega; \gamma) = \tilde{v}(q, \omega; \gamma)\, \Delta\,, \text{ and}$$
$$\frac{d\, EB(q, \omega; \gamma)}{d\, \gamma} = \tilde{v}_\gamma(q, \omega; \gamma)\, EB(q, \omega; \gamma)/\tilde{v}(q, \omega; \gamma) + \tilde{v}(q, \omega; \gamma)\, \Delta_\gamma\,.$$

As status effects represent a negative externality, $\tilde{v}_\gamma(q, \omega; \gamma) < 0$. Moreover, both the excess burden and indirect utility are nonnegative. The first term on the right hand side is therefore negative. It remains to show that $\Delta_\gamma|_{q>\hat{q}}$ is negative as well. Observe that $\tilde{c}^h_\gamma > 0$, as every consumer needs to rise consumption to keep utility constant at unity. Moreover, $u(\tilde{c}^h(q, 1; \gamma), \tilde{l}^h(q, 1; \gamma), 1; \gamma) \equiv 1$, thus, $u_1/u_2\, \tilde{c}^h_\gamma + \tilde{l}^h_\gamma = 0$. Lemma 1 implies: $u_1/u_2 \gtreqless 1 \Leftrightarrow q \gtreqless \hat{q}$.

$$\begin{aligned}\frac{d\, \Delta}{d\, \gamma} &= \tilde{c}^h_\gamma(q, 1; \gamma) + \tilde{l}^h_\gamma(q, 1; \gamma) = \tilde{c}^h_\gamma(q, 1; \gamma) - \frac{u_1}{u_2}\, \tilde{c}^h_\gamma(q, 1; \gamma)\\ &= \tilde{c}^h_\gamma(q, 1; \gamma)\left(1 - \frac{u_1}{u_2}\right) \gtreqless 0 \Leftrightarrow q \lesseqgtr \hat{q}\,.\end{aligned}$$

Q.E.D.

A.5 Proof of Proposition 2. The sign of the marginal excess burden is equal to the sign of $d\, EB/d\, q$ (see footnote 17). Without loss of generality, we assume: $v(.) > 0$. We distinguish two main cases: $q \leq \hat{q}$ (Case 1), and $q > \hat{q}$ (Case 2). We proceed as follows.
Step 1. Show $MEB \leq 0$ if $q \leq \hat{q}$ (Case 1).
Step 2. Develop a general condition for $MEB > 0$ when $q > \hat{q}$ (Case 2).
Step 3. Show $MEB > 0$ when $q > \hat{q}$.

Step 1. Show $MEB \leq 0$ when $q \leq \hat{q}$.

$$\frac{d\, EB(q, \omega; \gamma)}{d\, q} = \tilde{v}_q(q, \omega; \gamma)\, EB(q, \omega; \gamma)/\tilde{v}(q, \omega; \gamma) + \tilde{v}(q, \omega; \gamma)\, \Delta_q\,,$$

where Δ is defined as in the proof of Proposition 1. Indirect utility is non-increasing in q: $\tilde{v}_q \leq 0$. That is, the first expression on the right hand side above is nonpositive. As $v(.) > 0$, we need to show that $\Delta_q \leq 0$ when $q \leq \hat{q}$.

First, we note that $u(.)$ is twice continuously differentiable and strictly concave. As shown by Dierker (1982, p. 573), it follows that compensated consumption is *strictly* decreasing in q: $\tilde{c}^h_q < 0$. Next, Lemma 1 implies: $u_1/u_2 \gtreqless 1 \Leftrightarrow q \gtreqless \hat{q}$. Therefore, Δ is decreasing in q when $q < \hat{q}$, and it does not change in q if $q = \hat{q}$:

$$\begin{aligned}\Delta_q &= \tilde{c}^h_q(q,1;\gamma) + \tilde{l}^h_q(q,1;\gamma) = \tilde{c}^h_q(q,1;\gamma) - u_1/u_2\, \tilde{c}^h_q(q,1;\gamma) \\ &= \tilde{c}^h_q(q,1;\gamma)\left(1 - \frac{u_1}{u_2}\right) \gtreqless 0 \Leftrightarrow q \gtreqless \hat{q}\,.\end{aligned}$$

Thus, if $q < \hat{q}$, $MEB < 0$. If $q = \hat{q}$, $MEB = 0$, as $EB|_{q=\hat{q}} = 0$.

