Chapter 29

THEORETICAL ANALYSIS OF LOCAL PUBLIC ECONOMICS

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1. Introduction

Local public economics, even theoretical local public economics, is a diverse, large, and growing field. It is an area in which ongoing policy debates continually present important new topics for economic analysis, both theoretical and empirical. Theoretical work in the area has contributed much to the understanding of policy issues, and has motivated many empirical studies. Empirical analysis, in turn, has frequently presented findings that challenge existing theoretical models and prompt the development of new ones. Together, these factors make the field an intellectually stimulating one.

They also make it somewhat difficult to survey. Indeed, any short survey must inevitably be rather selective in its coverage. The objective of the present essay is to provide a coherent and reasonably integrated view of major issues and recent developments in theoretical local public economics. In doing so, it must leave aside explicit consideration of most policy and empirical problems.

From the theoretical perspective, the fundamental goal of local public economics must be to understand how local governments affect resource allocation. In reality, of course, they do this in many ways, and it is difficult to study them all simultaneously. Conceptual clarity requires a separation of major issues which can then be examined, and better understood, in comparative isolation from one another. In broadest terms, this survey is organized around three major problems, corresponding roughly to Sections 2, 3, and 4. The first concerns the

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distribution of households across jurisdictions. The second involves the allocation of non-human resources within and across jurisdictions. The third concerns the allocation of resources through the institution of the local public sector itself.

More specifically: Section 2 examines how local government tax, expenditure, and zoning policies affect the locational choices of mobile households, and asks whether and under what conditions these policies result in efficient or inefficient equilibria. The issue of optimal jurisdiction size, or of the optimal number of jurisdictions, is also discussed in Section II.

Section 3 considers first the incidence and allocative effects of property and land taxation. In much (although not all) of the literature, the discussion of these issues focuses on interjurisdictional capital flows and abstracts from mobility of households. Section 3 also discusses the phenomena of tax exporting, tax competition, and, more generally, the determination of optimal local tax structure.

Section 4 focuses on the local government as a decisionmaking unit that makes important resource allocation decisions, particularly regarding the level of provision of local public goods. Median voter models of local public expenditure determination are discussed first. We then consider the effects of local taxes and public good provision on property values. This finally permits a more integrated treatment of household locational choice, property market equilibrium, and local government decisionmaking.

One advantage of this approach to research in urban public finance is that it highlights the contrasting institutional mechanisms through which resource allocation decisions are made. Roughly speaking, Sections 2 and 3 are concerned with the impact of local government policies on market-determined variables such as equilibrium prices, locational assignments, etc. Analyses of questions of this type, though they may be complex in detail and may involve many unusual features, are conceptually in a class of problems familiar to all students of public finance, that is, the class of problems that treats government policies, or changes in government policies, as exogenous to the system being modeled. The object of the analysis in problems of this type is to understand how the exogenous variables influence the endogenous ones, that is, how parametric changes in government policy affect market equilibrium and, more generally, the entire state of the economic system. Sometimes these questions are posed in a strictly positive spirit, as when one seeks to determine how taxes affect equilibrium factor prices, and sometimes they arise in normative analyses, as when one seeks to evaluate the welfare effects of incremental policy changes or to find an optimal policy.

By contrast, Section 4 is much more concerned with modeling the determination of local public policies themselves. That is, rather than treating public policies as exogenous variables, they become endogenous variables in models that attempt to represent both economic and political behavior. This, of course, is a highly ambitious objective, more ambitious than simply analyzing the response of the market to exogenous local government policies. There is a wide variety of models of local government behavior appearing in the literature, often with quite different assumptions about who the relevant decisionmakers are (voters, landowners, bureaucrats), their objectives (obtaining desired levels of public services, raising property values, increasing the size of the local budget), and the constraints under which they operate (they may be mobile or immobile, perfectly competitive or not, perfectly informed or not), etc. This diversity reflects the fact that the institutional structure, i.e. the local political process, through which decisions are made is at least superficially quite different from the usual market environment to which economic theory is ordinarily applied.

While it is hoped that this approach to theoretical local public economics is a useful one, it is unfortunately impossible to do justice to the entire subject in the limited space of this survey. A number of important issues cannot be discussed here in depth, and many can only be mentioned in passing. Interested readers may find it useful to peruse recent volumes edited by Thisse and Zoller (1984) and Zodrow (1984), and a survey by Rubinfeld (forthcoming). In particular, the former volume contains a substantial review of the local public finance literature by Pestieau (1984). Wildasin (1986a) provides a survey that is organized roughly along the same lines as the present one, but that covers many additional topics and goes into details that had to be omitted here for brevity's sake. Ultimately, of course, one must go to the original literature for a thorough understanding of the subject.

2. Locational assignment of households

The most interesting problems in local public economics are those in which the openness of the individual jurisdictions plays a major role. (When localities are treated as closed, each is like an independent country on a small scale, and the usual principles of closed-economy public finance apply without modification.) Openness can take the form of commodity and non-human factor flows across jurisdictional boundaries, of population flows, or, in general, of both. Relatively few studies in the literature deal with the general case. Rather, models which feature commodity trade often assume that the population of each jurisdiction is fixed, while models which emphasize locational choice often assume that only one commodity can flow across boundaries, and only then to distribute land rents and profits to non-resident owners of land and/or firms. Both strategies of analysis can of course be quite appropriate, but one should bear in mind that each suppresses certain issues that might be important for some purposes. This section focuses on models in which mobility of households plays the central role. It begins, in Section 2.1, with a simple economy in which there is a fixed set of jurisdictions, each providing some public services, and within which households may reside. The first task is to analyze the efficient assignment of households to jurisdictions. Then, after defining an equilibrium assignment of households, we explore the conditions under which an equilibrium will be efficient. It turns out that the efficiency of equilibria depends critically on the structure of local taxes: equilibria can be efficient if taxes are set appropriately, but if not, they provide incentives for inefficient locational choices.

Section 2.2 discusses the determination of the optimal number of jurisdictions, or, equivalently, of optimal city size. The optimal number of jurisdictions can be derived from a welfare maximization problem, and the resulting characterization has an interesting interpretation in terms of the "Henry George Theorem." This problem is closely related to the problems of optimal city size and of locational efficiency, since the number of households per jurisdiction varies inversely with the number of jurisdictions, and the results bear a close resemblance to those of Section 2.1.

2.1. *Locational efficiency*

In an economic system containing multiple jurisdictions, such as cities, states, provinces, school districts, etc., several conditions must be met for a fully efficient allocation of resources to be achieved. As is true for closed economies, markets for goods and factors must function efficiently within each jurisdiction. Moreover, each jurisdiction's government must provide efficient levels of public services to its residents. Possible breakdowns in these types of efficiency are discussed in subsequent sections. But in a system of open jurisdictions, among which households may move, there is a further dimension of efficient resource allocation to be considered, and upon which we now focus. That is, households must be distributed across jurisdictions in an efficient way.

In order to address this question, it is useful to present a simple model. Let us assume a fixed set of $M \geq 2$ jurisdictions, indexed by a subscript i. Each contains a fixed amount of homogeneous land T_i.[1] Suppose that there is a fixed total population of N individuals in the entire economy, each of whom must locate in one and only one jurisdiction. Each household supplies one unit of homogeneous labor, which is used, along with land, in a production process which produces a

[1]Homogeneity of land is a common simplifying assumption in the literature. Some analyses incorporate heterogeneity in the form of differential accessibility of various parcels to a central employment location, as in the standard monocentric city model of urban economics. (See, e.g. Straszheim's contribution to this volume for a discussion of such models.) For the most part, the results discussed in this survey do not depend critically on the homogeneity of land, in the sense that they carry over directly, or in recognizable extensions, to the heterogenous case. For some discussion of urban public finance issues in the monocentric city context, see, e.g. Kanemoto (1980) and Henderson (1985a).

single homogeneous product, used as a numeraire good. Let $F_i(n_i, T_i)$ be a well-behaved constant returns to scale production function for locality i, showing the amount of output produced as a function of local population, n_i, and local land.

Each jurisdiction provides a single public good or service z_i which is consumed only by residents. To produce z_i units of this local public good requires $C_i(n_i, z_i)$ units of numeraire. Note that C_i may depend on the size of population being served: if $C_{in} \triangleq \partial C_i/\partial n_i > 0$, we say that the local public good is subject to *congestion* or *crowding*, or is an *impure* local public good. If $C_{in} = 0$, the local public good is *uncongested* or *pure*. In the special case where C_i is proportional to n_i, i.e. $C_i(n_i, z_i) = n_i c_i(z_i)$, we shall say that the local public good is *quasi-private* or that it exhibits *constant per capita costs*.

To clarify these concepts, consider the case of elementary and secondary education. The level of education is measured, in the present notation, by z_i. z_i might correspond to the mean score on a standardized achievement test. (In a more sophisticated model, z_i might be a vector of attributes of the educational system, including variables such as percentage of dropouts, percentage of students going on to college, quality of athletic or other extra-curricular programs, or any other features of the system that are important to residents.) Note that z_i is the amount or quantity of education made available to or consumed by each resident, though z_i might be measured by what would be called, in ordinary parlance, the "quality" of education. The number of students educated, represented in this model by the number of resident's in the locality, n_i, does not measure the amount or quantity of education but simply the size of the population being served. $C_{iz} = \partial C_i/\partial z_i$ is the marginal cost of education in the sense that it is the marginal cost of increasing the level of education delivered to a fixed population. This corresponds to what would be called the marginal cost of a public good in a typical closed-economy public finance model. $C_{in} > 0$, in the present context, means that additional resources are required if one is to expand the population being provided with a given level of education. For example, C_{in} might represent the cost of obtaining the extra teachers, buildings, etc. that are required to maintain mean achievement scores in the face of an expanded student population. To say that $C_{in} > 0$ is equivalent to saying that an increase in n_i would cause z_i to fall, if the jurisdiction keeps the amount of resources spent on education fixed as population rises. This justifies the use of the terms "congestion" or "crowding" when referring to goods for which $C_{in} > 0$: an increase in population, with expenditure held fixed, causes a deterioration of public services.[2] C_{in} has also been called the marginal cost of a local public good, though of course

[2]An equivalent way of representing the technology of local public good provision, sometimes encountered in the literature, is to write $z_i = g(n_i, C_i)$ where C_i represents expenditures for, or the level of inputs used in, the provision of the local public good. In this case, $\partial g/\partial n_i < 0$ would imply congestion.

it is conceptually quite distinct from C_{iz}. The two will always be unambiguously distinguished here.[3]

We have now specified the technologies for private and public good provision, and it remains to discuss the preference side of the model. For simplicity, assume that all consumers derive utility only from consumption of the numeraire good and the local public good. Furthermore, assume that all households have identical preferences, and that they are treated identically within each jurisdiction. The utility of a household in locality i, therefore, is a function of its consumption x_i of the numeraire and of z_i, denoted by $u(x_i, z_i)$.

The technological constraints on the economy require that total production of the numeraire good be equal to its consumption by consumers plus its use as a public input, and that the total population of the economy be located in some jurisdiction. Hence, a feasible allocation of resources, which is completely described by vectors (n_i), (x_i), *and* (z_i), must satisfy

$$\sum_i [F_i(n_i, T_i) - n_i x_i - C_i(n_i, z_i)] = 0 , \tag{1.1}$$

$$N - \sum_i n_i = 0. \tag{1.2}$$

How does one characterize an efficient allocation of resources for this economy? One way to proceed would be to maximize the utility of residents in one jurisdiction, say 1, subject to the constraint that households in other jurisdictions receive at least an exogenously-prescribed level of utility. Equivalently, one could set up a social welfare maximization problem with the utilities of residents in different jurisdictions as arguments. As shown in the theory of the optimal monocentric city [see Mirrlees (1972) and Wildasin (1986b)] and in more general contexts as well [Stiglitz (1982), Chang and Wildasin (1986)], quite familiar social welfare criteria, such as utilitarianism, can result in optimal allocations in which identical individuals are given different utilities. Such optima cannot generally be sustained as equilibria in systems which allow free mobility of households, however, since migratory flows will arbitrage away any utility differentials among jurisdictions. Therefore, it is appropriate to impose equal utilities as a constraint at the outset, and to ask what allocation of resources will maximize the common

[3]Empirical work indicates that most local public services exhibit a high degree of crowding or impurity. Indeed, quasi-privateness seems typical. Oates (1986) points out, however, that more populous localities may find it optimal to offer a wider range of relatively pure or uncongestible services than do less populous ones. This could give rise empirically to an *apparent* quasi-privateness, or at least to an overestimate of the degree of congestion of local public services. This argument illustrates the important fact that quantification of the level of local public services is very difficult in practice.

level of utility for all households. Thus, we consider the problem[4]

$$\max_{<(x_i),(n_i)>} u_1(x_1, z_1) ,$$

subject to (1.1), (1.2), and

$$u_i(x_i, z_i) = u_1(x_1, z_1) \quad i = 2, \ldots, M. \tag{1.3}$$

Note that (z_i) is not included in the list of instruments for this problem. This is to emphasize the fact that the results to be derived below do not depend on the optimality or otherwise of the levels of public good provision in the economy.

