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INTRODUCING THE PEER GROUP EFFECT: WHY DECENTRALIZATION IS BAD FOR EFFICIENCY (BUT GOOD FOR EQUITY)

by

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INTRODUCING THE PEER GROUP EFFECT: WHY DECENTRALIZATION IS BAD FOR EFFICIENCY (BUT GOOD FOR EQUITY)[1]

By Charles A.M. de Bartolome[2]

The peer group effect is incorporated into a Tiebout-type model with public expenditure levels affecting, through migration, the communities' composition and land price differentials. Communities become heterogeneous and the efficiency claimed by Tiebout (1956) is lost. The inefficiency arises because migration causes private incentives to differ from social incentives when voters choose expenditures or, equivalently, when households choose residency. The land price differential does not play the part of the "price" of the better peer group but of a transfer payment. However, local decision-making may give an equity gain because each group is prevented from forming a "tyranny of the majority".

KEYWORDS: Peer Group, Decentralization, Voting, Second-best Inefficiency, Equity.

1. INTRODUCTION

Should public service levels be uniform throughout a large metropolitan area (centralization) or should the area be subdivided into small local communities with each community voting its own public service level (decentralization)? In Tiebout's (1956) seminal model of the local public sector, decentralization leads to efficiency by better matching of households with the public service levels they desire. In contrast, centralization is often argued to give equity - either because with proportional taxes it enables the rich to be charged a greater tax share or for the strictly egalitarian reason that it is per se good for all residents to have equal service levels (e.g., for all children to have equal educational opportunities). I show that the conclusions may be reversed when the empirical peer group effect is introduced: decentralization leads to inefficiency but may be preferred for equity. This is important in the discussion of the "New Federalism" in the United States and of the reform of local government in the United Kingdom.

In the Tiebout model, migration or "voting with the feet" converts the local public sector into a pseudo-competitive economy and forces communities to provide efficient service levels. Tiebout's model, and the later models which relax Tiebout's strong assumptions, assume that the production of the public service is solely determined by physical inputs and community size: however there is strong empirical evidence that the community composition (the peer group) is also a major determinant. In a provocative article, Oates (1981) wrote "... a central problem in local [public] finance ... [is that] the production function contains as arguments ... the characteristics of the individuals who comprise the community...." I show that the local public sector may be inefficient when the peer group is a determinant of the local public service level and provided that the peer group effect is neither "too strong" nor "too weak".

A model is developed with families having children of either high or low ability. Education is chosen as the motivating example of a public service showing peer group effects. Educational expenditure is financed by local taxes and the school technology is such that all children living in the same community attend the same school. Two empirical findings motivate the model. Firstly, more able children receive greater benefit than less able children from expenditures on educational inputs such as more experienced teachers (Summers and Wolfe (1977)): better facilities such as libraries and laboratories are also likely to differentially benefit more able children. Considering this effect alone, a planner would have a social incentive to form separate communities, grouping families of more able children in communities with high input levels. Private incentives similarly favor separation: families of less able children will migrate to communities with low input schools in order to avoid the high taxes associated with high inputs. This is of course Tiebout's original point, that private and social incentives coincide and that differences in tastes will lead to group separation and efficiency.

The second stylized fact concerns composition: the presence of more able children in the classroom has a large favorable effect on the educational achievement of the less able child, perhaps by imparting higher motivation and better learning discipline, but the presence of less able children in the classroom has only a small adverse effect on the more able child. Alternatively, when less able and more able children are mixed, there is a large gain in the educational achievement of the former but only a slight fall in the achievement of the latter (Coleman et al. (1966)). This is the peer group effect considered in this paper. Considering this effect alone, social incentives favor integrating communities of children with different abilities. From the private perspective, ignoring the input sensitivity difference, the gain from residing in a community with more able children is greater for the less able child and families of less able children will be prepared to pay a premium for this favorable characteristic. Families of less able children will therefore migrate into communities of predominantly families of more able children, to promote integration.

When each of these effects is considered in isolation, private and social incentives coincide and the laissez-faire outcomes are therefore efficient. I show that the conclusions change when both effects operate simultaneously: in particular laissez-faire is unable to efficiently resolve the tension between the tendency to segregate (due to the different taste for inputs) and the tendency to integrate (due to the different taste for peer groups). Under laissez-faire, all communities are likely to include both family types, with different majorities in each area voting different educational expenditures, but this arrangement is never efficient. The efficiency loss arises because adverse selection creates a market failure and makes an essentially private attribute, ability, public. This causes the private and social cost of inputs to differ or, equivalently, the private and social benefit of migration to differ. The rent differential does not play the part of the "price" of the better peer group in the pseudo-competitive allocation of resources but of a transfer payment. Unlike in the models of Flatters et al. (1974), Stiglitz (1977) and Brueckner (1979), the policy response to correct for the market failure does not involve inter-community transfers but a tax/subsidy scheme on public expenditure.

The model has important implications for the organization of local government within a metropolitan area. If a single educational expenditure decision is made centrally for the whole area, schools throughout the area will enjoy equal inputs and peer group. The alternative is to decentralize the expenditure decision to local communities within the area; this will lead to variety in inputs and peer group. As already indicated, when the peer group effect is sufficiently strong but not "too strong", the former centralized arrangement is efficient and the latter decentralized arrangement is inefficient. However, with decentralization, the "tyranny" of a single majority is avoided and the surplus is better distributed: under an equity objective, therefore, decision-making by decentralized local communities may be preferred.

Education is used in this paper as the example to motivate peer group effects. There are many other cases where peer group effects appear important. McPheters and Stronge (1974), Pogue (1975) and Oates (1977) establish the importance of community composition in the provision of public safety. In demand analysis, the willingness to pay for many innovative products may critically depend on the characteristics of the other buyers. The model can readily be reinterpreted to these cases.

2. A POSITIVE MODEL WITH DECENTRALIZED VOTING

Oates (1977) conjected that peer group quality might be proxied by income, a conjecture which Hamilton (1983) used to provide an explanation for the empirical "flypaper" effect. Because peer group effects should at least initially be differentiated from income effects, I consider families with children of two ability levels - low ability a_1 and high ability a_2 - but of equal endowed income y. The educational achievement e of a child depends on its ability a, per-capita inputs I, and the proportion θ of more able children in the community (the peer group), $e = e(I,\theta,a)$. A more able child is assumed to gain more from educational inputs, or

(1) $$e_I(I,\theta,a_1) < e_I(I,\theta,a_2),$$

and a less able child is assumed to gain more from a peer group improvement[3] or

(2) $$e_\theta(I,\theta,a_2) < e_\theta(I,\theta,a_1).$$

The utility U of a family decision maker depends on family consumption C and the educational achievement e of the child, $U = f(C,e) = U(C, I, \theta, a)$. A family is henceforth referred to by the ability level of its child. It is convenient to suppress the argument a and to write the utility of a less able family as $U^1(C, I, \theta) = U(C, I, \theta, a_1)$ and of a more able family as $U^2(C, I, \theta) = U(C, I, \theta, a_2)$.

Because there are only two family types, the discussion can be confined to two communities labelled as the urban area u and as the suburbs s, with the suburbs being the area with the better peer group. The urban area contains n^u families and the suburbs contains n^s families. In a departure from the pure Tiebout model (in which land is freely available and communities can be costlessly formed), house sizes and community boundaries, and hence n^u and n^s, are considered to be fixed. In the pure Tiebout model there is no land capitalization whereas this paper is specifically interested in whether the suburban rent premium plays the part of the "price" for the better peer group in the laissez-faire allocation of resources. The fixed size assumption also has the advantage of appearing more realistic, at least in the short run when housing stocks are relatively fixed, and of ensuring that an equilibrium exists.[4]

There are N_1 less able families and N_2 more able families. Notating the urban composition θ^u and the suburban composition θ^s, the conservation of more able families requires

$$(3) \qquad N_2 = n^s\theta^s + n^u\theta^u \quad \text{or} \quad \theta^u = (N_2 - n^s\theta^s)/n^u \ .$$

The school technology is such that all families in a community attend the same school, all urban families receiving inputs I^u per head and peer group composition θ^u. Inputs are financed by local taxes: educational costs are assumed to show constant returns to community size[5] and the unit of input is chosen so that one unit of input costs one unit of consumption (the numeraire). The optimal outcome of any public policy discussion critically depends on the instruments and information available to government: this paper assumes the second best world in which ability is not observed by the taxing authorities, so that the tax collector is constrained to levy identical taxes on all families in the community. Each urban family therefore pays educational taxes I^u. The urban rent is r^u and the central or metropolitan government may give a lump-sum transfer T to families so that the consumption of an urban family is $C^u = y - I^u - r^u + T$. Exactly similar notation applies for a suburban family who achieves consumption

$C^s = y - I^s - r^s + T$. In order to keep the model closed, I assume that all rents are collected by a central government and returned as the lump-sum transfer T. The central government budget balance requires that

$$T = \frac{n^s r^s + n^u r^u}{n^s + n^u}.$$

Substituting, the net suburban rent r and net urban rent (after transfers) become

$$r = r^s - T = \frac{n^u(r^s - r^u)}{n^s + n^u} \quad ,$$

$$r^u - T = \frac{n^s(r^u - r^s)}{n^s + n^u} = - \frac{n^s}{n^u} r \; .$$

The consumption of an urban family and a suburban family become

$$C^u = y - I^u + (n^s/n^u)r, \tag{4}$$

$$C^s = y - I^s - r. \tag{5}$$

The assumption of the central government returning rent revenue as lump-sum transfers is made for expositional simplicity only and is not important to the results. If rents were not returned, the model would have to include the welfare effects on landlords living outside the system. The important point, which is captured in the construction, is that the family budget available to finance consumption and pay taxes does depend on where the family lives.

