Public Goods as a Screening Mechanism

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Abstract

Court decisions in the past twenty years such as Southern Burlington County NAACP v. Mount Laurel Associated, as well recent legislation, have made exclusionary zoning laws based on race illegal and have limited, at least in many states, the legality of exclusionary zoning based on income. While there may be a number of reasons for the use of exclusionary or fiscal zoning, an economic rationale suggested by Hamilton (1975) is that fiscal zoning, in the form of minimum housing standards, can reduce or eliminate the divergence between tax payments and the cost of providing public services that arise from financing local public services through property taxes. In the absence of fiscal zoning an inefficient and possibly undefined equilibrium mix of residents among localities may exist. Fiscal zoning, by effectively requiring a minimum value of any house in the community, will lead to a minimum property tax payment for every household, thereby eliminating the possibility that the cost of public services received families with lower housing consumption and presumably income exceed the tax payments to them.

Here we demonstrate that in the absence of zoning, higher income households, to ensure that low income households do not enter their community, can either increase their public services or subsidize goods consumed by higher income households but not lower income households. These strategies will make the rich community less attractive to the poor leading them to leave the community, thereby reducing the subsidy paid by the rich and increasing their utility.

JEL Classification: H7: State and Local Government, Intergovernmental Issues; H4: Publicly-Provided Goods

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1. Introduction

Court decisions in the past twenty years, with Southern Burlington County NAACP v. Mount Laurel Associated being the most famous, as well recent legislation have made exclusionary zoning based on race illegal and have limited, at least in many states, the legality of exclusionary zoning based on income.[1] "Redlining", the practice by realtors of not showing houses in certain areas, generally higher income suburbs to African-Americans or other minority groups, as well as other illegal discriminatory practices in housing markets have been the focus of legal enforcement for a number of years. Both exclusionary zoning and more overt discriminatory practices such as redlining are intended to preserve the homogeneity of communities either with respect to income or along racial lines. While there may be a number of reasons for the use of exclusionary or fiscal zoning, an economic rationale suggested by Hamilton (1975, 1976) is that fiscal zoning, in the form of minimum housing standards, can reduce or eliminate the divergence between tax payments and the cost of providing public services that arise from financing local public services through property taxes.[2] In the absence of fiscal zoning an inefficient and possibly undefined equilibrium mix of residents among localities may exist. Fiscal zoning, by effectively requiring a minimum value of any house in the community, will lead to a minimum property tax payment for every household, thereby eliminating the possibility that the cost of public services received families with lower housing consumption and presumably income exceed the tax payments to them.

In this paper we present two alternative strategies in which higher income communities can engage to ensure low income households, paying less in taxes than it costs to provide public services to them, either do not enter their community or are at least reduced in number. One strategy is to increase or, under certain conditions, decrease public services in their community

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[1] For an excellent discussion of legal cases related to zoning see Fischel (1985).

[2] The past twenty years have also brought signification changes in educational funding through court cases such as Serrano v. Priest (1971) that have reduces the fiscal incentive of higher income communities to engage in exclusionary zoning.

relative to the level they would choose given the current population of the community. By changing the level of the public service in their community in a way that makes it less attractive to the poor they reduce the number of poor in the community. The gains from reducing the number of poor and the subsidy the rich pay to them outweighs the cost of distorting the public service. Another strategy is to expand the public sector by subsidizing or providing essentially private goods and services valued and consumed by high income households but not by lower income households. Essentially these are goods with higher income elasticities. Obvious examples of these types of services provided by localities might include golf courses and other recreational facilities, art and other museums, subsidies to performing arts, and community educational programs. By subsidizing private goods not consumed by the poor, the community becomes less attractive to the poor and again the number of poor and the subsidy paid to them are reduced. While there are no doubt other reasons for why these services might be provided in or subsidized by the public sector, we argue that public funding of services primarily used by higher income households is consistent with an attempt of the higher income households in these communities to make the communities less attractive to lower income households.[3]

Section 2 of this paper introduces the model and the concept of a non-screening equilibrium (NSE) in which we have heterogeneous communities but these communities do not engage in strategies to reduce the number ("screen out") the poor. In *Section 3* we consider both screening strategies in a simple model that will generate homogenous communities as a result of screening. In *Section 4* we briefly discuss a more complicated model in which screening may not lead to completely homogeneous communities but will reduce the number of poor in the rich community. *Section 5* concludes.

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[3] An alternative explanation as to why these services are publicly provided in higher income communities is that the subsidy to local public services due to the deductibility of local property and payroll taxes is higher in communities with high incomes as marginal tax rates there are higher and households are more likely to itemize their deductions.

2. A Simple Model of Screening

The economy consists of two types of individuals, rich and poor, denoted by supercript $i = p, r$. These two types of individuals differ only in their incomes with $y^r > y^p$. The utility function for both types is given by the separable function U[x,q] = A(x) + B(z) +C(q), where x and z are private goods both with prices normalized to unity and q is the quality of a public service. We also assume the public service is simply a publicly-provided good with the cost of providing the public service for n individuals equal to nq.

