ELSEVIER

Journal of Public Economics 92 (2008) 986–997

JOURNAL OF PUBLIC ECONOMICS

www.elsevier.com/locate/econbase

When the Joneses' consumption hurts: Optimal public good provision and nonlinear income taxation ☆

Thomas Aronsson [a,*], Olof Johansson-Stenman [b]

[a] *Department of Economics, Umeå University, SE — 901 87 Umeå, Sweden*
[b] *Department of Economics, School of Business, Economics and Law, Göteborg University, SE — 405 30 Göteborg, Sweden*

Received 11 May 2007; received in revised form 26 September 2007; accepted 18 December 2007
Available online 26 December 2007

Abstract

This paper considers a model with nonlinear income taxation and public good provision when people care about their relative consumption compared to others. The standard optimality expressions are modified by terms that reflect the extent to which people care about relative consumption. The extent to which the public good provision rule should be modified is shown to depend critically on the preference elicitation format. The modified tax formulas imply substantially higher marginal income tax rates than in the conventional case, under plausible assumptions and available empirical estimates regarding comparison consumption concerns.

JEL classification: D62; H21; H23; H41
Keywords: Optimal taxation; Redistribution; Public goods; Relative consumption; Status; Positional goods

1. Introduction

The literature on optimal taxation and public goods typically assumes that the utility of each individual depends only on his/her own consumption of goods, leisure and services. Yet, there is growing empirical evidence suggesting that this assumption may not be entirely appropriate. In particular, several recent empirical studies have focused on interdependence among individuals in the form of status effects, showing that individuals value their own consumption (or income) relative to that of others.[1] There are also recent evolutionary models that explain why selfish genes would prefer that the humans they belong to are motivated by relative concerns (Samuelson, 2004; Rayo and Becker, 2007). The purpose of the present paper is to analyze how the appearance of relative consumption concerns modifies the

☆ The authors would like to thank two anonymous referees, Sören Blomquist, Fredrik Carlsson, Tatiana Kornienko, Jukka Pirttilä and Tomas Sjögren, as well as seminar participants at Helsinki Center of Economic Research, Stockholm University and Örebro University, the IIPF conference in Warwick and Tax Forum (held in Jelöya, Moss, Norway) for helpful comments and suggestions. Research grants from FORMAS, the Swedish Research Council and the Swedish International Development Cooperation Agency (Sida) are also gratefully acknowledged.

* Corresponding author.
E-mail addresses: Thomas.Aronsson@econ.umu.se (T. Aronsson), Olof.Johansson@economics.gu.se (O. Johansson-Stenman).

[1] See e.g. Easterlin (1995, 2001), Clark and Oswald (1996), Solnick and Hemenway (1998, 2005), van Praag and Frijters (1999), Johansson-Stenman et al. (2002), Stutzer (2004), Alpizar et al. (2005), Ferrer-i-Carbonell (2005), Luttmer (2005) and Carlsson et al. (2007).

0047-2727/$ - see front matter © 2007 Elsevier B.V. All rights reserved.
doi:10.1016/j.jpubeco.2007.12.007

optimal tax structure and public good provision, respectively, compared with the outcome of the standard optimal income tax model with two ability-types.

Why is the optimal income tax model (in which agents face a nonlinear tax schedule) a suitable framework for analyzing the policy incentives created by positional preferences? First, a nonlinear income tax constitutes a reasonably realistic description of the income tax instrument that many countries have (or potentially have) at their disposal. In our case, therefore, the government's decision to use distortionary income taxation will follow from optimization, given the available information, and not from any a priori restrictions on the set of available policy instruments. This means that our model provides a suitable framework for analyzing the basic question of whether the appearance of relative consumption concerns itself motivates the use of distortionary taxation. Second, as we are able to show that such a motive indeed exists, our model also enables us to study how and why the externality correcting and redistributive (i.e. self-selection) components interact[2] in the context of marginal income taxation and public good provision.

Earlier literature dealing with public policy and relative consumption (or income) addresses a variety of issues such as income tax policy (Boskin and Sheshinski, 1978; Blomquist, 1993; Persson, 1995; Ireland, 2001), public good provision (Ng, 1987), social insurance (Abel, 2005), growth (Corneo and Jeanne, 1997, 2001), environmental externalities (Brekke and Howarth, 2002; Wendner, 2005; Howarth, 2006) and stabilization policy (Ljungqvist and Uhlig, 2000). Most studies dealing with tax policy in this particular context are based on linear tax instruments. Exceptions are Oswald (1983), Tuomala (1990) and Ireland (2001); however, none of these innovative studies addresses public good provision. To our knowledge, the only paper that analyzes public good provision in second best economies with relative consumption concerns isWendner and Goulder (2007), in a model with identical individuals where the public good is financed by linear taxation. As earlier studies have shown that policy rules for public goods are sensitive to the tax instruments available to the government – see e.g. Christiansen (1981) and Boadway and Keen (1993) – it appears worthwhile to analyze public good provision in the context of nonlinear taxation.

The present paper contributes to the literature in at least two ways. One is that this is the first paper analyzing the problem of optimal public good provision under nonlinear income taxation when relative consumption matters. In an economy where relative consumption matters, it can be shown that people's marginal willingness to pay for the public good depends critically on the value elicitation mechanism, and in particular whether others will have to pay too for the public good increase. Consequently, also the optimality expression depends critically on the elicitation mechanism used. Conditions will be presented for when the basic Samuelson rule still remains to hold in the presence of relative consumption concerns. Another contribution is that this is the first paper using a self-selection approach to analyze the problem of optimal nonlinear income taxes when relative consumption matters. This facilitates new interpretations, such as how the corrective and redistributive roles of public policy may interact due to possible differences in the degree of positionality among individuals (i.e. between the mimicker and the mimicked). Moreover, the expressions make it possible to relate the marginal income tax formulas to available empirical estimates regarding the extent to which relative consumption matters. Therefore, we are not only able to comment on qualitative effects of positional preferences; we are also able to discuss the magnitudes of the relevant effects. It is concluded that under plausible parameter estimates, the optimal marginal income tax rates should be substantially higher than in the conventional case.

