Income Distribution, Communities and the Quality of Public Education: A Policy Analysis

Raquel Fernandez*
Boston University and NBER

and

Richard Rogerson
University of Minnesota

June 1992

The authors acknowledge financial support from National Science Foundation grant SES-9122625 and wish to thank Bob Rosenthal and Monika Schnitzer for helpful comments.
*This paper was prepared under a cooperative agreement between the Instititute for Policy Reform (IPR) and the Agency for International Development (AID), cooperative agreement # PDC-0095-A-00-1126-00. Views expressed in this paper are those of the author and not necessarily those of IPR or AID.

1. Introduction

One of the most striking features of the primary and secondary public education system in the US is the large disparity exhibited across districts in spending per student.[1] As Table 1 illustrates for jurisdictions in several states, spending per pupil can vary by as much as a factor of two even across nearby communities. It is not really surprising that this is so. Given that a substantial proportion of the expenditures on public education is financed at the local level (approximately 45%), the differences in expenditures per student reflect, in large part, the realities of the US income distribution and its allocation across states and neighborhoods.

These unequal levels of educational expenditures per student have been condemned by many on grounds of efficiency, morality and legality. Advocates of reform have argued along the following lines: (i) Large differences in financing are inefficient since, given same initial abilities, poorer schools will turn out far fewer future scientists, violinists, etc., due to inadequate resources. (ii) A system that allows the accidents of geography and birth to determine the quality of education received by an individual is inimical to the idea of equal opportunity in the market place. And, (iii) that education is a fundamental right, equal access to which is thus mandated by the 14th Amendment of the US Constitution or by similar clauses in state constitutions.[2]

In the last few decades the question of whether inequality in educational expenditures constitutes a denial of equal opportunity and of constitutional

---

[1]For an eloquent, if unsystematic, portrayal of this fact see Kozol (1991).

[2]For a review of some of these arguments see Berne (1988) and Wise and Gendler (1989).

guarantees has been the subject of many court battles.[3] Arguments marshalled in defense of the status quo have contested the relationship between educational expenditure and educational quality (and hence equal opportunity) and the intrusion by the state on matters of local control.[4] Nonetheless, since 1970 almost half of the major judicial cases decided have resulted in an overturn of a state's school finance system and many other states have independently initiated reforms in response to these cases.[5] The judicial systems, however, have left it to the different states' legislatures to devise alternative systems of financing public education.

Although economic issues figure prominently in policy discussions concerning educational finance and its reforms, formal economic analysis seems to play little, if any, role in informing these debates.[6] In view of the importance of these issues, this is rather troubling. The interactions among all the variables involved in educational reforms are far from simple to comprehend and, as the experience of California eloquently attests, well-intentioned programs may have rather unfortunate and unintended consequences. There, the combination of the Serrano decision and Proposition 13 left 91.1% of students within a $100 expenditure band in 1985-1986. Between 1970 and 1989, however, California dropped from a rank of 23 to 46 among all states in

---

[3]For a history of US school finance policy see Guthrie (1983) and Berne (1988).

[4]The association between school quality and other variables has been a topic of controversy since the Coleman report (Coleman et al. (1966)). In a recent study, Card and Krueger (1992) find a significant positive effect of school quality on mean earnings. See references therein for a discussion of the related literature.

[5]Since 1970 New Jersey, Kansas, Wisconsin, California, Connecticut, Washington, West Virginia, Wyoming and Arkansas have had their school finance system overturned in court rulings.

[6]A notable exception is Inman (1978). He simulates the effect of diverse educational reforms on agents' welfare within a complex multi-community model.

terms of its expenditures on public elementary and secondary education as a percentage of personal income.[7]

This paper takes the stand that an examination of the interactions among communities, income distribution, individual preferences, and institutions is critical to understanding the effects of reforms of the public education finance system. Although any model that attempted to fully incorporate all aspects of these variables would be far too complex, our aim here is to provide a theoretical analysis of the effects of different reforms within a framework that is able to capture some features of the major forces likely to be at work, yet which retains sufficient tractability to illuminate their interactions. To this end we consider a multi-community model in which individuals differ in their initial income and in which education is publicly provided at the community level. Education is financed by a local income tax and individuals are free to decide in which community they wish to reside. The amount that is spent per student in a community determines the community's quality of education and consequently the future earnings of individuals in that community. The tax rate is determined by majority vote within the community.

The model outlined above is meant to capture three important features of the US economy and its system of public education: (i) heterogeneity of income across individuals and communities, (ii) mobility of individuals across communities, and (iii) community control of education. We further simplify the model by restricting most of our analysis to the case of two communities and three income groups—the minimum necessary to obtain an interesting

[7]See Benson, C. and O'Halloran, K. (1987). Serrano v Priest is the 1971 State Supreme Court case which ruled unconstitutional California's system of financing public education. Propositon 13 placed a limit on local tax rates. Data is from various issues of the US Statistical Abstract.

analysis. We subsequently discuss how the analysis is modified by the introduction a continuous income distribution.

In all the stable equilibria of our model, individuals stratify themselves into communities according to income. These equilibria are characterized by the coexistence of a high tax-high quality of education community peopled by those individuals with higher incomes and a low tax-low quality of education community where individuals with lower incomes reside.

We use the model described to assess the impact of several types of reforms (directly and indirectly related to education finance) on the quality of education in both communities and on individual welfare. We focus our analysis on three major types of policies: those that attempt to legislate quality directly, those that target primarily the composition of a particular community, and those that redistribute income through taxes.

Our model generates several interesting results. We find that reforms that attempt to directly affect the quality differential between the wealthy and the poor community by capping the quality level in the wealthy neighborhood lowers the welfare of all individuals. Depending on the identity of the median voter in the poor community, this may also be the consequence of a policy that mandates a higher quality of education in the poor community. Moreover, the difference in the quality levels between communities may even increase.

Policies that influence educational quality through attempts to change the composition of a community (by offering, for example, subsidies to individuals who choose to locate in a particular community) also have some rather surprising consequences. We find that a subsidy that promotes the location of middle-income individuals in the poor community is Pareto improving under certain circumstances and can raise the quality of education in both communities. A policy that subsidizes the residence of middle income individuals in the wealthy community, on the other hand, makes all individuals worse off (including those receiving the subsidy!) and decreases the quality of education in both communities. If the subsidy policy is used solely to assist the poorest individuals to locate in the wealthy community, however, this policy is then potentially Pareto improving.

We also consider redistributive tax policies. In one variant only the wealthiest individuals are taxed and the proceeds are distributed to the poorest individuals. We find that this policy may be Pareto improving and can increase the quality of education in both communities. In a different policy variation, taxes are levied on all individuals in the wealthiest community and redistributed to all residents of the poor community. This policy tends to make all individuals better off, to increase the quality of education in both communities, but also to increase the inequality in educational quality across communities. Some of the theoretical results we obtain in this section are ambiguous. A numerical example illustrates some possible outcomes of these tax policies.

The paper is organized as follows: Section 2 develops the model and the equilibrium concept that will be employed. Section 3 analyzes several policy reforms within the framework developed. Section 4 extends the analysis to a continuous income distribution and section 5 concludes.

