Federal Reserve Bank of Minneapolis
Research Department Staff Report 185

December 1994

On the Political Economy of Education Subsidies*

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ABSTRACT

Standard models of public education provision predict an implicit transfer of resources from higher income individuals toward lower income individuals. Many studies have documented that public higher education involves a transfer in the reverse direction. We show that this pattern of redistribution is an equilibrium outcome in a model in which education is only partially publicly provided and individuals vote over the extent to which it is subsidized. We show that increased inequality in the income distribution makes this outcome more likely and that the efficiency implications of this exclusion depend on the wealth of the economy.

*We gratefully acknowledge support from NSF grant SES-9122625 and from the Hoover Institution. We thank seminar participants at Brown, Harvard, and the NBER Summer Institute; Mathias Dewatripont; and two anonymous referees for comments. The views expressed in this paper are those of the authors and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

I. Introduction

Societies intervene in the area of education in a variety of ways. That they should choose to do so is perhaps not surprising: plausible economic justifications for intervention are plentiful and range from the existence of market imperfections of various sorts (especially imperfect capital markets) to externalities from education both static and dynamic to public goods arguments.[1] The factors that determine the extent and the forms that these interventions take seem far less obvious, however. Heterogeneity among individuals, whether in terms of income, ability, or locality, tends to generate conflicting preferences as to the kind of policies that are most desirable. There may be widespread disagreement in the choice of, for example, the optimal degree of subsidization of education, the quality of education, the rules that should determine an individual's eligibility for particular subsidies (e.g., guaranteed student loans, scholarships, or financial aid), or the desirability of barriers to entry such as entrance examinations or enrollment restrictions. In the absence of a social planner who chooses policies to maximize a well-defined welfare function, an analysis is required to understand how heterogeneity and the political system interact to generate different features of the educational system.[2]

A standard textbook treatment (see, e.g., Atkinson and Stiglitz (1980)) of public education provision considers the case of a publicly provided private good, financed by a proportional income tax. Such a model has implications both for the resources devoted to education and for the redistribution of income implicit in the financing scheme. In this setting, if collective choices are determined by majority vote, then the outcome involves a net transfer of resources from higher income individuals to lower income individuals.[3] This prediction of the standard model appears to be at odds with a well-documented fact concerning public higher education: Children from higher income families are more likely to attend college than are those from lower income families: hence, the net effect of public support for higher education is a transfer of resources from lower income individuals to higher income individuals.[4]

One explanation for this apparent discrepancy is that those individuals who do not attend college may nevertheless benefit from the fact that others do because of complementarities in production, spillovers, or effects on growth. Johnson (1984) and Creedy and Francois (1990) formally show that this possibility can resolve the apparent discrepancy. A second explanation is that majority voting is not an appropriate mechanism to capture how policies are decided upon and that in reality political power is concentrated among wealthier individuals.

In this paper we put forward a third possibility. We argue that there is a connection between the fact that subsidies to public education redistribute income toward higher income individuals and the fact that education is only *partially* publicly provided. An outline of our argument follows. If credit constraints affect education decisions, then a vote on the extent to subsidize education is also implicitly a vote over who receives the subsidy. By choosing to subsidize only partially the cost of an education, higher income individuals can effectively exclude poorer individuals from receiving this education and simultaneously extract resources from them. This endogenously determined exclusion is the novel feature of our analysis of redistributive schemes.

We develop this argument formally in a model which is deliberately simplified in order to highlight the fundamental forces at work. At the economic level, individuals are assumed to be ex ante identical in every respect except for their initial income. Education is a discrete investment good, and capital markets are imperfect. An individual's cost of acquiring an education can be uniformly subsidized through a proportional income tax levied on the general public. The subsidy, however, is available only to those individuals who choose to acquire an education. Since we assume that all individuals would benefit from obtaining an education, an individual's income and the subsidized cost of education are the sole determinants of whether that person will do so. The tax rate, and hence the extent to which education is subsidized, is determined by majority vote.

Several results emerge from our analysis. First, we show that under certain conditions the majority voting equilibrium consists of a positive subsidy to education but with only the rich and middle class obtaining an education: i.e., the poor subsidize the education of higher income individuals. Second, in a sense which is made precise in the paper, we find that the efficiency consequences of subsidization with excludability (relative to an equal subsidy system) may be positive for a poor economy, but never for a wealthy economy. Third, we argue that economies with more unequal income distributions are more likely to perpetuate this inequality over time. Lastly, we point out that there are instances in which wealthier individuals would profit from making education more costly since this affects their ability to exclude others and extract resources from them.

The paper is organized as follows. Section II lays out the structure of the model, and Section III examines preferred tax rates. Section IV defines equilibrium outcomes, and Section V discusses some of the more interesting implications. Section VI concludes.

II. The Model

In order to study in as stark and simple a framework as possible some of the interactions among income distribution, the political system, and education, we choose to abstract away from considerations that may be generated by other factors, such as income-smoothing concerns, intergenerational bequest motivations, and heterogeneity both in preferences and in abilities among individuals. We emphasize instead the affordability of education in an economy in which each individual would benefit by acquiring an education, but may be prevented from doing so by imperfect capital markets. In the context of the U.S. this model is perhaps best thought of as representing higher education, since affordability of primary and secondary education is not an issue. For less-developed countries, noting that the cost of education includes forgone income, it may be natural to think in terms of primary or secondary education.

