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Abstract
This study designs a laboratory experiment to investigate the link between personal responsibility and individual preferences for redistribution. We contribute to the literature by considering two key insights: first, effort is costly; second, its fruits can be grasped only in the future. Participants face a crucial trade-off between providing a costly effort or free-riding on their fellows' effort, playing in a context where the size and the distribution of the pie depend both on circumstances beyond their control, and on their choice of working hard and voting for redistribution. Our findings suggest that people tend to reward effort: the demand for redistribution decreases when the observed average effort in the society increases and the cost of effort is higher. Moreover, people ask for less redistribution the more they are interested in the future. These results hold controlling for a number of other possible determinants of the preferences for redistribution.

Keywords: income redistribution, personal responsibility, individual effort, social mobility, inter-temporal preferences.

JEL Classification: **:** C91, D63, D91, H24, H31

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1. Introduction

This study discusses the case for the stress placed in recent decades on *personal responsibility* in order to design financially and politically sustainable redistributive policies. The notion of personal responsibility (or *individual's effort* as opposed to *circumstances* beyond one's own control) has deeply inspired both the political discourse and the academic debate[1]. Although rarely mentioned in traditional welfare economics (e.g., Fleuerbay, 1995), personal responsibility has been deeply scrutinized by social scientists and political philosophers (e.g., Arneson, 1990; Cohen, 1990; Dworkin, 1981, 2000; Rawls, 1971; Roemer, 1995, 1996; Sen, 1985, 1990) and has received a wide acceptance, so that it is now generally recognized the principle that, in designing welfare policies, the agents should be let as free as possible to make their choices and to bear the consequences of such choices. The corollary of this agenda should be less inefficiencies in redistributive spending, hence less spending and more growth, coupled with social justice.

Despite its appeal, the importance attributed to personal responsibility does not necessarily lead citizens to ask for *less* redistribution. On the one hand, in a world where individual effort is important for increasing one's own economic well-being, observing greater effort by their fellows might really stimulate in citizens more personal effort and a reduced demand for redistribution. On the other hand, however, individuals might try to free-ride on their fellows' effort whenever they have the possibility of doing so, by reducing their own effort and increasing the demand for redistribution. What effect will prevail in societies where people believe that they are poor because of

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[1] As famous examples of the extent to which the notion of 'personal responsibility' has inspired the political debate on the role of public sector intervention through redistributive policies, one can consider the *Labour Party Manifesto* (1997), containing the proposals advanced by Tony Blair's New Labour, the speech with which President Bill Clinton introduced the *Personal Responsibility and Work Opportunity Reconciliation Act* in 1996, and, more recently, the electoral document *Cambiare Verso* in support of the Italian Premier Matteo Renzi during the primary for the leadership of the Democratic Party in December 2013.

bad luck? Or in societies with a low level of social mobility? Or in societies where people heavily discount the future?

The idea of investigating some of the above questions through laboratory experiments is clearly not novel in the literature (e.g., Rutstrom and Williams, 2000; Checchi and Filippin, 2004; Konrad and Morath, 2011; Becchetti *et al.*, 2012; Durante *et al.*, 2014). Previous works are basically structured in two stages. In the first stage, the initial distribution of incomes is determined either randomly (i.e., assuming *luck* is the source of income) or by taking into account the individual success in performing a given task (i.e., assuming *effort* or *ability* as sources of income). Playing *Tetris* or solving the *Tower of Hanoi* problem are the typical tasks used to determine income distribution in such studies. In the second stage, preferences for redistribution are elicited from participants for any given distribution of income, with the aim of inferring the criteria that individuals follow in assessing the fairness of the distribution and how the demand for redistribution is driven by the source of inequality.

But as far as personal responsibility is concerned, these studies are not fully satisfactory for at least two reasons. First, they do not appropriately take into account the key characteristic of any redistribution game, what makes it to look very much like a standard *public good game*, i.e., the presence of strong incentives to free-ride on the contribution by the other members of the society. This is particularly evident when considering the tasks used in these studies to measure effort. One could easily argue that performing such tasks is not *really costly* to participants, while a key characteristic of effort is that it has to be costly.[2] Second, previous literature does not consider the intertemporal nature of the redistribution game, which becomes evident as soon as the long-lasting features of redistributive policies are considered, together with the legitimate

[2] It is also worth noticing that these experiments usually compare different distributions, each of which mirroring a different income source – e.g., luck, ability, effort –*in isolation*, while the actual distributions are determined by all these sources *jointly*. In our experiment we take into account also this aspect.

aspirations of individuals to upward mobility[3]. The fruits of effort will be (hopefully) grasped *in the future*. Hence, both the *objective* degree of social mobility and the *subjective* preference for the future (the intrinsic tendency to be more "grasshopper" or more "ant" in a literary vein) are potentially important for explaining the demand for redistribution and should be properly considered in order to have a clear assessment of the role of individual effort in shaping preferences for redistribution. However, the role played by individual inter-temporal preferences has never been investigated in previous laboratory experiments, which focused their attention only on perceived social mobility (e.g., Checchi and Filippin, 2004; Konrad and Morath, 2011).

In this paper we provide an answer to these two issues, analyzing the demand for redistribution and the role of personal responsibility by designing the redistribution game as a two-period public good game. In our setting, participants face a crucial trade-off between providing a costly effort on their own or free-riding on their fellows' effort, playing in a framework where the future pie and its distribution simultaneously depend on circumstances which are both *under* and *beyond* the control of any individual. More precisely, while the *initial* distribution of gross incomes is determined randomly (mirroring inevitable exogenous differences among individuals which are *beyond* their control), the *future* distribution of net incomes depends both on the effort each individual decides to exercise (reflecting personal responsibility), and the redistribution carried out via a purely redistributive proportional income tax, on the rate of which individuals are asked to vote. The key issue here is that individuals may decide not to exert effort, trying to exploit the benevolence of their fellows, and voting for a higher degree of redistribution (e.g., a poor guy

[3] See, e.g., Alesina and Giuliano (2010). Although beliefs concerning the fairness of income distribution based on the source of income differences certainly play a role in explaining the desired level of redistribution, the demand for redistribution is driven by other important concerns. The degree of social mobility, may indeed play an important role (e.g., Piketty, 1995; Benabou and Ok, 2001; Alesina and La Ferrara, 2005), i.e., the desired level of redistribution, as well as the optimal individual effort, is likely to depend also on considerations about the future position the individual will be able to occupy in the income ranking.

that completely disregards the future is likely to exploit largely her fellows); or they may decide to exert effort, voting for less redistribution (e.g., a poor guy hoping to emerge in the future is likely to vote for less redistribution).

Our experimental results suggest that individuals reward personal effort: they prefer less redistribution the higher the average effort put forward in the society, and the higher the cost of effort. This suggests that in effort-rewarding (meritocratic[4]) societies – where effort matters more for personal achievements, individuals exercise more effort and effort is more costly than in more egalitarian societies – free-riding behaviour tends to be less frequent and individuals are less prone to redistribution. As for the inter-temporal nature of the redistributive game, the perceived degree of social mobility confirms to be important, since the prospect of a higher upward mobility increases the probability that an individual asks for zero redistribution and lowers the preferred tax rate. However, as an additional novel finding compared to previous studies, we also point out a positive link between the subjective preference for the present time with respect to the future and the demand for more redistribution. These results highlight that not only the *objective* opportunities to succeed but also the *subjective* desire to capture these opportunities are important factors affecting preferences for redistribution. Finally, confirming previous studies, we also find that self-interest alone cannot give a comprehensive explanation of the demand for redistribution. Although the support for redistribution is generally decreasing with the ex-ante defined gross income, one can observe that also net taxpayers are in favour of

[4] According to, e.g., Sen (1999), the term 'meritocracy' seems to have been introduced by Michael Young's 1958 book 'The Rise of Meritocracy'. Young proposed a negative view of societies in which merit is equated with 'intelligence-plus-effort' and is attached to people (because of their 'talents') rather than to people's actions. In particular, he imagined a society in which merit was defined according to individuals IQ tested throughout the life course, and described the future fall of these 'meritocratic' societies. Most of the scholars ignored this book and transformed the sarcastic Young's view of 'meritocracy' in a positive term for rewards to merit of individuals. Here we take this more contemporary 'incentive view', and look at the merit of actions (and not of individuals *per se*) by having in mind a 'good society' as one in which people do not free-ride on their fellows and have incentives to exercise more effort.

redistribution. Ethical concerns, inequality aversion or even loss aversion may help explain the support for redistribution by these individuals.

The paper is organized as follows. Section 2 defines our experiment, including a simple theoretical framework and the experimental design, while section 3 discusses the results on the main determinants of the preferences for redistribution. Section 3 concludes with a summary and policy suggestions.

2. Defining the experiment

2.1. Theoretical framework: a two-period model of individual choice

In order to define the general setup of the experiment, we begin our analysis by sketching a theoretical framework based on a two-period model of individual choice. We consider a society where any individual $i = 1, \dots, n$ is entitled to the same income y in both period, which can be either consumed (both at time t and $t + 1$) or invested (only at time t). The fundamental source of differences among individuals is given by the individual-specific exogenous probability of getting y, which reflects *circumstances* beyond one's control (like the family background or the innate capacities). At time t this probability is given by $\hat{q}_i \in (0,1)$.

