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Existence of a Condorcet winner when voters have other-regarding preferences*

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Abstract

In standard political economy models, voters are 'self-interested' i.e. care only about 'own' utility. However, the emerging evidence indicates that voters often have 'other-regarding preferences' (ORP), i.e., in deciding among alternative policies voters care about their payoffs relative to others. We extend a widely used general equilibrium framework in political economy to allow for voters with ORP, as in Fehr-Schmidt (1999). In line with the evidence, these preferences allow voters to exhibit 'envy' and 'altruism', in addition to the standard concern for 'own utility'. We give sufficient conditions for the existence of a Condorcet winner when voters have ORP. This could open the way for an incorporation of ORP in a variety of political economy models. Furthermore, as a corollary, we give more general conditions for the existence of a Condorcet winner when voters have purely selfish preferences.

Keywords: Redistribution, other regarding preferences, single crossing property.

JEL Classification: D64; D72; D78 .

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1. Introduction

The median voter theorem has been seminal to the development of modern political economy. The standard model relies on voters being self-interested. The main expository framework for this work relies on Romer (1975), Roberts (1977) and Meltzer and Richard (1981) (or the RRMR framework) which is a simple general equilibrium model with endogenous labor supply.

Despite the standard assumption of self-interested voters, it seems very plausible that explanations for redistribution should be underpinned by the inherent human desire to care directly for the well being of others. In other words, in the domain of redistribution, it seems reasonable to postulate that individuals have *other regarding preferences* (or ORP for short). An emerging empirical literature is strongly supportive of the role of ORP specifically in the domain of voting models; see, for instance, Ackert et al. (2007), Bolton and Ockenfels (2006) and Tyran and Sausgruber (2006). These papers establish that voters often choose policies that promote equity/fairness over purely selfish considerations. Bolton and Ockenfels (2006), for instance, examine the preference for equity versus efficiency in a voting game. Groups of three subjects are formed and are presented with two alternative policies: one that promotes equity while the other promotes efficiency. The final outcome is chosen by a majority vote. About twice as many experimental subjects preferred equity as compared to efficiency. Furthermore, even those willing to change the status-quo for efficiency are willing to pay, on average, less than half relative to those who wish to alter the status-quo for equity.

An important question is the following. Does a Condorcet winner exist in a model with ORP? The lack of a satisfactory answer is likely to hold up progress within the class of political economy models that seek to incorporate the important insights from the literature on ORP. The current situation is analogous to the period of time before the median voter theorem was discovered by Duncan Black (1948) (and later popularized by Anthony Downs, 1957) for the case of self-interested voters. However, once known, and popularized, the median voter theorem opened up the domain of modern political economy as we know it today. The aim of our paper is to provide sufficient conditions under which a Condorcet winner exists when voters have ORP in a RRMR framework.

There are several models of fairness in the literature. We choose to use the Fehr-Schmidt (1999) (henceforth, FS) approach to fairness[1]. In this approach, voters care,

[1]Bolton and Ockenfels (2002) provide yet another approach of inequity averse economic agents (referred to as 'ERC', short for equity, reciprocity and cooperation), but it cannot explain the outcome of the public good game with punishment, which is a fairly robust experimental finding. Charness and Rabin (2002) provide two successive versions of their model. In the first version, economic agents do not care directly about outcome differences or the role of 'intentions'. This model is unable to explain the results of the public good game with punishment. A second version of the model introduces the role of intentions.

not only about their own payoffs, but also about their payoffs relative to those of others. If their payoff is greater than other voters then they suffer from *advantageous-inequity* (arising from, say, *altruism*) and if their payoff is lower than other voters they suffer from *disadvantageous-inequity* (arising from, say, *envy*). Several reasons motivate our choice of the FS model.

1. The FS model is tractable and explains the experimental results arising from several games where the prediction of the standard game theory model with selfish agents yields results that are not consistent with the experimental evidence. These games include the ultimatum game, the gift-exchange game, the dictator game as well as the public-good game with punishment[2].

2. The FS model focusses on the role of inequity aversion. However, a possible objection is that it ignores the role played by 'intentions' that have been shown to be important in experimental results (Falk et al. (2002)) and treated explicitly in theoretical work (Rabin (1993), Falk and Fischbacher (2006)). However, experimental results on the importance of intentions come largely from bilateral interactions. Economy-wide voting, on the other hand, is impersonal and anonymous, thereby making it unlikely that intentions play any important role in this phenomenon.

3. Experimental results on voting lend support to the use of the FS model in such contexts. Tyran and Sausgruber (2006) explicitly test for the importance of the FS framework in the context of direct voting. They conclude that the FS model predicts much better than the standard selfish-voter model. In addition, the FS model provides, in their words, "strikingly accurate predictions for individual voting in all three income classes." The econometric results of Ackert et al. (2007), based on their experimental data, lend further support to the FS model in the context of redistributive taxation. The estimated coefficients of altruism and envy in the FS model are statistically significant and, as expected, negative in sign. Social preferences are found to influence participant's vote over alternative taxes. They find evidence that some participants are willing to reduce their own payoffs in order to support

However, voting is anonymous and involves very large numbers of voters, hence, intentions, in all possibility have a minor, if any, role to play. For a survey of theoretical models of ORP, its neuroeconomic foundations, and the empirical results, see Fehr and Fischbacher (2002).

[2] In the first three of these games, experimental subjects offer more to the other party relative to the predictions of the Nash outcome with selfish preferences. In the public good game with punishment, the possibility of ex-post punishment dramatically reduces the extent of free riding in voluntary giving towards a public good. In the standard theory with selfish agents, bygones are bygones, so there is no ex-post incentive for the contributors to punish the free-riders. Foreseeing this outcome, free riders are not deterred, which is in disagreement with the evidence. Such behavior can be easily explained within the FS framework.

taxes that reduce advantageous or disadvantageous inequity. In the context of voting experiments, Bolton and Ockenfels (2006) conclude that "...while not everyone measures fairness the same way, the simple measures offered by ERC or FS provide a pretty good approximation to population behavior over a wide range of scenarios that economists care about."

