Local Public Goods and Property Value  
in a Model of a Metropolitan Area

Abstract.

The idea that the quality of local public goods is fully capitalized into property values has been considered to be the theoretical basis of imposing the property tax on residents. The purpose of this paper is to examine this idea. A metropolitan area model is first set up, and the model is modified to include the relation between the provision level of local public good and tax rate. A small-open city model and a closed-city model are discussed in connection with the tax liability in the aforementioned metropolitan area model framework.

1. Introduction

Property tax is imposed on residents as the liability of provision of local public goods. The theoretical basis of imposing property tax on residents is that the quality of local public goods is fully capitalized into property value.

Recently a drastically different perspective on the effects of the property tax is provided by the so-called new view of the property tax, which holds that the property tax is not an efficient benefit tax but a distortionary tax on capital that is borne primarily by capital owners (See Mieszkowski and Zodrow, 1989). Most of the empirical research in this area has focused on the extent to which property taxes and local government expenditures are capitalized into house values.

Assuming a long-run equilibrium with perfectly mobile individuals, capitalization is likely to occur under both views, i.e., the benefit view and the new view, of the property tax. However the nature of capitalization is different in the two cases.

Under the benefit view, fiscal differentials (the present value of all future differences between benefits received and taxes paid on a property) are capitalized into land values. In contrast, under the new view, capitalization reflects the change in land rents that occurs as a result of capital migration induced by tax differentials relative to the national average. Further the expenditure increases in a single community would result in capitalization of the associated fiscal differentials, but should not change the aggregate value of land in the community under the benefit view. In contrast, under the new view, the capital out-migration induced by an increase in the property tax should result in lower land values in the community.

The purpose of this paper is to examine this property tax problem again. In our paper a metropolitan model will be used instead of a regional model (see Hagihara and Hagihara, 1991) for a simpli-
Tiebout's classic paper (see Tiebout, 1956) is cited as the paper in which the local finance is considered from the viewpoint of the relation between local public expenditure and residents' preference. Tiebout showed that the problem of inefficient provision of a pure public good in an economy with heterogeneous consumers, raised in Samuelson (1954), would be mitigated by the Tiebout hypothesis, that is consumers have an incentive to segregate into homogeneous communities by taste and income, where public goods are provided efficiently.

Oates (1969) showed the validity of the Tiebout hypothesis, by examining the empirical study of the effects of local property taxes and local expenditure programs on property values. The result of the study indicated that local property values bear a significant negative relationship to the effective tax rate and a significant positive correlation with expenditure per pupil in the public schools.

The problem that the output of public services (as well as taxes) influence the attraction of a community to potential residents and thereby affect local property values is studied by many economists; e.g., Brueckner (1979), Edel and Sclar (1974), Hamilton (1976), King (1977), Pauly (1976), Pollakowski (1973), Rosen and Fullerton (1977), etc. On the other hand, since Ridker and Henning's (1967) study, there has been growing interest in using property value data as a source of information on the benefits to be expected from controlling environmental disamenities such as air pollution, water pollution, and noise; e.g. Polinsky and Shavell (1975 and 1976) and White (1979), etc.

Along with these studies there has been continuing controversy and debate over the proper theoretical framework for the analysis of property values: some argue the theoretical framework from the viewpoint of the short-run aspect. A short-run model framework corresponds to a closed-city model framework, in which residents' mobility is restricted, whereas a long-run model framework corresponds to an open-city model framework, where perfect mobility is assumed. Nevertheless, there is an inconsistent assumption; that is, perfect mobility is assumed in the short-run model.

In our paper, the problem whether the quality of local public goods is fully capitalized or not is investigated under consistent assumptions, i.e., perfect mobility is assumed in the long-run model and no migration is assumed in the short-run model. According to the classification in our paper, the external and internal models which Starrett (1981) showed is the long-run model and the short-run model, respectively. Furthermore, the effect of the tax liability on property values in both the open-city model and the closed-city model framework is considered.

In section 2 below a metropolitan area model is set up and a bid rent curve (see, e.g. Alonso, 1964) is introduced. In section 3, the model is modified to include the relation between the provision level of local public goods and the tax rate. In section 4, a small-open city model and a closed-city model are discussed in connection with the tax liability. In section 5, the result of the paper is summarized.