Inputs are determined by majority voting. A family votes myopically, ignoring the possible effects of the input level on the house rent and community composition,[6] so that a majority of less able families (in the urban area) votes inputs as

$$(6) \qquad \theta^u < .5 : \quad \frac{\partial U^1(C^u, I^u, \theta^u)}{\partial C^u} = \frac{\partial U^1(C^u, I^u, \theta^u)}{\partial I^u} .$$

Similarly a majority of more able families (in the suburbs) votes inputs as

$$(7) \qquad .5 \le \theta^s : \quad \frac{\partial U^2(C^s, I^s, \theta^s)}{\partial C^s} = \frac{\partial U^2(C^s, I^s, \theta^s)}{\partial I^s} .$$

Finally, the community compositions and rent premium are determined through migration. A family evaluates each community, taking the input level, the associated tax, the net rent and the peer group as given, and moves into the community giving the highest utility. Community compositions and house rents adjust therefore until no family can obtain a higher utility by moving. For the less able family this implies either

$$(8a) \qquad \theta^s < 1 \text{ and } U^1(y-I^s-r,\ I^s, \theta^s) = U^1(y-I^u+(n^s/n^u)r,\ I^u, \theta^u), \text{ or}$$

$$(8b) \qquad \theta^s = 1 \text{ and } U^1(y-I^s-r,\ I^s, 1) \le U^1(y-I^u+(n^s/n^u)r,\ I^u, (N_2-n^s)/n^u).$$

Similarly, no migration by the more able families implies either

$$(9a) \qquad 0 < \theta^u \text{ and } U^2(y-I^u+(n^s/n^u)r,\ I^u, \theta^u) = U^2(y-I^s-r,\ I^s, \theta^s), \text{ or}$$

$$(9b) \qquad 0 = \theta^u \text{ and } U^2(y-I^u+(n^s/n^u)r,\ I^u, 0) \le U^2(y-I^s-r,\ I^s,\ N_2/n^s) .$$

Equations (1)-(9) determine the model. The postulated dynamic sequence of events is as follows (using superscripts to notate the relevant iteration level). Initially, (a) community inputs I^{u0}, I^{s0} are set (by historical chance or whatever); (b) families migrate between communities and house rents adjust until, taking the house rent differential, the input levels and the community compositions as given, no family wants to migrate; i.e., given I^{u0}, I^{s0}, the No-Migration Equations (8) and (9) determine $(r^0, \theta^{u0}, \theta^{s0})$. At the first iteration, (a) taking $(r^0, \theta^{u0}, \theta^{s0})$ as given, communities vote new input levels, i.e., I^{u1}, I^{s1} are determined by Equations (6) and (7); (b) families then migrate and house rents adjust setting $(r^1, \theta^{u1}, \theta^{s1})$. At each subsequent iteration, (a) majority voting fixes input levels, and then (b) families migrate and house rents adjust. Equilibrium occurs when the solution repeats itself at each iteration or the equilibrium values $(r, \theta^u, \theta^s, I^u, I^s)$ are the solutions to Equations (3) and (6)-(9).

It has been widely noted in the literature that the objective of renters (good education and low rents) and houseowners (good education and high house prices) differ. However, when families vote ignoring all effects on rents or house prices, the distinction is irrelevant.

For analytical convenience, utility is assumed to be additively separable,

(10) $$U^1 = F(C) + G(I) + H(\theta),$$

(11) $$U^2 = F(C) + R(I) + S(\theta).$$

where F,G,R,H,S are concave functions.[7] The greater input sensitivity of the more able family is assumed to imply

(1') $$G'(I) < R'(I).$$

The greater peer group sensitivity of the less able family is assumed to imply

(2') $$S'(\theta) < H'(\theta).$$

3. CHARACTERIZATION OF EQUILIBRIUM

I first show that, when families of the same ability level form the majority in two communities, the communities have identical composition.

PROPOSITION 1: <u>In the model of Section 2, equilibrium with either $0 \le \theta^u < \theta^s < .5$ or $.5 \le \theta^u < \theta^s \le 1$ is impossible.</u>

PROOF: From the Appendix (The Resource Allocation Lemma), the No Migration Equations imply that suburban families (with the better peer group) have higher inputs and less consumption than urban families, i.e.,

$$\theta^u < \theta^s \Rightarrow I^u < I^s \quad \text{and} \quad C^s < C^u.$$

Suppose the proposition is false. By normality and separability (or using the relevant equation of Equations (5′) and (6′)), the family type which forms the majorities votes for higher inputs only if it gets higher consumption, i.e.,

$$0 \le \theta^u < \theta^s < .5 \quad \text{or} \quad .5 \le \theta^u < \theta^s \le 1, \quad \text{and} \quad I^u < I^s \;\Rightarrow\; C^u < C^s.$$

This gives the contradiction.

A consequence of this proposition is that no generality has been lost by confining the discussion to two communities. If there were more than two communities in the metropolitan area, communities with majorities of the same type would become indistinguishable so that the metropolitan area would behave "as if" it were composed of only two communities.

(FIGURE 1 HERE)

A solution must belong to one of the following five types, of which the first solution is my primary focus.

Solution 1 has $0 < \theta^u < .5 \leq \theta^s < 1$. (With myopic voting) families vote ignoring the consequent migration and hence take r as given. Equations (6) and (7) become

$$(6') \qquad I^u = \underset{I}{\operatorname{argmax}}\ F(y-I+(n^s/n^u)r) + G(I) \quad \text{or} \quad F'(C^u) = G'(I^u)\ ,$$

$$(7') \qquad I^s = \underset{I}{\operatorname{argmax}}\ F(y - I - r) + R(I) \quad \text{or} \quad F'(C^s) = R'(I^s)\ .$$

House rents and community composition adjust until

$$(8') \qquad F(y - I^s - r) + G(I^s) + H(\theta^s) = F(y-I^u+(n^s/n^u)r) + G(I^u) + H(\theta^u),$$

$$(9') \qquad F(y-I^u+(n^s/n^u)r) + R(I^u) + S(\theta^u) = F(y - I^s - r) + R(I^s) + S(\theta^s).$$

If one community is totally segregated, containing families of only one ability level, the respective equalities are replaced by inequalities, viz.

Solution 2 has $0 < \theta^u < .5$ and $\theta^s = 1$. Equation (8') is replaced by an inequality.

Solution 3 has $0 = \theta^u$ and $.5 \leq \theta^s < 1$. Equation (9') is replaced by an inequality.

If both communities are totally segregated, then

Solution 4 has $0 = \theta^u$ and $\theta^s = 1$. Equation (8') and (9') are replaced by inequalities.

Finally, there is the solution with identical communities or full integration:

Solution 5: if $\theta^u = \theta^s = N_2/(N_1+N_2) < .5$, then $I^u = I^s = \underset{I}{\operatorname{argmax}}\ F(y-I) + G(I)$;

if $.5 \leq N_2/(N_1+N_2) = \theta^u = \theta^s$, then $I^u = I^s = \underset{I}{\operatorname{argmax}}\ F(y-I) + R(I)$.

These solutions are diagramatically represented in Figure 1. The feasible area is $0 \leq \theta^u \leq N_2/(N_1+N_2) \leq \theta^s \leq 1$ or area ABCDEF, which is drawn for the case of an overall majority of less able families or for $N_2/(N_1+N_2) < .5$. Possible equilibria are inside ABCF (Solution 1), on (AB) (Solution 2), on (AF] (Solution 3), at A (Solution 4) and at D (Solution 5).

The solution with identical communities (Solution 5) always exists: the interesting case on which I focus is with the two communities being dissimilar. The solution proceedure is firstly to solve Equations (3), (6′), (7′), (8′), and (9′) without any restriction on θ^s; i.e., to find the rent premium and compositions which ensure no migration when assuming that urban and suburban inputs are "as if" voted by majorities of less able and more able families respectively. I impose later the necessary conditions on θ^s to ensure that $0 \leq \theta^u < .5 \leq \theta^s \leq 1$ and to allow for the possibility of the Corner Solutions 2, 3 and 4.

(FIGURE 2 HERE)

The combinations of r and θ^s which ensure that the less able families and the more able families do not wish to migrate are given respectively by the AA′ and BB′ curves in Figure 2. Equation (3) gives $\theta^u = (N_2-n^s\theta^s)/n^u$. From Equations (6′) and (7′), inputs are functions of r only and can be written as $I^u(r)$ and $I^s(r)$: because of the assumed separability, voted input levels depend on net income and not on peer groups. From Equation (8′), less able families do not migrate if

(8″) $$F(y-I^s(r)-r)+G(I^s(r))+H(\theta^s) = F(y-I^u(r)+(n^s/n^u)r)+G(I^u(r))+H((N_2-n^s\theta^s)/n^u),$$

which implicitly defines the AA′ curve. Totally differentiating, using Equation (6′) and rearranging gives

$$(12)\qquad \left.\frac{dr}{d\theta^s}\right|_{AA'} = \frac{\frac{n^s}{n^u} H'(\theta^u) + H'(\theta^s)}{[\frac{n^s}{n^u} F'(C^u) + F'(C^s)] + [F'(C^s) - G'(I^s)] \frac{dI^s}{dr}} .$$

Normality implies $-1 < dI^s/dr < 0$. Combining Equations (1') and (7') gives $G'(I^s) < R'(I^s) = F'(C^s)$ and hence

$$\left.\frac{dr}{d\theta^s}\right|_{AA'} = (+),$$

or the AA' curve is upward sloping. It intersects the r=0 axis at θ^s such that

$$F(y-I^s(0)) + G(I^s(0)) + H(\theta^s) = F(y-I^u(0)) + G(I^u(0)) + H(\theta^u).$$

$I^u(0)$ is the input level chosen by the less able families given r=0 so that, by revealed preference,

$$F(y-I^s(0)) + G(I^s(0)) < F(y-I^u(0)) + G(I^u(0)) .$$

Hence, when $r=0$, $\theta^u < \theta^s$ or $N_2/(N_1+N_2) < \theta^s$. Thus the AA' curve intersects the r=0 axis to the right of the metropolitan composition $N_2/(N_1+N_2)$, as drawn in Figure 2.