Step 2. Develop a general condition for $MEB > 0$, when $q > \hat{q}$.

For $q > \hat{q}$, we want to demonstrate that:

$$EB_q = v_q(.)\,\Delta(q) + v(.)\,\Delta_q(q) = v(.)\,\left[\frac{v_q(.)}{v(.)}\Delta(q) + \Delta_q(q)\right] > 0\,.$$

We introduce the *unit* expenditure function: $b(q) \equiv e(q,1;\gamma) = q\,\tilde{c}^h(q,\ 1;\ \gamma) + \tilde{l}^h(q,\ 1;\ \gamma)$. As $e(q, v(q,\omega;\gamma);\gamma) \equiv \omega$, we know that $v(q,\omega;\gamma)\,e(q,1;\gamma) \equiv \omega$ (by homogeneity), thus, $v(q,\omega;\gamma)\,b(q) \equiv \omega$. Therefore, $v_q(q,1;\gamma)\,b(q) + v(q,1;\gamma)\,b'(q) = 0$. From these considerations, it follows that we need to show:

$$-\frac{b'(q)}{b(q)}\Delta(q) + \Delta_q(q) > 0 \Leftrightarrow \frac{b(q)}{q}\,\Delta_q(q) - b'(q)\,\frac{\Delta(q)}{q} > 0\,. \qquad (26)$$

Step 3. Show $MEB > 0$ when $q > \hat{q}$.

(i) As $b(q)$ is strictly concave, it follows that $b(q)/q > b'(q)$. Thus, a *sufficient* condition for (26) to hold is:

$$\frac{d\,\Delta(q)}{d\,q} \geq \frac{\Delta(q)}{q}\,. \qquad (27)$$

Notice that $\Delta(\hat{q}) = 0$, and $\Delta_q(q) > 0$ for all $q > \hat{q}$. At $\hat{q}$:

$$\frac{d\,\Delta(q)}{d\,q} = \frac{\Delta(q) - \Delta(\hat{q})}{q - \hat{q}} = \frac{\Delta(q)}{q - \hat{q}} > \frac{\Delta(q)}{q}\ ,\ \ q > \hat{q}\,. \qquad (28)$$

Thus, the sufficient condition (27) holds and the marginal excess burden is strictly positive when the tax rate is raised from $\hat{q}$ to any $q > \hat{q}$, as claimed in Proposition 2.
(ii) If the tax rate is raised from some $q > \hat{q}$, then the marginal excess burden is positive, if and only if

$$-\varepsilon_{\tilde{c}^h,q} > \frac{q}{q-1} - \varepsilon_{\Delta,q}\left[1 + \frac{\tilde{c}^h(\hat{q}) + \tilde{l}^h(\hat{q})}{(q-1)\tilde{c}^h(q)}\right], \tag{29}$$

$$\text{where } \varepsilon_{\tilde{c}^h,q} \equiv \frac{\tilde{c}^h_q(q)\, q}{\tilde{c}^h(q)}, \quad \varepsilon_{\Delta,q} \equiv \frac{\Delta_q(q)\, q}{\Delta(q)}$$

represent price elasticities. To see this, we observe that $\Delta(q) > 0$ and $b(q) > 0$, and notice that necessary and sufficient condition (26) amounts to: $\Delta_q(q)/\Delta(q) > b'(q)/b(q)$. Considering that $b(q) = \Delta(q) + (q-1)\,\tilde{c}^h(q) + \tilde{c}^h(\hat{q}) + \tilde{l}^h(\hat{q})$, $b'(q) = \Delta_q(q) + (q-1)\tilde{c}^h_q(q) + \tilde{c}^h(q)$, and employing the definitions for the elasticities from above yields inequality (29).

