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Abstract

We study optimal redistributive taxes when individuals differ in two characteristics - earning ability and leisure needs - assumed to be imperfectly correlated. Individuals have private information about their abilities but needs are observable. With two different levels of observable needs the population can be separated into two groups and needs may be used as a tag. We first assume that the social planner considers individuals should be compensated for their leisure needs and characterize the optimal redistributive policy, and the extent of compensation for needs, with tagging. We also consider an alternative social objective in which individuals are deemed responsible for their needs.

Keywords: optimal non-linear taxation, quasi-linear preferences, tagging, needs, responsibility.

JEL Classification: H21, H41

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1 Introduction

One of the most common differences across households is that they have to divert some time away from leisure or paid labor to a variety of duties. Examples of such duties are the need to take care of children or of dependent parents, the hours devoted each day to commuting, the extra time required for daily activities because of physical handicaps. These differences are often neglected when designing tax policies and the purpose of this paper is to introduce them explicitly. In particular we explore how information available on this type of needs may be used for redistributive purposes. We study the extent and nature of compensation for leisure needs when the observable needs provide information about the underlying distribution of ability and may be used as a tag.

In the standard optimal redistributive taxation framework individuals are assumed to differ in a single characteristic: ability, which is private information but whose distribution is commonly known. The private information nature of this characteristic imposes limits on the amount of redistribution that can be achieved. In particular, the redistributive policy must be designed so that individuals are given proper incentives to reveal their true types. The first paper to emphasize the implications of informational asymmetries on the design of optimal taxes was Mirrlees (1971). He did so by assuming a continuum of abilities. Stiglitz (1982) considered a discrete number of ability types instead and was able to provide further insights on the role of the incentive compatibility constraints.

In reality, however, individuals may differ in several characteristics. Some authors have explored the implications for the government's redistributive problem of using available information about additional individual characteristics and shown that they may have a role to play if they are correlated with ability. In a seminal paper in the area, Akerlof (1978) considered a society in which high- and low-ability individuals could be grouped into two categories on the basis of an exogenously observable characteristic. One category consisted of low-ability types only and the other of both low- and high-ability types. He showed that, within his setting, "tagging" (i.e. conditioning the tax on the observable individual characteristic) increases social welfare but for particular social objectives might violate the principle of horizontal equity.

Over time Akerlof's tagging idea has gained considerable attention and presently there is large interest in tagging and optimal income taxation. Recent contributions include Blomquist and Micheletto (2008) - on age-dependent taxation[1] - Cremer et al. (2009) - which provides general analytical results as well as an application to gender-based taxation-, Alesina et al. (2011) - on gender-based taxation - and Mankiw and Weinzierl (2010) - on height-based taxation. Until recently the literature had produced very few analytical results on the implications of tagging on the properties of optimal non-linear income tax schedules. Immonen et al. (1998) had previously relied on simulations to explore the pattern of optimal marginal income tax rates in an economy with a continuum of abilities and two tagged groups. In a similar setting Cremer et al. (2009) were recently able to provide analytical results by assuming quasilinear preferences, a Rawlsian social welfare function, and a constant and identical elasticity of labor supply within and across the tagged groups.

The papers cited above focus on the case where the tag does not carry in itself any normative significance but is used to separate the population into identifiable groups (denominated henceforth "pure tagging"). Another strand of the literature deals with the case where the tag has welfare significance. Boadway and Pestieau (2006) study the effects of tagging on redistributive taxation both when the observable characteristic does not have and does have welfare significance. In particular, they assume that households vary by consumption needs, which are reflected in differences in consumption requirements to achieve a given level of utility. They compare the solutions obtained with pure tagging and tagging with consumption needs. They also analyze the extent of compensation for needs when tagging is not feasible due, for instance, to political constraints or ethical concerns with the violation of horizontal equity. In order to be able to provide qualitative results they assume quasilinear preferences and social welfare functions that exhibit constant absolute aversion to inequality. With pure tagging they show that, under reasonable circumstances, the tax system is more redistributive in the tagged group with the higher proportion of high-ability persons and that inter-group redistribution always goes from the group with higher proportion of high-ability types to that with a lower proportion.

[1] Optimal age-dependent taxation had been previously studied by Lozachmeur (2006) in a life-cycle framework with representative agent, and hence abstracting from any (intracohort) redistributive aspect of the tax system.

When individuals differ in consumption needs and these can be used as a tag, full compensation for needs is optimal if a separate tax schedule applies to the two groups. The compensation for needs is indeed a component of the optimal inter-group lump-sum redistribution scheme and, within each group, the optimal tax schedule depends on the distribution of ability types in the group. When observable consumption needs cannot be used as a tag and individuals face a common tax schedule, there is generally imperfect compensation for needs: both under- and over-compensation can result depending on the correlation of needs with ability. This contrasts with Rowe and Woolley (1999) who had previously suggested giving universal credit for expenditures on consumption needs as part of an optimal non-linear income tax system.

In a related paper, Boadway and Pestieau (2003) incorporate leisure needs alongside consumption needs. They discuss the implications for the optimal tax problem of the different types of needs being observable or not. They provide, but do not explore in detail, a few results on tagging. With observable leisure needs, the maximin optimum would be characterized by a standard non-linear income tax schedule with the usual characteristics (i.e. non-distortion at the top and distortion at the bottom) within each group, and a transfer from the low-needs to the high-needs group, with the correlation between ability and needs playing a crucial role. In this paper we analyze tagging with leisure needs in further detail.

We model leisure needs in the same manner as Boadway and Pestieau (2003). The Stone-Geary representation has been common in the literature on tagging and redistributive taxation, especially for consumption needs, and we follow a similar approach. An important consequence of the particular additive specification adopted, which plays a crucial role in our analysis, is that the compensation for leisure needs is skill-dependent. Several examples of the type of handicap we wish to capture were given above; most of them have in common that the opportunity cost of the time devoted to those needs differs across ability groups. For instance, one hour of time wasted in traffic by a skilled individual is generally considered costlier than the same hour wasted by an unskilled individual.