The economy consists of a continuum of two-period lived agents with total mass equal to one. There is a single consumption good, and individuals have a linear utility function defined over first- and second-period consumption. There is no discounting.[5] The agents belong to one of three groups, differentiated by their initial income (equivalently, endowment of the consumption good) which is assumed to take on the values y_1, y_2, or y_3.[6] We assume that $y_1 > y_2 > y_3$ and will often refer to the three groups of agents as rich, middle class, and poor respectively. The fraction of agents in group i is written as λ_i.[7]

In the first period of life, each agent decides whether to obtain an education. The choice is zero-one and the unsubsidized cost of obtaining an education is E.[8] The benefit from education for an individual from group i is that second-period income equals $f(y_i)$. By contrast, an individual who does not obtain an education in the first period receives a second-period income equal to y_i.[9] We assume that

$$f(y_i) - E > y_i \text{ for all } i. \tag{1}$$

This ensures that, in the absence of government intervention, all individuals desire an education.[10]

The market structure does not necessarily permit all individuals to obtain an education. Individuals are assumed not to have access to credit markets and hence cannot borrow against future earnings to finance expenditures on education when young. It follows that first-period income is a determinant of whether an individual obtains an education.[11] Hence, in the absence of government intervention, an individual's utility given initial income y_i is[12]

$$u_i = y_i + \gamma_i \tag{2}$$

where

$$\gamma_i = \begin{cases} f(y_i) - E & \text{if } y_i \geq E \\ y_i & \text{if } y_i < E. \end{cases} \tag{3}$$

A second factor that determines whether a given individual receives an education is the extent to which education is subsidized. In our model education is (endogenously) a partially publicly provided private good that is subsidized solely via a proportional tax θ on period-one income.[13] The proceeds from taxation are distributed equally among all individuals who receive an education. Note, therefore, that it is possible that although all individuals are taxed, not all receive a subsidy. It is this feature of excludability that distinguishes our analysis from the rest of the literature and, in particular, from Perotti (1993), the model closest to ours.[14]

Before we proceed to the equilibrium analysis, it is useful to analyze the relationships among the tax rate, individual actions and utilities. Consider first the relationship between the tax rate, the government subsidy to education, and the fraction of the population that receives an education. With a tax rate equal to θ, tax revenues $T(\theta)$ are given by

$$T(\theta) = \theta \sum \lambda_i y_i = \theta\mu \tag{4}$$

where μ is total or (since the mass of agents is one) average income. If $N(\theta)$ represents the mass of agents who receive an education, then the per person subsidy $s(\theta)$ is given by

$$s(\theta) = \theta\mu/N(\theta). \tag{5}$$

Since N and s are jointly determined by θ, to determine the values of those that are mutually consistent we solve

$$\text{Max } j \text{ s.t. } (1-\theta)y_j - E + \theta\mu/(\sum_{i<j}\lambda_i) > 0 \tag{6}$$

where $\sum_{i<j} \lambda_i = 0$ for j=1. Given this j we find the greatest value of $\rho_j \in (0,1]$ such that

$$(1-\theta)y_j - E + \theta\mu/[\sum_{i<j}(\lambda_i)+\rho_j\lambda_j] \geq 0 \tag{7}$$

where $\rho_j(\theta)$ is the fraction of individuals of type j who receive an education given θ.

Note that for a given value of $s(\theta)$, an individual from group i can obtain an education if and only if $(1-\theta)y_i - E + s(\theta) \geq 0$. Clearly, if an individual from group j can afford to be educated, then so can all individuals from group i for all i < j: i.e., if $\rho_j \in (0,1]$, then $\rho_i=1$ for all i<j. Thus, (6) and (7) allow us to determine $N(\theta) = (\sum_{i<j}(\lambda_i)+\rho_j\lambda_j)$, which in turn determines $s(\theta)$. Whenever $0<\rho_j(\theta)<1$, we assume that the fraction $\rho_j(\theta)$ of agents from group j who obtain an education is randomly selected.

The value of the tax rate is chosen by majority vote. To determine an individual's preferences over any two tax rates, it is essential to understand how utility is affected by different values of θ. Having determined the values of the ρ_i's, we can express the expected utilities of each of the three groups as a function of the tax rate θ:

$$EU_i(\theta)= (1-\theta)y_i + \rho_i(\theta)[s(\theta) - E + f(y_i)] + [1-\rho_i(\theta)]y_i. \tag{8}$$

A few preliminary results are helpful. First note that each of the functions $\rho_i(\theta)$ is nondecreasing in θ. Second, and following directly from the assumption that all individuals would wish to obtain an education if they could afford to, if $0<\rho_i(\theta)<1$, then an individual from group i must just be able to afford an education: i.e., $E - s(\theta) = (1-\theta)y_i$. Furthermore, in that case, the tax revenue must be insufficient to subsidize any more members of that group: i.e., $[\sum_{i<j} \lambda_i+\rho_j\lambda_j]s(\theta) = \theta\mu$.

Some additional notation facilitates the characterization of the EU_i's. Let $\hat{\theta}_i$ be the maximum value of $\theta\in[0,1]$ for which $\rho_i(\theta)$ is equal to zero. If $y_i \geq E$, let $\hat{\theta}_i$ equal zero. Thus, $\hat{\theta}_2$ is, therefore, the value of θ at which for any strictly positive increase in the tax rate it becomes possible for some y_2 individuals to obtain an education. Lastly, define $\bar{\theta}_i$ to be the smallest value of $\theta\in[0,1]$ for which $\rho_i(\theta)=1$. Note that such a number may not exist in the unit interval, whereupon $\bar{\theta}_i$ is undefined. So $\bar{\theta}_i$ is the smallest value of θ at which all individuals in group i can afford an education.

III. Preferred Tax Rates

In this section we examine the preferred tax rates of individuals. We also contrast the effects of the combination of redistributive taxation and excludability on preferred tax rates with those of a purely redistributive scheme. By a "purely redistributive scheme" we refer to the case in which a proportional tax is used to finance equal per capita lump-sum transfers to *all* individuals. As is well known, in this case, y_1 individuals always prefer a tax rate of zero, y_3 individuals always prefer a tax rate of one, and y_2 individuals prefer a tax rate of zero or one depending upon whether y_2 is greater or less than mean income, μ. This outcome illustrates the simple fact that individuals whose income is below the mean favor redistribution whereas those whose income is above the mean oppose it.

The added feature of our model is that, depending upon the tax rate, transfers are not made to all individuals. Before we address the implications of this for preferred tax rates, it is instructive to consider the case in which the groups who receive transfers are exogenously determined and independent of the tax rate chosen.