While the probability of getting y is exogenous at time t, it is partially endogenous at $t + 1$, as it depends not only on exogenous circumstances but also on the effort $e_i \in [0, \bar{e}_i]$ provided by individuals at t; in particular, $q_{it+1}(e_i) = \hat{q}_i + \varphi_i(e_i)$. One can think at effort as an investment in human or physical capital. The function $\varphi_i(.)$ reflects the productivity of effort. We assume that this productivity is marginally decreasing $(\varphi_i', > 0, \varphi_i'' < 0)$; moreover, we assume that $\varphi_i(0) = 0$ and $q_{it+1}(e_i) \to 1$ as $e_i \to \bar{e}_i$; that is, the probability of getting y gets close to one when the effort tends to the maximum feasible level $\bar{e}_i$ for individual i. Notice also that the function $\varphi_i(.)$ is individual specific, so to capture differences across individuals in the productivity of effort which reflect personal abilities.

Besides choosing the effort level, individuals may affect the distribution of resources in the society also by *voting* the rate τ_i^* of a purely redistributive proportional income tax, the revenues of which are equally distributed among the members of the community. Therefore, an individual receives a subsidy whenever her income is below the mean income; she pays a tax in the opposite case.[5] As is common in the literature, to avoid strategic considerations in the choice of the desired tax rate, we apply the *Random Dictator Rule* to define the social tax rate, which is a truthful revelation mechanism for individual preferences.

To provide a useful benchmark for the following empirical analysis, we define here individuals' preferences as fully *self-regarding*. Each individual simply wishes to maximize her material welfare, given by her net income (consumption) over time:

$$U_i = \delta_i^t\left[\hat{q}_{it}y(1-\tau) + \frac{\tau}{n}\sum_{j=1}^{n}\hat{q}_{jt}\,y - \sigma(e_i)\right] + \delta_i^{t+1}\left[q_{it+1}(e_i)y(1-\tau) + \frac{\tau}{n}\sum_{j=1}^{n}q_{jt+1}(e_j)\,y\right] \quad [1],$$

where δ_i is i's specific time discount factor, $\sigma(e_i)$ the cost of effort (with $\sigma', \sigma'' > 0$), and all the other variables are defined as before.

The decision problem can be solved by backward induction. Each individual determines at the second stage the optimal effort level $e_i^* = e_i(\tau|e_{h\neq i})$ taking as given the tax rate τ and the effort of any other individual in the society, $e_{h\neq i}$. At the first stage, given $e_i^* = e_i(\tau|e_{h\neq i})$, each individual declares her preferred tax rate, τ_i^*. Given the social tax rate τ and the effort provided by any individual, e_i^*, the material welfare of any individual i is determined by [1].

We need to distinguish two cases, based on the interdependence of each individual's effort with those of the other members of the society. We first study the individual's choice problem by neglecting that the effort provided by each

[5] Clearly the tax-transfer scheme can never imply re-ranking.

individual might affect the effort provided by the others. The First Order Condition for maximizing [1] with respect to $e_i = e_i(\tau)$ is:

$$-\sigma'(e_i^*) + \delta_i \left[q'_{it+1}(e_i^*)y\left(1-\tau+\frac{\tau}{n}\right)\right]=0 \qquad [2],$$

which requires that the optimal effort level equates marginal current costs and future discounted benefits[6]. Notice from Eq. [2] that the optimal effort decreases when: the relevant tax rate increases (for this reduces the net benefit accruing to the individual for additional effort); the future is less important (the discount factor decreases); the marginal productivity of effort is lower. By differentiating Eq. [1] w.r.t. τ and using Eq. [2] we get to the following condition for the choice of the preferred tax rate, where $E(\bar{y})$ and $E(y_i)$ are the average expected income and the individual i's expected income respectively:

$$\frac{\delta U_i}{\delta \tau_i}\Big|_{e_j=e_j^*,\forall j} = \underbrace{[E(\bar{y}_t) - E(y_{it})]}_{\substack{difference\ between \\ the\ average \\ income\ and\ i's\ income: \\ \mathbf{beyond\ i's\ control}}} + $$

$$+\delta_i \underbrace{[E(\bar{y}_{t+1}) - E(y_{it+1})]}_{\substack{difference\ between\ the\ average \\ income\ and\ i's\ income: \\ \mathbf{partially\ under\ i's\ control}}} + \delta_i \underbrace{\left[\frac{\tau}{n}\sum_{h\neq i} q'_{ht+1}(e_h)e'_h(\tau)y\right]}_{\substack{reduction\ in\ transfers\ in\ i's \\ favour\ as\ \tau\ increases}} = 0$$

[3].

Equation [3] states that the preferred tax rate, τ_i^*, is determined by equating benefits from taxation to costs. The first addendum of Eq. [3] is the difference between the average expected income and i's expected income at time t, which is beyond individual control. The second addendum is the same difference at time t+1, which is at least partially under the individual control and depends on her effort as well as on the effort of all the other society's members. The third addendum represents the reduction in second-period transfers as τ increases, because of the disincentive effects of taxation on effort. To better understand Eq. [3], suppose both that the social tax rate is $\tau = \tau_i^* > 0$ and that effort has been

[6] Conditions for an interior solution will be discussed below.

consequently chosen according to Eq. [2]; suppose furthermore that i is benefitted by the redistributive scheme. As the social tax rate is selected in accordance with individual i's preferences, a marginal increase in the tax rate must be such as to leave i's welfare (hence income available for consumption) unaltered. This means that the marginal resources i would get by increasing τ, i.e., $[E(\bar{y}_t) - E(y_{it})] + \delta_i\,[E(\bar{y}_{t+1}) - E(y_{it+1})] > 0$, must be offset by the reduction in transfers received by i as τ increases, i.e., $\delta^i[\frac{\tau}{n}\sum_{h\neq i} q'_{ht+1}(e_h)e'_h(\tau)y]$. Clearly, if i's marginal benefit by increasing τ is lower (resp. higher) than the marginal cost for any given $\tau \geq 0$, then it would be better to vote for no redistribution at all and $\tau_i^* = 0$ (resp. $\tau_i^* = 1$).

Notice that in this setting free riding is limited by the reaction of the other members of the society to an increase in the tax rate. That is why there are limits to the strategy of reducing effort and asking for an higher tax rate. Indeed, the less the effort of any $h \neq i$ is affected by an increase in the tax rate, the more is convenient for i both to reduce her effort (to enlarge the difference $E(\bar{y}_{t+1}) - E(y_{it+1}) > 0$) and to ask for an higher tax rate. The following proposition summarizes these results:

Proposition 1 (*individual effort*). *Under the assumption that effort levels are independent, i's effort only depends on its net contribution to i's material welfare. It increases with both i's patience, δ_i, and i's productivity of effort, $\varphi_i(.)$, whereas it decreases with the tax rate τ. The optimal effort by individual i, e_i^*, is greater than zero at $\tau = 1$ iff $\delta_i\left[q'_{it+1}(e_i = 0)y\left(\frac{1}{n}\right)\right] > \sigma'(e_i = 0)$.*

Proof of Proposition 1. See Appendix A2. ■

It is worth noticing that, even if the social tax rate is set to one, an individual might still have an incentive to provide a positive effort, as the marginal cost of effort is low for low effort levels and a share $\frac{1}{n}$ of the gain deriving from her additional effort accrues at the individual herself. It is crucial, however, that the society is made up by a relatively small number of individuals[7], since the marginal benefit of effort goes to zero as the number of individuals increases.

The following two propositions characterize the desired tax rate by individual *i*.

Proposition 2 (*no redistribution* $\tau_i^* = 0$). *The desired tax rate τ_i^* is zero for any individual i for whom the marginal benefits of taxation are lower than the marginal cost for any given $\tau \in (0,1]$, i.e. $\frac{\delta U_i}{\delta \tau_i}|_{e_i=e_i^*} < 0$. A sufficient condition for $\tau_i^* = 0$ is that, for any given τ, the discounted sum (at t and t+1) of the average expected incomes is no greater than the discounted sum (at t and t+1) of i's incomes*

Proof of Proposition 2. See Appendix A2. ■

The main result in Proposition 2 is that with self-regarding preferences there might be individuals preferring no redistribution at all ($\tau_i^* = 0$). Among these, there are certainly those whose total income (considering both periods) is no lower than average income for any tax rate. Proposition 2 simply establishes that with self-regarding preferences individuals who cannot get any gain from redistribution desire no redistribution at all. Notice that this is independent from the source of inequality among individuals, i.e., it is independent from the fact that differences among individuals may ultimately depend on factors beyond one's control. The desired tax rate is defined in the following proposition:

Proposition 3 (*desired positive tax rate* τ_i^*). *For any individual i, provided that $\frac{\delta U_i}{\delta \tau_i}|_{e_i=e_i^*} > 0$ for some $\tau > 0$, $\tau_i^* \in (0,1]$. Moreover, for any such individual, the desired tax rate τ_i^* increases whenever:* **a)** *income differences which are beyond i's control, $E(\bar{y}_t) - E(y_{it})$, increase;* **b)** *the productivity of i's effort, $\varphi_i(\tilde{e})$, decreases for any given $\tilde{e}$;* **c)** *the*