It is worth noting that when the labor supply decision is endogenous, the median-voter theorem with selfish voters is known to hold only in special cases. Actual (and successful) applications largely use quasi-linear preferences with quadratic-disutility of labour effort. This forms the basis of Meltzer and Richard's (1981) celebrated result that the extent of redistribution varies directly with the ratio of the mean to median income. Piketty (1995) restricts preferences to the quasi-linear case with quadratic-disutility of labour. Benabou (2000) considers the additively-separable case with log-consumption and disutility of labor given by a constant-elasticity form. This brings us to our second contribution in the paper. For the special case of selfish voters, we establish the existence of a Condorcet winner for a more general class of utility functions as compared to the existing literature.

The plan of the paper is as follows. Section 2 formulates the model. Section 3 establishes the existence of a Condorcet winner when voters have other regarding preferences. For the special case of purely self interested preferences we establish the existence of a Condorcet winner for a more general class of utility functions relative to the existing literature. Section 4 provides an illustration and checks that our assumptions are satisfied in the quasi-linear case with constant elasticity of labour supply, which forms the basis of much research in the literature.

2. Model

We consider a general equilibrium model as in Meltzer and Richard (1981). Let there be $n = 2m - 1$ voter-worker-consumers (henceforth, voters). Let the skill level of voter j be s_j, $j = 1, 2, ..., n$, where

$$0 < s_i < s_j < 1, \text{ for } i < j, \tag{2.1}$$

Denote the skill vector by $\mathbf{s} = (s_1, s_2, ..., s_n)$ and the median skill level by s_m. Each voter has a fixed time endowment of one unit and supplies l_j units of labor and so enjoys $L_j = 1 - l_j$ units of leisure, where

$$0 \leq l_j \leq 1. \tag{2.2}$$

Labour markets are competitive and each firm has access to a linear production technology such that production equals $s_j l_j$. Hence, the wage rate offered to each voter coincides with the marginal product, i.e., the skill level, s_j. Thus, the before-tax income of voter j is given by

$$y_j = s_j l_j. \tag{2.3}$$

Note that 'skill' here need not represent any intrinsic talent, just ability to translate labour effort into income[3]. Let the average before-tax income be

$$\overline{y} = \frac{1}{n} \sum_{j=1}^{n} y_j. \tag{2.4}$$

The government operates a linear progressive income tax that is characterized by a constant marginal tax rate, t, $t \in [0,1]$, and a uniform transfer, b, to each voter that equals the average tax proceeds,

$$b = t\overline{y}. \tag{2.5}$$

The budget constraint of voter j is given by

$$0 \leq c_j \leq (1-t)\, y_j + b. \tag{2.6}$$

In view of (2.3), the budget constraint (2.6) can be written as

$$0 \leq c_j \leq (1-t)\, s_j l_j + b. \tag{2.7}$$

2.1. Preferences of Voters

We define a voter's preferences in two stages. First, let voter j have a concave *own-utility* function, $\widetilde{u}(c_j, 1-l_j)$, defined over own-consumption, c_j, and own-leisure, $1-l_j$. In common with the literature, we assume that all voters have the same own-utility function. Hence, voters differ only in that they are endowed with different skill levels, s_j. We assume that the utility function has the following, plausible, properties. It is thrice continuously differentiable and

$$\text{(a) } \widetilde{u}_1 > 0, \text{ (b) } l > 0 \Rightarrow \widetilde{u}_2(c, 1-l) > 0, \text{ (c) } \widetilde{u}_2(c,1) = 0, \text{ (d) } \widetilde{u}_1(c,0) \leq \widetilde{u}_2(c,0), \tag{2.8}$$

$$\text{(a) } \widetilde{u}_{11} \leq 0, \text{ (b) } \widetilde{u}_{12} \geq 0, \text{ (c) } l > 0 \Rightarrow \widetilde{u}_{22}(c, 1-l) < 0, \text{ (d) } (\widetilde{u}_{12})^2 \leq \widetilde{u}_{11}\widetilde{u}_{22}. \tag{2.9}$$

From (2.8a), the marginal utility of consumption is positive, while (2.8b) implies that marginal utility of leisure is positive, unless $l = 0$ in which case (2.8c) says that the consumer is satiated with leisure. From (2.8d), when a consumer has no leisure, she always (weakly) prefers one extra unit of leisure to one extra unit of consumption. (2.9a)

[3] For example, a highly talented classical musician may be able to earn only a modest income, while a merely competent 'pop' musician may earn millions. In our model, the former would be classified as having a low s while the latter would be classified as having a high s. Similarly, in recent years, there has been a record level of skilled (in the ordinary sense of the word) migration into Britain from Eastern Europe. However, since they are predominantly accepting low pay work, they would be classified in our model as having low s.

says that marginal utility of consumption is non-increasing. Consumption and leisure are complements (2.9b) while (2.9c) implies that the marginal utility of leisure is strictly declining unless, possibly, the consumer is satiated with leisure (in which case $\widetilde{u}_{22}(c,1) = 0$). Conditions (2.8) and (2.9a-c) guarantee that a maximum exists, that it is unique and that it is an interior point ($0 < l_i < 1$); unless $t = 1$ in which case the maximum will lie at $l_i = 0$. Conditions (2.9a,c,d) guarantee that $\widetilde{u}$ is concave.