Most of the analysis in this paper relies on the assumption that, while ability is private information, leisure needs are publicly observable and may be used as a tag. We first assume that the social planner considers that leisure needs deserve compensation and characterize the optimal redistributive policy, and the extent of compensation for needs, with tagging. It is worth noticing that, even if leisure needs are observable, the amount required to fully compensate for needs differs across ability types, and depends on the unobservable ability of individuals. This is in contrast with the linear consumption needs case studied by Boadway and Pestieau (2006), where the amount of compensation for needs is independent of the ability type. We obtain imperfect compensation for needs in most cases. We also explore the case in which the social planner may hold individuals responsible for their leisure needs. This might be particularly relevant if there is an element of choice underlying some existing needs (for instance, if the individual lives further from work because she enjoys the countryside). We show that, contrary to the linear consumption needs case, it is not possible to make all needy individuals responsible for their needs.

The rest of the paper is organized as follows. In the next section we describe the model with two levels of ability and two levels of leisure needs, and provide the laissez-faire allocation. In section 3 we characterize the first-best solution, when both ability and leisure needs are assumed to be observable. We characterize the second-best optimum, with unobservable ability but observable leisure needs, in section 4. We do so for a relatively general social welfare function. In order to shed more light on the results we explore several simpler specifications. We concentrate first on three-types societies, like Akerlof (1978), but take into account all the possible combinations. We also provide the maximin results. It is worth noticing that we consider a quasilinear utility specification, similar to the one used by Boadway and Pestieau (2006), but with the key difference that needs appear in the non-linear disutility of labor term rather than the linear consumption term. In the absence of needs, however, the utility specification would be the same and their analysis of pure tagging does then carry over provided we impose similar restrictions on the social utility. In section 5, we explore the consequences of adopting an alternative social objective in which the planner attempts to make the individuals responsible for their needs. We briefly discuss in section 6 the implications of being unable to observe leisure needs. A final section concludes.

2 The model

We assume that individuals differ in ability and leisure needs. We consider two types of ability w_i, with $w_2 > w_1$, where w_i corresponds to the wage rate of a type-i individual, and two levels of leisure needs, represented by $\overline{\ell}_j$, with $\overline{\ell}_1 > \overline{\ell}_2$. There are hence four types of individuals ij. We assume that individual preferences can be represented by a quasilinear utility of the form:[2]

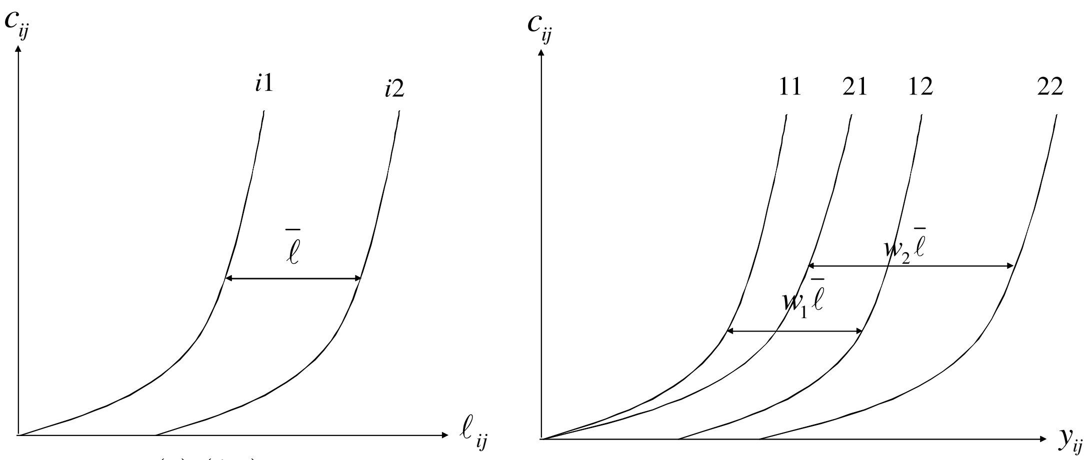
$$U_{ij} = c_{ij} - v\left(\ell_{ij} + \overline{\ell}_j\right) \qquad i, j = 1, 2 \tag{1}$$

where c_{ij} and ℓ_{ij} represent the consumption and the labor supply of individual ij, and the disutility of labor function $v(.)$ is assumed to be continuous, differentiable, strictly increasing and strictly convex function (i.e. $v' > 0$ and $v'' > 0$). In what follows we normalize the leisure need of the low-need individuals $\overline{\ell}_2$ to 0 and denote the leisure need of the high-need individual by $\overline{\ell}$. Accordingly, we refer to needy and non-needy individuals. The proportion of individuals with ability i and leisure need j in the full population is given by n_{ij}. Adding up across all types we obtain:

$$\sum_i \sum_j n_{ij} = 1.$$

As pointed out by Boadway and Pestieau (2003), the assumption that individual utilities are identical net of needs implies that utility levels are comparable among households. This avoids the conceptual problem of how to define the social planner's objective function when individual preferences are different and utilities are non-comparable (see Boadway et al. (2002) for an analysis of optimal redistribution with heterogeneous preferences). We represent in Figure 1 sets of individual indifference curves that yield the same utility level. We do so in Figure 1(a) for two individuals with the same ability w_i and different needs in the (ℓ, c)-space. The two

[2] The Stone-Geary specification is chosen on purpose. It implies that the opportunity cost of needs is increasing in productivity. Other specifications could have been adopted. One possibility could be to incorporate a constant need parameter $\delta > 1$ with the disutility term becoming $v(\delta \ell_j)$, which amounts to a proportional reduction in productivity. Another possibility could be $v\left(\ell_{ij} + \overline{\ell}_j / w_i\right)$, implying the same opportunity cost for all. With our additive specification we implicitly assume that the productivity of individuals at meeting these needs is constant and then independent of their productivity w_i. Recent empirical research on parental time use suggests that highly-educated parents view time spent with one's children as an investment, as opposed to simple supervision or traditional care, and tend to spend more time with their children despite the higher opportunity cost of their time (see Guryan et al. (2008)). If that is the case an alternative model might be more appropriate for that particular use of child care time, and the specification that we adopt would be appropriate for the portion of the child care time that is devoted to mere supervision and for which the parent's ability does not play a particular role.



