Asymmetric and Non-atmospheric Consumption Externalities, and Efficient Consumption Taxation*

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Abstract. We analyze the effects of a generalized class of negative consumption externalities (asymmetric and non-atmospheric) on the structure of efficient commodity tax programs. Households are not only concerned about consumption reference levels — that is, they gain utility from "keeping up with the Joneses" — they also exhibit altruism. Two sets of efficient tax regimes are compared, based, on a welfarist- and a non-welfarist optimality criterion, respectively. Altruism turns out not to be at odds with the consumption externalities. Rather, altruism implicates a bound on efficient utility allocations. A non-welfarist government tolerates less inequality than a welfarist one. In the welfarist (non-welfarist) case, first-best personalized commodity tax rates respond highly sensitively (barely) to whether or not a consumption externality is asymmetric or non-atmospheric. If personalized commodity tax rates are not available (second-best case), the tax rate on a non-positional good is typically different from zero for corrective reasons. For plausible functional forms and parameter values, numerical simulations suggest that second-best tax rates are rather insensitive with respect to both the optimality criterion and the "nature" of the consumption externality.

Keywords and Phrases: Consumption externality, keeping up with the Joneses, optimal commodity taxation, genuine altruism, non-welfarist government.

JEL Classification Numbers: D62, H21, H23

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Since ... appearance tyrannizes over truth and is lord of happiness, to appearance I must devote myself.

— Plato, The Republic (Book II)

1 Introduction

This paper addresses the effects of a generalized class of *negative* consumption externalities (asymmetric and non-atmospheric) on the structure of efficient commodity taxation in a framework with both a positional and a non-positional commodity. That is, individual utility is *not* independent of other individuals' consumption. In fact, households form consumption reference levels, a fact well established in the literature (cf. the discussion below). Consumption reference levels give rise to a consumption externality. This externality is often referred to as a keeping up with the Joneses externality.[1]

In contrast to the prior literature, the present analysis takes four important facts into account. First, some people typically contribute more to a consumption reference level than others. In this case, we refer to the consumption externality as a *non-atmospheric* one. In other words, not every household belongs to one's consumption reference group (to the same degree). In addition, not every household shares the same consumption reference group — a situation we refer to as an *asymmetric* consumption externality. Second, households are not only concerned about consumption reference levels, they also exhibit altruism (cf. Johansson, 1997). Third, we consider both welfarist and non-welfarist welfare criteria for evaluating efficient tax programs. Fourth, we offer a simulation section to indicate the relevance of the theoretical model.

This paper is motivated by the recent literature on consumption externalities and happiness. Psychologists and behavioral economists have established that individuals experience happiness by doing well relative to some reference group (Brekke and Howarth, 2002; Easterlin, 1995; Frank, 1985, 1999).[2] The main response of economic theory to this evidence has regularly consisted in allowing for a uniform consumption reference term — commonly the economy's average consumption — in the utility functions of households. While consideration of the consumption reference level in an otherwise standard framework has delivered important insights[3], the usual specification of "the"

[1]Different authors employ various terms, with slightly varying meanings. These terms include *(negative) consumption externality*, *positional-, status-, relative consumption*, *jealousy*, *envy*, *catching up with the Joneses*. As made precise below, we focus on the case of keeping up with the Joneses in this paper.

[2]A large number of further empirical studies add significant evidence. Cf. Alvarez-Cuadrado et al. (2012), Carlsson et al. (2007), Ferrer-i-Carbonell (2005), Johansson-Stenman et al. (2002, 2006), Luttmer (2005), Maurer et al. (2008), McBride (2001), Neumark et al. (1998), and Ravina (2007).

[3]Consumption externalities have shed light for example on the analysis of renewable resource extrac-

reference level still exhibits, in our view, three major shortcomings.

The first shortcoming refers to a household's reference group(s). There may be different reference groups, and even within a reference group, some individuals may be considered more influential than others. For example, Cowan et al. (2004) argue that some activities become more desirable when they can be shared with a group of peers (peer group effect). Other activities become more desirable if they allow the consumer to emulate the consumption of an elite group that he or she aspires to join (aspiration effect). Still other activities become more desirable when the individual can, through wealth or personal endowments, out-shine its peers (distinction effect). In the jargon adopted in this paper, within a reference group, a household may be more concerned with some individuals rather than with others. That is, a consumption externality is usually non-atmospheric. In addition, the consumption of a given household might matter more for some individuals than for others, that is, a consumption externality commonly is asymmetric. Put differently, even if two households are concerned with the *same* reference group, this does *not* imply that these households also share the same consumption reference level.

The second shortcoming concerns the fact that in reality both positional and non-positional forms of consumption coexist (see, e.g., Alpizar et al., 2005; Solnick and Hemenway, 1998, 2005). Typically more visible goods such as houses or cars tend to be more positional than less visible goods such as food or insurance consumption.[4] Models with only one consumption good cannot account for this difference. A further motivation to include both positional and non-positional commodities to the analysis was our objective to numerically quantify the magnitude of the *corrective* second-best tax rates on the *non*-positional commodity.

The third shortcoming refers to the fact that households not only care about consumption reference levels but also about inequality or redistribution (Brekke and Howarth, 2002). As has been shown, individuals dislike being "too different" from their peers. Fehr and Schmidt (1999), find that people dislike income inequality, but they are more upset when their own income falls short than they are pleased by an excess in comparison to their reference levels.

In this paper, we take these shortcomings into account for the derivation of efficient

tion (Alvarez-Cuadrado and Van Long, 2011), envy and inequality (Alvarez-Cuadrado and Van Long, 2012), happiness (Easterlin, 1995; Frank, 1985, 1999; Scitovsky, 1992), economic growth (Brekke and Howarth, 2002; Carroll *et al.*, 1997; Liu and Turnovsky, 2005), or asset pricing (Abel, 1999; Campbell and Cochrane, 1999; Dupor and Liu, 2003).

[4]We are aware that in practice it might be a difficult task to determine whether certain goods are positional or not, and if yes to what extent. Nevertheless we argue that incorporating both status and non-status goods into the analysis adds further insight and that a tax system which is able to treat these forms of consumption differently is superior to one which is not able to.

tax programs under both a welfarist and a non-welfarist government. A welfarist government fully respects individual preferences in the formulation of the welfare criterion. On the other hand, a non-welfarist government does not tolerate status preferences — those are basically a form of envy — to be part of the welfare criterion.[5] That is, in the non-welfarist case the government's and individuals' preferences differ. Our analysis sheds light on the optimal policies that emerge from these two different welfare criteria.

This paper is related to the prior literature on optimal taxation and consumption externalities (see, e.g., Aronsson and Johansson-Stenman, 2008, 2010; Boskin and Sheshinski, 1978; Layard, 1980; Ljungqvist and Uhlig, 2000). From this literature it is well established that an externality due to relative consumption concerns calls for some corrective element in the tax system. Aronsson and Johansson-Stenman (2008) show that the presence of a keeping up with the Joneses externality implies substantially higher marginal income tax rates. The issue of a consumption externality being non-atmospheric rather than atmospheric has also already been taken up by Eckerstorfer (2013), Micheletto (2008) and Wendner (2013). From these studies it has become evident that the nature of a consumption externality indeed matters for the optimal tax structure. However, this literature does not consider asymmetric consumption externalities. Our paper is also related to the literature that studies optimal tax policy from the perspective of a non-welfarist government (see, e.g., Besley, 1988; Blomquist and Micheletto, 2006; O'Donoghue and Rabin, 2006). These studies are concerned with the taxation of sin goods and (de)merit goods where the government does not fully respect households' preferences.

This paper shows four results. First, efficient welfarist first-best tax rates on the positional good are personalized and directly depend on the specific features of the non-atmospheric and asymmetric consumption externality. Specifically, households contributing more than others to the generation of the consumption externality face a higher first-best tax rate. However, in the non-welfarist case, efficient first-best tax rates directly depend on the specific features of the consumption externality only if the consumption reference level does have an impact on the marginal rate of substitution of the positional good for leisure. Second, if the consumption externality is non-atmospheric, the efficient corrective second-best tax rate on the *non*-positional good is generally different from zero, once a *personalized* tax on the positional good is not available. Third numerical simulations reveal that the first-best tax rates are highly sensitive with respect to the specific features of the consumption externality. In contrast, the second-best tax rates barely respond to the specific features of the consumption externality. Moreover,

[5] For example, Harsanyi (1982) claims that antisocial preferences such as envy or jealousy should not be allowed to be part of a social welfare function.

the second-best corrective tax rate on the non-positional good turns out to be quite low. Fourth, altruism and keeping up with the Joneses preferences are not contrasting motives — even if the consumption externality is non-atmospheric or asymmetric. Rather, altruism requires the distribution of utility not to bee too unequal, in a well-defined sense. It imposes a fairness condition which narrows the set of efficient allocations to those that are not too distant from an egalitarian allocation. The specific set of fair allocations is strongly affected by the features of the consumption externality. More inequality is tolerated towards households contributing more than others to the generation of the consumption externality. Moreover, for a given consumption externality, the set of fair allocations under a non-welfarist government is smaller than that under a welfarist government. A non-welfarist government tolerates less inequality compared to a welfarist government.

Section 2 of this paper presents the model and defines non-atmospheric and asymmetric consumption externalities as well as the type of altruism adopted. It also characterizes a welfarist efficient first-best tax program. Section 3 discusses both a welfarist efficient second-best tax program (with uniform tax rates) and the impact of altruism on "fair" (utility) allocations. Section 4 considers efficient first- and second-best tax programs under a non-welfarist government. The efficient tax rates differ between the welfarist- and non-welfarist optimality criteria. Therefore, Section 5 presents numerical simulations in order to give a rough indication of the magnitude of the differences in efficient tax rates between the welfarist- and non-welfarist cases. Section 6 concludes the paper. The Appendix contains proofs and mathematical results that support the analysis of the main text.

2 The model

We consider a static economy with n households. A household $i \in N = \{1, ..., n\}$ has preferences over two private goods x_i and z_i, leisure l_i and a reference consumption level $\overline{z}_i$. In addition, households derive utility from the average utility of all households in the economy. We consider spending on x as a non-positional form of consumption and spending on z as status consumption, i.e. for good z households care about their relative consumption with respect to others. Households differ in their exogenous earning ability w_i and in their preferences. The time endowment of a household is normalized to one and is divided between labor and leisure. Hence, the labor income of a household is given by $w_i(1-l_i)$. There is a linear technology for the production of private goods with labor as the only input. Quantities of goods are chosen such that the producer prices are equal to one for both commodities.

The preferences of a household are represented by the concave utility function

$$u_i(x_i, z_i, l_i, \overline{z}_i) + \varphi \left[\frac{1}{n} \sum_{j=1}^{n} u_j(x_j, z_j, l_j, \overline{z}_j) \right], \tag{1}$$

where $\varphi \geq 0$ is a weighting factor which is assumed to be constant across households.[6] Utility of a household i increases in own private consumption and leisure and decreases in the reference level $\overline{z}_i$. Further, utility of a household increases with the average utility of the whole population, i.e. households are altruistic as they also derive satisfaction from the general welfare in the economy. The strength of altruism is reflected by parameter φ. Our choice of the specific form of altruism[7] was motivated by the work of Brekke and Howarth (2002). In addition, we found this form of altruism appealing, as it implies the fact that individuals dislike too strong an inequality — a fact well documented in the literature (cf. Fehr and Schmidt, 1999). Both the reference level and the average utility of all households are considered to be exogenous by a household.[8]

The consumption reference level $\overline{z}_i$ gives rise to a negative consumption externality. In this paper, we focus on the case of a keeping up with the Joneses (KUJ-) externality. Dupor and Liu (2003) define preferences exhibiting a KUJ externality by $\partial(u_z/u_l)/\partial\overline{z} > 0$.[9] That is, we assume that the marginal utility of consuming the status good relative to that of leisure increases in the reference level.

Let the reference level of a household i concerning consumption of good z be determined by

$$\overline{z}_i = \frac{1}{n} \sum_{j=1}^{n} a_{ij} z_j. \tag{2}$$

with $i, j \in N$. The nonnegative coefficient a_{ij} indicates the amount by which the consumption of one unit of the status good, z, by the externality-generating household j raises the consumption reference level of household i. Thus, regarding the composition of $\overline{z}_i$, the *second* index of coefficients a_{ij} refers to the household of origin of the consumption externality, and the *first* index of coefficients a_{ij} refers to the household of destination of the consumption externality.

We say that an externality is of the *atmospheric* type if weights are constant across all households of origin. In contrast, if weights differ across households of origin, then

[6]In principle the altruism parameter φ can be allowed to vary across households without affecting most of our results. It would only complicate the analysis of fair utility allocations without altering the main message, which is why we abstract from this form of heterogeneity.

[7]Johansson (1997) refers to this form of altruism as *genuine* altruism.

[8]Intuitively a household considers her own contribution to the reference level and to the average utility in the population as extremely small and therefore negligible.