Remark. Elasticity $\varepsilon_{\Delta,q} > 0$, as $\Delta_q(q) > 0$ for all $q > \hat{q}$. In particular, $\lim_{q->\hat{q}} \varepsilon_{\Delta,q} = \lim_{q->\hat{q}} [q\,\Delta_q(q)]/\Delta(q) = \lim_{q->\hat{q}} [q\,\Delta_{q,q}(q)]/\Delta_q(q) = +\infty$. In the derivation, we employ l'Hôpital's rule, as $\hat{q}\,\Delta(\hat{q}) = \Delta_q(\hat{q}) = 0$. The expression in square brackets on the right hand side of the inequality is strictly positive (and exceeds unity). The left hand side of inequality (29) is always strictly positive, whereas the right hand side goes to minus infinity as q approaches $\hat{q}$ (from the right). Thus, inequality (29) necessarily holds not only for $q = \hat{q}$ (see (i) above) but also for q "close" to $\hat{q}$.[35] Q.E.D.

A.6 Proof of Proposition 3. According to (10'), the first best level of public goods provision is given by

$$g_G(G^*;\Psi) = \frac{\tilde{v}(\hat{q},\, 1;\, \gamma)}{N\,\zeta}, \tag{30}$$

[35] "Close" refers to inequality (29) and does *not* mean *small* tax rates.

where ζ is defined as in the derivation of FOC (10) above.

From (16) we know that $\tilde{v}(q,\,\omega;\,\gamma) = \tilde{v}(\hat{q},\,\omega - EB - R + \hat{R};\,\gamma)$. Moreover, $\hat{R} = (\hat{q}-1)\,\tilde{c}(\hat{q},\,\omega - EB - R + \hat{R};\,\gamma) = (\hat{q}-1)(\omega - EB - R)\,\tilde{c}(\hat{q},\,1;\,\gamma) + (\hat{q}-1)\,\hat{R}\,\tilde{c}(\hat{q},\,1;\,\gamma)$ (by homotheticity). Using ζ, $\hat{R} = (1-\zeta)/\zeta\,(\omega - EB - R)$, thus, $(\omega - EB - R) + \hat{R} = (\omega - EB - R)/\zeta$. It follows $\tilde{v}(q,\,\omega;\,\gamma) = \tilde{v}(\hat{q},\,\omega - EB - R;\,\gamma)/\zeta$ (using homotheticity again). The government's problem, in the second-best case, therefore becomes:

$$\{q,\,G\} \equiv \arg\max_{q,\,G}\{\tilde{v}(\hat{q},\,\omega - EB - R;\,\gamma)/\zeta + g(G;\,\Psi)\,|N\,R = G\}\,.$$

Notice that $R_q > 0$ by assumption (A.6), and $MEB = EB_q/R_q$ (see footnote 17). Thus, the government's problem gives rise to the following first order condition:

$$g_G(G^{**};\Psi) = \frac{\tilde{v}(\hat{q},\,1;\,\gamma)}{N\,\zeta}\,[1 + MEB(q,\,\omega;\,\gamma)]\,. \tag{31}$$

From (30) and (31) follows that $G^{**} \gtreqless G^* \Leftrightarrow MEB(q,\,\omega;\,\gamma) \lesseqgtr 0$. Q.E.D.