The economy has two communities. In each community, the public service is financed by a linear income tax so that an individual with an income of y^i pays taxes of ty^i with $t \in (0,1)$. The budget constraint of the community depends on the composition of the community. Regardless of the equilibrium we consider, given our two income groups, we shall always have someone residing in both communities.

Proposition 1: No community is empty in equilibrium.

Proposition 1 will hold because if one community is empty, then a rich individual (or group) would be better off by moving to the empty community where they can obtain a lower tax rate for any given level of the public service. Thus possible equilibria will always consist of two communities with possible equilibria including homogenous communities (rich in one community and the poor in the other); two heterogeneous but identical communities; one community consisting only of the poor and the other consisting of both the rich and the poor; and one community consisting only of the rich and the other consisting of both the rich and the poor.

2.1 Equilibrium with Homogenous Communities

We now wish to consider the equilibrium conditions, that is, the public service levels, if the communities were homogenous. We postpone any discussion of whether this homogeneity can be achieved in the absence of any market intervention, such as zoning, or requires zoning. Since our interest is considering how higher-income communities might strategically alter their public service provision to reduce the "subsidization" of lower income residents, we consider their public service provision rule in the absence of the need to act strategically.

When homogenous, community *i*'s budget constraint is

$$tN^i ty^i = N^i q^i. \qquad (1)$$

where N^i is the number of type *i* in the economy. An individual's budget constraint is given by

$$x^i + z^i = y^i - ty^i . \qquad (2)$$

Since we have two private goods and one public good and later we consider the impact of subsidizing a private good it will be useful to express utility in the form of the indirect utility function, U = V(y(1-t),p_z,q), where p_z denotes the price of *z* to the individual and in the absence of any subsidy equals unity. We make the assumption that

$$\frac{d\left[\frac{V_q}{V_y y}\right]}{dy} > 0 \qquad (3)$$

where the subscript i refers to $\frac{\partial V}{\partial i}$. This is the single crossing assumption (Westhoff (1977)) which implies that the higher the income for the public service the higher the demand.

Then the public service level q^i is chosen to maximize V(y(1-t),p_z,q) subject to *(1)* and *(2).* Let q^{i^*} denote the optimal level for type *i*. Then q^{i^*} will maximize

$$V(y^i - q, 1, q). \qquad (4)$$

The first order condition is simply

$$-V_y^i (y^i - q^{i^*}) + V_q^i = 0 \quad . \qquad (5)$$

where $V_y^i = \frac{\partial V^i}{\partial y}$, and $V_q^i = \frac{\partial U^i}{\partial q}$, i = p, r. Assuming that in the separable utility function that x, z, and q exhibit increasing but diminishing utility, $q^{r^*} > q^{p^*}$, the desired public service level increases with income. We state the first order condition as a basis for comparing the public service level in the absence of screening to the public service level with screening.

2.2 Non-Screening Equilibrium

If the two communities are homogeneous with respect to income, it can be seen that no rich individual has an incentive to move to the poor community since

$$V[y^r - q^{r^*}, 1, q^{r^*}] > V[y^r - q^{p^*}, 1, q^{p^*}] > V\left[y^r\left(1 - \frac{q^{p^*}}{y^p}\right), 1, q^{p^*}\right]. \quad (6)$$

The first inequality follows from the definition of q^{r^*} and the second comes from the fact that $\frac{y^r}{y^p} q^{p^*} > q^{p^*}$. In the poor community, the rich individual would obtain a lower level of the public service than he desires and face a higher tax rate as well. We should note that throughout the analysis we assume that an individual takes (q^i, t^i) as given in both communities when he is deciding in which community to reside.

However, the poor, under other conditions may desire to move to the rich community depending on

$$V\left[y^p - q^{p^*}, 1, q^{p^*}\right] > (<) \; V\left[y^r\left(1 - \frac{q^{r^*}_r}{y^r}\right), 1, q^{r^*}\right] \quad (7)$$

This inequality depends on the respective incomes of the rich and poor (y^p and y^r and the shape of the utility function. If utility for the poor is greater with (q^{p^*}, t^{p^*}) than with (q^{r^*}, t^{r^*}) (> holds) then each of the communities in homogeneous and the level of public services in each community is efficient, satisfying (5). The case in which we are interested is when the utility of the poor is greater in the rich community (< holds). A sufficient condition for this to occur is

$$q^{p^*} > \frac{y^p}{y^r}\left(q^{r^*}\right), \quad (8)$$

which simply says that the tax payment for a poor individual is lower in the rich community than in the poor community. While this is a sufficient condition, it is not, by any means, necessary. Since level of public service will be higher in the rich community than the poor community, it possible that even though taxes may be higher for the poor individual in the rich community the poor individual still prefers the rich community because of the higher public services.

If (8) holds, or, more generally if utility is higher for the poor in the rich community, then the poor will move to the rich community. In this equilibrium, the non-screening equilibrium (NSE), the poor must be indifferent between the two communities, or

$$V[y^p(1-t^r),1,q^r] = V[y^p - q^{p^*},1,q^{p^*}] \tag{9}$$

where

$$t^r = \frac{(n^p + N^r)q^r}{(n^p y^p + N^r y^r)} = C(n^p)q^r . \tag{10}$$

where n^p denotes the number of poor moving to the rich community and C(n^p) denotes the marginal tax cost of the public service, a function of n^p .

