Tiebout Models

A **local public good** is one that benefits only consumers in the local community rather than benefiting the total population of consumers. This introduces a meaningful dimension of location into the model of the economy. The fundamental notion here is that individuals must consume (basically) all goods—both public and private—at the same location. In a number of local public goods models, it is the implied bundling of the consumption of housing (residence) and the consumption of local public goods (schools, police, air quality) that is particularly critical.

It may also be the case that where you work is also bundled with where you consume.

Tiebout (1956))

Samuelson had asserted that no " 'market type solution'" exists in economies with public goods. By "market type solution" it is assumed that he meant a decentralized and efficient allocation.

The Tiebout response is that if the public goods are local, i.e. that consumption of the public goods and locational choice are bundled, then a market type solution may exist, at least "approximately."

The basic Tiebout world is one with a large number of communities offering different (and fixed) levels of local public good(s). The brilliant insight of Tiebout was to argue that as people sorted or "**voted with their feet**" to choose their most preferred community, they would reveal their demand for the public goods, thus overcoming the fundamental preference revelation problem that would hamstring governments from choosing optimal public goods levels. As we will point out below, the supply side of the original Tiebout world can benefit from

additional study. A basic point that foot voting can serve as a mechanism to impact/constrain/discipline local government behavior, however, certainly emerges.

Tiebout's Model

Seven assumptions:

Assumption 1: consumers are perfectly mobile

Assumption 2: full information

Assumption 3: large number of communities

Assumption 4: all income from dividends (exogenous)

Assumption 5: no spillovers among communities

Assumption 6: average cost of providing public goods as a function of population is U-shaped, i.e. there exists a cost minimizing population size

Assumption 7: communities with population sizes below (above) the cost minimizing size seek to expand (contract)

Tiebout asserted that under these assumptions, efficient provision of public goods would obtain. That is, communities would be of the optimal (cost-minimizing) size and citizen-voters would live in communities where the public good-tax bundles were optimal for them.

The original Tiebout article has generated a huge literature that builds upon, formalizes, and refines the fundamental ideas of the original work.

Tiebout Models

Basic framework is a general equilibrium model of regions.

An *allocation* in a Tiebout model includes: the two standards—a consumption bundle for each consumer and a production plan for each firm; a public good bundle for each regional government; and an assignment of each consumer to a region of residency

A *Tiebout equilibrium* consists of an allocation; a price for each commodity; and a tax system for each region such that the following conditions are satisfied:

(i) consumers choose their consumptions bundles optimally

(ii) consumers choose their regions of residence/consumption optimally (no household wishes to move, taking as given public good levels and taxes across regions)

(iii) firms maximize profits

(iv) markets clear

(v) each regional government balances its budget

(vi) each regional government's public goods and tax plan maximizes its objective

As usual in public economics, a fundamental question will be whether Tiebout equilibria (assuming they exist) are efficient. The new efficiency margins that emerge in Tiebout models (relative to standard Arrow-Debreu type models of private good economies) are:

(i) whether the number of regions/communities is correct
(ii) whether the allocation of individuals among communities is correct
(iii) whether the level of provision of public goods within each community is correct

The general message from most of the Tiebout literature is that efficiency is not likely to obtain in Tiebout equilibrium except under very restrictive assumptions. Some of the features of the models that are critical to equilibrium properties include:

(i) the objectives of local governments
(ii) the tax instruments assumed to be feasible
(iii) the pattern of factor ownership
(iv) the nature of local government competition

Relationship to Theory of Clubs

Both the Tiebout models and the Club models we discussed earlier are considering market type solutions to the problem of providing public goods. A number of the modeling issues are common to the two literatures. The relationship between the two classes of models is actually a subject of ongoing debate.

The summary paper by Scotchmer (1994) that we looked at earlier in the course suggests that the critical difference lies in the rental price an individual has to pay for land (or housing), in addition to possible head or income taxes, to be included in the local public goods jurisdiction while the admission price to each consumer of a club is fixed. That is, an individual can reduce the price of living in a jurisdiction by consuming less land or housing.