[7] It must be $n < \bar{n}$, where $\bar{n}$ is such that $\delta_i \left[q'_{it+1}(e_i = 0) y \left(\frac{1}{n}\right)\right] = \sigma'(e_i = 0)$.

difference between the average productivity of effort and the productivity of i's effort increases. The desired tax rate τ_i^* decreases if : **d)** *i's discount factor, δ_i, increases, provided that $E(\bar{y}_t) - E(y_{it}) > 0$.*

Proof of Proposition 3. See Appendix A2. ■

Proposition 3 suggests that there are three main determinants of the desired tax rate: circumstances beyond one's own control, the productivity of effort, and the intertemporal discount factor. In particular, the demand for redistribution increases whenever the differences that are beyond the individual's control get larger. Additionally, the desired tax rate increases whenever the productivity of effort is less important in determining the outcome. In a sense, these results can be interpreted by saying that individuals try to compensate with more redistribution the disadvantage they are not responsible for. Notice however, that when i's productivity of effort increases, a tax increase is preferred by i if the relative (w.r.t. to the mean) productivity of her effort decreases. Finally, the tax rate decreases if i regards more the future, provided that i's income is below the average at time t. This is because, as i's discount factor increases, its effort increases correspondingly, hence her desire for redistribution decreases.

Removing the assumption of independent efforts clearly affects the solution to the individual choice problem, but the sign of this effect depends on whether individuals' efforts are strategic complements or substitutes. If effort levels are positively correlated, then optimal solutions for individual efforts are higher than in the case without interdependence. Otherwise, when they are substitutes, the opposite is true. Notice that if effort levels are correlated, the disincentive effect of taxation is strengthened. In this case it is indeed necessary to consider not only the reduction in effort provided by $h \neq i$ because of an increase in the tax rate, but also the disincentive effect on the effort provided by $h \neq i$ caused by a reduction in i's effort when τ increases. All the above suggests the following:

Proposition 4 (*interdependent efforts*). *If $\partial e_h / \partial e_i \neq 0$, in deciding both the effort to be provided and the tax rate, i has to take into account that her effort will have a direct impact on the effort provided by the other individuals. If $\partial e_h / \partial e_i > 0$ effort levels are higher and the desired tax rate lower with respect to the case in which efforts are independent.*

Proof of Proposition 4. See Appendix A2. ■

Starting from the above theoretical framework we now proceed to define the experimental design.

2.2. *The experimental design*

The timing of the experiment is represented in Figure 1. In a generic round *r*, a random draw q_{ir} from a uniform distribution with support [0.3, 0.7] determines the initial gross endowment for any participant *i*, i.e., her present (time *t*) and future (time *t*+*h*) exogenous income $\hat{y}_{ir} = q_{ir} \times y$. The potential income *y* is set equal to 100 tokens: for instance, if q_{ir} = 0.43, the gross income of individual *i* in round *r* will be $\hat{y}_{ir}$ = 0.43×100 = 43 tokens. Tokens can be converted twice in euro at the established fixed exchange rate 0.10 € = 1 token: at time *t* (time BEFORE, one month after the experiment[8]); at time *t*+*h* (time THEN, one+*h* months after the experiment; *h* = 1, 2, 3).

[Figure 1 near here]

If only exogenous circumstances were important, this would be the level of income accruing to each individual in both periods. However, there are two mechanisms affecting distribution: one is the possibility to exercise effort, which is costly in the first period, but allow to increase expected income in the second one; the second is the redistributive tax, which determines net payoffs both in the first and the second period. After observing the whole distribution of initial incomes in round *r*, $\hat{y}_r = \{\hat{y}_{ir}\}$, any individual is then asked to declare both her

[8] The first payment is provided one month after the experiment to avoid the bias in favor of payments on the spot (e.g., Andreoni and Sprenger, 2012a,b).

desired level of redistribution τ_i^*, and the desired effort level e_i^*. The social tax rate τ_s^* is determined afterwards by means of the *Random Dictator Rule* from the full set of the desired tax rates $\tau^* = \{\tau_i^*\}$; hence, there is an equal chance for every participant that her desired tax rate will actually become the effective tax rate. Finally, given the effective tax rate, τ_s^*, each individual sets her actual effort level e_i^a.

As for the effort, each individual can choose among ten possible levels, $e_i \in [1, 10]$. Effort is costly in terms of resources that *i* has to give up at time BEFORE: a useful interpretation is the amount of resources one would invest in education. The cost of effort in terms of tokens is set according to the following function:

$$\sigma(e_i) = \frac{e_i^2}{2+\alpha}, \text{ where } \alpha > 0 \text{ and } \sigma_i', \sigma_i'' > 0;$$

in particular, we consider two different scenarios, one in which the cost of effort is high and $\alpha = 0.5$; the other in which the cost of effort is low and $\alpha = 3$. In the experiment each participant is shown a table reporting the amount of tokens she has to give up for any possible effort level according to the scenario she is facing (i.e., the value of the parameter α chosen for that session). The effort is however also productive, since it improves the future income. The productivity of effort is specified according to the following function:

$$\varphi_i(e_i) = \left[\left(\frac{1-q_{ir}}{10}\right) \times \left(\sum_{e=1}^{e_i} \frac{\theta}{e}\right)\right], \text{ where } \theta > 0 \text{ and } \varphi_i' > 0, \varphi_i'' < 0;$$

in particular, we set $\theta = 3$, and each participant is shown a table reporting the additional amount of tokens she would receive at time THEN for any possible effort level (increase in *i*'s endowment *under* *i*'s control), which now depends on her randomly assigned starting income $\hat{y}_{ir}$ (*i*'s endowment *beyond* *i*'s control). Notice that this specification holds the realistic properties to be decreasing in the income level – i.e., the productivity associated to each effort level is higher for the more initially disadvantaged individuals – but without re-ranking: for any two individuals *providing the same effort level*, the gross income at time THEN will be always higher for the individual with better starting conditions.[9]

If we rule out redistribution, *pre-tax* incomes including effort e_i in round r at time BEFORE and THEN (*gross* $\hat{y}_{ir}$) can be defined as follows:

$$gross\ \hat{y}_{ir}^{\text{BEFORE}} = (q_{ir} \times y) - \sigma(e_i)$$

$$gross\ \hat{y}_{ir}^{\text{THEN}} = [q_{ir} + \varphi(e_i)] \times y$$

This distribution of incomes can be modified by the choice of the individual tax rate τ_i^*, and the subsequent determination of social tax rate τ_s^* by means of the *Random Dictator Rule*. Hence, in each period t and $t+h$, *post-tax* incomes (*net* $\hat{y}_{ir}$) are computed, respectively, as follows:

$$net\ \hat{y}_{ir}^{\text{BEFORE}} = [(q_{ir} \times y) \times (1 - \tau_s^*)] - \sigma(e_i)$$

$$net\ \hat{y}_{ir}^{\text{THEN}} = [q_{ir} + \varphi(e_i)] \times y \times (1 - \tau_s^*)$$

The tax-transfer structure is defined in a way that any individual pays a share τ_s^* of her income and then total proceeds are equally distributed among all the participants. This implies that, as τ_s^* increases, the tax-transfer structure drives any participant's final income towards the society's average income. Whether an individual pays a net tax or receives a net transfer will depend on whether her income is above or below the average income, respectively. The tax is purely redistributive and basically produces the effect of reducing the variance around the mean as the tax rate increases. With $\tau_s^* = 1$ the final (*post-redistribution*) income of any individual is equal to the society's average income, hence the variance equals zero. Before choosing the preferred tax rate τ_i^*, each participant is shown a

[9] Notice that social mobility is not ruled out with this specification, since re-ranking might occur whenever the more disadvantaged provide more effort than individuals characterized by better starting conditions. A corollary of this statement is that social mobility per se *cannot* be used as an easy way to empirically identify a 'meritocratic' society. In fact, if everybody provides the same high level of effort and effort is rewarded (as it should be in a meritocratic society), we will not observe re-ranking. Probably income growth is the most likely candidate for a variable to look at when trying to assess empirically whether a society rewards merit or not.

practical example that illustrates the functioning of the tax-transfer mechanism (i.e., the distribution of final incomes) for a society formed by three individuals with three different initial endowments (30, 50, 70 tokens) and five alternative social tax rates (τ_s^* = 0.2, 0.4, 0.6, 0.8, 1).

The experiment consists of four sessions involving different participants. In two of these sessions the cost of effort is high [Scenario 1: α = 0.5 in the function $\sigma(e_i)$]; in the other two the cost of effort is low [Scenario 2: α = 3 in the function $\sigma(e_i)$]. We then adopt a within-subject design, i.e., in any session each participant chooses the level of redistribution 12 times under a different set of conditions, each resulting by a particular combination of the following three types of treatments:

A) observability of fellows' effort: individuals either have (A1) or do not have (A2) information on the *average effort exerted in the society*, which is a random number between 1 and 10 communicated to all participants in the same session. This treatment allows us to explore whether effort levels are complements or substitutes.