In this non-screening equilibrium we also assume that the public good level in the rich community q^r is chosen to maximize the utility of the rich given the number of poor in the rich community. This is an assumption that the rich do not consider the impacts of the public service level in their community on the number of poor there. More formally, let $\hat{q}^r$ solve

$$-V_y^r y^r C(n^p) + V_q^r = 0. \tag{11}$$

Equivalently, if the level of public service is determined by the median voter, this is an assumption that in equilibrium $\hat{n}^p < N^r$. Thus, we can state the following result:

Proposition 2. If there exists an $\hat{n}^p < N^r$ *that satisfies (9)-(11), then an NSE exists, and one community consists of both the poor and the rich while the other community consists of only the poor.*

Equations (9) and (10) define an implicit relationship between q^r and n^p, $n^p(q^r)$. Then differentiating (9) and (10) with respect to q^r and n^p and solving gives

$$\frac{\partial n^p}{\partial q^r} = \frac{\left(-V_y^p y^p C(n^p) + V_q^p\right)}{V_y^p y^p C'(n^p) q^r} \; where \; C'(n_p) = \frac{N^r (y^r - y^p)}{\left[n^p y^p + N^r y^r\right]^2} > 0 \qquad (12)$$

As the denominator of (12) is always positive, the sign of $\frac{\partial n^p}{\partial q^r}$ depends on the sign of the numerator. The numerator is simply the $\frac{dU^p}{dq^r}$, the balanced-budget change in utility from an increase in q^r. Then (12) is positive, that is the poor will move into the rich community when an increase in q^r increases the utility of the poor. Conversely, if the numerator of (12) is negative, the poor will leave the rich community when q^r increases as it decreases the poor's utility. We can summarize the impacts of changes in q^r on the migration of the poor in the following proposition.

Proposition 3. In the NSE $\frac{\partial n^p}{\partial q^r} < 0.$

This follows from the fact that in the NSE $\hat{q}^r$ maximizes the utility for the rich with $-V_y^r y^r C(n^p) + V_q^r = 0$ by (11). Then given our assumption on demands, (3) it must be the case that $-V_y^p y^p C(n^p) + V_q^p < 0$ at $\hat{q}^r$ and therefore by (12) we have $\frac{\partial n^p}{\partial q^r} < 0.$

3. Screening Equilibrium

We now consider the equilibrium when the rich, when choosing their policies consider the impact of these policies on the migration of the poor into the rich community. Because, in this framework in which the poor always have the level of utility in equilibrium, we obtain homogenous communities, we refer to these equilibria as "screening equilibria." We first consider the equilibrium when the rich alter the level of public service to influence the number of poor in their community. Next we consider another policy tool, subsidizing a private good of which the rich consume proportionately more. Finally, we examine the mix of these two policies.

3.1 Screening with the Public Service

In the NSE we assume that the rich, when choosing the public service quality, ignore the impact service quality has on the number of poor in their community as (10), the first order condition for the public service, indicates. In the screening equilibrium with the public service (SEQ) we consider the impacts of changes in quality have on the number of poor in the community and how, if residents consider these effects, they might alter the level of public service. Since we wish to consider whether the rich have reason to deviate from the NSE, we evaluate a change in q^r at $\hat{q}_r$ on the utility of the rich and poor. For the rich we have

$$\left.\frac{dU^r}{dq^r}\right|_{q^r=\hat{q}^r} = -V_y^r y^r \hat{q}^r C'(n^p(\hat{q}^r))\frac{\partial n^p}{\partial q^r} > 0 . \tag{13}$$

For the rich, the impact of a marginal increase in the public service starting from $\hat{q}_r$ depends on the impact on the marginal tax cost which, in turn, depends on the impact on the number of poor in the rich community. This is the only effect of the increase in q^r on the rich's utility since we are evaluating the impact of an increase in the public service at the level that maximizes the rich's utility (envelope theorem). Then if the desired level by the rich exceeds the level desired by the poor, as we assume, then an increase in the quality of public service will increase the utility of the rich by causing the poor to leave the rich community and decreasing public service costs.

The utility of the poor is not affected by the change in q^r because the equal utility condition, (9), means that the migration of the poor into the rich's community will not increase the utility they receive since it does not affect the utility they can obtain in the poor community.[4]

Proposition 4. In the SEQ we have $n^p = 0$ *and* $q = \tilde{q}^r > q^{r^8}$ *and* $\tilde{q}^r$ *satisfies* $V(y^p(1-\tilde{t}^r),1, \tilde{q}^r) = U^{p^8}$ where $\tilde{t}^r = \dfrac{\tilde{q}^r}{y^r}$.

