CESifo *Working Paper Series*

THE EFFICIENT SIDE OF PROGRESSIVE INCOME TAXATION

Giacomo Corneo

Working Paper No. 364

November 2000

CESifo
Poschingerstr. 5
81679 Munich
Germany
Phone: +49 (89) 9224-1410/1425
Fax: +49 (89) 9224-1409
http://www.CESifo.de

CESifo *Working Paper No. 364*
November 2000

THE EFFICIENT SIDE OF PROGRESSIVE INCOME TAXATION

Abstract

This paper examines the allocative implications of progressive income taxation when individuals care about their relative income. It shows that tax progressivity might improve efficiency, and the more so in egalitarian economies. Introducing a progressive income tax can yield a Pareto improvement if pre-tax income is evenly distributed. Implementing undistorted choices of working hours requires a progressive tax schedule, and the optimal degree of progressivity decreases with pre-tax income inequality.

Keywords: Progressive income tax, inequality, social status

JEL Classification: H2, J2

Giacomo Corneo
University of Osnabrück
Department of Economics
Rolandstr. 8
49069 Osnabrück
Germany

1 Introduction

Recent multy-country studies suggest that there is a tendency for income taxation to be highly redistributive precisely in the countries where the distribution of pre-tax income is already fairly egalitarian (see e.g. Lindert (1996), Perotti (1996), Persson (1995)). That empirical evidence is quite puzzling from the viewpoint of the theory. Indeed, both normative and positive analysis of tax policy typically predicts that the extent of income redistribution should be positively correlated with pre-tax income inequality (see e.g. Atkinson (1995)).

The current paper proposes an efficiency-based explanation for that empirical evidence. In essence, it argues that a progressive income tax may improve the allocation of resources by reducing inefficient overwork.[1] That efficiency gain is shown to be more valuable in economies in which pre-tax income is evenly distributed.

The essential ingredient for my argument is the hypothesis that individuals care about their relative position in society, in addition to caring about more usual things like consumption and leisure. Veblen (1922) extensively elaborated around the idea that in modern societies individuals strive for higher relative income in order to satisfy their need for social status. There is substantial empirical evidence suggesting that the relative-income hypotesis is correct. Econometric investigations in support of that view include, among others, Clark and Oswald (1996), Neumark and Postlewaite (1998), and Woittiez and Kapteyn (1998). From a theoretical perspective, Cole *et al.* (1992) have developed microfoundations for the hypothesis that the rank of individuals in the income distribution determines their social success. The rationale behind their approach can be summarized as follows. Many goods about which individu-

[1]Because of a number of methodological problems, it is difficult to detect overwork empirically, as tried e.g. by Schor (1991) in a well-known study. Frank (1999, ch. 4) presents several pieces of socio-economic evidence showing that inefficient overwork is a real problem in developed economies.

als care, like honours and mates, are not allocated through market transactions but through contests. A higher income rank can be beneficial to the individual by helping him in various ways to improve his position in those contests. The specific example considered in their article is marriage, which is modeled as a voluntary matching game. A higher income rank, by securing a larger consumption to the mate, increases the expected payoff of the individual in the matching game.

The current paper assumes that people are concerned with their rank in the distribution of income or, equivalently, in the distribution of consumption. Armed with that assumption, I study how the degree of progressivity of the income tax affects allocative efficiency in an otherwise standard model of labor supply. For simple functional forms, the following main results are showed. First, introducing a small progressive income tax yields a Pareto improvement whenever the Gini coefficient of the distribution of pre-tax income is lower than a critical level. Second, implementing undistorted choices of working hours requires a progressive tax schedule, and the optimal degree of progressivity decreases with the Gini coefficient of the distribution of pre-tax income.