2. Residential Choice

Consider a simple model of residential choice in which the following assumptions will be introduced. A fixed population lives in a closed metropolitan area and they are partitioned into R exogenous governmental jurisdictions, denoted by the set $J = \{1, ..., R\}$ which collect taxes and provide public goods. An individual consumes the public goods only of the jurisdiction to which he belongs. Let $g_j$ denote the vector of public goods provided by jurisdiction $j$. The
number of residents residing in the jurisdiction is $N_j$ and the amount of residential land in the $j$-th jurisdiction is $D_j$. Each resident must occupy one and only one place, and his income, $y$, is independent of his place. Residents have identical tastes and income. Taxes are raised through a tax proportional to the rent. The price of the composite private good is assumed invariant throughout the metropolitan area and is set at unity. Land is assumed to be the only input into the production of housing; the land is owned by agents living outside of the metropolitan area, and it is supplied perfectly inelastically within each jurisdiction. Jurisdictions lie at various distance from a central business district (CBD) in the metropolitan area, where there are many common public services to the residents in the metropolitan area and the distance is taken to be identical for all places in a given jurisdiction. The commuting costs from the $j$-th jurisdiction to the CBD will increase with distance from the CBD. These costs will be represented by the function $k(t_j)$.

Given these assumptions, the utility function for a representative individual is denoted by

$$U = U(x, q, g_j, t_j)$$

where

- $x$ = consumption of a composite private good;
- $q$ = consumption of housing;
- $g_j$ = quality of local public goods in the $j$-th jurisdiction;
- $t_j$ = distance from the CBD to the $j$-th jurisdiction.

It is assumed that

$$U_x > 0, U_q > 0, U_{g_j} > 0, \text{ and } U_{t_j} < 0.$$ 

All other things being equal, the individual will prefer to have more than less of the public good. Assume that, all other things being equal, a rational individual will prefer a more accessible location to a less accessible one. Since $t$ represents the distance from the CBD, and thus the distance the individual must commute to the principal place of shopping, amusement, and employment, it may be said that accessibility decrease as $t$ increases. In other words, the individual would prefer $t$ to be smaller rather than larger, so that $t$ may be thought of as a good with negative utility.

The budget equation for a representative individual is as follows:

$$y = x + Rq + k(t_j)$$

where

- $y$ = income;
- $R_j$ = rent in the $j$-th jurisdiction;
- $k(t_j)$ = transportation cost from the $j$-th jurisdiction to the CBD.

The residential choice for a representative resident may be stated as

$$\max_{x, q, g_j, t_j} U(x, q, g_j, t_j) \text{ subject to } y = x + Rq + k(t_j).$$

The indirect utility function is introduced. A residents' utility is expressed as a function of income net of transportation costs from the $j$-th jurisdiction, rent at the $j$-th jurisdiction, quality of local public good at jurisdiction $j$, and distance from jurisdiction $j$ to the CBD. Since the indirect utility function is related to each specific location, the price of the composite consumption good does not enter into it since this price is assumed to be the same everywhere. The indirect utility function is

$$V = V(y - k(t_j), R_j, g_j, t_j).$$

All other things being equal, an increase in net income
increases utility; an increase in rent decreases utility; an increase in quality of local public goods increases utility; an increase in distance decreases utility. Namely, assume that

\[ V > 0, V_2 < 0, V_1 > 0, \text{ and } V_4 < 0, \]  

(5)

where \( V_i \) denotes partial derivative of \( V \)'s first element, and so on.

It is assumed that an individual chooses to reside in the community where it can attain the highest level of utility: i.e., the jurisdiction \( j \) for which \( \max_j V(y - k(t_j), R_j, g_j, t_j) \) is attained. An individual's bid rent function is defined as that the resident would offer for jurisdiction \( j \), given some indifference level \( V^* \). That is, \( V^* \) must satisfy the following equation:

\[ V(y - k(t_j), R_j, g_j, t_j) - V^* = 0 \]  

(6)

From Eqs. (6), the resident's bid for jurisdiction \( j \) is

\[ R_j = f(V^*, y - k(t_j), g_j, t_j). \]  

(7)

Though the form of the bid rent curve cannot be stated explicitly without knowing the form of the utility function, characteristics of the bid rent curve can be stated as follows. Using Eqs. (4), the following equation is derived from \( dV = 0 \):

\[ dR_j = \frac{V_1 \left[ \frac{dk}{dt_j} \right] - V_4}{V_2} dt_j - \frac{V_1}{V_2} dy - \frac{V_3}{V_2} dg_j, \]

\( \text{and we have:} \)

\[ \frac{dR_j}{dt_j} \bigg| \left[ \frac{dk}{dt_j} \right] - V_4 \]  