The outline of the study is as follows. Section 2 presents the model and the outcome of private optimization. Section 3 characterizes the optimal tax and expenditure problem of the government, whereas Sections 4 and 5 present the corresponding results in a format that aims to facilitate straightforward interpretations and comparisons with earlier literature. Section 6 provides some concluding remarks.

2. Positional preferences and the consumers' problem

There are two types of individuals, where the low-ability type (type 1) is less productive than the high-ability type (type 2); n^i denotes the number of individuals of ability-type i.[3] An individual of ability-type i cares about his/her

[2] Earlier literature on optimal nonlinear income taxation often abstracts from the corrective motive for taxation. Exceptions are the studies dealing with environmental externalities (e.g. Pirttilä and Tuomala, 1997; Cremer et al., 1998; and Aronsson and Blomquist, 2003), unemployment (e.g. Marceau and Boadway, 1994; Aronsson and Sjögren, 2004; and Aronsson et al., in press), and more recently the taxation of life annuities (Brunner and Pech, in press).

[3] Of course, there are limits to what can be explained by a two-type model. For example, Frank (2007) argues that the middle class in the U.S. has suffered severely from the positional arms race, and in order to analyze more than two classes we clearly need a richer set-up. However, in our reading of Frank, it appears to us that several of the implications to the middle class discussed can be interpreted in terms of the low-ability type in our framework.

private consumption, x^i, the provided amount of a public good, G, and leisure, z^i, which is given by a time endowment, H, less the hours of work, l^i. In addition, people care about their *relative* consumption. Here, we follow the dominating bulk of the literature and assume that each individual compares his/her own consumption with a reference level determined by the average consumption in the economy, $\overline{x} \equiv (n^1 x^1 + n^2 x^2)/(n^1 + n^2)$, which is treated as exogenous to the individual. We also follow e.g. Akerlof (1997), Corneo and Jeanne (1997), Ljungqvist and Uhlig (2000), Bowles and Park (2005) and Carlsson et al. (2007) in letting the relative consumption be described by the *difference* between the individual's own consumption and the mean consumption in the economy as a whole, so $\Delta^i = x^i - \overline{x}$.[4]

The utility function of ability-type i can then be written as

$$U^i = v^i\left(x^i, z^i, \Delta^i, G\right) = v^i\left(x^i, z^i, x^i - \overline{x}, G\right) = u^i\left(x^i, z^i, \overline{x}, G\right), \tag{1}$$

where the function $v^i(\cdot)$ is increasing in each argument, implying that $u^i(\cdot)$ is decreasing in $\overline{x}$ (a property that Dupor and Liu, 2003 denote "jealousy") and increasing in the other arguments; both $v^i(\cdot)$ and $u^i(\cdot)$ are assumed to be twice continuously differentiable in their respective arguments and strictly concave.

In order to measure the extent to which relative consumption concerns matter for each individual, let us follow Johansson-Stenman et al. (2002) and define the *degree of positionality* for ability-type i, based on the utility function in Eq. (1), as follows:

$$\alpha^i = \frac{v^i_\Delta}{v^i_\Delta + v^i_x}, \tag{2}$$

in which $v^i_x \equiv \partial v^i/\partial x^i$ and $v_\Delta{}^i \equiv \partial v^i/\partial \Delta^i$. The parameter α^i can then be interpreted as the fraction of the overall utility increase from the last dollar earned that is due to the increased relative consumption. For instance, if $\alpha^i = 0$ relative consumption does not matter at all at the margin, whereas in the other extreme case where $\alpha^i = 1$ absolute consumption does not matter at all (i.e. all that matters is relative consumption). From the assumptions about the utility functions, we have $0 < \alpha^i < 1$. In addition, let us denote the *average degree of positionality* by $\overline{\alpha} \equiv (n^1\alpha^1 + n^2\alpha^2)/(n^1 + n^2)$.

Following earlier comparable literature, we assume that leisure is completely non-positional, meaning that people only care about the absolute level of leisure. It is, nevertheless, possible to think of a situation where people also care about their relative amount of leisure compared to others. In addition, although G is a pure public good in our study, one can easily think of publicly provided goods that have a spatial distribution that makes them less valuable for some people, and where people care about the relative possibility to use these goods. For example, people may derive utility not only from having access to a publicly provided recreation area, but also from having *better* access to such an area than others. Although these assumptions are crucial for most of the subsequent results, it is straightforward to adjust the model in order to take relative concerns with respect to leisure and publicly provided goods into account. The qualitative insights will still hold as long as private consumption is more positional than leisure and the publicly provided good. The (scarce) available empirical evidence is consistent with our approach. Carlsson et al. (2007) found that leisure is, in fact, much less positional than private consumption/income, and that it may even be completely non-positional. Solnick and Hemenway (2005) found that (spatially distributed) public goods too are considerably less positional than private consumption/income.

The individual budget constraint is given by

$$w^i l^i - T\left(w^i l^i\right) = x^i, \tag{3}$$

where $T(\cdot)$ denotes the income tax paid, implying the first order condition for hours of work:

$$u^i_x w^i\left[1 - T'\left(w^i l^i\right)\right] = u^i_z, \tag{4}$$

where $u^i_x = \partial u^i/\partial x^i$, $u^i_z = \partial u^i/\partial z^i$, and $T'(w^i l^i)$ is the marginal income tax rate.

[4] Alternative approaches include ratio comparisons (Boskin and Sheshinski, 1978; Layard, 1980) and comparisons of the ordinal rank (Frank, 1985; Hopkins and Kornienko, 2004). Dupor and Liu (2003) consider a specific flexible functional form that includes the difference comparison and ratio comparison approaches as special cases. It is, of course, also possible that people compare themselves more to some people than to others, although, as noted by Clark et al. (in press), empirical evidence is scarce. Still, we believe that most qualitative results hold for many generalizations along those lines. Nevertheless, such generalizations constitute worthwhile extensions for future research.