2. The Model

We wish to analyze a model that will help shed light on how different policies may affect both the quality of education across communities and welfare among income groups. The essential features that such a model should possess are (i) communities, (ii) individuals that differ with respect to income and that are able to exercise some element of choice with respect to where they wish to reside, (iii) a mechanism that translates individual preferences into a collective choice, and (iv) a technology that transforms expenditures on education into a quality of education.

To incorporate all the above characteristics into a model in a tractable fashion is difficult. We choose to focus on a model in which there are only two periods, two communities, three income groups, public education is the only option available to individuals, the quality of education is solely a function of the level of expenditure per capita within a community, and spending on education is determined by majority vote. While it is possible to argue with each one of these assumptions and simplifications, they nonetheless seem to possess enough richness to highlight many issues of concern in the debate about education finance, while at the same time preserving sufficient simplicity to permit an analysis within a multi-community model. Models of this genre can easily become intractable and most of the related literature either restricts their analysis to characterization of equilibria and conditions for existence or resorts immediately to simulations.[8]

There is a continuum of two-period lived individuals with identical preferences given by

$$u(c_1) + \beta u(c_2) \tag{1}$$

where c_1 is period-one consumption and c_2 is consumption in period two. We assume that u is strictly concave and differentiable. Individuals differ in

[8] For a discussion of the difficulties inherent in working with multi-community models of local public goods see, for example, Rose-Ackerman (1979), Rubinfeld (1987), Stiglitz (1977) and Epple, Filimon, and Romer (1984). These types of models have been used by, among others, Epple and Romer (1991) to study redistribution, by Durlauf (1992) to sudy the dynamics of income distribution, and by de Bartolome (1991) to examine efficency properties when peer effects exist.

their initial (period one) income y_i which takes on one of three values indexed by $i=1,2,3$ with $y_1>y_2>y_3$. The fraction of individuals with initial income y_i is given by λ_i. We assume $\lambda_i>0$ $\forall i$.

There are two communities. Each community is characterized by a proportional tax rate on first-period income and by the quality of public education that it provides.[9] We assume that all residents of a given community receive the same quality of public education and that, furthermore, they cannot choose to supplement this education privately. All tax revenue is assumed to be spent on education and the quality of public education is determined by the amount of public spending per resident. Education, therefore, is a local publicly provided private good.

An individual's period-one consumption is equal to her after-tax income. Second-period consumption is given by second-period income, which is determined by the quality of education. In particular, we assume that second-period income is an increasing, concave and differentiable function (f) of the quality (q) of education received in the first period. Note that we rule out both the existence of capital markets that allow individuals to borrow against future earnings and of a technology (other than education) that allows individuals to transfer period-one income into the future.[10]

For a given profile of tax rates and educational quality across communities, each individual is assumed to choose a community in which to live

[9]Although in reality property taxes determine the level of spending on local public goods in a community, we preferred not to introduce another market (housing) and an additional source of distortionary taxation and to keep the analysis more transparent instead. For multi-community models that explicitly incorporate a land/housing market see, for example, Rose-Ackerman (1979), Epple and Zelenitz (1981), Inman (1978), Epple, Filimon, and Romer (1984), and Epple and Romer (1991). See, however, Henderson (1985) for a critique of the literature's way of incorporating these markets.

[10]The extreme form of this assumption could easily be relaxed.

taking as given the choices of all other individuals. Given each individual's choice of residence, a community's tax rate t (and hence the quality of its education) must correspond to that which would be chosen by its residents through majority vote. That is, for $t' \in [0,1]$ to be the tax rate in a community, there must be no tax rate $t \in [0,1]$ which is preferred to t' by more than 50% of the community's residents.[11]

An important issue in defining equilibrium is the nature of the assumptions made by the voters upon choosing a tax rate. Here we assume that communities are not "too strategic". That is, each individual's preferred tax rate is chosen under the assumption that the composition of the community's residents will not change as a result of the tax rate voted in, and taking as given the other community's tax rate and quality of education. This is a subgame-perfect equilibrium for a two-stage extensive form version of this game in which all individuals simultaneously choose a community in the first stage, and the tax rate is decided upon by majority vote in each community in the second stage.[12] We now turn to a formal description of equilibrium.

Define ρ_i as the fraction of those individuals with income y_i that reside in community 1 and V_i^j as the indirect utility of an individual with income y_i that resides in community j, i.e.,

$$V_i^j = u((1-t_j)y_i) + \beta u(f(q_j)) \tag{2}$$

where t_j and q_j are, respectively, the tax rate and quality level in community j. Note that q_j is given by:

---

[11]We are assuming throughout that all individuals vote sincerely.

[12]With the exception of Epple and Romer (1991), a similar version of this extensive form is implicitly employed by the multi-community literature. It would be of interest, but beyond the scope of this paper, to also examine other extensive forms (i.e, alternative definitions of equilibrium) which allow for more strategic interactions between communities.

$$q_j = t_j \mu_j, \tag{3}$$

where μ_j is the mean income in community j, and thus equal to

$$\begin{aligned} \mu_1 &= (\textstyle\sum_i \rho_i \lambda_i y_i)/\sum_i \rho_i \lambda_i \\ \mu_2 &= (\textstyle\sum_i (1-\rho_i)\lambda_i y_i)/\sum_i (1-\rho_i)\lambda_i \quad . \end{aligned} \tag{4}$$

The preferred tax rate $\tilde{t}$ of an individual with income y in a community with mean income μ is implicitly defined by:

$$u'(y(1-\tilde{t})) = \beta f'(\tilde{t}\mu)u'(f(\tilde{t}\mu))\mu/y \ . \tag{5}$$

If either $\rho_i=0$ $\forall i$ or $\rho_i=1$ $\forall i$, then we define the tax rate in the empty community to be that given by (5) for $y=\mu=y_1$ (i.e. the preferred tax rate for a y_1 individual in a community with mean income equal to y_1).

<u>Definition 1</u>: An equilibrium is an $x^*=(\rho_1^*,\rho_2^*,\rho_3^*,t_1^*,t_2^*)$ such that:

(i) Taking x^* as given, each individual chooses to reside in the community in which her utility is highest, resulting at the aggregate level in $\rho_i=\rho_i^*$.

(ii) Taking the ρ_i^* as given, each t_j^* is a majority voting equilibrium for community j.

<u>Lemma 1</u>: In equilibrium no community is empty.

<u>Proof</u>: Suppose one community is empty. Then a y_1 individual can always be made strictly better off by relocating in this empty community where she obtains her preferred tax rate at a higher mean income than in the other community.||

There is always a trivial equilibrium in this model given by $\rho_i^*=.5$ for all i and thus $t_1^*=t_2^*$ (i.e., both communities are identical). This is not, however, a particularly interesting equilibrium from the point of view of the questions that we wish to pose. Furthermore, this equilibrium is unstable.[13]

---

[13] Instability is discussed at greater length further on in the paper.

There is, however, at this level of generality, a problem with obtaining the existence of any other equilibrium. This problem is due to the tendency for individuals to wish to reside with others that possess an income greater than their own in order to obtain, for the same tax rate, a higher quality of education than that obtained by living with individuals of the same or lower income. In order to facilitate the existence and characterization of an equilibrium in this model, therefore, we impose the restriction on preferences given by Assumption 1:[14]

Assumption 1:

$$-\,u''(c)c/u'(c) > 1 \qquad \forall\ c \tag{6}$$

This assumption ensures that the increase in the income tax rate that an individual is just willing to accept in return for any given increase in the quality of education is an increasing function of the level of her period-one income, for all quality-tax pairs.[15]

In addition to (6), we assume the following joint condition on u and f:

Assumption 2:

$$\frac{\partial^2 u(f(t\mu))}{\partial t \partial \mu} \le 0 \qquad \forall\ (t,\mu)\ . \tag{7}$$

This condition implies that, when faced with an increase in μ, the preferred tax rate of an individual with a given income yields higher consumption in

[14]Westhoff (1977) provides the first use of this kind of condition to obtain stratified equilibria. Similar versions of this condition have been employed by Roberts (1977), Epple and Romer (1991) and Epple, Filimon and Romer (1984).