Since $\frac{\partial \widetilde{u}}{\partial c_j} > 0$, (2.8a), it follows that the budget constraint (2.7) holds with equality. Substituting $c_j = (1-t)\, s_j l_j + b$, from (2.7), into the own-utility function, $\widetilde{u}(c_j, 1 - l_j)$, gives the following form for own-utility

$$u_j = u\left(l_j; t, b, s_j\right) = \widetilde{u}((1-t)\, s_j l_j + b, 1 - l_j). \tag{2.10}$$

Second, and for the reasons stated in the introduction, voters have *other-regarding preferences* as in Fehr-Schmidt (1999). Under Fehr-Schmidt preferences the *FS-utility* of voter j, $U_j\left(l_j; \mathbf{l}_{-j}, t, b, \mathbf{s}\right)$, is as follows. Let $\mathbf{l}_{-j}$ be the vector of labour supplies of voters other than voter j. Then

$$U_j\left(l_j; \mathbf{l}_{-j}, t, b, \mathbf{s}\right) = u_j - \frac{\alpha}{n-1} \sum_{k \neq j} \max\left\{0, u_k - u_j\right\} - \frac{\beta}{n-1} \sum_{i \neq j} \max\left\{0, u_j - u_i\right\}, \tag{2.11}$$

where u_j is defined in (2.10) and

$$\text{for } \textit{selfish} \text{ voters } \alpha = \beta = 0, \text{ so } U_j\left(l_j; \mathbf{l}_{-j}, t, b, \mathbf{s}\right) = u\left(l_j; t, b, s_j\right), \tag{2.12}$$

$$\text{for } \textit{fair} \text{ voters } 0 < \beta < 1,\ \beta < \alpha, \text{ so } U_j\left(l_j; \mathbf{l}_{-j}, t, b, \mathbf{s}\right) \neq u\left(l_j; t, b, s_j\right). \tag{2.13}$$

Thus, u is also the utility function of a selfish voter, as in the standard textbook model. From (2.11), the fair voter cares about own-utility (first term), utility relative to those where inequality is disadvantageous (second term) and utility relative to those where inequality is advantageous (third term). The second and third terms which capture respectively, *envy* and *altruism*, are normalized by the term $n - 1$. Notice that in FS preferences, inequality is *self-centered*, i.e., the individual uses her own utility as a reference point with which everyone else is compared. $\beta > 1$ would imply that an individual could increase utility by simply destroying all his/her wealth; this is counterfactual. The restriction $\beta < \alpha$ is based on experimental evidence. These and related issues are more fully discussed in Fehr and Schmidt (1999).

2.2. Sequence of moves

We consider a two-stage game. In the first stage, all voters vote directly and sincerely on the redistributive tax rate. Should a median voter equilibrium exist, then the tax rate preferred by the median voter is implemented. In the second stage, all voters make their labour supply decision, conditional on the tax rate chosen by the median voter in the first stage. On choosing their labour supplies in the second stage, the announced first period tax rate is implemented and transfers made according to (2.5).

In the second stage the voters play a one-shot Nash game: each voter, j, chooses his/her labour supply, l_j, given the vector, $\mathbf{l}_{-j}$, of labour supplies of the other voters, so as to maximize his/her FS-utility (2.11). In the first stage, each voter votes for his/her preferred tax rate, correctly anticipating the second stage play.

The solution is by backward induction. We first solve for the Nash equilibrium in labour supply decisions of voters conditional on the announced tax rates and transfers. The second stage decision is then fed into the first stage FS-utilities to arrive at the indirect utilities of voters, which are purely in terms of the tax rate. Voters then choose their most desired tax rates which maximize their indirect FS-utilities, with the proposal of the median voter being the one that is implemented.

2.3. Labour supply decision of taxpayers (second stage problem)

Given the tax rate, t, and the transfer, b, both determined in the first stage, the voters play a one-shot Nash game (in the subgame determined by t and b). Each voter, j, chooses own labour supply, l_j, so as to maximize his/her FS-utility (2.11), given the labour supplies, $\mathbf{l}_{-j}$, of all other voters.

Proposition 1 *: In the second stage of the game, voter j, whether fair or selfish, chooses own labour supply, l_j, so as to maximize own-utility, $u(l_j; t, b, s_j)$, given t, b and s_j.*

We list, in Lemmas 1 and 2 below, some useful results.

Lemma 1 *(Properties of labour supply): (a) Given t, b and s_j, there is a unique labour supply for voter j, $l_j = l(t, b, s_j)$, that maximizes own-utility $u(l_j; t, b, s_j)$,*
(b) $t \in [0, 1) \Rightarrow 0 < l_j < 1$,
(c) $l_j = 0$ at $t = 1$,
(d) $t \in [0, 1] \Rightarrow \left[\frac{\partial u}{\partial l_j}(l_j; t, b, s_j)\right]_{l_j = l(t,b,s_j)} = 0$,
(e) $l(t, b, s_j)$ is twice continuously differentiable,
(f) $\frac{\partial l(t,b,s)}{\partial b} \leq 0$,
(g) for each $t \in [0, 1]$, the equation $b = \frac{1}{n} t \Sigma_{i=1}^{n} s_i l(t, b, s_i)$ has a unique solution $b(t, \mathbf{s}) \geq 0$; and $b(t, \mathbf{s})$ is twice continuously differentiable.

Substituting labour supply, given by Lemma 1(a), in $u(l_j; t, b, s_j)$ we get the indirect own-utility function of voter j:

$$v_j = v(t, b, s_j) = u(l(t, b, s_j); t, b, s_j). \tag{2.14}$$

Lemma 2 *(Properties of the indirect own-utility function): (a)* $\frac{\partial v(t,b,s)}{\partial b} > 0$,
(bi) $\frac{\partial v(1,b,s)}{\partial s} = 0$, *(bii)* $t \in [0,1) \Rightarrow \frac{\partial v(t,b,s)}{\partial s} > 0$,
(ci) $\left[\frac{\partial v(t,b,s)}{\partial t}\right]_{t=1} = 0$, *(cii)* $t \in [0,1) \Rightarrow \frac{\partial v(t,b,s)}{\partial t} < 0$,
(d) $t \in [0,1) \Rightarrow \frac{\partial^2 v}{\partial s \partial b} < 0$.