Associating Lagrange multipliers μ, π, and λ_i with the constraints (1.1), (1.2), and (1.3), respectively, one finds the first-order conditions

$$u_{11}\left(1 - \sum_{i \neq 1} \lambda_i\right) - \mu = 0, \tag{2.1}$$

$$\lambda_i u_{i1} - \mu = 0 \quad i = 2, \ldots, M, \tag{2.2}$$

$$\mu(F_{in} - x_i - C_{in}) - \pi = 0 \quad i = 1, \ldots, M, \tag{2.3}$$

for $x_1, x_i (i \neq 1)$, and n_i, resp., where n_i is treated as a continuous variable. Here $u_{i1} \stackrel{\Delta}{=} \partial u_i / \partial x_i$ and $F_{in} \stackrel{\Delta}{=} \partial F_i / \partial n_i$. The most important of these conditions is (2.3), which implies that

$$F_{in} - x_i - C_{in} = F_{jn} - x_j - C_{jn}, \tag{3}$$

for all jurisdictions i, j.

Consider the interpretation of (3) in the special case where there are no public goods in the economy. Then (1.3) implies $x_i = x_j$ and (3) just reduces to $F_{in} = F_{jn}$. As expected intuitively, efficiency is achieved in the pure private goods economy when total output is maximized, which occurs when the marginal product of labor is equalized everywhere.

Next consider the special case where there are local public goods, but they are purely public, i.e. $C_{in} = C_{jn} = 0$. Then, by (1.3), $x_i - x_j$ (which may be positive or negative) is the compensating differential in private good consumption that keeps utility constant in the face of whatever differential exists in public good provision, $z_j - z_i$. If $z_j > z_i$, then $x_i > x_j$, and it is socially more costly to assign households to locality i rather than j. Nonetheless, it may be efficient to do so, provided that workers in i are sufficiently more productive. At an optimum, (3) implies that the productivity differential $F_{in} - F_{jn}$ just balances the compensating differential $x_i - x_j$ arising from unequal levels of public service provision.

[4]In formulating this problem, it is assumed for simplicity that $n_i > 0$, for all i, at an optimum. This assumption could be violated if there are strong scale economies in private or public good production. See Stiglitz (1977) and Schweizer (1985) for some discussion of this problem. For the sake of simplified exposition, this survey will implicitly assume smoothness, interior solutions, etc. wherever convenient.

Finally, in the general case, the same principles continue to apply, except that one must take into account the marginal congestion costs C_{in}, C_{jn} that households impose when assigned to one locality or the other. The net benefit from assigning a household to a jurisdiction is reduced by this amount.

While this model is very simple, its basic message holds in more general settings [see Wildasin (1986a)]. A version of (3) holds in models where there are many types of households, possibly exhibiting interpersonal crowding tastes or distastes, and with multiple types of private consumption goods, including possibly residential land. The essential efficiency condition is that, for each household type, the value of incremental output obtained by adding one more household to a locality, net of the value of the household's private good consumption and any marginal congestion or crowding costs, must be equated across jurisdictions.

It is worth emphasizing that efficiency condition (3) holds irrespective of the values of the z_i's. One can easily amend the above optimization problem by including the z_i's as instruments, in which case the first-order conditions for the z_i's and x_i's can be manipulated to show that

$$n_i u_{i2}/u_{i1} = C_{iz}, \tag{4}$$

must hold for all i – which is just the standard Samuelsonian condition for efficient public expenditure. This extension is of interest for two reasons. First, observe that it does not alter the derivation of equation (3) which, by itself, is therefore a necessary but not sufficient condition for full efficiency of resource allocation.[5] Since (3) describes the efficient distribution of population, conditional on public good provision, let us say that the economy has achieved *locational efficiency* when it is satisfied. Second, it is useful to observe that (4) characterizes the efficient z_i's regardless of their congestibility features. Thus, (4) applies to both pure and impure local public goods, including quasi-private ones.

Now let us define a competitive equilibrium for this simple economy. Suppose first that each jurisdiction is required to use taxes on land rents or head taxes residents to finance its purchases of inputs for exogenously specified levels of public good provision. It is assumed that jurisdictions use only uniform taxes, and can tax all land rents generated within their borders, no matter what the residence of the owner may be, but cannot tax land rents from other jurisdictions accruing to their residents. In other words, land rents are taxed at source. (Other cases are considered below.) Households own their labor and are also endowed with ownership of all of the land in the economy. Firms hire land and labor in

[5]Obviously, the optimal (n_i) vector that satisfies (3) will depend on the (z_i) vector. That is, the efficient population distribution certainly depends on the levels of local public good provision. What should be stressed, however, is the fact that the *form* of the locational efficiency condition is independent of (z_i).

competitive markets and maximize profits. Furthermore, assume that all households have equal endowments of land and labor – in particular, each owns a share T_i/N of the land in locality i. Finally, assume that households are freely mobile, and make utility-maximizing locational choices, believing that their individual decisions will leave all factor prices and tax rates unchanged.

Under these assumptions, the gross wage and land rent for labor and land will be

$$w_i = F_{in} \qquad \text{all } i\,, \tag{5.1}$$

$$r_i = F_{it} \qquad \text{all } i\,, \tag{5.2}$$

where $F_{it} = \partial F_i/\partial T_i$. Let τ_{in} and τ_{ir} be the head tax and ad valorem land tax rates in locality i. Then the budget constraint for a household locating in jurisdiction i is

$$x_i = w_i + \sum_j (1-\tau_{jr}) r_j T_j/N - \tau_{in} \quad \text{all } i, \tag{5.3}$$

while the balanced-budget constraint for the government in jurisdiction i is

$$n_i \tau_{in} + \tau_{ir} r_j T_j = C_i(n_i, z_i). \tag{5.4}$$

Eq. (5.3) states that households use their net income to obtain the numeraire private good, and that net income consists of wages plus net land rents minus the head tax. Given constant returns to scale and competitive production, no pure profits remain to be distributed to owners of firms. Constraint (5.4) requires that the own-source revenue for locality i equal its requirement for the provision of the level z_i of the public good, given the population n_i. A vector $(w_i, r_i, \tau_{in}, \tau_{ir})$ of factor prices and tax rates satisfying (5), and also satisfying (1.3), will be called a *competitive equilibrium* for this economy. Condition (1.3) embodies the free mobility of households: in a competitive equilibrium, all utility differentials are competed away. Note that conditions (5) and Euler's theorem imply (1.1): this is Walras' law for this economy, and it guarantees that the economy-wide resource constraint for the numeraire good will be met.

The stage is now set for an examination of the conditions under which a competitive equilibrium may be efficient. Specifically, one must determine whether or not the locational efficiency condition (3) is satisfied in a competitive equilibrium. (It is obvious that the public expenditure efficiency condition (4) need not be met, since the (z_i) vector has been fixed arbitrarily.) The answer to this question varies, depending on the assumptions made about local tax structure and about the congestibility of local public goods. In the literature, many different assumptions have been made, and conclusions differ accordingly.

Some readers might wonder why efficiency cannot always be achieved, given that head taxes are allowable instruments in this model. It might therefore be best to begin with the case where all localities use only head taxes to finance their expenditures.

Proposition 1.

Under a regime of pure head taxation, a competitive equilibrium will be locationally efficient if local public goods are quasi-private, and possibly in other cases as well. Efficiency is not generally achieved under head taxation, however.

To see how this result is established, use the household budget constraint (5.3) and the factor pricing equation (5.1) to show that

$$F_{in}-x_i-\tau_{in}=F_{jn}-x_j-\tau_{jn} \quad \text{all } i,j. \tag{6}$$

Comparing this to the locational efficiency condition (3), it is clear that an equilibrium will be efficient if and only if

$$C_{in}-C_{jn}=\tau_{in}-\tau_{jn} \quad \text{all } i,j. \tag{7}$$

When head taxes are the only revenue source, (7) holds if local public goods are quasi-private because the government budget constraint (5.4) with head taxation implies $\tau_{in}=C_i/n_i$. Since $C_i=n_i c_i(z_i)$ in the quasi-private case,

$$\tau_{in}=C_i/n_i=c_i(z_i)=C_{in}$$

which guarantees (7). More generally, (7) could hold under pure head taxation whenever the per capita cost of local public goods is at a minimum with respect to population size, since this again implies $C_i/n_i=C_{in}$.

Despite these "positive" results on the efficiency of equilibrium, there are obviously situations where equilibria will not be efficient. To take one example, suppose local public goods are purely public, but that the levels of the z_i's are such that the per capita costs of local public goods are unequal. Then $\tau_{in}\neq\tau_{jn}$ for some i and j, while the left-hand-side of (7) is zero ($C_{in}=C_{jn}=0$). Efficiency breaks down in this case. Thus, several authors, including Buchanan and Goetz (1972), Flatters et al. (1974), and Bewley (1981), who explicitly or implicitly restrict attention to the case where only head taxes can be used to finance local public goods, conclude that efficiency is achievable only under special conditions, such as when local public goods are quasi-private.

Why do head taxes not guarantee locational efficiency in economies with local public goods? The answer is simply that they are not neutral when levied at the local level in an economy with mobile households: households can successfully avoid the head taxes imposed in any one locality by moving to another. In the quasi-private case, non-neutral taxes are needed for efficiency because migrant households impose congestion externalities on jurisdictions that they enter, and a location-contingent tax serves to internalize this externality. In the quasi-private case, sole reliance on a head tax is sufficient for the efficiency of a competitive equalibrium because the tax that internalizes the congestion externality ($\tau_{in} = C_{in}$) also happens to balance the local budget ($\tau_{in} = C_i/n_i$). In general, however, a head tax alone cannot simultaneously achieve both of these conditions. An additional instrument, provided in the present model by the tax on land rents, is needed. In fact, it is easy to see, by comparing (3), (5.4), and (7), that

Proposition 2.

In general, locational efficiency can be achieved by setting $\tau_{in} = C_{in}$, all i, and by then setting τ_{ir} so as to satisfy (5.4) for all i.

Results of this type appear in Helpman et al. (1976), Hochman (1981, 1982a, 1982b), Wildasin (1980) and elsewhere.

To illustrate the application of Proposition 2, if local public goods are purely public, a pure land rent tax will suffice to insure locational efficiency [Negishi (1972), Wildasin (1977)], while, as noted above, inefficiency will typically result in this case under head taxation. By contrast, pure land rent taxation with congestible public goods is generally incompatible with locational efficiency [Bucovetsky (1981)]. These results accord with the intuition developed above: when there are no congestion effects to internalize, it is efficient to rely solely on land rent taxation. Recall that we have assumed all land rent taxes accrue to the jurisdiction in which the rents are generated. Thus, a household's land rent tax is not location-contingent, and is therefore neutral with respect to locational choices.

So far we have discussed the efficiency implications of local taxation only within the context of a very simple model with very limited tax instruments. The basic principles, however, generalize: congestion effects must be internalized to achieve locational efficiency, which can be done not only with head taxes but with other residence-contingent taxes. In practice, wage income taxes, sales taxes, and property taxes (the part of property taxes that falls on mobile residential capital) might all serve this purpose, although each of these is also likely to distort certain other margins of decisionmaking. For example, a wage income tax might discourage the supply of labor, in additon to discouraging entry into a jurisdiction. Similarly, a tax on residential housing can discourage housing consumption, as well as serve to internalize congestion costs. In view of the prominent role of the property tax in the financing of local public services, this case is empirically important. Hamilton (1975, 1983) has argued, however [see also Mills and Oates, (1975) and Mills, (1979)], that localities can use zoning constraints to prevent property taxes from distorting housing consumption decisions. Optimal zoning would replicate the economic effects of true head taxes. Zodrow and Mieszkowski (1983) question whether zoning can function in the ideal way that is required for locational efficiency. This seems to be an empirical question. Note, however, that zoning need not be perfect in order for the property tax to approximate a system of head taxation.