B) fairness in the distribution of initial gross incomes: participants may have either different (B1) endowments $q_{ir} \neq q_{jr}, \forall i \neq j$, or equal (B2) endowments $q_{ir} = q_{jr}, \forall i \neq j$. This treatment is introduced to check whether the *unfairness of the initial income distribution* do affect the demand for redistribution.

C) time of payment: we change the time *when individuals obtain the second payment*, considering a delay of two (C1), three (C2) or four (C3) months, in order to control for the impact of time required to grasp the fruits of effort, which makes the effort more costly for given time preferences.

[Figure 2 near here]

The structure of the experiment and the order of treatments are represented in Figure 2. Individuals were informed that only the tokens won in a randomly selected round (determined at the end of each session) would have been converted in euro at appropriate times. They were also informed that the show up fee of 150 tokens due because of their participation in the experiment would have been equally split in two tranches of identical amount, to be paid at time BEFORE and THEN respectively.

3. Empirical analysis

3.1. Empirical strategy and variables description

The experiment was held at the *Laboratory of Experimental and Simulative Economics* (University of Eastern Piedmont, Alessandria) on October 16th–17th, 2012. We elicited preferences from 71 subjects divided in four sessions of about twenty participants. We run two sessions each day, one in the morning, the other in the afternoon. Each session lasted about two hours. In any given session, participants were asked to choose their preferred tax rate τ_i^* and their desired level of effort e_i^* in 12 rounds under different conditions. This provided 852 observations overall. At the end of each session, participants were also asked to fill in a socio-demographic questionnaire; questions mainly concerned their intertemporal preferences, their perceived degree of upward mobility, their beliefs about the source of income inequality, and their political attitudes.

To identify the role played by both the cost of effort and the intertemporal nature of redistribution, our contribution in this paper, we consider two very simple models based on two different dependent variables: the first one, $\tau_i^*\_0$, is a dummy variable taking value 1 when the optimal tax rate for individuals is equal to zero, allowing us to explore how our main drivers of interest affect the extreme choice of no redistribution. The second dependent variable is the continuous variable τ_i^*, with a range of variation between 0 and 1, identifying the optimal tax rate for each individual in each round of the experiment.

As for the variables affecting the choice of these tax rates, consistently with our theoretical analysis, we consider different groups of regressors. The first group consists of variables identifying *circumstances* beyond individual's control. More precisely, we consider the following variables: $\hat{y}_{ir}$, the income randomly assigned to individual *i* at the beginning of round *r* (corresponding to $q_{ir} \times y$ in the notation above); *unfair_d*, a dummy variable identifying whether the distribution of exogenously assigned incomes in the initial period is unfair; an interaction variable, *unfair_ymean*, which measures the proportion to which the society's average income in the initial period is higher with respect to the individual *i*'s income when the distribution of income is unfair (*unfair_d* = 1).

The second group includes two variables related to the *effort*: *cost_level*, a dummy variable which identifies the scenarios corresponding to a high cost of effort (α = 0.5); *info_emean*, a measure of the society's average effort level *when such information is provided* to all the participants.

The third group considers two variables related to *subjective time preferences*: the variable, *future*, aimed at capturing the importance individuals give to the future with respect to present. It measures how much of an unexpected monetary gift, equal to one's own monthly household income, an individual would save, taking up values from 1 (*no saving*, corresponding to individuals with a very low discount factor δ_i) to 5 (*all saving*, which identifies individuals with a very high discount factor δ_i). We also include the variable *months_post*, which indicates the number of months before the second payment, to control for the delay in grasping the fruits of effort.

The fourth group provides controls for *demographic factors* which might affect redistribution: the dummy *sex* which takes value 1 if the individual is a male; the variable *age* measures the individual's age in years; the dummy variable *foreign* which takes value 1 if the individual was born in a foreign country.

Finally, we consider a number of additional stories that the literature has shown to be important in defining the preferred degree of redistribution. These include:

- the role played by *perceived social mobility* (e.g., Benabou and Ok, 2001; Alesina and Giuliano, 2010): we define the variable *succ_father* as a dummy taking value 1 if the individual believes that her chances of earning are higher than those of her father;
- the individuals' opinions about *the source of income differences* (e.g., Alesina and Glaeser, 2004; Alesina and Angeletos, 2005): we define the variable *succ_luck*, taking up values from 1 (strong disagreement) to 5 (strong agreement), which captures the importance individuals place on luck as a determinant of the economic success of a person; a second variable, *noeff_poor*, which also takes values from 1 to 5, indicates how much one believes that the poor are trapped in their condition because they do not exercise any effort to find a job;
- the role played by *religion and political ideology* (e.g., Alesina and Giuliano, 2010). We define the variable *succ_god* to measure the degree to which one believes that the economic success of a person is an award from God for her effort, ranging again from 1 (strong disagreement) to 5 (strong agreement). We also define the variable *equality* to take into account the opinions towards equality-oriented policies as opposed to individual freedom-oriented policies: here the range of variation is from 1 (strong disagreement) to 10 (strong agreement);
- the role played by *civicness*: we consider the variable *trust*, which measures the degree to which the individuals believe that one can have trust in most people (e.g., Kauppinen and Poutvaara, 2012), with a range of variation from 1 (strong disagreement) to 5 (strong agreement).

Table A1 in the Appendix provides descriptive statistics for all the variables included in our analysis. Notice that the average optimal tax rate τ_i^* is about 38%, and in the 16% of cases people prefer to have no redistribution at all (τ_i^*_0 = 1), identifying an optimal tax rate equal to zero.

3.2. Results

For the two dependent variables, results are consistent across the seven different specifications. In both cases, we begin with a Basic Model including variables reflecting circumstances, effort, and subjective time preferences. We then augment this specification with demographic controls in Model 1, and different groups of variables picking up subjective opinions and attitudes in Model 2 to 5. We finally consider all the variables together in the Full Model.

3.2.1. No redistribution

Consider first the determinants of the extreme choice of no redistribution at all $\tau_i^* \_0$ (Table 1). The model has been estimated according to a random effects logit specification to allow for unobserved residual heterogeneity across individuals.

[Table 1 near here]

Most of the variables are significant and with the expected sign. A first persistent result (in terms of both magnitudes and statistical significance), consistent with previous empirical evidence (e.g., Alesina and Giuliano, 2010; Durante *et al.*, 2014), is the negative coefficient associated to *unfair_ymean* (while coefficients for $\hat{y}_{ir}$ and *unfair_d* considered alone are not statistically significant). Unsurprisingly, consistently with our theoretical framework that assumes self-regarding preferences, people ask for more redistribution when circumstances beyond their control make them poorer with respect to average society's income (see Propositions 2 and 3a).

A second and more important result, strictly related to the main research question of the study, again strong in terms of both magnitude and statistical significance, is the positive coefficient on *info_emean*, which means that – *ceteris paribus* – the higher the *observable* society's average effort level, the higher the probability to prefer a zero tax rate. There are two possible explanations for this finding. The first one is that individuals are inclined not to depress their fellows' effort whenever they know that most of them are contributing to increase the size of the social pie. This interpretation relies on the theoretical argument that agents may take care of aggregate payoffs[10] and is also consistent with the hypothesis that effort levels are substitutes: it is better not to ask for an excessively high level of redistribution if one wishes to provide low effort, so that the social pie on which the tax rate applies is not reduced too much because of disincentive effects of taxation on effort. As for the second explanation, notice that whenever the effort generally provided is high, an individual might be encouraged to provide, *ceteris paribus*, an higher effort, since she perceives to play in a context where most people believe that individual effort (and not luck or social assistance) is the main driver of their income level, hence she might be more favourable to a very low tax rate. Although our theoretical setting does not provide a definitive prediction on how individual effort and the desired level of redistribution change in response to observed society's average effort (see Proposition 4), we believe this second interpretation – consistent with the assumption of complementarity among efforts –better describes agents' choices in our context, given the positive and significant correlation observed in the data between society's average effort and optimal individual effort. Furthermore, we also find the probability to ask for zero redistribution to be positively correlated with the cost of effort (even if the coefficient of *cost_effort* is only marginally significant in the Full Model), which means that people are less willing to share with the others the results due to their own effort when the latter is more costly.

Looking at the role of subjective time preferences, the variable *future* appears to exert a positive and significant impact in all the specifications (except the Basic Model and the Full Model, for which the coefficient is only marginally significant): this finding is consistent with the prediction of our theoretical model of lower propensity towards the redistribution for the individuals with a higher

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[10] The possibility that agents may take care of social efficiency – i.e. they show a preference for aggregate payoffs – has been considered in theoretical modelling of redistribution problems by Charness and Rabin (2002) and found support in the experimental evidence by, e.g., Engelmann and Strobel (2004) and Durante *et al.* (2014).

discount factor (see Proposition 3d) and provides support for the argument that in societies where individuals give more importance to the future, hence to expected results of their investments, it is more likely to observe a demand for zero redistribution. Also the increase in the number of months before the second payment is associated with a higher probability to choose a preferred tax rate equal to zero, being the coefficient for *months* always positive and statistically significant, suggesting that when effort is more 'costly' because people needs to wait more to grasp the fruits of their effort, they ask for less redistribution.