To simplify the analysis, we follow much of the earlier literature on optimal income taxation in assuming that output is produced by a linear technology, implying that the gross wage rates are fixed.

3. The government's problem

The objective of the government is to obtain a Pareto efficient allocation by maximizing utility of the low-ability type, while holding utility constant for the high-ability type, subject to a self-selection constraint and a resource constraint. The informational assumptions are conventional: The government is able to observe income, although ability is private information. As in most of the earlier literature on the self-selection approach to optimal taxation, we assume that the government wants to redistribute from the high income to the low income earners. This means that the most interesting aspect of self-selection is to prevent the high-ability type from pretending to be a low-ability type. The self-selection constraint that may bind then becomes

$$U^2 = u^2\left(x^2, z^2, \overline{x}, G\right) \geq u^2\left(x^1, H - \phi l^1, \overline{x}, G\right) = \hat{U}^2, \tag{5}$$

where $\phi = w^1/w^2$ is the wage ratio. The expression on the right-hand side of the weak inequality is the utility of the mimicker. Although the mimicker enjoys the same consumption as the low-ability type, he/she enjoys more leisure since the mimicker is more productive than the low-ability type.

Note that $T(\cdot)$ is a general income tax, which can be used to implement any desired combination of l^1, x^1, l^2 and x^2. Therefore, we will use l^1, x^1, l^2 and x^2, instead of the parameters of the income tax function, as direct decision variables. The resource constraint implies that the total production equals total private and public consumption, so that

$$\sum_i n^i w^i l^i = \sum_i n^i x^i + p^G G, \tag{6}$$

in which p^G is the production price of G in terms of x, i.e. the marginal rate of transformation between the public good and the private consumption good.

The Lagrangean can then be written as

$$£ = U^1 + \mu\left[U^2 - \tilde{U}^2\right] + \lambda\left[U^2 - \hat{U}^2\right] + \gamma\left[\sum_i n^i\left\{w^i l^i - x^i\right\} - p^G G\right], \tag{7}$$

where $\tilde{U}^2$ is an arbitrarily fixed utility level for the high-ability type, while μ, λ and γ are Lagrange multipliers associated with the minimum utility restriction for the high-ability type, the self-selection constraint and the resource constraint, respectively. For further use, note that

$$\frac{\partial £}{\partial \overline{x}} = u^1_{\overline{x}} + (\mu + \lambda)u^2_{\overline{x}} - \lambda\hat{u}^2_{\overline{x}}, \tag{8}$$

in which $\hat{u}^2 = u^2(x^1, H - \phi l^1, \overline{x}, G)$, and subindices denote partial derivatives.

The first order conditions for l^1, x^1, l^2, x^2 and G are given by

$$-u^1_z + \lambda\phi\hat{u}^2_z + \gamma n^1 w^1 = 0, \tag{9}$$

$$u^1_x - \lambda\hat{u}^2_x - \gamma n^1 + \frac{n^1}{n^1 + n^2}\frac{\partial £}{\partial \overline{x}} = 0, \tag{10}$$

$$-(\mu + \lambda)u^2_z + \gamma n^2 w^2 = 0, \tag{11}$$

$$(\mu + \lambda)u^2_x - \gamma n^2 + \frac{n^2}{n^1 + n^2}\frac{\partial £}{\partial \overline{x}} = 0, \tag{12}$$

$$u^1_G + (\mu + \lambda)u^2_G - \lambda\hat{u}^2_G - p^G\gamma = 0. \tag{13}$$

4. Income tax results

The marginal income tax rate of the low-ability type is derived by combining Eqs. (4), (9) and (10), while the marginal income tax rate of the high-ability type is correspondingly derived by combining Eqs. (4), (11) and (12). Let $MRS^i_{z,x}=u^i_z/u^i_x$ and $M\hat{R}S^2_{z,x}=\hat{u}^{\,2}_z/\hat{u}^2_x$ be the marginal rate of substitution between leisure and private consumption for ability-type i and the mimicker, respectively. We show in the Appendix that

$$T'\left(w^1 l^1\right)=\frac{\lambda\hat{u}^2_x}{\gamma n^1 w^1}\left(MRS^1_{z,x}-M\hat{R}S^2_{z,x}\phi\right)-\frac{MRS^1_{z,x}}{\gamma w^1}\frac{1}{n^1+n^2}\frac{\partial £}{\partial\overline{x}} \tag{14}$$

$$T'\left(w^2 l^2\right)=-\frac{MRS^2_{z,x}}{\gamma w^2}\frac{1}{n^1+n^2}\frac{\partial £}{\partial\overline{x}}\,. \tag{15}$$

Note first that if $\partial £/\partial\overline{x}=0$, meaning that relative consumption comparisons are of no concern, we obtain the standard result; namely, that the marginal income tax rate is zero for the high-ability type and positive for the low-ability type (at least if the preferences do not differ between individuals). This result is well known and understood from earlier research; see e.g. Stiglitz (1982).

The terms reflecting the relative consumption concerns (i.e. those proportional to $\partial £/\partial\overline{x}$) are novel. Since utility for both ability-types depends negatively on $\overline{x}$, one might conjecture that $\partial £/\partial\overline{x}<0$, so that these effects would contribute to higher marginal income tax rates. This intuition appears correct for most cases but, as we will show below, it is in fact theoretically possible that $\partial £/\partial\overline{x}>0$, so that the relative consumption terms imply lower marginal income tax rates (i.e. a negative rate for the high-ability type). Expressed in the form of Eqs. (14) and (15), the tax results are quite general and do not assume anything of the structure of the relative consumption concerns beyond that average consumption affects utility negatively for each individual. Thus, Eqs. (14) and (15) hold also more generally, where private consumption causes negative externalities, such as in the case of air pollution.