In any case, many taxes could potentially play the role of the head tax in our simple model. Taxes on capital income (including land rents) could serve this function if such income is taxed in the income recipient's jurisdiction of residence. This is how some capital income is in fact treated under state individual income taxes in the U.S.: states tax the dividend, profit, and rental income accruing to their residents regardless of source. By contrast, a state corporation income tax taxes capital income at its source and would be locationally neutral from the viewpoint of the households that own the corporation – that is, the state corporation income tax is not contingent on the location of the owners.[6] Redistributive transfers administered at the local level provide important examples of location–contingent negative taxes. Since they provide an artificial incentive for households to enter a locality, they are generally incompatible with locational efficiency.

Finally, land rent taxation in our simple model represents any sort of tax that is neutral with respect to household locational choice. For example, equivalent results obtain in models where land is used for residential housing purposes rather than as a factor of production in the non-residential sector of the economy. Also, taxes on other natural resources (oil, coal, etc.) would be locationally neutral, and while these taxes may not be important for many cities or other small jurisdictions, they certainly are important for larger jurisdictions such as some U.S. states or Canadian provinces. The urban property tax itself is of course partly assessed against the value of land, and so to some extent exemplifies the land tax in the model. Furthermore, the stock of urban residential and business capital is quite durable. For sufficiently short time frames, one might also regard this part of the tax as functioning like the land tax in our model.[7]

2.2. *Optimal jurisdiction size*

The discussion thus far has been restricted to the analysis of the distribution of a fixed population among a fixed set of jurisdictions. This framework is not particularly well-suited for an investigation of the optimal size of a jurisdiction, since the average jurisdiction size is exogenously fixed.

[6]See Boadway and Flatters (1982) and Boadway and Wildasin (1984, Chapter 15) for more discussion of the distinction between source-based and residence-based taxation.

[7]This view, of course, conflicts with the long run view, noted above, in which residential capital migrates along with households. The differing role of the property tax in the short and long run points out an important limitation of the foregoing analysis, namely its static nature. An explicitly dynamic model of household migration with durable residential capital would present an important advance over existing studies.

Let us therefore consider a different type of economy, one in which the number of localities can vary. There are two ways that one can imagine doing this. First, one might suppose that the total endowment of land available to the set of all localities is fixed, and that the only question is how to partition the fixed land to form jurisdictions. Second, one might suppose that land is available, either for free or at a cost, for the creation of new jurisdictions. We can analyze both cases briefly.

In the first, let T be the total amount of land to be allocated among M jurisdictions. Since heterogeneity of households complicates matters somewhat, the assumption is maintained that all households are identical. Also assume that all jurisdictions have access to identical technologies for production of private and public goods.

If each jurisdiction is constrained to provide an exogeneously-specified level $\bar{z}$ of the local public good, the utility of each household will depend only on the common level $\bar{x}$ of private good consumed. Given constant returns to scale in private good production, total output of the numeraire private good, which is the sum across all M identical jurisdictions of their individual outputs, is given by $MF(N/M,\ T/M)=F(N,T)$, where F is the common production function for all localities. Note that this is independent of M. To maximize $\bar{x}$, therefore, M should be chosen to minimize the total cost, across all jurisdictions, of providing $\bar{z}$. That is, M should be chosen to

$$\min_{\langle M \rangle} MC(N/M,\bar{z}), \tag{8}$$

where C is the cost function for the local public good faced by all jurisdictions. If M is sufficiently large that it can be treated as a continuous variable, the solution to (8) will be characterized by

$$\frac{C}{N/M}=C_n, \tag{9}$$

i.e. equality of average and marginal cost of public goods with respect to population. Of course, this is simply the rule for least-cost provision of public goods. If there are no congestion effects ($C_n=0$) or if congestion effects are sufficiently small, the optimal M is 1. If the local public good is quasi-private, the optimal M is indeterminate.

Now suppose that new land is available at a cost per unit of r. Again suppose each jurisdiction must provide $\bar{z}$ units of the local public good. Then the problem, assuming that land must be paid for from the production of the numeraire good, is to

$$\max_{\langle M \rangle} \bar{x}=N^{-1}\ [MF(N/M,\ T)-MC(N/M,\ \bar{z})-rMT], \tag{10}$$

where T, the amount of land per locality, is now taken as fixed. The first-order condition for this problem, again treating M as continuously variable, yields (after some rearrangement)

$$\bar{x}=\frac{F-C-rT}{N/M}=F_n-C_n, \tag{11}$$

or, by Euler's theorem,

$$(F_t-r)T=C-C_n\frac{N}{M}. \tag{12}$$

To interpret (11), think of the determination of M as equivalent to the determination of population size for each jurisdiction, N/M. Adding one more household to a representative jurisdiction raises $\bar{x}$, and thus welfare, if the household adds more to the net production of numeraire than it consumes. An entrant adds F_n of output, but imposes congestion costs of C_n. (11) shows that the net marginal production of an additional household is just balanced against its consumption of $\bar{x}$. See, e.g., Schweizer (1983a,b) for further analysis along these lines.

To understand (12), consider first the case where the local public good is purely public, so that $C_n=0$, and where r, the cost of land, is zero as well. Then (12) states that the imputed rent on land in each locality is equated to expenditure on the local public good. Since this optimum could be sustained (once the optimal number of jurisdictions was somehow established) by each jurisdiction taxing away all land rents and using no other taxes, this result has been called the "Henry George Theorem", and it appears, along with much further discussion, in Flatters et al. (1974), Stiglitz (1977), Arnott (1979), Arnott and Stiglitz (1979), and Berglas (1982), among others.

When $r>0$, the interpretation is modified slightly: the cost of pure local public goods would be covered by a 100 percent tax on differential land rents, that is, land rents in excess of the opportunity cost. When local public goods are impure, so that $C_n>0$, a head tax would be needed to internalize the congestion externality, according to our earlier discussion of locational efficiency. If this tax is imposed, $C-C_n(N/M)$ would represent the additional costs of local public good provision that would have to be met by land taxation. (12) shows that when the number of jurisdictions is optimal, this remaining land tax would just exhaust (differential) land rents. In the special case of a quasi-private local public good, the right-hand-side of (12) is zero, so that $F_t=r$ when M is optimized. In particular, $M\rightarrow\infty$ when $r=0$: in this case, the optimal policy is to endow each household with its own jurisdiction, since there are no scale economies in local public good provision.

In this discussion of the determination of the number of jurisdictions, we have focused on the normative problem of finding an optimum. As noted above, once an optimum number of jurisdictions has been achieved, the attainment of an efficient allocation reduces to the problem of achieving locational efficiency. This explains the close similarity between the locational efficiency results, summarized in Proposition 2, and the Henry George Theorem in its general form (i.e., with allowance for impure local public goods). For an arbitrary M, we know that head taxes that internalize congestion costs, together with land taxes that provide any needed additional revenue, insure locational efficiency. The Henry George Theorem tells us, in addition, that these land taxes will precisely exhaust (differential) land rents, when M is chosen optimally.

The positive or public choice question of how M is or might be chosen has not yet been addressed. It is not difficult, however, to imagine how this might be done, at least if each jurisdiction is somehow institutionally committed to using (or finds it optimal to choose) efficient taxes. Suppose that M were not optimal, e.g., suppose $F_t T - [C - C_n(N/M)] > rT$. By the Henry George Theorem, this means that land rents net of land taxes would be greater on any T units of land that were taken from their alternative use, at rent r, and used to form a new jurisdiction providing $\bar{z}$ units of the local public good. If one imagines an institutional framework such that landowners can set up new jurisdictions if desired, it follows that $F_t T - [C - C_n(N/M)] > rT$ cannot persist in equilibrium: new jurisdictions would "enter", causing M to rise, N/M to fall, and F_t to fall. If $C - C_n(N/M)$ rises with M (which will occur if C is convex in its first argument) or at least falls more slowly than $F_t T$, entry will compete away the excess net land rents. Conversely, $F_t T - [C - C_n(N/M)] < rT$ cannot hold in equilibrium: exit will cause M to fall. In equilibrium, the Henry George Theorem is satisfied, and an optimal M is achieved.

Models of this sort, in which land developers control the formation of jurisdictions, appear, for example, in Stiglitz (1983a,b). In clubs models such as Berglas and Pines (1981), entry and exit of profit maximizing club owners causes an efficient number of clubs to obtain in equilibrium. It is a notable fact that these models provide an example of an institutional framework within which self-interested behavior leads to efficient formation of jurisdictions. Whether or not such a model might have explanatory power as a positive theory of jurisdiction formation is unknown at present. It would not be far-fetched, however, to hypothesize that land rent differentials trigger political behavior that results in outcomes similar to those predicted by the developer model. Such positive theories warrant further investigation, both theoretical and empirical. Section 4 discusses local public choice models in greater depth.

3. Local taxation with mobile commodities: Incidence and efficiency analysis

Section 2 has examined in some detail how local tax policy can affect the locational choices of households, and the implications of such policies for efficient resource allocation. It has abstracted, however, from any interjurisdictional commodity flows other than the migration (or, given the static nature of the model, one might better say "assignment") of households, plus a flow of numeraire that compensates non-resident landowners for the use of their land. By contrast, this section deals with problems of local public finance in which trade in goods and/or factors plays a much more significant role. It begins with a review of recent research on property taxation, especially concerning the incidence of the property tax. Interjurisdictional mobility of capital figures prominently in this discussion. Land taxation is considered in Section 3.2. Other tax issues, including tax exporting and tax competition, are treated in Section 3.3. The flow of goods and factors across jurisdictional boundaries is critically important here as well. Section 3.4 briefly considers the incentives for excessive or inadequate local spending that are created by tax exporting and tax competition.

3.1. Property taxation

The incidence and allocative effects of property taxation are issues that can be considered from varying perspectives. In particular, one can analyze the effect of a property tax change in a single locality, or one can consider the impact of an entire system of property taxes imposed simultaneously by many localities. Also, when studying the tax imposed by a single locality, one can restrict attention to its impact within the locality or one can consider its effect on the general equilibrium of the whole economy. As a matter of fact, each of these perspectives can be useful for different purposes. One must bear in mind the question to be investigated, however, in order to avoid confusion.

Let us begin by considering the effect of an increase in the rate of property taxation in a single small jurisdiction. Here, "small" means that the jurisdiction faces demands and supplies for goods and factors, on the external market, that are very highly elastic. Suppose in particular that this is true of the supply of (homogeneous) capital: capital is freely mobile across jurisdictions, and net capital returns in all locations are equalized in long-run equilibrium. If the share of capital in each locality is small, and the demand elasticity for capital in individual jurisdictions is moderately large, the supply of capital to each locality will be highly elastic, even if the supply of capital to the economy as a whole is highly inelastic.

Now suppose that property taxes are assessed on the value of residential and/or commercial and industrial real property. Conceptually, the value of a parcel of property depends both on the land and on the structure on the parcel, and therefore the property tax is often considered to be like two taxes administered simultaneously: a tax on land value, and a tax on capital. In the static framework within which discussions of property tax incidence have usually taken place, the part of the tax assessed against land is borne by landowners, in the form of a reduction in net land rents.[8] The incidence of the part that falls on capital has been the subject of more analysis.

A common approach is to suppose that the tax rate on capital can be varied independently of that on land, at least hypothetically, and to conduct a comparative static analysis of the effect of a change in this tax rate. The essential features of such an analysis are easily understood. Let t_i be the ad valorem tax rate on capital in locality i, K_i and T_i the amount of capital and land in the jurisdiction, r_i the gross rental value of land, and ρ the net return to capital. T_i is exogenously fixed, but K_i is variable, and is assumed to adjust so as to provide a net return equal to that obtained on external markets, ρ. The individual jurisdiction is assumed to be small relative to the capital market so that ρ is exogenous. Suppose that land and capital are used by perfectly competitive profit maximizing firms, operating under conditions of constant returns to scale, to produce a single output. This good might be residential housing or some other non-traded good, or it might be an exported commodity. Let $D_i(p_i)$ be the demand for this good as a function of its price. For non-traded goods, the elasticity of demand $\varepsilon_i \overset{\Delta}{=} \mathrm{d}\log D_i/\mathrm{d}\log p_i$ is presumed to be considerably less than infinite. This may also be true for traded goods if the jurisdiction's producers, though individually small, are collectively large relative to the external market.