[9]We use subscripts to denote partial derivatives with respect to the subscripted variable, that is $u_z = \partial u/\partial z$. Subscripts i, j refer to households (rather than being partial derivatives).

the externality is said to be of the *non-atmospheric* type.

Definition 1 (Non-atmospheric consumption externality)
An externality is said to be non-atmospheric *if $a_{ij} \neq a_{ij'}$ for some $i, j, j' \in N$ with $j \neq j'$. Otherwise it is atmospheric.*

If an externality is non-atmospheric, the status consumption $(z_j, z_{j'})$ of households j and j' are not perfect substitutes regarding the generation of $\overline{z}_i$.

We say that an externality is *symmetric* if weights are constant across households of destination. In contrast, we say that an externality is *asymmetric* if weights differ between households of destination.

Definition 2 (Asymmetric consumption externality)
An externality is said to be asymmetric *if $a_{ij} \neq a_{i'j}$ for some $i, i', j \in N$ with $i \neq i'$. Otherwise, it is symmetric.*

As long as $a_{ij} = a_{i'j}$ for all $i, i', j \in N$, $\overline{z}_i = \overline{z_{i'}}$. That is, as long as the externality is symmetric, there is a unique reference level for the whole population. Only if the externality is asymmetric, households have different reference levels, no matter whether the externality is non-atmospheric or not.

At the one hand, due to the fact that households are altruistic, individuals dislike too strong an inequality. At the other hand, due to the consumption externality, households like to be ahead of others. At first sight, these preference traits seem to be in conflict with each other. Our subsequent analysis, however, shows that this is not the case.

2.1 The household's maximization problem

Households maximize their utility subject to the private budget constraint

$$q_x x_i + q_z z_i \leq w_i(1 - l_i) + \tau_i, \tag{3}$$

where $q_x = 1 + t_x$ and $q_z = 1 + t_z$ are consumer prices and τ_i is a lump-sum transfer. The tax instruments of the government consist of proportional commodity taxes t_x and t_z and a lump-sum element τ_i.[10] Labor income is left untaxed without loss of generality.

Households choose consumption and leisure such that the following necessary conditions hold:

$$-MRS^i_{zx} = \frac{1 + t_z}{1 + t_x}, \tag{4}$$

$$-MRS^i_{lx} = \frac{w_i}{1 + t_x}, \tag{5}$$

[10]In first-best we allow the tax rate on the status good to vary across households, i.e. we allow for personalized commodity taxes $t_{z,i}$, and hence, for personalized consumer prices $q_{z,i}$.

with $MRS_{kx} \equiv -u_k/u_x$ and $k \in \{z, l\}$. Observe that the altruism parameter φ does not appear in these optimality conditions, i.e. the presence of altruism has no effect on the consumption and leisure decision of a household. A household's indirect utility function is given by

$$v_i(q_x, q_z, \tau_i, \overline{z}_i) + \frac{\varphi}{n}\sum_{j=1}^{n} v_j(q_x, q_z, \tau_j, \overline{z}_j). \tag{6}$$

Note that due to the presence of altruism the indirect utility of household i also depends on the lump-sum element and reference level of all other households.

2.2 Characterization of a first-best allocation

In this subsection we characterize first-best allocations for this economy and analyze which tax instruments are required to implement these allocations. Assume that a social planner can directly determine x_i, z_i, l_i for each household i. Then a Pareto efficient first-best allocation is a solution to the following problem:

$$\max_{x_i, z_i, l_i, \overline{z}_i, i=1,\ldots,n} u_1(x_1, z_1, l_1, \overline{z}_1) + \frac{\varphi}{n}\sum_{j=1}^{n} u_j(x_j, z_j, l_j, \overline{z}_j) \tag{7}$$

subject to

$$u_i(x_i, z_i, l_i, \overline{z}_i) + \frac{\varphi}{n}\sum_{j=1}^{n} u_j(x_j, z_j, l_j, \overline{z}_j) \geq \overline{u}_i \qquad i = 2, ..., n \qquad (\mu_i^{FB}) \tag{8}$$

$$\sum_{i=1}^{n} x_i + \sum_{i=1}^{n} z_i = \sum_{i=1}^{n} w_i(1 - l_i) \qquad (\lambda^{FB}) \tag{9}$$

$$\overline{z}_i = \frac{1}{n}\sum_{j=1}^{n} a_{ij} z_j \qquad i = 1, ..., n \qquad (\gamma_i^{FB}) \tag{10}$$

where $\overline{u}_i$ is some minimum utility requirement for household i. Lagrange multipliers are given within parenthesis and the index FB refers to *first-best*. By varying the minimum utility requirement $\overline{u}_i$ the family of Pareto efficient allocations can be characterized. In the Appendix we show that for an interior solution the following conditions hold:

$$-MRS_{zx}^i = 1 + \underbrace{\frac{\frac{1}{n}\sum_{j=1}^{n} \gamma_j^{FB} a_{ji}}{\lambda^{FB}}}_{\Psi_i} \tag{11}$$

$$-MRS_{lx}^i = w_i \tag{12}$$

$$\frac{1+\varphi}{\varphi} \geq \frac{1}{n}\sum_{j=1}^{n} \frac{\partial u_i/\partial x_i}{\partial u_j/\partial x_j} \tag{13}$$

for $i = 1, ..., n$. Equations (11) and (12) state conditions for an efficient allocation of consumption goods and leisure. Equation (13) is a *fairness condition* that puts a limit on the set of allocations consistent with the Pareto criterion.

Combining conditions (11) and (12) with conditions (4) and (5), the following result follows.

Proposition 1 (First-best tax structure)
(i) If the externality is atmospheric, then optimal commodity tax rates are given by a single tax on z, $t^*_{z,i} = \Psi_i = \Psi = t^*_z$ *and* $t^*_x = 0$*, whether or not the consumption externality is asymmetric.*
(ii) If the externality is non-atmospheric, then optimal commodity tax rates are given by differentiated taxes on z, $t^*_{z,i} = \Psi_i$ *and* $t^*_x = 0$*, whether or not the consumption externality is asymmetric.*
(iii) The lump-sum element τ^*_i *is required for the efficient redistribution of resources.*
Proof. See Appendix.

If the externality is non-atmospheric a personalized commodity tax $t_{z,i}$ (set equal to the the correction term Ψ_i) in addition to the personalized lump-sum element is required to implement the first-best allocation as a competitive equilibrium.[11] If the externality is atmospheric, a uniform tax on status consumption in addition to the lump-sum element suffices to implement a first-best allocation. Commodity x stays untaxed in first-best as the externality can be fully internalized with $t_{z,i}$ and redistribution can be achieved through τ_i without distortion. Parallel results are shown by Micheletto (2008) in a related framework. In his paper, the first-best case can be recovered by setting to zero the Lagrange multipliers associated with self-selection constraints.

The fairness condition in equation (13) has no impact on optimal commodity taxes but it narrows the set of fair utility allocations. It is implied by the presence of genuine altruism in the utility function.[12] It states that for an allocation to be Pareto efficient the average ratio of the marginal utility of consuming good x between household i and all (other) households must not be too large. This ratio is large if household i consumes relatively little of good x compared to all other households. In other words the fairness

[11] The fact that personalized commodity taxes are required to implement a first-best allocation, when the externalities vary among the individuals causing them, has also been raised by Diamond (1973) and Green and Sheshinski (1976).

[12] In fact, it can be shown that the existence of such a fairness condition is also implied by the presence of pure (instead of genuine) altruism in the utility function. We need to add, however, that *different* forms of altruism may have an impact on the necessary first-order conditions and thereby on efficient tax rates. Ley (1997), however, suggests in the context of optimal public good provision that even if altruism is modeled in a very general way, Pareto optima of an altruistic economy are also Pareto optima of the egoistic economy (but not necessarily vice versa).

condition rules out allocations which are too unequal in terms of different marginal utilities of x (and which would be Pareto efficient with purely egoistic preferences).

In Figure 1 we illustrate the fairness condition if there are only two types of households.[13] One can see that the higher φ, the smaller the set of utility allocations consistent with the fairness condition. Specifically, for $\varphi = 5$ all utility allocations on the segment $(\overline{A}, \underline{A})$ are consistent with the fairness condition. With $\varphi = 15$, only the smaller segment $(\overline{B}, \underline{B})$ is consistent with the fairness condition. As the strength of altruism approaches infinity, the left hand side of (13) approaches unity. That is, $\partial u_i(.)/\partial x_i = 1$, for all $i \in N$. Then, under strict quasiconcavity of the individual utility functions, only a single utility allocation is consistent with the fairness condition. As the fairness condition requires equalization of *marginal* utilities, this singleton set need not correspond to an egalitarian utility allocation.

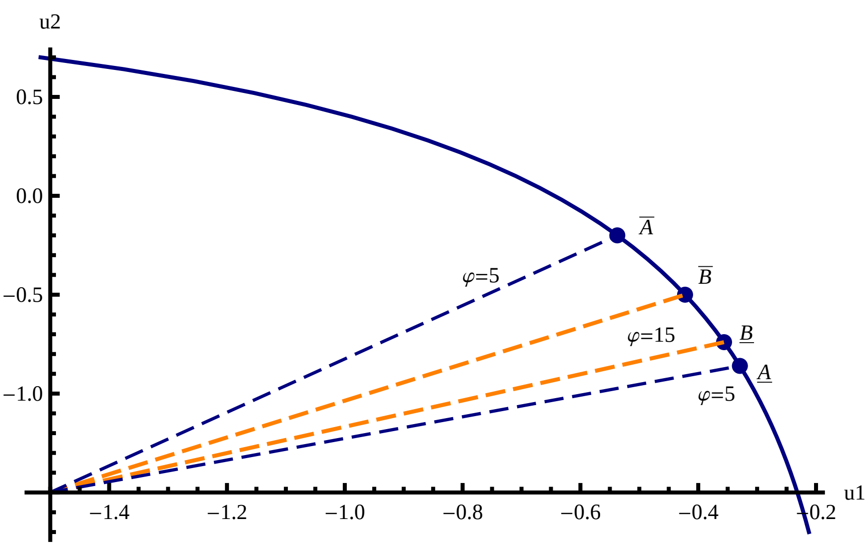

FIGURE 1. Fairness condition in first-best; $\varphi = 5$ vs. $\varphi = 15$.

3 Optimal second-best tax system

We now analyze the second-best optimal tax policy, when commodity taxes are restricted to be uniform across households. We make this assumption for the following reasons. First, many transactions are anonymous which makes personalized commodity taxes infeasible. Second, personalized commodity taxes would enable households to engage in side transactions to exploit interpersonal commodity tax differentials and it may be impossible for the government to prevent that. Third, on a political level such a tax would be very controversial and hard to implement.

[13]All figures are based on functional specifications and baseline parameter values that are discussed in Section 5.

A Pareto efficient second-best tax system is a solution to the following problem:

$$\max_{t_x, t_z, \tau_i, \overline{z}_i, i=1,\ldots,n} v_1(q_x, q_z, \tau_1, \overline{z}_1) + \frac{\varphi}{n} \sum_{j=1}^{n} v_j(q_x, q_z, \tau_j, \overline{z}_j) \tag{14}$$

subject to

$$v_i(q_x, q_z, \tau_i, \overline{z}_i) + \frac{\varphi}{n} \sum_{j=1}^{n} v_j(q_x, q_z, \tau_j, \overline{z}_j) \geq \overline{v}_i \qquad i = 2, ..., n \qquad (\mu_i^{SB}) \tag{15}$$

$$t_x \sum_{i=1}^{n} x_i + t_z \sum_{i=1}^{n} z_i \geq \sum_{i=1}^{n} \tau_i \qquad (\lambda^{SB}) \tag{16}$$

$$\overline{z}_i = \frac{1}{n} \sum_{j=1}^{n} a_{ij} z_j \qquad i = 1, ..., n \qquad (\gamma_i^{SB}) \tag{17}$$

where again $\overline{v}_i$ is some minimum utility requirement for household i. The index SB for the Lagrange multipliers refers to second-best. We provide the first-order conditions for this problem in the Appendix.

3.1 Optimal commodity taxes

From the first-order conditions of this maximization problem the optimal commodity tax structure can be derived. To facilitate notation we define

$$\epsilon_i \equiv \frac{1}{n} \sum_{j=1}^{n} \frac{\gamma_j^{SB}}{\lambda^{SB}} a_{ji}. \tag{18}$$

It can be interpreted as the marginal social harm induced by the status consumption of household i measured in terms of the government's tax revenues. We assume that $\epsilon_i > 0$, i.e. that status consumption is socially harmful.[14]

In the Appendix we show that optimal commodity tax rates satisfy

$$\begin{pmatrix} \overline{s}_{xx} & \overline{s}_{zx} \\ \overline{s}_{xz} & \overline{s}_{zz} \end{pmatrix} \begin{pmatrix} t_x \\ t_z \end{pmatrix} = \begin{pmatrix} \frac{1}{n} \sum_{i=1}^{n} \epsilon_i s_{zx}^i \\ \frac{1}{n} \sum_{i=1}^{n} \epsilon_i s_{zz}^i \end{pmatrix}, \tag{19}$$

where compensated price effects are denoted by $s_{zk}^i = \partial z_i^{com} / \partial q_k$ and $s_{xk}^i = \partial x_i^{com} / \partial q_k$, $k = \{z, x\}$, and the upper bar is used to denote the mean. By applying Cramer's rule, (19) yields an implicit solution for the optimal second-best commodity taxes t_z^{**} and t_x^{**}.[15]

[14] In principle γ_j^{SB} and by this ϵ_i could also be negative. For a detailed discussion on the sign of the Lagrange multiplier of constraint (17) see Eckerstorfer (2013).