To go further, we make use of *how* people compare themselves to others by utilizing the first utility formulation in Eq. (1), i.e. that $U^i=v^i(x^i,z^i,x^i-\overline{x},G)$, together with the definition of the degree of positionality from Eq. (2). We show in the Appendix that Eqs. (14) and (15) can then be rewritten so that the marginal income tax rates can be expressed in terms of the degree of positionality, and also that the effect of positionality can be decomposed into two distinct parts. To see this, let $N=n^1+n^2$ and define

$$\Gamma=\frac{\lambda\hat{u}^2_x}{\gamma N}\left[\hat{\alpha}^2-\alpha^1\right]$$

to reflect the difference in the degree of positionality between the mimicker and the low-ability type, and use

$$\tau^1\equiv\frac{\lambda\hat{u}^2_x}{\gamma n^1 w^1}\left(MRS^1_{z,x}-M\hat{R}S^2_{z,x}\phi\right)$$

as a short notation for how the self-selection constraint affects the marginal income tax rate of the low-ability type, i.e. the first term on the right hand side of Eq. (14). Consider Proposition 1:

Proposition 1. *The optimal marginal income tax rates can be written in the following additive form:*

$$T'\left(w^1 l^1\right)=\tau^1+\left[1-\tau^1\right]\overline{\alpha}-\left[1-\tau^1\right]\left[1-\overline{\alpha}\right]\frac{\Gamma}{1-\Gamma} \tag{16}$$

$$T'\left(w^2 l^2\right)=\overline{\alpha}-\left(1-\overline{\alpha}\right)\frac{\Gamma}{1-\Gamma}. \tag{17}$$

Consequently, a sufficient, but not necessary, condition for the relative consumption concerns to contribute to higher marginal income tax rates is that $\Gamma\leq 0$, meaning that the low-ability type is at least as positional as the mimicker.

To interpret Proposition 1, let us start with the simple (and unrealistic) first best case where there is no cost of fulfilling the self-selection constraint, so $\lambda=0$ and $\tau^1=\Gamma=0$. In this case, the marginal income tax rate equals $\overline{\alpha}$ for

both ability-types, which is interpretable as a Pigouvian tax motivated on pure efficiency grounds, where people are taxed because their consumption imposes negative (positional) externalities on others, whereas leisure does not. One additional dollar for all in the economy, ceteris paribus, implies that the average utility increase is only $1-\overline{\alpha}$ of the sum of each individual's utility increase in isolation. Therefore, the "loss", $\overline{\alpha}$, reflects the marginal external cost of private consumption.[5]

In the more realistic second best world, the second term on the right hand side in the tax formula for the low-ability type and the first term on the right hand side in the tax formula for the high-ability type reflect the marginal external cost of consumption. The intuition for why this term is smaller for the low-ability type than in the first best, provided that $\tau^1>0$, is that the fraction of the marginal income already taxed away will not give rise to any positional externalities.

The last terms reflect self-selection effects of the positional concerns. Suppose first that $\Gamma>0$, in which case an increase in the reference consumption, $\overline{x}$, ceteris paribus, means a larger utility loss for the mimicker than for the low-ability type. Therefore, as increased reference consumption contributes to relax the self-selection constraint, there is an incentive for the government to implement lower marginal income tax rates than it would otherwise have done (i.e. than it would have done if Γ were equal to zero). The intuition is that lower marginal income tax rates tend to increase the hours of work; with G held constant, this means increased private consumption and, therefore, a higher level of reference consumption. The opposite argument applies if $\Gamma<0$. This mechanism also explains why it is theoretically possible that relative consumption concerns work to reduce the marginal income tax rates. If $\Gamma>0$, and if increased marginal income taxation creates a sufficiently strong incentive to become a mimicker, then this effect may dominate the externality-correcting component.

Consider also the factors that are proportional to $\Gamma/[1-\Gamma]$. The factor $[1-\tau^1]$ in the low-ability case is interpretable in a way similar to its effect on the second term on the right hand side of Eq. (16): if $[1-\tau^1]$ of an additional dollar is already taxed away, it does not give rise to positional externalities. Similarly, the factor $[1-\overline{\alpha}]$ appears because the induced self-selection effects are due to the non-positional part of the marginal income.

Consider finally the order of magnitudes. Since concerns for relative consumption are difficult to measure, it is not surprising that the available estimates of $\overline{\alpha}$ vary considerably in the literature, although almost all estimates are substantially above zero. For instance, according to Alpizar et al. (2005) and Carlsson et al. (2007), $\overline{\alpha}$ is typically in the order of magnitude of 0.5, whereas Luttmer (2005) obtained larger estimates close to one. There is little empirical evidence regarding the size of Γ; perhaps a value of zero is a reasonable first approximation[6]. Overall, the results then suggest that, given the framework, the optimal marginal income tax rates may be substantially higher when taking relative consumption effects into account.

5. Public good provision results

The optimal public good provision is derived by substituting Eqs. (10) and (12) into Eq. (13). Let $MRS^i_{G,x}=u^i_G/u^i_x$ and $M\hat{R}S^2_{G,x}=\hat{u}^2_G/\hat{u}^2_x$ denote the marginal rate of substitution between the public good and private consumption for ability-type i and the mimicker, respectively. We show in the Appendix that

$$\sum_i n^i MRS^i_{G,x}=p^G+\frac{\lambda}{\gamma}\hat{u}^2_x\left[M\hat{R}S^2_{G,x}-MRS^1_{G,x}\right]+\sum_i n^i MRS^i_{G,x}\frac{1}{\gamma N}\frac{\partial \pounds}{\partial \overline{x}}. \tag{18}$$

The left hand side of Eq. (18) is the sum of each individual's marginal willingness to pay (WTP) for the public good expressed in terms of his/her private consumption. Note that this individual marginal WTP is defined while holding the consumption of everybody else fixed, which will be discussed further subsequently. The first term on the right-hand side of Eq. (18), p^G, reflects the marginal rate of transformation between public and private goods. The second term reflects self-selection effects that are well understood from earlier research (e.g. Boadway and Keen, 1993). Finally, the

[5] This case resembles the identical consumption tax derived by Dupor and Liu (2003) in a first best economy.