To begin with, consider the case where only y_1 individuals receive the subsidy. It is trivial to show that y_1 individuals would prefer a tax rate of one whereas the other two groups each prefer a tax rate of zero. Next, suppose that both y_1 and y_2 individuals receive the subsidy, and consider the impact of a marginal increase in the tax rate on the lifetime income of a y_1 individual. On the margin, that person's tax payments increase by y_1 and her or his subsidy increases by $\mu/(\lambda_1+\lambda_2)$. Since these effects are independent of the initial level of the tax rate, it follows that y_1 individuals prefer either a tax rate of zero or a tax rate of one, depending upon whether y_1 is greater than $\mu/(\lambda_1+\lambda_2)$ or, equivalently whether $[(y_1-y_2)/y_3](\lambda_2/\lambda_3)$ is greater than one.

Note that three factors favor a preferred tax rate of one: (i) small middle class relative to the poor, (ii) middle class similar to rich, and (iii) high income for the poor. These factors capture a key tension: On the one hand, positive taxation hurts y_1 individuals by forcing them to distribute toward the (relatively) poorer y_2 individuals. On the other hand, positive taxation allows them to extract resources from the poor. Thus, the closer y_2 is to y_1, the smaller the y_2 group, and the more that y_3 individuals can contribute to tax proceeds (i.e., the larger is y_3), the better the case for positive taxation from the viewpoint of a y_1 individual. It is also easy to see that y_2 individuals always prefer a tax rate of one. In particular, it is now irrelevant whether y_2 is greater or smaller than μ. Lastly, the case in which all three groups receive the subsidy is the pure redistributive scheme already discussed.

The simplified case of exogenously specified transfer recipients is informative because it indicates how restricted redistribution has very different implications for the preferred tax rate of a particular group. In our model, the determination of preferred tax rates is more complicated; the tax rate determines both the amount of income being redistributed and the identity of those individuals who receive transfers. Nonetheless, it is possible to provide a complete characterization of the $EU_i(\theta)$ (and, hence, preferred tax rates) as a function of the model's parameters. This is done in Proposition 1.

Proposition 1: (i) $EU_i(\theta)$ is continuous, and $EU_i(0) < EU_i(\bar{\theta}_i)$ for $\bar{\theta}_i \varepsilon (0,1]$ and for all i.

(ii) $EU_1(\theta)$ is increasing and concave on $[0,\bar{\theta}_1]$, linearly increasing on $[\bar{\theta}_1,\hat{\theta}_2]$ with marginal utility of $(\mu/\lambda_1)-y_1$, linearly decreasing on $[\hat{\theta}_2,\bar{\theta}_2]$ with marginal utility y_2-y_1, linear on $[\bar{\theta}_2,\hat{\theta}_3]$ with marginal utility $[\mu/(\lambda_1+\lambda_2)]-y_1$, linearly decreasing on $[\hat{\theta}_3,\bar{\theta}_3]$ with marginal utility y_3-y_1, and linearly decreasing on $[\bar{\theta}_3,1]$ with marginal utility $\mu-y_1$.

(iii) $EU_2(\theta)$ is linearly decreasing on $[0,\hat{\theta}_2]$ with marginal utility $-y_2$, increasing and concave on $[\hat{\theta}_2,\bar{\theta}_2]$, linearly increasing on $[\bar{\theta}_2,\hat{\theta}_3]$ with marginal utility $[\mu/(\lambda_1+\lambda_2)]-y_2$, linearly decreasing on $[\hat{\theta}_3,\bar{\theta}_3]$ with marginal utility y_3-y_2, and linear on $[\bar{\theta}_3,1]$ with a marginal utility $\mu-y_2$.

(iv) $EU_3(\theta)$ is decreasing on $[0,\hat{\theta}_3]$ with marginal utility of $-y_3$, increasing and concave on $[\hat{\theta}_3,\bar{\theta}_3]$, and linearly increasing on $[\bar{\theta}_3,1]$ with marginal utility $\mu-y_3$.

Proof: See the appendix.

To illustrate some key results of Proposition 1, consider the shape of EU_2 assuming that $y_2<E$. If θ is less than $\hat{\theta}_2$, then the sole effect of a marginal tax increase is to decrease a y_2 individual's lifetime income by y_2 since in this interval no individual from this group can afford to obtain an education and hence the subsidy received is zero. For θ between $\hat{\theta}_2$ and $\bar{\theta}_2$,

marginal increases in θ allow more y_2 individuals to obtain an education. Although y_2 individuals who do not obtain an education are made worse off by the marginal increase, the overall effect on the expected utility of a y_2 individual is positive. A marginal increase in θ in the interval between $\bar{\theta}_2$ and $\hat{\theta}_3$ always increases the lifetime income of a y_2 individual. At the margin, tax payments increase by y_2, but the subsidy increases by $\mu/(\lambda_1+\lambda_2)$, which necessarily exceeds y_2. Note that over this interval marginal increases in θ serve only to redistribute income. Hence, y_2 individuals, who are the poorest individuals receiving the subsidy, prefer more redistribution to less. Next consider a marginal tax increase for θ in the interval $[\hat{\theta}_3,\bar{\theta}_3]$. Throughout this interval, since y_3 individuals can just afford an education, it follows that the marginal increase in the subsidy must exactly offset the marginal increase in tax payments for a y_3 individual. Hence, the marginal increase in the subsidy must be y_3. Since the marginal increase in tax payments for a y_2 individual is y_2, EU_2 is strictly decreasing over this interval. Lastly, for θ greater than $\hat{\theta}_3$, there are opposing effects. On the one hand, tax payments increase at the margin by y_2, but on the other hand the subsidy increases by μ. Either effect may dominate, and Proposition 1 lays out the exact conditions which determines the net effect. Figure 1 indicates one possible configuration of the EU_i's.

We next examine some of the interesting implications of Proposition 1 for preferred tax rates. In contrast to the case of purely redistributive taxation, it is now the case that the total wealth of the economy matters (in particular, the relationship between mean income and E): hence, we consider two separate cases. The first we refer to as a "poor" economy and corresponds to the case where $\mu \le E < \mu/(\lambda_1+\lambda_2)$. The second we refer to as a "wealthy" economy, and it corresponds to $\mu > E$.[15] The important distinction is that in a wealthy economy there is more than sufficient wealth to allow all individuals to obtain an education, whereas in a poor economy there is sufficient wealth to send the rich and middle class to school, but not necessarily anyone else. In the wealthiest extreme of a poor economy ($\bar{\mu}$=E), allowing everyone to obtain an education would exhaust all of the economy's resources.