(a) (ℓ, c)-space

(b) (y, c)-space

Figure 1: Sets of indifference curves yielding the same level of utility

indifference curves are horizontally parallel and the horizontal distance is given by the amount of leisure need $\bar{\ell}$. The indifference curves of individuals with different ability and identical needs have the same shape in this space. However, this is no longer the case in the (y, c)-space where $y = w\ell$. In Figure 1(b) we represent a set of indifference curves for the four types that yields the same utility level to all. For each needs type, the indifference curve of a low-ability individual is steeper than the indifference curve of a high-ability individual (that is, the usual single crossing property applies within each needs group). The indifference curves of individuals with the same ability but different needs are horizontally parallel, and the horizontal distance is given by the value of the leisure needs, $w_i\bar{\ell}$, which is different for different ability levels. The four individuals' indifference curves would all have the same shape if represented in the $\left(\widehat{\ell}, c\right)$-space where, as in Boadway and Pestieau (2003), $\widehat{\ell}_{ij} = \ell_{ij} + \bar{\ell}_j$ denotes the effective labor supply.

In a market economy, each individual chooses c_{ij} and ℓ_{ij} to maximize (1) subject to the budget constraint $c_{ij} = w_i \ell_{ij}$. Hence,

$$\max_{\ell_{ij}} \quad U_{ij} = w_i\,\ell_{ij} - v\left(\ell_{ij} + \bar{\ell}_j\right) \qquad i, j = 1, 2.$$

The first-order condition (hereafter FOC) is $v'\left(\ell_{ij} + \bar{\ell}_j\right) = w_i$. Hence, $\ell_{i2} = \ell_{i1} + \bar{\ell}$ (i.e. $\ell_{i2} > \ell_{i1}$) for all i, and $\ell_{2j} > \ell_{1j}$ for all j. All individuals with the same ability provide the same effective labor supply. However, the amount of hours worked in the labor market, and appropriately remunerated, is lower for needy individuals. Hence, needy individuals earn a lower income.

Among those individuals with the same needs, we have the standard result that those with higher ability work and earn more. High-ability non-needy individuals work and earn the most. Low-ability needy individuals work and earn the least. It is not possible to disentangle a priori the relationship between high-ability needy individuals and low-ability non-needy individuals (i.e. y_{21} and y_{12}). The precise relationship depends on the particular ability and need gaps, as well as the specific functional form for the disutility of labor. In any case, within each ability group, needy individuals earn less than non-needy ones. It seems in principle fair to compensate for differences in leisure needs within ability groups, and for differences in ability overall.

3 The first-best

As a benchmark we analyze the first-best solution. The problem of the planner who fully observes individual characteristics is expressed by the following Lagrangian:

$$\pounds = \sum_i \sum_j n_{ij} \left[G \left[c_{ij} - v \left(\ell_{ij} + \overline{\ell}_j \right) \right] + \mu \left(w_i \ell_{ij} - c_{ij} \right) \right],$$

where μ is the Lagrange multiplier associated with the budget constraint. Given the quasi-linearity of individual utilities, we use a strictly concave social utility transformation $G(\cdot)$ to reflect different degrees of aversion towards inequality.

The FOCs yield $v' \left(\ell_{ij} + \overline{\ell}_j \right) = w_i$ and $G'_{ij} = \mu \; \forall ij$, where G'_{ij} is the marginal social utility of consumption accruing to individual ij. As before, $\ell_{i2} = \ell_{i1} + \overline{\ell}$ (i.e. $\ell_{i2} > \ell_{i1}$) for all i, and $\ell_{2j} > \ell_{1j}$ for all j. Among individuals with the same needs, the most productive work and consume more. Individuals with the same ability supply the same effective amount of labor $\widehat{\ell}$, with those with higher needs working less in the marketplace. However, in the first-best all individuals achieve the same level of utility regardless their ability or needs: $U_{ij} = c_{ij} - v \left(\widehat{\ell}_{ij} \right)$ is equal for all ij, with $c_{i1} = c_{i2}$ for all i. How can this first-best allocation be decentralized? In addition to the traditional redistribution between ability groups there is redistribution within each ability group from non-needy to needy individuals.

Boadway and Pestieau (2003) show that full compensation for linear consumption needs would require a rather simple tax-transfer scheme. In order to fully compensate for needs in consumption $\overline{c}$, and achieve the same effective consumption $\widehat{c} = c - \overline{c}$ for all the individuals with the same ability, a lump-sum transfer of $(n_{12}+n_{22})\,\overline{c}$ needs to be provided to each needy individual and a lump-sum tax of $(n_{11}+n_{21})\,\overline{c}$ has to be raised from each non-needy individual, regardless of their ability. In our case, since the valuation of the leisure needs differs by ability type, a transfer of equal magnitude to both ability types within the needy group would not lead to full compensation.