As for demographic characteristics, we find that male tend to prefer zero redistribution more than female, while age and being born in a foreign country do not seem to matter (except Model 2, where being foreign reduces the demand for a zero tax rate). As for the role played by perceived social mobility, we find that coefficient for *succ_father* is positive and significant. Hence, the prospect of upward mobility increases the chances to ask for zero redistribution, providing support to the POUM hypothesis advanced by Benabou and Ok (2001). This finding is reinforced here by the argument discussed above concerning the importance each individual gives to the future with respect to the present time. Results for the subjective beliefs about the main determinants of income inequality are less clear-cut: we find that the coefficient for *succ_luck* is negative and statistically significant at the 10% level only in Model 3, while it is not significant but still negative in the Full Model. This is reasonable, since it means that the more individuals believe economic success is guided by luck instead of own work and effort, the less they vote for zero redistribution (in line with, e.g., Fong, 2001; Alesina and La Ferrara, 2005; Kauppinen and Poutvaara, 2012). This is somewhat consistent with the estimated coefficient for *succ_god*, which is always negative and highly significant: the more the individuals believe economic success is a reward by God for their effort, the less they vote for zero redistribution, a result in line with the evidence of Alesina and Giuliano (2010) about the importance of being raised religiously in terms of preferences for redistribution. Finally, coefficient for *trust* is negative, although statistically significant only in the Full Model. As expected, trusting more the other individuals in the society reduces the likelihood of choosing zero redistribution, confirming previous results on this issue (e.g., Kauppinen and Poutvaara, 2012).

3.2.2. The desired tax rate

Turning now the attention to the determinants of τ_i^* (Table 2), we do find a confirmation of previous results. The models have been estimated using a PCSE Prais-Winsten estimator; errors are assumed to be groupwise heteroskedastic, correlated across individuals, and also correlated within subjects with individuals' specific ρ. [11]

[Table 2 near here]

First, we find again that the relative position of the individuals in the income ladder does matter when the income distribution is unfair, and the relationship with the preferred tax rate is monotonically decreasing with income, being negative for richer people and positive for the poorer (consistently with our Propositions 2 and 3a). Interestingly, however, both the coefficients for *unfair_d* and the interaction term *unfair_ymean* are now statistically significant, but the signs are negative and positive respectively. To highlight what this result implies, let us consider the Full Model: assuming that income distribution becomes unfair, people prefer a higher tax rate if the ratio between the average society's income ($\hat{y}_{mr}$) and own individual income ($\hat{y}_{ir}$) is at least 0.62. Hence, people want more redistribution *even if their income is above society's average level* and they are *net taxpayers.* This holds for incomes higher up to about 60% of society's average income. When the ratio $\hat{y}_{mr}/\hat{y}_{ir}$ is equal to one, the estimated impact of the unfairness on preferred tax rate is strongly positive (10 percentage points more) and shows its maximum (around 30 percentage points more) for the poorest, i.e., individuals whose income is lower of about 40% with respect to society's average income. On the contrary, for very rich people the effect is

[11] See Hoechle (2007) for more details on PCSE Prais-Winsten estimator.

negative and, in the limiting case of $\hat{y}_{mr}/\hat{y}_{ir}$ equal to zero, the estimated impact on preferred tax rate is about 17 percentage points less. Notice that, according to our theoretical framework, demand for redistribution should only be supported by those subjects with below average incomes, as they expect to be net recipients. Thus, a standard paradigm of fully self-interested individuals makes it difficult to explain why in our experiment more redistribution is demanded also by some rich individuals who are well aware of bearing simply a monetary cost because of it. From a theoretical perspective, ethical concerns or – as behavioural economists point out – *inequality aversion* may support the demand for more redistribution by these individuals (e.g., Fehr and Schmidt, 1999). Indeed, there is an extensive experimental literature showing that preferences for redistribution may be dictated by a sense of fairness or aversion to social inequality[12]. However, our results also confirms that the importance of social equality concerns strongly depends on the source of unfairness, i.e., whether poverty comes from laziness or bad luck, as pointed out in the experiments by, e.g., Konow (2000), Krawczyk (2010), Becker (2013). In particular, being the differences in our (randomly assigned) initial income levels beyond the individuals' control, we can argue that – at least up to a certain threshold – the richer people may decide to help the poorer overcome the disadvantages they are not responsible for by choosing more redistribution.[13]

Second, results confirm that the notion of personal responsibility matters and the individuals reward individual effort. On the one hand, the coefficient for *cost_effort* is always negative and statistically significant for almost all specifications (except only the Basic Model and Model 2): when effort for given productivity gains is more costly, individuals tend to prefer less redistribution (about 6 percentage points less). On the other hand, the coefficient for

[12] See, among the others, Cowell and Schokkaert, 2001; Tyran and Sausgruber, 2006; Ackert *et al.*, 2007; Schildberg-Hörisch, 2010; Durante *et al.*, 2014.

[13] Such a behaviour is consistent with a norm stating that a fair distribution of resources should even out inequalities that do not reflect choices that an agent has made, and over which she therefore lacked control. In philosophy this norm is usually referred to as *luck egalitarianism* (see, e.g., Dworkin, 2000).

info_emean is always negative, albeit not statistically significant at the usual confidence level in all models. This means that when people are able to know what the society's average effort is, they prefer a lower degree of redistribution the higher is the average effort exerted by the members of the society, with a reduction of the preferred tax rate up to 4 percentage points when the society's average effort is at 10, the highest possible level. An interesting way to interpret these findings is to think to 'meritocratic' societies as those systems in which the average effort level and related costs are presumably higher: in these societies, according to our evidence, people would tend to provide more effort and vote for less redistribution since they believe that merit is more important than luck (or public support) in determining the individual position in the income ladder (e.g., Alesina and Angeletos, 2005).

Third, also the results for the two time variables *future* and *months_post* are confirmed: coefficients are consistently negative, although statistical significance does not appear in all the seven specifications (but is observed for both variables in the Full Model). Hence, the stronger individuals' subjective preference for the future with respect to the present time (i.e., the more the individuals behave like "ants") and the longer the delay in obtaining the second payment, the lower their preferred degree of redistribution (percentage point reductions of the optimal tax rate are 3.3 and 1.2 per additional waiting month, respectively, in the Full Model).

As for demographic characteristics, the coefficient for *sex* is now at odds with previous findings: while the probability to observe a demand for zero redistribution has shown to be higher for male (the mean score is 0.24 against 0.12 for female), male also exhibit a desired tax rate higher than female (around 12 percentage point more in the Full Model), a result in line with, e.g., Checchi and Filippin (2004), which marks a difference with respect to American women (e.g., Alesina and Giuliano, 2010)[14]. We also find – again in line with Checchi

[14] For a review on experimental evidence on gender differences in preferences, see Croson and Gneezy (2009).

and Filippin (2004) – that coefficient for *age* is negative and statistically significant in all models: younger individuals are more in favour of redistribution than older ones. As for individual opinions, we find now that only coefficients for *succ_father* and *equality* are statistically significant (both separately and jointly considered). The former is negative, confirming the support to the POUM hypothesis: the stronger the prospect of upward mobility perceived by the individual, the lower her preferred tax rate, with a reduction of about 6-10 percentage points according to the model. This result is consistent with previous evidence from both experiments (e.g., Checchi and Filippin, 2004; Konrad and Morath, 2011) and survey data (e.g., Alesina and La Ferrara, 2005; Alesina and Giuliano, 2010). The coefficient for *equality* is instead positive (around 3 percentage points more), suggesting that more left-wing people with a greater feeling towards equality-oriented policies prefer higher tax rates, confirming the importance of political ideology in shaping preferences for redistribution highlighted by, e.g., Alesina and Giuliano (2010) and Durante *et al.* (2014).

4. Concluding remarks

In this paper we analyze the link between personal responsibility and individual preferences for redistribution by considering two key and novel elements with respect to current literature: first, effort is costly, and its cost needs to be appropriately accounted for; second, its fruits can be grasped in the future, hence subjective time preferences should matter. Our analysis is based on a laboratory experiment where the participants face a trade-off between taking a costly effort or free-riding on the effort of their fellows, playing in a framework where the social pie and its distribution depend both on circumstances beyond their control, and on their choice of working hard and voting for redistribution.

We find support for a key role of both effort and time preferences in shaping redistribution. First, our findings suggest that individuals tend to exert more effort, and ask for less redistribution, the higher the societal average effort, and the higher the cost of effort. This suggests that in effort-rewarding societies, where effort matters more for personal achievements (and is presumably higher and more costly than in other more egalitarian contexts), individuals are likely to support less redistribution. Second, the results confirms the importance of considering the long-lasting nature of redistributive policies when studying preferences for redistribution and their interplay with the individual effort. Besides providing further support to the POUM hypothesis that a perceived higher social mobility leads individuals to ask for less redistribution, our experiment highlights a positive relationship between subjective preferences for the present time and the demand for more redistribution. This implies that both the *objective* conditions of the context where the individuals play (i.e., the opportunity to succeed) and their *subjective* values (i.e., the will to exploit this opportunity) are important determinants of their preferences for redistribution.