The AA' curve is interpreted as the willingness to pay of a less able family for any given suburban environment θ^s: its willingness to pay increases as the suburban composition improves. The AA' curve passes to the right of the point $(r=0, \theta^s=N_2/(N_1+N_2))$ because less able families are choosing the urban consumption/input bundle - if there were no rent premium, a less able family must prefer this choice to the suburban consumption/input bundle chosen for it so that it would remain in the suburbs only if the peer group were better.

A similar description applies for the more able families. Remembering that I^u and I^s are functions of r only, the more able families do not migrate if

$$(9'') \quad F(y-I^u(r)+(n^s/n^u)r)+R(I^u(r))+S((N_2-n^s\theta^s)/n^u) = F(y-I^s(r)-r)+R(I^s(r))+ S(\theta^s),$$

which implicitly defines the BB′ curve. Totally differentiating as before, using Equation (7′) and rearranging,

$$(13) \quad \left.\frac{dr}{d\theta^s}\right|_{BB'} = \frac{\frac{n^s}{n^u} S'(\theta^u) + S'(\theta^s)}{[\frac{n^s}{n^u} F'(C^u) + F'(C^s)] + [R'(I^u) - F'(C^u)] \frac{dI^u}{dr}} .$$

Normality implies $0 < dI^u/dr$ and hence, using Equations (1′) and (6′), the BB′ curve is upward sloping. As before, using revealed preference but for the more able family, when $r=0$ then $\theta^s < N_2/(N_1+N_2)$, or the BB′ curve must pass to the left of the point $(r = 0,\ \theta^s = N_2/(N_1+N_2))$.

The simultaneous solution of Equations (3)-(9′) is given by the intersection (r^*,θ^*) of the AA′ and BB′ curves. Below θ^*, the peer group difference is relatively small so that the input difference dominates: the willingness to pay of the urban more able family (given by the BB′ curve) exceeds the willingness to pay of the suburban less able family (given by the AA′ curve). Migration therefore occurs with θ^s rising. Conversely, above θ^* the peer group difference dominates and urban less able families outbid suburban more able families with θ^s falling.

It is easy to show that the intersection is unique. Using Equations (2′), (12) and (13) and normality, at any point of intersection

$$\left.\frac{dr}{d\theta^s}\right|_{BB'} < \left.\frac{dr}{d\theta^s}\right|_{AA'},$$

so that the possibility of a second intersection with BB′ crossing AA′ from below is ruled out.

The AA′ and BB′ curves have been drawn with expenditure levels being set by Equations (6′) and (7′). With expenditures being set by majority voting, this translates into the condition that $\theta^u < .5 \le \theta^s$ or that there is a lower bound $\underline{\theta}$ to permissible θ^s:

$$\underline{\theta} = \max\ [.5,\ \text{value of}\ \ \theta^s\ \text{when}\ \ \theta^u = .5] \le \theta^s\ .$$

Using Equation (3), the voting condition can be rewritten as

$$\underline{\theta} = \max\ [.5,\ (N_2-N_1+n^s)/2n^s] \le \theta^s\ .$$

Finally there are the feasibility conditions that $0 \le \theta^u$ and $\theta^s \le 1$, or there is an upper bound $\overline{\theta}$ to feasible θ^s:

$$\theta^s \le \overline{\theta} = \min\ [1,\ \text{value of}\ \ \theta^s\ \ \text{when}\ \ \theta^u = 0]\quad \text{or}\quad \theta^s \le \overline{\theta} = \min\ [1, N_2/n^s].$$

(FIGURE 3 HERE)

Equilibrium requires no migration and the consequent compositions being of the assumed majorities and feasible, or $\underline{\theta} \le \theta^* \le \overline{\theta}$.[8] The three possibilities are shown in the panels of Figure 3 and are described as:

(a) either $\theta^* < \underline{\theta}$ or $\overline{\theta} < \underline{\theta}$ (there is no permissible range). Distinct communities cannot coexist and integration (Solution 5) is the only equilibrium.

(b) $\underline{\theta} < \theta^* < \overline{\theta}$. This corresponds to two communities which are heterogeneous but of unequal composition (Solution 1).[9]

(c) $\underline{\theta} \leq \overline{\theta} \leq \theta^*$. In this case, the willingness to pay of a more able family to move to the suburbs (higher inputs) always exceeds the willingness to pay of a less able family for the better peer group. So $\theta^s = \overline{\theta}$ is the solution, or one community is homogeneous. Using Panel (c) of Figure 3, if $\overline{\theta} = 1$ and the associated $\theta^u > 0$ (i.e., Solution 2), more able families are in both communities and the rent is bid up by the more able urban families to their willingness to pay r_2^*. Alternatively, if $\overline{\theta} < 1$ (i.e., Solution 3), it is the less able families who are in both communities and the rent is bid up to their willingness to pay r_1^*. If $\overline{\theta} = 1$ and the associated $\theta^u = 0$ (i.e., Solution 4), the rent is undetermined in the range $[r_1^*, r_2^*]$. (This last possibility requires that the community sizes have been set exactly at $n^u = N_1$, $n^s = N_2$).

4. COMPARATIVE STATICS AND THE EXISTENCE OF SOLUTION 1

I use the comparative statics to establish the following proposition:

PROPOSITION 2: Equilibrium with heterogeneous and dissimilar communities (Solution 1) exists when the peer group effect is neither "too strong" nor "too weak" with respect to the input sensitivity difference, or when the income difference is not too large, and provided $\underline{\theta} < \overline{\theta}$.

(FIGURE 4 HERE)

The statement "the less able become more peer group sensitive" is interpreted to mean that $H(\theta^s) - H(\theta^u)$ increases at any given compositions θ^s and θ^u. Holding θ^s fixed, totally differentiating Equation (8") gives

$$F'(C^s)[-\frac{dI^s}{dr}dr - dr] + G'(I^s)\frac{dI^s}{dr}dr + dH(\theta^s)$$

$$= F'(C^u)[-\frac{dI^u}{dr}dr + \frac{n^s}{n^u}dr] + G'(I^u)\frac{dI^u}{dr}dr + dH(\theta^u).$$

Rearranging, using Equations (1′), (6′) and (7′) and $-1 < \frac{dI^s}{dr} < 0$ (from normality),

$$dr = \frac{d[H(\theta^s) - H(\theta^u)]}{[\frac{n^s}{n^u}F'(C^u) + F'(C^s)] + [F'(C^s) - G'(I^s)]\frac{dI^s}{dr}} = (+),$$

or the AA′ curve shifts up (Figure 4), lowering the equilibrium values of r and θ^s. The increased attractiveness of the suburban peer group increases the tendency of the urban less able families to migrate, making the communities more alike: it should by noted that, in spite of a less able family having a higher willingness to pay for a given peer group difference, the general equilibrium effect is to lower the suburban rent premium after the change in θ^s is taken into account.

Similarly, as more able families become more peer group sensitive (decreasing the peer group sensitivity difference), the BB′ curve shifts up, raising the equilibrium values of r and θ^s. The increased tendency for the more able to dissociate themselves makes the communities less alike.

These comparative statics show that two heterogeneous communities of unequal composition (i.e., Solution 1) can always exist provided that the peer group effect is of intermediate strength (and provided that the community sizes are chosen such that $\underline{\theta} < \overline{\theta}$). If the peer group sensitivity difference is relatively weak, AA′ and BB′ intersect above $\overline{\theta}$ and one community is homogeneous. If the peer group sensitivity difference is increased, the intersection moves to lower θ^s and into the permissible range with both communities becoming heterogeneous. If the strength of the peer group effect is further increased, the intersection moves below $\underline{\theta}$ and the communities become fully integrated. This progression (from Panel (c) to Panel (a) in Figure 3) is in accordance with the intuition that the peer group effect is associated with the tendency to integrate.

It is more difficult to interpret the effect of changing input sensitivities as not only do the G(.) and R(.) functions change but the input levels voted by the two communities also change. To do comparative statics therefore necessitates more structure being put on the problem: a suggested structure is to write $U^1 = F(C) + aG(I) + H(\theta)$ and $U^2 = F(C) + bR(I) + S(\theta)$. Suburban more able families vote inputs until $F'(y-I^s-r) = bR'(I^s)$. Increasing the input sensitivity of the more able (increasing the input sensitivity difference) is interpreted as increasing b, and

$\partial I^s/\partial b = - R'/(F'' + bR'') = (+)$. Holding θ^s fixed, totally differentiating the amended Equation (8") to find the shift in the AA' curve, and rearranging,

$$\left.\frac{\partial r}{\partial b}\right|_{\theta^s} = - \frac{[F'(C^s) - aG'(I^s)]\dfrac{\partial I^s}{\partial b}}{[\dfrac{n^s}{n^u}F'(C^u) + F'(C^s)] + [F'(C^s) - aG'(I^s)]\dfrac{\partial I^s}{\partial r}} = (-),$$

or the AA' curve shifts down: at any given θ^s, the suburban community is voting higher inputs and is less attractive to the less able family. Similarly, holding θ^s constant and totally differentiating the amended Equation (9") to find the shift in BB',

$$\left.\frac{\partial r}{\partial b}\right|_{\theta^s} = \frac{R(I^s) - R(I^u)}{[\dfrac{n^s}{n^u}F'(C^u) + F'(C^s)] + [bR'(I^u) - F'(C^u)]\dfrac{\partial I^u}{\partial r}} = (+),$$

or the BB' curve shifts up. Combining these two shifts shows that, as the more able family becomes more input sensitive, the communities become less alike - r and θ^s rise. Intuitively, increasing the difference in taste for inputs increases the forces leading to segregation.