A Simple Tiebout Model

An economy consists of identical individuals, each of whom is endowed with a unit of labor that is inelastically supplied independent of residence. Labor is used to produce output, good Y. A unit of Y can be transformed into one unit of private good x or one unit of (pure) public good g. The assumptions about the Y technology are:

$$f(0) = 0,\ f' > 0,\ f'' < 0$$

Preferences for each individual *i* are defined over the private good and public good consumption:

$$u(g, x_i)$$

If there are N people in the community, the aggregate resource constraint is

$$Nx_i + g = f(N)$$

If we focus on equal-treatment allocations—those that give all agents in the same community the same allocation—then the set of feasible equal-treatment individual allocations is characterized by

$$x_i + g/N = f(N)/N$$

Now consider the optimal community size question. There is a tradeoff involved in increasing N in this model. The per-capita quantity of the productive good Y is decreasing in N, while the per-capita resource cost of providing a unit of the non-congestible local public good is also decreasing in N.

Characterizing Pareto Efficient allocations

1. Consider the case of identical consumer types and an endogenous number of communities

Planner Problem

$$\max_{x_i, g, N} u(g, x_i) \text{ subject to } Nx_i + g + f(N)$$

First order conditions:

$$u_x - \lambda N = 0$$

$$u_g - \lambda = 0$$

$$\lambda[f'(N) - x_i] = 0$$

The first two conditions imply:

$Nu_{g/}u_x = 1$ Samuelson condition

The third condition gives:

$f'(N) = x_i$ Individuals added until marginal product just equals their allocation of private good

Combining the resource constraint and condition three yields:

$$g = f(N) - Nf'(N)$$

If worker/consumers are paid the marginal product of labor, then at the optimal population, the return to fixed factors (say land) exactly covers the cost of the local public

good. This is well-known result, and is often referred to as the **Henry George Theorem.**

Note: the optimal number of communities equals N^T/N^*

2. Now consider the case of a fixed number of communities, but still assume one-type of consumer

Assume there are 2 jurisdictions: $j = 1,2$

Let utility in a community be represented as: $u^j(g^j, x_i^j)$

The community production possibilities frontier:

$$f_j(N^j) = X^j + C^j(g^j,N^j)$$

where X^j is total private goods consumption in *j* and $C^j(g^{j,} N^j)$ is the cost in foregone private good X to provide each individual in *j* with g^j units of public good; this formulation allows for congestion

Every consumer is assigned a community: $N^1 + N^2 = N^T$

Setup the relevant Pareto planner problem:

Lagrangian:

$$\mathbf{L} = u^1(g^1,x_i^1) + \lambda[u^2(g^2,x_i^2) - u^{20}]$$

$$+ \mu[f_1(N^1) + f_2(N^2) - N^1x_i^1 - N^2x_i^2 - C^1(g^1, N^1) - C^2(g^{2,} N^2)]$$

$$+ \psi[N^T - N^1 - N^2]$$

Then derive first order conditions.

The four first order conditions with respect to x_i^j and g^j yield:

$$N^j u_g^j / u_x^j = C_g^j \qquad \text{Samuelson condition}$$

The two first order conditions with respect to N^j yield:

$$f_1' - x_i^1 - C_N^1 = f_2' - x_i^2 - C_N^2 \qquad \text{Locational efficiency condition}$$

If we assume that there is no congestion and that there is a linear transformation between x_i^j and g^j then locational efficiency requires:

$$f_1' - x_i^1 = f_2' - x_i^2$$

This condition differs from the related optimal population condition from the first Pareto problem above when the population constraint is binding, i.e. $\psi^* \neq 0$.

A necessary and sufficient condition for the Henry George Theorem to hold in this economy (pure public good) is that the marginal net contribution of an additional individual be equal to zero across communities.