Proof: The first order condition (for an interior solution) is

$$\left(-V_y^r y^r C(n^p(\tilde{q}^r)) + V_q^r\right) - V_y^r y^r \tilde{q}^r C'(n^p(\tilde{q}^r)) \frac{\partial n^p}{\partial q^r} = 0 \tag{14}$$

then if we substitute for $\dfrac{\partial n^p}{\partial q^r}$ using (11) an simplify gives

$$\left(-V_y^r y^r C(n^p(\tilde{q}^r)) + V_q^r\right) - \frac{V_y^r y^r}{V_y^p y^p}\left(-V_y^p y^p C(n^p(\tilde{q}^r)) + V_q^p\right) = 0$$
$$or, equivalently, \tag{15}$$
$$\frac{V_q^r}{V_y^p y^p} - \frac{V_q^p}{V_y^p y^p} = 0$$

Only if (15) is satisfied can $n^p > 0$ which by (3) can never be satisfied. Thus, since the rich always have a greater demand for the public service than the poor for any tax rate at which $n^p > 0$ with screening communities must again be homogeneous. While the poor's utility is not affected by this screening, the utility of the rich is greater in the SEQ than in the NSE but lower than utility in the homogeneous community since $\tilde{q}^r > q^{r^*}$ for the poor not to reside in the rich community.

3.2 Screening by Subsidizing Private Goods

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[4] This result is very specific to this relatively simply model. For example, if the public service exhibited increasing or decreasing marginal cost with respect to community size, then the utility of the poor would be affected by a change in q^r as changes in the population of the poor community will change the cost of providing public services there. In *Section 4* we consider screening when the utility of the poor is affected by the population of the poor community.

We now consider an alternative strategy the rich community might employ to "screen" the poor. This strategy consists of subsidizing a private good on which the rich spend proportionately more of their income. We denote this good by z. In this section we outline the conditions under which the rich community would offer this subsidy and define the optimal subsidy. We refer to this equilibrium as the SES, the screening equilibrium with a subsidy. In this section we follow our assumption in the NSE that the rich community will choose the public service level ignoring the impact it has on migration of the poor. In *Section 3.3* we consider both screening with the public service and through a subsidy simultaneously. With a subsidy of *s* per unit of *z* the budget constraint in the rich community is given by

$$t^r = \frac{(n^p + N^r)q^r + s(z^r N^r + z^p n^p)}{(n^p y^p + N^r y^r)} \tag{16}$$

where $z^i = z(y^i(1-t^r), 1-s),\ i = p, r$. The equal utility condition for the poor is now

$$V(y^p(1-t^r), 1-s, q^r) = u_p^* . \tag{17}$$

Then differentiating (16) with respect to *s* gives

$$\frac{\partial t^r}{\partial s} = \left(\left(N^r \left[z^r - s z^r_{1-s} \right] + n^p \left[z^p - s z^p_{1-s} \right] \right) + \left(q^r + s z^p - t^r y^p \right) \frac{\partial n^p}{\partial s} \right) A \tag{18}$$

where $A = \left[\left(n^p y^p + N^r y^r \right) + s\left(N^r y^r z^r_y + n^p y^p z^p_y \right) \right]^{-1} > 0$. There are two effects of the subsidy on the tax rate. The first is the expected increase because of the direct increase in costs given the consumption of the current population and the increase in consumption the subsidy will cause. The second effect, however, depends on the impact of the subsidy on the number of poor in the rich community. Given that the poor are being subsidized, $\left(q^r + s z^p - t^r y^p \right) > 0$, if the subsidy makes the rich community less attract to the poor, $\frac{\partial n^p}{\partial s} < 0$, this will act to reduce taxes. We can solve explicitly for the impact of an increase in the subsidy on the tax rate and number of poor by also differentiating (17) with respect to *s* and using this with (18) to give

$$\frac{\partial t^r}{\partial s} = \frac{z^p}{y^p} \qquad (19)$$

and $$\frac{\partial n^p}{\partial s} = N^r y^r \left[\frac{z^p}{y^p} - \frac{z^r}{y^r}\right] + s\left[N^r\left(z_y^r z^r\left(\frac{z^p}{y^p}\frac{y^r}{z^r}\right) + z_{1-s}^r\right) + n^p\left(z_y^p z^p + z_{1-s}^p\right)\right]B \qquad (20)$$

where $B = (q^r + sz^p - t^r y^p)^{-1} > 0$. The impact of the subsidy on the tax rate is determined entirely by the equal utility condition (21). The impact of the subsidy on the number of poor in the rich community depends on whether $\frac{z^p}{y^p} < (>) \frac{z^r}{y^r}$. If $\frac{z^p}{y^p} < \frac{z^r}{y^r}$ then, regardless of the level of the subsidy, it reduces the number of poor in the rich community. If $\frac{z^p}{y^p} > \frac{z^r}{y^r}$ while the subsidy initially increases the number of poor, at higher levels it may decrease the their number.[5]

To determine whether it is optimal for the rich community to subsidize z we totally differentiate the utility of the rich with respect to s to obtain:

$$\frac{dU^r}{ds} = -V_y^r y^r \frac{\partial t^r}{\partial s} - V_{(1-s)}^r = V_y^r\left[-y^r \frac{z^p}{y^p} - z^r\right] \qquad (22)$$

The second expression for $\frac{dU^r}{ds}$ is obtained by using (19) to substitute for $\frac{\partial t^r}{\partial s}$. As (21) indicates, $\frac{dU^r}{ds} > 0$ if $\frac{z_r}{y_r} > \frac{z_p}{y_p}$. One immediate implication of (21) can be summarized in the following proposition.