[15] The 2×2 sub-Slutsky matrix of the taxed goods is assumed to be non-singular and negative semi-definite, i.e. a solution to this system of equations exists and the determinant of this matrix is strictly positive.

Proposition 2 (Second-best commodity tax structure: general case)
The optimal second-best commodity taxes are given by

$$t_z^{**} = \frac{\frac{1}{n}\left(\overline{s}_{xx}\sum_{i=1}^{n}\epsilon_i s_{zz}^i - \overline{s}_{xz}\sum_{i=1}^{n}\epsilon_i s_{zx}^i\right)}{\overline{s}_{zz}\overline{s}_{xx} - \overline{s}_{zx}\overline{s}_{xz}}, \tag{20}$$

$$t_x^{**} = \frac{\frac{1}{n}\left(\overline{s}_{zz}\sum_{i=1}^{n}\epsilon_i s_{zx}^i - \overline{s}_{zx}\sum_{i=1}^{n}\epsilon_i s_{zz}^i\right)}{\overline{s}_{zz}\overline{s}_{xx} - \overline{s}_{zx}\overline{s}_{xz}}. \tag{21}$$

The optimal tax on the status good is strictly positive. The sign of t_x^{**} is ambiguous.
Proof. See the Appendix.

Observe that both t_z^{**} and t_x^{**} are used to correct for the status externalities as they both depend on the correction element ϵ_i.[16] Thus, the *additivity property*, derived by Sandmo (1975) in a model with an atmospheric externality, does not apply. The additivity property states that an externality is best addressed by imposing a tax directly on the externality-generating good and by leaving the rest of the tax system unaffected by the externality.[17] In our framework it is optimal to also tax good x to correct for the externality as this allows for additional internalization of the externality to what is possible with t_z alone.[18] Further note that the presence of altruism has no impact on optimal commodity tax rates. This is because the incentive structure of households is not affected by this form of altruism.

To get a better insight in how the optimal commodity taxes depend on the specific form of the reference level and on compensated price effects we consider the following special cases.

Corollary 1 (Second-best commodity tax structure: special cases)
(i) If the externality is atmospheric and no matter whether the externality is asymmetric or not, the optimal commodity tax rates are given by

$$t_z^{**} = t_z^* = \epsilon, \qquad t_x^{**} = t_x^* = 0, \tag{22}$$

with $\epsilon \equiv \epsilon_i$ for all i.

[16]The optimal tax formulas contain no redistributive component as personalized lump-sum taxes are available. If lump-sum taxes were restricted to be uniform, t_z^{**} and t_x^{**} would also depend on a redistributive term. This can be seen from the many-person Ramsey rule which we provide in the Appendix (equations (60) and (61)).

[17]It has already been shown by Micheletto (2008) and Eckerstorfer (2013) in Mirrlees-type models that this result does not hold if the externality is of the non-atmospheric type, as it is the case in our study. Hence, we confirm this finding for a Ramsey-type optimal tax model.

[18]A parallel result is due to Sandmo (1976) who finds that there is a case for a tax or subsidy on related goods in addition to a tax on the externality-generating good when the uses of commodities in particular consumption processes generate externalities (rather than their consumption as such).

(ii) If $s^i_{zx} = 0$ or $s^i_{zx} = s^i_{zz}$ for all $i \in N$ and without any restriction on the reference levels

$$t^{**}_z = \frac{\sum_{i=1}^n \epsilon_i s^i_{zz}}{\sum_{i=1}^n s^i_{zz}}, \qquad t^{**}_x = 0. \tag{23}$$

Optimal commodity taxes in Corollary 1 follow immediately from (20) and (21). Case (i) can also be inferred from Proposition 1. If the externality is of the atmospheric type, good x needs not to be taxed in the optimum and $t^{**}_z = t^*_z$ is equal to the marginal social harm of status consumption ϵ, no matter whether the externality is asymmetric or not.[19]

From case (ii) it can be seen that imposing a tax on the non-positional good is not optimal if compensated cross price effects are zero or if the compensated cross price effects are equal to the own compensated price effect for the status good. If there are no compensated cross price effects t_x can obviously not be used to internalize the externality. Suppose $s^i_{zx} = s^i_{zz}$, then t_z and t_x are equally effective as instruments to target the externality. However, concavity requires that then $|\overline{s}_{xx}| > |\overline{s}_{zz}|$. Thus, t_x would be a more distortionary instrument which is why only t_z is used.

Regarding the lump-sum element, one can easily show that in second-best τ_i should also be used to correct for the externalities, in addition to redistributing resources. This can be seen by plugging the optimal commodity taxes given by (20) and (21) into the first-order condition for τ_i (see (56) in the Appendix) which reveals that, in general, a term depending on ϵ_i, and therefore on the externality, remains.[20] This implies that the optimal second-best lump-sum element τ^{**}_i indeed depends on ϵ_i.[21] The intuition for this result is that t^{**}_z might overcorrect for the status consumption of some households with low ϵ_i and undercorrect for the status consumption of other households with high ϵ_i. The lump-sum element can then be used to compensate those whose status consumption causes little social damage (low ϵ_i) and to extract income from those whose consumption is particularly harmful (high ϵ_i).

3.2 Fairness condition

We have shown that the presence of altruism, as specified in this paper, has no impact on the optimal commodity tax structure. However, similar to the first-best case, also

[19] Note, however, that the expressions for ϵ depends on whether the externality is asymmetric or not as ϵ depends on the different values for a_{ij} (see (18)). Thus, whether the externality is asymmetric or not has no impact on the optimal commodity tax structure but on the optimal level of t^{**}_z.

[20] A related result is provided by Micheletto (2008) who has shown that it is desirable to use the nonlinear income tax function as an externality-correcting device, if the externality is of the non-atmospheric type.

[21] This is not the case if the externality is atmospheric. Then the externalities can be fully internalized with t^{**}_z alone and a first-best allocation can be reached.

in second-best a fairness condition exists which limits the set of allocations consistent with the Pareto criterion. There exists a set of allocations which would be Pareto efficient with purely egoistic preferences but which does not satisfy the Pareto criterion if households are altruistic. Intuitively, at such allocations altruistic households would prefer to give income away to those with very little income instead of consuming it on their own. Such a reallocation would make all households better off leading to a Pareto improvement.[22] Since, in our framework there is no mechanism for households to give money directly to poorer ones, optimal tax policy is affected by the fairness-condition. In second-best, the fairness condition is given by:

$$\frac{1+\varphi}{\varphi} \geq \frac{1}{n} \sum_{j=1}^{n} \frac{\frac{\partial v_i/\partial \tau_i}{MSC_i}}{\frac{\partial v_j/\partial \tau_j}{MSC_j}} \tag{24}$$

for all $i = 1, ..., n$ and where the marginal social cost of income (MSC_i) is defined by

$$MSC_i \equiv 1 - t_x \frac{\partial x_i}{\partial \tau_i} - t_z \frac{\partial z_i}{\partial \tau_i} + \epsilon_i \frac{\partial z_i}{\partial \tau_i}. \tag{25}$$

The first three terms on the right-hand side of (25) reflect the net budget cost of a marginal income increase, and the last term denotes the social harm caused by that income increase due to an increase in status consumption. From (24) it can be seen that in second best the average ratio of marginal utilities of income is weighted by MSC_i. The fairness condition (24) states that for an allocation to be Pareto efficient the average ratio of the marginal utility of income of household i to that of all other households must not be too large. Interestingly, in the second best case more inequality towards household i is tolerated if the marginal social cost of increasing the income of that household is large. From (25) it can be seen that MSC_i increases with the marginal social cost of status consumption of household i, as given by ϵ_i. That is, if the status consumption of household i is particularly harmful at the margin, then more inequality is tolerated with respect to that household.

In Figure 2 we illustrate this point for two types of households. The figure shows the impact of a consumption externality being non-atmospheric rather than atmospheric on the set of utility allocations that are consistent with the fairness condition in second-best. A shift from an atmospheric to a non-atmospheric externality goes along with a shift in MSC_i, as in contrast to an atmospheric externality a non-atmospheric externality implies that ϵ_i differs between households. The dashed lines indicate the utility

[22] A similar point has been made by Johansson-Stenman (2005) in the context of global environmental problems and the free-riding problem between countries. He shows that if there is a rich and a poor country and the rich country is altruistic toward the poor country, the rich country may still undertake globally efficient abatement investments as it takes utility effects on poor countries into account.

possibility frontier and fair allocations (segment between $\overline{A}$ and $\underline{A}$) for the case of an atmospheric consumption externality. The solid lines show the respective utility allocations for the non-atmospheric consumption externality with $a_{j1} > a_{j2}$, $j = 1, 2$, i.e. the consumption of type 1 is socially more harmful at the margin ($\epsilon_1 > \epsilon_2$).[23] Graphically, the fairness condition, as given by (24), defines upper and lower bounds of the slope of the utility possibility frontier. As the slope of the Pareto frontier increases, the set of allocations satisfying the fairness condition shifts up and to the left, as depicted in Figure 2. The fairness condition imposes a requirement on the utility allocation that is very intuitive. As consumer 1 has become the main generator of a negative consumption externality, the fairness condition demands a redistribution of lump sum transfers away from consumer 1 towards consumer 2.

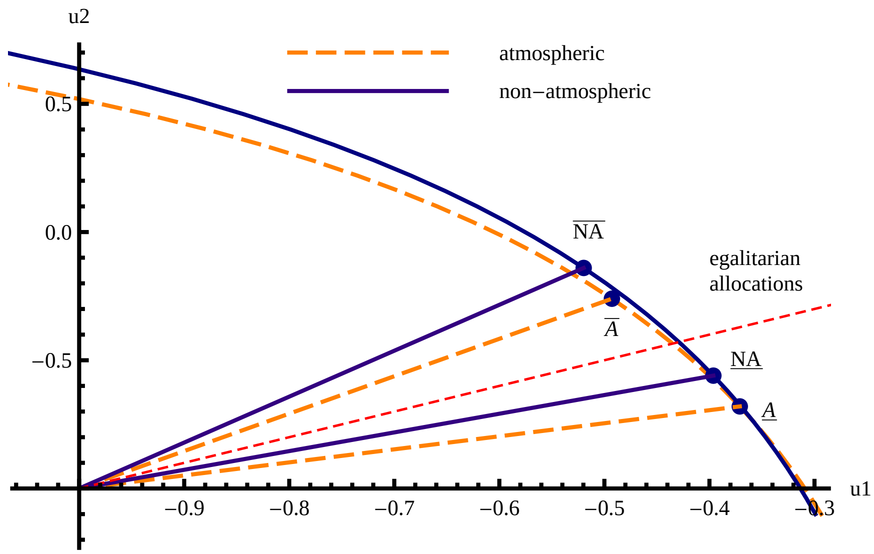

FIGURE 2. Fariness conditions in second-best: atmospheric vs. non-atmospheric externality; $\varphi = 5$.

3.3 Alternative informational second-best settings

Alternative second-best settings emerge if the government is ignorant about some personal-specific characteristics, but where no ex-ante assumptions on the set of available tax instruments are made. From an informational point of view, there is no informational limitation in our model that prevents the government from using personalized commodity taxes. And indeed some visible goods, such as housing or cars, for which there is empirical evidence of positional concerns, are not necessarily subject to anonymous transactions. Instead, the ownership of such goods is typically registered and the infor-

[23]Clearly, with the externality being different in the two cases, the utility possibility frontier is different as well.

mation is fully available to the public authorities. Therefore, personalized commodity taxes might in principle be feasible for some goods.[24]

If no restrictions on the set of available tax instruments are made, an alternative second-best scenario is that the government does not have complete information about the type of households in terms of its contribution to the formation of consumption reference levels. Stated differently, the government might not be fully informed about how reference groups are formed. In this informational setting, it is possible to elicit a household's non-atmospheric or asymmetric characteristic of the consumption externality, a_{ij}, via a compensation mechanism (Varian, 1994). The mechanism requires the government to set personalized taxes on the positional commodity. However, while the compensation mechanism ensures a Pareto efficient allocation, it does not imply a first-best allocation. The reason is that the mechanism relies on the fact that a households announcement of the other household types affects those households behaviors and thereby has an indirect impact on own utility — via the consumption reference level. This indirect impact is taken into account by the announcing household. By contrast, in the first-best allocation, the consumption reference level is considered fully exogenous to individual households.