The analysis can be repeated to find the effect of changing the input sensitivity of the less able family. As the input sensitivity a increases (decreasing the input sensitivity difference), AA' shifts up and BB' shifts down or the net effect is to make the communities more similar.

As before, these comparative statics on the input sensitivity difference confirm the existence of Solution 1. As the input sensitivity difference is increased, θ^* rises and there is a progression from Panel (a) to Panel (c) in

Figure 3. Provided the input sensitivity difference is of intermediate strength (with respect to the peer group sensitivity difference), the outcome of Panel (b) is achieved - both communities are heterogeneous but dissimilar. Intuitively, the peer group sensitivity difference is associated with a tendency to integrate and the input sensitivity difference is associated with a tendency to segregate: two heterogeneous communities of unequal composition exist if neither effect is too strong.

The procedure can be directly repeated to consider the comparative statics of changing the endowed income of each family type. If each less able family has income y_1 and each more able family has income y_2, then the effect on AA' of increasing y_2 from the point of equal incomes $y_1 = y_2 = y$ is obtained by differentiating the amended Equation (8"), holding θ^s fixed,

$$\left.\frac{\partial r}{\partial y_2}\right|_{\theta^s} = - \frac{[F'(C^s) - G'(I^s)]\dfrac{\partial I^s}{\partial y_2}}{[\dfrac{n^s}{n^u}F'(C^u) + F'(C^s)] + [F'(C^s) - G'(I^s)]\dfrac{\partial I^s}{\partial r}} = (-),$$

or the AA' curve shifts down. Similarly, BB' shifts up. The overall effect is to make the communities less similar, r and θ^s rising. Descriptively raising the income of the more able families increases their willingness to pay for inputs and is qualitatively similar to raising their input sensitivity. Little generality is therefore lost with the equal income assumption. This is likely to be important when Oates'(1981) conjecture, that ability might be proxied by income, is remembered.

5. THE NORMATIVE MODEL

The efficient outcomes achievable by a planner are characterized in this section. In the next section these will be compared to the laissez-faire outcomes already derived. It will be shown that an arrangement with two heterogeneous and dissimilar communities (Solution 1) is always inefficient - even when holding constant the community sizes, residents could reorganize themselves to make everybody better off.

The planner chooses consumptions C^u, C^s, inputs I^u, I^s and allocates families to communities by choosing θ^u, θ^s. Because the allocation of the planner is the yardstick against which the laissez-faire outcome will be measured, the planner is constrained to those choices he could implement with the same information as is available to communities, viz. he cannot observe ability so that all families within a community must be treated equally, and no family must wish to "undo" the allocation by migrating. The planner is also required to maintain the same community sizes. Therefore, the planner's allocation is efficient only in a second-best sense.

The planner is constrained to treat equally all families within a community. Equations (3), (4) and (5) are now interpreted as the budget constraints faced by the planner for composition and resources. In the same way that the rent premium in laissez-faire transfers resources between the communities, the planner is able to effect inter-community transfers. The planner chooses the parameter r in the Consumption Equations (4) and (5) and interprets it as a tax on families in the suburban community and a transfer to families in the urban community. Because the allocation must be implementable, the planner must also ensure that no family wishes to migrate:

hence the planner is additionally constrained by Equations (8) and (9) which are now interpreted as the self-selection constraints.

The planner's problem is therefore to choose I^u, I^s, r, θ^s to maximize the utility of the less able family subject to a reservation utility of the more able family,

$$(14) \qquad U^2(y-I^s-r,\ I^s,\ \theta^s) \geq \bar{U}$$

and the Self-Selection Constraints (8) and (9). The Self-Selection Constraints (8) and (9) constitute two equations which can be used to "solve out" for the two variables (r, θ^s) as functions of I^u, I^s. The interpretation therefore is of a central government setting input levels I^u, I^s and allowing composition θ^s and rent premium r to adjust.

Taking into account the possible corner solutions and writing $U^{1u} = U^1(y-I^u+(n^s/n^u)r,\ I^u,\ \theta^u)$, the planner's outcome is the maximand of the solutions to the following four cases:

<u>Case 1</u>: $0<\theta^u\leq\theta^s<1$: U^{*1} is the solution to max U^{1u} s.t. (3), (8a), (9a) and (14).
<u>Case 2</u>: $0<\theta^u<\theta^s=1$: U^{*2} is the solution to max U^{1u} s.t. (3), (8b), (9a) and (14).
<u>Case 3</u>: $0=\theta^u<\theta^s<1$: U^{*3} is the solution to max U^{1u} s.t. (3), (8a), (9b) and (14).
<u>Case 4</u>: $0=\theta^u<\theta^s=1$: U^{*4} is the solution to max U^{1u} s.t. (3), (8b), (9b) and (14).

The efficient allocation is the maximand $U^* = \max\ [U^{*1},\ U^{*2},\ U^{*3},\ U^{*4}]$.

Each case can be interpreted as the planner's equivalent to the laissez-faire solution of equal number. My interest lies in Case 1.

PROPOSITION 3: <u>The solution to Case 1 is identical communities.</u>

PROOF: It is relatively easy to see that the solution to Case 1 will be the (unique) solution to the simpler Problem A.[10] Writing U^{ic} as the utility of a family of ability level a_i in community c, and using Equation (3) to eliminate θ^u as a variable,

<u>Problem A</u>: $\max\limits_{I^u, I^s, r, \theta^s} \quad U^{1u} \quad \text{s.t.} \quad U^{1s} = U^{1u}, \quad U^{2u} = \bar{U}, \quad U^{2s} = \bar{U}.$

The first order condition is

$$(15) \qquad \frac{1}{\left[\frac{U_I^{2u}}{U_C^{2u}} - \frac{U_I^{1u}}{U_C^{1u}}\right]}\left[\left[\frac{U_I^{2u}}{U_C^{2u}} - 1\right]\frac{U_\theta^{1u}}{U_C^{1u}} + \left[1 - \frac{U_I^{1u}}{U_C^{1u}}\right]\frac{U_\theta^{2u}}{U_C^{2u}}\right]$$

$$= \frac{1}{\left[\frac{U_I^{2s}}{U_C^{2s}} - \frac{U_I^{1s}}{U_C^{1s}}\right]}\left[\left[\frac{U_I^{2s}}{U_C^{2s}} - 1\right]\frac{U_\theta^{1s}}{U_C^{1s}} + \left[1 - \frac{U_I^{1s}}{U_C^{1s}}\right]\frac{U_\theta^{2s}}{U_C^{2s}}\right],$$

which is clearly satisfied with identical communities, $\theta^u = \theta^s = N_2/(N_1+N_2)$, $r = 0$, and $I^u = I^s$. The second-order condition confirms that this is a maximum, viz. that the determinant of the bordered Hessian is positive.

n^u and n^s have been held arbitrarily fixed but the consequent first order condition is independant of n^u and n^s and hence the result is true for all n^u and n^s: i.e., if both communities contain families of both types but in dissimilar proportions, a planner can make all families better off even when required to maintain the existing community sizes.

6. LAISSEZ-FAIRE AND EFFICIENCY

THEOREM: In the model of Section 2, laissez-faire equilibrium with $0 < \theta^s_\_ < .5 \leq \theta^s_\_ < 1$ (Solution 1) may exist and is second-best inefficient.

PROOF: From Propositions 2 and 3.

The planner's outcomes can be compared to the laissez-faire outcomes using Figure 1. The second-best efficient outcomes lie only at D (case 1), on (AB) (case 2), on (AE) (case 3) and at A (case 4) but laissez-faire solutions can lie anywhere in the area ABCF or at D. Section 4 established the existence of laissez-faire solutions lying strictly within the area ABCF. Section 5 established that such solutions are (second-best) inefficient.

What Is Causing The Inefficiency?

In order to understand what is causing the loss of second-best efficiency, it is helpful to establish first what is not causing the loss. In a single community and when the tax burden is constrained to be shared equally, majority voting may lead to a loss of first-best efficiency (Bowen (1943)) but not of second-best efficiency: specifically a planner restricted to sharing the tax burden equally is unable to make the decisive median voter better off. Because housing sizes have been held fixed, the inefficiency is also not being caused by capitalization feeding through into housing distortions (as in Epple and Zelenitz (1981)).

In a Tiebout-type model, without peer group effects but with input sensitivity differences and with fixed community sizes, under laissez-faire one community will be heterogeneous and one community will be homogeneous (in the interesting case when both communities are economically different, voting different input levels).[11] The input level voted in one community affects the rent premium between communities. With myopia, a family votes inputs, taking as given the rent premium and ignoring the linkage between inputs and rent: it therefore thinks it is choosing one attribute (inputs) whereas in fact it is choosing two (inputs and rent). Nevertheless the consequent allocation has $\theta^s = \overline{\theta}$, lies on AF or AB in Figure 1 and is (second-best) efficient: therefore the inefficiency in my model is not caused per se either by the communities being of fixed size or by myopic voting.