[15]In other words, the assumption implies that the slope of an individual's indifference curves in q-t space increases with period-one income for all (q,t).

both periods.[16] The importance of Assumptions 1 and 2 will be made clear in Propositions 1 and 4.

Assumption 1 has strong implications for the nature of the possible equilibria independently of the mechanism chosen to translate individual preferences within a community into tax rates. In particular, it implies that all equilibria (other than the set of trivial ones discussed further on) must be characterized by the properties ennumerated in Proposition 1.

Proposition 1: All equilibria in which communities have different qualities of education must satisfy:

(i) $(q_1^*, t_1^*) \gg (q_2^*, t_2^*)$

(ii) The income of every individual in community one is at least as great as that of any individual in community two.

Community one has arbitrarily been defined as the community with the highest quality of education.

Proof: (i) If $q_1 > q_2$ then necessarily $t_1 > t_2$, otherwise all individuals prefer community one to community two and, by Lemma 1, no community can be empty. (ii) By (5), if an individual with income y_j prefers (q_1^*, t_1^*) to (q_2^*, t_2^*), then so does every individual with income $y_k > y_j$. ||

Thus, in equilibrium, individuals are stratified into communities according to initial income. One community (henceforth called C1) will be characterized by a higher tax rate, a higher quality education, and higher income residents than the other (henceforth called C2). Note that stratification is implied simply by Assumption 1 on preferences and by individuals' ability to choose the community in which they wish to reside.

---

[16] Given (6), a sufficient condition on technology to meet the requirement specified by (7) is $f' \geq (f/q) + (f''f/q)$. This is satisfied, for example, if f is log linear or quadratic (over the relevant region).

Proposition 2: Majority voting results in the preferred tax rate of the individual with the median income within the community.

Proof: First note that, by (6), $\delta\tilde{t}/\delta y>0$ (where $\tilde{t}$ is, as defined in (5), the preferred tax rate of an individual with income y in a community with mean income μ). Next, by concavity of u, given a distribution of individuals across communities each individual's preferences are single peaked with respect to the tax rate in her community. Lastly, monotonicity and single peakedness together imply that the preferences of the individual with the median income in the community will be imposed as a result of majority vote.||

Although (6) and (7) do not ensure the existence of a stratified equilibrium for all initial income distributions and utility functions, we focus on those cases in which such an equilibrium exists.[17] The following proposition restricts the set of equilibrium outcomes.

Proposition 3: Let x^* be a stratified equilibrium. Then,

(i). All y_1 individuals reside in C1.

(ii). If $\rho_2^* \epsilon (0,1)$ the median voter in C1 is a y_1 individual.

Proof: (i) Suppose not. Then C2 is inhabited by all three income groups and C1 is inhabited only by y_1 individuals. The median voter in C1, therefore, is necessarily a y_1 individual. But then the utility of a y_1 individual is higher in C1 than in C2 since mean income is higher in the former.

(ii) Suppose not. Then a y_2 individual must be the median voter in C1. But then the utility of a y_2 individual is higher in C1 than in C2 since mean income is higher in the former and y_2 is obtaining its preferred tax rate there. Hence, no y_2 individual would choose to locate in C2.||

[17]In fact, modifying the quality technology by adding a fixed cost of producing education, it is easy to ensure the existence of equilibria for all non-degenerate income distributions and utility functions (see Westhoff (1977).

In view of Proposition 3, the two remaining candidates for equilibrium are $\rho_3=0$ and $\rho_2\in[0,1]$, or $\rho_3\in[0,1]$ and $\rho_2=1$. The case we consider to be of greatest interest and realism is that in which no community is completely homogeneous. Furthermore, for a continuous income distribution this is naturally the only possiblity. Consequently, we restrict our attention to stratified equilibria characterized by $\rho_3=0$ and $\rho_2\in(0,1)$.

In the stratified heterogeneous community equilibrium just described, Proposition 3 implies that the median voter in C1 necessarily is a y_1 individual. The median voter in C2, on the other hand, can be either a y_2 or y_3 individual. Because most of our analysis is local, we will hold the identity of the median voter fixed when we determine the effects of different policies on the equilibrium. We will, however, examine the consequences for both possible identities of the median voter in C2.

The potential equilibria of the type specified above can be parametrized by the fraction (ρ_2) of the middle class that resides in the rich community, C1. To simplify notation we drop the subscript and call this fraction ρ. Each choice of ρ determines the residents of the two communities and hence the quality-tax pair for each community. Let $V_2^j(\rho)$ denote the utility of a y_2 individual that resides in community j given that a fraction ρ of all y_2 individuals reside in C1. In equilibrium $V_2^1(\rho)$ must equal $V_2^2(\rho)$, i.e. an individual with income y_2 must be indifferent between residing in C1 and C2 given that a fraction ρ of y_2 individuals reside in C1. Thus, an equilibrium can be depicted graphically as an intersection of two curves, $V_2^1(\rho)$ and $V_2^2(\rho)$.

Note that for a given identity of the median voter in each community, a change in ρ affects community allocations solely through its effect on mean income. Proposition 4 characterizes the effects of a change in mean income on the tax rate and quality of education in a community.

<u>Proposition 4</u>: Let t^* be the majority vote tax rate for a community with mean income μ. Then, holding the identity of the median voter constant:

(i) t^* is decreasing in μ and $q^*=t^*\mu$ is increasing in μ.

(ii) $V_2^j(\rho)$ is decreasing in ρ for $j=1,2$.

<u>Proof</u>: (i) Differentiation of (5) yields:

$$\frac{dt^*}{d\mu} = - \frac{\beta[u''(f(q))f'^2q+u'(f(q))f''q+u'(f(q))f']}{u''(y(1-t))y^2+ \beta\mu^2[u''(f(q))f'^2+u'(f(q))f'']} < 0 \qquad (8)$$

and

$$\frac{dq^*}{d\mu} = - \frac{\beta u'(f(q))f'\mu-u''(y(1-t^*))t^*y^2}{u''(y(1-t))y^2+ \beta\mu^2[u''(f(q))f'^2+u'(f(q))f'']} > 0 \qquad (9)$$

Note that (7) implies that the numerator in (8) is negative.

(ii) Follows directly from (8) and (9) and noting that the effect of an increase in ρ, keeping the median voter constant, is to decrease mean income in both communities.||

There are two situations that may characterize a point of intersection, depending upon which V_2^j curve is steeper. Figure 1 depicts both possibilities. A stability argument suggests focussing on the situation depicted by point A in Figure 1 and shown in isolation in Figure 2.