A.7 Proof of Proposition 4. The first order condition (10') determines the optimal level of public goods provision. Notice that the government budget constraint implies: $(\omega - t^*)\,\zeta = \omega - G^*/N$. Thus, (10') can be written as:

$$\begin{aligned} N\,g_G(G;\,\Psi) &= \frac{\tilde{v}(\hat{q},\,1;\,\gamma)}{\zeta} = \frac{(\omega - t^*)\,\tilde{v}(\hat{q},\,1;\,\gamma)}{(\omega - t^*)\,\zeta} = \frac{\tilde{v}(\hat{q},\,\omega - t^*;\,\gamma)}{\omega - G^*/N} \\ &= \frac{\tilde{v}(1,\,\omega - G^*/N;\,0)}{\omega - G^*/N} = \frac{(\omega - G^*/N)\,\tilde{v}(1,\,1;\,0)}{\omega - G^*/N} = \tilde{v}(1,\,1;\,0)\,. \end{aligned}$$

Observe that the right hand side of the first order condition is independent of both γ and Ψ. Implicit differentiation of the first order condition with respect to Ψ and γ yields:

$$\frac{d\,\Psi}{d\,\gamma}|_{MEB=0} = -\frac{g_{G,G}(G;\,\Psi)\,N\,[R_q|_{q=\hat{q}}\,\hat{q}_\gamma + (\hat{q}-1)\,\tilde{c}_\gamma(\hat{q},\omega;\,\gamma)]}{g_{G,\Psi}(G;\,\Psi)} > 0\,. \tag{32}$$

Observe that $g_{G,G}(G;\,\Psi) < 0$, $g_{G,\Psi}(G;\,\Psi) > 0$ (from (A.5)), $R_q > 0$ (by (A.6)), $\tilde{c}_\gamma > 0$, and the corrective tax rate increases in γ, ($\hat{q}_\gamma > 0$). Thus, $(d\,\Psi)/(d\,\gamma)|_{MEB=0} > 0$. I.e., (32) implicitly defines a relationship: $\Psi = \Psi(\gamma)$. Finally, $\Psi(0) = 0$. Since $MEB = 0$ along the locus $\Psi = \Psi(\gamma)$, we know that

$G^* = G^{**}$. At $\gamma = 0$, $G^* = G^{**} = (\hat{q} - 1)\,\tilde{c}(\hat{q}, \omega;\, 0) = (1-1)\tilde{c}(1, \omega;\, 0) = 0$, which is obviously fulfilled for $\Psi = 0$ only. Q.E.D.

A.8 Benchmark Data.

[Table A.1 here]

A.9 MCF and MEB. We can write (16) as:

$$\tilde{v}(q+dq, \omega; \gamma) = \tilde{v}(\hat{q}, \omega + \hat{R}(q) + d\,\hat{R} - R(q) - d\,R - EB(q) - d\,EB; \gamma)\,. \quad (33)$$

Expanding the left hand side by a Taylor expansion around $(q, \omega; \gamma)$, and the right hand side by a Taylor expansion around $(\hat{q}, \omega + \hat{R} - R - EB; \gamma)$, and approximating to first-order terms, yield:

$$\tilde{v}_q(q, \omega; \gamma) d\,q = -\tilde{v}_\omega(\hat{q}, \omega + \hat{R}(q) - R(q) - EB(q); \gamma)\,(d\,R + d\,EB - d\,\hat{R})\,.$$

As $\hat{R} = (\hat{q} - 1)\tilde{c}(\hat{q}, 1; \gamma)[\omega - EB - (R - \hat{R})]$, it follows: $\hat{R} = (\omega - EB - R)(1 - \zeta)/\zeta$. Therefore, $(d\,EB + d\,R - d\,\hat{R}) = (d\,EB + d\,R)/\zeta$. Recognizing further that $\tilde{v}_\omega(\hat{q}, \omega + R(\hat{q}) - R(q) - EB(q); \gamma) = \tilde{v}(\hat{q}, 1; \gamma)$, and observing that $(d\,R + d\,EB)/d\,R = (1 + MEB)$ we know:

$$\tilde{v}(\hat{q}, 1; \gamma)\,(1 + MEB)/\zeta = -\tilde{v}_q(q, \omega; \gamma)\,/(d\,R/d\,q) \quad (34)$$