If we call T_{i1} the net transfer to individual $i1$ (where i stands for the two different ability types within the needy group) and T_2 the net transfer from non-needy individuals regardless of ability,[3] we have that, in order to fully compensate for needs within ability groups:

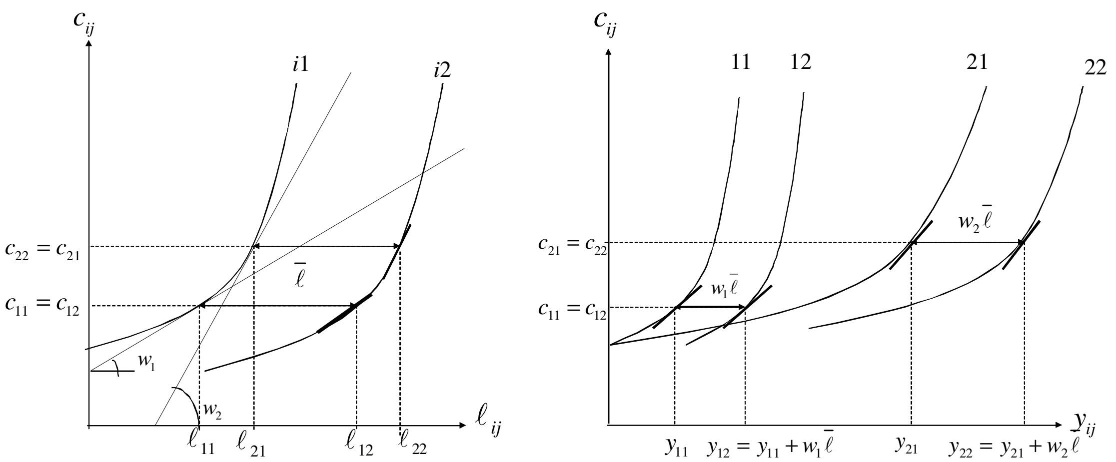
$$\begin{aligned} T_{11} &= w_1\overline{\ell}+T_2, \\ T_{21} &= w_2\overline{\ell}+T_2. \end{aligned}$$

The sum of net transfers should fulfill the budget constraint $n_{11}T_{11}+n_{21}T_{21}+(n_{12}+n_{22})\,T_2=0$. The equilibrium set of transfers is:

$$\begin{aligned} T_2 &= -\left(n_{11}w_1+n_{21}w_2\right)\overline{\ell}<0, \\ T_{11} &= \left[\left(n_{12}+n_{22}\right)w_1-n_{21}\left(w_2-w_1\right)\right]\overline{\ell},\text{ and} \\ T_{21} &= \left[\left(n_{12}+n_{22}\right)w_2+n_{11}\left(w_2-w_1\right)\right]\overline{\ell}>0. \end{aligned}$$

Both types of non-needy individuals pay a lump-sum tax. High-ability needy individuals receive a lump-sum transfer but low-ability needy individuals may pay a lump-sum tax or receive a lump-sum transfer. The two possibilities regarding the treatment of low-ability needy individuals arise because the compensation for leisure needs depends on the ability level. Low-ability needy individuals receive a transfer when $(n_{12}+n_{22})\,w_1>n_{21}\,(w_2-w_1)$, which is satisfied when the proportion of high-ability needy individuals and/or the productivity gap are sufficiently small. The first-best allocation is depicted in Figure 2, both in the (ℓ,c)-space and the (y,c)-space. In this last space the set of indifference curves represented - 11, 12, 21 and 22 - yield the same utility level.

[3] Note that a set of three different net transfers $\{T_{11},T_{21},T_2\}$ is sufficient in this case because the valuation of leisure needs for all non-needy individuals is the same (i.e. zero). In the more general case, with positive high and low needs, a complete set of four net transfers $\{T_{11},T_{21},T_{21},T_{22}\}$ would be required to decentralize the first-best.



(a) (ℓ, c)-space (a) (y, c)-space

Figure 2: First-best allocation

4 Tagging with leisure needs

In a second-best framework with imperfect information we need to incorporate self-selection constraints (hereafter SSCs) to ensure individuals reveal their true types. When needs are observable but ability is not observable the FB allocation represented in Figure 2 is no longer feasible. A type-21 individual would be better off with the treatment designed for a type-11. We represent the utility level achieved by such a mimicker by indifference curve 21' in Figure 3. Similarly a type-22 individual would be better off with the treatment designed for 12, at indifference curve 22'. Note also that the horizontal distance between the indifference curves of the high-ability individuals in the first-best allocation is $w_2\bar{\ell}$, while the horizontal distance between two high-ability individuals attempting to mimic the low-ability individuals in their respective groups is $w_1\bar{\ell}$, which implies that in such an event a type-22 mimicker would be better off than a type-21. When needs are observable, the relevant SSCs are the ones that relate individuals of different ability in each needs group (i.e. preventing 21 from mimicking 11 and 22 from mimicking 12).

The second-best problem is then:

$$\max_{c_{ij}, y_{ij}} \quad \sum_i \sum_j n_{ij} G \left[c_{ij} - v\left(\frac{y_{ij}}{w_i} + \bar{\ell}_j \right) \right]$$

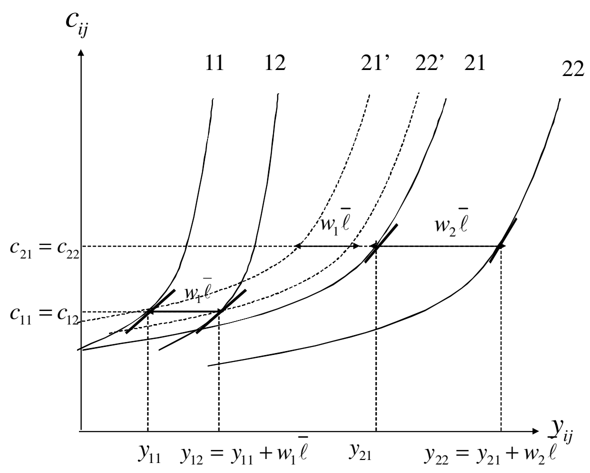


Figure 3: Inability to achieve the FB allocation with asymmetric information

s.t.

$$
\begin{aligned}
(\mu) &: \sum_i \sum_j n_{ij}\left(y_{ij}-c_{ij}\right) \geq 0 \\
(\lambda_1) &: c_{21}-v\left(\frac{y_{21}}{w_2}+\bar{\ell}\right) \geq c_{11}-v\left(\frac{y_{11}}{w_2}+\bar{\ell}\right) \\
(\lambda_2) &: c_{22}-v\left(\frac{y_{22}}{w_2}\right) \geq c_{12}-v\left(\frac{y_{12}}{w_2}\right)
\end{aligned}
$$

where λ_j stand for the Lagrange multipliers associated with SSCs within each needs group j (with $j=1,2$).