Proposition 5. If $\frac{z(y^r(1-\hat{t}^r),1)}{y^r} > \frac{z(y^p(1-\hat{t}^p),1)}{y^p}$ *in the NSE (s=0) then the rich can increase their utility and reduce* n^p *by instituting a subsidy on z.*

Then if the budget share of z in the absence of any subsidy is greater for the rich than the poor, it is always advantageous for the rich to institute a subsidy. If $\frac{z_r}{y_r} > \frac{z_p}{y_p}$ and the poor were

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[5] The term $z_y^p z^p + z_{(1-s)}^p < 0$ as this is simply the derivative of compensated demand for z with respect to its price. If $\frac{z^r}{y^r} > \frac{z^p}{y^p}$ then it also must be the case that $z_y^r z^r\left(\frac{z^p}{y^p}\frac{y^r}{z^r}\right) + z_{(1-s)}^r < 0$.

not mobile, that is, $\frac{\partial n^p}{\partial s}=0$, it would still be optimal for the rich to subsidize z. This can be seen by using (18) to determine $\frac{\partial t^r}{\partial s}$ when $\frac{\partial n^p}{\partial s}=0$ and *s* = 0. The reason is at *s* = 0 for a marginal increase in the subsidy, the benefits of the subsidy are proportionate to the amount of *z* consumed while the cost, since it is financed by an income tax, is proportionate to income. Then the benefits outweigh the costs for the rich if they spend proportionately more on *z* than the poor.

While we have shown that it is optimal for the rich community to offer a subsidy, we have not attempted to determine the optimal amount of the subsidy, that is, the subsidy that maximizes the utility of the rich. Letting $\tilde{s}$ denote the optimal subsidy, we summarize some of the conditions determining it in the following proposition.

Proposition 6. i) If $\frac{z(y^r(1-t^r(q^r,s)),1-s)}{y^r}>\frac{z(y^p(1-t^r(q^r,s)),1-s)}{y^p}$ *for all* $(s,q^r(s))$ *where* $t^r(q^r,s)$ *is defined by (16) and* $q^r(s)$ *satisfies* $-V_y\left[y^r(1-t^r),1-s\right]\frac{\left(n^p+N^r\right)}{\left(n^py^p+N^ry^r\right)}y^r+V_q\left[q^r\right]=0$ *then in the SES we have* $n^p = 0$. *ii) The optimal subsidy/public service mix,* $(\tilde{s},q^r(\tilde{s}))$ *satisfies* $V(y^p(1-\tilde{t}^r),1-\tilde{s},\ q^r(\tilde{s}))=U^{p^*}$ where $\tilde{t}^r=\frac{\tilde{q}^r+\tilde{s}z(y^r(1-\tilde{t}^r),1-\tilde{s})}{y^r}$.

As with the case with the public good, it will be optimal for the rich community to continue subsidizing the public good until $n^p = 0$ if $\frac{z_r}{y_r}>\frac{z_p}{y_p}$. This result is dramatically different than if the community was homogeneous or the poor were immobile. Not only do the rich have an incentive to subsidize private goods with income elasticities exceeding unity, they have incentive to subsidize these goods as much as possible – even offering them at no charge if the rich will still consume proportionately more of the goods when they are offered at no cost.

The subsidy is clearly welfare improving, having no effect on the utility of the poor and increasing the utility of the rich. This result occurs because the NSE is clearly inefficient as an efficient equilibrium requires homogenous communities. Then because of the existing inefficiency, the subsidy, while distorting consumption is welfare improving by reducing the heterogeneity of the communities. While we obtain homogenous communities in the SES, this is clearly a second-best equilibrium as the subsidy will distort consumption relative to what would be obtained if homogenous communities could be enforced by some more direct method such as income requirements.

3.3 Screening with both the Public Good and Subsidizing Private Goods

In *Sections 3.1* and *3.2* we have shown that either the public good or a subsidized private good that is a luxury can be used as screening mechanisms. Of course, presumably the rich community would consider the use of both strategies to screen out the poor. In this section we show that, in general, it is optimal for the rich to use both strategies.