If we measure the welfare loss (MCF) by the compensating variation, $d\,\omega$, we note: $\tilde{v}(q, \omega; \gamma) = \tilde{v}(q + d\,q, \omega + d\,\omega; \gamma)$. Expanding the right hand side around $(q, \omega; \gamma)$ and approximating to first-order terms:

$$\tilde{v}(q, \omega; \gamma) = \tilde{v}(q, \omega; \gamma) + \tilde{v}_q(q, \omega; \gamma) d\,q + \tilde{v}_\omega(q, \omega; \gamma) d\,\omega\,. \quad (35)$$

From the government budget constraint it follows that $[1 + \partial\,R/\partial\,G]d\,G = [\partial\,R/\partial\,q]d\,q$. The separability assumption implies: $\partial\,R/\partial\,G = 0$. Therefore,

$d\,q = d\,G/[\partial\,R/\partial\,q]$. Using this equation in (35) and considering $\tilde{v}_\omega(q,\omega;\gamma) = \tilde{v}(q,1;\gamma)$ (by homogeneity) yields:

$$MCF = \frac{d\,\omega}{d\,G} = -\frac{\tilde{v}_q(q,\omega;\gamma)}{\tilde{v}(q,1;\gamma)} \Bigg/ \frac{\partial\,R}{\partial\,q}\,. \tag{36}$$

The MCF is equivalent to the ratio of additional tax revenue that would have been raised if there were no behavioral responses to the actual revenues collected. The difference between numerator and denominator is caused by the substitution effect.

Taking (34) and (36) together gives the relationship between the marginal excess burden and the marginal cost of funds:

$$\frac{\tilde{v}(\hat{q},1;\gamma)}{\tilde{v}(q,1;\gamma)}\,\frac{(1+MEB)}{\zeta} = MCF\,.$$

References

[1] Abel, A.B., 1990. Asset Pricing under Habit Formation and Catching up with the Joneses. American Economic Review 80, 38–42.

[2] Abel, A.B., 1999. Risk Premia and Term Premia in General Equilibrium. Journal of Monetary Economics 43, 3–33.

[3] Abel, A.B., 2005. Optimal Taxation when Consumers have Endogenous Benchmark Levels of Consumption. Review of Economic Studies 72, 21–42.

[4] Alpizar, F., Carlsson, F., Johansson-Stenman, O., 2005. How Much Do We Care About Absolute versus Relative Income and Consumption? Journal of Economic Behavior & Organization 56, 405–421.

[5] Atkinson, A.B., Stern, N.H., 1974. Pigou, Taxation and Public Goods. Review of Economic Studies 41, 119–128.

[6] Barten, A.P., Boehm, V., 1982. Consumer Theory. In: Arrow, K.J., Intrilligator, M.D. (Eds.). Handbook of Mathematical Economics, Vol. II. Amsterdam: North-Holland, 381–429.

[7] Ballard, C.L., Shoven, J.B., Whalley, J., 1985. General Equilibrium Computations of the Marginal Welfare Costs of Taxes in the United States. American Economic Review 75, 128–138.

[8] Bartolomé, C.A.M., 1999. Integrating Tax Distortions and Externality Theory. Journal of Public Economic Theory 1, 339–358.

[9] Bartolomé, C.A.M., 2001. Is Pigou Wrong? Can Distortionary Taxation Cause Public Spending to Exceed the Efficient Level? Mimeo. Colorado: University of Boulder.

[10] Batina, R.G., 1990. On the Interpretation of the Modified Samuelson Rule for Public Goods in Static Models with Heterogeneity. Journal of Public Economics 42, 125–133.

[11] Batina, R.G., Ihori, T., 2005. Public Goods. Theories and Evidence. Berlin et al.: Springer.

[12] Blundell, R., 1992. Labour Supply and Taxation: A Survey. Fiscal Studies 13, 15–40.

[13] Boskin, M.J., Sheshinsky, E., 1978. Optimal Redistributive Taxation When Individual Welfare Depends upon Relative Income. Quarterly Journal of Economics 92, 589–601.

[14] Brekke, K.A., Howarth, R.B., 2002. Status, Growth and the Environment. Goods as Symbols in Applied Welfare Economics. Cheltenham: Edward Elgar.