Proposition 1 has implications for the possible preferred tax rates for each individual in each of these two cases. Table 1 shows the possible configurations.

Table 1 Preferred Tax Rates

Income Group	Wealthy Economy	Poor Economy
y_1	$\hat{\theta}_2$, $\hat{\theta}_3$	$\hat{\theta}_2$, $\hat{\theta}_3$
y_2	$\hat{\theta}_3$, 1	$\hat{\theta}_3$
y_3	1	0, 1

Note that in contrast with either the pure redistributive case or the case of redistribution with exogenously determined subsidy recipients, interior preferred tax rates now emerge. This is a consequence of income groups wishing to restrain the tax rate in order not to allow some other group to obtain an education and thus share the subsidy.

In a wealthy economy, y_1 and y_2 individuals each face a similar situation; they face the trade-off between sharing the proceeds of a lower tax rate among fewer individuals (i.e., precluding the groups below them from obtaining an education) versus sharing the proceeds from a higher tax rate with more individuals. In a poor economy, y_1 individuals again face this trade-off, but there is no longer any incentive for y_2 individuals to choose a tax rate that allows any y_3 individuals to obtain an education. (Recall the above discussion about the shape of EU_2 over the interval $[\hat{\theta}_3,\bar{\theta}_3]$.) Observe that in both a wealthy and poor economy it is possible for all y_1 and y_2

individuals to prefer $\hat{\theta}_3$, i.e., a tax such that the poor do not obtain an education but still help cover the costs of education for the rich and the middle class.

A final implication of Proposition 1 that we note is that individual preferences over tax rates in many cases are not single peaked.[16] This is illustrated in Figure 1. This feature is intimately related to the excludability: as long as an individual is not receiving a transfer, higher tax rates decrease utility, but when this individual's group first begins to receive the transfer, higher tax rates increase utility. As our discussion following Proposition 1 indicated, utility thereafter can alternate between decreasing and increasing as a function of θ.

IV. Majority Voting Equilibrium

In this section, we examine the equilibrium outcomes. Recall that the tax rate is chosen by majority vote.

<u>Definition</u>: An equilibrium is a tax rate θ^*, $0 \le \theta^* \le 1$, such that for all $\theta' \varepsilon [0,1]$, the fraction of agents with $EU_i(\theta^*) \ge EU_i(\theta')$ is strictly greater than .5.

There is one case for which the equilibrium is immediate. If any λ_i is at least as great as .5, then this group's preferred tax rate is clearly the majority voting equilibrium. The following analysis, therefore, focuses only on the case where $\lambda_i < .5$ for all i. Thus the sum of any two of the λ_i's exceeds .5. Hereafter, therefore,

<u>Assumption</u>: $\lambda_i < .5$ for all i.

For a tax rate θ^* to be a majority voting equilibrium it must win against all alternatives and, in particular, against all local alternatives. This gives the following result:

<u>Theorem 1</u>: If θ^* is a majority voting equilibrium, then at least one of

the EU_i's has a local maximum at θ^*.

<u>Proof</u>: Assume that no group has a local maximum at θ^*. This implies that if θ^* equals zero, then $EU_i(\theta)$ must be upward-sloping at zero for all i. But then there exists some $\theta > 0$ which all three groups prefer to zero. This rules out zero as a candidate. If θ^* equals one, then $EU_i(\theta)$ must be decreasing for all i as θ approaches one from below. Again, this implies that there must be some $\theta < 1$ which is preferred by all three groups, ruling out one as a candidate. Now assume that $0 < \theta^* < 1$. Since θ^* is not a local maximum for any of the i's, either a small decrease or increase in θ must increase utility for at least two of the groups, which is sufficient to rule out θ^* as a majority voting equilibrium.||

This theorem establishes that the potential majority voting equilibria must lie in the set $\{0,\hat{\theta}_2,\hat{\theta}_3,1\}$. This set can be further reduced, however, by noting that an implication of Proposition 1 is that both groups two and three strictly prefer a tax rate of zero to a tax rate of $\hat{\theta}_2$ (for $\hat{\theta}_2$ not equal to zero). This follows directly from the fact that at $\hat{\theta}_2$ both groups two and three pay taxes but do not receive an education. This leaves $\{0,\hat{\theta}_3,1\}$ as the only equilibrium candidates. In particular, there is only one possible interior equilibrium.[17]

Table 2 gives the equilibrium outcomes for each and every possible configuration of the parameters describing the economy. (The appendix contains some details relevant for the construction of this table.) Table 2 is divided into four panels, each one corresponding to economies in which the ratio of total income to the cost of education is progressively greater. Panels 3 and 4 correspond to what we have referred to as poor and wealthy economies respectively. Our subsequent discussion focuses on these cases since, as alluded to in note 15, majority voting is a less plausible decision mechanism for the very poor economies of Panels 1 and 2. As mentioned previously, there are some cases where a majority voting equilibrium does not exist (labelled NE).[18] Whenever an equilibrium exists, however, it is unique. Non-single-peaked preferences also give rise to the possibility of outcomes other than that preferred by the median voter (indicated by NMV in Table 2).[19]

V. Discussion

Here we focus on what we believe to be the more interesting implications of Table 2. This model nests the case of pure redistribution (when $y_3 \geq E$) and for some other parameter configurations produces the same results. Our discussion focuses on those instances where different outcomes arise.

As documented in the introduction, a situation that characterizes the provision of (higher) education in many countries is that costs are subsidized using general tax revenues although the rich and middle classes benefit disproportionately since their children are more likely to obtain this education. We find that in both wealthy and poor economies this outcome may emerge as a result of majority voting: i.e., the equilibrium tax rate is positive, yet only the rich and middle class individuals obtain an education.

The fact that "exploitation" of the poor emerges as a majority voting equilibrium in this model is significant for two reasons. First, it indicates that this outcome need not be due to poorer individuals being attributed less weight in the political process. Second, it shows that this result need not be a consequence of positive spillovers from educated to noneducated individuals and may be detrimental to the poor rather than beneficial.