Substituting labour supply, $l(t,b,s_j)$, into (2.3) gives before-tax income:

$$y_j(t,b,s_j) = s_j l(t,b,s_j). \tag{2.15}$$

Substituting $b(t,\mathbf{s})$, given by Lemma 1 (g), into the indirect own-utility (2.14), gives

$$w_j(t,\mathbf{s}) = v(t, b(t,\mathbf{s}), s_j). \tag{2.16}$$

2.4. Existence of most desired tax rates (first stage)

Substituting labour supply, $l(t,b,s_j)$, into the utility function, $U_j(l_j;\mathbf{l}_{-j},t,b,\mathbf{s})$, and using (2.11) and (2.14), gives the indirect utility function, $V_j(t,b,\alpha,\beta,\mathbf{s})$, of voter j

$$V_j(t,b,\alpha,\beta,\mathbf{s}) = v_j - \frac{\alpha}{n-1}\sum_{k\neq j}\max\{0, v_k - v_j\} - \frac{\beta}{n-1}\sum_{i\neq j}\max\{0, v_j - v_i\}, \tag{2.17}$$

where v_j is defined in (2.14).

In the light of Lemmas 2(bi) and 2(bii), (2.17) becomes

$$V_j(t,b,\alpha,\beta,\mathbf{s}) = v_j - \frac{\alpha}{n-1}\sum_{k>j}[v_k - v_j] - \frac{\beta}{n-1}\sum_{i<j}[v_j - v_i], \tag{2.18}$$

equivalently,

$$V_j(t,b,\alpha,\beta,\mathbf{s}) = \frac{\beta}{n-1}\sum_{i<j} v_i + \left(1 - \frac{(j-1)\beta}{n-1} + \frac{(n-j)\alpha}{n-1}\right) v_j - \frac{\alpha}{n-1}\sum_{k>j} v_k. \tag{2.19}$$

Let

$$W_j(t,\alpha,\beta,\mathbf{s}) = V_j(t, b(t,\mathbf{s}), \alpha, \beta, \mathbf{s}), \tag{2.20}$$

where $b(t,\mathbf{s})$ is given by Lemma 1(g). Then (2.16), (2.18), (2.19) and (2.20) give

$$W_j(t,\alpha,\beta,\mathbf{s}) = w_j - \frac{\alpha}{n-1}\sum_{k>j}[w_k - w_j] - \frac{\beta}{n-1}\sum_{i<j}[w_j - w_i], \tag{2.21}$$

where w_j is defined in (2.16). Equivalently,

$$W_j(t,\alpha,\beta,\mathbf{s}) = \frac{\beta}{n-1}\sum_{i<j} w_i + \left(1 - \frac{(j-1)\beta}{n-1} + \frac{(n-j)\alpha}{n-1}\right) w_j - \frac{\alpha}{n-1}\sum_{k>j} w_k. \tag{2.22}$$

Since $\widetilde{u}(c_i, 1-l_i)$ is continuous by assumption, and since $l(t,b,s_i)$ and $b(t,\mathbf{s})$ are continuous, by Lemma 1(e) and (g), it follows, from (2.10), (2.14), (2.16) and (2.21) or (2.22), that $W_j(t,\alpha,\beta,\mathbf{s})$ is a continuous function of $t \in [0,1]$. Hence, $W_j(t,\alpha,\beta,\mathbf{s})$ attains a maximum at some $t_j \in [0,1]$. This is the most desired tax tax rate for voter j. Thus, we have established:

Proposition 2 *: In the first stage of the game, for each voter j, there exists a most desired tax rate, $t_j \in [0,1]$, that maximizes his/her indirect FS-utility, $W_j(t,\alpha,\beta,\mathbf{s})$, given $\alpha,\beta,\mathbf{s}$.*

The model with fair voters is similar in structure to the one with selfish voters in that a weighted social welfare function is maximized, where the weight placed by voter j on the i^{th} voter's indirect utility is λ_{ji}. To see this, rewrite (2.22) as

$$W_j(t,\alpha,\beta,\mathbf{s}) = \sum_{i=1}^{n} \lambda_{ji} w_i(t,\mathbf{s}) \tag{2.23}$$

where the weights on the individuals are defined by:

$$\begin{aligned} \lambda_{ji} &= \begin{cases} \frac{\beta}{n-1} > 0 & \text{if} \quad i<j \\ 1 - \frac{(j-1)\beta}{n-1} + \frac{(n-j)\alpha}{n-1} > 0 & \text{if} \quad i=j \\ \frac{-\alpha}{n-1} < 0 & \text{if} \quad i>j \end{cases}, \\ \sum_{i=1}^{n} \lambda_{ji} &= 1. \end{aligned} \tag{2.24}$$

Finding a tax rate to maximize (2.23) is a completely standard problem in public economics.

3. Existence of a Condorcet winner

We shall show that a majority chooses the tax rate, t_m, that is optimal for the median-skill voter, in the sense that, for each $j \neq m$, a majority prefers t_m over t_j. We do this by using the *single-crossing property* of Gans and Smart (1996).

Definition 1 *: (Gans and Smart, 1996) The 'single-crossing' property holds if for tax rates t,T and voters j,J,*

$t<T,\ j<J,\ W_j(t,\alpha,\beta,\mathbf{s}) > W_j(T,\alpha,\beta,\mathbf{s}) \Rightarrow W_J(t,\alpha,\beta,\mathbf{s}) > W_J(T,\alpha,\beta,\mathbf{s})$.[4]

Lemma 3 *: (Gans and Smart, 1996) The 'single-crossing' property holds if $-\frac{\partial V_j}{\partial t} / \frac{\partial V_j}{\partial b}$ is an increasing function of j (where V_j is defined in (2.18)).*

Lemma 4 *: (Gans and Smart, 1996) If the 'single-crossing' property holds, then the median-voter is decisive, i.e., a majority chooses the tax rate that is optimal for the median-voter.*

The proofs of Lemmas 3, 4 can be found in Gans and Smart (1996).