[15] Browning, E.K., 1976. The Marginal Cost of Public Funds. Journal of Political Economy 84, 283–298.

[16] Campbell, H., 1975. Deadweight Loss and Commodity Taxation in Canada. Canadian Journal of Economics 8, 441–446.

[17] Carlsson, F., Johansson-Stenman, O., Martinsson, P., 2003. Do You Enjoy Having More than Others? Survey Evidence of Positional Goods. Working Papers in Economics 100, Göteborg University, Sweden.

[18] Carroll, C.D., Overland, J., Weil, D.N., 1997. Comparison Utility in a Growth Model. Journal of Economic Growth 2, 339–367.

[19] Chang, M.C., 2000. Rules and Levels in the Provision of Public Goods: The Role of Complementarities between the Public Good and Taxed Commodities. International Tax and Public Finance 7, 83–91.

[20] Diamond, P., Mirrlees, J. 1971. Optimal Taxation and Public Production I and II. American Economic Review 61, 8–27, 261–278.

[21] Dierker, W.E., 1982. Duality Approaches to Microeconomic Theory. In: Arrow, K.J., Intrilligator, M.D. (Eds.). Handbook of Mathematical Economics, Vol. II. Amsterdam: North-Holland, 535–600.

[22] Dupor, B., Liu, W.F., 2003. Jealousy and Equilibrium Overconsumption. American Economic Review 93, 423 – 428.

[23] Easterlin, R.A., 1995. Will Raising the Incomes of All Increase the Happiness of All? Journal of Economic Behavior & Organization 27, 35–47.

[24] Feldstein, M., 1997. How Big Should Government Be? National Tax Journal 50, 197–213.

[25] Ferrer-i-Carbonell, A., 2005. Income and Well-Being: An Empirical Analysis of the Comparison Income Effect. Journal of Public Economics 89, 997–1019.

[26] Frank, R.H., 1985. Choosing the Right Pond. Human Behavior and the Quest for Status. New York: Oxford University Press.

[27] Frank, R.H., 1999. Luxury Fever. Why Money Fails to Satisfy in an Era of Excess. New York: The Free Press.

[28] Gaube, T., 2000. When Do Distortionary Taxes Reduce the Optimal Supply of Public Goods? Journal of Public Economics 76, 151–180.

[29] Gaube, T., 2005. Financing Public Goods with Income Taxation: Provision Rules vs. Provision Level. International Tax and Public Finance 12, 319–334.

[30] Gronberg, T., Liu, L., 2001. The Second-Best Level of a Public Good: An Approach Based on the Marginal Excess Burden. Journal of Public Economic Theory 3, 431 – 453.

[31] Hansson, I., Stuart, C., 1985. Tax Revenue and the Marginal Cost of Public Funds in Sweden. Journal of Public Economics 27, 331–353.

[32] Hirsch, F., 1976. The Social Limits to Growth. Cambridge, Mass.: Harvard University Press.

[33] Johansson-Stenman, O., Martinsson, P., 2006. Honestly, Why are You Driving a BMW? Journal of Economic Behavior & Organization 60, 129–146.

[34] Johansson-Stenman, O., Carlsson, F., Daruvala, D., 2002. Measuring Future Grandparents' Preferences for Equality and Relative Standing. Economic Journal 112, 362–383.

[35] King, M.A., 1986. A Pigouvian Rule for the Optimum Provision of Public Goods. Journal of Public Economics 30, 273–291.

[36] Layard, R., 1980. Human Satisfactions and Public Policy. Economic Journal 90, 737—750.

[37] Layard, R., 2006. Happiness and Public Policy: A Challenge to the Profession. Economic Journal 116, C24–C33.

[38] Liu, W.F., Turnovsky, S.J., 2005. Consumption Externalities, Production Externalities, and Long-Run Macroeconomic Efficiency. Journal of Public Economics 89, 1097–1129.

[39] Luttmer, E.F.P., 2005. Neighbors as Negatives: Relative Earnings and Well-Being, Quarterly Journal of Economics 120, 963–1002.