<u>Definition 2</u>: An equilibrium $x^*=(\rho_1^*,\rho_2^*,\rho_3^*,t_1^*,t_2^*)$ is locally stable if there exists an $\epsilon>0$ such that for all ρ_i with $|\rho_i-\rho_i^*|<\epsilon$,

$$(\rho_i-\rho_i^*)(V_i^2(r)-V_i^1(r))>0 \qquad (10)$$

where $r=(\rho_1,\rho_2,\rho_3)$. If an equilibrium is not locally stable, it is defined to be unstable.

This definition states that for small perturbations of the equilibrium distribution of individuals between communities at least some individuals should wish to relocate to their original community.

Propostion 5: (i) The equilibrium depicted by point B Figure 1 is generically unstable.

(ii) The equilibrium depicted by point A of Figure 1 is generically locally stable.

Proof: (i) Consider an arbitrarily small movement of y_2 indiduals from C1 to C2 such that the median voters are unchanged.[18] Then $V_2^2(\rho)>V_2^1(\rho)$ and this equilibrium is unstable. (ii) Small perturbations of y_1 or y_3 individuals (that do not change the median voter) meet the stability condition (10) since each income group strictly prefers one community over the other and (q^*,t^*) are continuous in a neighborhood of r. A perturbation that involves only y_2 individuals, by inspection of Figure 2, obeys (10). Hence the equilibrium depicted by point A is locally stable.||

Proposition 6: All equilibria that are not stratified are unstable.

Proof: Note first that all non-stratified equilibria must, by Propostion 1, have $q_1^*=q_2^*$ and $t_1^*=t_1^*$. Thus, both communities have the same mean income and the same median voter. Take the community with the greatest fraction of y_1 individuals (if both communities have equal fractions of y_1 individuals, arbitrarily choose a community). Call this community C2. Now perturb the equilibrium by taking a small fraction of y_1 individuals from C2 and relocating them in C1. Mean income in C1 now exceeds mean income in C2 and

---

[18]Generically, the median voter will not change as a result of small perturbations.

the income of the median voter in C1 is now either the same or higher than before whereas that of the median voter's in C2 is either the same or lower than before. Since for a given distribution of individuals between communities u is single peaked in t and $\delta t^{*}/\delta y>0$, the possible change in median voter implies $V_1^1(r) \geq V_1^2(r)$. Furthermore, by (8) and (9), the change in mean income implies $V_1^1(r)>V_1^2(r)$. Hence all unstratified equilibria are unstable.||

An equilibrium of the type depicted in Figure 2 exists if there exists a ρ' and a ρ'' such that for $\rho''>\rho'$ we have $V_2^1(\rho')>V_2^2(\rho')$ and $V_2^1(\rho'')<V_2^2(\rho'')$, and the identity of the median voter is unchanged in the interval $[\rho',\rho'']$.[19] Most of the results obtained in the next section are local results, and hence apply to any equilibrium of the type depicted in Figure 2. The remainder of this paper is concerned with analyzing the implications of policy interventions assuming that the economy starts at this type of equilibrium.

3. Policy Analysis

(i) Subsidy Policies to Increase Residency in the Wealthy Community

There are various policies in place in the US which attempt to increase the exposure of lower income individuals to the higher quality public services provided by wealthier communities. This is arguably something that is accomplished by policies that subsidize housing for low-income individuals in richer communities, by the busing of school children across school districts,

[19] A sufficient condition for uniqueness of equilibrium (ignoring the trivial equilibria), in addition to the conditions for existence given above, is that the slope of $V_2^1(\rho)$ be greater in absolute value than the slope of $V_2^2(\rho)$ at each ρ and that the identity of the median voter in both communities remain unchanged. A necessary and sufficient condition for the identity of the median voters not to change is $\lambda_1>\lambda_2<\lambda_3$.

etc.. We shall show that it matters very much which individuals are targeted by these policies. In fact, we demonstrate that subsidy policies that target y_2 individuals make all individuals in both communities worse off, whereas those that target y_3 individuals are potentially Pareto improving.

(a). A Policy that Targets y_2 Individuals

Within the context of our model, a reasonable interpretation of the policies described above is a subsidy to y_2 individuals in C1. We shall show that this policy not only makes those individuals left residing in C2 worse off, which is not surprising in itself, but that it actually decreases the utility of all individuals. On the other hand, as we show in section 3(ii), a policy that subsidizes the residency of y_2 individuals in the poorer community may be Pareto improving.

Consider, therefore, a marginal subsidy to those y_2 individuals that reside in C1, postponing for now the issue of how to finance this policy. In terms of Figure 2, this policy shifts the V_2^1 curve upward and leaves the V_2^2 curve unchanged since, for a given ρ, the utility of y_2 individuals in C2 is unaffected by such a policy. Consequently, the new equilibrium is characterized by a higher ρ and a lower V_2.

The effect on V_1 is not immediate from the induced shifts in the V_2^j curves. On the one hand, the subsidy to y_2 individuals increases mean income in C1 at the initial ρ (and therefore has a positive effect on V_1). On the other, however, the increased inflow of y_2 individuals into C1 works to decrease μ_1 with the opposite effect on $\dot{V}_1$. The net effect, nonetheless, is unambiguous—μ_1 decreases. To see this, observe that had μ_1 increased or remained constant, then the equilibrium V_2 would also have increased since, by Proposition 4, taxes would not have increased and quality would not have decreased in C1. In equilibrium V_2 falls however, indicating that μ_1 must also be lower and, therefore, that V_1 also decreases.

Independently of whether a y_2 or a y_3 individual is the median voter in C2, the decrease in the mean income in that community implies a higher tax rate and a lower quality education. Consequently, V_3 also decreases in equilibrium. Thus, the new equilibrium is Pareto inferior to the zero subsidy equilibrium and has higher tax rates and lower quality of education in both communities than the original equilibrium.

The preceding discussion ignored the issue of how the subsidy is financed. Importantly, the result—a decrease in the welfare of all individuals—is robust to the identity of the group of individuals taxed to finance the subsidy.[20] A tax on y_3 individuals either leaves the original equilibrium unchanged (if a y_2 individual is the median voter in C2) or shifts the V_2^2 curve down (if a y_3 individual is the median voter) since y_3 now prefers a lower tax rate for the same mean income, thereby reinforcing the above effects. Similarly, a tax on y_1 individuals causes them to vote in a lower tax rate than before, thereby increasing V_2^1 and augmenting the effects outlined above. Finally, a tax on y_2 individuals that subsidizes those y_2 individuals that reside in C1 is only a transfer from y_2 individuals in C2 to those in C1. In terms of Figure 2, therefore, this policy shifts the V_2^1 curve up and the V_2^2 curve down, again reinforcing the initial effects. It follows that a policy that uses the proceeds of any combination of the taxes discussed above to subsidize the residency of y_2 individuals in C1 results in lower welfare for all.

---

[20] We assume the use of a proportional income tax to finance the subsidy.

(b). A Policy that Targets y_3 Individuals

Consider next a policy that subsidizes the residency of y_3 individuals in C1. The analysis of the effects of this policy cannot be conducted in terms of the V_2^1 curves since that diagram assumes that all of group y_3 resides in C2.