[4] Here we use "$<$" to denote the usual ordering of real numbers. In the more general setting of Gans and Smart (1996), "$<$" is used to denote several (possibly different) abstract orderings. In particular, a literal translation of Gants and Smart (1996) gives: $T<t,\ j<J,\ W_j(t,\alpha,\beta,\mathbf{s}) > W_j(T,\alpha,\beta,\mathbf{s}) \Rightarrow W_J(t,\alpha,\beta,\mathbf{s}) > W_J(T,\alpha,\beta,\mathbf{s})$, where "$j<J$" has the usual meaning "j is less than J" but "$T<t$" means "t is less than T".

3.1. Main results

We now introduce two further assumptions, A1 and A2, followed by the main result of the paper.[5]

A1: $t \in [0,1) \Rightarrow \frac{\partial^2 v}{\partial s \partial t}(t,b,s) < 0$.

Recall, from Lemma 2(cii), that $t \in [0,1) \Rightarrow \frac{\partial v}{\partial t} < 0$. Hence, $\frac{\partial}{\partial s}\left(t\frac{\partial v}{\partial t}\right) = t\frac{\partial^2 v}{\partial s \partial t} < 0$ can be interpreted as saying that an extra 1% on the redistributive tax rate hurts a poor person less than a rich person. Thus Assumption A1 roughly says that redistributive taxes hurt the poor less than the rich. This is the basic foundation of the modern welfare state, and as we show below, satisfied in the important case of quasilinear preferences with constant labor supply, which is widely used in the literature.

A2: $\frac{\partial V_j}{\partial t}(t,b,\alpha,\beta,\mathbf{s}) \leq 0$.

Since $\frac{\partial v}{\partial t} < 0$, for $t < 1$ (Lemma 2(cii)), an increase in tax (benefit, b, remaining fixed), is undesirable for a selfish-voter which is, of course, entirely reasonable. Assumption A2 extends this to fair-voters as well. It implies that envy/altruism is not so great as to make a fair-voter prefer an increase in tax, even if it has no gain for any one at all in terms of an increase in the benefits, b (b is held fixed in computing $\frac{\partial V_j}{\partial t}$ in A2).

Proposition 3 : *Under assumptions A1 and A2 a majority prefers the tax rate that is optimal for the median-skill voter.*

Corollary 1 : *Under assumption A1, if utility is quasi-linear, then a majority prefers the tax rate that is optimal for the median-voter. In particular, assumption A2 is not needed in this case.*

Corollary 2 : *Under assumption A1, if voters are selfish ($\alpha = \beta = 0$), then a majority prefers the tax rate that is optimal for the median-voter. Assumption A2 is satisfied in this case.*

As noted in the introduction, when labor supply is endogenous, the median-voter theorem with selfish voters is known to hold only in special cases. Corollary 2 establishes the existence of a Condorcet winner for a more general class of utility functions as compared to the existing literature.

[5] Assumptions A1 and A2 are stated in terms of the indirect own-utility, v, and the indirect utility, V. A1 and A2 can, of course, be rewritten in terms of the direct own-utility $\widetilde{u}$. However, the resulting conditions on $\widetilde{u}$ are extremely complex and difficult to interpret. Moreover, by duality, neither direct utility nor indirect utility can be regarded as more fundamental than the other.

4. An example: Quasi-linear preferences and constant elasticity of labor supply

We assume that the own-utility function is quasi-linear, with constant elasticity of labour supply, which is the most commonly used functional form in various applications of the median voter theorems.

$$\widetilde{u}(c, 1-l) = c - \frac{\epsilon}{1+\epsilon} l^{\frac{1+\epsilon}{\epsilon}}, \tag{4.1}$$

where ϵ is the constant elasticity of labour supply, and satisfies[6]

$$0 < \epsilon \leq 1, \tag{4.2}$$

The case $\epsilon = 1$ has special significance in the literature. In this case,

$$\widetilde{u}(c, 1-l) = c - \frac{1}{2} l^2. \tag{4.3}$$

Meltzer and Richard (1981) use (4.3) to derive the celebrated result that the extent of redistribution varies directly with the ratio of the mean to median income. Piketty (1995) restricts preferences to the quasi-linear case with disutility of labour given by the quadratic form, (4.3).

It is straightforward to check that (4.1) satisfies (2.8) and (2.9).

Substituting $c_j = (1-t) s_j l_j + b$ in (4.1), the own-utility function of voter j, we get

$$u_j(l_j; t, b, s_j) = u(l_j; t, b, s_j) = (1-t) s_j l_j + b - \frac{\epsilon}{1+\epsilon} l_j^{\frac{1+\epsilon}{\epsilon}}, \tag{4.4}$$

which corresponds to (2.10) above.

Lemma 1 gives labour supply for voter j,

$$l_j = l(t, b, s_j) = (1-t)^{\epsilon} s_j^{\epsilon}, \tag{4.5}$$

Substituting labour supply, $l(t, b, s_j)$, given by (4.5), into (2.3), (2.5) and (4.4) gives, respectively, before-tax income,

$$y_j(t, b, s_j) = (1-t)^{\epsilon} s_j^{1+\epsilon}, \tag{4.6}$$

the transfer to each voter,

$$b(t, \mathbf{s}) = \frac{1}{n} t (1-t)^{\epsilon} \Sigma_{i=1}^{n} s_i^{1+\epsilon}, \tag{4.7}$$

[6] A large number of studies suggest labour supply elasticities consistent with (4.2) (see, for example, Pencavel (1986) and Killingworth and Heckman (1986)). Those that do not (for example, negative labour supply elasticities) may be due to estimating misspecified models (see Camerer and Loewenstein (2004), Chapter 1, 'Labor Economics', pp33-34).

and the indirect own-utility function of voter j:

$$v_j = v(t, b, s_j) = u(l(t, b, s_j); t, b, s_j) = b + \frac{(1-t)^{1+\epsilon}}{1+\epsilon} s_j^{1+\epsilon}. \tag{4.8}$$