[40] Miller, J., Ulrich, R., 2001. On the Analysis of Psychometric Functions: The Spearman-Kärber Method. Perception and Psychophysics 63, 1399–1420.

[41] McBride, M., 2001. Relative-Income Effects on Subjective Well-Being in the Cross-Section. Journal of Economic Behavior & Organization 45, 251–278.

[42] Neumark, D., Postlewaite, A., 1998. Relative Income Concerns and the Rise in Married Women's Employment. Journal of Public Economics 70, 157–183.

[43] Ng, Y.K., 1980. Optimal Corrective Taxes or Subsidies when Revenue Raising Imposes an Excess Burden. American Economic Review 70, 744–751.

[44] Ng, Y.K., 1987. Relative-Income Effects and the Appropriate Level of Public Expenditure. Oxford Economic Papers 39, 293–300.

[45] Ng, Y.K., 2000. The Optimal Size of Public Spending and the Distortionary Cost of Taxation. National Tax Journal 53, 253–272.

[46] Ng, Y.K., Wang, J., 1993. Relative Income, Aspiration, Environmental Quality, Individual and Political Myopia. Why May the Rat-Race for Marterial Growth be Welfare-Reducing? Mathematical Social Sciences. 26, 3–23.

[47] Pigou, A., 1947. A Study in Public Finance (3rd edn). London: Macmillan.

[48] Sandmo, A., 1975. Optimal Taxation in the Presence of Externalities. Swedish Journal of Economics 77, 86–98.

[49] Scitovsky, T., 1976. The Joyless Economy. An Investigation intoHuman Satisfaction and Consumer Dissatisfaction. New York: Oxford University Press.

[50] Slemrod, J., Yitzhaki, S., 2001. Integrating Expenditure and Tax Decisions: The Marginal Cost of Funds and the Marginal Benefit of Projects. National Tax Journal 54, 189–201.

[51] Solnick, S.J., Hemenway, D., 1998. Is More Always Better? A Survey on Positional Concerns. Journal of Economic Behavior & Organization 37, 373–383.

[52] Solnick, S.J., Hemenway, D., 2005. Are Positional Concerns Stronger in Some Domains than in Others? American Economic Review 95, 147–151.

[53] Stiglitz, J.E., Dasgupta, P., 1971. Differential Taxation, Public Goods, and Economic Efficiency. Review of Eonomic Studies 38, 151–174.

[54] Wildasin, D.E., 1984. On Public Good Provision with Distortionary Taxation. Economic Inquiry 22, 227–585.

[55] Wilson, J.D., 1991a. Optimal Public Good Provision and the Ramsey Tax Model. Economics Letters 35, 57–61.

[56] Wilson, J.D., 1991b. Optimal Public Good Provision with Limited Lump-Sum Taxation. American Economic Review 81, 153–166.

[57] USEPA, 1993. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms. EPA/600/4-90/027F. Washington: United States Environmental Protection Agency.

TABLE 1
EMPIRICAL ESTIMATES OF STATUS EFFECTS

STUDY	REMARKS	#	METHOD	PROBIT ANALYSIS γ	SPEARMAN-KARBER γ
Alpizar et al. (2005)	7 R-states with differing implicit degrees of positionality ($\bar{\gamma}_i$)	283	A	0.43 (0.37 – 0.48)	0.49 (0.47 – 0.52)
Carlsson et al. (2003)	3 data sets with different $\bar{\gamma}_i$	329	A	0.65 (0.54 – 0.76)	0.53 (0.50 – 0.57)
Johansson-Stenman et al. (2002)	7 different $\bar{\gamma}_i$; low income and high income versions of the questionnaire in addition	356	A	0.36 (0.33 – 0.39)	0.39 (0.37 – 0.41)
	"Low income" sample, same $\bar{\gamma}_i$ as above but lower individual income levels	90	A	0.37 (0.33 – 0.42)	0.37 (0.34 – 0.42)
	"High income" sample, same $\bar{\gamma}_i$ as above but higher individual income levels	90	A	0.22 (0.15 – 0.28)	0.31 (0.27 – 0.35)
Solnick and Hemenway (1998)	1 R state; probit sensitivity (see footnote 27): $E[\gamma] = 0.26$ (0.12 – 0.39)	238	B	0.28 (0.18 – 0.37)	0.23 (0.21 – 0.25)
Solnick and Hemenway (2005)	1 implicit degree of positionality; probit sensitivity (see footnote 27): $E[\gamma] = 0.15$ (0.02 – 0.29)	226	B	0.20 (0.10 – 0.30)	0.21 (0.18 – 0.23)