A further second-best scenario is that the government does not have complete information about the individual ability of a household. In such a framework taxes cannot directly be tied to abilities and the tax system has to be designed in such a way that individuals reveal their true types. In general, self-selection constraints are affected by the reference levels and optimal commodity tax rates would depend on a self-selection based part in addition to a correction term. The signs of the mimicking-deterring terms would not only depend on whether a given good is positively or negatively related to labor but also on how the consumption choice of a mimicker and a mimicked is (differently) affected by the externality (see Micheletto, 2008).

4 Optimal taxes under a non-welfarist government

Should the government accept status effects in its welfare criterion? Concerns for status and relative position are basically a form of jealousy and envy and one can question whether such behavior has to be respected by the policy maker. In contrast to status concerns, altruism is a prosocial form of behavior and a paternalistic and benevolent government is likely to respect the latter to be part of the welfare criterion and to

[24] Nevertheless, we think the arguments we raise at the beginning of Section 3 against the use of personalized commodity taxes are rather strong.

exclude the former. In this section we analyze the optimal tax policy of a government which knows that households care about status effects but which does not want to include status preferences in the welfare criterion. So far, the literature has paid almost no attention to the idea that the presence of relative concerns in the social objective might have to be questioned. Notable exceptions are Kanbur et al. (2006) who discuss this issue in a survey article on non-welfarist optimal taxation, and Micheletto (2011) who studies optimal income taxation both from the perspective of a welfarist and non-welfarist government when households compare their income with those households that rank higher in the income distribution.

We proceed in a similar way as before. First, we characterize the first-best allocation from the perspective of the government and its implementation through taxes. Next, we discuss the optimal second-best tax policy of a non-welfarist government. In order to be able to present the results in a clear way, we assume, from now on, that status preferences enter the utility function additively. Preferences of households are described by the concave utility function

$$\tilde{u}_i(x_i, z_i, l_i) + m_i(r_i) + \frac{\varphi}{n}\sum_{j=1}^{n}(\tilde{u}_j(x_j, z_j, l_j) + m_j(r_j)), \tag{26}$$

where $r_i \equiv z_i/\overline{z}_i$. We assume $m_r > 0$ and $m_{rr} \leq 0$ for all $i = 1, ..., n$. The optimal decision of a household is, again, described by conditions (4) and (5) which can also be written as

$$\frac{\partial \tilde{u}_i/\partial z_i}{\partial \tilde{u}_i/\partial x_i} + \underbrace{\frac{1}{\overline{z}_i}\frac{\partial m_i/\partial r_i}{\partial \tilde{u}_i/\partial x_i}}_{\tilde{\Psi}_i} = \frac{1+t_z}{1+t_x}, \tag{27}$$

$$\frac{\partial \tilde{u}_i/\partial l_i}{\partial \tilde{u}_i/\partial x_i} = \frac{w_i}{1+t_x}. \tag{28}$$

We call $\tilde{\Psi}_i$ the part of the MRS^i_{zx} that stems from relative consumption concerns, that is it tells how much of good x a household is willing to give up for the better relative position an additional unit of z provides. Note that in general $\tilde{\Psi}_i$ differs between households.

The government knows that households base their decisions on the utility function in (26) but it behaves in a paternalistic way and ignores $m_i(r_i)$ in its welfare criterion. Let the indirect utility function of a household be given by

$$\underbrace{\tilde{u}_i(z_i^*(\cdot), x_i^*(\cdot), l_i^*(\cdot))}_{\tilde{v}_i(q_x,q_z,\tau_i,\overline{z}_i)} + \underbrace{m_i\left(\frac{z_i^*(\cdot)}{\overline{z}_i}\right)}_{s_i(q_x,q_z,\tau_i,\overline{z}_i)} + \frac{\varphi}{n}\sum_{j=1}^{n}\left(\underbrace{\tilde{u}_j(z_j^*(\cdot), x_j^*(\cdot), l_j^*(\cdot))}_{\tilde{v}_j(q_x,q_z,\tau_j,\overline{z}_j)} + \underbrace{m_j\left(\frac{z_j^*(\cdot)}{\overline{z}_j}\right)}_{s_j(q_x,q_z,\tau_j,\overline{z}_j)}\right). \tag{29}$$

The government considers only $\tilde{v}_i + \frac{\varphi}{n}\sum_{j=1}^{n}\tilde{v}_j$ in the welfare criterion.[25] Hence, the altruistic part of individual utility is included in the welfare criterion while the utility part s_i emerging from the relative position of households will be omitted.[26]

4.1 Characterization of first-best allocations

We first characterize first-best allocations from the perspective of the government. Assume again that the government can directly determine x_i, z_i, l_i for each household i. Then an efficient first-best allocation from the perspective of the government is a solution to the problem

$$\max_{x_i,z_i,l_i,i=1,\ldots,n} \tilde{u}_1(x_1,z_1,l_1) + \frac{\varphi}{n}\sum_{j=1}^{n}\tilde{u}_j(x_j,z_j,l_j) \tag{30}$$

subject to

$$\tilde{u}_i(x_i,z_i,l_i) + \frac{\varphi}{n}\sum_{j=1}^{n}\tilde{u}_j(x_j,z_j,l_j) \geq \overline{u}_i \qquad i=2,...,n \qquad (\tilde{\mu}_i^{FB}) \tag{31}$$

$$\sum_{i=1}^{n} x_i + \sum_{i=1}^{n} z_i = \sum_{i=1}^{n} w_i(1-l_i) \qquad (\tilde{\lambda}^{FB}) \tag{32}$$

$$\tag{33}$$

Observe that the government ignores the reference consumption levels and their impact on private utility in its maximization problem. In the Appendix, we provide the first-order conditions for this problem from which the following optimality conditions can be derived:

$$\frac{\partial\tilde{u}_i/\partial z_i}{\partial\tilde{u}_i/\partial x_i} = 1, \tag{34}$$

$$\frac{\partial\tilde{u}_i/\partial l_i}{\partial\tilde{u}_i/\partial x_i} = w_i, \tag{35}$$

$$\frac{1+\varphi}{\varphi} \geq \frac{1}{n}\sum_{j=1}^{n}\frac{\partial\tilde{u}_i/\partial x_i}{\partial\tilde{u}_j/\partial x_j}, \tag{36}$$

for all $i=1,...,n$. From (34) and (35) it can be seen that if households had no relative consumption concerns, the government would not want to distort their consumption and leisure decision. But since households care about status consumption, the government

[25] Note that now the envelope theorem has to be used with care when taking derivatives of $\tilde{v}_i$. For example Roy's identity becomes $\frac{\partial\tilde{v}_i}{\partial t_z} = -z_i\frac{\partial\tilde{v}_i}{\partial\tau_i} - (\frac{\partial s_i}{\partial t_z} + z_i\frac{\partial s_i}{\partial\tau_i})$.

[26] Excluding also the altruistic part of the utility function from the welfare criterion would not affect the optimal tax policy of a paternalistic government. However, then there exist very unequal Pareto efficient allocations which will be excluded by a fairness condition if altruism is allowed for in the welfare criterion.

wants to distort the decision of households so that they behave as if they had no status concerns. In other words, the government wants to correct for the status preferences. In addition, similar to the welfarist case, the fairness condition given by (36) limits the set of allocations consistent with the Pareto criterion. This fairness condition also holds in the non-welfarist case because the government respects altruism to be part of the welfare criterion.[27]

In order to see which tax instruments are required to implement a first-best allocation, one has to contrast conditions (34) and (35) with the optimality conditions of a household given by (27) and (28). Then one obtains the following result.

Proposition 3 (Non-welfarist government: first-best tax structure)
(i) In general optimal commodity tax rates are given by differentiated taxes on z, $\tilde{t}^*_{z,i} = \tilde{\Psi}_i$ and $\tilde{t}^*_x = 0$, whether or not the consumption externality is non-atmospheric.
(ii) If the externality is atmospheric and symmetric and if $m_r/\tilde{u}_x$ is the same for all households, then optimal commodity tax rates are given by a single tax on z, $\tilde{t}^*_{z,i} = \tilde{\Psi}_i = \tilde{\Psi} = \tilde{t}^*_z$ and $\tilde{t}^*_x = 0$.
(iii) If $\partial MRS^i_{zx}/\partial \overline{z}_i = 0$, the efficient tax rates $\tilde{t}^*_z$ and $\tilde{t}^*_x$ are independent of a_{ij} .
(iv) The lump-sum element $\tilde{\tau}^*_i$ is required for the efficient redistribution of resources.
Proof. See Appendix.

Similar to the welfarist case, a personalized commodity tax $\tilde{t}^*_{z,i} = \tilde{\Psi}_i$ on the status good, in addition to the personalized lump-sum element, is required to implement a first-best allocation as a competitive equilibrium. Intuitively a personalized commodity tax is required in the non-welfarist case if different households are willing to give up different amounts of x for the better relative position an additional unit of z provides. Loosely speaking some households care more about status than others, hence a government which wants to correct for status preferences would want to treat these households differently. Only if $\tilde{\Psi}_i$ is constant across households, a uniform commodity tax on all households would suffice. This is the case if the externality is symmetric and atmospheric and if $m_r/\tilde{u}_x$ is constant across households. Note that the nature of the externality does not affect the first-best tax rate if $\partial MRS^i_{zx}/\partial \overline{z}_i = 0$, as then the household decision does not depend on $\overline{z}_i$.

[27] In the next section, for a specified utility function, we compare the fairness condition of a welfarist with that of a non-welfarist government. There we show that the set of allocations considered as fair by a non-welfarist government is a strict subset of the set of allocations considered as fair by a welfarist government.

4.2 Optimal second-best tax system

If personalized commodity taxes are not feasible, a second-best tax system, from the perspective of the government, is a solution to the following problem:

$$\max_{t_x,t_z,\tau_i,\overline{z}_i,i=1,...,n} \tilde{v}_1(q_x, q_z, \tau_1, \overline{z}_1) + \frac{\varphi}{n}\sum_{j=1}^{n} \tilde{v}_j(q_x, q_z, \tau_j, \overline{z}_j) \tag{37}$$

subject to

$$\tilde{v}_i(q_x, q_z, \tau_i, \overline{z}_i) + \frac{\varphi}{n}\sum_{j=1}^{n} \tilde{v}_j(q_x, q_z, \tau_j, \overline{z}_j) \geq \overline{v}_i \qquad i = 2, ..., n \qquad (\tilde{\mu}_i^{SB}) \tag{38}$$

$$t_x \sum_{i=1}^{n} x_i + t_z \sum_{i=1}^{n} z_i \geq \sum_{i=1}^{n} \tau_i \qquad (\tilde{\lambda}^{SB}) \tag{39}$$

$$\overline{z}_i = \frac{1}{n}\sum_{j=1}^{n} a_{ij} z_j \qquad i = 1, ..., n \qquad (\tilde{\gamma}_i^{SB}) \tag{40}$$

The first-order conditions for this problem are provided in the Appendix. Note that the only difference to problem (14) – (17) is the objective function in which the status part of the utility function is now omitted. Still, $\tilde{v}_i$ is affected by the reference level through the effect of $\overline{z}_i$ on x, z, l.[28] Thus, when designing the optimal tax system the effect of taxes on the reference levels has to be taken into account, even though the direct impact of $\overline{z}_i$ on individual utility is not considered.

From the first-order conditions of problem (37)-(40) one can derive an implicit solution for the optimal second-best commodity taxes chosen by a non-welfarist government.