The obtained results have a natural economic explanation. Income generation causes a negative externality when people care about their relative income. Improving one's rank in the income distribution necessarily worsens somebody other's rank. An income tax may thus improve efficiency in the same fashion Pigouvian taxation does. If leisure is a normal good, individuals with a high earning potential have a strong incentive to engage in "social climbing" and must be prevented to do so by using high marginal tax rates, so that the Pareto-improving tax schedule is progressive. Inequality comes in the picture as follows. More equality in the distribution of earning potentials makes it relatively easy to climb the income hierarchy, for given earning decisions by the rest of individuals. Hence, equality implies a strong incentive to expend working effort just for status reasons. In order to improve efficiency in an egalitarian economy, a very progressive taxation of income is thus required.

The possibility of an efficiency-enhancing role of income taxation was already noted by Duesenberry (1949), who devoted almost a full chapter to the tax implications of the relative-income hypothesis. Recent contributions that make use of game-theoretical tools have been offered by Persson (1995) and Ireland (1998). Persson (1995) has analyzed an economy consisting of two individuals who care about their relative consumption. According to some numerical simulations, a tendency has been pointed out for Pareto-improving tax rates to decrease with the pre-tax hourly wage differential between the two individuals. Ireland (1998) has studied a signalling model of status with a continuum of individuals who maximize a convex combination of their fundamental utility and spectators' view of that utility. In his model individuals earn the same hourly wage but differ with respect to their time endowments. If the range of time endowments in the population is not too great, a Pareto-improving income tax has been shown to exist.

Whereas in previous contributions attention is restricted to redistribution by means of a linear income tax, in the current model the marginal tax rate can vary with the income level. This enables one to consider regressive as well as progressive tax schedules and to examine the link between optimal tax progressivity and the standard measure of income inequality, the Gini coefficient. Furthermore, the current model encompasses both heterogeneity with respect to hourly wages and time endowments.[2]

[2]The relative-income hypothesis has received some attention also in the literature on optimal taxation, where a social welfare function is maximized. Boskin and Sheshinski (1978) studied a model of the optimal negative income tax when an individual's utility is negatively affected by the average consumption level in the population. They showed that a concern for relative position leads to an increase in the optimal marginal tax rate compared with the case of sole concern for absolute position. Oswald (1983) derived optimal non-linear tax rules for an economy in which people care about the consumption of other individuals. He proved that in such a setting general results of optimal tax theory are easily overturned.

The efficiency view on tax progressivity proposed in this paper contrasts with the current European trend towards substantial cuts of the marginal tax rates faced by high-income taxpayers and scaling down of income transfer programs. Such policies are commonly justified on the ground of various sorts of efficiency costs induced by the welfare state. The fact that progressive income taxation may bring people, and especially highly productive people, relief from status competition is, however, typically overlooked. At most, an efficiency role for redistributive taxation is recognized to the extent it substitutes for missing insurance markets and it lowers wage pressure in unionized labor markets. The current paper might thus contribute to a more balanced assessment of the actual efficiency cost of the welfare state.

The rest of the paper proceeds as follows. Section 2 sets up the formal model. Section 3 derives the main results. Section 4 briefly concludes the paper.

2 The model

The model economy is populated by a continuum of individuals denoted by $i \in [0,1] \equiv I$. Individuals have identical preferences that are summarized by the following utility function:

$$U(i) = \log(c(i)) + \lambda \log(l(i)) + \rho \log(r(i)) \tag{1}$$

where $c(i)$ represents consumption by individual i, $l(i) = t(i) - h(i)$ is active leisure for individual i, defined as the difference between his time endowment $t(i)$ and his working hours $h(i)$, and $r(i)$ is the rank occupied by the individual in the distribution of income. In the current model the ranking of pre-tax income always equals the ranking of consumption, so that $r(i)$ may as well be interpreted as the individual's rank with respect to consumption. The term $\rho \; log(r)$ is the part of the utility function which represents the utility derived by the individual in the social sphere as a consequence of his social status.