Differentiating (4.8) gives

$$\frac{\partial v_j}{\partial t} = -(1-t)^{\epsilon} s_j^{1+\epsilon}, \tag{4.9}$$

and

$$\frac{\partial^2 v}{\partial s \partial t}(t, b, s) = -(1+\epsilon)(1-t)^{\epsilon} s^{\epsilon} < 0. \tag{4.10}$$

From (4.10) we see that assumption A1 holds. From Corollary 1, assumption A2 is not needed to demonstrate the existence of a Condorcet winner for the quasi-linear case. Hence, it follows that a majority prefers the tax rate that is optimal for the median-voter. Thus, our assumptions (2.8), (2.9), and A1 are satisfied by the example of quasi-linear preferences and constant elasticity of labour supply. Hence, they are satisfiable in an important special case.

5. Conclusions

We replace the self-interested voters in the Romer-Roberts-Meltzer-Richard (RRMR) framework with voters who have a preference for fairness, as in Fehr-Schmidt (1999). We show that a Condorcet exists under plausible conditions. We believe that our contribution can open the way for further applications of behavioral concerns for fairness in political economy models. We also give a more general condition for the existence of a Condorcet winner when voters have purely selfish preferences.

6. Appendix: Proofs

Proof of Proposition 1: Consider voter j. Let $\mathbf{l}_{-j}$ be the vector of labour supplies of all other voters. Hence $u(l_i; t, b, s_i), i \neq j$, are fixed numbers. Since $u(l_j; t, b, s_j)$ is continuous in l_j, and since $\max\{0, x\}$ is continuous in x, it follows that $U_j(l_j; \mathbf{l}_{-j}, t, b, \mathbf{s})$, as as given by (2.11), is a continuous function of $l_j \in [0,1]$. Hence, $U_j(l_j; \mathbf{l}_{-j}, t, b, \mathbf{s})$ attains a maximum at some $l_j^* \in [0,1]$. We shall argue that l_j^* must maximize own-utility, $u(l_j; t, b, s_j)$. Let

$$\begin{aligned} A_j &= \{i : i \neq j \text{ and } u(l_i; t, b, s_i) \leq u(l_j; t, b, s_j)\}, \\ D_j &= \{k : k \neq j \text{ and } u(l_k; t, b, s_k) > u(l_j; t, b, s_j)\}, \end{aligned}$$

$$\begin{aligned} &\omega_{ji} = \tfrac{\beta}{n-1} > 0, \text{ for } i \in A_j, \\ &\omega_{jj} = 1 - \tfrac{|A_j|\beta}{n-1} + \tfrac{|D_j|\alpha}{n-1} > 0, \\ &\omega_{jk} = -\tfrac{\alpha}{n-1} < 0, \text{ for } k \in D_j. \end{aligned}$$

Then $U_j(l_j; \mathbf{l}_{-j}, t, b, \mathbf{s})$ can be written as[7]

$$U_j(l_j; \mathbf{l}_{-j}, t, b, \mathbf{s}) = \omega_{jj} u(l_j; t, b, s_j) + \sum_{i \in A_j} \omega_{ji} u(l_i; t, b, s_i) + \sum_{k \in D_j} \omega_{jk} u(l_k; t, b, s_k),$$

In particular,

$$U_j\left(l_j^*; \mathbf{l}_{-j}, t, b, \mathbf{s}\right) = \omega_{jj} u\left(l_j^*; t, b, s_j\right) + \sum_{i \in A_j} \omega_{ji} u(l_i; t, b, s_i) + \sum_{k \in D_j} \omega_{jk} u(l_k; t, b, s_k).$$

Suppose l_j^* does not maximize own-utility $u(l_j; t, b, s_j)$. Then we can find an l_j^{**}, sufficiently close to l_j^*, so that $u\left(l_j^{**}; t, b, s_j\right) > u\left(l_j^*; t, b, s_j\right)$ and the sets A_j and D_j are unchanged. Then

$$U_j\left(l_j^{**}; \mathbf{l}_{-j}, t, b, \mathbf{s}\right) = \omega_{jj} u\left(l_j^{**}; t, b, s_j\right) + \sum_{i \in A_j} \omega_{ji} u(l_i; t, b, s_i) + \sum_{k \in D_j} \omega_{jk} u(l_k; t, b, s_k).$$

Hence, $U_j\left(l_j^{**}; \mathbf{l}_{-j}, t, b, \mathbf{s}\right) > U_j\left(l_j^*; \mathbf{l}_{-j}, t, b, \mathbf{s}\right)$, which cannot be, since l_j^* maximizes $U_j\left(l_j^*; \mathbf{l}_{-j}, t, b, \mathbf{s}\right)$. ■

Proof of Lemma 1: Given t, b and s_i, $u(l_i; t, b, s_i)$ is a continuous function of l_i on the non-empty compact set $[0,1]$. Hence, a maximum exists. Since $\widetilde{u}$ is thrice differentiable, so is u and, from (2.10), we get

$$\frac{\partial u}{\partial l_i} = (1-t) s_i \widetilde{u}_1((1-t) s_i l_i + b, 1 - l_i) - \widetilde{u}_2((1-t) s_i l_i + b, 1 - l_i), \tag{6.1}$$

$$\frac{\partial^2 u}{\partial b \partial l_i} = (1-t) s_i \widetilde{u}_{11} - \widetilde{u}_{12}, \tag{6.2}$$

$$\frac{\partial^2 u}{\partial l_i^2} = (1-t)^2 s_i^2 \widetilde{u}_{11} - 2(1-t) s_i \widetilde{u}_{12} + \widetilde{u}_{22}. \tag{6.3}$$

[7] Note that A_j and D_j, and hence also ω_{ji}, are functions of l_i, l_j, s_i, s_j, t and b, $i = 1, 2, ..., n$, $j = 1, 2, ..., n$: $\omega_{ji} = \omega_{ji}(l_i, l_j, s_i, s_j, t, b)$. The connection between ω_{ji}, defined above, and λ_{ji} defined in (2.24), is as follows. In the light of Lemma 1 (a), (g) we can define $\lambda_{ji} = \lambda_{ji}(t, \mathbf{s}) = \omega_{ji}(l_i((t, b(t, \mathbf{s}), s_i)), l_j((t, b(t, \mathbf{s}), s_j)), s_i, s_j, t, b(t, \mathbf{s}))$. In fact, λ_{ji} turn out to be functions of, i and j only, as is obvious from (2.22), (2.23) and (2.24).