Bewley (1981)

This famous paper provides an extensive list of counter-examples to Tiebout's efficiency claims. The paper concludes with a set of sufficient conditions under which Tiebout's claims are valid.

Some particularly germane examples include:

Example 1: (Economies of Scale)

There are 2 consumers and 2 regions.

There is a single public good g and labor l.

Each consumer is endowed with a unit of labor and utility is solely a function of public goods consumption.

The regional technology is of the form: $g_j = l_j$

The regional government chooses g and uses a tax on the endowment to fund provision. The objective of the government is to maximize utility for its citizens.

A Tiebout equilibrium: the price of the public good and of labor is 1. One consumer is assigned to each region. The tax in each region is equal to 1 and the government in each region provides 1 unit of the public good. Consumers are indifferent between living in either region. Each government is behaving optimally, given its citizen's preferences.

But this equilibrium is inefficient. Both consumers would be better off living in the same region. The fundamental reason for the failure here is that individuals are assumed to be public good/tax bundle takers, and thus do not take into

account the economies of scale based spillovers that result when they move into a region.

Example 2: (Inefficient sorting)

There are 4 consumer types (A,B,C,D) and 2 regions.

There are 4 types of public services (g_A, g_B, g_C, g_D) and labor l.

Each consumer is endowed with one unit of labor. The consumer utility functions are of the form:

$$u_A = 2g_{Aj} + g_{Bj}$$

$$u_B = g_{Aj} + 2g_{Bj}$$

$$u_C = 2g_{Cj} + g_{Dj}$$

$$u_D = g_{Cj} + 2g_{Dj}$$

The public services technology is of the form

$$n_j(g_{Aj} + g_{Bj} + gC_j + gD_j) = 2l_j$$

where g_{kj} is the amount of public service k provided in region j, n_j is the number of consumers in region j and l_j is the quantity of labor used in region j. Note that as the number of users increases so does the resource cost of producing the public service. This is the distinction in Bewley's paper between public services (fully rival/congestible) and public goods (nonrival).

Consider the following Tiebout equilibrium in this economy.

Consumers A and C live in region 1 and consumers B and D live in region 2.

$(g_{A1}, g_{B1}, g_{C1}, g_{D1}) = (1, 0, 1, 0)$
$(g_{A2}, g_{B2}, g_{C2}, g_{D2}) = (0, 1, 0, 1)$

The price of each type of public service and of labor is 1. The tax in each region is equal to 1.

Thus consumers are in locational equilibrium with respect to regional prices and public sector bundles, and governments are optimizing over taxes and public services given their citizens' preferences.

This equilibrium is not efficient. Consider the following alternative Tiebout equilibrium allocation:

Consumers A and B live in region 1. Consumers C and D live in region 2.

$(g_{A1}, g_{B1}, g_{C1}, g_{D1}) = (1, 1, 0, 0)$
$(g_{A2}, g_{B2}, g_{C2}, g_{D2}) = (0, 0, 1, 1)$

The price of each type of public service and of labor is 1. The tax in each region is equal to 1.

This equilibrium Pareto-dominates the first one.

The problem here is that consumers can find themselves in an inefficiently sorted allocation and migration incentives alone do not lead to an efficient resorting.

Bewley's response to the type of inefficiencies identified in these two examples is that forward-looking local governments might "fix" the problem if they were to

anticipate migration responses to their choice of public goods and tax levels. But this raises issues about the relevant objective function for local governments.

Sufficient Conditions

There are many more counterexamples, each designed to draw out another difficulty with obtaining efficient allocations in Tiebout equilibrium.

Bewley then identifies a set of sufficient conditions for a Tiebout equilibrium to exist and to be efficient. Those conditions are:

1. Public services rather than public goods.
2. The number of regions matches the number of consumer types.
3. Governments are profit-maximizing and anticipatory, and also make zero profits in equilibrium.
4. Free trade among regions.

As Bewley points out, this is hardly a comforting result.