The FOCs yield:

$$
G'_{11}=\mu+\frac{\lambda_1}{n_{11}}, \quad G'_{12}=\mu+\frac{\lambda_2}{n_{12}}, \quad G'_{21}=\mu-\frac{\lambda_1}{n_{21}} \text{ and } G'_{22}=\mu-\frac{\lambda_2}{n_{22}}. \tag{2}
$$

The relationship between the utility level achieved by individuals of the same ability and different needs depends on the ratio of the value of the Lagrange multiplier (the strength of the SSC in the group) to the proportion of individuals of that ability level in each group (the larger or smaller relative presence of a particular type in the population).

Rearranging the FOCs,

$$
v'\left(\frac{y_{21}}{w_2}+\bar{\ell}\right)=v'\left(\frac{y_{22}}{w_2}\right)=w_2,
$$

$$
v'\left(\frac{y_{11}}{w_1}+\bar{\ell}\right)<w_1 \text{ and } v'\left(\frac{y_{12}}{w_1}\right)<w_1,
$$

$$\mu = \sum_i \sum_j n_{ij} G'_{ij}.$$

The second-best levels of y_{22} and y_{21} coincide with the first-best ones and both types of high-ability individuals supply the same effective amount of labor $\widehat{\ell}$.[4] There is no efficiency gain in distorting the labor supply choice of any of the high-ability individuals. This does not mean that both types achieve the same utility because, as mentioned above, they might end up with different consumption. Both low-ability individuals are distorted at the margin and supply a lower effective labor than in the first-best. However, the relationship between the amounts of effective labor supplied by the two low-ability individuals is ambiguous.

At this level of generality it is difficult to give more precise results. We cannot obtain explicit expressions for the Lagrange multipliers in terms of the parameters, particularly the distribution of types. In order to shed more light we explore several simpler specifications. We concentrate first on three-types societies. With 3 types one of the needs groups is composed by individuals of the same ability, which becomes then public information. This is similar to the kind of society considered originally by Akerlof (1978). We also explore the consequences of adopting a particular social objective - the maximin - when all 4 types of individuals are present. This particular social objective has been commonly employed in the literature on tagging. For instance, Cremer et al. (2009) assume that the social planner is Rawlsian and Boadway and Pestieau (2006) restrict the analysis to social objectives characterized by constant absolute aversion to inequality, among which the maximin outcome is amply discussed.

4.1 Three-types societies

There are four different possible three-types societies: {11,12,22}, {11,12,21}, {11,21,22} and {12,21,22}. We formally analyze the first case and briefly mention the results for the other three.

When only individuals of types 11, 12 and 22 are present in the population, all needy individuals are low-ability, and this information can be taken into account in the design of the optimal tax system. There is now only one relevant self-selection constraint, the one that links high- and low-ability types in the non-needy group and from (2) we know that $U_{22} > U_{11} > U_{12}$

[4] The second-best levels of y_{22} and y_{21} do not longer coincide with the first-best ones, and the high-ability individuals do not necessarily supply the same effective amount of labor $\widehat{\ell}$, with a separable but not quasilinear utility specification.

as long as $\lambda_2 > 0$ (i.e. the relevant self-selection constraint is binding). A low-ability needy individual is made better off compared to a low-ability non-needy individual because the social planner can identify her as being low-ability by observing her leisure needs. This is consistent with Akerlof (1978)'s findings.

We can also study the marginal tax rates and the extent of compensation for leisure needs. Type-22 individuals face a zero marginal tax rate and type-12 individuals face a positive marginal tax rate. This is consistent with the more general results shown above. When all needy individuals are low-ability, and we apply separate tax schedules to needy and non-needy, there is no reason to impose a positive marginal tax rate on type-11 individuals. The effective labor supply of needy individuals is higher, but they are more than fully compensated for their leisure needs with extra consumption:[5]

$$c_{11} - c_{12} > v\left(\frac{y_{11}}{w_1} + \bar{\ell}\right) - v\left(\frac{y_{12}}{w_1}\right).$$

This situation is depicted in Figure 4. The lines 11, 12 and 22 represent the utility levels achieved by these three types of individuals in the second-best allocation. The dashed lines 12' and 22' represent the indifference curves in situations where types 12 and 22 would obtain the same utility level as type 11. Clearly type-12 individuals are worse off, and type-22 individuals better off, than type-11 ones.

If all non-needy individuals are low-ability instead, there is no benefit in distorting the labor supply decision of type-12 individuals. The effective labor supply of type-11 individuals is low relative to type-12 ($\ell_{11} + \bar{\ell} < \ell_{12}$), but type-11 individuals also receive considerably less consumption, and end up being worse than type-12 ones: $U_{21} > U_{12} > U_{11}$.

In societies composed by two types, needy and non-needy, of high-ability individuals and one type of low-ability individual, the relationship between the level of utility achieved by the high-ability types depends on whether the low-ability type is needy or non-needy. We showed in the general case that there is non-distortion at the margin on both high-ability types and they provide the same effective amount of labor. However, they are allocated different amounts of consumption depending on the group they belong to. If the low-ability type is needy, the

[5] In the separable case it is possible to show that $c_{11} > c_{12}$ but any relationship between utility levels and the amount of effective labor supplied by the two low-ability types remains possible.