Individuals differ with respect to their earning potentials, i.e. hourly wages, $w(i)$, and time endowments, $t(i)$. The latter are distributed in the population according to $t(i) = \alpha i^{\beta}$, whereas hourly wages vary according to $w(i) = \gamma i^{\delta}$. Parameters $\alpha, \beta, \gamma, \delta$ are all positive. If they are all strictly positive, then time endowments and wages are perfectly correlated in the population. If $\beta = 0$ (resp. $\delta = 0$), individuals have identical time endowments (resp. hourly wages). I assume that β and δ cannot both be nil, so that the earning potential $w(i)t(i)$ is strictly increasing with the index of the individual.

The pre-tax income of individual i is denoted by $y(i) = w(i)h(i)$. Letting $F(\cdot)$ denote the cumulative distribution function of income over the population, individual i's rank in the income distribution is given by:

$$r(i) = F(y(i)) \tag{2}$$

The rank is increasing with the level of income: $r = 0$ corresponds to the poorest individual in the population, and $r = 1$ to the richest one.

Income is taxed according to a tax schedule $\tau(y)$. In order to focus on the issue of tax progressivity, attention is restricted to a class of tax schedules that can be ordered according to their global degree of progressivity. I thus posit that the tax schedule satisfies $y - \tau(y) = by^a$, where a and b are positive scalars. Parameter a represents the elasticity of post-tax income to pre-tax income and is termed the residual progression of the tax schedule $\tau(y)$. A tax schedule is progressive (i.e. the average tax rate increases with pre-tax income) if its residual progression is smaller than unity. If $a > 1$, then $\tau(y)$ is regressive. Furthermore, the smaller the residual progression, the more progressive is said to be the tax schedule. For any given distribution of pre-tax income and tax schedules τ_1 and τ_2, if $a_1 < a_2$, then the distribution of post-tax income under τ_1 Lorenz dominates the one under τ_2 (Jakobsson (1976)).

Parameter b has to ensure that, for given a, the tax revenue is wholly redistributed to individuals. From the definition of $\tau(y)$ it follows that:

$$b = \frac{\int_0^1 y(i)di}{\int_0^1 y(i)^a di} \tag{3}$$

Individuals maximize their utility function (1) under their budget constraint: $c(i) = by(i)^a$. Since an individual's utility depends on earning decisions by all others through their impact on the individual's rank in the income distribution, the maximization decision takes place in a strategic environment. The Nash equilibrium of the corresponding nonatomic game can be characterized by a labor supply function $h^*(i)$ and a cumulative distribution function of income $F^*(y)$ such that:

$$h^*(i) = \arg\max \log(b(w(i)h)^a + \lambda \log(t(i) - h) + \rho \log(F^*(w(i)h), \tag{4}$$

and

$$F^*(w(i)h^*(i)) = i \tag{5}$$

for all $i \in I$. The first equilibrium condition requires that each individual's working hours maximize his utility, given his expectation about the shape of the income distribution. The second equilibrium condition ensures that the income distribution resulting from individual decisions is the one anticipated by the individuals.

3 Analysis and results

To begin with, the following fact will be established:

Proposition 1 . *In equilibrium, working hours satisfy:*

$$\frac{h^*(i)}{t(i)} = K, \qquad \forall i \in I, \tag{6}$$

where $K \in (0,1)$ *is given by:*

$$K = \frac{a + \frac{\rho}{\beta+\delta}}{a + \frac{\rho}{\beta+\delta} + \lambda}. \tag{7}$$

Proof. Suppose that in equilibrium the cumulative distribution function of income reads:

$$F^*(y) = my^n, \tag{8}$$

where m and n are positive scalars to be determined. Inserting that function into (4) and computing the first-order condition yields:

$$h^*(i) = \left(\frac{a + \rho n}{a + \rho n + \lambda}\right) t(i). \tag{9}$$

Using the definitions of $t(i)$ and $w(i)$, the resulting income distribution turns out to be:

$$y(i) = \alpha\gamma \left(\frac{a + \rho n}{a + \rho n + \lambda}\right) i^{\beta+\delta}. \tag{10}$$

In order to obtain the cumulative distribution function, write (10) as:

$$i = \left[\frac{(a + \rho n + \lambda)y}{\alpha\gamma(a + \rho n)}\right]^{\frac{1}{\beta+\delta}} \tag{11}$$

It is easy to see that the anticipated income distribution is the correct one if and only if parameters m and n are given by:

$$m = \left[\frac{a + \rho n + \lambda}{\alpha\gamma(a + \rho n)}\right]^{\frac{1}{\beta+\delta}} \tag{12}$$

$$n = \frac{1}{\beta + \delta} \tag{13}$$

Inserting (13) into (9) establishes the Proposition 1. Q.E.D.