In equilibrium, gross land rents equal the value of output less gross outlays on capital, while the price of the output is equal to its unit cost of production, $\gamma_i(\rho[1+t_i], r_i)$. Hence

$$r_i T_i = p_i D_i(p_i) - \rho(1+t_i)K_i, \tag{13.1}$$

$$p_i = \gamma_i(\rho[1+t_i],\ r_i). \tag{13.2}$$

Let an asterisk denote a proportionate change in a variable (e.g., $p_i^* = \mathrm{d}p_i/p_i$, $t_i^* = \mathrm{d}t_i/(1+t_i)$) and let f_{iT} and f_{iK} denote the gross value shares of land and capital (i.e., $f_{iT} \overset{\Delta}{=} r_i T_i/p_i D_i$, and similarly for f_{iK}). Then differentiation of the system (13) yields

$$r_i^* f_{iT} = (1+\varepsilon_i)p_i^* - f_{iK}(K_i^* + t_i^*), \tag{14.1}$$

$$p_i^* = f_{iK} t_i^* + f_{iT} r_i^*, \tag{14.2}$$

using well-known properties of the unit cost function. Since $T_i^* = 0$, one has $K_i^* = \sigma_i(r_i^* - t_i^*)$, where σ_i is the elasticity of substitution between land and capital.

[8]The usual sorts of caveats must be imposed for this result to follow. See, e.g. Mieszkowski (1969) or McLure (1975) for general discussions of tax incidence. As can be seen from these articles, or from Feldstein (1977), the presumption that land taxes are not shifted depends on several simplifying assumptions: the general equilibrium relative price changes brought about by reduced consumption by landowners and increased spending by government are ignored, as are possible changes in landowners' supplies of other factors of production. Other questions that arise in an intertemporal setting are discussed below.

Thus eliminating K_i^* from (14.1), and using (14.2) to eliminate p_i^*, one obtains

$$(f_{iK}\sigma_i - f_{iT}\varepsilon_i)r_i^* = (\varepsilon_i + \sigma_i)f_{iK}t_i^*. \tag{15.1}$$

Solving for r_i^* and substituting back into (14.2) finally yields

$$p_i^* = \frac{f_{iK}\,\sigma_i}{f_{iK}\sigma_i - f_{iT}\,\varepsilon_i}\,t_i^*. \tag{15.2}$$

To see the implications of these results for tax incidence, note first that ε_i and σ_i are crucial parameters. The intuitive role that they play in (15.1) is as follows: an increase in the tax rate causes an increase in the cost of capital to the firms in the locality. This induces substitution of land for capital, as firms respond to the change in the relative factor prices, to an extent that depends on σ_i. The greater is this substitution effect, the larger is the bidding up of the price of the fixed supply of land. On the other hand, an increase in the cost of capital causes an increase in the cost of production, which reduces output to an extent that depends on the demand elasticity ε_i. This tends to reduce the demand for land and puts downward pressure on r_i. As (15.1) reveals, these effects are exactly in balance when $\sigma_i = |\varepsilon_i|$, for then $r_i^* = 0$. In this case, as shown by either (14.2) or (15.2), the effect of the tax is to raise the output price by $f_{iK}t_i^*$. The burden of the tax is therefore shifted from capital to consumers. If we consider a tax on residential housing, consumers may be tenants, and the conclusion is then that the tax is shifted from landlords to tenants. Similar conclusions apply if the output corresponds to other non-traded goods. If the output is a traded good, then one concludes in this case (where $\sigma + \varepsilon = 0$) that the tax on capital is *exported*, or, more accurately, that its burden is split between resident and non-resident consumers in proportion to their consumption shares of total output.

If σ_i is smaller than $|\varepsilon_i|$, (15.1) shows that $r_i^* < 0$, because the output effect dominates the substitution effect. If $\sigma_i = 0$, no substitution is possible. Since T_i is fixed, total output and hence the output price cannot change, as confirmed by (15.2). Hence, as (15.1) or (14.2) shows, r_i must fall enough to keep the unit cost of production constant in the face of an increase in the cost of capital. In this case, none of the tax is shifted to consumers, hence there can be no tax exporting if the output is a traded good, and the burden of the tax on capital is shifted to landowners. If, to take the other extreme, σ_i is very large ($\sigma_i \to \infty$), the substitution effect dominates the output effect and $r_i^* = t_i^*$, as shown by (15.1). By (14.2) or (15.2), it then follows that $p_i^* = t_i^*$, that is, the tax actually makes landowners better off at the expense of consumers, who bear more than the full burden of the tax.

Now consider the role of the demand elasticity, ε_i. It, of course, determines the size of the output effect. If $\varepsilon_i = 0$, this effect cannot operate and all the conclusions of the $\sigma_i \to \infty$ case emerge again. If instead $\varepsilon_i \to -\infty$, the output effect dominates, $p_i^* = 0$, and r_i falls to offset the rise in the gross cost of capital.

In the literature, various models have appeared that produce results of the type just described. Aaron (1975), in summarizing the traditional or "old view" of property tax incidence, presents a partial equilibrium argument under which the part of the property tax assessed on capital is passed forward to tenants or consumers of other goods in the form of higher housing or other output prices. Since this partial equilibrium view abstracts from the effects of the "structures" part of the property tax on the return to land, it probably is best understood as corresponding to the case $\sigma_i + \varepsilon_i = 0$, in which $r_i^* = 0$. Aaron also discusses the fact, however, that capital flows in response to changes in a jurisdiction's property tax rate will change factor proportions and therefore may change factor prices. Aaron notes, for example, that a tax increase can cause a capital outflow, a corresponding reduction in the capital/land ratio, and hence a fall in land rents. In terms of the model just developed, this corresponds to the case where $\sigma_i < |\varepsilon_i|$.

The relationship between output and substitution effects identified above underlies the results of a number of other studies. In some work [e.g., LeRoy (1976)], the analysis is conducted within the context of a monocentric city model with explicit spatial structure. Other investigators consider a variable supply of land [Hobson (forthcoming)] or vary the structure of the model in other ways, for example by distinguishing between housing and non-housing production. Studies of this latter type, such as Sonstelie (1979) or Lin (1985), have examined the effects of differential taxation of capital across uses. For additional analyses of property tax incidence in settings comparable to the above, see Grieson (1974) and Haurin (1980). Mieszkowski (1972) discusses some of the complications involved in moving to the case of more than one immobile factor. Arnott and MacKinnon (1977) and Sullivan (1984) present computable general equilibrium models in which the effects of property taxation can be simulated. It should be noted that in most of this literature, the limiting case $\varepsilon_i \to -\infty$ is often implicitly or explicitly assumed for traded goods, which means that exporting of the property tax, in the form of higher output prices, is precluded. In the case where the tax is imposed on residential housing or some other non-traded good, of course, tax exporting is ruled out by the structure of the model. Section 3.3 below considers tax exporting in more detail.

So far, we have focused on the effects of property tax changes in a single jurisdiction. From the viewpoint of tax incidence, at least for small jurisdictions, it might appear that the *only* effects of such a tax change, aside from the case where the jurisdiction exports a commodity for which it has a significant market share, are those which occur within the taxing jurisdiction – i.e., effects which show up in the prices of non-traded goods (e.g., land). An interesting demonstration that this is not the case is provided by Bradford (1978) and Mieszkowski and Zodrow (1984b), who cite Brown (1924) as an antecedent. These authors emphasize that a complete incidence analysis of a tax change in an individual locality must consider the effects of the tax not only within the locality but outside of it as well. At first sight one might think that the rest of the economy is affected so slightly by a tax change in one small jurisdiction that these effects can be ignored. A simple example, however, will demonstrate that this is not so.

Using the notation developed earlier in this section, let ρ, t_i, and K_i be the net return to capital, the tax rate on capital, and the amount of capital in locality i. Suppose for the moment that each locality produces a single traded good, the price of which is taken as exogenous at $p_i=\bar{p}$, and that $\phi_i(K_i)$ is the output of this good as a function of the amount of capital in the jurisdiction. Imagine that ϕ_i is derived from an underlying constant-returns to scale function of K_i and T_i, so that ϕ_i can be assumed strictly concave in K_i alone. Finally, to make the exposition as simple as possible, assume that the land endowment and technology of all localities are identical, that all tax rates are initially identical ($t_i=\bar{t}$, all $i=1,\ldots,M$), and that the total stock of capital in the economy is fixed at $\bar{K}$. In equilibrium, net returns on capital are equalized, so that

$$\bar{p}\phi_i'(K_i)=(1+t_i)\rho \quad \text{all } i, \tag{16.1}$$

and all capital is employed, so that

$$\bar{K}-\sum_i K_i=0. \tag{16.2}$$

This provides a system of $M+1$ equations which determine equilibrium values of the K_i's and ρ, given the t_i's as parameters. More precisely, (16.1) can be used to solve for each K_i in terms of $(1+t_i)\rho$, such that

$$K_i' \triangleq \frac{\mathrm{d}K_i([1+t_i]\rho)}{\mathrm{d}([1+t_i]\rho)}=\frac{1}{\bar{p}\phi_i''}<0. \tag{17}$$

Substitution of the $K_i(\cdot)$ functions into (16.2) allows one to solve for ρ in terms of the t_i's.

Now suppose one jurisdiction i raises its tax rate. From (16.2) we obtain

$$\frac{\partial\rho}{\partial t_i}=\frac{-\rho K_i'}{\Sigma_j(1+t_j)K_j'}=-\frac{\rho}{1+\bar{t}}\frac{1}{M}, \tag{18}$$

using the simplifying assumption that all jurisdictions are identical.

As (18) shows, a tax increase by one small jurisdiction (i.e., in the case where M is large) will have a small effect on the equilibrium net return to capital. Indeed, this justifies the perception, from the viewpoint of any one locality, that ρ is exogenously fixed. However, note that the total reduction in the net return to the economy as a whole is

$$\frac{\partial\rho}{\partial t_i}\bar{K}=\frac{\rho}{1+\bar{t}}\frac{\bar{K}}{M}\frac{\rho}{1-\bar{t}}K_i. \tag{19}$$

The amount of incremental tax revenue collected in locality i is

$$\frac{\mathrm{d}t_i\rho K_i}{\mathrm{d}t_i} \simeq \rho K_i + t_i\rho K_i'. \tag{20}$$

If $\bar{t}=0$, i.e., if we start from a zero-tax initial situation, (19) and (20) imply that the tax in locality i reduces net capital income in the economy as a whole by exactly the amount of the tax collected in i. Although the amount of tax burden shifted from locality i to capital owners in the economy as a whole is small compared to the total return to capital in the entire economy, it is *not* small relative to the amount of tax collected in the taxing jurisdiction.

Now recall the discussion which showed that when the output price facing an individual locality is fixed ($\varepsilon_i \to -\infty$), the imposition of an incremental tax on capital causes a reduction in total land rents. In fact, if $t_i=0$ initially, (14.2) implies that the reduction in land rents is equal to the amount of incremental tax revenue collected. There seems to be a paradox here: on the one hand, the tax is fully shifted to landowners in the taxing jurisdiction, and on the other hand it is fully shifted to capital in the economy as a whole. The resolution of the paradox rests on a recognition that it is the flow of capital from the taxing locality to the rest of the economy that depresses (slightly) the economy-wide net return to capital. It lowers the net return to capital because the capital/land ratio outside the taxing jurisdiction is (slightly) increased. But this change in factor intensity also means that the return to land in the rest of the economy is increasing, and one can show (in the simple case of identical jurisdictions) that the total loss of net land rents in the taxing jurisdiction is equal to the total gain in net land rents in the remaining jurisdictions. This resolves the paradox, since the tax burden that shows up twice – once in depressed local land rents and once in a lower economy-wide return to capital – is offset (once) by the increase in land rents outside the taxing locality.

While the case of initially zero tax rates is easier to analyze ($\bar{t}=0$), the conclusions do not change very much when $\bar{t}>0$. Here, the taxing jurisdiction receives less incremental tax revenue from an increase in the tax rate because of the loss of tax revenue on capital leaving the locality, as reflected in the $t_i\rho K_i'$ term in (20). The capital flow increases tax revenue by $-\bar{t}\rho K_i'$ in the rest of the economy, however. One could therefore characterize the general case where $\bar{t}>0$ as follows: the increase in one locality's tax on capital causes an economy-wide reduction in the net return to capital equal to the product of the incremental tax per unit of capital and the amount of capital initially located in the taxing jurisdiction. In addition, there are transfers from taxpayers and landowners in the taxing jurisdiction to taxpayers and landowners in the rest of the economy.