These results hold when controlling for other determinants that the literature deem to be important. For instance, given a randomly assigned initial unfair distribution of income, we find that individuals ask for more redistribution the lower their position in the income ladder; however, also individuals endowed with income above average support more redistribution, even if it would not be rational for them to do so. This result corroborates the argument that ethical concerns and/or inequality aversion, besides self-interest, matter for redistribution. At the same time, our results remark that this feeling towards social equality depends on the beliefs about the origin of poverty, i.e. bad luck versus the lack of effort, again emphasizing the key role of personal responsibility.

Overall, our experimental evidence provides helpful insights for the ongoing policy debate about the effectiveness of reforming welfare systems in order to make them more responsive to individual incentives. In particular, looking at a society where one would like to stimulate private investments in order to support economic development and growth, our results would suggest that, besides promoting policies that foster a greater social mobility through individual effort, it may also be desirable for government institutions to make citizens more aware of the importance of saving and investing for future well-being.

In order to stress the importance of factors like the cost of effort and time preferences, so far neglected by the literature to explain individuals' desire for redistribution, in this paper we have neither considered individuals' attitude towards risk, nor the possibility for them to hide part of their income to Tax Authorities. It is clear, however, that – on the one hand – including risk attitudes (and possibly loss aversion) in the analysis would allow to catch an additional feature of the investment process: not only its fruits will be grasped in the future, they are also uncertain. This will also help shed some light on the current situation, where the prevailing pessimism about the resilience of the economy tends to bias individuals' attention towards the present and to increase uncertainty, with obvious negative effects on investment choices. On the other hand, including in the picture the possibility to evade taxes will allow to understand how the demand for redistribution changes in countries where the shadow economy constitutes a large share of the national income. Considering the role of risk attitudes, loss aversion, and tax evasion in the framework outlined here is the agenda for our future research.

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Figure 1. Timing of the experiment

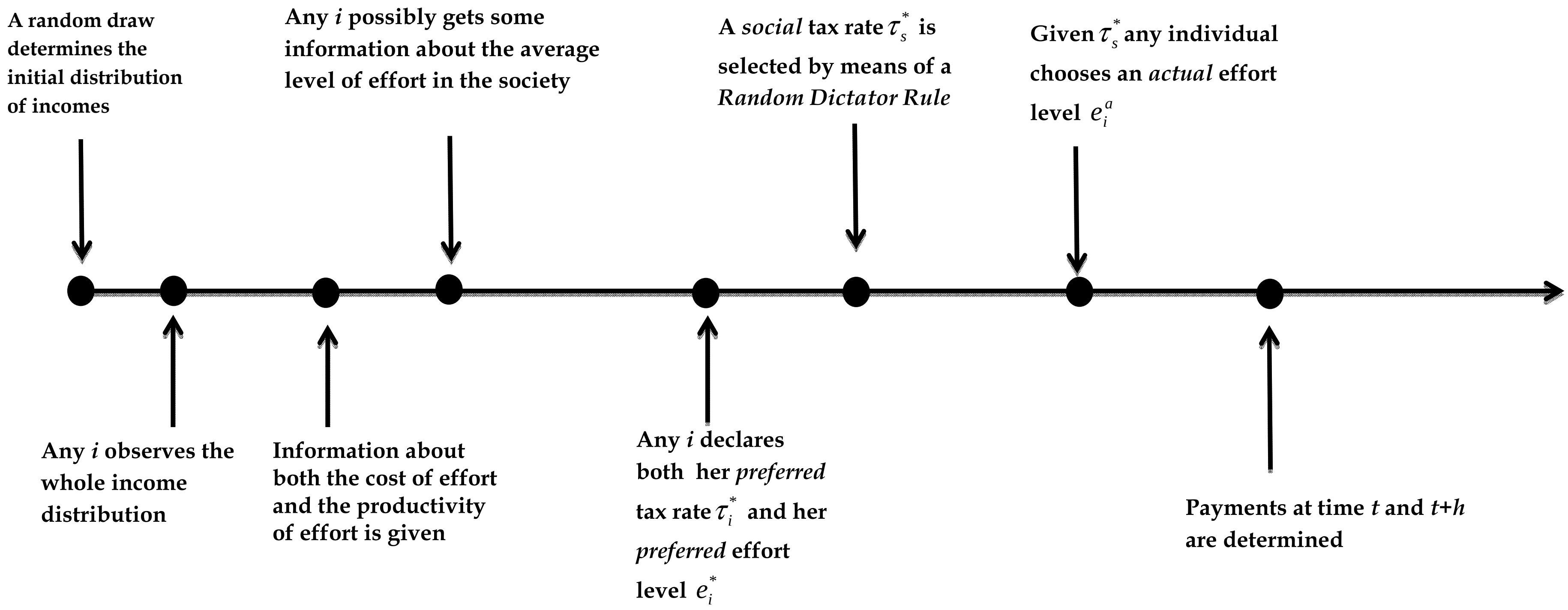

Figure 2. Structure of the experiment

Individuals make their choices under different circumstances, in order to test how their preferred tax rate (desired redistribution) changes according to: A) the average effort exerted in the society, B) the fairness in the distribution of initial gross incomes, C) the time when individuals receive the second payment.

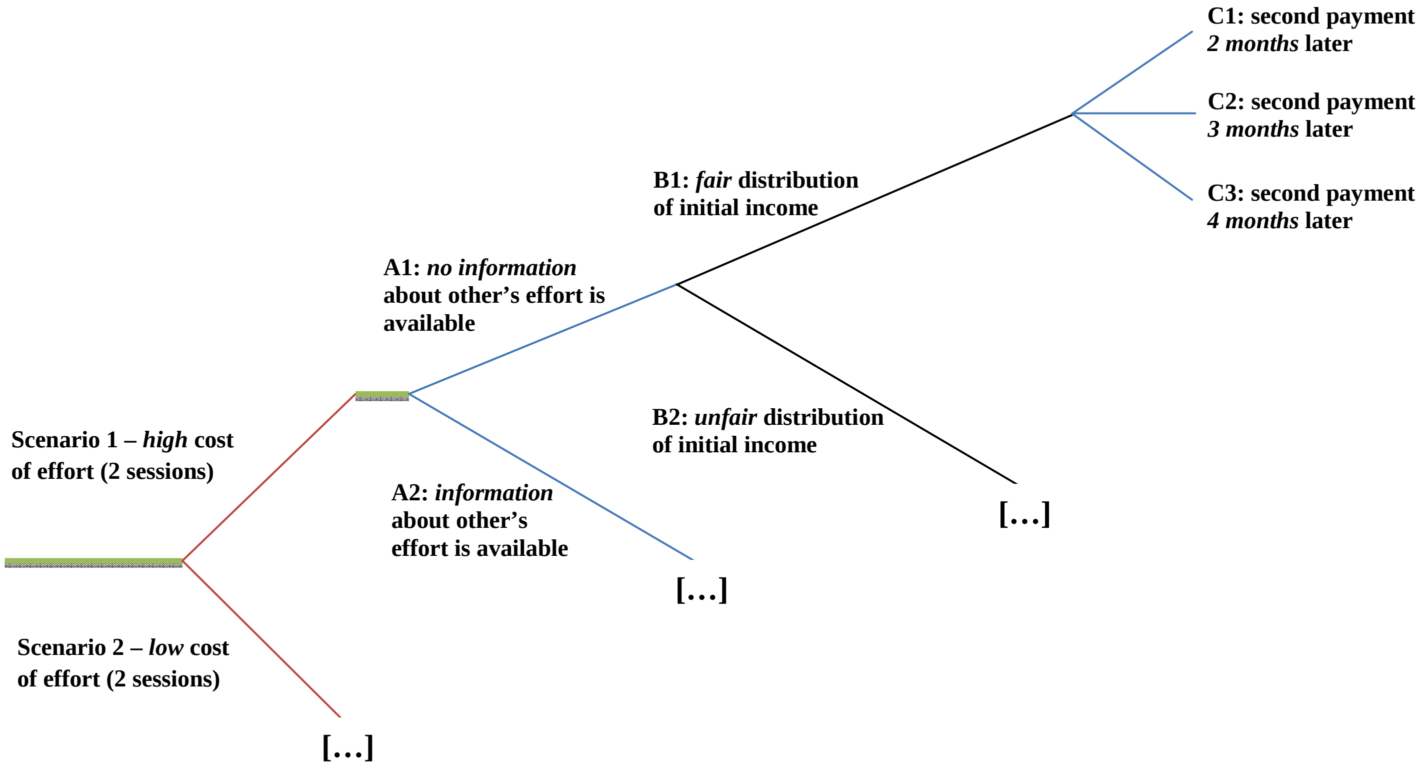

Table 2. Determinants of the probability to choose a preferred tax rate = 0 (random effects logit estimates)