Note first that the subsidy needed to induce any y_3 individual to reside in C1 (for any value of $\rho\epsilon(0,1)$) is less than y_2-y_3. To see this, note that in equilibrium a y_2 individual is indifferent between residing in both communities. Since a y_3 individual's alternative to receiving a subsidy by residing in C1 is to remain with income y_3 in C2, it follows that the subsidy needed by a y_3 individual to move to C1 is less than y_2-y_3. At the original value of ρ, therefore, the effect of this policy is to decrease μ_1 (and hence also V_2^1 and V_1) and to increase μ_2 (and hence also V_2^2 and V_3). The induced inequality in the level of utility enjoyed by y_2 individuals between communities implies that ρ must fall from its original level, which serves to reverse the original decrease in μ_1 but further increases μ_2, V_2^2, and V_3. The outflow of y_2 individuals from C1 to C2, therefore, must be of a sufficiently large magnitude that μ_1 in the new equilibrium exceeds that in the original equilibrium (otherwise the inequality between the utilities of y_2 individuals across communities would persist). In particular, the outflow of y_2 individuals from C1 must exceed the inflow of y_3 individuals. The new equilibrium, therefore, is characterized by a greater mean income in both communities and, consequently, by an increase in the level of utility of all individuals (regardless of the identity of the median voter in C2).

Before concluding that the above policy is Pareto improving, we must discuss how this subsidy can be financed. One tax policy that serves to reinforce the Pareto improving nature of the subsidy is a tax on y_2

individuals in C1. Such a policy increases the outflow of y_2 individuals from the wealthy community, thereby contributing to the positive effects of the subsidy policy.[21]

(ii) A Policy to Increase Residency in the Poor Community

We now consider instead a policy that subsidizes (marginally) the residency of y_2 individuals in C2. Assume that the subsidy is financed by a tax on those y_2 individuals that choose to reside in C1.[22] In terms of Figure 2, this policy has the effect, for a given ρ, of shifting the V_2^1 curve down and the V_2^2 curve up, resulting in a decrease in the equilibrium level of ρ and an increase in V_2. This policy also benefits y_1 individuals since the fall in ρ increases mean income in C1, implying a lower equilibrium tax rate and a higher quality level there.

If a y_3 individual is the median voter in C2, the subsidy policy makes y_3 individuals better off since, by Proposition 4, the increase in C2's mean income implies, in this case, a lower equilibrium tax rate and a higher quality of education in C2 also. Consequently, under these conditions a policy that subsidizes the residency of y_2 individuals in C2 is Pareto improving.

If, however, a y_2 individual is the median voter in C2, the effect on V_3 is ambiguous. On the one hand, for any given tax rate the increase in mean income in C2 makes all individuals in that community better off. On the other hand, the y_2 median voter responds to the change in her income and in C2's mean income by voting in a different tax rate. By (5), the sign of the change

[21]Taxes levied on other groups have ambiguous welfare effects in general.

[22]We are assuming that the tax is levied on period one income. Other tax policies have ambiguous welfare consequences.

in the tax rate depends on the magnitudes of the changes in both y_2's income and in the community's mean income. A lower tax rate increases V_3; a higher tax rate decreases V_3. In the latter case the net effect on V_3 is ambiguous since the increase in mean income works to increase y_3 welfare but the greater tax rate reduces it.

(iii) A Cap on the Quality of Education in the Wealthy Community

Some states have implemented policies that in effect place a cap on the quality of public education of their richer communities. The effects of such policies can be studied in our model by analyzing a restriction of the quality of education in C1 to some level $\overline{q}_1$ (or, equivalently, a restriction on the level of spending on education per student). This restriction is assumed to be binding at the original equilibrium level of quality in C1.

In terms of Figure 2, a (marginally binding) cap on the quality of education in C1 shifts the V_2^1 curve up in the vicinity of the original equilibrium. To see why, note that at the initial level of mean income, C1 must institute a lower tax rate than previously in order to reduce the quality of education to its maximum allowed level. This decrease in the tax rate is preferred by y_2 individuals since, for the same mean income, they desire a lower tax rate than y_1 individuals. Thus, the new equilibrium is characterized by a greater ρ and a decrease in V_2. Note that in the new equilibrium the quality cap must be binding. If it were not, the V_2^j curves would be unchanged and would thus yield the original equilibrium.

The consequences of the quality cap policy are somewhat surprising. Although at the initial ρ y_2 individuals in C1 are better off than before, the resulting outflow of y_2 individuals from C2 lowers V_2^2 and decreases mean income in C1. The decrease in μ_1 allows C1's tax rate to increase which serves to lower the utility of y_2 individuals in C1. Thus, the new equilibrium is characterized by a higher ρ, a decrease in quality in both communities ($q_1^*=\bar{q}_1$), a higher tax rate in C2, and a decrease in V_1, V_2 and V_3.[23] Note that this conclusion holds independently of the identity of the median voter in C2. Thus, this policy results in a Pareto inferior equilibrium relative to the policy of zero cap.

(iv) A Floor on the Quality of Education in the Poor Community

Next we consider a policy that mandates a (marginally) higher quality of education, $\bar{q}_2$, in C2. We assume that at the original equilibrium $q_2<\bar{q}_2$ so that at the original ρ this policy requires a higher tax rate in C2. Note that, as in the previous policy analysis, the quality constraint must be binding in the new equilibrium.

The identity of the median voter in C2 determines the direction in which the curves in Figure 1a shift in response to this policy. If y_3 is the median voter, the tax increase at the orignal ρ moves the tax rate in C2 closer to one preferred by a y_2 individual, thus increasing V_2^2 at the original ρ. If, however, y_2 is the median voter, the forced tax increase decreases the utility of a y_2 individual in C2 at the original ρ. Hence, the V_2^2 curve shifts up in the former case and down in the latter. We analyze each case separately.

Given y_3 as the median voter in C2, the new equilibrium is characterized by a decrease in ρ, an increase in the quality of education of both communities ($q_2^*=\bar{q_2}$), a lower tax rate in C1, a higher tax rate in C2, and an increase in V_2. V_1 is also greater (since mean income in C1 increases), but the effect on V_3 is ambiguous. Whereas the higher tax rate at the initial

[23]The effect of this policy on t_1 is ambiguous.

mean income decreases their welfare, the increase in mean income in C2 makes them better off.

If, instead, y_2 is the median voter in C2, the new equilibrium is characterized by an increase in ρ and a decrease in V_2. The increase in ρ implies that y_1 individuals are likewise worse off than before since mean income in C1 falls. As in the previous case, two factors affect V_3. Now, however, they both serve to decrease V_3 since mean income falls and the tax rate is increased. Consequently, when y_2 is the median voter in C2 a policy that mandates an increase in the quality of education in C2 makes all individuals worse off.

The above disparity in results stems entirely from the fact that the tax increase has opposite effects on y_2's utility in C2 (at the initial ρ) depending on the identity of the median voter in that community. If y_3 is the median voter, a y_2 individual prefers a higher tax rate for the same mean income than that chosen by the community. Consequently, a small tax increase raises V_2^2 above V_2^1 and generates a y_2 inflow into C2, thereby increasing mean income in both communities with the attendant beneficial effects. In the case of a y_2 median voter, the move away from this group's preferred tax rate causes a y_2 outfow into C1, thereby decreasing mean income in both communities and all individuals' utilities.

(v) Redistributive Tax Policy

We now explore the effects of some redistributive tax policies on the equilibrium of the model. We consider two policies: one that redistributes from the wealthiest to the poorest individuals (i.e. from y_1 to y_3), and the other that redistributes from the wealthiest to the poorest community (i.e. from C1 to C2). Both policies are in place in many states.