[6] Solnick and Hemenway (1998) and Carlsson et al. (2007) found no significant correlations between, on the one hand, the degree of positionality and, on the other, demographic characteristics at the individual level. Similarly, in a study analyzing the positional preferences among students, Alpizar et al. (2005) found no significant relationship between the individual degree of positionality and the income of the parents, although the point estimate of the relevant coefficient was negative for all commodities being analyzed. A possible interpretation in terms of our model is that the low-ability type is at least as positional as the mimicking high-ability type; a condition used in Propositions 1 and 2.

third term is novel and is due to the relative consumption concerns. In general, and for reasons analogous to those discussed in the context of marginal income taxation, this effect can be either positive or negative.

In order to further interpret Eq. (18), let us again make use of the first utility formulation in Eq. (1) together with the definition of the degree of positionality in Eq. (2). Using

$$\Omega = \frac{\lambda}{\gamma}\hat{u}_x^2\left[M\hat{R}S_{G,x}^2 - MRS_{G,x}^1\right]$$

as a short notation for the self-selection term that would result without any positional concerns, we obtain (see the Appendix):[7]

Proposition 2. *The optimal provision of the public good is given by*

$$\sum\nolimits_i n^i MRS_{G,x}^i = \left(p^G + \Omega\right)\frac{1-\overline{\alpha}}{1-\Gamma}. \tag{19}$$

Consequently, a sufficient, but not necessary, condition for the relative consumption concerns to contribute to increased optimal provision of the public good is that $\Gamma \leq 0$, meaning that the low-ability type is at least as positional as the mimicker.

Before interpreting each factor of Eq. (19), we can observe the following result for a special case:

Corollary 1. *If the mimickers' degree of positionality is the same as the one of the low-ability type, and if leisure is weakly separable from private and public consumption so that the utility function can be written as $U^i = q^i(f(x^i, G, x^i - \overline{x}), z^i)$, then the optimal provision of G is given by $\Sigma_i n^i MRS_{G,x}^i = p^G(1-\overline{\alpha})$.*

Corollary 1 follows directly from Proposition 2. Since $f(\cdot)$ is the same for both ability-types, and the mimicker has the same absolute as well as relative consumption as the low-ability type, it follows both that $M\hat{R}S_{G,x}^2 = MRS_{G,x}^1$ and that $\hat{\alpha}^2 = \alpha^1$. The former implies that $\Omega = 0$, whereas the latter means that $\Gamma = 0$. Note also that, although the function $f(\cdot)$ is the same for both ability-types, the function $q^i(\cdot)$ can still vary between agents.

Although the assumptions underlying Corollary 1 are strong, they will, nevertheless, provide a natural benchmark case. The interpretation is straightforward: given suitable separability assumptions, we cannot relax the self-selection constraint via provision of public goods. If each person receives one additional dollar, then the relative consumption is held constant, and what remains is the absolute, or the non-positional, utility effect. Suppose, for example, that $\overline{\alpha} = 0.8$, and that everybody pays one additional dollar for increased provision of the public good. Then, the utility decrease following this additional payment is only 20% (i.e. $1-\overline{\alpha}$), $z^i = 1 - 0.8$) as large as it would have been, had we aggregated the utility losses of each dollar payment in isolation. For the public good there is by definition no such leakage.

Consider now the interpretation of Γ in Eq. (19). Increased public good provision clearly implies a reduction in private consumption. If the mimicker is more positional than the low-ability type, then $\Gamma > 0$, in which case the reduction in private consumption for all implies a relatively larger utility loss for the less positional. Thus, in this case, it becomes relatively more attractive to become a mimicker, in turn implying that the relevant self-selection constraint tightens and a corresponding marginal social cost.

5.1. A reinterpretation of the benefit side of G

Let us now return to the interpretation of the benefit side of the policy rule for the public good. How to measure the benefit of a public good is a classic problem in economics at least since Samuelson (1954), but we will not dig deeper into different practical methods here. However, we will briefly discuss some important implications of different ways to

[7] Note that Proposition 2 should of course not be interpreted to mean that the amount provided in an economy where people care about relative consumption should necessarily be larger than in an economy where they do not. Rather, the appropriate interpretation is that, if people do care about relative consumption, the provision of the public good should be extended beyond the level that corresponds to the optimality rule without considering the positionality effect.

measure the benefit *given that the method works as intended*. In principle, i.e. given that people respond truthfully according to their preferences, $\Sigma_i n^i MRS^i_{G,x}$ reflects the sum of all people's marginal WTP for G, ceteris paribus, i.e. while holding everything else fixed. However, an increase in G typically comes together with other changes, notably that other people's taxes or charges are increased. In one frequently used method, the survey-based so-called contingent valuation (CV) method, it is typically recommended (see Arrow et al., 1993) that a realistic payment vehicle is used when asking people about their maximum WTP. One often used payment vehicle is to ask the subjects how they would vote in a referendum where everybody would have to pay a certain amount, the same for all, through increased taxes (or charges) for the improvement. In the standard case where people do not care about relative consumption, this formulation has no important theoretical implication given that people respond truthfully (although it may of course make the exercise more realistic). Here, however, it does. Consider the case where others will have to pay the same amount as an individual i for the increment. This implies that i's relative consumption will be unaffected, so $x^i - \overline{x}$ is constant. This, in turn, implies that the relevant marginal WTP measures will instead be given by $CMRS^i_{G,x} \equiv v^i_G / v^i_x$, where thus $CMRS^i_{G,x}$ can be interpreted as ability-type i's marginal WTP for G in terms of x, provided that everybody else pays the same amount at the margin.