Finally, allowing p_i to vary, as for instance in the case where one is analyzing the residential property tax, changes the results slightly once again. The increase in the price of housing in the taxing jurisdiction would partially offset the reduction in local land rents. There would also be a reduction in the price of housing in other localities.

All of the foregoing discussion has been simplified by the assumption that all localities are identical in terms of technologies, fixed resource endowments, and initial tax rates. The conclusions of the analysis will certainly differ if this assumption is relaxed. (Note that differential tax rates will introduce excess burden complications that are discussed further below.) Presumably the conclusions would be essentially unchanged for small departures from this restrictive assumption, however. (Simulations might be used to verify this conjecture. Also, there is scope here for additional theoretical work.)

We have now analyzed two types of property tax incidence problems: we have explored, first, what happens in an individual locality when its tax rate changes, and second, what happens in a *system* of localities when an individual locality changes its tax rate. Mieszkowski (1972) and subsequently Aaron (1975) and others have investigated a third question: what is the effect of property taxes imposed by *all* localities in a system of local governments? The analysis of the impact of a system of local property taxes is one of the main features of what has come to be called the "new view" of property tax incidence.

The simplest world in which to evaluate the incidence of a system of local property taxes is one in which a fixed stock of capital is allocated among a set of jurisdictions. In this world, a simultaneous increase in the property tax rate in all jurisdictions is identical to a general capital tax (ignoring the tax on land for simplicity). Given the fixed supply of total capital, together with the other usual simplifying assumptions of tax incidence analysis, this tax will be borne entirely by capital, and will not be shifted to other factors or to consumers of housing or other goods. As Aaron (1975) emphasizes, this result has far-reaching implications when compared to the "old view", according to which the property tax would be passed forward into housing or other output prices and would be regressively or, at best, proportionally distributed with respect to income. Since capital income and/or wealth is distributed more unequally than total income, the new view suggests, in contrast, that the property tax is progressive in its incidence. Of course, it must be kept in mind that this conclusion is conditional on the assumption of a fixed supply of capital. If one examines capital taxation in a growing economy in which the capital stock depends on the savings behavior of households, incidence analysis might lead to quite different conclusions.[9]

Proponents of the new view of property tax incidence recognize, of course, that property tax rates in practice vary considerably, both across jurisdictions and

[9] It is not possible to consider here the general question of the incidence of capital income taxation, since this would involve an examination of a large part of the literature of public finance of the past decade or so. For discussion of the issues involved in dynamic tax incidence analysis and some references to the literature, see Atkinson and Stiglitz (1980), Boadway and Wildasin (1984), and Kotlikoff (1984).

across sectors (e.g., residential vs. non-residential capital). The intuition behind the new view would suggest that a system of non-uniform property taxation could be regarded as a system of uniform taxation at some average rate, together with a system of jurisdiction- or sector-specific tax differentials. "On average" the tax would be borne by capital, while the differentials would be shifted through mechanisms like those analyzed above in our discussion of taxation in individual jurisdictions. As Courant (1977) shows, however, the concept of an average tax rate is elusive. In general, there is no uniform tax rate that would produce the same total revenue and simultaneously lower the net return to capital by the same amount as a given system of non-uniform taxation. For a given tax revenue, the net return to capital under a uniform tax would depend on the precise production technologies in the various localities, and could be either higher or lower than an equal-revenue non-uniform system. Despite this difficulty with the concept of the "average" tax rate, however, the essential new view conclusion – that the system of property taxation depresses the net return to capital, rather than leaving the net return unaffected as traditional analysis would have it – remains unchanged.

Let us now turn to a discussion of the allocative effects of property taxation. Except possibly in a dynamic setting, as discussed in Section 3.2, it is generally agreed that the part of the property tax that is assessed against land is neutral and by itself does not distort any decisionmaking margin. The part of the tax that falls on capital, by contrast, may obviously be non-neutral, as discussed formally in Brueckner (forthcoming).

A conventional argument is that this part of the tax generates an efficiency loss by increasing the gross price of capital for a small open jurisdiction that faces a perfectly elastic capital supply. To present this argument diagrammatically, let MP_1 and MP_2 in Figure 1 be marginal product of capital schedules for a single small jurisdiction 1 and an aggregate of all other jurisdictions, denoted by 2, resp. Suppose $\bar{K}$ is the fixed supply of capital to the economy as a whole, and let K_1, the amount of capital allocated to locality 1, be measured in the positive direction along the horizontal axis. Then the difference between $\bar{K}$ and K_1 represents the amount of capital in jurisdiction 2. To capture the notion that 1 is small, MP_2 is shown as horizontal, at least in the relevant range, although this is not crucial for the analysis. Suppose each jurisdiction is imposing a tax on capital at ad valorem rates $t_1 = t_2 = \bar{t}$. The net return to capital is fixed at $\rho = MP_2/(1+t_2)$. The equilibrium amount of capital is K_1^e. If locality 1 were now to eliminate its property tax, it would experience a capital inflow that would result in a new equilibrium at $K_1 = K_1'$. From the viewpoint of locality 1, the tax at rate t_1 discourages "development" and produces an excess burden of *abc*.

It is immediately apparent, however, that this analysis is incomplete and misleading, because the initial equilibrium, with equal tax rates and $K_1 = K_1^e$, is clearly efficient. (The marginal product of capital is equalized across jurisdic-

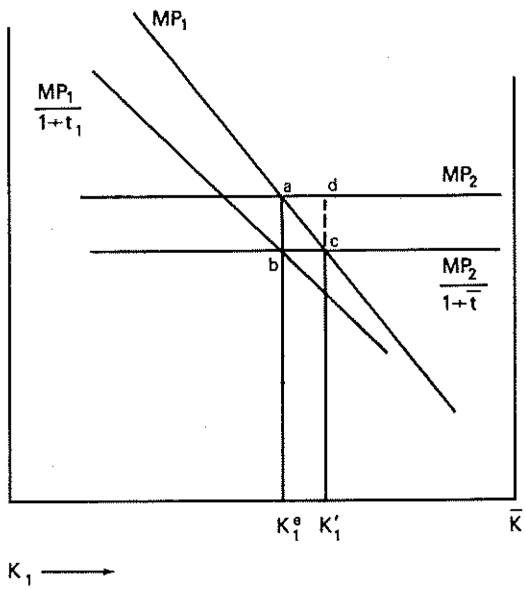

Figure 1.

tions.) Hence, the elimination of the tax in locality 1, instead of enhancing the efficiency of resource allocation, actually creates a distortion resulting in a loss of output to the economy as a whole equal to *acd*. The explanation for the apparent contradiction is easily found, of course: in a second best situation, given that $t_2 = \bar{t}$, an equal tax in locality 1 offsets the non-neutrality of the property tax in jurisdiction 2. The apparent excess burden in locality 1 of *abc* is more than offset by an increase in tax revenue to locality 2 equal to *abcd*, resulting from the flow of capital of $K_1' - K_1^e$ to locality 2 and yielding a net benefit of *acd*. Thus, a policy that may be welfare improving for an individual jurisdiction need not be socially welfare-enhancing.[10] [See Gordon (1983), Wilson (1985a) and Wildasin (forthcoming).]

It is important to analyze the allocative effects of property taxes in a framework that takes not only the interjurisdictional mobility of capital into account, but the intersectoral mobility of capital as well. In the U.S. and in other countries, effective tax rates on capital vary widely across industries and types of capital. One important source of intersectoral variation in tax rates is the taxation of income from capital in the business sector of the economy via the corporate and personal income taxes. Such taxes do not fall on the returns to capital in the

[10] In an economy in which the capital stock is not exogenously fixed, the property tax might also distort the efficiency of resource allocation through its impact on savings behavior. The general problem of the distortionary impact of capital taxation is beyond the scope of this survey, but see the references of the preceding footnote for an introduction to the issues.

residential sector of the economy, especially capital invested in owner-occupied housing. In such a system, the residential property tax may reduce the variations in effective tax rates across categories of capital, and therefore may improve the efficiency of resource allocation. Hobson (1985) and Thirsk (1982) discuss this issue, and Devarajan et al. (1980) and Hamilton and Whalley (1985) present simulations which illustrate the potential efficiency gains from property taxation in models with other capital taxes.

The preceding discussion has been comparatively silent on the implications of household mobility for the analysis of the incidence and efficiency effects of property taxation. Indeed, in much of the property tax literature, interjurisdictional mobility is implicitly or explicitly restricted to capital, with households appearing, if at all, in a composite immobile factor of production (often called land). In all of the formal analysis presented up to this point, for example, one might have supposed that each jurisdiction consists simply of a single immobile household, or a group of identical immobile households. While this convenient simplifying assumption is often very useful, it may also be misleading.

For example, the work of Hamilton (1983) and others, mentioned in Section 2, suggests that zoning and household mobility must be taken into account in the analysis of property taxation. In a world of ideal zoning, capital would not flow freely, independently of population, so as to equalize net returns everywhere. The deadweight loss from property tax distortions would be obviated in such a system. Mieszkowski and Zodrow (1983, 1984a,b) contend that ideal zoning will not likely be achieved. As long as zoning policies leave some scope for the escape of capital from taxation, there will be the possibility of inefficient interjurisdictional or intersectoral allocations of capital. Nonetheless, these views are not necessarily mutually exclusive. A priori, one might suppose that, in practice, property taxes have some of the effects attributed to them in fiscal zoning models (i.e., they may influence locational choices by households somewhat like head taxes) and also some of the effects suggested by the "new view" literature (i.e., they act somewhat like taxes on mobile capital). Perhaps a theoretical synthesis of the two approaches is necessary.

Another illustration of the potential inadequacy of ignoring household mobility in the analysis of property taxation is provided by Wilson (1984). Wilson considers the effect of an increase in a single locality's property tax, when that locality is part of a system of jurisdictions among which utility-maximizing households and capital can migrate freely. Each jurisdiction uses land, labor, and capital to produce a non-traded good such as residential housing. Wilson shows, however, that the mobility of households may make the elasticity of demand for the non-traded good infinitely elastic, even when each individual consumer has a finite demand elasticity. The upshot is that the expected incidence result in this case, that is, that the property tax is shifted forward to consumers of the non-traded good (e.g., residential housing), can be overturned. This result confirms, once again, that analysis of the property tax can be quite sensitive to the assumed mobility or immobility of households. See Brueckner (1981) and Hobson (forthcoming) for further investigation of property taxation with mobile households.

3.2. Land taxation

A simple partial equilibrium analysis of the effects of a tax on land is revealing. Given that "land" is interpreted as unimproved land, and given that one confines the analysis to a jurisdiction with exogenously fixed boundaries, land will be perfectly inelastically supplied. A land tax should therefore be neutral, with no shifting and no efficiency loss. This is the conventional view of land taxation, and, especially because of its neutrality feature, it has appealed to many students of urban public finance [e.g., Vickrey (1970)]. These standard conclusions on both the incidence and efficiency of land taxation have been challenged, however. Interestingly, in both cases, questions have arisen when land taxation is evaluated in an intertemporal setting.

In analyzing the incidence of a tax on land rents, Feldstein (1977) considers a simple two-period overlapping generations model in which households are not linked across generations by bequests or other transfers. Feldstein finds that the land rent tax induces households to hold larger amounts of capital, so that the net return to capital is depressed and the productivity (and thus gross factor prices) of other factors, including land, is increased. The land tax can thereby be shifted to capital. Calvo et al. (1979) however, point out that this result changes when one assumes rational bequest behavior. In this case, land taxes are fully capitalized into land values, and bequests are changed so as to leave the real intertemporal equilibrium of the economy undisturbed. Fane (1984) observes that Feldstein's original conclusion results from an implicit intergenerational transfer caused by land taxation: land values fall to reflect the taxes that landowners will pay throughout the future, and this makes the current generation worse off at the expense of future generations. Intergenerational altruism can nullify the effect of this transfer, as the Calvo et al. analysis demonstrates. But the effect can also be nullified, for example, by having the government give bonds to landowners at the time the land tax is imposed, to be financed by future land rent tax collections. Such bonds would have a present value equal to the present value of these taxes, i.e., equal to the capitalized loss in land values that the taxes generate. Such bonds would therefore leave the net worth of landowners, and the real equilibrium of the economy, unchanged – even in the absence of private bequests motivated by intergenerational altruism.