Proposition 4 (Non-welfarist government: second-best commodity taxes) *The optimal second-best commodity taxes from the perspective of a non-welfarist government are given by*

$$\begin{aligned} \tilde{t}_z^{**} &= \frac{\frac{1}{n}\left(\overline{s}_{xx} \sum_{i=1}^n \frac{\tilde{\theta}_i^{SB}}{\tilde{\lambda}^{SB}} \frac{1}{\overline{z}_i} \frac{\partial m}{\partial r_i} s_{zz}^i - \overline{s}_{xz} \sum_{i=1}^n \frac{\tilde{\theta}_i^{SB}}{\tilde{\lambda}^{SB}} \frac{1}{\overline{z}_i} \frac{\partial m}{\partial r_i} s_{zx}^i\right)}{\overline{s}_{zz}\overline{s}_{xx} - \overline{s}_{zx}\overline{s}_{xz}} \\ &\quad + \frac{\frac{1}{n}\left(\overline{s}_{xx} \sum_{i=1}^n \tilde{\epsilon}_i s_{zz}^i - \overline{s}_{xz} \sum_{i=1}^n \tilde{\epsilon}_i s_{zx}^i\right)}{\overline{s}_{zz}\overline{s}_{xx} - \overline{s}_{zx}\overline{s}_{xz}}, \end{aligned} \tag{41}$$

$$\begin{aligned} \tilde{t}_x^{**} &= \frac{\frac{1}{n}\left(\overline{s}_{zz} \sum_{i=1}^n \frac{\tilde{\theta}_i^{SB}}{\tilde{\lambda}^{SB}} \frac{1}{\overline{z}_i} \frac{\partial m}{\partial r_i} s_{zx}^i - \overline{s}_{zx} \sum_{i=1}^n \frac{\tilde{\theta}_i^{SB}}{\tilde{\lambda}^{SB}} \frac{1}{\overline{z}_i} \frac{\partial m}{\partial r_i} s_{zz}^i\right)}{\overline{s}_{zz}\overline{s}_{xx} - \overline{s}_{zx}\overline{s}_{xz}} \\ &\quad + \frac{\frac{1}{n}\left(\overline{s}_{zz} \sum_{i=1}^n \tilde{\epsilon}_i s_{zx}^i - \overline{s}_{zx} \sum_{i=1}^n \tilde{\epsilon}_i s_{zz}^i\right)}{\overline{s}_{zz}\overline{s}_{xx} - \overline{s}_{zx}\overline{s}_{xz}}, \end{aligned} \tag{42}$$

[28] The sign of $\tilde{v}_{\overline{z}}$ is ambiguous. In contrast to the previous section, now the government only takes the indirect effect of $\overline{z}_i$ on $\tilde{u}_i(x, z, l)$ through its effect on demand for x, z, l into account and not the direct impact on $m_i(r_i)$.

where $\tilde{\theta}_i^{SB} \equiv \tilde{\mu}_i^{SB} + \varphi/n \sum_{j=1}^n \tilde{\mu}_j^{SB}$ *and* $\tilde{\epsilon}_i \equiv n^{-1} \sum_{j=1}^n (\tilde{\gamma}_j^{SB}/\tilde{\lambda}^{SB}) a_{ji}$.
Proof. See Appendix.

Here, the optimal commodity tax rates depend on two terms. The first term can be interpreted as the preference correcting part of the optimal tax formulas. From the perspective of the government, households consume too much of the status good and it wants to deter individuals to purchase good z just for status reasons. Therefore, this term is strictly positive in the case of $\tilde{t}_z^{**}$, making the status good more expensive. Note that $\tilde{t}_x^{**}$ also depends on a preference correcting part, given by the first term on the right-hand side (42). The reason is similar to the welfarist case in which t_x is used to correct for the status externality. Due to differences across households in their willingness to pay for additional status the government would want to tax status consumption of each household at a different rate. Since it is restricted to use a single rate, it is optimal to use other tax instruments to correct for status preferences. The sign of the correction term in the case of $\tilde{t}_x^{**}$ is ambiguous.

The second term on the right hand side of (41) and (42) looks very similar to the term determining the optimal commodity tax rates in the welfarist case. However, its interpretation is different as $\tilde{\epsilon}_i$ differs from ϵ_i. If the government has a welfarist objective function, ϵ_i basically describes the marginal welfare cost of an increase in the externality level $\overline{z}_i$. In the case of a non-welfarist government there is no direct welfare loss associated with an increase of $\overline{z}_i$. But since demand for x, z, l reacts to changes in the reference levels there is an indirect effect of $\overline{z}_i$ on the objective function and on commodity tax revenues and these effects are summarized by $\tilde{\epsilon}_i$. Thus, when determining $\tilde{t}_z^{**}$ and $\tilde{t}_x^{**}$ the government has to take the effect of taxes on the reference levels into account, even though it has no externality-correcting motive.

Similarly to the welfarist case the optimal commodity tax structure depends crucially on compensated price effects and on how the reference levels are formed.

Corollary 2 (Non-welfarist government: second-best commodity tax structure - special cases)
(i) If the externality is atmospheric and symmetric and if $\frac{\tilde{\theta}_i^{SB}}{\tilde{\lambda}^{SB}} \frac{\partial m_i}{\partial r_i} = \frac{\tilde{\theta}^{SB}}{\tilde{\lambda}^{SB}} \frac{\partial m}{\partial r}$ *for all* $i \in N$, *optimal commodity tax rates are given by*

$$\tilde{t}_z^{**} = \tilde{t}_z^{*} = \frac{\tilde{\theta}^{SB}}{\tilde{\lambda}^{SB}} \frac{1}{\overline{z}} \frac{\partial m}{\partial r}, \qquad \tilde{t}_x^{**} = \tilde{t}_x^{*} = 0. \tag{43}$$

(ii) If $s_{zx}^i = 0$ *or* $s_{zx}^i = s_{zz}^i$ *for all* $i \in N$ *and without any restriction on the reference*

levels

$$\tilde{t}_z^{**} = \frac{1}{\sum_{i=1}^n s_{zz}^i} \left(\sum_{i=1}^n \frac{\tilde{\theta}_i^{SB}}{\tilde{\lambda}^{SB}} \frac{1}{\overline{z}_i} \frac{\partial m}{\partial r_i} s_{zz}^i + \sum_{i=1}^n \tilde{\epsilon}_i s_{zz}^i \right), \qquad \tilde{t}_x^{**} = 0. \tag{44}$$

Proof. See Appendix.

Case (i) refers to a scenario in which there is a unique reference level and in which the consumption of all households is weighted equally in the formation of that reference level. If in addition $\frac{\tilde{\theta}_i^{SB}}{\tilde{\lambda}^{SB}} \frac{\partial m_i}{\partial r_i}$ is the same for all households[29] then the first-best allocation can be implemented without personalized commodity taxes and good x needs not to be taxed. This statement is equivalent to the one in Proposition 3 (ii). Observe that for a welfarist government a uniform tax on the status good in addition to the lump-sum element suffices to implement the first-best allocation as soon as the externality is atmospheric (see Corollary 1). For a non-welfarist government more conditions are required. This is because a non-welfarist government has to take two aspects into account when correcting for status consumption, namely correction of preferences and correction of the indirect effect of the reference level on social welfare. For the former the heterogeneity in preferences among households for status consumption matters, for the latter the heterogeneity among households in the generation of the reference levels matters.

From case (ii) it can be seen that also in the non-welfarist case the structure of compensated price effects has a strong impact on optimal commodity taxes. If there are no compensated cross price effects or if the compensated cross price effects are equal to the own compensated price effect for the status good, then good x needs not to be taxed to correct for status preferences. The explanation for this result is the same as the one provided after Corollary 1.

With respect to the optimal-lump sum element, a similar result to the one provided in the welfarist case can be derived. By plugging optimal commodity taxes into the first-order condition for $\tilde{\tau}_i$, it can be seen that $\tilde{\tau}_i^{**}$ also serves to correct for status preference if a uniform tax on the status good does not suffice to fully correct for status preferences. Loosely speaking, the lump-sum element can be used to compensate those who have no or only a very weak taste for status and whose consumption of good z is overcorrected by the commodity taxes. From those who have a very strong taste for status, additional correction of status consumption can be achieved by extracting income through the lump-sum element.

[29] The amount of income a household is prepared to give up for an additional unit of status (r_i) is identical across households.

Also in second-best, a non-welfarist government has to take a fairness condition into account which limits the set of allocations consistent with the Pareto criterion. The reason is that the government respects altruism to be part of the utility function. Formally the fairness condition is now given by

$$\frac{1+\varphi}{\varphi} \geq \frac{1}{n} \sum_{j=1}^{n} \frac{\frac{\partial \tilde{v}_i / \partial \tilde{\tau}_i}{\widetilde{MSC}_i}}{\frac{\partial \tilde{v}_j / \partial \tilde{\tau}_j}{\widetilde{MSC}_j}} \tag{45}$$

for all $i = 1, ..., n$.[30] Thus, again for an allocation to be Pareto efficient the weighted average ratio of the marginal utility of income between household i and all other households must not be too large.

5 Results from Numerical Simulations

The above propositions imply the qualitative result that the nature of the consumption externality does have an impact on the first-best and second-best efficient commodity tax rates both for a welfarist and for a non-welfarist welfare criterion. Considering reasonable calibrations, three main *quantitative* questions suggest themselves. First, for a given consumption externality (benchmark case), how different are first-best and second-best efficient commodity tax rates between the welfarist and the non-welfarist case? Second, what are the effects of the nature of the consumption externality – whether it is atmospheric or non-atmospheric, whether it is symmetric or asymmetric – on the first-best and second-best commodity tax rate of the positional good both in the welfarist and the non-welfarist case? Third, in a second-best setting, what is the impact of the nature of the consumption externality on the commodity tax rate of the non-positional good, which is essentially zero in the first-best?

Numerical simulations, addressing these questions, are presented in the following. The results of those simulations are *not* intended to suggest precise first-best or second-best tax rates on (non-)positional goods. Rather, they are intended to provide a rough indication of how important the nature of the consumption externality for efficient tax rates – under a reasonable calibration – is. Therefore, the numerical simulations focus on the *change* of efficient tax rates due to the consumption externality rather than on the *levels* of efficient tax rates.

We employ a specified model with two types of households, 1 and 2. There are n households. A share of η is of type 1, and a share of $(1-\eta)$ is of type 2. Household

[30] In the non-welfarist case we define the marginal social cost of increasing income for household i by $\widetilde{MSC}_i \equiv 1 - t_x \frac{\partial x_i}{\partial \tau_i} - t_z \frac{\partial z_i}{\partial \tau_i} + \tilde{\epsilon}_i \frac{\partial z_i}{\partial \tau_i}$. For a derivation of (45), we proceed in the same way as in the derivation of the fairness condition for the welfarist case (see Appendix).

types differ with respect to three attributes: preferences, labor productivity, and (possibly) externality coefficients a_{ij}. Every household is endowed with one unit of time. A household of type i receives a wage rate of w_i per unit of labor supplied. Preferences are represented by the following utility functions.

$$u_i(x_i, z_i, l_i, \bar{z}_i) = \alpha_i \ln x_i + \beta_i \ln \left[z_i \left(\frac{z_i}{\bar{z}_i} \right)^{p_i} \right] + \gamma_i \ln l_i \,, \quad i = 1, 2 \,, \tag{46}$$

where $\bar{z}_i \equiv \eta \, a_{i1} z_1 + (1 - \eta) \, a_{i2} z_2$. Notice that these utility functions satisfy the separability requirement of the non-welfarist case. Preference parameter p_i represents the strength of "positionality." If $p_i = 0$, the consumption reference level does not affect type i's behavior. However, the higher is p_i, the stronger is the impact of $\bar{z}_i$ on household type i's behavior. Johansson-Stenman et al. (2002) refer to $[p_i/(1+p_i)]$ as the *marginal degree of positionality.*

What we call baseline values of the background parameters is listed in Table 1. Unless stated otherwise, tables and graphs are based on these parameter values that imply standard stylized facts, as discussed below.

TABLE 1

BASELINE VALUES OF BACKGROUND PARAMETERS

Households		Type 1	Type 2 ("rich")
Preference parameters	α_i	1/3	1/4
	β_i	5/12	5/12
	γ_i	1/4	1/3
	p_i	1/5	2/5
Productivity	w_i	2	4
Externality parameters	a_{1i}	4/5	9/5
	a_{2i}	3/5	13/5
Share parameter	η_i	4/5	1/5
Utility	u_i	endogenous	-7/20

NOTE. Notice that $\eta_1 a_{i1} + \eta_2 a_{i2} = 1$.

With this parameterization, households of type 2 are considered significantly more productive than households of type 1 ($w_2 > w_1$). Consistent with empirical evidence, those households have a stronger impact on the consumption reference levels than type 1-households ($a_{i2} > a_{i1}$). Roughly, households of type 2 are rich and they are the primary externality generators. These households are typically a small group within an economy. Therefore, we give this group just a small weight ($(1 - \eta) = 1/5$).

Regarding the degree of positionality, we consider "rich" households as at least as positional as other households. Specifically, $2/5 = p_2 > p_1 = 1/5$. Empirical studies, including Alvarez-Cuadrado et al. (2012), Maurer et al. (2008), Ravina (2007), or Wendner and Goulder (2008) demonstrate that the marginal degree of positionality falls into the range $[0.2, 0.4]$. Converting this range into a range for our p_i yields $p_i \in [0.25, 0.67]$. In our study we are quite conservative and consider the low end of $p_i = 0.2$, and the high end of $p_i = 0.4$ (see Table 1).

Minimum utility of household type 2 is chosen to amount to a value of -0.35. As $w_2 > w_1$, this value is somewhat higher than the endogenous value of u_1. Given this parameterization, we fix the values of the other preference parameters $(\alpha_i, \beta_i, \gamma_i)$ so that households choose an employment share in between $(0.6, 0.75)$, that is, $l_i \in (0.25, 0.4)$. Close to no empirical evidence exists for the coefficients a_{ij}. Therefore, most numerical simulations deal with the sensitivity of efficient tax rates with respect to a_{ij}. We are now ready to turn to our first question.

5.1 Welfarist versus non-welfarist tax rates

For the consumption externality as given by the baseline values (Table 1), how different are first-best and second-best efficient commodity tax rates between the welfarist and the non-welfarist case?