It can be shown (see the Appendix) that Eq. (19) can be rewritten as

$$\sum_i n^i CMRS^i_{G,x} = \frac{p^G + \Omega}{(1-\Gamma)(1+\Psi)}, \tag{20}$$

where

$$\Psi \equiv \operatorname{cov}\left(\frac{1-\alpha}{1-\overline{\alpha}}, \frac{CMRS_{G,x}}{\overline{CMRS_{G,x}}}\right)$$

reflects the normalized covariance between the degree of non-positionality of private consumption and the marginal WTP as reflected by a contingent valuation study of a referendum type, where $\overline{CMRS_{G,x}}$ denotes the mean marginal WTP for the public good conditional on the payments of others. Before interpreting Eq. (20) further, let us consider an important special case:

Proposition 3. *If (i) the degree of positionality is the same for both ability-types, (ii) leisure is weakly separable from private and public consumption, so that the utility function can be written as* $U^i = q^i(f(x^i, G, x^i - \overline{x}), z^i)$, *and (iii) the individual maximum WTP for the public good is elicited with a payment vehicle where all individuals have to pay the same amount, then the optimal provision of the public good is given by*

$$\sum_i n^i CMRS^i_{G,x} = p^G. \tag{21}$$

Proposition 3 follows directly from Eq. (20): $\Omega = \Gamma = 0$ for the same reasons as in Corollary 1. Furthermore, by assuming that the degree of positionality is the same for both ability-types, we have $\Psi = 0$.

Given that all individuals have to pay the same amount at the margin, the marginal benefit measured as the sum of marginal WTP should equal the marginal production cost. In other words, we are back to the basic cost–benefit rule where marginal benefit in terms of people's aggregate marginal WTP equals marginal cost. Alternatively speaking, the basic Samuelson (1954) rule holds; the sum of marginal rates of substitution between the public good and the private consumption is equal to the corresponding marginal rate of transformation, when the relative consumption is held constant. The intuition is again straightforward. If others too have to pay, there is no "leakage" of the change in private consumption through relative consumption effects, implying that there are no reasons to correct for positional effects.[8]

Let us finally for completeness explain the intuition behind the term Ψ in Eq. (20). If the conditional marginal WTP for G differs between the types, and all people will pay the same amount equal to $\overline{CMRS_{G,x}}$ for the additional G, then those with a higher conditional marginal WTP will obtain a utility increase, while the others will face a utility loss. The utility increase, in monetary terms, will more than outweigh the utility loss if, and only if, those with a higher conditional marginal WTP are less positional.

[8] However, what is perhaps less clear is whether people really manage to see through all effects while responding to WTP questions in practice. Still, before taking possible cognitive limitations or other deviations from rationality into account, it is important to know the point of departure.

6. Conclusion

This paper has analyzed the importance of relative consumption concerns for optimal nonlinear income taxation as well as for public good provision. The results are possible to express in terms of straightforward modifications of the standard optimality results. Under reasonable assumptions, relative consumption concerns work in the direction of increasing the marginal income tax rates. Moreover, linking the results to available empirical evidence on the degree to which people care about relative consumption suggests that the marginal income tax rates may be substantially higher when such concerns are taken into account.

The importance of relative consumption concerns for public good provision depends, in principle, on how people's marginal WTP for a public good increase is elicited. If people are asked about their WTP independently of others, then relative consumption concerns may imply that substantially more of the public good should be provided compared to the choice rule without such concerns. However, if people's maximum WTPs are elicited conditional on a payment vehicle where others have to pay too, e.g. through a tax increase, then there is little effect of relative consumption concerns on the appropriate choice rule for public good provision. Whether people in reality manage to see through all interdependent effects is of course less clear, and is an issue for future research also more generally.

There are several interesting ways to extend the current contribution. First, as we have used a static model, one possible extension would be to consider an OLG framework along the lines of Pirttilä and Tuomala (2001), which facilitates the study of how relative consumption concerns affect the optimal capital income tax structure. Second, there is evidence suggesting that some goods are more positional than others (e.g. Carlsson et al., 2007 and Solnick and Hemenway, 2005). Thus, it would be interesting to analyze the optimal mix of nonlinear income and consumption taxes when relative consumption matters. Third, our study is based on a closed economy, which means that we disregard the possibility that cross-country interactions affect the measure of reference consumption used at the individual level. A relaxation of the latter assumption is particularly interesting, as it opens up for the study of public policy and relative consumption in a multi-country setting, where people also to some extent compare their consumption with the consumption of people in other countries. This means that the economy is characterized by transboundary positional externalities, suggesting that the optimal tax and expenditure policies derived in the context of a non-cooperative Nash equilibrium may differ substantially from those corresponding to a (second-best) cooperative equilibrium. Therefore, relative consumption concerns may also be an argument for international policy coordination. We leave these and other possible extensions for future research.

Appendix. *The marginal income tax rates*

To derive Eq. (14), note that Eq. (9) can be rewritten as

$$MRS^1_{z,x}u^1_x = \lambda\phi\hat{u}^2_z + \gamma n^1 w^1. \tag{A1}$$

From Eq. (10), we have

$$u^1_x = \lambda\hat{u}^2_x + \gamma n^1 - \frac{n^1}{n^1+n^2}\frac{\partial £}{\partial \overline{x}}. \tag{A2}$$

By substituting Eq. (A2) into Eq. (A1), we obtain

$$MRS^1_{z,x}\left(\lambda\hat{u}^2_x - \frac{n^1}{n^1+n^2}\frac{\partial £}{\partial \overline{x}}\right) = \lambda\phi\hat{u}^2_z + \gamma n^1\left(w^1 - MRS^1_{z,x}\right). \tag{A3}$$

From Eq. (4), we have $w^1 - MRS^1_{z,x} = T'(w^1 l^1)w^1$. Substituting into Eq. (A3) gives

$$MRS^1_{z,x}\left(\lambda\hat{u}^2_x - \frac{n^1}{n^1+n^2}\frac{\partial £}{\partial \overline{x}}\right) = \lambda\phi\hat{u}^2_z + \gamma n^1 T'\left(w^1 l^1\right)w^1. \tag{A4}$$

Solving for $T'(w^1 l^1)$ and rearranging gives Eq. (14). The procedure used to derive Eq. (15) is analogous.