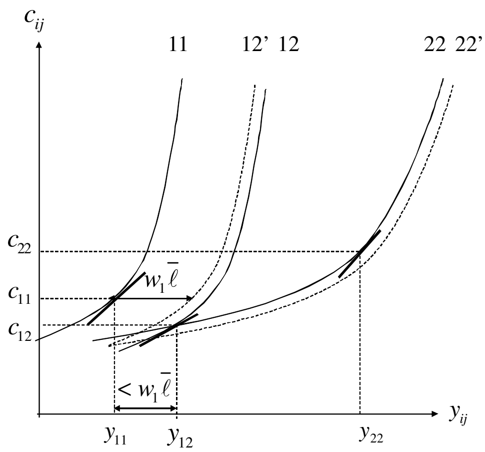


Figure 4: Second-best allocation in the 11,12 and 22 society

non-needy individuals are identified as high-ability types and $U_{21} > U_{22} > U_{11}$. If the low-ability type is non-needy, the needy individuals are identified as high-ability types and $U_{22} > U_{21} > U_{12}$.

4.2 Maximin

We now explore the consequences of adopting a maximin social objective. As mentioned above, this objective has been commonly assumed in the literature on tagging. In our case, the maximin solution can be obtained by solving the following problem:

$$\max_{c_{ij},y_{ij}} c_{11} - v\left(\frac{y_{11}}{w_1} + \bar{\ell}\right)$$

s.t.

$$\begin{aligned}
(\mu) &\ :\ \sum_i \sum_j n_{ij}\left(y_{ij} - c_{ij}\right) \geq 0 \\
(\lambda_1) &\ :\ c_{21} - v\left(\frac{y_{21}}{w_2} + \bar{\ell}\right) \geq c_{11} - v\left(\frac{y_{11}}{w_2} + \bar{\ell}\right) \\
(\lambda_2) &\ :\ c_{22} - v\left(\frac{y_{22}}{w_2}\right) \geq c_{12} - v\left(\frac{y_{12}}{w_2}\right) \\
(\gamma) &\ :\ c_{12} - v\left(\frac{y_{12}}{w_1}\right) \geq c_{11} - v\left(\frac{y_{11}}{w_1} + \bar{\ell}\right)
\end{aligned}$$

where γ stands for the Lagrange multiplier associated with the constraint that relates both low-ability types. The public information on leisure needs implies that the two low-ability types can be separated. There is then no incentive compatibility constraint linking the two low-ability types but instead a constraint that ensures that the utility of type-12 individuals does not fall below the utility of type-11 ones. The FOCs associated with the consumption variables yield:

$$\mu = 1, \quad \lambda_1 = n_{21}, \quad \lambda_2 = n_{22} \quad \text{and} \quad \gamma = n_{12} + n_{22}.$$

Therefore, all the constraints bind. It is worth noticing that $U_{11} = U_{12}$ in the maximin outcome, regardless of the distribution of abilities in the needy and non-needy groups. The relationship between the marginal tax rates they face and the effective amount of labor they supply depends, however, on the distribution of abilities in each needs groups:

$$\frac{1}{w_1} v'\left(\frac{y_{11}}{w_1} + \bar{\ell}\right) = \frac{1 + \frac{n_{21}}{n_{11}} \frac{1}{w_2} v'\left(\frac{y_{11}}{w_2} + \bar{\ell}\right)}{1 + \frac{n_{21}}{n_{11}}},$$

$$\frac{1}{w_1} v'\left(\frac{y_{12}}{w_1}\right) = \frac{1 + \frac{n_{22}}{n_{12}} \frac{1}{w_2} v'\left(\frac{y_{12}}{w_2}\right)}{1 + \frac{n_{22}}{n_{12}}}.$$

The low-ability individuals face positive marginal tax rates, which coincide if the effective amount of labor supplied is the same. Both high-ability individuals face face zero marginal tax rates and supply the same effective amount of labor, as shown for the general case. This does not mean however that they achieve the same utility levels. It can be shown that the relationship between the levels of utility achieved by the two high-ability types is linked to the relationship between the effective labor supplied by the low-ability types: $\ell_{11} + \bar{\ell} \leq \ell_{12}$ implies $U_{22} > U_{21}$ whereas $\ell_{11} + \bar{\ell} > \ell_{12}$ implies $U_{21} > U_{22}$.

The expressions for the marginal tax rates faced by the low-ability individuals depend on the ratio of high- to low-ability individuals in each needs group. In the particular case where those ratios coincide it can be shown that $\ell_{12} = \ell_{11} + \alpha\bar{\ell}$ with $1 < \alpha < w_2/w_1$. Hence, the effective amount supplied by the non-needy is larger, and $U_{22} > U_{21}$. In the extreme distributional cases where all high-ability individuals belong to the same group, it is easy to show that $\ell_{11} + \bar{\ell} > \ell_{12}$ when high-ability individuals are non-needy (i.e. $n_{21} = 0$), whereas $\ell_{11} + \bar{\ell} < \ell_{12}$ when high-ability individuals are needy (i.e. $n_{22} = 0$). In any case, the low-ability individual who is pushed to work a relatively larger effective amount of time (inclusive of her need) is compensated by a higher consumption that equates both low-ability utility levels. The high-ability individual achieves a higher level of utility.[6]

5 Responsibility

We have assumed so far that needy individuals deserve compensation for their needs, even if the absence of full information on abilities implies imperfect compensation for leisure needs in most cases. Compensation for leisure needs may seem fair when the need stems from some type of handicap that the individual is somehow forced to address before she can become an active participant in the labor market. It is unclear, however, that the social planner would want to compensate individuals for all possible types of leisure needs. For instance, in the case of commuting time the planner may be reluctant to compensate someone who opts to leave far away from work because she enjoys the countryside. In this section we consider the consequences of attempting to hold the individuals responsible for their needs.[7]