From (2.9a), (2.9b) and (6.2) we get

$$\frac{\partial^2 u}{\partial b \partial l_i} \leq 0, \tag{6.4}$$

and from (2.9a), (2.9b), (2.9c) and (6.3) we get

$$l_i > 0 \Rightarrow \frac{\partial^2 u}{\partial l_i^2} < 0. \tag{6.5}$$

First, consider the case $t = 1$. From (2.10), $u(l_i; 1, b, s_i) = \widetilde{u}(b, 1 - l_i)$. From (2.8b), $\widetilde{u}(b, 1 - l_i)$ is a strictly decreasing function of l_i on $(0, 1]$. By continuity, $\widetilde{u}(b, 1 - l_i)$ must be a strictly decreasing function of l_i on $[0, 1]$. Hence, the optimum must be

$$l_i = 0 \text{ at } t = 1. \tag{6.6}$$

Now suppose $t \in [0, 1)$. From (2.1), (2.8a), (2.8c) and (6.1) we get:

$$\frac{\partial u}{\partial l_i}(0; t, b, s_i) = (1-t)\, s_i \widetilde{u}_1(b, 1) - \widetilde{u}_2(b, 1) = (1-t)\, s_i \widetilde{u}_1(b, 1) > 0,$$

and, using (2.8d),

$$\frac{\partial u}{\partial l_i}(1; t, b, s_i) = (1-t)\, s_i \widetilde{u}_1((1-t)\, s_i + b, 0) - \widetilde{u}_2((1-t)\, s_i + b, 0) < \widetilde{u}_1(0, 0) - \widetilde{u}_2(0, 0) \leq 0.$$

Hence, a maximum is an interior point, i.e.,

$$0 < l_i < 1. \tag{6.7}$$

From (6.7) and (6.5) it follows that $\frac{\partial^2 u}{\partial l_i^2} < 0$. Hence, the maximum is unique and is given by

$$\frac{\partial u}{\partial l_i}(l_i; t, b, s_i) = 0. \tag{6.8}$$

Since, from (2.8c), $\widetilde{u}_2(b, 0) = 0$, it follows, from (6.1) and (6.6), that (6.8) also holds for $t = 1$. Hence, for any voter i, the labor supply,

$$l_i = l(t, b, s_i), t \in [0, 1], \tag{6.9}$$

can be found by solving (6.8).

Since u is thrice continuously differentiable it follows, from (2.10) and (6.8) that $l(t, b, s_i)$ is twice continuously differentiable. If $t = 1$ then, from (6.6), $\frac{\partial l_i}{\partial b} = 0$. Now suppose $t < 1$. From (6.5), $\frac{\partial^2 u}{\partial l_i^2} < 0$. Hence, from (6.4) and the implicit function theorem (or differentiating the identity (6.8)), we get $\frac{\partial l_i}{\partial b} = -\left[\frac{\partial^2 u}{\partial b \partial l_i} / \frac{\partial^2 u}{\partial l_i^2}\right]_{l_i = l(t, b, s_i)} \leq 0$. Hence, for all $t \in [0, 1]$,

$$\frac{\partial l_i}{\partial b} \leq 0. \tag{6.10}$$

Let $f(b) = \frac{1}{n} t \Sigma_{i=1}^{n} s_i l(t, b, s_i)$. Since $f(b) \geq 0$, $f(b)$ is twice differentiable (hence continuous) and $f'(b) \leq 0$ (from (6.10)), it follows that $f(b) = b$ has a unique solution, $b(t, \mathbf{s}) \geq 0$; and $b(t, \mathbf{s})$ is twice continuously differentiable. ■

Proof of Lemma 2: From (2.10), (2.14) and the envelope theorem (or Lemma 1 (d)), we get

$$\frac{\partial v(t,b,s)}{\partial b} = \left[\frac{\partial u(l;t,b,s)}{\partial b}\right]_{l=l(t,b,s)} = \left[\widetilde{u}_1\left((1-t)sl+b, 1-l\right)\right]_{l=l(t,b,s)}, \tag{6.11}$$

$$\frac{\partial v(t,b,s)}{\partial s} = \left[\frac{\partial u(l;t,b,s)}{\partial s}\right]_{l=l(t,b,s)} = \left[(1-t)\, l\widetilde{u}_1\left((1-t)sl+b, 1-l\right)\right]_{l=l(t,b,s)}, \tag{6.12}$$

$$\frac{\partial v(t,b,s)}{\partial t} = \left[\frac{\partial u(l;t,b,s)}{\partial t}\right]_{l=l(t,b,s)} = -\left[sl\widetilde{u}_1\left((1-t)sl+b, 1-l\right)\right]_{l=l(t,b,s)}. \tag{6.13}$$

Part (a) follows from (2.8a) and (6.11). Part (b) follows from (2.8a) and (6.12). Part (c) follows from (2.8a), Lemma 1 (b) and (c), and (6.13).