TABLE 2

Welfarist versus Non-welfarist Tax Rates (baseline values)

	FB welfarist	SB welfarist	FB non-welfarist	SB non-welfarist
$t_{z,1}$, $t_{z,2}$	0.17, 0.50	0.26	0.20, 0.40	0.26
t_x	0.000	0.014	0.000	0.007
τ_1, τ_2	0.35, -0.14	0.45, -0.44	0.36, -0.17	0.41, -0.33
u_1	-0.47	-0.48	-0.47	-0.47
x_1, x_2	0.72, 0.83	0.74, 0.75	0.73, 0.82	0.74, 0.78
z_1, z_2	0.93, 1.28	0.90, 1.41	0.91, 1.37	0.88, 1.46
$\bar{z}_1$, $\bar{z}_2$	1.06, 1.11	1.08, 1.17	1.07, 1.15	1.09, 1.18
l_1, l_2	0.27, 0.28	0.28, 0.25	0.27, 0.27	0.28, 0.26

Note. FB = first-best, SB = second-best. In SB, a unique value for t_z is given, as $t_{z,1} = t_{z,2}$.

Table 2 suggests three main results. First, the magnitude of efficient tax rates of a welfarist and non-welfarist government (both in first-best and second-best) are very similar. Second, in the first-best, the efficient tax rate on the positional good is vastly sensitive with respect to a household's strength of externality generation. For the baseline calibration, household type 2 is the primary generator of the consumption externality

($a_{i2} > a_{i1}$, $i = 1, 2$). In the welfarist (non-welfarist) case, $t_{z,2}$ is three times (twice) as large as $t_{z,1}$. Third, in the second-best, the efficient tax on the non-positional good is different from zero, but quite small as compared to t_z. In the welfarist (non-welfarist) case, $t_x = 1.4\%$ ($t_x = 0.7\%$). That is, from a corrective point of view, positional and non-positional commodities need to be taxed highly differently.

5.2 Welfarist versus non-welfarist tax rates and the nature of the consumption externality

This subsection considers the effects of the nature of the consumption externality on the first-best and second-best commodity tax rates of the positional good both in the welfarist and the non-welfarist case.

5.2.1 Efficient taxation in the first-best

In Table 3 below, by systematically varying coefficients a_{ij}, we identify the effects on efficient commodity tax rates of the consumption externality being non-atmospheric rather than atmospheric as well as being asymmetric rather than symmetric. Specifically, Panel A considers an atmospheric and symmetric consumption externality ($a_{ij} = 1$). Panel B takes up a *non-atmospheric* and symmetric consumption externality. Comparing Panels A and B allows some inference of the impact of the consumption externality being non-atmospheric rather than atmospheric on efficient taxation. Panels C.1 and C.2 investigate a non-atmospheric and *asymmetric* consumption externality. Comparing Panels B and C allows some assessment of the effects of the consumption externality being asymmetric rather than symmetric.

Table 3 offers several insights. Here we focus on the first-best tax regimes, for which $t_x = 0$. In the following subsection, we focus on the second-best tax regimes. In order to sharpen the differences between the welfarist and the non-welfarist case, preferences (46) are chosen such that only direct effects — effects via the welfare criterion — are caused by $\bar{z}_i$.[31]

To begin with, consider the first column, labeled "FB welfarist", of Table 3. It is evident that the nature of the consumption externality does have a major impact on the first-best efficient tax rates of the positional good. In particular — in the welfarist case — $t_{z,i}$ is identical across individuals as long as the consumption externality is atmospheric.

[31] In other words, in the optimum, (x_i, z_i, l_i) are affected by p_i but not by $\bar{z}_i$. Thus, in the non-welfarist case, individual behavior is independent of the composition of $\bar{z}_i$. As the welfare criterion is independent of $\bar{z}_i$ too, the efficient non-welfarist tax regimes are identical across Panels A to C.2. In contrast, in the welfarist case, the welfare criterion does depend on $\bar{z}_i$. Thus, the efficient welfarist tax regime also depends on the composition of $\bar{z}_i$.

Once it becomes non-atmospheric, $t_{z,i}$ vary greatly across household types, no matter whether the externality is asymmetric or not, as seen from comparing Panel A with Panels B , C.1, and C.2.

TABLE 3

EFFECTS OF THE NATURE OF THE CONSUMPTION EXTERNALITY

	FB welfarist	SB welfarist	FB non-welfarist	SB non-welfarist
PANEL A				
$a_{11} = 1$, $a_{12} = 1$				
$a_{21} = 1$, $a_{22} = 1$				
$t_{z,1}$, $t_{z,2}$	0.25, 0.25	0.25	0.20, 0.40	0.26
t_x	0.000	0.000	0.000	0.007
τ_1, τ_2	0.45, -0.54	0.45, -0.54	0.36, -0.17	0.41, -0.33
PANEL B				
$a_{11} = 0.6$, $a_{12} = 2.6$				
$a_{21} = 0.6$, $a_{22} = 2.6$				
$t_{z,1}$, $t_{z,2}$	0.14, 0.61	0.26	0.20, 0.40	0.26
t_x	0.000	0.019	0.000	0.007
τ_1, τ_2	0.33, -0.02	0.45, -0.43	0.36, -0.17	0.41, -0.33
PANEL C.1				
$a_{11} = 0.6$, $a_{12} = 2.6$				
$a_{21} = 0.4$, $a_{22} = 3.4$				
$t_{z,1}$, $t_{z,2}$	0.12, 0.69	0.27	0.20, 0.40	0.26
t_x	0.000	0.023	0.000	0.007
τ_1, τ_2	0.30, 0.10	0.45, -0.38	0.36, -0.17	0.41, -0.33
PANEL C.2				
$a_{11} = 0.6$, $a_{12} = 2.6$				
$a_{21} = 0.8$, $a_{22} = 1.8$				
$t_{z,1}$, $t_{z,2}$	0.16, 0.53	0.26	0.20, 0.40	0.26
t_x	0.000	0.015	0.000	0.007
τ_1, τ_2	0.35, -0.14	0.46, -0.47	0.36, -0.17	0.41, -0.33

NOTE. FB = first-best, SB = second-best. Except for a_{ij}, background parameters assume the baseline values.

Panels C depicts situations in which type 2 households have a much stronger impact on the build up of the consumption reference level than households of type 1, that is, the externality is non-atmospheric. However, this effect is significantly more (significantly less) pronounced for type 2-households than for type 1-households in Panel C.1 (Panel C.2). That is, the consumption externalities are also asymmetric. The asymmetry effect may either strengthen or weaken the above result. Particularly, in Panel C.1, the primary externality generating type has a comparatively higher impact on its own type 2 than on the less positional type 1 ($a_{22} > a_{12}$). Consequently, $t_{z,i}$ vary by more across household types than in case of a symmetric consumption externality. In Panel C.2, the primary externality generating type has a comparatively lower impact on its own type 2 than on the less positional type 1 ($a_{22} < a_{12}$), with the consequence that the $t_{z,i}$ vary by less across household types than in case of a symmetric externality.

Next, consider the third column of Table 3, labeled "FB non-welfarist." Here, the tax rates on the positional good vary across households even for an atmospheric and symmetric consumption externality. In the non-welfarist case, the variation is not driven by the consumption reference levels (see Footnote 31) but by the strength of positionality, p_i. Considering the baseline values of the parameters, $p_2 = 2\,p_1$, which — for the given preferences (46) — translates in household type 2 facing a tax rate twice as high as that of household type 1.

5.2.2 Efficient taxation in the second-best

The second-best results are probably of greater policy relevance than first-best tax rates. Table 3 evokes the following three insights. While the nature of the consumption externality vastly influences first-best efficient tax rates, it has only a minimal impact on second-best tax rates. This holds for both the tax rates on the positional good as well as the tax rates on the non-positional good. Although the unique second-best tax rate on the positional good mimics the first-best tax regime very incompletely only, the second-best tax rate on the non-positional good — not exceeding 2.3% — is quite low in all cases. Finally, while first-best efficient tax rates in the welfarist- and the non-welfarist cases are quite different, the respective second-best tax regimes are remarkably close to each other.

The results inferred from the above tables hold for a considerably wider set of parameter values. Sensitivity analysis with respect to p_i and further patterns of a_{ij} (including special cases addressed in Section 3.1) are available from the authors upon request.

5.2.3 The fairness condition under a (non-) welfarist government

In Section 3.2, we argue that the fairness condition rules out efficient allocations that are "too" different in terms of marginal utilities of income. Does the fairness condition under a welfarist optimality criterion rule out other allocations compared to a non-welfarist criterion? Numerical simulations suggest an affirmative answer.Under a non-welfarist criterion, the fairness condition systematically rules out efficient allocations that are not ruled out under a welfarist welfare criterion.[32] Non-welfarism narrows the set of fair utility allocations. Phrased differently, a non-welfarist government acts more egalitarian

[32]This is a rough statement, though, as *different* allocations are efficient under the two welfare criteria.

than a welfarist government.

In Figure 4, all parameters except for p_i assume their baseline values. The strengths of positionality are higher here ($p_1 = 1/2$, $p_2 = 4/5$) in order to make the differences between the welfarist- and the non-welfarist case better visible. In (u_1, u_2) space, the figure shows the utility possibility frontiers. The thick (thin) frontier refers to the welfarist (non-welfarist) case. Along the line labeled "egalitarian allocations," $u_1 = u_2$ holds. In Figure 4, the altruism parameter is chosen to be $\varphi = 5$.

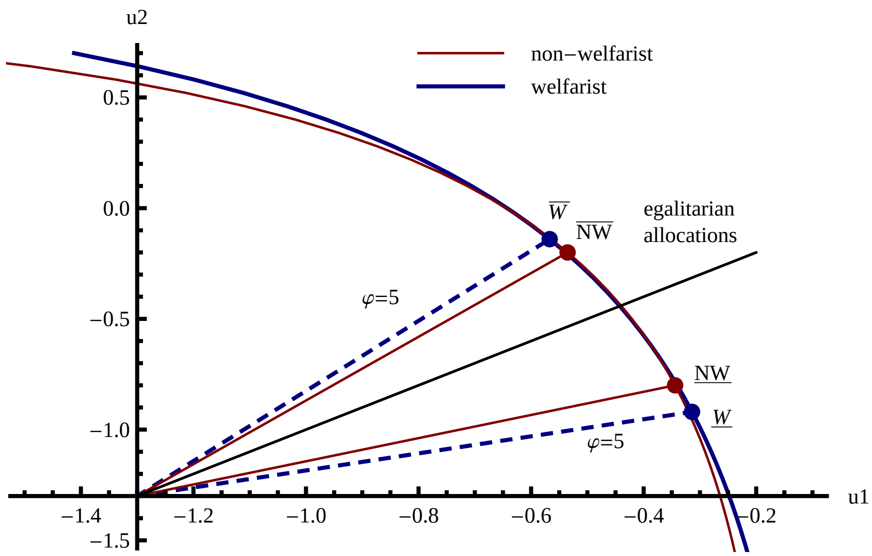

FIGURE 4. First-best: Fair allocations under welfarist and non-welfarist welfare criteria; $\varphi = 5$.

The thin non-welfarist utility possibility frontier is weakly below the thick welfarist frontier. Dots $\{\underline{W}, \overline{W}\}$ indicate the boundaries of the welfarist fair utility allocations, while dots $\{\underline{NW}, \overline{NW}\}$ indicate the boundaries of the non-welfarist fair utility allocations. As argued above, the fairness condition puts a limit on the marginal utilities of income, or equivalently, on the slopes of the utility possibility frontiers. At $\{\underline{W}, \underline{NW}\}$ as well as at $\{\overline{W}, \overline{NW}\}$ the slopes of the utility possibility frontiers are identical.

As seen in Figure 4, non-welfarism "shrinks" the set of fair utility allocations. A number of utility allocations that are fair under a welfarist optimality criterion are not considered fair under a non-welfarist criterion. To gain intuition to this shrinking, think about the elasticity of $\tilde{v}_j$ with respect to $d\tau_j > 0, d\tau_i < 0$. The elasticity is higher in the welfarist case than in the non-welfarist case. The reason is that a non-welfarist government (in contrast to a welfarist government) does not take into account the additional rise in utility, gained by type j from a decrease of the consumption of the positional good by i, due to a decline of the lump sum transfer $d\tau_i$. In other words, the utility possibility frontier is flatter (less curved) under a welfarist criterion than under a non-welfarist criterion. So, more utility allocations are compatible with the fairness condition under a welfarist criterion as compared to a non-welfarist criterion. As a consequence, the fairness condition requires a non-welfarist government to act more egalitarian than a welfarist government.

6 Conclusions

This paper addresses the effects of non-atmospheric and asymmetric consumption externalities on efficient commodity taxes. The analysis is motivated by the fact that a KUJ-externality typically involves substantial preference-heterogeneities. In addition to being status conscious households are assumed to be altruistic in our framework. That is, households care about their relative position in society but, at the same time, they dislike income inequality. The analysis is conducted from two perspectives, that of a welfarist and that of a non-welfarist government. The reason is that it is questionable whether or not status preferences, which are a form of envy, should be respected by the policy maker. Finally, numerical simulations illustrate the theoretical results.