We choose to capture responsibility for leisure needs in the social objective by rescaling type-ij individual utility by a factor $w_i\overline{\ell}_j$.[8] In other words we keep the disutility of labor as it is, with the leisure need, but we compensate for this undue handicap by "taxing" the individual with its market value. In Figure 5 we represent this cardinalization: a type-$i1$ individual works ℓ_{i1}, earns y_{i1} and consumes c_{i1}, whereas a type-$i2$ individual works $\ell_{i1} + \overline{\ell}$, earns $y_{i2} = y_{i1} + w_i\overline{\ell}$ and consumes c_{i1}+ $w_i\overline{\ell}$ (i.e. the needy individual earns and consumes $w_i\overline{\ell}$ less than the non-needy one for an equal amount of effective labor supply). The fact that two individuals with the same ability and different needs achieve different allocations along the same budget constraint is not

[6]When all low-ability individuals belong to a single type (say, needy), those individuals belonging to the other type (say, non-needy) can be identified as high-ability ones. If all non-needy individuals are high-ability ones, there is no SSC in the non-needy group that sets a minimum bound on type 22's utility. Hence, we must ensure type-22's utility does nof fall bellow type-11. This constraint binds and $U_{21} > U_{22} = U_{11}$. If the low-ability type is non-needy, the needy individuals are identified as high-ability types and $U_{22} > U_{21} = U_{12}$.

[7]We study the case in which the planner attempts to make the individuals fully responsible for their needs. However, an alternative option would be to specify a fraction of the leisure need that an individual is responsible for. This was suggested to us by a referee and we believe it would be highly appropriate in instances where, using the same commuting example as above, an individual who has a longer time to commute derives to some extent joy from living in the countryside, or from contacts made while communting, that partly compensate for the longer commute.

[8]Note that the type of rescaling required to make the individuals responsible for their leisure needs depends on the individuals' preferences, including the utility specification and the nature of the leisure needs, considered.

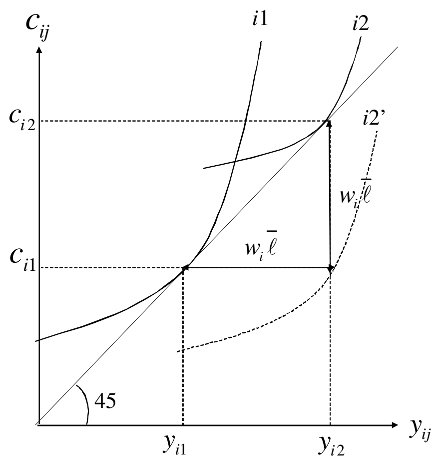


Figure 5: Compensation versus responsibility for leisure needs

considered problematic when the needy individual is deemed responsible for the shortfall.[9]

This is one possible representation of the concept of responsibility. There are other ways although none is perfect. Fleurbaey (1995) provides a rather broad discussion of the treatment of responsibility in economic theory and in egalitarian theories of justice. Fleurbaey and Maniquet (2006, 2007) deal with this issue in a framework more closely related to ours. They characterize the optimal income tax when individuals differ in ability and preferences for leisure, and consider fairness principles that capture the notions of compensation and responsibility. In particular, Fleurbaey and Maniquet (2006) propose a fairness requirement that is based on the respect of individual preferences and relates to Dworkin (1981) argument that, when all agents have the same wage rate and all have access to the same labor-consumption bundles, there is no need for redistribution as any income difference is then a matter of personal preferences. We apply a similar principle to needs rather than to preferences.

The Lagrangian in the first-best problem is now

$$\pounds = \sum_i \sum_j n_{ij} \left[G \left[c_{ij} - v\left(\frac{y_{ij}}{w_i} + \bar{\ell}_j \right) + w_i \bar{\ell}_j \right] + \mu \left(w_i \ell_{ij} - c_{ij} \right) \right].$$

The FOCs yield $v'\left(\ell_{ij} + \bar{\ell}_j\right) = w_i$ and $G'_{ij} = \mu \ \forall ij$. The labor supply of each type coincides with what was obtained before in the first-best problem with compensation for leisure needs.

[9] Note that with compensation for leisure needs the indifference curves $i1$ and $i2'$ represented the same utility level for types $i1$ and $i2$, respectively, whereas under responsibility, it is now the indifference curves $i1$ and $i2$ that capture the same utility level for these two types.

However, now it is not $c_{ij} - v\left(\widehat{\ell}_{ij}\right)$ but $c_{ij} - v\left(\widehat{\ell}_{ij}\right) + w_i\overline{\ell}_j$ that is equal for all individuals:

$$c_{i1} - v\left(\frac{y_{i1}}{w_i} + \overline{\ell}\right) + w_i\overline{\ell} = c_{i2} - v\left(\frac{y_{i2}}{w_i}\right),$$

which implies $c_{i2} - c_{i1} = w_i\overline{\ell}$ and, hence, no compensation for leisure needs.

The second-best problem and the associated FOCs are similar in form to those obtained with compensation. The only difference is that the argument of $G'(.)$ in the FOCs includes now the rescaling factor $w_i\overline{\ell}_j$. It is worth noticing that, although the social planner employs it in the social objective, the rescaling factor does not appear in the SSCs. All high-ability individuals face zero marginal tax rates. The effective labor supply is the same for both high-ability types (i.e. $\ell_{21} + \overline{\ell} = \ell_{22}$) and coincides with the one obtained in the first-best. In any case the relationship between the utility levels, which now include the rescaling factor $w_2\overline{\ell}_j$, is determined by comparing λ_1/n_{21} and λ_2/n_{22}. Both low-ability individuals face positive marginal tax rates, and the relationship between their utility levels depends on the relationship between λ_1/n_{11} and λ_2/n_{12}.