We are considering which of the combinations of (q^r,s) will maximize the utility of the rich while ensuring that $n^p = 0$. Formally, we have

$$\begin{aligned} &\underset{q^r,s}{Maximize}\ V(y^r(1-t^r),1-s,q^r) \\ &s.t.\ V(y^p(1-t^r),1-s,q^r) \le U^{p^*} \\ &\quad t^r = \frac{q^r + sz(y^r(1-t^r),1-s)}{y^r} \end{aligned} \tag{22}$$

The first order conditions for (22) are:

$$V_y^r\left(-y^r\frac{\partial t^r}{\partial q^r}+\frac{V_q}{V_y^r}\right)-\lambda V_y^p\left(-y^p\frac{\partial t^r}{\partial q^r}+\frac{V_q}{V_y^p}\right)=0 \tag{23}$$

and
$$V_y^r\left(-y^r\frac{\partial t^r}{\partial s}+z^r\right)-\lambda V_y^p\left(-y^p\frac{\partial t^r}{\partial s}+z^p\right)=0 \tag{24}$$

where $\lambda > 0$. Our interest here is in merely determining when and whether it is optimal to screen using both the public good and the subsidy. To simplify our discussion, we assume that the single crossing condition is satisfied so that $\tilde{q}^r > q^{r^*}$. We first consider when it is optimal to use the subsidy given that $q^r = \tilde{q}^r$ (23 is satisfied) and therefore $n^p = 0$. At $s = 0$, $\left.\frac{dU^r}{ds}\right|_{s=0}$, the left side of (24), equals

$$\left.\frac{dU^r}{ds}\right|_{s=0} = -\lambda V_y^p\left(-y^p \frac{z^r}{y^r} + z^p\right) > (<)\ 0\ if\ \frac{z^r}{y^r} > \frac{z^p}{y^p} \tag{25}$$

We obtain (25) by using the fact that $\frac{\partial t^r}{\partial s} = \frac{z^r}{y^r}$. Again, when we only use the public service to screen, it is optimal to also subsidize z if the rich consume proportionately more of it. If we consider using only the private subsidy to screen ($s = \tilde{s}$) and setting the public good level while ignoring its impacts on migration $\left(-y^r \frac{\partial t^r}{\partial q^r} + \frac{V_q}{V_y^r} = 0\right)$ we find that $\left.\frac{dU^r}{dq^r}\right|_{q^r = q^r(\tilde{s})}$ equals

$$\left.\frac{dU^r}{dq^r}\right|_{q^r = q^r(\tilde{s})} = -\lambda V_y^p\left(-y^p \frac{\partial t^r}{\partial q^r} + \frac{V_q}{V_y^p}\right) > 0.. \tag{26}$$

Expression (26) is positive – the public service level should be increased. Thus we should expect communities to both over-provide the public service and subsidize a private good with an income elasticity exceeding unity. Given that both strategies are being used it follows that the strategies that satisfy (22), $(q^{r^{**}}, s^{**})$ it will be the case that $q^{r^{**}} < \tilde{q}^r$ and $s^{**} < \tilde{s}$.

Our analysis here suggests that screening will, under very reasonable conditions, lead to completely homogenous communities. This result, while interesting and important, should be viewed with some skepticism for two reasons. One reason is that the utility of the poor may be affected by the policies of the rich because of increasing costs in the poor community as its population increases. Another reason which would result in it optimal for the rich not to attempt to obtain a homogenous community through screening would occur if there are heterogeneous tastes with some of the poor have higher demands for the public service and “luxury” than the rich. Both of these extensions are examined in *Section 4*.

4. Screening Equilibrium with Mixed Communities

In our simple model we showed that, under very reasonable assumptions, screening would lead to homogeneous communities – the rich community would increase (or decrease) its public service and/or subsidize a private good of which the rich consume proportionately more until no poor remained in the rich community. Two features of our model are critical to obtaining this result. First, the utility of the poor is independent of any of the policies chosen in the rich community. Second, all the poor have identical tastes so they all have a lower (or higher) demand for the public service and a lower demand for the subsidized private good than the rich. In this section we briefly relax both of these features, first demonstrating that if the poor's utility does depend on the utility of the rich, because of a limited resource such as housing, that screening will decrease the number of poor in the rich community but not necessarily eliminate all poor. We then discuss how heterogeneity in preferences of the poor, with some having a high demand for the public service or subsidized good, will mean that the rich community will be heterogeneous with respect to income in the SE.

4.1 SE with Limited Housing

The independence of the utility of the poor on policies in the rich community occurs because there are no diseconomies of scale in producing the public service or limited resources in the poor community. If, however, there is limited housing increases in the population of the poor community will reduce their utility by increasing housing prices. Rather than attempting to formally model a housing market as in Epple et. al. (1984) or Epple and Romer (1991) we simply assume that there is a cost associated with living in a community that depends on the number in the community H(n) with H'> 0 and H"> 0 for some n > n^*. Each of the n individuals must pay $\frac{H(n)}{n}$ to cover this cost. One interpretation of this could be that individual's have an inelastic demand for housing and it costs H(n) to produce *n* housing units. As before, to make this an interesting problem we assuming that in the NSE there will be poor in the rich community, $n^p > 0$. With the additional housing cost the equilibrium conditions are now

$$V[y^p(1-t^r) - \frac{C(N^r+n^p)}{(N^r+n^p)}, 1-s, q^r] = V[y^p - q^p - \frac{C(N^p-n^p)}{(N^p-n^p)}, 1, q^p] \qquad (27)$$

where

$$t^r = \frac{(n^p+N^r)q^r + s(n^p z^p + N^r z^r)}{(n^p y^p + N^r y^r)} = C(n^p)q^r . \qquad (28)$$