(FIGURE 5 HERE)

The efficiency of a Tiebout-type model without peer group effects but with fixed community sizes and myopia is shown using Figure 5. U^1 and U^2 are indifference curves of a less able and more able family: an indifference curve of a less able family has slope $-G'(I)/F'(C)$ and is flatter at any point than the indifference curve of a more able family with slope $-R'(I)/F'(C)$. With the suburbs being homogeneous and the urban area being heterogeneous but with a majority of less able families, there is a rent premium in the suburbs or the budget line XX' perceived by suburban voters lies below the budget line YY' perceived by urban voters. With myopic voting, each majority moves to the point of tangency of its indifference curve with its perceived budget line: the rent premium adjusts until a more able family achieves equal utility in both communities. The laissez-faire equilibrium is therefore with the suburbs at S and the urban area at U. This arrangement is (second-best) efficient: raising the utility of less able urban families involves moving them onto a "higher" indifference curve or "higher" iso-resource line, which in turn involves lowering the iso-resource line XX' and hence lowering the utility of suburban more able families. More strongly, myopic voting would appear necessary for laissez-faire to achieve (second-best) efficiency: the planner's first order condition requires that the marginal rate of substitution between inputs and consumption in the homogeneous suburbs is unity, and this would not be achieved under laissez-faire if a voter were to understand that the input level affects the rent. Descriptively, the rent premium is a redistributive lump-sum transfer between communities without efficiency implications - the resource gain of one community is exactly offset by the resource loss of the other community. The social marginal benefit of inputs is the amount of consumption which the metropolitan area as a whole is prepared to forego in order to get one extra unit of input, and is unity. With myopic voting, the perceived private marginal benefit of inputs therefore coincides with the social marginal benefit and the outcome is (second-best) efficient.

Second-best efficiency <u>is</u> lost in my model because adverse selection creates a market failure and makes an essentially private attribute, ability, locally public. Ability is essentially a private attribute so that, in a first-best world, a more able family would seek compensation for living in an area with predominantly less able families and the less able families would be prepared to pay this compensation:[12] the outcome would be efficient. In a second-best world, a more able family is unable to distinguish itself from a less able family so that adverse selection prevents such compensation being paid. Although both the individual voter and the planner face similar information constraints, they solve the problem differently.

The divergence of private incentives from social incentives can be seen in the way either voters choose inputs or households choose residences. When setting inputs, because higher inputs would lead to an improvement in composition, the voter underestimates the private marginal benefit of inputs. Also, because a change in the composition of the community affects the composition in the adjacent community, the private marginal cost of a change in inputs calculated by the voter understates the true social marginal cost (which includes compensation to families in the adjacent community). The planner is able to make a Pareto-improvement because he is able to allocate inputs using the true private marginal benefit and social marginal cost.

The voters' underestimate of the benefit and cost of marginal input changes, arising from ignored compositional effects (but not from ignored rent effects), is why the efficiency loss only occurs when both communities include both types. When one community is homogeneous, a marginal change in the input level of either community has no effect on community compositions.

Equivalently, the inefficiency can be seen in the incentive of a family to migrate. At equilibrium no family sees a private gain to migrating. However, because of the local publicness of ability, all families in a community benefit when a more able family in-migrates and suffer when it out-migrates - this is the externality that is not being internalized by the migrant. When a more able family migrates from the suburbs to the urban area and a less able family reverse-migrates from the urban area to the suburbs, because of diminishing returns to peer group, the beneficial effect in the urban area exceeds the negative effect in the suburbs, or there is a social gain. Because private incentives do not take this gain into account, migration stops when θ^s is "too high". This interpretation is formalized in Equation (15): the left hand side is interpreted as the urban resources which may be saved (with utilities being unchanged) when a more able family moves into the urban area and the right hand side is interpreted as the compensation required by the suburbs for the reverse migration of a less able family. When $\theta^u < \theta^s$, the resource saving exceeds the required compensation, and migration is socially desirable.

It should be noted that the inefficiency does not depend on the assumption of only two communities. Because of Proposition 1, a metropolitan area subdivided into a large number of small communities behaves "as if" it were composed of only two communities.

The Role Of The Rent Premium.

Tiebout's insight was to realise that, in a simple model, families searching over communities was isomorphic to consumers shopping over bundles. The "price" of the local public service in the Tiebout economy is its tax-price: families treat it as given and choose the community providing the optimal service level at least cost so that the competitive forces that drive a private economy to efficiency also drive the pure Tiebout economy to efficiency.

Why is the suburban rent premium not playing the part of the "price" for the better peer group to promote the efficient allocation of families in my pseudo-competitive economy? My economy has three "goods", consumption, inputs and peer group. The two family types which form the majorities in the two areas are pictured as "calling out" (to an auctioneer) their demands for consumption and inputs, and then the peer group and its associated "price" are adjusted by the auctioneer until all families are indifferent as to which bundle they choose. As the total number of more able families is fixed, a natural comparison is with two households choosing over two goods and over land of which the supply is fixed. In a competitive model, the households would "call out" demands for the two goods and for land, and the auctioneer would adjust prices until demand equalled supply and households were indifferent to marginal trades. In the anologue to my model, the households would "call out" demands only for the two goods and the auctioneer would then transfer parcels of land between them, at different prices per parcel, so that both households would be indifferent to which bundle they were given. However, the price per acre in each parcel would not be equal and households would not be indifferent to marginal land trades. In my model, therefore, the suburban rent premium is not acting as the "price" of the better peer group but as a transfer payment.

Relation To The Literature And Policy Implications

In the models of Flatters et al. (1974), Stiglitz (1977) and Brueckner (1979), the publically provided good is a pure local public good, communities have some fixed factor (i.e. capital or land), households have identical tastes and they must live in the same community as they work, so that their income is not independent of their residence. Community population size is variable and communities are linked by population flows. At equilibrium the better endowed community has a larger population: it therefore affords a higher level of the pure local public good. All households obtain equal utility, so that there is no private incentive to migrate: the lower public good level in the less populated community is offset by a higher wage. However, there is a social gain to migration. A household migrating from a low tax to a high tax area would pay higher taxes but, because of the pureness of the local public goods, total public expenditure would be unchanged. The migration would thus lead to a fiscal gain equal to the difference in tax levels. Because the migrating household is unable to expropriate this fiscal gain, migration from the low tax to the high tax area stops "too soon" and the lower tax area is overpopulated.

Although in their and my models the inefficiency arises because of the divergence between the social and private benefit of migration, the implications for policy differ. In their models the marginal household compares after-tax wages when, from a social viewpoint, he should be comparing pre-tax wages. In order to internalize the externality, the overpopulated community should provide grants to the underpopulated community until net taxes are equalized in the two communities. Public spending should be neither taxed nor subsidized in the two communities (as otherwise inefficient allocations are made within the communities). In my model, the inefficiency arises because the migrating more able family is unable to expropriate the productivity gains from the peer group improvement. The externality cannot be internalized by inter-community grants because, as community sizes are fixed, any grant will be immediately capitalized so that net rents remain unchanged. Put differently, any grant to the urban area would favor all urban families whereas the favorable externality is due to the in-migration of the more able family. Because inputs differentially favor more able families, the correct policy response is to tax suburban inputs and to subsidize urban inputs (making the suburbs less attractive and the urban area more attractive to the more able family), until both communities vote equal inputs. An alternative policy response is to merge the communities[13] (or to choose community sizes so that $\overline{\theta} < \underline{\theta}$ or $\theta^* < \underline{\theta}$).

7. EQUITY CONSIDERATIONS

The preceeding discussion has concentrated on efficiency. A related concern is equity. If the choice of community sizes is the only available instrument, jurisdictions may be set so that either there is a single metropolitan area ($n^u = N_1 + N_2$, $n^s = 0$) or there are many communities. The latter arrangement can be thought of as being more decentralized than the former. (FIGURE 6 HERE)

The efficiency-equity trade-off is represented by points C and D in Figure 6. Centralized decision-making leads to uniformity in inputs and composition and, with a sufficiently strong peer group effect, is efficient: if the less able families form the metropolitan majority (henceforth assumed), point C is achieved on the utility possibility frontier. In contrast, decentralized decision-making may lead to variety in inputs and composition, and be inefficient so that the achieved outcome D lies inside the utility possibility frontier.

Centralized decision-making leads to efficiency but there is a potential equity problem because all the surplus is extracted by the "tyranny" of the families which form the metropolitan majority: point C corresponds to low inputs voted by the "tyranny" of the less able families. An attractive property of decentralized decision-making is that the final outcome in both communities reflects the tastes of both family types: with decentralization, the suburbs vote higher inputs, suburban rents rise and the consequent income transfer causes the urban input level to rise above that voted at C under centralized decision-making. This benefits the more able family. A more able family living in the urban area may therefore lack direct political power but the linkage between communities implies that he benefits from the decisions of his taste-type in the suburbs. In consequence, decentralized decision-making is associated with a sharing of the surplus so that point D may be equity preferred: Figure 6 is drawn so that point D lies on a higher (additive utilitarian) iso-welfare line than point C.

A simple example illustrates the point: suppose that $U^1 = \ln C + g\ln I + h \ln \theta$ and that $U^2 = \ln C + \ln(I-R)$, where the constants g and R have values such that $0 < g < 1$ and $R = gy/(1+g)$, and suppose also that there is a metropolitan majority of the less able. Under centralized decision-making, the less able majority votes $I = gy/(1+g)$ and, with h sufficiently large, this is (second-best) efficient; however, the utility achieved by the more able family is infinitely negative. Under decentralized decision-making, the fall in the net urban rent causes the less able urban majority to vote inputs above $gy/(1+g)$. Therefore the utility achieved by a more able family is finite and, under an additive utilitarian welfare objective, decentralization is preferred.

8. CONCLUDING REMARKS

The empirical peer group effect may make local public government (second-best) inefficient. The inefficiency arises because private incentives differ from social incentives when voters choose inputs or, equivalently, when households choose residency. In spite of the efficiency loss, decentralized decision-making by local communities may have possible equity gains. This has important implications for the discussion on authority over local government both in the United States and in the United Kingdom.