Boadway and Pestieau (2006) did not consider making individuals responsible for their consumption needs. Nevertheless, it could similarly be argued that, even though it may seem fair to compensate individuals for certain kinds of consumption needs (for instance, certain expenses on health care), there may be other kinds of consumption needs that the individuals could be deemed responsible for. It is worth recalling that, in their framework, consumption needs appear in the linear term of the quasilinear utility specification, and the magnitude of the need is the same regardless of ability type. It is quite straightforward to show that, in such a setting, tagging with responsibility for needs would yield the same results as pure tagging (i.e. tagging when the observable characteristic has no welfare significance).

In our case responsibility for leisure needs does not lead to the pure tagging outcome because a uniform rescaling down of the consumption of both needy individuals does not imply that both ability types are made responsible for their needs to the same extent. This is best illustrated by the maximin outcome. With responsibility for needs,

$$c_{12} - v\left(\frac{y_{12}}{w_1}\right) = c_{11} - v\left(\frac{y_{11}}{w_1} + \overline{\ell}\right) + w_1\overline{\ell}.$$

The needy low-ability individuals are made responsible for their leisure needs when their consumption is shifted down by the amount $w_1\overline{\ell}$. The allocation of high-ability individuals is shifted down by the same amount due to the SSC that links both needy individuals. This means that the needy high-ability individuals are not made fully responsible for their leisure needs, which would require shifting down their consumption by $w_2\overline{\ell}$.

6 Non-observable needs

We have assumed that needs are observable and can be used as a tag. We briefly discuss here the implications of being unable to observe leisure needs. This exercise is relevant because it enables us to assess differences with respect to the analysis carried out above where needs could be observed and used as a tag. With unobservable ability and leisure needs, we have an optimal tax problem similar to the one studied by Cremer et al. (2001).[10] They show that the distribution of the two characteristics, and in particular the correlation between them, plays a crucial role. Their analysis also emphasizes the complexities involved in determining the pattern of binding self-selection constraints.

In our case, a simple comparison of the marginal rates of substitution of consumption for income for different type-ij individuals,

$$MRS_{yc}^{ij} = \frac{v'\left(\dfrac{y_{ij}}{w_i} + \overline{\ell}_j\right)}{w_i}, \tag{3}$$

points to the impossibility of establishing in general whether the indifference curves of type-21 individuals are steeper or flatter than those of type-12 ones. This has important implications for the analysis of binding self-selection constraints in the general four-types society.[11] In the three-types societies, where those two types do not coexist, it is possible to unambiguously determine

[10] Cremer et al. (2001) studies the optimal tax mix problem when individuals differ in unobservable productivity and endowments. They consider several consumption goods and a separable, but not necessarily quasi-linear, utility specification.

[11] There are in principle two cases to analyze: 1) $MRS_{yc}^{11} > MRS_{yc}^{21} > MRS_{yc}^{12} > MRS_{yc}^{22}$ and 2) $MRS_{yc}^{11} > MRS_{yc}^{12} > MRS_{yc}^{21} > MRS_{yc}^{22}$. Because $v(.)$ is strictly increasing and strictly convex the ordering of marginal rates of substitution is the exact opposite of the ordering of utility and, due to the concavity of the social welfare function, to the direction of redistribution. Both cases may be analyzed in the traditional Mirrlees setting and yield the usual prediction of potitive marginal tax rates for all but type-22 individuals. We are grateful to an anonymous referee for highlighting this point.

the direction in which the single-crossing property holds. For the 3-type society {11,12,22}, we obtained a ranking of individual utility levels $U_{22} > U_{11} > U_{12}$ when leisure needs were observable and used as a tag. When leisure needs are not observable, and can no longer be used as a tag, type-11 individuals are clearly the worst-off and we have that $U_{22} > U_{12} > U_{11}$. The marginal tax rate on type-11 individuals is now positive due to an additional binding self-selection constraint that precludes type-12 individuals from applying for the treatment designed for type-11 individuals. For the 3-type society {11,21,22} we obtained $U_{21} > U_{22} > U_{11}$ before but if the tag is no longer available we have that $U_{22} > U_{21} > U_{11}$.

It is worth emphasizing a key difference with respect to the consumption needs case studied by Boadway and Pestieau (2006). Recall that the utility specification is the same: quasi-linear in consumption. If consumption needs, which enter the linear part of the utility function, were unobservable in their framework, two individuals with the same ability but different needs would become effectively indistinguishable. Their indifference curves in the (y, c)-space exhibit the same shape, even if the two types achieve different utility levels when allocated the same (y, c)-bundle, given that the effective consumption of the needy individual is then lower. In our framework, where the needs enter the non-linear disutility of labor function, the indifference curves of two individuals with the same ability and different needs exhibit, according to (3), different shapes. This feature can be exploited to separate them in the case of unobservable leisure needs if it is shown optimal to do so.

7 Conclusions

In this paper we have studied the optimal redistributive tax scheme when individuals differ in two characteristics, earning ability and leisure needs, which were assumed to be imperfectly correlated. Individuals have private information about their abilities, but needs are observable. The population can then be separated into two groups and needs can be used as a tag. We first assumed that the social planner considered leisure needs as a characteristic relevant for compensation and characterized the optimal redistributive policy, and the extent of compensation for leisure needs, with tagging. Even if leisure needs are observable, the amount required to fully compensate the individuals for their needs differs across ability types, and depends on their unobservable ability. This implies imperfect compensation for needs in most cases. We have also considered situations in which the social planner deemed individuals responsible for their leisure needs and characterized the optimal solution in this case. We showed, using the maximin illustration with four types, that attempting to make individuals responsible for their leisure needs does not correspond to pure tagging, as it would be the case with linear consumption needs. Even if needy low-ability individuals were made fully responsible for their needs, it is not possible to make needy high-ability individuals fully responsible. We also briefly discussed the implications of being unable to observe leisure needs, which is an issue that deserves further research.

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