As before the rich choose the (q^r,s) to maximize their utility subject to (27) and (28).

$$\begin{aligned} &\underset{q^r,s}{Maximize}\; V(y^r(1-t^r) - \frac{H(N^r+n^p)}{(N^r+n^p)}, 1-s, q^r) \\ &s.t.\; V(y^p(1-t^r) - \frac{H(N^p+n^p)}{(N^p+n^p)}, 1-s, q^r) = V(y^p - q^p - \frac{H(N^p-n^p)}{(N^p-n^p)}, 1-s, q^p) \\ &\quad t^r = \frac{q^r + sz(y^r(1-t^r), 1-s)}{y^r} \end{aligned} \qquad (29)$$

The first order conditions for (29) are:

$$V_y^r\left(-y^r\frac{\partial t^r}{\partial q^r} - AH_n^r\frac{\partial n^p}{\partial q^r} + \frac{V_q}{V_y^r}\right) + \lambda\left[V_y^p AH_n^r\frac{\partial n^p}{\partial q^r} - V_y^p\left(-y^p\frac{\partial t^r}{\partial q^r} - AH_n^r\frac{\partial n^p}{\partial q^r} + \frac{V_q}{V_y^p}\right)\right] = 0 \qquad (30)$$

and

$$V_y^r\left(-y^r\frac{\partial t^r}{\partial s} - AH_n^r\frac{\partial n^p}{\partial s} + z^r\right) + \lambda\left[V_y^p AH_n^r\frac{\partial n^p}{\partial s} - V_y^p\left(-y^p\frac{\partial t^r}{\partial s} - AH_n^r\frac{\partial n^p}{\partial s} + z^p\right)\right] = 0 \qquad (31)$$

where AH_n denotes $\frac{\partial[H(n)/n]}{\partial n}$. Note that in our formulation of (30) and (31) we are assuming that the rich consider the impact of the migration of poor on both their taxes and housing costs. Assume that $-y^r\frac{\partial t^r}{\partial q^r} - AH_n^r\frac{\partial n^p}{\partial q^r} + \frac{V_q}{V_y^r} > -y^p\frac{\partial t^r}{\partial q^r} - AH_n^r\frac{\partial n^p}{\partial q^r} + \frac{V_q}{V_y^p}$ for any q^r-- the rich have a higher demand for the public service given any tax rate, t^r. In the absence of any impact of increasing q^r on the utility the poor received in the poor community, this condition lead to the rich increasing q^r until $n^p = 0$, Now, however, increases in q^r, by increasing the population in the poor community, will decrease the utility received by the poor. Then because utility of the poor is decreasing in the poor community, the optimal q^r can be obtained with $n^p > 0$ even when we assume $-y^r \frac{\partial t^r}{\partial q^r} - AH_n^r \frac{\partial n^p}{\partial q^r} + \frac{V_q}{V_y^r} > -y^p \frac{\partial t^r}{\partial q^r} - AH_n^r \frac{\partial n^p}{\partial q^r} + \frac{V_q}{V_y^p}$. A similar argument applies to the possibility of an interior solution ($n^p > 0$) for *s* as well.

Whether our analysis in *Section 3* in which we would expect screening to result in homogeneous communities or that here, in which it may not, is more appropriate, is in part an issue of the size of the rich community relative to the poor communities. If the rich community has a small fraction of the entire population in the metropolitan area, that is, the area in which people can costlessly migrate, then the policies of this community are unlikely to affect the utility that can be obtained by the poor.[6] Then if these communities should engage in screening practices we should expect them to be very homogenous. Of course, as we discussed in *Section 3,* the heterogeneity of tastes among the rich and poor, might preclude complete homogeneity as some poor may desire a higher public service level than the rich or consume proportionately more of their income than rich on the "luxury" z.

Larger communities, however, may influence the general utility level by their policies. and therefore for these communities we should not expect to observe complete homogeneity regardless of the heterogeneity of tastes.

4.2 Screening with Heterogeneous Tastes

[6] Of course, expanding to more than two communities requires some conditions limiting the size of the communities. One obvious condition is housing supply or land. In a model with a housing market and mobility and a number of rich communities, we would expect to have the rich have their utility independent of their community's actions as well as the poor's utility. In this case, the rich, if they owned land in the community in which they resided, would still have the incentive to screen out the poor as it would increase property values.

We now wish to consider the equilibrium if not all the poor have the same tastes. Specifically, we assume there are two groups of poor, N^{p_H} "high" demanders of the public service and z and N^{p_L} "low" demanders with $N^{p_H} < N^{p_L}$. We assume that for any given tax rate and public service mix, it is the case that

$$\frac{V_q^{p_L}}{V_y^{p_L} y^p} < \frac{V_q^r}{V_y^r y^r} < \frac{V_q^{p_H}}{V_y^{p_H} y^p} \tag{32}$$

and that for any mix of the subsidy and tax rate (s,t) we have

$$\frac{z^L(y^p(1-t),1-s)}{y^p} < \frac{z(y^r(1-t),1-s)}{y^r} < \frac{z^H(y^p(1-t),1-s)}{y^p} \tag{33}$$

Then (32) and (33) are stating that the demand for q and z by the high demanding poor exceeds the demand for q and z by the rich.