Regressors [a]	BASIC MODEL	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5	FULL MODEL
$\hat{y}_{ir}$	0.013	0.013	0.013	0.014	0.013	0.013	0.012
	(0.81)	(0.82)	(0.82)	(0.85)	(0.80)	(0.80)	(0.77)
unfair_d	0.200	0.214	0.178	0.177	0.246	0.271	0.250
	(0.14)	(0.15)	(0.13)	(0.12)	(0.17)	(0.19)	(0.18)
unfair_ymean	-2.873**	-2.891**	-2.851**	-2.851**	-2.916**	-2.941**	-2.899**
	(-2.07)	(-2.08)	(-2.06)	(-2.06)	(-2.10)	(-2.12)	(-2.11)
cost_effort	1.548*	1.472*	1.374*	1.395*	1.417*	1.507*	1.132
	(1.84)	(1.86)	(1.83)	(1.79)	(1.86)	(1.94)	(1.61)
info_emean	0.138***	0.138***	0.138***	0.138***	0.139***	0.138***	0.140***
	(3.31)	(3.31)	(3.32)	(3.30)	(3.33)	(3.32)	(3.36)
future	0.839	1.145**	0.870*	1.114**	0.942**	1.091**	0.641
	(1.62)	(2.31)	(1.83)	(2.26)	(1.98)	(2.26)	(1.46)
months_post	0.319*	0.319*	0.319*	0.319*	0.315*	0.317*	0.312*
	(1.83)	(1.84)	(1.84)	(1.84)	(1.81)	(1.82)	(1.80)
sex	-	2.167***	2.019***	2.336***	1.665**	2.004***	1.798**
		(2.75)	(2.68)	(2.96)	(2.12)	(2.58)	(2.44)
age	-	0.084	0.065	0.100	0.067	0.089	0.062
		(1.10)	(0.88)	(1.31)	(0.95)	(1.19)	(0.95)
foreign	-	-1.709	-2.076*	-2.064	-0.786	-1.666	-1.831
		(-1.35)	(-1.68)	(-1.61)	(-0.64)	(-1.34)	(-1.51)
succ_father	-	-	1.626**	-	-	-	1.817**
			(2.12)				(2.44)
succ_luck	-	-	-	-0.740*	-	-	-0.552
				(-1.81)			(-1.51)
noeff_poor	-	-	-	-0.134	-	-	-0.091
				(-0.35)			(-0.26)
succ_god	-	-	-	-	-0.854***	-	-0.802***
					(-2.77)		(-2.79)
equality	-	-	-	-	-0.315	-	-0.067
					(-1.61)		(-0.33)
trust	-	-	-	-	-	-0.523	-0.657*
						(-1.37)	(-1.80)
constant	-8.403***	-12.073***	-11.139***	-9.916***	-6.591**	-10.548***	-4.205
	(-3.47)	(-3.98)	(-3.88)	(-3.11)	(-2.00)	(-3.38)	(-1.31)
Observations	852	852	852	852	852	852	852
Wald statistic (χ^2)	74.03***	77.89***	79.90***	79.02***	81.67***	78.70***	85.71***

Log-likelihood	-231.97	-227.17	-225.00	-225.48	-222.22	-226.25	-217.45

[a] Dependent variable: τ_i^*_0; z-statistics in round brackets; significance level: *** 1%, ** 5%, *10%.

Table 3. Determinants of preferred tax rate (Prais-Winsten estimates with panel-corrected standard errors)

Regressors [a]	BASIC MODEL	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5	FULL MODEL
$\hat{y}_{ir}$	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(-1.16)	(-1.04)	(-1.02)	(-1.07)	(-1.17)	(-1.06)	(-1.22)
unfair_d	-0.180***	-0.182***	-0.191***	-0.179***	-0.170***	-0.180***	-0.166**
	(-2.85)	(-2.74)	(-2.80)	(-2.67)	(-2.61)	(-2.70)	(-2.49)
unfair_ymean	0.279***	0.280***	0.288***	0.277***	0.272***	0.278***	0.269***
	(4.98)	(4.73)	(4.75)	(4.65)	(4.67)	(4.69)	(4.53)
cost_effort	-0.022	-0.057**	-0.040	-0.054*	-0.073**	-0.058**	-0.061*
	(-0.85)	(-2.23)	(-1.43)	(-1.94)	(-2.47)	(-2.26)	(-1.73)
info_emean	-0.005*	-0.004	-0.005*	-0.004	-0.004*	-0.004	-0.004*
	(-1.77)	(-1.59)	(-1.82)	(-1.57)	(-1.65)	(-1.57)	(-1.72)
future	-0.047***	-0.046**	-0.025	-0.047***	-0.040**	-0.048***	-0.033*
	(-2.62)	(-2.46)	(-1.24)	(-2.63)	(-2.30)	(-2.85)	(-1.91)
months_post	-0.014*	-0.012	-0.011	-0.012	-0.013*	-0.012*	-0.012*
	(-1.73)	(-1.63)	(-1.49)	(-1.63)	(-1.82)	(-1.66)	(-1.68)
sex	-	0.062**	0.072***	0.067***	0.121***	0.056**	0.122***
		(2.22)	(2.83)	(2.63)	(3.33)	(2.01)	(3.70)
age	-	-0.013***	-0.012***	-0.013***	-0.014***	-0.013***	-0.012***
		(-5.05)	(-5.56)	(-4.50)	(-6.11)	(-5.17)	(-5.50)
foreign	-	0.014	0.045	0.015	-0.020	0.014	-0.003
		(0.29)	(0.89)	(0.29)	(-0.34)	(0.29)	(-0.04)
succ_father	-	-	-0.095***	-	-	-	-0.058**
			(-4.18)				(-2.45)
succ_luck	-	-	-	-0.010	-	-	-0.008
				(-0.62)			(-0.56)
noeff_poor	-	-	-	0.013	-	-	0.023
				(0.82)			(1.23)
succ_god	-	-	-	-	0.015	-	0.016
					(1.10)		(1.16)
equality	-	-	-	-	0.032***	-	0.032***
					(3.56)		(3.48)
trust	-	-	-	-	-	-0.011	-0.015
						(-0.60)	(-0.65)
constant	0.644***	0.929***	0.847***	0.918****	0.667***	0.967***	0.616***

	(7.41)	(11.25)	(9.86)	(9.99)	(6.05)	(10.03)	(4.21)
Observations	852	852	852	852	852	852	852
Wald statistic (χ^2)	90.56***	166.62***	216.59***	232.99***	279.10***	168.11***	514.21***
R^2	0.31	0.35	0.35	0.35	0.37	0.35	0.38

[a] Dependent variable: τ_i^*; z-statistics in round brackets; significance level: *** 1%, ** 5%, *10%.

APPENDIX

A1. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
τ_i^*	852	0.38	0.37	0.00	1.00
$\tau_i^*\_0$	852	0.16	0.37	0.00	1.00
$\hat{y}_{ir}$	852	48.96	11.83	30.00	70.00
unfair_d	852	0.50	0.50	0.00	1.00
unfair_ymean	852	0.53	0.57	0.00	1.72
cost_effort	852	0.44	0.50	0.00	1.00
info_emean	852	2.68	3.41	0.00	10.00
future	852	3.76	0.83	1.00	5.00
months_post	852	3.00	0.82	2.00	4.00
sex	852	0.38	0.49	0.00	1.00
age	852	23.63	4.71	19.00	46.00
foreign	852	0.11	0.32	0.00	1.00
succ_father	852	0.46	0.50	0.00	1.00
succ_luck	852	2.86	0.94	1.00	5.00
noeff_poor	852	2.30	0.98	1.00	5.00
succ_god	852	2.46	1.29	1.00	5.00
equality	852	6.54	2.04	1.00	10.00
trust	852	2.58	0.96	1.00	4.00

A2. Theoretical framework: proofs of propositions

Proof of Proposition 1. From [2] it is straightforward to notice that i's effort increases with both δ_i and $\varphi_i(.)$ and decreases with τ. If we suppose that the relevant tax rate equals one, [2] becomes:

$$-\sigma'(e_i) + \delta_i \left[q'_{it+1}(e_i)y\left(\frac{\tau}{n}\right)\right] = 0,$$

$e_i^* > 0$ if the marginal benefit of effort is greater than the marginal cost when $e_i = 0$, that is $\delta_i \left[q'_{it+1}(e_i = 0)y\left(\frac{1}{n}\right)\right] > \sigma'(e_i = 0)$. ■

Proof of Proposition 2. Suppose $\frac{\delta U_i}{\delta \tau_i}|_{e_i=e_i^*} < 0 \; at \; \tau' > 0$, hence, a lower tax rate $\tau = \tau'' < \tau'$, must be preferred by i. If $\frac{\delta U_i}{\delta \tau_i}|_{e_i=e_i^*} < 0$ holds $\forall \tau \in (0,1]$, $\tau_i^* = inf\{\tau | \tau \in (0,1]\} = 0$.