Most studies of local government find communities to be heterogeneous in composition (e.g., Pack and Pack (1978)) and better local services to be capitalized into higher house prices. However, there is some confusion as to exactly what is being capitalized: Oates (1969) and Meadows (1976) found high input levels to be capitalized whereas McDougall (1976) and Rosen and Fullerton (1977) found output levels but not input levels to be capitalized. These findings contradict the "pure" Tiebout model which predicts that the process of "voting with the feet" leads to homogeneous communities with no capitalization. In contrast, the Tiebout-type model developed in this paper is consistent with the empirical observations. All communities are predicted to be heterogeneous and rents are predicted to rise in the community providing the higher service level - but it is the peer group which is being capitalized and neither the input nor the output per se. As such, the peer group effect may provide a missing link to testing the Tiebout hypothesis.

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APPENDIX: THE RESOURCE ALLOCATION LEMMA

LEMMA: With additively separable utility functions, equilibrium with $\theta^u < \theta^s$ implies $I^u < I^s$ and $C^s < C^u$.

PROOF: Using the additively separable utility of Equations (10) and (11) and considering the case when both communities contain both types (the corner outcomes can be similarly proved), the No-Migration Equations (8a) and (9a) become

$$F(C^s) + G(I^s) + H(\theta^s) = F(C^u) + G(I^u) + H(\theta^u),$$

$$F(C^u) + R(I^u) + S(\theta^u) = F(C^s) + R(I^s) + S(\theta^s);$$

or

$$G(I^s)-G(I^u) + H(\theta^s)-H(\theta^u) = F(C^u)-F(C^s) = R(I^s)-R(I^u) + S(\theta^s)-S(\theta^u).$$

But Equation (2') implies $S(\theta^s)-S(\theta^u) < H(\theta^s)-H(\theta^u)$ and hence $G(I^s)-G(I^u) < R(I^s)-R(I^u)$: from Equation (1') this latter inequality implies $I^u < I^s$. With $I^u < I^s$, $F(C^u)-F(C^s) = R(I^s)-R(I^u) + S(\theta^s)-S(\theta^u) > 0$ and hence $C^s < C^u$.

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FOOTNOTES

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2 I am greatly indebted to my dissertation supervisors Franklin Allen, Alan Auerbach, and Robert Inman for their helpful comments and encouragement, and also to Moshe Adler, Claudia Goldin and Andy Postlewaite.

3 As already noted, the peer group sensitivity difference was pioneered by Coleman et al. (1966). The difference in input and peer group sensitivities with ability, as formalized in Equations (1) and (2), is a stylized generalization of the findings of Summers and Wolfe (1977).

4 With the peer group effect and tastes over inputs being not too different, if community sizes were flexible, the beneficial effect of the more able families on a less able family would lead a less able family to always migrate into neighborhoods of more able families. However, if new communites could be costlessly formed, the converse undesirable effect of the less able families on a more able family would lead each more able family to always respond to the in-migration by establishing a new community without the less able. Hence no equilibrium would exist.

5 Borcherding and Deacon (1972) and Bergstrom and Goodman (1973) find the cost function of local public services to be homogeneous of degree one in community size.

6 In the pure Tiebout model, with congestion but without peer group effects, a family votes expenditures taking as given the community size; the community

sizes are then determined by migration. The natural analogue in my model is for a family to vote taking as given the rent and composition, and for the rent and composition to be then determined by migration. This is further discussed in Section 6.

7 Henderson et al. (1978) confirm that e is a concave function of θ.

8 Note that $\underline{\theta}$ and $\overline{\theta}$ are completely determined by the numbers N_1, N_2, n^s and n^u.

9 It is easy to show that this solution is stable under a wide range of parameter values: the calculations are available from the author upon request.

10 The proof is available from the author upon request.

11 Without peer group effects, there is always the possibility that both communities have the same majorities and vote identical input levels – which corresponds to a solution in the area FCDE in Figure 1 – but this outcome is economically identical to the outcome with identical communities, i.e., outcome D in Figure 1.

12 In the private educational sector, this rent to the more able child is provided by competitive scholarships.

13 If the difference between families is interpreted to be racial, this policy would correspond to court decisions putting a whole metropolitan area under a desegregation order with busing across local community lines.

LIST OF FIGURES

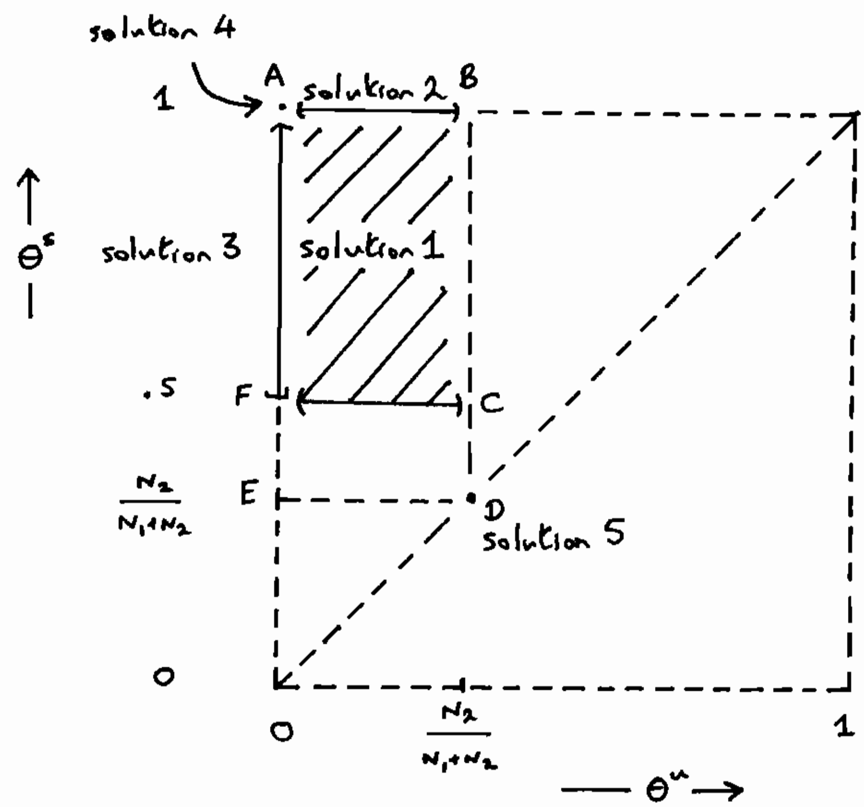

Figure 1 - Outcomes of laissez-faire.

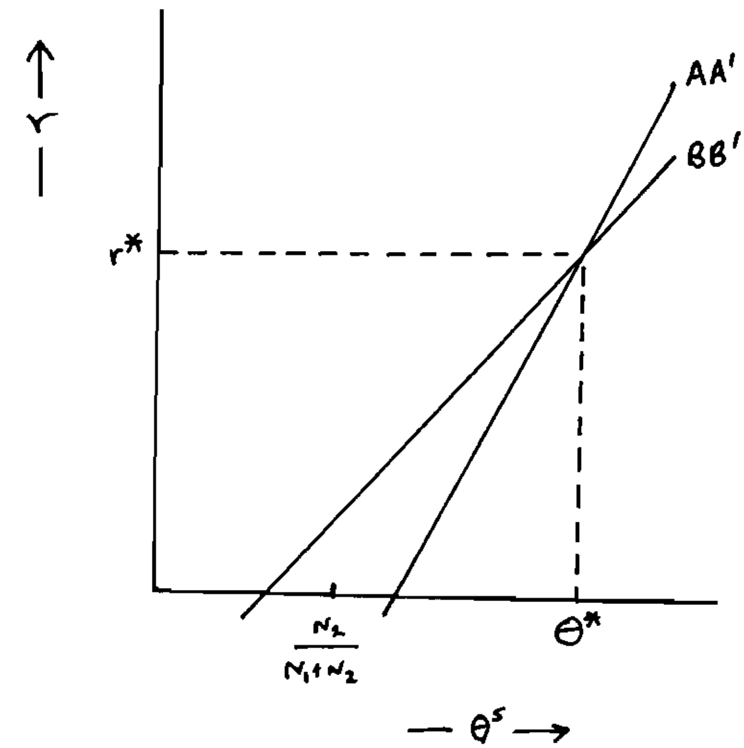

Figure 2 - "Equilibrium" (r,θ^s) combinations ensuring no migration.

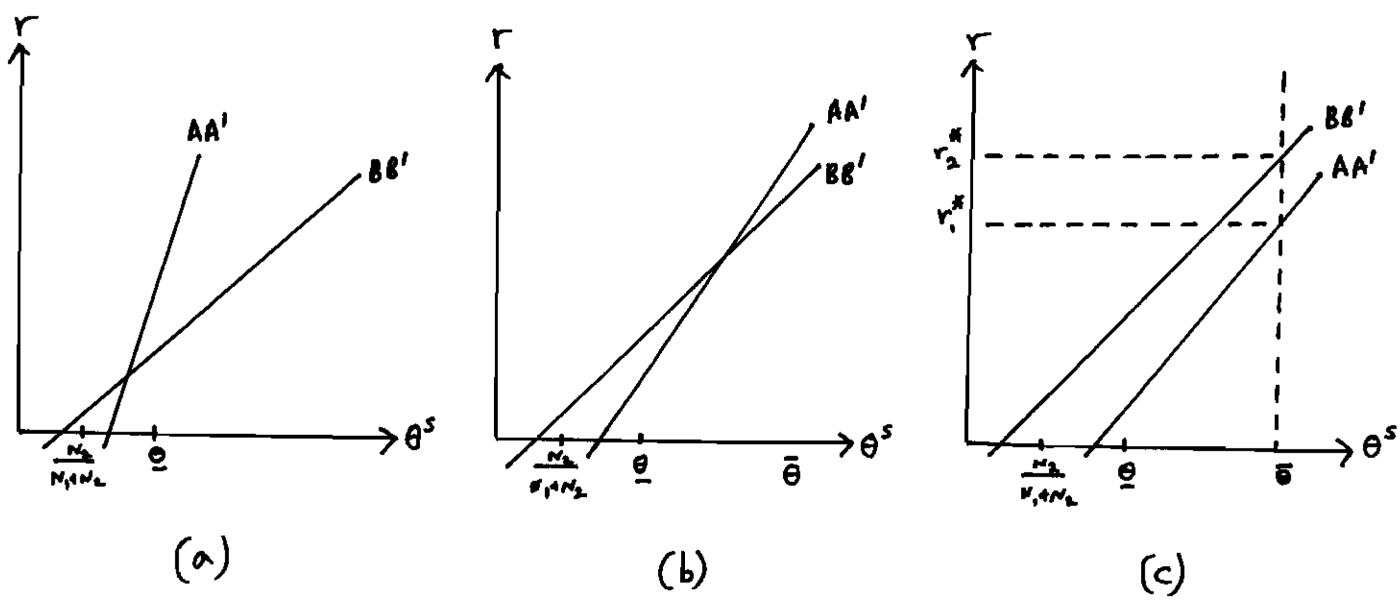

Figure 3 - Characterizing the asymmetric equilibrium.