Proposition 7. Assume that a NSE exists with $n^p > 0$. *Then it must be the case that either: i)* $n^p < N^{p_H}$ *and only high demanding poor live in the rich community; or 2)* $n^p > N^{p_H}$ *and all high demanding poor live in the rich community.*

Proposition 8 follows from the fact that it cannot be an equilibrium if any individuals with the same income and tastes live in both communities and obtain different levels of utility and it is not possible for both the high and low-demanding poor to both be indifferent between the poor and rich community. Our interest is in the NSE in which $n^p > N^{p_H}$ and all the high-demanding poor live in the rich community. In this case we have the equilibrium conditions,

$$V^L[y^p(1-t^r),1,q^r] = V^L[y^p - q^{p^*},1,q^{p^*}] \tag{34}$$

$$t^r = \frac{(n^{p_L} + N^{P_H} + N^r)q^r + s(z^r N^r + z^{p_L} n^{p_L} + z^{P_H} N^{P_H})}{((n^{p_L} + N^{P_H})y^p + N^r y^r)} \tag{35}$$

where V^L[.] denotes the indirect utility for the low-demand poor; n^{p_L} is the number of low-demanding poor in the rich community; and $Z^{P_i}, i = H, L$ denotes the demand for z by poor group i. Then essentially the problem of the rich is identical to the general problem in *Section 3.3*. Formally,

$$\underset{q^r,s}{Maximize}\ V(y^r(1-t^r(q^r,s)),1-s,q^r)$$
$$s.t.\ V^L(y^p(1-t^r(q^r,s)),1-s,q^r) \leq U^{p^*} \qquad (36)$$

where $U^{P_L^*}$ denotes the utility that can be received by the low-demanding poor in the poor community and $t^r(q^r,s)$ is defined by . The first order conditions for (36) are:

$$V_y^r\left(-y^r\frac{\partial t^r}{\partial q^r}+\frac{V_y^r}{V_y^r}\right)-\lambda V_y^{p_L}\left(-y^{p_L}\frac{\partial t^r}{\partial q^r}+\frac{V_q^{P_L}}{V_y^{p_L}}\right)=0 \qquad (37)$$

and $$V_y^r\left(-y^r\frac{\partial t^r}{\partial s}+z^r\right)-\lambda V_y^p\left(-y^{p_L}\frac{\partial t^r}{\partial s}+z^{p_L}\right)=0 \qquad (38)$$

Again, given our assumptions on the preferences of the rich and the low-demanding poor, (32)-(34), the conditions (37) and (38) are never satisfied. Then in equilibrium, there can be no low-demanding poor in the rich community, $n^{P_L} = 0$. However, increasing the public service level or the subsidy beyond the levels that give $n^{P_L} = 0$ will not reduce the number of high-demanding poor as their demands for z and q^r exceed those of the rich by assumption. Thus in the SE we have $n^p = N^{P_H}$, screening eliminates the poor with lower demands for the public service and subsidized luxury but not the poor who have demands for these goods that exceed those of the rich.

5. Conclusion

We show that when communities are not homogeneous with respect to income and publicly-provided goods are financed in a way to subsidize the poor, higher income communities have an incentive to try to screen out the poor from its community. We consider two alternative strategies for screening out the poor. One strategy is to over-provide public services relative to the level the community would choose given its current population. Changes in the public service levels of the community will reduce the number of the poor in the community, thereby reducing the subsidy the rich pay to the poor. Another way in which communities can screen is to expand the size of the public sector by subsidizing the consumption of private goods which rich spend a greater share of their income on than the poor do. By doing this, the rich accomplish two things, they get the poor to subsidize their consumption and they reduce the number of the poor in the community, thereby reducing the amount they subsidize the poor's consumption of other publicly-provided goods. Both strategies will result in lower populations of the poor in high income communities, with the possibility of complete screening of the poor out of the community.

Screening could be one explanation as why a variety of services and facilities, including golf courses, museums, community education, that could, on efficiency grounds, operate in the private sector and are primarily used by higher income households are subsidized or operated in the public sector.

References

Epple, Dennis, Radu Filimon, and Thomas Romer. (1984) "Equilibrium among Local Jurisdictions: Toward an Integrated Treatment of Voting and Residential Choice," *Journal of Public Economics*, 24: 281-308.

Epple, Dennis and Thomas Romer. (1991) "Mobility and Redistribution," *Journal of Political Economy*, 99(4):828-858.

Fischel, William A. (1985). *The Economics of Zoning Laws*, Johns Hopkins University Press, Baltimore.

Hamilton, Bruce. (1975) "Zoning and Property Tax in a System of Local Governments," *Urban Studies*, 12: 205-11

_____________. (1976) "Capitalization of Intrajurisdictional Differences in Local Tax Prices," *American Economic Review*, 66: 743-53.

Westhoff, Frank. (1977) "Existence of Equilibria in Economies with a Local Public Good," *Journal of Economic Theory*, 14: 84-112.