(a). Redistribution From the Wealthiest to the Poorest Individuals

We consider a policy that places a proportional tax τ on the income of y_1 individuals and distributes the proceeds in a lump-sum fashion to y_3 individuals. The tax base in C1 remains unchanged (i.e. t_1^* is levied on y_1, not $y_1(1-\tau)$) but the tax base in C2 includes the transfer (i.e. t_2^* is levied on $y_3+\tau y_1(\lambda_1/\lambda_3)$). We analyze the two components of this redistributive policy separately, beginning with the transfer of income to y_3 individuals.

Consider, therefore, a situation where y_3 increases and y_1 and y_2 remain unchanged. Independently of the identity of the median voter in C2, the V_2^2 curve shifts upward and the V_2^1 curve is left unchanged resulting, in equilibrium, in a fall in ρ and an increase in V_2. In the new equilibrium mean income has increased in both communities. Thus, by Proposition 4, the utility of all three groups is higher as is the quality of education in both communities.

Next consider a proportional tax τ solely on the income of y_1 individuals, assuming for now that the resulting revenue is simply discarded. Note that since C1's tax base is unchanged at the original equilibrium tax rate, y_1 individuals have the same second-period consumption but lower first-period consumption. Consequently, they prefer a lower tax rate which, at the initial level of ρ, is also closer to the rate preferred by y_2 individuals in C1. Thus, the V_2^1 curve shifts up and the V_2^2 curve is left unchanged. The new equilibrium is characterized by a higher ρ and a lower V_2. Since mean income falls in both communities, so do V_1, V_3 and the quality of education in both communities.

Combining the two components of the redistributive tax policy suggests that the net effect on utility and on the quality of education is ambiguous.

Two different effects are at work here. First, the community composition effect given by changes in ρ affects all individuals' utilities in the same direction (i.e. V_i increases (decreases) as ρ decreases (increases)). Second, y_1 individuals are worse off due to τ and y_3 individuals are better off because of the transfer. Intuitively, for this tax policy to be Pareto improving ρ must decrease by a sufficient amount to offset the negative effect of τ on y_1 individuals. Although one can obtain analytic expressions for changes in utilities and ρ, these expressions are not particularly illuminating. A numerical examples serves to illustrate some of the outcomes. The specification and results are shown in Table 2.

Panel A reports percent changes in utilities, in ρ, in total spending on education (E), and in educational qualilty in each community. For higher values of y_2, this policy makes y_1 individuals worse off but all other individuals better off, whereas for lower values of y_2 all individuals are made better off. The table shows that as y_2 decreases, the responsiveness of ρ increases, resulting in a greater outflow of y_2 individuals from the rich community.

Table 2 also indicates changes in spending on education. In this example when y_1 individuals are made worse off, total spending on education increases although quality increases in the poor community and decreases in the rich community. When the policy is Pareto improving, quality increases in both communities and the ratio of quality in the poor to rich neighborhood increases. Increases in quality for both communities need not imply that total spending on education increases (since the poor community is becoming relatively larger) and, in fact, in these examples it decreases.

(b). Redistribution From the Wealthy to the Poor Community

We now consider a policy that taxes the income of all individuals in C1 at rate τ and distributes the proceeds lump sum to all individuals in C2. As indicated by our previous arguments (see also (3.ib)), the effect of this policy on the equilibrium is ambiguous. Intuition suggests, however, that this policy should have a larger impact on the movement of y_2 individuals from C1 into C2 since the tax directly affects their relative incomes in the two communities.

Panel B presents results for the same example used in panel A. In all cases the tax is Pareto improving, lowers total spending on education, and increases the quality of education in both communities. This is in accordance with the intuition expressed above since the greater the ρ response, the more likely that this policy is Pareto improving. One difference between this and the previous policy, however, is that in all cases the increase in quality in the wealthy community exceeds that in the poor community in percentage terms, implying that inequality as measured by the ratio of qualities is increased by this policy.

4. Continuous Income Distributions

While the assumption of only three income types is a useful simplification, it is important to determine whether the results of the preceding section are robust with respect to changes in this feature. This section assumes a continuous distribution of income types and argues that the conclusions of section 3 carry over to this setting.

Note that Propositions 1 and 2 do not depend on the 3-type discrete income distribution and are also valid for any continuous income distribution. A stratified equilibrium, therefore, is now characterized by an income level

$\tilde{y}$ such that C1 contains all individuals with $y<\tilde{y}$, and C2 contains all individuals with $y>\tilde{y}$. Individuals with income $\tilde{y}$ reside in both communities. Each choice of $\tilde{y}$, henceforth called the boundary individual, implies tax rates and education qualities for the two communities. If $V_b^j(\tilde{y})$ is the utility attained by the boundary individual conditional upon residing in community j, equilibrium requires $V_b^1(\tilde{y})=V_b^2(\tilde{y})$.

An important result in the earlier analysis was given by Proposition 4: increases in ρ implied a lower tax rate and a higher quality of education in both communities. This result reflected the effect of a change in a community's mean income on allocations holding median income constant. With a continuous income distribution the effect of the induced change in the identity of the median individual within a community can no longer be ignored. Letting $\hat{y}$ denote the median income in a community with mean income μ, differentiation of equation (5) yields:

$$\frac{dt^*}{d\tilde{y}} = \frac{A(\delta\hat{y}/\delta\tilde{y}) - \beta[u''(f(q))f'^2q+u'(f(q))f''q+u'(f(q))f'](\delta\mu/\delta\tilde{y})}{u''(\hat{y}(1-t))\hat{y}^2+\beta\mu^2[u''(f(q))f'^2+u'(f(q))f'']} \tag{11}$$

$$\frac{dq^*}{d\tilde{y}} = \frac{\mu A(\delta\hat{y}/\delta\tilde{y}) - [\beta u'(f(q))f'\mu-u''(y(1-t^*))t^*y^2](\delta\mu/\delta\tilde{y})}{u''(\hat{y}(1-t))\hat{y}^2+\beta\mu^2[u''(f(q))f'^2+u'(f(q))f'']} > 0 \tag{12}$$

where $A = [u''((1-t^*)\hat{y})(1-t^*)\hat{y}+u'((1-t^*)\hat{y})] < 0$.

Note that both mean and median income in each community are increasing in $\tilde{y}$. The denominator in these expressions is identical to the one in (8) and (9) and is negative. The numerators, however, now contain an additional term A which, by Assumption 1, is negative. Although expression (12) is therefore always positive, the numerator of (11) cannot be signed without additional assumptions. Previously, condition (7) implied $dt/d\rho<0$. Now a stronger condition is required to ensure that the effect of the change in mean income on the tax rate dominates the effect of a median voter with a greater income. We henceforth simply impose $dt^*/d\tilde{y}<0$ and show that with this assumption the results of section 3 are robust to the introduction of continuous income distributions.

Given our previous assumption, $V_b^j(\tilde{y})$ is an increasing function of $\tilde{y}$. The intersection of the $V_b^j(\tilde{y})$ curves define an equilibrium. Proposition 6, which states that all non-stratified equilibria are unstable, carries over to this setting as does the argument in Proposition 5 which characterizes as unstable equilibria produced by V_b^1 intersecting V_b^2 from above. Thus, we focus only on stable equilibria as depicted in Figure 3.