Notice that, by [3], $\frac{\delta U_i}{\delta \tau_i}|_{e_i=e_i^*} < 0 \rightarrow$

$$E(\bar{y}_t) - E(y_{it}) + \delta_i[E(\bar{y}_{t+1}) - E(y_{it+1})] + \delta_i\left(\frac{\tau}{n}\sum_{h\neq i} q'_{ht+1}(e_h)e'_h(\tau)y\right) < 0$$

or

$$E(\bar{y}_t) - E(y_{it}) + \delta_i[E(\bar{y}_{t+1}) - E(y_{it+1})] < -\delta_i\left(\frac{\tau}{n}\sum_{h\neq i} q'_{ht+1}(e_h)e'_h(\tau)y\right) \quad [A2]$$

As – by Proposition 1 – $e'_h(\tau) < 0$, the r.h.s. of [A2] is positive. It is therefore sufficient for $\frac{\delta U_i}{\delta \tau_i}|_{e_i=e_i^*} < 0$ to hold that the l.h.s. is non-positive for any given τ, which implies that $E(\bar{y}_t) - E(y_{it}) + \delta_i[E(\bar{y}_{t+1}) - E(y_{it+1})] < 0$ for any given τ, or that

$[E(\bar{y}_t) + \delta_i E(\bar{y}_{t+1})] - [E(y_{it}) + \delta_i E(y_{it+1})] < 0$. ■

Proof of Proposition 3. Suppose $\frac{\delta U_i}{\delta \tau_i}|_{e_i=e_i^*} > 0$ for some $\tau = \tau^{'} \geq 0$. As $U(.)$ is continuous and $[\tau^{'}, 1]$ is a convex compact set, by the Bolzano-Weierstrass theorem either *i*'s problem has an interior solution, $\tau_i^* \in (0,1)$, or the problem has a boundary solution with $\tau_i^* = 1$; in any case $\tau_i^* > 0$.

Suppose $\tau_i^* \in (0,1)$ is an interior solution to *i's* problem. Since*:*

$$E(\bar{y}_t) - E(y_{it}) = y[\bar{q}_t - \hat{q}_{it}] = y\left[\frac{\sum_{j=1}^{n} \hat{q}_{jt}}{n} - \hat{q}_{it}\right]$$

and

$$\delta_i[E(\bar{y}_{t+1}) - E(y_{it+1})] = \delta_i y[\bar{q}_{t+1} - q_{it+1}] = \delta_i y\left[\frac{\sum_{j=1}^{n} \hat{q}_{jt+}\varphi_j(e_j)}{n} - \hat{q}_{it+}\varphi_i(e_i)\right],$$

the first order condition of *i*'s problem w.r.t. τ_i, [3], can be re-written as:

$$y\left[\frac{\sum_{j=1}^{n} \hat{q}_{jt}}{n} - \hat{q}_{it}\right] + \delta_i y\left[\left(\frac{\sum_{j=1}^{n} \hat{q}_{jt}}{n} - \hat{q}_{it}\right) + \left(\frac{\sum_{j=1}^{n} \varphi_j\left(e_j(\tau_i^*)\right)}{n} - \varphi_i\left(e_i(\tau_i^*)\right)\right)\right]$$

$$+ \delta_i y\left[\frac{\tau_i^*}{n} \sum\nolimits_{h \neq i} \varphi_{ht+1}^{'}\left(e_h(\tau_i^*)\right)e_h^{'}(\tau_i^*)\right] = 0$$

[A1].

a) *If* $\frac{\sum_{j=1}^{n} \hat{q}_{jt}}{n} - \hat{q}_{it}$ increases, $\frac{\partial U_i(\tau=\tau_i^*)}{\partial \tau_i}|_{e_j=e_j^*, \forall j=1,\ldots,n} > 0$, hence the desired tax rate increases.

b) Suppose $\left(\frac{\sum_{j=1}^{n} \varphi_j(e_j)}{n} - \varphi_i(e_i)\right)$ increases. This is either because $\varphi_i(\tilde{e})$ decreases or $\frac{\sum_{j=1}^{n} \varphi_j(\tilde{e})}{n}$ increases more than $\varphi_i(\tilde{e})$, for any effort level $\tilde{e}$. A decrease in $\varphi_i(.)$, $\forall \tilde{e}$, does not have any effect both on the first and the third term of $[A1]$, therefore if $\varphi_i(.)$ decreases $\forall \tilde{e}$, $\frac{\partial U_i(\tau=\tau_i^*)}{\partial \tau_i}|_{e_j=e_j^*, \forall j=1,\ldots,n} > 0$ and the desired tax rate increases.

c) Suppose for some j' (possibly including i) $\varphi_{j'}(.)$ increases $\forall \tilde{e}$ such that the difference between the average productivity of effort and the productivity of *i*'s effort, increases. As the second and the third term of [A1] increase, $\frac{\partial U_i(\tau=\tau_i^*)}{\partial \tau_i} > 0$, hence the desired tax rate increases.

d) Write the f.o.c. w.r.t. τ as follows*:*

$$\left[\frac{\sum_{j=1}^{n}\hat{q}_{jt}}{n}-\hat{q}_{it}\right]$$

$$=-\delta_i y\left[\left(\frac{\sum_{j=1}^{n}\hat{q}_{jt}}{n}-\hat{q}_{it}\right)+\left(\frac{\sum_{j=1}^{n}\varphi_j\left(e_j(\tau_i^*)\right)}{n}-\varphi_i\left(e_i(\tau_i^*)\right)\right)\right.$$

$$\left.+\frac{\tau_i^*}{n}\sum_{h\neq i}\varphi_{ht+1}^{'}\left(e_h(\tau_i^*)\right)e_h^{'}(\tau_i^*)\right]$$

[A2].

If δ_i increases marginally, the l.h.s. remains constant, whereas the variation in the r.h.s. is (hence, the equality in [A2] does not necessarily hold):

$$-y\left[\left(\frac{\sum_{j=1}^{n}\hat{q}_{jt}}{n}-\hat{q}_{it}\right)+\left(\frac{\sum_{j=1}^{n}\varphi_j\left(e_j(\tau_i^*)\right)}{n}-\varphi_i\left(e_i(\tau_i^*)\right)\right)+\frac{\tau_i^*}{n}\sum_{h\neq i}\varphi_{ht+1}^{'}\left(e_h(\tau_i^*)\right)e_h^{'}(\tau_i^*)\right]+$$

$$-\delta_i y\varphi^{'}\left(e_i(\tau_i^*)\right)\left(\frac{1}{n}-1\right)\frac{\partial e_i(\tau_i^*)}{\partial\delta_i}$$

[A3],

where $\delta_i y\varphi^{'}\left(e_i(\tau_i^*)\right)\left(\frac{1}{n}-1\right)\frac{\partial e_i(\tau_i^*)}{\partial\delta_i}$ is the impact of a change in the effort level by *i* following a change in δ_i. For $\tau_i^*$to decrease as δ_i increases, [A3] has to be positive (so that at τ_i^*, we have $\frac{\partial U_i(\tau=\tau_i^*)}{\partial\tau_i}<0$). Consider than that the term in brackets in [A3], by [A2], equals $-\frac{\frac{\sum_{j=1}^{n}\hat{q}_{jt}}{n}-\hat{q}_{it}}{\delta_i y}$.

Therefore, the change in the r.h.s. of [A2] following an increase in δ_i equals:

$$-y\left[-\frac{\frac{\sum_{j=1}^{n}\hat{q}_{jt}}{n}-\hat{q}_{it}}{\delta_i y}\right]\underbrace{-\delta_i y\varphi^{'}\left(e_i(\tau_i^*)\right)\left(\frac{1}{n}-1\right)\frac{\partial e_i(\tau_i^*)}{\partial\delta_i}}_{+}$$

A sufficient condition for this to be positive is that $\frac{\sum_{j=1}^{n}\hat{q}_{jt}}{n}-\hat{q}_{it}>0,\ or\ E(\bar{y}_t)-E(y_{it})>0.$ ■

Proof of Proposition 4. Differentiating [3] w.r.t. e_i and τ_i we get to the following first order conditions, [A4] and [A5], implicitly determining the optimal choice of e_i and τ by individual *i*, that is e_i^* and τ_i^*:

$$-\sigma^{'}(e_i) + \delta_i \left[q^{'}_{it+1}(e_i)y\left(1-\tau+\frac{\tau}{n}\right) + \frac{\tau}{n}\sum_{h\neq i} y q^{'}_{ht+1}(e_h)\left(\frac{\partial e_h}{\partial e_i}\right)\right]=0$$

[A4]

$$E(\bar{y}_t) - E(y_{it}) - \sigma^{'}(e_i)\frac{\partial e_i}{\partial \tau} + \delta_i \left[E(\bar{y}_{t+1}) - E(y_{it+1}) + y\left(1-\tau+\frac{\tau}{n}\right)q^{'}_{it+1}(e_i)\frac{\partial e_i}{\partial \tau} + \right.$$

$\tau n h \neq i y q h t+1' e h \partial e h \partial \tau$=0

[A5].

By substituting [A4] in [A5], we get to

$$E(\bar{y}_t) - E(y_{it}) + \delta_i[E(\bar{y}_{t+1}) - E(y_{it+1})] + \delta_i\left[\frac{\tau}{n}\sum_{h\neq i} y q^{'}_{ht+1}(e_h)\right]\left(\frac{\partial e_h}{\partial \tau} - \frac{\partial e_h}{\partial e_i}\frac{\partial e_i}{\partial \tau}\right)=0\ .\ \blacksquare$$