To derive Eq. (16), note first from Eq. (1) that $u_x^i = v_x^i + v_\Delta{}^i$ *and* $u_{\overline{x}}^i = -v_\Delta{}^i$, so

$$u_{\overline{x}}^i = -\alpha^i u_x^i. \tag{A5}$$

Substituting Eq. (A5) into Eq. (8) implies

$$\frac{\partial \pounds}{\partial \overline{x}} = -\alpha^1 u_x^1 - \alpha^2(\mu+\lambda)u_x^2 + \hat{\alpha}^2 \lambda \hat{u}_x^2. \tag{A6}$$

From Eq. (12), we have

$$(\mu+\lambda)u_x^2 = \gamma n^2 - \frac{n^2}{n^1+n^2}\frac{\partial \pounds}{\partial \overline{x}}. \tag{A7}$$

Substituting Eqs. (A2) and (A7) into Eq. (A6) gives

$$\frac{\partial \pounds}{\partial \overline{x}} = -\alpha^1\left(\lambda \hat{u}_x^2 + \gamma n^1 - \frac{n^1}{n^1+n^2}\frac{\partial \pounds}{\partial \overline{x}}\right) - \alpha^2\left(\gamma n^2 - \frac{n^2}{n^1+n^2}\frac{\partial \pounds}{\partial \overline{x}}\right) + \hat{\alpha}^2\lambda\hat{u}_x^2.$$

Collecting terms and rearranging gives

$$\frac{\partial \pounds}{\partial \overline{x}} = -\gamma\left(n^1+n^2\right)\frac{\overline{\alpha}}{1-\overline{\alpha}} + \lambda\hat{u}_x^2\frac{\hat{\alpha}^2-\alpha^1}{1-\overline{\alpha}}. \tag{A8}$$

Substituting Eq. (A8) into Eq. (14), we have

$$\begin{aligned} T'\left(w^1 l^1\right) &= \tau^1 - \frac{MRS_{z,x}^1}{\gamma w^1}\frac{1}{n^1+n^2}\left(-\gamma\left(n^1+n^2\right)\frac{\overline{\alpha}}{1-\overline{\alpha}} + \lambda\hat{u}_x^2\frac{\hat{\alpha}^2-\alpha^1}{1-\overline{\alpha}}\right) \\ &= \tau^1 - \frac{MRS_{z,x}^1}{w^1}\left(-\frac{\overline{\alpha}}{1-\overline{\alpha}} + \frac{\lambda\hat{u}_x^2}{\gamma(n^1+n^2)}\frac{\hat{\alpha}^2-\alpha^1}{1-\overline{\alpha}}\right). \end{aligned} \tag{A9}$$

Using that $MRS_{z,x}^1/w^1 = 1 - T'(w^1 l^1)$ and $\Gamma = \frac{\lambda\hat{u}_x^2}{\gamma N}\left[\hat{\alpha}^2 - \alpha^1\right]$, we obtain

$$T'\left(w^1 l^1\right) = \tau^1 - \left(1 - T'\left(w^1 l^1\right)\right)\left(-\frac{\overline{\alpha}}{1-\overline{\alpha}} + \frac{\Gamma}{1-\overline{\alpha}}\right). \tag{A10}$$

Solving for $T'(w^1 l^1)$ and collecting terms gives Eq. (16). Again, the procedure used to derive Eq. (17) is analogous.

Public good provision

Using the *MRS* definitions, we can rewrite Eq. (13) as

$$MRS_{G,x}^1 u_x^1 + MRS_{G,x}^2(\mu+\lambda)u_x^2 - \lambda M\hat{R}S_{G,x}^2\hat{u}_x^2 - p^G\gamma = 0. \tag{A11}$$

Substituting Eqs. (A2) and (A7) into Eq. (A11) gives

$$MRS_{G,x}^1\left(\lambda\hat{u}_x^2 + \gamma n^1 - \frac{n^1}{n^1+n^2}\frac{\partial \pounds}{\partial \overline{x}}\right) + MRS_{G,x}^2\left(\gamma n^2 - \frac{n^2}{n^1+n^2}\frac{\partial \pounds}{\partial \overline{x}}\right) - \lambda M\hat{R}S_{G,x}^2\hat{u}_x^2 - p^G\gamma = 0\,.$$

Collecting terms implies Eq. (18).

Eq. (19) is derived by substituting Eq. (A8) into Eq. (18). To derive Eq. (20), note first that $MRS^i_{G,x}=CMRS^i_{G,x}v^i_x/u^i_x$. Then, from Eq. (1) we have that $v^i_x/u^i_x=1-\alpha^i$, so

$$MRS^i_{G,x}=\left(1-\alpha^i\right)CMRS^i_{G,x}, \tag{A12}$$

By substituting Eq. (A12) into Eq. (19), we obtain

$$\sum_i\left(1-\alpha^i\right)CMRS^i_{G,x}=\left(p^G+\Omega\right)\frac{1-\overline{\alpha}}{1-\Gamma}. \tag{A13}$$

The left hand side of Eq. (A13) can be rewritten by using a covariance expression

$$\sum_i\left(1-\alpha^i\right)CMRS^i_{G,x}=\left(1-\overline{\alpha}\right)\sum_i CMRS^i_{G,x}\left[1+\operatorname{cov}\left(\frac{1-\alpha}{1-\overline{\alpha}},\frac{CMRS_{G,x}}{\overline{CMRS_{G,x}}}\right)\right]. \tag{A14}$$

Substituting Eq. (A14) into Eq. (A13) gives Eq. (20).

References

Abel, A.B., 2005. Optimal taxation when consumers have endogenous benchmark levels of consumption. Review of Economic Studies 72, 1–19.

Akerlof, G.A., 1997. Social distance and social decisions. Econometrica 65, 1005–1027.

Alpizar, F., Carlsson, F., Johansson-Stenman, O., 2005. How much do we care about absolute versus relative income and consumption? Journal of Economic Behavior and Organization 56, 405–421.

Aronsson, T., Blomquist, S., 2003. Optimal taxation, global externalities and labor mobility. Journal of Public Economics 87, 2749–2764.

Aronsson, T., Sjögren, T., 2004. Is the optimal labor income tax progressive in a unionized economy? Scandinavian Journal of Economics 106, 661–675.

Aronsson, T., Sjögren, T., Dalin, T., in press. Optimal taxation and redistribution in an OLG model with unemployment. International Tax and Public Finance.