Two examples illustrate how the results of section 3 carry over to this setting. First consider a cap on quality in the wealthy community. This shifts the V_b^1 curve up in the vicinity of $\tilde{y}^*$ and leaves the V_b^2 curve unchanged. The equilibrium value of $\tilde{y}$ decreases and, by (11) and (12), tax rates increase and quality of education falls in both communities. Thus, all individuals are made worse off by this policy (as in section 3.iii).

Consider now the policy of the previous section that subsidized y_2 individuals to locate in C1. A similar policy in the present context would be to subsidize those individuals in C2 with an income in a small neighborhood of $\tilde{y}^*$. Ignoring the financing of this subsidy, this policy induces a discontinuity in the V_b^1 curve, shifting it upward in the neighborhood of $\tilde{y}^*$. Consequently, the new equilibrium is characterized by a lower value of $\tilde{y}$, higher taxes and a lower quality of education in both communities. Obviously, all individuals that do not move as a result of this subsidy policy are worse off than before. Some individuals that move to C1 and receive the subsidy, however, may be better off. Although this last possibility indicates a slight weakening of the result obtained in section 3 (where this policy was

Pareto dominated by a zero subsidy policy), it is at most a fraction of those individuals who move that may be made better off since one can show that the boundary individual in the new equilibrium is strictly worse off and thus, by continuity, so are individuals with incomes only slightly greater.

The other policies can be analyzed similarly; the important point is that our previous findings are fairly robust when extended to continuous income distributions.

5. Conclusion

Making use of a simple multi-community model we obtain strong predictions about the impact of several policies on community tax rates, qualities of education, the allocation of individuals across communities, and welfare. We summarize our main findings below.

Policies that subsidize the location of particular individuals in specific communities have very different effects depending both on the income group and the community targeted. Whereas subsidizing middle income people to locate in the wealthy community reduces the welfare of all individuals and lowers the quality of education in both communities, a subsidy to locate lowest income individuals in the wealthy community can make everyone better off and raise the quality of education in both communities. A policy that subsidizes the residency of middle income individuals in the poor community, on the other hand, is Pareto improving and increases the quality of education in both communities.

Many states have attempted to deal with inequality in per pupil spending across communities by requiring that rich communities spend less and/or poor communities spend more. We find that a policy that limits spending in the rich community has negative consequences: the quality of education in both communities decreases and all individuals are made worse off. The effects of a policy that mandates greater spending on education in the poor community depends on the identity of the median voter in that community. If the median voter is a middle income individual, then all individuals are made worse off.

A significant finding of our analysis is that a large number of policies produce the same qualitative welfare effect for all individuals. This is surprising since, given heterogeneity of individuals and the redistributive nature of the policies considered, one might have expected most policies to generate both winners and losers. Community composition effects play a key role in obtaining this consensus: were it possible to simply decrease (increase) the fraction of middle income people in the wealthy community, this would by itself increase (decrease) the welfare of all individuals. Policies that affect community composition, therefore, can make all better or worse off.

The analysis was deliberately carried out in a simple framework in order to facilitate an understanding of the interactions of some of the basic forces at work. The model as is captures three important features of the context in which expenditures on primary and secondary education are determined in the US: individuals differ in income, decision-making on educational finance occurs largely at the local level, and households are mobile across communities. Of course, many other factors were left out and would be of great interest to examine in future analyses. Prominent among these are: (i) the existence of a private alternative to public education,[24] (ii) the ability of communities to render themselves more impermeable to the inflow of low

[24]See Stiglitz (1974) for an interesting analysis although not in the context of a multi-community model.

income individuals (through zoning, for example),[25] (iii) different strategic interactions among communities, (iv) dynamic considerations,[26] and (v) the existence of a housing market.

---

[25]See Hamilton (1974).

[26]See Durlauf (1992)

References

Benabou, R., "Workings of a City: Location, Education, and Production," mimeo, MIT, (1991).

Benson C., and O'Halloran K., "The Economic History of School Finance in the United States," Journal of Education Finance 12 (Spring 1987), 495-515.

Berne, R., "Equity Issues in School Finance," Journal of Education Finance 14 (Fall 1988), 159-180.

Card, D. and A. Krueger, "Does School Quality Matter? Returns to Education and the Characteristics of Public Schools in the United States", Journal of Political Economy 100 (1992), 1-40.

Coleman, J. et al, Equality of Educational Opportunity. Washington: Government Printing Office, (1966).

de Bartolome, C., "Equilibrium and Inefficiency in a Community Model With Peer Group Effects," Journal of Political Economy 98 (1990), 110-133.

Durlauf, S., "A Theory of Persistent Income Inequality", mimeo, Stanford, (1992).

Epple, D., Filimon, R., and T. Romer, "Equilibrium Among Local Jurisdictions: Toward an Integrated Treatment of Voting and Residential Choice," Journal of Public Economics 24 (1984), 281-308.

Epple, D. and T. Romer, "Mobility and Redistribution," Journal of Political Economy 99 (1991), 828-858.

Epple, D. and A. Zelenitz, "The Implications of Competition Among Jurisdictions: Does Tiebout Need Politics," Journal of Political Economy 89 (1981), 1197-1217.

Guthrie, J.W., "United States School Finance Policy, 1955-1980," Educational Evaluation and Policy Analysis 5 (Summer 1983), 207-230.

Hamilton, B., "Zoning and Property Taxation in a System of Local Governments," Urban Studies 12 (1975), 205-211.

Inman, R., "Optimal Fiscal Reform of Metropolitan Schools: Some Simulation Results,", American Economic Review 68 (1978), 107-122.

Kozol, J., Savage Inequalities, New York: Crown Publishers, (1991).

Roberts, K.W.S., "Voting Over Income Tax Schedules," Journal of Public Economics 8 (1977), 329-40.

Rose-Ackerman, S., "Beyond Tiebout: Modeling the Political Economy of Local Government," in Zodrow, G.R. ed., Local Provision of Public Services: The Tiebout Model After Twenty-five Years, (Academic Press), (1983), 55-83.

Rose-Ackerman, S., "Market Models of Local Government: Exit, Voting and the Land Market," Journal of Urban Economy 6 (1979), 319-337.

Rubinfeld, D., "The Economics of the Local Public Sector," in A.J. Auerbach and M. Feldstein, eds., Handbook of Public Economics, vol.2, (Elsevier Science Publishers North Holland), (1987), 571-645.

Stiglitz, J.E., "The Demand for Education in Public and Private School Systems," Journal of Public Economics 3 (1974), 349-385.

Stiglitz, J.E., "The Theory of Local Public Goods," in Feldstein, M. and R.P. Inman, eds., The Economics of Public Services, (Macmillan, London), (1977), 274-333.

Westhoff, F., "Existence of Equilibria in Economies With a Local Public Good," Journal of Economic Theory 14 (1977), 84-112.

Wise, A.E. and T. Gendler, "Rich Schools, Poor Schools: the Resistence of Unequal Education," The College Board Review 151 (Spring 1989), 12-17 36-37.