Proposition 1 shows that tax progressivity reduces the level of economic activity. Decreasing the residual progression of the tax schedule lowers the fraction K of time that people devote to work and consequently the aggregate income level. Of course, this does not say anything about the efficiency cost, if any, of tax progressivity. In order to assess how allocative efficiency is affected, a status-quo situation is posited in which no income taxation occurs, i.e. $a = b = 1$. Starting from that situation, I examine how equilibrium utilities change if a small progressive income tax is introduced.

Proposition 2 .

(A) Suppose $\lambda > \rho > 0$. If the Gini coefficient of the pre-tax income distribution is smaller than a critical value $\widetilde{G} > 0$, then introducing a progressive income tax at the margin constitutes a Pareto improvement.

(B) Suppose either $\rho = 0$ or $\rho \geq \lambda$. Then, introducing a progressive income tax at the margin can never constitute a Pareto improvement.

Proof. From Proposition 1 it follows that the utility level enjoyed by individual $i \in I$ in equilibrium is given by:

$$U^*(i) = a \log(bKw(i)t(i)) + \lambda \log((1 - K)t(i)) + \rho \log(i), \tag{14}$$

where K is defined by (7). In order to express the equilibrium utility as a function of the tax parameter a alone, insert (10) into the definition of b as given by (3). Computing the integrals of that expression leads to:

$$b = (\alpha\gamma K)^{1-a}\left(\frac{1+a\beta+a\delta}{1+\beta+\delta}\right). \tag{15}$$

Inserting (15) and (7) into (14) gives $U^*(i)$ as a function of the residual progression and the other exogenous parameters. Take the first derivative of that $U^*(i)$ with respect to a and evaluate it at the point $a=1$. After some tedious but straightforward manipulations, one obtains:

$$\frac{\partial U^*(i)}{\partial a}|_{a=1} = (\beta+\delta)[2\rho+(1+\lambda)(\beta+\delta)+\log(i)] - \rho(\lambda-\rho). \tag{16}$$

Unsurprising, the term on the r.h.s. of the last equation is increasing in i, the individual's rank in the income distribution. Hence, if tax progressivity makes the richest individual ($i=1$) better off, then it will make everybody else better off as well. The necessary and sufficient condition for a Pareto improvement is therefore:

$$\frac{\partial U^*(1)}{\partial a}|_{a=1} < 0 \Longleftrightarrow (\beta+\delta)[2\rho+(1+\lambda)(\beta+\delta)] < \rho(\lambda-\rho). \tag{17}$$

If $\rho=0$ or $\rho\geq\lambda$, this condition is impossibly met, which proves part (B) of the Proposition.

In order to prove Part (A) and show the role played by inequality, recall that in equilibrium the cumulative distribution function of income reads:

$$F^*(y) = my^n,$$

where the parameters m and n are respectively defined by (12) and (13). The Gini coefficient of inequality for the income distribution is defined as:

$$G = \frac{2}{\mu}\int_0^1 xF^{*-1}(x)dx - 1 \tag{18}$$

where μ is average income. It is a standard exercise to show that the Gini coefficient of $F^*(y)$ is given by:

$$G = \frac{1}{1+2n}. \tag{19}$$

By (19) and (13), it follows that:

$$\beta + \delta = \frac{2G}{1-G}. \tag{20}$$

Inserting (20) into (17), the condition for a Pareto improvement can be rewritten as:

$$\frac{4G[2\rho + G(1+\lambda-\rho)]}{(1-G)^2} < \rho(\lambda - \rho). \tag{21}$$

The expression on the l.h.s. of (21) is a strictly increasing function of the Gini coefficient, which takes the value 0 in the case of perfect equality ($G = 0$) and tends to $+\infty$ when the Gini coefficient tends to 1. As the r.h.s. of (21) is a strictly positive constant, there exists a unique value $\widetilde{G}$ for the Gini coefficient such that the term on the l.h.s. equals the term on the r.h.s.. Hence, the condition for a Pareto improvement is met if and only if $G < \widetilde{G}$. Q.E.D.