We find that the nature of the consumption externality has a strong impact on efficient first-best commodity taxes in the *welfarist* case. Even if a personalized lump-sum element is available, personalized commodity taxes are required to implement a first-best allocation, given the externality is non-atmospheric. Numerical simulations suggest that first-best tax rates in the welfarist case are highly sensitive to the specific nature of the consumption externality. In the *non-welfarist* case, personalized commodity taxes (in addition to personalized lump-sum taxes) are required to achieve a first-best allocation if, loosely speaking, some households are more status conscious than others. This implies that the nature of the consumption externality affects first-best tax rates only if the reference level has an impact on how much households are willing to give up in terms of additional status. This is the case if the marginal rate of substitution between leisure and the positional good changes with the reference level.[33]

Since personalized commodity taxes are hardly a feasible policy instrument we also study efficient tax programs when commodity taxes are restricted to be uniform across households. The nature of the consumption externality affects the efficient tax structure in the welfarist case insofar as all tax instruments (all commodity- and lump sum taxes) are required to correct for the externality as soon as personalized commodity taxes are not available. However, our numerical simulations suggest that quantitatively these effects are only of minor relevance. Also in the non-welfarist case the whole tax system

[33] In the section on numerical simulations we consider preferences where $\partial MRS_{zx}/\partial \overline{z}_i = 0$, which explains why there is no effect of the nature of the consumption externality on the simulation results in the non-welfarist case.

is required to correct for status preference if personalized commodity taxes are not available, but again, in the numerical simulations it turns out that these effects are small.

Perhaps surprisingly, the structures of efficient commodity tax programs of both a welfarist and a non-welfarist government are similar. Still, the motive for the taxation of status consumption is very different in the two scenarios. A welfarist government wants to tax status consumption in order to correct for a consumption externality. From the perspective of a non-welfarist government this consumption externality does not exist. Its motive for taxing status consumption is to correct for status preferences, that is, its goal is to design a tax system which induces households to behave as if they had no status concerns. Our numerical simulations suggest that not only the qualitative structure of efficient tax programs is similar but also quantitatively efficient tax rates are surprisingly similar in the two cases.

The presence of genuine altruism has no impact on the structure of efficient commodity tax programs. However, it gives rise to a fairness condition which requires the distribution of utility not to be too unequal. The nature of the consumption externality has a strong impact on the set of allocations considered as fair. For example, in the welfarist case more inequality is tolerated towards households whose status consumption is particularly harmful. Further, we show that, everything else equal, the set of allocations considered as fair by a non-welfarist government is smaller than that considered as fair by a welfarist government, i.e. less inequality is tolerated if the government is non-welfarist.

There are several interesting ways to extend the contribution of this paper. First, the weights a_{ij} are assumed to be exogenous in this paper. A major further step consists in developing a theory that endogenizes these weights and develops a mechanism explaining how individuals form their reference groups and reference levels. Second, although redistribution is part of our model, its impact on the tax structure is limited since we allow for personalized lump-sum taxes. A further step is the analysis of efficient tax programs in the current context in case the lump-sum element is restricted to be uniform. This might have a strong impact on the relationship between the fairness condition and the tax system. Third, besides genuine altruism, as considered in our paper, there exist other forms of altruism such as pure or paternalistic altruism (see, e.g., Johansson, 1997). An interesting further step consists in studying the impact of other forms of altruism on efficient tax programs. Notwithstanding these limitations, we hope this study clarifies the impact of status effects on optimal commodity taxation and is able to contribute to future discussions of tax reform.

Appendix

Characterization of first-best allocations in the welfarist case

The Lagrangian for the maximization problem (7)-(10) reads

$$\begin{aligned}\mathcal{L} &= \sum_{i=1}^{n} \theta_i^{FB} u_i(x_i, z_i, l_i, \overline{z}_i) - \sum_{i=2}^{n} \mu_i^{FB} \overline{u}_i + \lambda^{FB} (\sum_{i=1}^{n} w_i(1-l_i) - \sum_{i=1}^{n} x_i - \sum_{i=1}^{n} z_i) \\ &\quad + \sum_{i=1}^{n} \gamma_i^{FB} (\overline{z}_i - \frac{1}{n} \sum_{j=1}^{n} a_{ij} z_j). \qquad (47)\end{aligned}$$

with $\theta_i^{FB} \equiv \mu_i^{FB} + \frac{\varphi}{n} \sum_{j=1}^{n} \mu_j^{FB}$ and $\mu_1^{FB} \equiv 1$. The first-order conditions with respect to x_i, z_i, l_i and $\overline{z}_i$ are given by

$$\theta_i^{FB} \frac{\partial u_i}{\partial x_i} - \lambda^{FB} = 0 \qquad (48)$$

$$\theta_i^{FB} \frac{\partial u_i}{\partial z_i} - \lambda^{FB} - \frac{1}{n} \sum_{j=1}^{n} \gamma_j^{FB} a_{ji} = 0 \qquad (49)$$

$$\theta_i^{FB} \frac{\partial u_i}{\partial l_i} - \lambda^{FB} w_i = 0 \qquad (50)$$

$$\theta_i^{FB} \frac{\partial u_i}{\partial \overline{z}_i} + \gamma_i^{FB} = 0 \qquad (51)$$

for $i = 1, ..., n$. Combining (49) and (48) yields equation (11) in the text and combing (48) and (50) yields equation (12) in the text.

The fairness condition in (13) can be derived as follows. From the definition for θ_i^{FB} it follows that

$$\mu_i^{FB} = \theta_i^{FB} - \frac{\varphi}{n} \sum_{j=1}^{n} \mu_j^{FB}, \qquad (52)$$

and hence $\sum_{i=1}^{n} \mu_i^{FB} = \frac{1}{1+\varphi} \sum_{i=1}^{n} \theta_i^{FB}$. Plug in for $\sum_{i=1}^{n} \mu_i^{FB}$ in (52) to get $\mu_i^{FB} = \theta_i^{FB} - \frac{\varphi}{(1+\varphi)n} \sum_{j=1}^{n} \theta_j^{FB}$. Then the non-negativity of μ_i^{FB} together with (48) to substitute for θ_i^{FB} yields the fairness condition given by (13).

Proof of Proposition 1

(i) From Definition 1 we know that an externality is atmospheric if $a_{ji} = a_{ji'}$ for all $j, i, i' \in N$, whether or not the externality is asymmetric. This implies that then $\Psi_i = \Psi_{i'}$ for all $i, i' \in N$. Combining the optimality condition of the households ((4)and (5)) with

those of the government ((11) and (12)) shows that households choose the optimal consumption bundle if $t_z^* = \Psi$ and $t_x^* = 0$.
(ii) From Definition 1 it follows that $\Psi_i \neq \Psi_{i'}$ for some $i, i' \in N$ if the externality is non-atmospheric. This implies that personalized commodity taxes $t_{z,i} = \Psi_i$ are required to induce households to choose the optimal consumption bundle.
(iii) Households differ in preferences and wages. The lump-sum element τ_i is adapted such that (11)-(13) hold, given that t_z^*, t_x^* are set optimally.

First-order condition for problem (14)-(17)

The Lagrangian for the maximization problem (14)-(17) reads

$$\begin{aligned}\mathcal{L} &= \sum_{i=1}^{n} \theta_i^{SB} v_i(q_x, q_z, \tau_i, \overline{z}_i) - \sum_{i=2}^{n} \mu_i^{SB} \overline{v}_i + \lambda^{SB}(t_x \sum_{i=1}^{n} x_i + t_z \sum_{i=1}^{n} z_i - \sum_{i=1}^{n} \tau_i) \\ &\quad + \sum_{i=1}^{n} \gamma_i^{SB} (\overline{z}_i - \frac{1}{n} \sum_{j=1}^{n} a_{ij} z_j). \end{aligned} \tag{53}$$

The first-order conditions with respect to t_x, t_z, τ_i and $\overline{z}_i$ are given by

$$\sum_{i=1}^{n} \theta_i^{SB} \frac{\partial v_i}{\partial t_x} + \lambda^{SB}(\sum_{i=1}^{n} x_i + t_x \sum_{i=1}^{n} \frac{\partial x_i}{\partial t_x} + t_z \sum_{i=1}^{n} \frac{\partial z_i}{\partial t_x}) - \frac{1}{n} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_i^{SB} a_{ij} \frac{\partial z_j}{\partial t_x} = 0 \tag{54}$$

$$\sum_{i=1}^{n} \theta_i^{SB} \frac{\partial v_i}{\partial t_z} + \lambda^{SB}(\sum_{i=1}^{n} z_i + t_x \sum_{i=1}^{n} \frac{\partial x_i}{\partial t_z} + t_z \sum_{i=1}^{n} \frac{\partial z_i}{\partial t_z}) - \frac{1}{n} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_i^{SB} a_{ij} \frac{\partial z_j}{\partial t_z} = 0 \tag{55}$$

$$\theta_i^{SB} \frac{\partial v_i}{\partial \tau_i} + \lambda^{SB}(t_x \frac{\partial x_i}{\partial \tau_i} + t_z \frac{\partial z_i}{\partial \tau_i}) - \lambda^{SB} - \frac{1}{n} \sum_{j=1}^{n} \gamma_j^{SB} a_{ji} \frac{\partial z_i}{\partial \tau_i} = 0 \tag{56}$$

$$\theta_i^{SB} \frac{\partial v_i}{\partial \overline{z}_i} + \lambda^{SB}(t_x \frac{\partial x_i}{\partial \overline{z}_i} + t_z \frac{\partial z_i}{\partial \overline{z}_i}) + \gamma_i^{SB} - \frac{1}{n} \sum_{j=1}^{n} \gamma_j^{SB} a_{ji} \frac{\partial z_i}{\partial \overline{z}_i} = 0 \tag{57}$$

with $\theta_i^{SB} \equiv \mu_i^{SB} + \frac{\varphi}{n} \sum_{j=1}^{n} \mu_j^{SB}$ and $\mu_1^{SB} \equiv 1$.

Derivation of optimal commodity taxes in second best: welfarist case

Take the first-order condition (55) for t_z, plug in for $\frac{\partial v_i}{\partial t_z} = -z_i \frac{\partial v_i}{\partial \tau_i}$ and use the definition for the net social marginal utility $b_i \equiv \frac{\theta_i^{SB}}{\lambda^{SB}} \frac{\partial v_i}{\partial \tau_i} + t_x \frac{\partial x_i}{\partial \tau_i} + t_z \frac{\partial z_i}{\partial \tau_i} - \epsilon_i \frac{\partial z_i}{\partial \tau_i}$ to get

$$\begin{aligned} &-\sum_{i=1}^{n} b_i z_i + \sum_{i=1}^{n} z_i + t_x \sum_{i=1}^{n} (\frac{\partial x_i}{\partial t_z} + z_i \frac{\partial x_i}{\partial \tau_i}) + t_z \sum_{i=1}^{n} (\frac{\partial z_i}{\partial t_z} + z_i \frac{\partial z_i}{\partial \tau_i}) \\ &- \sum_{i=1}^{n} \epsilon_i (\frac{\partial z_i}{\partial t_z} + z_i \frac{\partial z_i}{\partial \tau_i}) = 0. \end{aligned} \tag{58}$$

Now, make use of the Slutsky decomposition $s^i_{zz} = \frac{\partial z_i}{\partial t_z} + z_i \frac{\partial z_i}{\partial \tau_i}$ and $s^i_{xz} = \frac{\partial x_i}{\partial t_z} + z_i \frac{\partial x_i}{\partial \tau_i}$ and of the definition for the covariance $\phi(b,z) = \frac{1}{n}\sum_{i=1}^n b_i z_i - \overline{b}\overline{z}$ to get

$$-\overline{b}\overline{z} + \overline{z} - \phi(b,z) = -\frac{1}{n} t_x \sum_{i=1}^n s^i_{xz} - \frac{1}{n} t_z \sum_{i=1}^n s^i_{zz} + \frac{1}{n}\sum_{i=1}^n \epsilon_i s^i_{zz}. \tag{59}$$

Divide (59) by the average consumption of the status good $\overline{z}$ and rearrange terms to get the first part of the many-person Ramsey rule

$$1 - \overline{b} - \frac{\phi(b,z)}{\overline{z}} = \frac{-t_x \overline{s}_{xz} - t_z \overline{s}_{zz} + \frac{1}{n}\sum_{i=1}^n \epsilon_i s^i_{zz}}{\overline{z}}. \tag{60}$$

Take the first-order condition (54) for t_x and proceed in the same way to get the second part of the many-person Ramsey rule

$$1 - \overline{b} - \frac{\phi(b,x)}{\overline{x}} = \frac{-t_x \overline{s}_{xx} - t_z \overline{s}_{zx} + \frac{1}{n}\sum_{i=1}^n \epsilon_i s^i_{zx}}{\overline{x}}. \tag{61}$$

With personalized lump-sum taxes available, the left-hand sides of (60) and (61) become zero as $b_i = \overline{b} = 1$, which follows from (56), and because the covariance $\phi(b,k) = 0$ with $k = \{z, x\}$, as the covariance of a variable with a constant is always zero. After rearranging terms equations, (60) and (61) can be written in matrix form as given in (19) in the text.