From (6.11) (or (6.12)), we get

$$\frac{\partial^2 v}{\partial b \partial s} = \frac{l(1-t)\left[\widetilde{u}_{11}\widetilde{u}_{22} - (\widetilde{u}_{12})^2\right] + (1-t)\,\widetilde{u}_1\widetilde{u}_{12} - (1-t)^2 s\widetilde{u}_1\widetilde{u}_{11}}{(1-t)^2 s^2\widetilde{u}_{11} - 2(1-t)\, s\widetilde{u}_{12} + \widetilde{u}_{22}} < 0. \tag{6.14}$$

From (2.8)a, (2.9) and (6.14), we get $\frac{\partial^2 v}{\partial b \partial s} < 0$ for $t < 1$. This establishes part (d). ■

Proof of Proposition 3: From (2.19),

$$\frac{\partial V_{j+1}(t,b,\alpha,\beta,\mathbf{s})}{\partial t} - \frac{\partial V_j(t,b,\alpha,\beta,\mathbf{s})}{\partial t} = \left(1 - \frac{j\beta}{n-1} + \frac{(n-j)\,\alpha}{n-1}\right)\left(\frac{\partial v(t,b,s_{j+1})}{\partial t} - \frac{\partial v(t,b,s_j)}{\partial t}\right). \tag{6.15}$$

From (2.13), Assumption A1 and (6.15), it follows that, for $t \in [0, 1)$,

$$\frac{\partial V_{j+1}(t,b,\alpha,\beta,\mathbf{s})}{\partial t} - \frac{\partial V_j(t,b,\alpha,\beta,\mathbf{s})}{\partial t} < 0. \tag{6.16}$$

From (2.18)

$$\begin{aligned}\frac{\partial V_j(t,b,\alpha,\beta,\mathbf{s})}{\partial b} \quad = \quad & \frac{\partial v(t,b,s_j)}{\partial b} - \frac{\alpha}{n-1}\sum_{k>j}\left[\frac{\partial v(t,b,s_k)}{\partial b} - \frac{\partial v(t,b,s_j)}{\partial b}\right] \\ & - \frac{\beta}{n-1}\sum_{i<j}\left[\frac{\partial v(t,b,s_j)}{\partial b} - \frac{\partial v(t,b,s_i)}{\partial b}\right]\end{aligned} \tag{6.17}$$

From Lemma 2(a), Assumption A1 and (6.17)

$$\frac{\partial V_j(t,b,\alpha,\beta,\mathbf{s})}{\partial b} > 0. \tag{6.18}$$

From (2.19)

$$\frac{\partial V_{j+1}(t,b,\alpha,\beta,\mathbf{s})}{\partial b}-\frac{\partial V_{j}(t,b,\alpha,\beta,\mathbf{s})}{\partial b}=\left(1-\frac{j\beta}{n-1}+\frac{(n-j)\,\alpha}{n-1}\right)\left(\frac{\partial v(t,b,s_{j+1})}{\partial b}-\frac{\partial v(t,b,s_{j})}{\partial b}\right). \tag{6.19}$$

From (2.13), Assumption A1 and (6.19)

$$\frac{\partial V_{j+1}(t,b,\alpha,\beta,\mathbf{s})}{\partial b}-\frac{\partial V_{j}(t,b,\alpha,\beta,\mathbf{s})}{\partial b}\leq 0. \tag{6.20}$$

Now,

$$\left(\frac{-\frac{\partial V_{j+1}}{\partial t}}{\frac{\partial V_{j+1}}{\partial b}}\right)-\left(\frac{-\frac{\partial V_{j}}{\partial t}}{\frac{\partial V_{j}}{\partial b}}\right)=\frac{\left(\frac{\partial V_{j+1}}{\partial b}-\frac{\partial V_{j}}{\partial b}\right)\frac{\partial V_{j}}{\partial t}+\frac{\partial V_{j}}{\partial b}\left(\frac{\partial V_{j}}{\partial t}-\frac{\partial V_{j+1}}{\partial t}\right)}{\frac{\partial V_{j}}{\partial b}\frac{\partial V_{j+1}}{\partial b}}. \tag{6.21}$$

From (6.16), (6.18), (6.20), (6.21) and Assumption A2, we get that, for $t\in[0,1)$,

$$\left(\frac{-\frac{\partial V_{j+1}}{\partial t}}{\frac{\partial V_{j+1}}{\partial b}}\right)-\left(\frac{-\frac{\partial V_{j}}{\partial t}}{\frac{\partial V_{j}}{\partial b}}\right)>0, \tag{6.22}$$

hence,

$$-\frac{\partial V_{j}}{\partial t}/\frac{\partial V_{j}}{\partial b}\text{ is strictly increasing in }j. \tag{6.23}$$

From Lemma 3 and (6.23) we get that 'single-crossing' holds. Hence, from Lemma 4, the median-voter is decisive, i.e., a majority chooses the tax rate that is optimal for the median-voter. This establishes Proposition 3. ■

Proof of Corollary 1: Note that if u is quasi-linear, then $u(c,1-l)=c-f(l)$. Hence, $U(l;t,b,s)=(1-t)\,sl+b-f(l)$. By the envelope theorem (or direct calculation), $\frac{\partial v(t,b,s)}{\partial b}=\frac{\partial U(l;t,b,s)}{\partial b}=1$. From this, and (6.17), we get that $\frac{\partial V_j}{\partial b}=1$. Hence, (6.21) reduces to

$$\left(\frac{-\frac{\partial V_{j+1}}{\partial t}}{\frac{\partial V_{j+1}}{\partial b}}\right)-\left(\frac{-\frac{\partial V_{j}}{\partial t}}{\frac{\partial V_{j}}{\partial b}}\right)=\frac{\partial V_{j}}{\partial t}-\frac{\partial V_{j+1}}{\partial t}>0, \tag{6.24}$$

where the inequality in (6.24) comes from (6.16). Hence, (6.23) again holds, but we have not used Assumption A2.

Proof of Corollary 2: If voters are selfish, so that $\alpha=\beta=0$, then Assumption A2 reduces to $\frac{\partial v}{\partial t}\leq 0$, which we know holds from Lemma 2(c). This establishes Corollary 2. ■

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