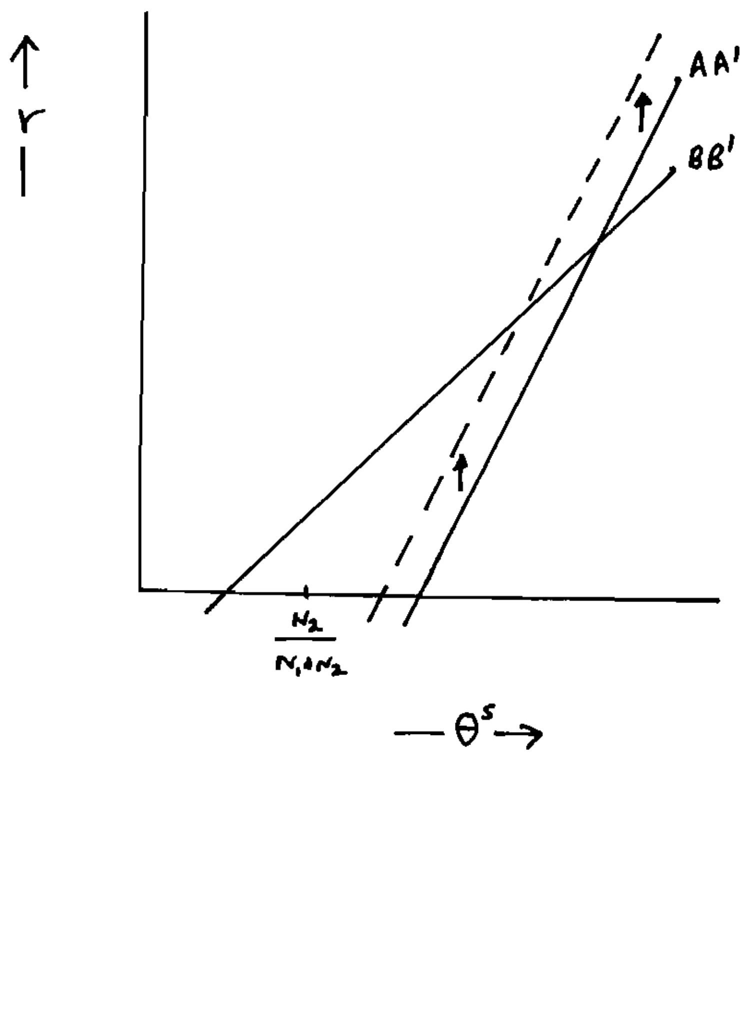

Figure 4 - Increasing the peer group sensitivity of less able families.

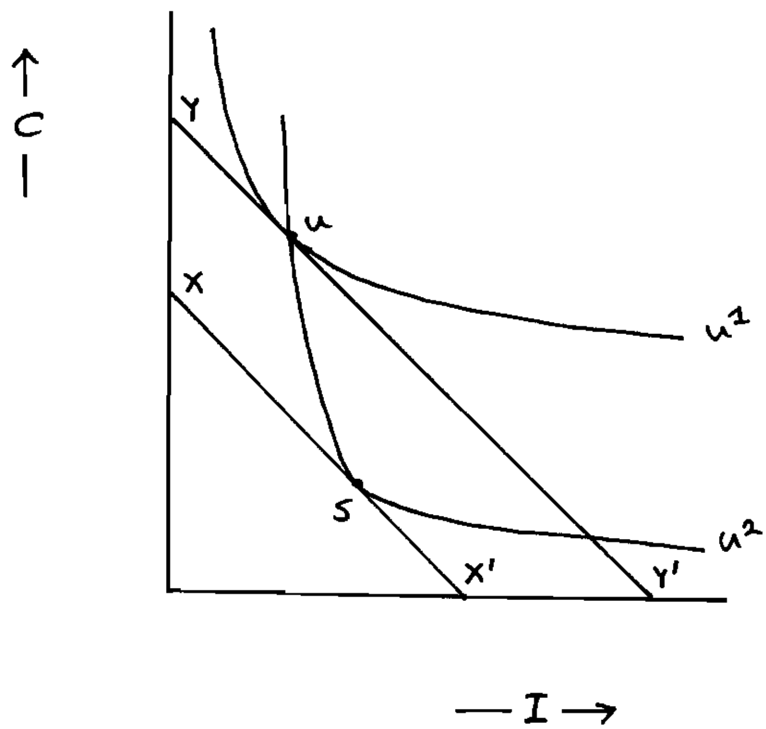

Figure 5 - Laissez-faire outcome if no peer group effects.

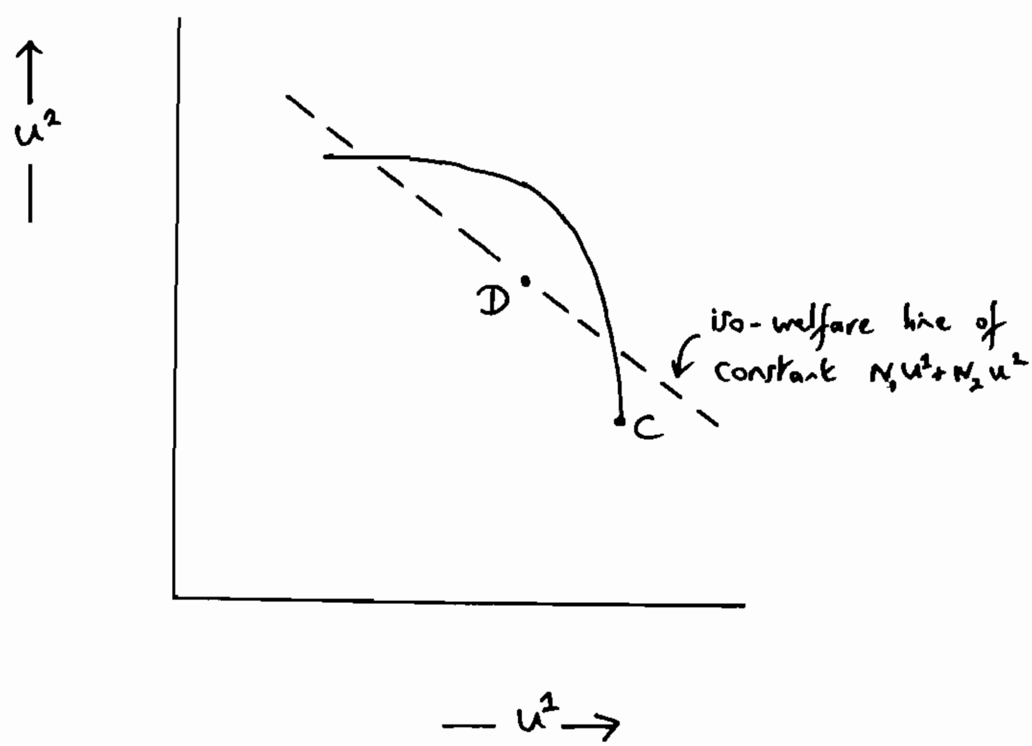

Figure 6 - Efficiency and equity.

Working papers supporting footnotes 9 and 10 (of "Introducing the Peer Group Effect: Why Decentralization Is Bad for Efficiency (but Good for Equity)").

WORKING PAPER SUPPORTING FOOTNOTE 9:

STABILITY OF THE ASYMMETRIC EQUILIBRIUM

This appendix considers the stability of Solution 1. By considering a small disturbance dr_0 from the equilibrium rent r^* and using the iterative process described in Section 2, the "inherited" rent premium at the start of the iteration is $r^* + dr_0$. This leads (a) to voted input levels $I^u(r^* + dr_0)$, $I^s(r^* + dr_0)$, and (b) to consequent migration to achieve suburban composition $\theta^* + d\theta_1$ and rent premium $r^* + dr_1$. $r^* + dr_1$ is the rent premium on which households vote in the next iteration. Noting that $d\theta_1$ is a function of dr_0, the movement in the whole system is completely described by the movement in r. Stability requires $|dr_1/dr_0| < 1$. Putting $r_0 = r^* + dr_0$, $r_1 = r^* + dr_1$, $\theta_1 = \theta^* + d\theta_1$, then $I^u(r_0)$ and $I^s(r_0)$ are determined by voting and (r_1, θ_1) are determined by migration or, using Equations (8′) and (9′),

$$F(y-I^s(r_0)-r_1) + G(I^s(r_0)) + H(\theta_1) = F(y-I^u(r_0)+(n^s/n^u)r_1) + G(I^u(r_0)) + H((N_2-n^s\theta_1)/n^u),$$

$$F(y-I^u(r_0)+(n^s/n^u)r_1) + R(I^u(r_0)) + S((N_2-n^s\theta_1)/n^u) = F(y-I^s(r_0)-r_1) + R(I^s(r_0)) + S(\theta_1).$$

Expanding around the equilibrium values, eliminating $d\theta_1$, writing income effects as $dI^u/dr = (n^s/n^u)dI^u/dM$, $dI^s/dr = -dI^s/dM$, and rearranging,

$$\frac{dr_1}{dr_0} = -\frac{[R'(I^u)-G'(I^u)]\frac{n^s}{n^u}\frac{dI^u}{dM}[\frac{n^s}{n^u}H'(\theta^u)+H'(\theta^s)] + [R'(I^s)-G'(I^s)]\frac{dI^s}{dM}[\frac{n^s}{n^u}S'(\theta^s)+S'(\theta^u)]}{[\frac{n^s}{n^u}F'(C^u) + F'(C^s)]\,[(\frac{n^s}{n^u}H'(\theta^u) + H'(\theta^s)) - (\frac{n^s}{n^u}S'(\theta^u) + S'(\theta^s))]}.$$

and there is nothing to ensure that this has absolute value less than 1. But stability is favoured when (1) income effects on inputs dI/dM are small, (2) input sensitivity differences R'-G' are small, and (3) peer group sensitivity differences H'-S' are large.