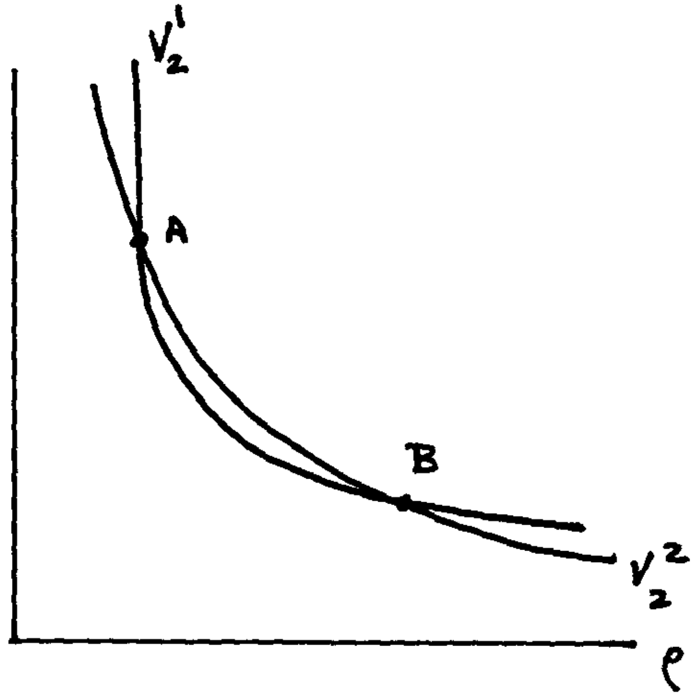

FIGURE 1

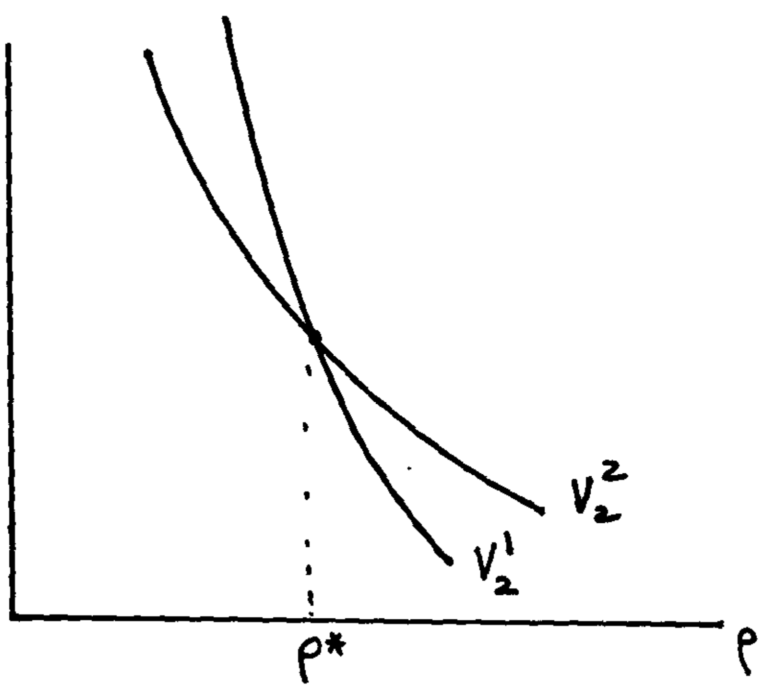

FIGURE 2

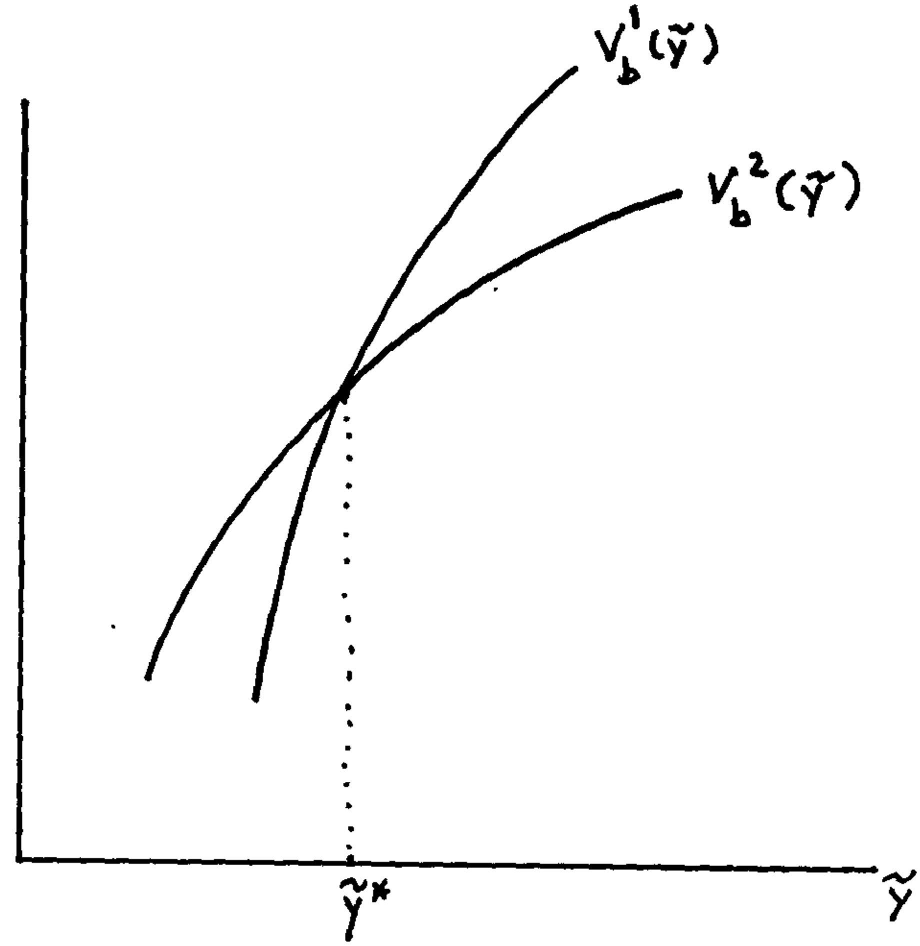

FIGURE 3

Table One

Expenditures Per Pupil in Several School Districts

New Jersey, 1988-89		New York City Area, 1989-90		Chicago Area, 1988-89	
Princeton	7725	Great Neck	15594	Niles Township	9371
Summit	7275	Manhasset	15084	New Trier	8823
West Orange	6505	Jericho	14355	Glencoe	7363
Cherry Hill	5981	Mount Vernon	9112	Winnetka	7059
Jersey City	4566	Roosevelt	8349	Wilmette	6009
East Orange	4457	New York City	7299	Chicago	5265
Paterson	4422				
Camden	3538				

Source: Kozol (1991)

Table Two Simulation Results

A. Tax on y_1 individuals

y_2	% change in V_1	V_2	V_3	ρ	E	q_1	q_2
.2	-.62	.34	.65	.23	.04	-.06	.06
.4	-.48	.48	.95	-.01	.04	-.04	.09
.6	.04	.94	1.87	-.62	-.12	.01	.18

B. Tax on community one

y_2	% change in V_1	V_2	V_3	ρ	E	q_1	q_2
.2	1.0	.84	.85	-2.4	-.36	.12	.09
.4	1.0	.84	.86	-2.0	-.35	.12	.09
.6	1.7	1.5	1.5	-2.6	-.77	.19	.14

Notes:

Specification in all cases is $u(c)=c^{\alpha}/\alpha$, $f(q)=q$, with $y_1=1$, $y_3=.95y_2$, $\alpha=-10$, $\beta=.5$, $\lambda=(.20,.35,.45)$. Percent changes correspond to change from $\tau=0$ to $\tau=.001$.