The key to obtaining the above outcome is a situation in which y_1 individuals profit more by not excluding y_2 individuals and simultaneously y_2 individuals prefer to exclude y_3 individuals. It is easy to derive explicit expressions providing conditions under which this occurs. Consider for example, a wealthy economy in which $y_3 < E$. It is straightforward to show that

y_2 individuals prefer $\hat{\theta}_3$ to one if and only if:

$$E-\mu + (1-\hat{\theta}_3)(y_2-y_3) > 0, \tag{9}$$

and y_1 individuals prefer $\hat{\theta}_3$ to $\hat{\theta}_2$ if and only if

$$y_2-y_3 + \hat{\theta}_3(y_3-y_1) - \hat{\theta}_2(y_2-y_1) > 0, \tag{10}$$

where simple manipulation of the equation in (7) yields

$$\hat{\theta}_2 = (E-y_2)/(\frac{\mu}{\lambda_1} - y_2), \tag{11}$$

and

$$\hat{\theta}_3 = (E-y_3)/(\frac{\mu}{\lambda_1+\lambda_2} - y_3). \tag{12}$$

Note that for y_2 close to y_1 the above inequalities are both necessarily satisfied.

The above configuration has interesting implications concerning economies that have similar per capita incomes but different income distributions. Increasing λ_1 and λ_3 but holding mean income constant (i.e. a mean-preserving increase in spread), the left hand sides of (9) and (10) both increase, so an equilibrium tax rate of $\hat{\theta}_3$ becomes more likely. In this sense, increased inequality makes it more likely that the poor are excluded in equilibrium.[20] Although our model is effectively static, this result has some potentially interesting dynamic implications.[21] Since exclusion of the poor from higher education may be expected to increase future income inequality, exclusion at one date enhances the possibility of future exclusion. Thus, inequality may beget further inequality. Alternatively, economies with a large middle class relative to the poor and rich may be expected to produce more educated individuals.

Next we address the efficiency implications of excludability. The simple structure of the model implies that total income is increasing in the number of individuals who obtain an education. In particular, total income is maximized when the number of people obtaining an education is maximized. This particular result is due to the linear structure of the model and is not to be taken as a literal prescription for optimal human capital accumulation in reality. The aspect of the model which we stress for this analysis is that autarky results in too few people obtaining an education from the perspective of efficiency. We take a pure redistributive scheme as our benchmark and ask how introducing excludability affects the results. It should be clear that a pure redistributive scheme need not maximize output--nonetheless, it is a useful benchmark since it allows us to focus on the effect of excludability.

The efficiency effects of introducing excludability depend very strikingly on the wealth of the economy. In a poor economy, excludability never decreases efficiency and in some cases will enhance it, whereas in a wealthy economy, introducing excludability never enhances efficiency and in some cases will decrease it. The intuition behind this result is straightforward; in a poor economy, spreading resources evenly can preclude everyone from obtaining an education, whereas consolidating resources can allow more individuals to obtain an education. In a wealthy economy, the reverse is true.[22]

The degree of inequality, discussed previously, therefore, also has important efficiency implications. A more unequal economy is more likely to generate an equilibrium tax rate of $\hat{\theta}_3$ (relative to a tax rate of one) with the attendant negative efficiency consequences.

The asymmetry between the effects of excludability in wealthy and poor economies provides an interesting perspective on their adoption and continued presence. The prior results suggest that at an early stage of development a scheme with excludability may have some desirable consequences for society as a whole. Once an economy becomes wealthier, there may no longer be a positive role for this feature, but because it allows the rich and the middle class to extract resources from the poor altering the system may be difficult. Note that there are several instances where the only effect of the system with excludability relative to autarky is to transfer resources from the poor to the rich and middle class without any effect on the number of individuals who obtain an education (see, e.g., the seventh entry in Panel 4 of Table 2).

Finally, this model has implications for individual incentives to change the "height" of the barrier to education, i.e., E. In a pure redistributive system, reductions in E holding individual incomes constant (or equivalently, proportional increases in income holding E constant) make all individuals better off. This is not true in the presence of excludability. For example, as an economy switches from being "poor" to being "wealthy", the majority voting equilibrium can switch from $\hat{\theta}_3$ to one (see 3A and 4A in Table 2) thus making y_1 individuals strictly worse off. Although it is beyond the scope of this paper to endogenize this possibility, it would be in the interest of y_1 individuals (and possibly y_2 individuals) in cases like the above to support actions which increase the size of this barrier. These actions could take several forms--imposing additional entrance requirements which are more difficult for poorer individuals to meet, locating colleges in places which increase living and transportation costs for potential students, or maintaining higher quality of education (e.g. higher teacher-to-student ratios and more highly paid teachers).[23]

VI. Conclusion

Many studies have found that public support for higher education involves a transfer of resources from lower income individuals to higher income individuals. Standard models of redistribution or public provision of goods and services under majority voting predict transfers of resources in the reverse direction and are thus unable to provide an explanation of the above. Within a simple setting, we have shown that transfers of resources from lower income groups to higher income groups are possible if individuals vote over the extent to which they subsidize education.[24] If education is only partially subsidized, poorer individuals who are credit-constrained cannot afford to obtain an education and are thereby excluded from benefiting from the subsidies.

We find that increased inequality in the income distribution increases the likelihood that, in net resources will be transferred away from the poor. Furthermore our model has interesting implications for the efficiency consequences of subsidies to higher education relative to a system of pure income redistribution. In a poor economy, subsidizing education may enhance efficiency by increasing educational attainment, whereas in a wealthy economy, efficiency never is enhanced and may be decreased by reducing educational attainment. We also show that there are instances in which wealthier individuals would profit from making education more costly since this affects their ability to exclude others and extract resources from them.

A basic message of our analysis is that when the degree of subsidization of publicly provided services is chosen endogenously, implications for redistribution of income, efficiency, and future income distribution may be very different from those implicit in a system of total public provision. Similar analysis may be relevant for other partially publicly provided goods and services, such as health care.