The possibility of a Pareto improvement due to a progressive income tax is exclusively generated by the status-seeking behaviour of individuals. If $\rho = 0$, condition (17) for a Pareto improvement cannot be met. The reason is simple. The quest for status distorts individual working hours upwards, since everybody is seeking to improve his rank at the cost of others' social status. Since progressive income taxation tends to lower individual hours through the traditional incentive channel, tax progressivity makes the rat race of income generation less severe for everybody. While also the rich benefit from that effect of progressive income taxation, they are those who carry the burden of financing redistribution to the poor. In order for the rich to be better off under tax progressivity, the burden of financing redistribution has to be sufficiently small, which is the case if the distribution of pre-tax income is fairly even.

Interestingly, the possibility of a Pareto improvement vanishes if the status-seeking motive behind individual work decisions is too strong. If individuals care a lot about their income rank and little about leisure, a great deal of their time will be devoted to working. Progressive income taxation benefits all individuals by raising their inefficiently low amount of leisure, without altering anyone's status. However, if λ is small relative to ρ, individuals accord little value to their incremental leisure. With respect to the well-being of the rich, that additional leisure does not offset the consumption loss inflicted upon them by transferring some of their income to the poor. Hence, tax progressivity turns out to harm the rich and no Pareto improvement can occur.

I now turn to the selection of a tax schedule by a social planner that must not confine himself to Pareto improvements. By appropriate choice of the residual progression of the tax schedule, a social planner can try to implement the labor allocation that would arise if individual choices of working time were undistorted. Formally, the undistorted labor allocation $h^+(i)$, $i \in I$ is the one which results from maximization of the utility function (1) by each individual under the budget constraint $c(i) = w(i)h(i)$ and taking his rank $r(i) = i$ as exogenously given.

Proposition 3 . *Suppose $\rho \in (0, \beta + \delta)$. The tax schedule that implements the undistorted labor allocation $h^+(i)$ is progressive. Its degree of progressivity decreases with the Gini coefficient of the pre-tax income distribution.*

Proof. By its definition, the undistorted labor allocation is equal to $h^*(i)$, $i \in I$, in the special case in which the latter is determined under both $a = b = 1$ and $\rho = 0$. From (7) it follows that

$$h^+(i) = \left(\frac{1}{1+\lambda}\right) t(i), \qquad i \in I. \tag{22}$$

Comparing equilibrium behavior given by (6) with the undistorted behavior given by (22), it is easy to see that the latter can be implemented if and only if the residual progression of the tax schedule equals a value a^+ such that:

$$\frac{\frac{\rho}{\beta+\delta}+a^+}{\frac{\rho}{\beta+\delta}+\lambda+a^+}=\frac{1}{1+\lambda}. \tag{23}$$

It follows that the required coefficient of residual progression is:

$$a^+=1-\frac{\rho}{\beta+\delta}. \tag{24}$$

By use of (20), the last expression can be rewritten as:

$$a^+=1-\frac{\rho}{2}\left(\frac{1-G}{G}\right), \tag{25}$$

which immediately proves the statements in Proposition 3. Q.E.D.