Proof of Proposition 2

Apply Cramer's rule to equation (19) to get (20) and (21). $t_z^{**} > 0$ is implied by $\epsilon_i > 0$ together with the assumption that the $2x2$ sub-Slutsky matrix of the taxed goods is non-singular and negative semidefinite.

Derivation of fairness condition in second-best

From the definition for θ_i^{SB} it follows that

$$\mu_i^{SB} = \theta_i^{SB} - \frac{\varphi}{n}\sum_{j=1}^n \mu_j^{SB}, \tag{62}$$

and hence $\sum_{i=1}^n \mu_i^{SB} = \frac{1}{1+\varphi}\sum_{i=1}^n \theta_i^{SB}$. Plug in for $\sum_{i=1}^n \mu_i^{FB}$ in (62) to get $\mu_i^{SB} = \theta_i^{SB} - \frac{\varphi}{(1+\varphi)n}\sum_{j=1}^n \theta_j^{SB}$. Then the non-negativity of μ_i^{SB} togeter with (56) to substitute for θ_i^{SB} yields the fairness condition given by (24).

Characterization of first-best allocations in the non-welfarist case

The Lagrangian for the maximization problem (30)-(33) reads

$$\mathcal{L} = \sum_{i=1}^n \tilde{\theta}_i^{FB} \tilde{u}_i(x_i, z_i, l_i) - \sum_{i=2}^n \tilde{\mu}_i^{FB} \overline{u}_i + \tilde{\lambda}^{FB}(\sum_{i=1}^n w_i(1-l_i) - \sum_{i=1}^n x_i - \sum_{i=1}^n z_i), \tag{63}$$

with $\tilde{\theta}_i^{FB} \equiv \tilde{\mu}_i^{FB} + \frac{\varphi}{n}\sum_{j=1}^{n}\tilde{\mu}_j^{FB}$ and $\tilde{\mu}_1^{FB} \equiv 1$. The first-order conditions with respect to x_i, z_i, l_i are given by

$$\tilde{\theta}_i^{FB}\frac{\partial u_i}{\partial x_i} - \tilde{\lambda}^{FB} = 0 \tag{64}$$

$$\tilde{\theta}_i^{FB}\frac{\partial u_i}{\partial z_i} - \tilde{\lambda}^{FB} = 0 \tag{65}$$

$$\tilde{\theta}_i^{FB}\frac{\partial u_i}{\partial l_i} - \tilde{\lambda}^{FB} w_i = 0 \tag{66}$$

for $i = 1, ..., n$. Combining (65) and (64) yields equation (34) in the text and combing (64) and (66) yields equation (35) in the text. The fairness condition in (36) can be derived in the same way as the one in the welfarist case.

Proof of Proposition 3

(i) Since households differ in preferences and wages they are in general willing to give up different amounts of good x for the better relative position an additional unit of good z provides, i.e. $\Psi_i \neq \Psi_{i'}$ for some $i, i' \in N$ no matter whether the externality is atmospheric or not. Combining the optimality condition of the households ((27)and (28)) with those of the government ((34) and (35)) shows that households choose the optimal consumption bundle if $\tilde{t}_z^i * = \tilde{\Psi}_i$ and $\tilde{t}_x^* = 0$.

(ii) If the externality is symmetric and $m_r/\tilde{u}_x$ is the same for all households, then $\tilde{\Psi}_i = \tilde{\Psi}_{i'}$ for all $i, i' \in N$. Combining the optimality condition of the households ((27)and (28)) with those of the government ((34) and (35)) shows that households choose the optimal consumption bundle if $\tilde{t}_z^* = \tilde{\Psi}$ and $\tilde{t}_x^* = 0$. However, a uniform tax on the status good is only sufficient to implement a first-best allocation if in addition the externality is atmospheric. As soon as the externality is non-atmospheric a personalized commodity tax is required to implement a first-best allocation even if the externality is symmetric and $m_r/\tilde{u}_x$ is the same for all households. The reason is that then the indirect effect of the reference level on social welfare (which is zero in first best) can not be fully internalized.

(iii) If $\partial MRS_{zx}/\partial \overline{z}_i = 0$ then the correction term $\tilde{\Psi}_i$ is independent of $\overline{z}_i$.

(iv) Households differ in preferences and wages. The lump-sum element τ_i is adapted such that (34)-(36) hold, given that $\tilde{t}_z^*, \tilde{t}_x^*$ are set optimally.

First-order condition for problem (37)-(40)

The Lagrangian for the maximization problem (37)-(40) reads

$$\begin{aligned}\mathcal{L} &= \sum_{i=1}^{n}\tilde{\theta}_i^{SB}\tilde{v}_i(q_x,q_z,\tau_i,\overline{z}_i) - \sum_{i=2}^{n}\tilde{\mu}_i^{SB}\overline{v}_i + \tilde{\lambda}^{SB}(t_x\sum_{i=1}^{n}x_i + t_z\sum_{i=1}^{n}z_i - \sum_{i=1}^{n}\tau_i) \\ &\quad + \sum_{i=1}^{n}\tilde{\gamma}_i^{SB}(\overline{z}_i - \frac{1}{n}\sum_{j=1}^{n}a_{ij}z_j). \end{aligned} \tag{67}$$

The first-order conditions with respect to t_x, t_z, τ_i and $\overline{z}_i$ are given by

$$\sum_{i=1}^{n}\tilde{\theta}_i^{SB}\frac{\partial\tilde{v}_i}{\partial t_x} + \tilde{\lambda}^{SB}(\sum_{i=1}^{n}x_i + t_x\sum_{i=1}^{n}\frac{\partial x_i}{\partial t_x} + t_z\sum_{i=1}^{n}\frac{\partial z_i}{\partial t_x}) - \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n}\tilde{\gamma}_i^{SB}a_{ij}\frac{\partial z_j}{\partial t_x} = 0 \tag{68}$$

$$\sum_{i=1}^{n}\tilde{\theta}_i^{SB}\frac{\partial\tilde{v}_i}{\partial t_z} + \tilde{\lambda}^{SB}(\sum_{i=1}^{n}z_i + t_x\sum_{i=1}^{n}\frac{\partial x_i}{\partial t_z} + t_z\sum_{i=1}^{n}\frac{\partial z_i}{\partial t_z}) - \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n}\tilde{\gamma}_i^{SB}a_{ij}\frac{\partial z_j}{\partial t_z} = 0 \tag{69}$$

$$\tilde{\theta}_i^{SB}\frac{\partial\tilde{v}_i}{\partial\tau_i} + \tilde{\lambda}^{SB}(t_x\frac{\partial x_i}{\partial\tau_i} + t_z\frac{\partial z_i}{\partial\tau_i}) - \tilde{\lambda}^{SB} - \frac{1}{n}\sum_{j=1}^{n}\tilde{\gamma}_j^{SB}a_{ji}\frac{\partial z_i}{\partial\tau_i} = 0 \tag{70}$$

$$\tilde{\theta}_i^{SB}\frac{\partial\tilde{v}_i}{\partial\overline{z}_i} + \tilde{\lambda}^{SB}(t_x\frac{\partial x_i}{\partial\overline{z}_i} + t_z\frac{\partial z_i}{\partial\overline{z}_i}) + \tilde{\gamma}_i^{SB} - \frac{1}{n}\sum_{j=1}^{n}\tilde{\gamma}_j^{SB}a_{ji}\frac{\partial z_i}{\partial\overline{z}_i} = 0 \tag{71}$$

with $\tilde{\theta}_i^{SB} \equiv \tilde{\mu}_i^{SB} + \frac{\varphi}{n}\sum_{j=1}^{n}\tilde{\mu}_j^{SB}$ and $\tilde{\mu}_1^{SB} \equiv 1$.

Proof of Proposition 4

Take (69) and plug in for Roy's identity $\frac{\partial\tilde{v}_i}{\partial t_z} = -z_i\frac{\partial\tilde{v}_i}{\partial\tau_i} - (\frac{\partial s_i}{\partial t_z} + z_i\frac{\partial s_i}{\partial\tau_i})$ to get

$$\begin{aligned}&\tilde{\lambda}^{SB}(\sum_{i=1}^{n}z_i + t_x\sum_{i=1}^{n}\frac{\partial x_i}{\partial t_z} + t_z\sum_{i=1}^{n}\frac{\partial z_i}{\partial t_z}) = \sum_{i=1}^{n}\tilde{\theta}_i^{SB}\frac{\partial\tilde{v}_i}{\partial\tau_i}z_i + \sum_{i=1}^{n}\tilde{\theta}_i^{SB}(\frac{\partial s_i}{\partial t_z} + z_i\frac{\partial s_i}{\partial\tau_i}) \\ &+\frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n}\tilde{\gamma}_i a_{ij}\frac{\partial z_j}{\partial t_z}\end{aligned} \tag{72}$$

Next, take (70) and multiply it with z_i. Then plug in for $\tilde{\theta}_i^{SB}\frac{\partial\tilde{v}_i}{\partial\tau_i}z_i$ from (70) into (72) and use the Slutsky decomposition $s_{zz}^i = \frac{\partial z_i}{\partial t_z} + z_i\frac{\partial z_i}{\partial\tau_i}$ and $s_{xz}^i = \frac{\partial x_i}{\partial t_z} + z_i\frac{\partial x_i}{\partial\tau_i}$ to get

$$t_x\sum_{i=1}^{n}s_{xz}^i + t_z\sum_{i=1}^{n}s_{zz}^i = \sum_{i=1}^{n}\frac{\tilde{\theta}_i^{SB}}{\tilde{\lambda}^{SB}}(\frac{\partial s_i}{\partial t_z} + z_i\frac{\partial s_i}{\partial\tau_i}) + \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n}\frac{\tilde{\gamma}_i^{SB}}{\tilde{\lambda}^{SB}}a_{ji}s_{zz}^i \tag{73}$$

Apply the same steps to the first order condition for t_x given by (68) to get

$$t_x\sum_{i=1}^{n}s_{xx}^i + t_z\sum_{i=1}^{n}s_{zx}^i = \sum_{i=1}^{n}\frac{\tilde{\theta}_i^{SB}}{\tilde{\lambda}^{SB}}(\frac{\partial s_i}{\partial t_x} + x_i\frac{\partial s_i}{\partial\tau_i}) + \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{n}\frac{\tilde{\gamma}_i^{SB}}{\tilde{\lambda}^{SB}}a_{ji}s_{zx}^i. \tag{74}$$

Finally, apply Cramer's rule to the system of equations given by (73) and (74) and substitute for $(\frac{\partial s_i}{\partial t_k} + k_i \frac{\partial s_i}{\partial \tau_i}) = \frac{1}{\overline{z}_i} \frac{\partial m_i}{\partial r_i} s_{zk}$ with $k = x, z$ to get (41) and (42).

Proof of Corollary 2

(i) It follows from (41) and (42) that $t_z^{**} = \frac{\tilde{\theta}^{SB}}{\tilde{\lambda}^{SB}} \frac{1}{\overline{z}} \frac{\partial m}{\partial r} + \tilde{\epsilon}_i$ and $t_x^{**} = 0$ if the externality is atmospheric and symmetric and if $\frac{\tilde{\theta}_i^{SB}}{\tilde{\lambda}^{SB}} \frac{\partial m_i}{\partial r_i} = \frac{\tilde{\theta}^{SB}}{\tilde{\lambda}^{SB}} \frac{\partial m}{\partial r}$ for all $i \in N$. To see that in this case $\tilde{\epsilon}_i = \tilde{\epsilon} = 0$ for all $i \in N$ in the optimum, take the first order condition for $\overline{z}_i$ given by (71) which can also be written as

$$\frac{\tilde{\gamma}_i^{SB}}{\tilde{\lambda}^{SB}} = -\frac{\tilde{\theta}_i^{SB}}{\tilde{\lambda}^{SB}} \frac{\partial \tilde{v}_i}{\partial \overline{z}_i} - t_x \frac{\partial x_i}{\partial \overline{z}_i} - t_z \frac{\partial z_i}{\partial \overline{z}_i} + \tilde{\epsilon}_i \frac{\partial z_i}{\partial \overline{z}_i}. \tag{75}$$

Use $\frac{\partial \tilde{v}_i}{\partial \overline{z}_i} = -\frac{1}{\overline{z}_i} \frac{\partial m_i}{\partial r_i} \frac{\partial z_i}{\partial \overline{z}_i}$ and plug in for t_z^{**} and t_x^{**} as given above. Then one can see that $\tilde{\gamma}_i^{SB} = 0$ for all $i \in N$, and consequently $\tilde{\epsilon}_i = \tilde{\epsilon} = 0$ in the optimum. This implies that under the condition in Corollary (i) optimal commodity tax rates are given by (43).

(ii) Follows immediately from (41) and (42).

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