Figure 1

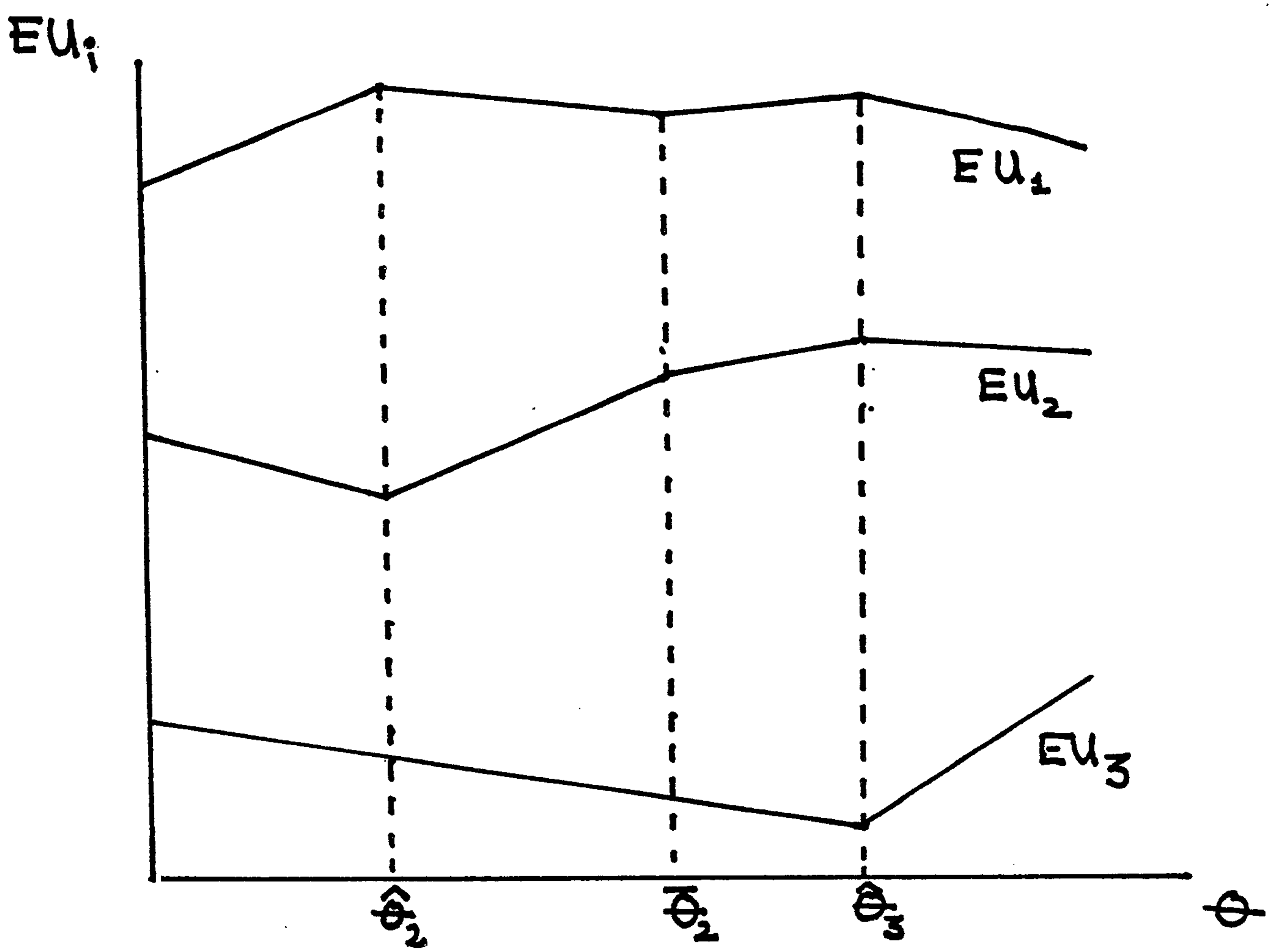

Table 2 Voting Equilibria

Parameter Restrictions		$\tilde{\theta}_1$	$\tilde{\theta}_2$	$\tilde{\theta}_3$	Equilibrium
1.	$\mu/\lambda_1 \le E$	1	0	0	0
2.	$\mu/\lambda_1 > E \ge \mu/(\lambda_1+\lambda_2)$	$\hat{\theta}_2$	0	0	0
		$\hat{\theta}_2$	1	0	0 or NE (NMV)
3.	$\mu/(\lambda_1+\lambda_2) > E \ge \mu$				
	A. $y_2<E$				
	a. $y_1<\mu/(\lambda_1+\lambda_2)$	$\hat{\theta}_2$	$\hat{\theta}_3$	0	NE
		$\hat{\theta}_3$	$\hat{\theta}_3$	0	$\hat{\theta}_3$
		$\hat{\theta}_2$	$\hat{\theta}_3$	1	NE
		$\hat{\theta}_3$	$\hat{\theta}_3$	1	$\hat{\theta}_3$
	b. $y_1>\mu/(\lambda_1+\lambda_2)$	$\hat{\theta}_2$	$\hat{\theta}_3$	0	0 or NE (NMV)
		$\hat{\theta}_2$	$\hat{\theta}_3$	1	NE
	B. $y_2 \ge E$				
	a. $y_1<\mu/(\lambda_1+\lambda_2)$	$\hat{\theta}_3$	$\hat{\theta}_3$	0	$\hat{\theta}_3$
		$\hat{\theta}_3$	$\hat{\theta}_3$	1	$\hat{\theta}_3$
	b. $y_1>\mu/(\lambda_1+\lambda_2)$	0	$\hat{\theta}_3$	0	0 (NMV)
		0	$\hat{\theta}_3$	1	0 or NE (NMV)