NOTES.– # refers to the number of respondents. Numbers in brackets below the estimates of $E[\gamma]$ indicate the 95% confidence intervals. $\bar{\gamma}$ is the implicit degree of positionality (γ for which, according to (20), the data yield the same utility for both states A and R).

TABLE 2

MARGINAL EXCESS BURDEN AND STATUS EFFECTS

		Parameter Set IA					Parameter Set IB				
		γ					γ				
		0.0	0.1	0.2	0.3	0.4	0.0	0.1	0.2	0.3	0.4
	0.2	0.07	0.03	0.00	-0.04	-0.08	0.09	0.05	0.00	-0.05	-0.11
τ	0.3	0.10	0.07	0.04	0.00	-0.04	0.15	0.10	0.05	0.00	-0.06
	0.4	0.14	0.11	0.08	0.04	0.00	0.21	0.16	0.11	0.06	0.00
	0.5	0.18	0.15	0.12	0.09	0.05	0.27	0.23	0.18	0.13	0.07
		Parameter Set IIA					Parameter Set IIB				
	0.2	0.17	0.09	0.00	-0.09	-0.18	0.28	0.14	0.00	-0.14	-0.27
τ	0.3	0.30	0.20	0.10	0.00	-0.10	0.51	0.34	0.17	0.00	-0.16
	0.4	0.46	0.35	0.24	0.12	0.00	0.88	0.66	0.43	0.22	0.00
	0.5	0.70	0.56	0.43	0.29	0.15	1.57	1.23	0.91	0.59	0.28

NOTE.– The marginal excess burden equals zero when the tax rate corresponds to the corrective tax rate. This is this case where $\tau = \gamma$ for the employed utility function. The parameters underlying the simulations are shown in Table A.1 in the appendix.

TABLE A.1

CALIBRATED PARAMETER VALUES

ε_{cL}	γ	β	σ	SET
0.3	0.0	2.813	0.500	IA
0.3	0.3	3.107	0.629	IB
0.7	0.0	1.371	1.167	IIA
0.7	0.3	1.754	1.467	IIB

NOTE. $\alpha = 1$, $\tau = 0.2$, $(\omega - l)/\omega = 0.4$.

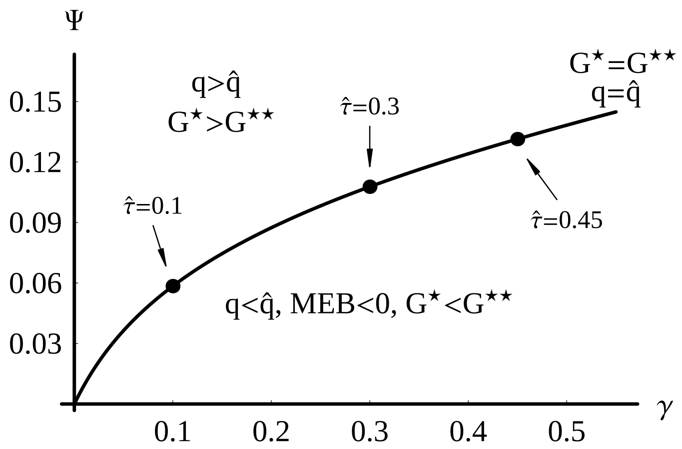

Figure 1: Preferences, MEB, and G*, G**