Arrow, K., Solow, R., Leamer, E., Portney, P., Radner, R., Schuman, H., 1993. Report of the NOAA panel on contingent valuation. Federal Register 58, 4601–4614.

Blomquist, S., 1993. Interdependent behavior and the effect of taxes. Journal of Public Economics 51, 211–218.

Boadway, R., Keen, M., 1993. Public goods, self-selection and optimal income taxation. International Economic Review 34, 463–478.

Boskin, M.J., Sheshinski, E., 1978. Optimal redistributive taxation when individual welfare depends upon relative income. Quarterly Journal of Economics 92, 589–601.

Bowles, S., Park, Y.-J., 2005. Inequality, emulation, and work hours: was Thorsten Veblen right? Economic Journal 15, F397–F413.

Brekke, K.-A., Howarth, R.B., 2002. Affluence, Well-Being and Environmental Quality. Edward Elgar, Cheltenham.

Brunner, J.K., Pech, S., in press. Optimal taxation of life annuities. Social Choice and Welfare.

Carlsson, F., Johansson-Stenman, O., Martinsson, P., 2007. Do you enjoy having more than others? Survey evidence of positional goods. Economica 74, 586–598.

Christiansen, V., 1981. Evaluation of public projects under optimal taxation. Review of Economic Studies 48, 447–457.

Clark, A.E., Oswald, A.J., 1996. Satisfaction and comparison income. Journal of Public Economics 51, 359–381.

Clark, A.E., Frijters, P., Shields, M.A., in press. Relative income, happiness and utility: an explanation for the Easterlin Paradox and other puzzles. Journal of Economic Literature.

Corneo, G., Jeanne, O., 1997. Conspicuous consumption, snobbism and conformism. Journal of Public Economics 66, 55–71.

Corneo, G., Jeanne, O., 2001. Status, the distribution of wealth, and growth. Scandinavian Journal of Economics 103, 283–293.

Cremer, H., Gahvari, F., Ladoux, N., 1998. Externalities and optimal taxation. Journal of Public Economics 70, 343–364.

Dupor, B., Liu, W.F., 2003. Jealousy and overconsumption. American Economic Review 93, 423–428.

Easterlin, R.A., 1995. Will raising the incomes of all increase the happiness of all? Journal of Economic Behavior and Organization 27, 35–47.

Easterlin, R.A., 2001. Income and happiness: towards a unified theory. Economic Journal 111, 465–484.

Ferrer-i-Carbonell, A., 2005. Income and well-being: an empirical analysis of the comparison income effect. Journal of Public Economics 89, 997–1019.

Frank, R.H., 1985. The demand for unobservable and other nonpositional goods. American Economic Review 75, 101–116.

Frank, R.H., 2007. Falling Behind: How Rising Inequality Harms the Middle Class. University of California Press.

Hopkins, E., Kornienko, T., 2004. Running to keep in the same place: consumer choice as a game of status. American Economic Review 94, 1085–1107.

Howarth, R.B., 2006. Optimal environmental taxation under relative consumption effects. Ecological Economics 58, 209–219.

Ireland, N.J., 2001. Optimal income tax in the presence of status effects. Journal of Public Economics 81, 193–212.

Johansson-Stenman, O., Carlsson, F., Daruvala, D., 2002. Measuring future grandparents' preferences for equality and relative standing. Economic Journal 112, 362–383.

Layard, R., 1980. Human satisfaction and public policy. Economic Journal 90, 737–750.
Ljungqvist, L., Uhlig, H., 2000. Tax policy and aggregate demand management under catching up with the Joneses. American Economic Review 90, 356–366.
Luttmer, E.F.P., 2005. Neighbors as negatives: relative earnings and well-being. Quarterly Journal of Economics 120, 963–1002.
Marceau, N., Boadway, R., 1994. Minimum wage legislation and unemployment insurance as instruments for redistribution. Scandinavian Journal of Economics 96, 67–81.
Ng, Y.-K., 1987. Relative income effects and the appropriate level of public expenditure. Oxford Economic Papers 39, 293–300.
Oswald, A., 1983. Altruism, jealousy and the theory of optimal non-linear taxation. Journal of Public Economics 20, 77–87.
Persson, M., 1995. Why are taxes so high in egalitarian societies? Scandinavian Journal of Economics 97, 569–580.
Pirttilä, J., Tuomala, M., 1997. Income tax, commodity tax and environmental policy. International Tax and Public Finance 4, 379–393.
Pirttilä, J., Tuomala, M., 2001. On optimal non-linear taxation and public good provision in an overlapping generations economy. Journal of Public Economics 79, 485–501.
Rayo, L., Becker, G.S., 2007. Evolutionary efficiency and happiness. Journal of Political Economy 115, 302–337.
Samuelson, L., 2004. Information-based relative consumption effects. Econometrica 72, 93–118.
Samuelson, P.A., 1954. The pure theory of public expenditure. Review of Economics and Statistics 36, 387–389.
Solnick, S., Hemenway, D., 1998. Is more always better?: a survey on positional concerns. Journal of Economic Behavior and Organization 37, 373–383.
Solnick, S., Hemenway, D., 2005. Are positional concerns stronger in some domains than in others? American Economic Review, Papers and Proceedings 45, 147–151.
Stiglitz, J.E., 1982. Self-selection and Pareto efficient taxation. Journal of Public Economics 17, 213–240.
Stutzer, A., 2004. The role of income aspirations in individual happiness. Journal of Economic Behavior and Organization 54, 89–110.
Tuomala, M., 1990. Optimal income tax and redistribution. Clarendon Press, Oxford.
van Praag, B.M.S., Frijters, P., 1999. The measurement of welfare and well-being; the Leyden approach. In: Kahneman, D., Diener, E., Schwarz, N. (Eds.), Foundations of Hedonic Psychology: Scientific Perspectives on Enjoyment and Suffering. Russel Sage Foundation, New York.
Wendner, R., 2005. Frames of reference, the environment, and efficient taxation. Economics of Governance 6, 13–31.
Wendner, R., Goulder, L.H., 2007. Status effects, public goods provision, and the excess burden, working paper.