How should we understand this result? Suppose that suburban rents differ from equilibrium values by $dr_0 > 0$ (due to input differences or whatever). At the next iteration, the perceived income of suburban families is less than the equilibrium level and hence they vote less inputs than at equilibrium: conversely, the urban families have higher perceived income and vote more inputs than at equilibrium. If more able families are highly input sensitive, the combined effect is to make the urban area much more attractive to them than at equilibrium and, as they move from the suburbs, the attractiveness of the suburbs to less able families falls, so the overall effect is to lower suburban rents <u>below</u> the equilibrium value. The process now works in reverse and the consequent oscillations will become larger and the process less stable as (1) income effects on inputs are large, (2) input sensitivity differences are large, and (3) peer group sensitivity differences are small.

WORKING PAPER SUPPORTING FOOTNOTE 10:

PROVING THAT THE SYMMETRIC ALLOCATION IS THE GLOBAL OPTIMUM

To find the efficient solution to the problem with mixing in both communities, i.e., writing U^{ic} as the utility of a family of ability a_i in community c,

Case 1:

$$\max_{C^u, C^s, I^u, I^s, \theta^u, \theta^s} U^{1u}$$

$$\text{s.t.} \quad U^{1s} = U^{1u},$$

$$U^{2u} = U^{2s},$$

$$U^{2s} \geq \bar{U},$$

$$(N_1 + N_2)y \geq n^u(C^u + I^u) + n^s(C^s + I^s) \ ,$$

$$\theta^u = (N_2 - n^s\theta^s)/n^u \ ,$$

I solved

Problem A:

$$\max_{C^u, C^s, I^u, I^s, \theta^u, \theta^s} U^{1u}$$

$$\text{s.t.} \quad U^{1s} = U^{1u} \ ,$$

$$U^{2u} = \bar{U} \ ,$$

$$U^{2s} = \bar{U} \ ,$$

$$(N_1 + N_2)y = n^u(C^u + I^u) + n^s(C^s + I^s) \ ,$$

$$\theta^u = (N_2 - n^s\theta^s)/n^u \ ,$$

This appendix shows that the (symmetric) solution to Problem A is the unique global solution to Case 1. To do this, I show that the symmetric outcome is the unique global maximum of the Problem B. Because Problem A and Case 1 are both more constrained than Problem B, their objectives can never exceed the objective of Problem B. Therefore, if the symmetric outcome solves Problem B, it must also solve Problem A and Case 1.

Problem B:

$$\max_{C^u, C^s, I^u, I^s, \theta^u, \theta^s} \min [U^{1u}, U^{1s}]$$

$$\text{s.t.} \quad U^{2u} \geq \bar{U} ,$$

$$U^{2s} \geq \bar{U} ,$$

$$(N_1 + N_2)y \geq n^u(C^u + I^u) + n^s(C^s + I^s) ,$$

(3) $$\theta^u = (N_2 - n^s\theta^s)/n^u.$$

The objective function of Problem B is strictly concave, viz. $\{C^u, I^u, \theta^u : U^{1u} \geq \tilde{U}\}$ is strictly convex, $\{C^s, I^s, \theta^s : U^{1s} \geq \tilde{U}\}$ is strictly convex, and the intersection of two strictly convex sets is strictly convex. Similarly, the opportunity set is convex. Therefore any local maximum of Problem B is the unique global maximum.

Referring to Figure A, the assumed sensitivities of Equation (1′) and (2′) imply that an indifference curve U^1 of a less able family is flatter at any point than the indifference curve U^2 of a more able family. Points A and B are the points of tangency of the indifference curves, of the less able and more able families respectively, with the metropolitan budget line. Allocations "above" A or "below" B on the metropolitan budget line are definitely not solutions to Problem B: moving towards A or B, respectively, would raise all utilities. I therefore choose, as a candidate solution to Problem B, a symmetric allocation on AB with $U^2_C \leq U^2_I$ and $U^1_I \leq U^1_C$.

The argument to show that my candidate allocation on AB is a local maximum of Problem B (and hence also a global maximum) is by contradiction: suppose that the symmetric case $(C^u = C^s,\ I^u = I^s,\ \theta^u = \theta^s = N_2/(N_1+N_2))$, with the constraints holding as equalities, is not a solution to Problem B. Then, using Equation (3) to eliminate θ^u as a variable, there must exist some $\Delta = (dC^u, dC^s, dI^u, dI^s, d\theta^s)$ which is

(1) feasible for Problem B, i.e., $dU^{2u} \geq 0,$

$$dU^{2s} \geq 0,$$

$$n^u(dC^u + dI^u) + n^s(dC^s + dI^s) \leq 0,$$

(2) increases the objective of Problem B, $dU^{1u} > 0,$

$$dU^{1s} > 0.$$

Feasibility gives

$$dU^{2u} = U_C^{2u}dC^u + U_I^{2u}dI^u - (n^s/n^u)U_\theta^{2u}d\theta^s \geq 0,$$

$$dU^{2s} = U_C^{2s}dC^s + U_I^{2s}dI^s + U_\theta^{2s}d\theta^s \geq 0,$$

$$n^u(dC^u + dI^u) + n^s(dC^s + dI^s) \leq 0.$$

The first and last inequalities, evaluated at the symmetric point, give

$$d\theta^s \leq \frac{U_C^2 dC^u + U_I^2 dI^u}{\frac{n^s}{n^u} U_\theta^2} ,$$

$$dI^s \leq -dC^s - \frac{n^u}{n^s}dC^u - \frac{n^u}{n^s}dI^u \quad .$$

Inserting these inequalities into the middle inequality gives

$$U_C^2 dC^s + U_I^2[-dC^s - \frac{n^u}{n^s}dC^u - \frac{n^u}{n^s} dI^u] + U_\theta^2 \frac{[U_C^2 dC^u + U_I^2 dI^u]}{\frac{n^s}{n^u} U_\theta^2} \geq 0 ,$$

or

$$(U_C^2 - U_I^2)(dC^s + \frac{n^u}{n^s}dC^u) \geq 0 .$$

On [AB), $U_C^2 < U_I^2$, which implies $dC^s + \frac{n^u}{n^s} dC^u \leq 0$ and hence

$$(dI^s + \frac{n^u}{n^s} dI^u) \leq -(dC^s + \frac{n^u}{n^s} dC^u) = (+) \ .$$

If the objective is increased, $dU^{1u} = U_C^1 dC^u + U_I^1 dI^u - \frac{n^s}{n^u} U_\theta^1 d\theta^s > 0$

$$dU^{1s} = U_C^1 dC^s + U_I^1 dI^s + U_\theta^1 d\theta^s > 0$$

Adding, $U_C^1(dC^s + \frac{n^u}{n^s} dC^u) + U_I^1(dI^s + \frac{n^u}{n^s} dI^u) > 0$

or $$(U_C^1 - U_I^1)(dC^s + \frac{n^u}{n^s} dC^u) > 0$$

or $$U_C^1 < U_I^1$$

But on [AB), $U_C^2 < U_I^2$ and $U_I^1 \leq U_C^1$. This gives the contradiction. The corner case at B is similarly proved. Therefore no such Δ exists and the symmetric case (on AB) is the solution to Problem B and hence to Problem A and Case 1.

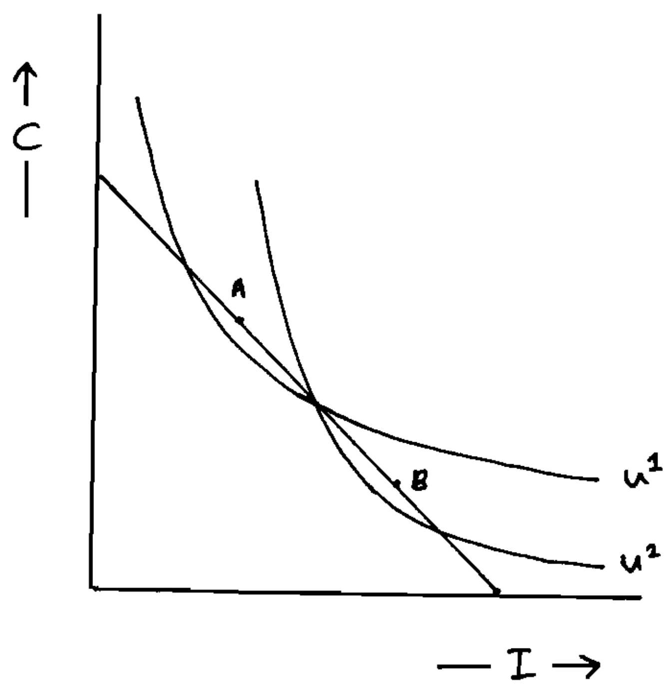

Figure A