Table 2, continued

4. $\mu>E$				
A. $y_2<E$	$\hat{\theta}_2$	1	1	1
	$\hat{\theta}_3$	1	1	1
	$\hat{\theta}_2$	$\hat{\theta}_3$	1	NE
	$\hat{\theta}_3$	$\hat{\theta}_3$	1	$\hat{\theta}_3$
B. $y_2\geq E$ $y_3<E$				
a. $y_1<\mu/(\lambda_1+\lambda_2)$				
i. $y_2<\mu$	$\hat{\theta}_3$	$\hat{\theta}_3$	1	$\hat{\theta}_3$
	$\hat{\theta}_3$	1	1	1
ii. $y_2\geq\mu$	$\hat{\theta}_3$	$\hat{\theta}_3$	1	$\hat{\theta}_3$
b. $y_1>\mu/(\lambda_1+\lambda_2)$				
i. $y_2<\mu$	0	$\hat{\theta}_3$	1	NE
	0	1	1	1
ii. $y_2\geq\mu$	0	$\hat{\theta}_3$	1	0 or NE (NMV)
C. $y_3\geq E$				
a. $y_2 > \mu$	0	0	1	0
b. $y_2 < \mu$	0	1	1	1

Appendix

1. Proof of Proposition 1

Continuity of the EU_i's follows directly from the fact that the $\rho_i(\theta)$'s are continuous. At $\bar{\theta}_i$, $EU_i=f(y_i)$. At $\theta=0$, $EU_i=2y_i$. Given $f(y_i)-E > y_i$ and $y_i<E$ (i.e. $\bar{\theta}_i>0$) it follows that $f(y_i)>2y_i$ and hence that $EU_i(0)<EU_i(\bar{\theta}_i)$ for $\bar{\theta}_i\in(0,1]$.

We prove (ii); the other statements can be demonstrated similarly. On $[0,\bar{\theta}_1]$, $EU_1(\theta)$ is given by $EU_1(\theta) = \rho_1(\theta)[f(y_1)] + [1-\rho_1(\theta)][(1-\theta)y_1+y_1]$, where $\rho_1(\theta) = \theta\mu/[\lambda_1(E-(1-\theta)y_1)]$. Note that $EU_1(\bar{\theta}_1)>EU_1(\theta)$ for all $\theta\in[0,\bar{\theta}_1)$. Calculation yields $dEU_1/d\theta|_{\theta=0} = [\mu(f(y_1)-y_1-E)+(\mu-\lambda_1 y_1)(E-y_1)]/[(E-y_1)\lambda_1]$ which is positive since $f(y_1)>E+y_1$ and $E>y_1$(if $\bar{\theta}_1>0$) and $\mu>\lambda_1 y_1$. Furthermore, $d^2EU_1(\theta)/d\theta^2 = -2\mu(E-y_1)y_1[f(y_1)-y_1-E]/[E-(1-\theta)y_1]^3\lambda_1 < 0$. Since EU_1 is increasing at zero and is concave throughout and $EU_1(\bar{\theta}_1) > EU_1(\theta)$ for all $\theta\in[0,\bar{\theta}_1)$, it follows that EU_1 is increasing on the interval $(0,\bar{\theta}_1)$. On the interval $[\bar{\theta}_1,\hat{\theta}_2]$, EU_1 is given by $EU_1(\theta) = (1-\theta)y_1-E +(\mu\theta/\lambda_1)+f(y_1)$. Differentiation gives: $dEU_1/d\theta = -y_1 + \mu/\lambda_1 > 0$. On the interval $[\hat{\theta}_2,\bar{\theta}_2]$, $EU_1(\theta)$ is given by $EU_1(\theta) = (1-\theta)y_1 - (1-\theta)y_2 + f(y_1)$, since for $0<\rho_2(\theta)<1$, $s(\theta) = E - (1-\theta)y_2$. Differentiation gives $dEU_1/d\theta = y_2-y_1 < 0$. On the interval $[\bar{\theta}_2,\hat{\theta}_3]$, EU_1 is given by $EU_1(\theta) = (1-\theta)y_1 - E + [\mu\theta/(\lambda_1+\lambda_2)] + f(y_1)$. Differentiation gives $dEU_1/d\theta = -y_1 + \mu/(\lambda_1+\lambda_2)$. Marginal utility in this region is positive if $y_1<\mu/(\lambda_1+\lambda_2)$ and negative if the reverse inequality holds. In the interval $[\hat{\theta}_3,\bar{\theta}_3]$ we have $EU_1(\theta) = (1-\theta)y_1-(1-\theta)y_3+f(y_1)$. Differentiation yields $dEU_1/d\theta = -y_1+y_3 < 0$. Finally, if θ lies in the interval $[\bar{\theta}_3,1]$, then EU_1 is given by $EU_1(\theta)=(1-\theta)y_1-E+\mu\theta$. Differentiation gives $dEU_1/d\theta = -y_1+\mu$. This is negative since μ is simply the average of the y_i's. This completes the proof of (ii). Parts (iii) and (iv) can be demonstrated similarly.||

2. Construction of Table 2

Generically, each of the EU_i's has a unique maximizer on $[0,1]$. The discussion that follows assumes that the maximizers are unique, although the case where uniqueness does not obtain is easily handled. We denote the maximizer for group i by $\tilde{\theta}_i$.

As a first step in the characterization of equilibrium, note that $\tilde{\theta}_i$ necessarily corresponds to a local maximum of $EU_i(\theta)$, and hence Proposition 1 can be used to restrict the set of possible values of $\tilde{\theta}_i$. Consequently, the possible values for $\tilde{\theta}_1$ are $\{\hat{\theta}_2, \hat{\theta}_3\}$, for $\tilde{\theta}_2$ are $\{0, \hat{\theta}_3, 1\}$, and for $\tilde{\theta}_3$ are $\{0,1\}$. For all groups $EU_i(\bar{\theta}_i) > EU_i(0)$ (for $\bar{\theta}_i \in (0,1]$), so zero can be a global maximizer for an individual of group i only if it is not feasible for all individuals in that group to obtain an education at any tax rate. Also, it is possible for a tax rate of one to be a global maximum for group one, but only if $\hat{\theta}_3=1$, i.e., only if there is no tax rate at which any individual of group three can obtain an education.

The following proposition helps establish which value is taken by $\tilde{\theta}_1$.

<u>Proposition 2</u>: Assume that $y_2<E$. Then $EU_1(0) > EU_1(\bar{\theta}_2)$ if and only if $y_1 > E$ and $\mu/(\lambda_1+\lambda_2) < y_1$.