The neutrality of land value taxation has been studied by several authors, including Bentick (1979) and Mills (1981), who conclude that neutrality breaks down in a dynamic economy. A simple way to appreciate the essence of the non-neutrality argument is as follows. Consider first the simple special case of a parcel of land that can be developed in a way that will yield a constant return of R per year in perpetuity. If returns are discounted at rate r, and the market value of the property is taxed at rate t, then its market value V must satisfy

$$V=\frac{R-tV}{r}=\frac{R}{r+t}. \tag{21}$$

Comparing V with and without a tax on land value (i.e., with $t>0$ vs. $t=0$), it is clear that the effect of land value taxation on land value is identical to that of an increase in the discount rate. Although the valuation formula analogous to (21) becomes more complex in the more general case where the return to land R or the discount rate r may vary over time, it is still true that an increase in the rate of land value taxation is similar to an increase in the discount rate. On the basis of this observation, Bentick (1979) and Mills (1981) argue that land value taxation promotes excessively rapid development of land: uses of land with low immediate returns and high deferred returns appear relatively less attractive in the presence of such taxes than projects that yield higher returns in the present or immediate future. As emphasized in Wildasin (1982), this non-neutrality can be traced to the fact that the market value of a parcel differs over time according to its use, so that land value tax liabilities are not use-independent. Nonetheless, neutral land taxation is still achievable, even in an intertemporal setting. A per unit tax on land, for example, would be independent of the use to which land is put, and would be neutral. A tax on some "standard value" of land, again independent of use, would similarly be neutral.

3.3. More complex structures of local taxation, production and trade

The property tax is a mainstay of local taxation in the U.S. and many other countries. At least as a first approximation, it is often useful and appropriate to assume that this is the only tax instrument available to localities. One should recognize, however, that this is only an approximation. Some local governments, both in the U.S. and elsewhere, use sales or income taxes. Many use fees or special assessments to finance utilities or certain types of improvements. At the state or provincial level, one finds substantial use of taxes on both individual and corporate income, sales, property, minerals and other natural resources, wealth, and other bases. Furthermore, the property tax itself may not be such a simple instrument as it might first appear. For example, effective property tax rates can vary across classes of property, such as commercial, light industrial, heavy industrial, single family residential, multi-family residential, agricultural, etc. In particular, the ratio of assessed to market value often differs from one category of property to another. Variations in assessment practice might be the result of explicit decisions to assess some kinds of property more heavily than others, or they might arise in a more implicit – or even inadvertent – fashion.

Not only can localities have more complex tax structures than is captured by simple models of uniform property taxation. The local economy itself might contain several industries, among which there could be factor or intermediate good flows, and there could be in general a complex pattern of interjurisdictional trade. This, too, is important for understanding the effects of local taxation.

A number of studies have examined the incidence and welfare effects of local taxation in models which incorporate some of these added features. For example, McLure (1969, 1970, 1971), Homma (1977), and Gerking and Mutti (1981) examine tax incidence in an economy with open regions which may produce more than one good and which trade goods and factors. In models of this type, results often depend on the general equilibrium adjustment of factor markets, as industries expand or contract in response to tax changes. As expected from other work on tax incidence in the Harberger (1962) tradition, these analyses show that factor intensities and ease of factor substitution are frequently important determinants of tax incidence.

An intriguing possibility that occurs in open economy tax incidence analysis is that taxes may be shifted to households that do not reside in the taxing jurisdiction, a phenomenon known as tax exporting. As mentioned earlier, one of the ways that tax exporting can occur is through the effect of local taxes on the output prices of traded goods. Equally, it can occur through a lowering of input prices for traded factors. Most of the discussion in the literature has focused on the case where the taxing jurisdiction has a "significant" effect on the price of a traded commodity, i.e., where the jurisdiction is not "small" and, in the language of international trade theory, can affect the terms of trade. For example, it has been suggested [see, e.g., McLure (1983) and Mieszkowski and Toder (1983)] that severance taxes on natural resources, such as coal produced in several western states in the U.S. (which collectively produce a large share of certain types of coal), might reduce output and drive up the price paid by (largely) non-resident consumers for these resources or derived products. As another example, many localities impose taxes on hotels or restaurant meals, presumably because these tend to fall especially on non-residents. It might even be argued that such local taxes as the property tax are shifted to non-residents. As indicated in the analysis in Section 3.1 above, this can occur if the output price faced by firms in the locality is not parametrically given. If local firms produce differentiated traded goods, they may have some monopoly power even if they are small in some sense. (Formal modeling along these lines would be quite useful.) For studies that analyze tax exporting in terms of the effect of local taxes on traded goods prices, see, e.g., McLure (1964, 1967, 1981).

There may be other important tax exporting mechanisms open to localities, in addition to exploitation of monopoly or monopsony power. In the U.S., state and local government taxes are presently (1985) deductible expenses under the federal individual income tax. This means that a portion (depending on the taxpayers' marginal tax rates) of state and local taxes assessed on households that itemize their deductions are shifted, via the federal income tax, to all federal taxpayers. (There is some controversy about the removal of this feature of the tax law.) Some of the implications of state and local tax deductibility are examined by Zimmerman (1983), Gramlich (1985), and Inman (1985).

Finally, our earlier discussion of property tax incidence has shown that even when an individual jurisdiction takes external output and factor prices as fixed, it does not necessarily follow that local taxes, e.g., on capital, are borne only by residents. Since a property tax imposed by one small locality can be borne by capital in the economy as a whole, it could be argued that taxes can be exported even by small, open jurisdictions. Recall, however, that the property tax imposed by a single locality will also change land values and/or non-traded goods prices, and that these effects tend to reverse the shifting of the burden from the locality to outsiders.

How might a locality optimally exploit its ability to export taxes? More generally, what is an optimal tax structure for an individual jurisdiction, with or without the ability to influence the terms of trade? These questions are investigated in Arnott and Grieson (1981), who examine an individual jurisdiction inhabited by a single immobile household (or many identical immobile households). Many of the results obtained by Arnott and Grieson are recognizable as a blend of results from the theory of optimal tariffs, on the one hand, and the theory of optimal taxation on the other. They show that the optimal tax structure can be characterized in terms of a modified inverse elasticity formula.[11] This formula shows that when the jurisdiction is small in the market for a particular traded good, the optimal tax on that good is zero. In cases where the locality can affect the terms of trade, one obtains the usual optimal tariff rule, slightly modified if the household in the taxing jurisdiction itself consumes the traded good. In short, the intuition behind the concept of tax exporting is formally vindicated, and turns out to be essentially equivalent to the terms of trade effect of a tariff. For non-traded goods, the Arnott–Grieson analysis yields results quite like those obtained in the standard theory of closed-economy optimal taxation.

3.4. Behavioral models of local taxation and expenditure

In general, it is difficult to model local government policy determination, since political decisionmaking processes are not well understood. Tractable and useful models can be constructed, however, on the hypothesis that each jurisdiction

[11] This formula can be derived under certain simplifying assumptions, including an absence of cross-price effects. See the original paper for details.

contains a single immobile household (or many such) and that local policies are chosen to maximize welfare for this household.[12]

It is natural to ask, in this setting, whether or not equilibrium local policies are socially efficient. In general, the answer is no. Tax exporting possibilities, for example, might induce a locality to use a distortionary tax on traded goods in place of a non-distortionary tax on local land, in an effort to shift the burden of local taxes to non-residents. Tax exporting may also lower the cost of local public goods to the jurisdiction, and induce inefficiently high levels of local public expenditure, as argued, e.g., by McLure (1967), Oates (1972), or Zimmerman (1983). It should be noted that the degree of distortion of local public spending depends on the entire structure of local taxation, however, and not just on the presence or absence of tax exporting, as discussed by Mieszkowski and Toder (1983) and Wildasin (1984b).

There may also be incentives for inefficient local policy when localities are not able to influence the terms of trade. First, as noted above, a tax on mobile capital may generate a welfare loss from the perspective of a single jurisdiction, even if the tax is non-distortionary from the perspective of the entire economy. This may induce a locality to distort its tax structure away from socially efficient taxes, toward more distortionary ones. Second, this may induce localities to keep tax rates, and thus local public spending, too low – a phenomenon often called tax competition, and analyzed by Zodrow and Mieszkowski (1986), Wilson (1986), Wildasin (forthcoming) and others. More generally, as shown by Wilson (1985b), the taxation of mobile capital in an economy with interjurisdictional trade in commodities might result in too little public good provision in some localities and too much in others.

Finally, it is worth noting that in systems where the number of jurisdictions is small, the possibility exists of strategy interaction in the determination of local public policy. Analysis of local government behavior in a small-number setting appears in Kolstad and Wolak (1983) and Mintz and Tulkens (1984).

4. Local public expenditure theory

A distinguishing characteristic of research in local public economics has been the sustained effort, in both theoretical and empirical work, to develop predictive models of local public expenditure.

Models of this sort – which we shall refer to here as *public choice* models, although this term should be interpreted very broadly in the present context –

[12]By contrast, welfare analysis with many households, particularly mobile ones, is more problematic. See, e.g. Starrett (1980), Boadway (1982), and Gordon (1983) for analysis of local policy with mobile households.

arise with much greater frequency in local public finance than in the analysis of public policy at the level of the central government. There are at least three reasons why this is the case.

First, local governments are numerous. This stimulates formal modeling of local government behavior in two ways. On the one hand, they provide ample observations for cross-sectional empirical analysis. At the central government level, empirical analysis is generally restricted to time series or to international cross-sections. The former is problematic because the institutional framework of government policymaking is always evolving and is subject to many unique historical events, while the latter presents equally difficult problems arising from the unique institutional structures found in different countries. On the other hand, because of the sheer number of local governments, analysts who seek to explain local policy determination are almost forced to develop abstract models which can be implemented in a more or less formal way. One must model local governments at "arm's length", as it were, simply because no one can imagine telling detailed stories about unique historical and institutional developments for hundreds or thousands of individual localities.

Second, there are many policy questions which hinge in a crucial way on the behavior of local governments. For example, note that around $\frac{1}{3}$ of the funding for local government expenditure in the U.S. comes from higher level (state and federal) governments. In some other countries the proportion is even higher. (See Prud'homme, this volume.) It is clear that transfers of this magnitude must have enormous effects on local tax and expenditure policy. These effects could vary widely, however, depending on the behavioral response of the recipient governments. Thus, in order to deal with very practical problems of grant policy design and reform, an analyst immediately confronts the problem of predicting the response of a large system of local governments to parametric changes in their environment. This clearly necessitates model building in which the policies of local governments are endogenous variables. The need for a behavioral theory of local governments arises in many other contexts as well. To take a further example of great current interest in the U.S., such a theory is essential for a satisfactory analysis of the effect of the proposed elimination of federal income tax deductibility of state and local taxes.

Third, models of local government behavior have been developed partly as a result of the inherent intellectual dynamics of the field. In particular, Tiebout's famous 1956 paper has provided a powerful stimulus in this direction. The Tiebout article was a direct response to Samuelson's classic 1954 and 1955 papers on public expenditure theory, in which it was claimed that there exists no market or other mechanism that would provide proper incentives for the efficient provision of public goods. Tiebout argued, instead, that when households can freely choose the jurisdictions in which they will reside, there will be a kind of market for local public goods which will provide the proper institutional framework for the attainment of efficient resource allocation. In view of the apparently powerful arguments adduced by Samuelson, this is a most provocative conclusion. Although the Tiebout paper attracted relatively little attention for a decade or more after its publication, it has motivated a great deal of more recent work. Much of this work, unlike the original Tiebout paper itself, has been primarily concerned with modeling the determination of local policy, since it is clear that a fully efficient allocation of resources cannot be achieved under arbitrary specifications of exogenously fixed local taxes and public expenditures, whether households are freely mobile or not.

This section discusses several approaches to the problem of modeling local fiscal policy determination. Like most of the literature, determination of local public spending is the focus of attention, with tax structure assuming a very simple form (e.g. a uniform head tax or land tax). While this is a useful and convenient modeling strategy, it does suppress most of the issues treated in Section 3 of this review. An important problem for future research is to develop models which better enable one to investigate simultaneous determination of tax and expenditure policy, especially in an environment with mobile households.

4.1. Voting models in a non-spatial environment

A great deal of empirical analysis of local public expenditure has been based on the Bowen (1943) – Black (1948) model of voting for a fixed population of voters. That model, it will be recalled, shows that a simple majority voting equilibrium exists when the alternatives to be decided upon can be ordered in such a way that every voter's preferences over the alternatives satisfy the single-peakedness property. In this case, the equilibrium will be the median preferred alternative. The individual with the median preferred alternative is called the *median voter*.