In the current framework, introducing a progressive income tax amounts to neutralize an existing distorsion by adding a new one, which explains why progressivity is required to implement the undistorted labor allocation. The effect of inequality on the selected tax schedule has a natural interpretation. If individuals are far apart from each other in terms of their earning potentials (and therefore also in terms of their equilibrium pre-tax incomes), the rank improvement that can be achieved by expending additional work effort is small. Hence, the marginal status utility provided by income generation decreases when income becomes more unequally distributed. As a consequence, individuals work less for status reasons under large income inequality and tax progressivity is needed to a smaller extent in order to implement the undistorted work choices.

It is worthwhile noticing that the degree of progressivity selected by the social planner may become extremely large if the distribution of earning potential is very egalitarian. By use of (25), when the Gini coefficient approaches the value $\frac{\rho}{\rho+2}$ from above, the coefficient of residual progression a^+ approaches 0, which means that income is entirely redistributed and individual consumption levels are equalized.[3]

4 Concluding remarks

The current paper argues that if people care about their relative income, tax progressivity plays an efficiency role and that role is the more important the more egalitarian the economy is. A small progressive income tax has been shown to generate a Pareto improvement whenever the Gini coefficient of the distribution of pre-tax income is lower than a critical level. Furthermore, it has been shown that implementing undistorted choices of working hours requires a progressive tax schedule, and the optimal degree of progressivity decreases with the Gini coefficient of the distribution of pre-tax income.

The above clear-cut results have been derived in the context of a model that makes use of special functional forms. Such a modeling option is useful as it allows one to obtain closed-form solutions for the equilibrium allocation. Although assessing the analytical generalizability of those results is beyond the scope of this paper, it is worthwhile stressing that the results are backed by a sound economic rationale and can thus be expected to hold similarly in more general settings.

[3]For levels of the Gini coefficient below $\rho/(\rho+2)$ the tax schedule should exhibit a negative a, in which case consumption decreases with pre-tax income. Under negative a one must thus specify whether individuals care about relative income or relative consumption. If it is income, and the status motive is sufficiently strong, a negative a may implement the undistorted labor allocation.

REFERENCES

Atkinson, A., 1995, *Public Economics in Action*, Clarendon Press, Oxford.

Boskin, M. and E. Sheshinski, 1978, Optimal Redistributive Taxation When Individual Welfare Depends Upon Relative Income, *Quarterly Journal of Economics* 92, 589-601.

Clark, A. and A. Oswald, 1996, Satisfaction and Comparison Income, *Journal of Public Economics* 61, 359-381.

Cole, H.L., Mailath, G.J. and A. Postlewaite, 1992, Social Norms, Savings Behavior, and Growth, *Journal of Political Economy* 100, 1092-1125.

Duesenberry, J., 1949, *Income, Saving and the Theory of Consumer Behaviour*, Harvard University Press, Cambridge.

Frank, R., 1999, *Luxury Fever*, Free Press, New York.

Jakobsson, U., 1976, On the Measurement of the Degree of Progression, *Journal of Public Economics* 5, 161-168.

Ireland, N., 1998, Status-Seeking, Income Taxation and Efficiency, *Journal of Public Economics* 70, 99-113.

Lindert, P., 1996, What Limits Social Spending?, *Explorations in Economic History* 33, 1-34.

Neumark, D. and A. Postlewaite, 1998, Relative Income Concerns and the Rise in Married Women's Employment, *Journal of Public Economics* 70, 157-183.

Oswald, A., 1983, Altruism, Jealousy, and the Theory of Optimal Non-Linear Taxation, *Journal of Public Economics* 20, 77-88.

Perotti, R., 1996, Growth, Income Distribution, and Democracy: What the Data Say, *Journal of Economic Growth* 1, 149-187.

Persson, M., 1995, Why Are Taxes So High in Egalitarian Societies?, *Scandinavian Journal of Economics* 84, 569-580.

Schor, J., 1991, *The Overworked American*, Basic Books, New York.

Veblen, T., 1922, *The Theory of the Leisure Class; An Economic Study of Institutions*, George Allen Unwin, London (first published 1899).

Woittiez, I. and A. Kapteyn, 1998, Social Interactions and Habit Formation in a Model of Female Labour Supply, *Journal of Public Economics* 70, 185-205.