<u>Proof of Proposition 2</u>

If $E>y_1$, then $EU_1(\theta)>EU_1(0)$ for $0<\theta\le 1$. If $E\le y_1$, then $EU_1(0)=f(y_1)+y_1-E$ and $EU_1(\bar{\theta}_2) = f(y_1) + (1-\bar{\theta}_2)y_1 + \bar{\theta}_2\mu/(\lambda_1+\lambda_2) - E$. Hence, $EU_1(0)-EU_1(\bar{\theta}_2) = \bar{\theta}_2[y_1-\mu/(\lambda_1+\lambda_2)] \gtreqless 0$ as $y_1 \gtreqless \mu/(\lambda_1+\lambda_2)$. ||

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[1] In a rather different vein, Lommerud (1989) discusses the role of relative income concerns as an additional justification for the provision of educational subsidies and Lott (1990) suggests that the public provision of schooling is undertaken by the state since it lowers the opposition to wealth transfers by indoctrinating students with the "correct" set of beliefs.

[2] There is a growing literature that examines political forces as a determinant of economic outcomes. Early examples are Schumpeter (1947), Downs (1957), and Buchanan and Tullock (1962). More recent studies include Meltzer and Richard (1981), Alesina (1987), Persson and Tabellini (1990), and Fernandez and Rodrik (1991). See also the readings in Persson and Tabellini (1994).

[3] Saint-Paul and Verdier (1993) and Glomm and Ravikumar (1992) provide models where this result obtains. They examine economies in which all individuals obtain the same education but the amount spent on education (and, hence, human capital accumulation) is determined by majority vote over tax rates. See also Stiglitz (1974).

[4] Studies which document this fact include Hansen and Weisbrod (1969), Radner and Miller (1970), Peltzman (1973), Jackson and Weathersby (1975) and Bishop (1977) for the United States and Psacharopoulos (1986) for several developing countries.

[5] We have chosen a linear utility function since it allows closed form solutions and highlights the nature of the tensions among income groups. No discounting reduces notation without changing the nature of the results.

[6] This model takes initial income heterogeneity as given, but it would not be difficult to generate this endogenously as a result of, for example, parents having differing preferences over their offspring's education or from a stochastic element in lifetime income, whereupon the variables in our model should be interpreted as expected values.

[7] The model can easily be generalized to $n>3$ discrete groups. The assumption of three groups, however, significantly reduces the number of voting equilibrium candidates.

[8] We have deliberately chosen to model the acquisition of education as a discrete choice. In terms of our results, what matters is that as a result of capital market imperfections some individuals should find themselves at a corner with respect to their choice to invest in education.

[9] We assume that there are no spillovers from educated to noneducated individuals and that the returns to education are unaffected by the number of individuals that obtain an education. These simplifications are not necessary but allow us to focus on other factors.

[10] Note that $f(y_i)=F$ is a special case of the model.

[11] We do not model here the particular microfoundations underlying the capital market failure. This would merely complicate the model, and its exact features are not critical. We stress that the essential feature is not that individuals are unable to borrow at all, but rather that access to credit markets is such that initial income remains a determinant in an individual's decision to acquire education.

[12] Our specification implies that individuals may spend all their income on education. This could be generalized to include expenditures on other goods as long as individual income remains a binding constraint on the purchase of education for some individuals.

[13] Thus we are implicitly constraining our system from resorting to lump-sum taxation and other schemes.

[14] This model also assumes credit constraints, that education is a discrete investment good, and that tax rates are determined by majority vote. Tax proceeds, however, provide equal lump-sum transfers to all individuals, independently of whether they obtain an education and there are assumed to be spillovers from educated to noneducated individuals.

[15] Although these two cases are not exhaustive, the others are not particularly interesting. Furthermore, the others correspond to even poorer economies for which one would probably not view majority voting as a compelling description. For completeness, however, Table 2 later in the paper does include these cases.

[16] As is well known, this feature implies that a majority voting equilibrium may not exist.

[17] The existence of a sole interior equilibrium is an artifact of the three income group distribution and of the lack of other economic disincentives for tax rates of one; larger sets of interior equilibria are easily obtained by increasing the numbers of income groups. It is also easy to introduce assumptions to bound the tax rate away from one.

[18] Nonexistence of majority voting equilibrium due to non-single peaked preferences has been dealt with either by imposing more institutional structure (see, e.g., Shepsle and Weingast (1987)) or by considering a less restrictive rule for selecting outcomes (see, e.g, the concept of an uncovered set in McKelvey (1986) and Miller (1980)). Our main interest is in providing a benchmark by considering only outcomes consistent with majority voting. Hence, we do not pursue any other alternatives here.

[19] In a poor economy, for example, (see Panel 3B) an equilibrium of zero is possible, supported by a coalition of the rich and the poor. A similar situation arises in the analysis of Dewatripont and Roland (1992) concerning restructuring of an economy. Nonmonotonic preferences give rise to coalitions between groups with the maximum degree of heterogeneity.

[20] Note that the cases of restricted redistribution discussed in section III provide some intuition for this result. In particular, there we found that the y_1 individuals are more likely to prefer taxation when sharing with y_2 individuals if y_2 is much closer to y_1 than to y_3 or if λ_3 is large relative to λ_2.

[21] Building on the work of Becker and Tomes (1979) and Loury (1981), recent work by Galor and Zeira (1993) and Ljungqvist (1993) studies the evolution of income distribution in dynamic models in which credit constraints affect educational attainment. In these models, however, there is no endogenous choice of policy; all features of the educational system are taken to be exogenous. The work of Durlauf (1991) is an exception.

[22] Perotti (1993) shows that pure redistributive schemes may be bad for growth in poor economies if education is discrete and individuals are credit constrained.

[23]Even for a wealthy economy with an equilibrium tax rate of $\hat{\theta}_3$ it may be in the interest of the y_1 and y_2 individuals to increase E. The implied increase in $\hat{\theta}_3$ may outweigh the negative effects of a higher E.

[24]It would be interesting to incorporate several additional features into the model, such as endogenizing the cost and quality of education, allowing for the (endogenous) existence of private alternatives (see Glomm and Ravikumar (1992)), and extending the analysis to a dynamic framework.