Median voter models have been applied in the local public finance context by assuming that each locality provides a single public good, the quantity of which varies directly with local public expenditure, and that the tax system in each jurisdiction assigns resident households fixed (or other well-behaved) shares of the cost of the local public good. If one assumes in addition that households cannot exit public facilities in order to use private alternatives (e.g., if one cannot send one's children to private rather than public schools), households with well-behaved underlying preferences over consumption of private and public goods will have single-peaked preferences for local public spending.[13] One can then

[13]See Stiglitz (1974) for a demonstration that single-peakedness can fail when private education is available as a substitute for public education. The essential intuition is that if the quantity of public education is very low, households choose private education and prefer still smaller levels of public education (which imposes costs but no benefits). If the quantity of public education is somewhat higher, one may withdraw from the private system. Then still higher levels of public education would be desired. The result is a U-shaped preference curve at low levels of public education.

regress local spending against the median voter's income and tax price, or proxies thereof, in order to obtain estimates of price and income elasticities of demand. To control for congestion effects, local population is often included as an explanatory variable. Studies of this sort include Barr and Davis (1966), Barlow (1970), Borcherding and Deacon (1972), Bergstrom and Goodman (1973), and Inman (1978).[14] A potential difficulty with this approach is that it is not easy to identify the median voter, and therefore to determine that voter's income or tax share. Bergstrom and Goodman prove a fundamental theorem that provides conditions under which income and price elasticities will be correctly estimated when expenditure is regressed against median income, and the median income household's tax share, a result that greatly facilitates empirical implementation of the median voter model.

The median voter model has been criticized, revised, and extended in many ways. One might object, for example, to the assumption that each locality provides a single public good. The single-peakedness condition generally does not obtain when issues are multidimensional, as shown, e.g. in Plott (1967) and Kramer (1973).

One might also criticize the empirical implementation of the model because it does not allow one specifically to test whether or not the equilibrium outcome is actually equal to the ideal point of the median voter [Romer and Rosenthal (1979a)]. Rather, this is a maintained hypothesis on the basis of which the relevant demand parameters can be estimated. Indeed, Borcherding et al. (1977), Courant et al. (1979), Romer and Rosenthal (1978, 1979), Gramlich (1982), and others have developed theoretical and empirical models in which public spending is determined in part by the influence of self-interested bureaucrats. The channels of bureaucratic influence range from manipulation of the agenda put before the electorate, to turning out to vote in higher proportions than other segments of the population.[15] Generally, it is assumed that bureaucrats prefer larger budgets to smaller ones, and, of course, the implication of models built around this assumption is that equilibrium budgets will be higher than the median voter (or the median voter within the set of non-bureaucratic voters) would prefer.

The median voter model has been important for empirical work partly because it relates observed equilibrium outcomes of the political process to the underlying preference structure of voters. In empirical work based on the median voter model, the jurisdiction is the unit of observation. An alternative approach, developed by Bergstrom et al. (1982) and Gramlich and Rubinfeld (1982), is based

[14]For critical reviews of the literature, see Inman (1979) and Rubinfeld (forthcoming).

[15]As stressed by Ledyard (1984), it is important to develop a theory of rational turnout for elections. The problem is that the expected payoff from voting is very small when large numbers of individuals vote, and it is not clear why rational individuals would incur the costs involved in going to vote. Ledyard develops a model of rational voters and analyzes the amount of voting observed in equilibrium and the behavior of candidates seeking election in such a world.

on surveys of individual voter preferences. While surveys might be unreliable guides of how individuals would actually vote, these authors find that the price and income elasticities estimated from the survey data are similar to those obtained from the median voter literature. The survey data, therefore, seem compatible with actual voting behavior as revealed in median voter models. Models estimated from voter surveys, however, have the added advantage that they allow one to determine the effect of many individual characteristics (age, race, occupation, religion, sex, etc.) on the demand for local public spending. This information is not easily inferred from median voter models.

Conventional median voter models ignore the possibility of household mobility. Mobility can be important for several reasons. First, as indicated by Goldstein and Pauly (1981), if mobility leads to clustering of individuals in communities of similar tastes, estimates of the income elasticity of demand for local public goods, derived from cross-section regressions, will be biased. Second, consider the basic problem of existence of equilibrium: how can one be certain that there exists a level of public good provision for each locality (together with a tax system for financing it) and an assignment of households to localities such that (i) the local public policy in each locality is a political equilibrium, given the assignment of households to jurisdictions, and (ii) no household has an incentive to relocate to another jurisdiction, given the public policies of each jurisdiction? The detailed investigation of this problem, of course, requires a specification of the tax system by which local public goods are financed, of the political process by which decisions are made, and of the economic environment which forms the background for the political process, and which is affected by local public policies. One simple example of such a specification is provided by Westhoff (1977), who assumes that localities use proportional wealth taxes to finance their spending on pure local public goods, that public expenditure decisions are determined by simple majority voting, and that there is only one homogeneous private good, not locationally fixed, in the private sector of the economy. With this structure and some additional assumptions, Westhoff proves existence of an equilibrium, but notes [see also Westhoff (1979)] that equilibria may not be stable.

Recall from Propositions 1 and 2 that equilibrium assignments of households to jurisdictions are generally inefficient if head or wealth taxes are used to finance pure local public goods. This means that even when equilibria exist in a model such as Westhoff's, they will be locationally inefficient. However, one might suspect that this need not be the case if spatially fixed commodities are included in the model. Furthermore, locationally-fixed commodities (land, durable structures) are empirically important in actual local tax structures. These considerations motivate interest in models which simultaneously accommodate household mobility, land or other property, and a public choice mechanism for determining local public policy. Enriching the economic environment by including spatially fixed goods complicates the modeling of the political process, however. In particular, it is now necessary to take into account the possibility that local policy can affect equilibrium prices for some commodities, particularly residential property, and that anticipation of this effect might influence voting behavior. Therefore, before turning to more complex voting models, it is important to discuss the phenomenon of tax and expenditure capitalization.

4.2. Tax and expenditure capitalization

Standard asset valuation principles dictate that anticipated tax payments tend to reduce the price of land or other forms of property that are subject to local taxes. However, an increase in local taxes that is accompanied by an increase in local public good provision need not depress the value of a parcel of property. Intuitively, if rental or ownership of property is used as an exclusion device for local public goods, and if the level of local public good provision is "too" low, a simultaneous increase in public spending and taxes will make property more attractive on balance, and its price should rise. If the level of public good provision is "too" high, presumably the effect of extra taxes would outwiegh that incremental public spending, and an increase in public good provision would then lower property values. Would property values be left unchanged by a small increment of local public spending and taxes when the level of public good provision is "just right"?

Thorough theoretical and empirical analysis of these issues has been stimulated by a seminal paper by Oates (1969). To illustrate the principles involved, consider a simple model. Suppose each of M jurisdictions provides a pure local public good, at level z_i, and that each uses a per unit tax on land, at rate τ_{ir}, to finance the cost of this public good. Assume that each jurisdiction has an identical cost function $C(z_i)$ for the local public good, and contains an identical amount T of perfectly divisible and homogeneous land. Suppose that land is used for residential purposes by households, and that the utility of each household is a function of its consumption of an all-purpose private (numeraire) good, land, and the local public good. To keep the notation and analysis simple, although this is not critical for the results, assume that all households have identical preferences and endowments. In equilibrium, then, all n_i households in a given locality will have identical consumption bundles, (x_i, t_i, z_i), of all-purpose good, land, and the public good, and will achieve the utility level $u(x_i, t_i, z_i)$.

Let r_i be the net-of-tax price of land in i, let N be the total population of households, and let $\bar{x}$ be the (common) endowment of all-purpose good held by each household. Then the budget constraint facing each consumer residing in locality i is

$$x_i + r_i(1+\tau_{ir})t_i = \bar{x} + \sum_j r_j T_i / N \triangleq \bar{w}, \tag{22}$$

say, given that each household has identical land endowments. If every locality chooses its ad valorem land tax rate τ_{ir} to balance its budget, so that

$\tau_{ir} r_i = = C(z_i)$, this constraint becomes

$$x_i + (r_i + C[z_i]/T)t_i = \bar{w}, \tag{23}$$

which means that the maximized utility of a household living in i is given by the indirect utility function $v(r_i + C(z_i)/T, \bar{w}, z_i) \stackrel{\Delta}{=} v_i$, say.

Finally, suppose that households are costlessly mobile. Then, in equilibrium, the vectors (r_i) and (n_i) and a scalar $\bar{v}$ must satisfy the following conditions:

$$v_i = \bar{v} \quad \text{all } i \text{ (locational equilibrium)}, \tag{24.1}$$

$$-n_i \frac{v_{ir}}{v_{iw}} = T \quad \text{all } i \text{ (land market equilibrium)}, \tag{24.2}$$

where $\bar{v}$ represents the equilibrium utility level for all households and where v_{ir}, v_{iw} are derivatives of v_i w.r.t. $r_i + C(z_i)/T$ and w, resp. (Thus, $-v_{ir}/v_{iw} = t_i$, the demand for land in locality i.)

In the large literature on capitalization, two basic positive sorts of results have been derived. Both require that the number of localities be large. First, if M is sufficiently large, a small change in z_i should have a very small effect on $\bar{v}$. Suppose then that one uses (24.1) to solve for r_i implicitly in terms of z_i, holding $\bar{v}$ fixed. Then, using well-known properties of the indirect utility function, one obtains

$$t_i \frac{\mathrm{d}r_i}{\mathrm{d}z_i} = MRS_i - C'(z_i)\frac{t_i}{T}, \tag{25.1}$$

where $MRS_i = (\partial u/\partial z_i)/(\partial u/\partial x_i)$, evaluated, of course, at equilibrium values. Note first that this result potentially allows one to observe MRS_i: $\mathrm{d}r_i/\mathrm{d}z_i$, $C'(z_i)$, and the other terms in (25.1) are all observable in principle. Thus, in an important sense, households' preferences for local public goods are revealed in an economy of the type specified. Furthermore, multiplying (25.1) through by n_i and using the equilibrium condition (24.2), one has

$$T\frac{\mathrm{d}r_i}{\mathrm{d}z_i} = n_i MRS_i - C'(z_i), \tag{25.2}$$

that is, an increase in z_i will raise r_i if the sum of the marginal benefits of the local public good exceeds its cost. The reverse will be true if the marginal cost is greater than the marginal benefit. The Samuelsonian condition is met when $\mathrm{d}r_i/\mathrm{d}z_i = 0$.

A second kind of result on capitalization obtains when there are many localities, and their levels of public good provision are sufficiently close to one another to approximate a continuum of choice for households deciding where to live. In this case, if $r(z_i)$ denotes the equilibrium land price in a locality providing z_i units of the local public good, and if one assumes that the function r is differentiable, a condition for utility–maximizing locational choice by households is that $dv(\cdot)/dz_i=0$, which reduces to (25.1) and again implies (25.2). Note the difference in the conceptual basis for this result: here, the z_i's are supposed to be fixed, and (25.1) is derived from utility–maximizing behavior by consumers. In the preceding derivation, (25.1) was obtained from a comparative statics exercise in which the level of an individual z_i changes. In the latter case, the fact that the marginal benefits and costs of local public goods are reflected in the change in equilibrium land prices might be summarized by saying that *comparative statics* capitalization effects occur. In the former case, where marginal benefits and costs are reflected in the structure of equilibrium land prices that obtain in a given equilibrium, we might say that *cross-sectional* capitalization obtains. At least in this model, it appears that the conditions for cross-sectional capitalization are more stringent than those for comparative statics capitalization.

Cross-sectional capitalization is particularly interesting because it invites empirical testing: one could imagine regressing observed r_i's on z_i's in order to check whether the Samuelsonian condition for efficient local public spending is satisfied. Of course, a "large" number of localities, or an approximation thereof, appears necessary (in general) for the derivation of both cross-sectional and comparative statics capitalization results, and it has been demonstrated in the literature that these results in fact break down when this assumption is relaxed. For examples of theoretical and empirical work on capitalization, consult Brueckner (1979, 1982, 1983), Edel and Sclar (1974), Hamilton (1976), Kanemoto (1980), Pauly (1976), Pines (1984, forthcoming), Sonstelie and Portney (1978, 1980a,b), Starrett (1981), and Wildasin (1979, 1984a).

4.3. *Public choice in an economy with capitalization effects*

Voting models of public expenditure determination, like the median voter model discussed in Section 4.1, have traditionally assumed that individual votes are determined by a comparison of the marginal benefit of the public good with its marginal tax-price, that is, the individual's share of the marginal cost of the public good as determined by the tax system. However, in an economy where households are mobile, and where equilibrium prices change in response to changes in public policy, this conception of voting behavior can be seriously inaccurate.

Consider, for example, a model like that of Section 4.2 above: identical households are costlessly mobile among a set of jurisdictions that, for simplicity, are assumed to differ only in their levels of public good provision and taxation. To generalize the model somewhat, let the local public good cost function be

$C(n_i, z_i)$, allowing possibly for congestion effects, and suppose each locality i can use both a head tax, at rate τ_{in}, and a land tax, at ad valorem rate τ_{ir}, to finance its spending. Finally, let us temporarily change the model by specifying that all land endowments are concentrated in the hands of absentee landowners who only consume the all-purpose private good and who therefore seek only to maximize their wealth. The other households in the economy are as specified earlier: each has a direct and indirect utility function u and v, and a private good endowment of $\bar{x}$. Of course, since these households are now assumed to own no land, and since head taxes are allowed, the budget constraint for a household located in jurisdiction i is slightly changed. It now reads

$$x_i + r_i(1+\tau_{ir})t_i = \bar{x} - \tau_{in} \stackrel{\Delta}{=} w_i. \tag{26.1}$$

The direct utility function $u(x_i, t_i, z_i)$ is as before, and the indirect utility function is $v_i \stackrel{\Delta}{=} v(r_i[1+\tau_{ir}], w_i, z_i)$. Households are assumed to be costlessly mobile, so that (24.1) holds in equilibrium. The government budget constraint for locality i is

$$\tau_{ir} r_i T + n_i \tau_{in} = C(n_i, z_i). \tag{26.2}$$

Using (26.2), we can express τ_{ir} in terms of τ_{in}, z_i, and n_i.

Finally, suppose that the number of localities is "large", i.e., that $\bar{v}$ in (24.1) is taken as exogenously fixed from the perspective of any single jurisdiction. Imagine that each locality has initially given policies $(\tau_{in}, \tau_{ir}, z_i)$, and that an initial equilibrium exists which satisfies (24) and (26.2). Now consider how one might model the determination of local policy. One possibility is to let the households initially residing in the jurisdiction constitute an electorate that votes on tax and expenditure policy. A problem immediately arises with this approach, however: by assumption, local policy cannot affect $\bar{v}$, the equilibrium utility level of the mobile households. Therefore, they should all be *indifferent* about $(\tau_{in}, \tau_{ir}, z_i)$. Any equilibrium in a voting model with such an electorate would be indeterminate.

Landowners, on the other hand, are affected in a significant way by local policy, and would therefore have an incentive to participate in the local political process. Note that (24.1) allows one to solve for the equilibrium net land rent r_i in terms of τ_{in}, τ_{ir}, and z_i. One can then use (24.2) to solve for the equilibrium n_i as a function of the same variables. Finally, use the government budget constraint to solve for τ_{ir} in terms of τ_{in} and z_i. Then, after straightforward manipulations, one finds

$$T\frac{\partial r_i}{\partial \tau_{in}} = (\tau_{in} - C_{in})\frac{\partial n_i}{\partial \tau_{in}}, \tag{27.1}$$

and

$$T\frac{\partial r_i}{\partial z_i}=n_i MRS_i - C_{iz}+(\tau_{in}-C_{in})\frac{\partial n_i}{\partial z_i}, \tag{27.2}$$

where C_{in} and C_{iz} are partial derivatives of C, evaluated at (n_i, z_i).[16]

The left-hand sides of (27) represent the change in equilibrium land values associated with changes in the local policy variables. In general, land values will not be invariant to local tax and expenditure policy, and it follows that landowners will not be indifferent about these policies.

Thus, allowance for costless mobility of households has a rather drastic effect on the analysis of the local public choice process. In this simple model, far from comparing marginal benefits and tax-prices in deciding how to vote, the consumers of local public services – the residents of each jurisdiction – actually become totally indifferent to local policy. Instead, landowners become the natural agents around which to build a model of local government decisionmaking.[17] Models of this type appear in Berglas and Pines (1981), Henderson (1980, 1985), Epple et al. (1985) and elsewhere. It is easy to see, from (27), that an equilibrium of local policies in such a model can be efficient. A land-value-maximizing policy would require setting $\partial r_i/\partial \tau_{in}=\partial r_i/\partial z_i=0$, which, by (27.1), means that head taxes would internalize congestion effects, and, by (27.2), it then follows that the Samuelsonian condition for local public spending would be met. Overall efficiency – both efficient locational choice by households, and efficient local public spending – would thus be achieved in equilibrium. Of course, if instead jurisdictions are assumed not to have full flexibility in their choice of policy instruments, the equilibrium may not be efficient. Suppose, for example, that local public goods are congested and that localities, for some reason, are able only to use land taxation to finance local public goods. Then (27.2) reveals that z_i will be used indirectly to control entry into the locality. Expenditure efficiency will not, therefore, be achieved – a typical illustration of the problem of second best.

This simple model assumes an unrealistically sharp distinction between landowners and residents. In practice, one observes that many residents – especially in certain types of localities, such as suburbs of major cities – are homeowners. That is, they both own property in a jurisdiction, and consume public services there. This complicates the analysis of the political process considerably, although it does not necessarily invalidate the conclusion that an equilibrium can be efficient. To see the nature of this complexity, note first that it introduces an inherent heterogeneity of endowments among the households in the economy: households that own land or other property in one locality are essentially different from those owning land in another locality, because land in different

[16]For similar derivations, see Wildasin (1983).

[17]Alternatives to this approach appear in Epple et al., (1984) and Yinger (1982).

localities can trade at different prices. One must therefore move beyond the simple model of a single class of mobile households.[18] Second, when households can own property, the assumption of wealth-maximizing behavior by voter-residents may be hard to justify. If the resident-property owners in a locality also receive utility from the consumption of local public services, as one would naturally assume, they will presumably recognize that their decisions about local public good provision influence both the value of their property and their consumption opportunities. If a particular locality provides $\bar{z}$ units of a public service, if all other localities provide quite different levels of the local public good, and if the existing residents of the locality strongly prefer $\bar{z}$ or a similar level of the local public good, then the fact that $\bar{z}$ does not maximize property values does not necessarily imply that residents will vote for a different level of provision. It can still be argued, however [Wildasin (1979, 1984a)] that wealth maximization decisions can be separated from consumption decisions when the conditions for cross-sectional capitalization obtain, and that in this case rational voter-residents will prefer policies that lead to efficient outcomes.

Under less idealized circumstances, political equilibria need not have these efficiency properties. Henderson (1980, 1985b), for example, considers local policy determination in a two-period model. Suppose that a jurisdiction initially contains no residents, that local public goods are subject to congestion, and that property taxation along with fiscal zoning is used, in lieu of ideal head taxes, to internalize congestion externalities. Profit maximizing landowners might allow a certain amount of land to be developed in the first period, imposing zoning constraints that insure that each resident household bears its marginal congestion cost. Suppose, however, that not all land is developed in the first period. Then, in the second period, suppose that additional households are allowed to enter the locality. If landowners (i.e., owners of still-undeveloped land) contrive to control the political process, they will have an incentive to reduce second-period zoning requirements. In doing so, they can effect a transfer from first-period to second-period residents via the property tax: property tax payments by second-period residents will be lower than their marginal congestion costs, and property taxes paid by initial residents will be correspondingly higher. This transfer makes the locality more attractive to potential second-period residents, which allows developers to sell land for second-period development at a higher price. First-period residents, of course, would oppose this policy, and in fact have an incentive to increase zoning requirements. One can imagine models in which one or the other of these conflicting interests might dominate the other, so it is not clear whether or not one should expect over- or under-development in the second period. Also,

[18] This is not to insist that the equilibria with landowning households will necessarily involve utility differentials. Nonetheless, the prospect of obtaining higher wealth and utility than agents owning land in other jurisdictions will enter into the decisionmaking calculus of the landowners in any one locality.

if developers (and residents) can make binding first-period commitments about second-period policy, the problem of dynamically inconsistent policy and associated inefficiencies may be obviated. See Epple et al. (1985) for further analysis along these lines.

Finally, consider the implications of relaxation of the assumption of costless mobility of households. In the models of Henderson and Epple et al., households, once assigned to a jurisdiction, become completely immobile. More generally, one might suppose that households are able to relocate, but only at a cost. This case, covering the middle ground between complete immobility and perfect mobility, is presumably one of considerable empirical relevance. Preliminary analysis by Wildasin and Wilson (in preparation) indicates that it opens up a number of possibilities that do not arise in either of the conventional polar cases. For instance, suppose local government policies are controlled by landowners who seek to maximize land values in an economy with overlapping generations of finite-lived households. Suppose that households live for two periods, and that in the first period of life they are freely mobile. They choose a locality in which to reside so as to maximize expected lifetime utility. However, in the second period of life, they can only relocate at a cost. This cost is randomly distributed across households. In order to attract young households, jurisdictions must offer competitive tax and expenditure packages. Landowners also have an incentive to exploit their old residents by offering less favorable tax-expenditure policies, but their ability to do so is limited by the partial mobility of these households. If long-term (explicit or implicit) contracts or precommitments are possible, it will be profitable for landowners to trade away the opportunity to take advantage of their older residents, and a first-best efficient equilibrium will be achieved. If such contracts are not possible, however, landowners will exploit a monopsony relationship with their older residents, and, in equilibrium, some of these residents will find it optimal to relocate. Since migration is costly and (in this particular model) socially wasteful, it follows that the equilibrium will be inefficient. In fact, it can be shown that first-best efficient equilibria would be attained in either of the polar cases of costless mobility or complete immobility, but that the equilibria in intermediate cases of imperfect or costly mobility are generally ex ante Pareto inferior to these first-best equilibria. In particular, landowners are neither better off nor worse off in the presence of imperfect mobility, but the other households in the system have lower expected utilities.

Since this model is special in some respects, it is difficult to know how robust its conclusions are. It is simple, however, and basic qualitative conclusions drawn from it are unlikely to be reversed merely by adding realistic complications to the model. It suggests that the more realistic intermediate case of costly mobility may not be well approximated by the standard polar cases of free mobility or complete immobility. Presumably, further analysis of models with imperfect mobility will uncover other results that differ from those that depend on the standard idealizations, such as many of those described earlier in this section.[19]

4.4. Conclusion

The above discussion has identified several fruitful approaches to the analysis of local public choice, and has summarized some of the key findings that have been obtained in the literature. Obviously this literature has yielded many important insights into the process of local government decisionmaking. At the same time, local government behavior is clearly quite complex and it cannot be claimed that a satisfactory understanding of the local political process has yet been achieved. While the local public choice models that we have reviewed all bear some resemblance to observed institutional realities, they differ widely in terms of the aspects of reality that they emphasize, and the simplifications and abstractions that they make. This is to be expected in a field in which a standard theoretical framework has not been definitively established. There is clearly much scope for additional work.

In closing, it might be worthwhile emphasizing that theoretical work in local public choice, or in local public finance in general, has great potential relevance to many practical policy issues. Put somewhat differently, there are many policy problems that cannot be dealt with satisfactorily without appeal to some empirically-validated theoretical model. Consider, for example, that in the U.S. alone, the past decade and a half has seen bursts of popular attention focused on the fiscal problems of central cities, school finance reform, revenue sharing, state and local government indebtedness, public infrastructure, tax limitation movements, disentanglement of federal, state, and local responsibilities for income redistribution and health care, and federal income tax deductibility of state and local taxes. In each of these cases, an understanding of the behavior of local governments – whether they spend too much or too little, how they might respond to changes in transfers from higher level governments, how they make intertemporal resource allocation decisions – is central to the correct specification of policy. Practical policy issues such as these demand adequate theoretical and empirical models. In the long run, such practical problems can be expected to exert powerful influence over the development of theoretical local public economics.

[19]Indeed, mobility costs have played a central role in some analyses of state and local government redistribution. If one assumes that the recipient population consists of identical freely mobile individuals, the elasticity of the recipient population in any one locality with respect to that locality's level of redistribution can be very high, perhaps infinite. Jurisdictions facing such high elasticities would not find it optimal to engage in significant redistribution. Therefore, models which attempt to explain the significant redistribution that is actually carried out by lower-level governments have often assumed costly mobility. See, e.g. Gramlich (1985) and Brown and Oates (1985).

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