< 0  

(9)

\[ \frac{dR_j}{dt} = - \frac{V_1}{V_2} > 0 \]  

(10)

\[ \frac{dR_j}{dg_j} = - \frac{V_3}{V_2} > 0 \]  

(11)

The sign of \( \frac{dR_j}{dt_j} \) is negative when \( t_j \) increases, other things being equal, jurisdiction \( j \) is a less accessible one and commuting cost rises. When commuting cost rises, less income is left expenditure on \( x \), and \( R_j \) must fall to allow the individual to maintain his \( x \) consumption. When income increases, \( R_j \) increases. Since utility increases with quality of local public goods, \( R_j \) must rise to allow the individual to maintain his \( x \) consumption.

3. Local Expenditure and Tax Liability

Property tax is introduced. Property tax is levied on land values at a constant tax rate, \( a_j \), i.e.,

\[ r_j = r_i \left( 1 + a_j \right) \]  

(12)

where

\[ r_j = \text{land values in jurisdiction } j; \]

\[ a_j = \text{property tax rate in jurisdiction } j. \]

The budget equation for a representative individual is denoted by

\[ y = x + r_i \left( 1 + a_i \right) q + k(t_i). \]  

(13)

The indirect utility function is

\[ V = V(y - k(t_j), r_i \left( 1 + a_i \right) g_j, t_i). \]  

(14)

Similarly as above, it is assumed that

\[ V_1 > 0, V_2 < 0, V_3 > 0, \text{ and } V_4 < 0. \]  

(15)

And we have
\[
\frac{dr_j}{d\alpha} = \frac{V_j}{V_j + V_i} < 0 
\]

(16)

\[
\frac{dr_j}{dg_j} = \frac{V_j}{V_j + V_i} < 0 
\]

(17)

\[
\frac{dr_j}{dy} = \frac{V_j}{V_j + V_i} > 0 
\]

(18)

\[
\frac{dr_j}{dy} = \frac{V_j}{V_j + V_i} > 0 
\]

(19)

The sign of \(dr_j/\alpha\) is negative because when the property tax rate increases, less of the fixed rent \(R_j\) is available to the owner, and land values falls. Other signs is the same as before.

Equilibrium state where any resident cannot increase utility by migration, is attained when market values of land is decided such that all residents' utility is equal. Hence, land values in equilibrium market is a decreasing function of distance, \(t\), and property tax rate, \(\alpha\), and an increasing function of quality of local public, \(g\), and income, \(y\).

The budget constraint of the local government is introduced. Suppose that the cost, \(C_i\), of providing the public goods is an increasing function of the quality of local public goods, \(g\), and the number of residents in the jurisdiction, \(N_i\):

\[
C_i = C_i (g, n_i) 
\]

(20)

The cost function is assumed to exhibit "constant returns to scale":

\[
C_i = C_i (g_i) N_i 
\]

(21)

Local tax revenue, \(T_i\), is raised through a proportional tax, \(\alpha\), on the value of land:

\[
T_i = \alpha_i r_i D_i 
\]

(22)

where \(D_i\) is the amount of residential land in the \(j\)-th jurisdiction. If each local government balances its budget, then:

\[
C_i (g_i) N_i = \alpha_i r_i D_i 
\]

(23)

Defining \(n_i = N_i /D_i\), the rent, \(R_i = r_i (1 + \alpha_i)\), becomes \(n_i C_i (g_i) + r_i\).

Eqs. (24) shows the rent when property tax rate is closely related to the provision of local public goods.

Then the budget constraint of a representative individual is

\[
y = x + [n_i C_i (g_i) + r_i] q + k (t). 
\]

(25)

The indirect utility function is

\[
V = V (y - k (t), n_i C_i (g_i) + r_i, g, t) 
\]

(26)

and assume that

\[
V_i > 0, V_z < 0, V_y > 0, \text{ and } V_r < 0. 
\]

Then we have

\[
\frac{dr_j}{d\alpha} = \frac{V_j}{V_j + V_i} < 0 
\]

(27)

\[
\frac{dr_j}{dg_j} = - \frac{n_i dC_i}{dg_j} - \frac{V_z}{V_z} \geq 0 
\]

(28)

\[
\frac{dr_j}{dy} = - \frac{V_j}{V_i} > 0 
\]

(29)

The ambiguous sign of \(dr_j/dg_j\) is due to two opposing effects. When \(V_z > n_i dC_i/dg_j\), the resident desired the increase of local public goods (or the increase of liability). However, when \(n_i dC_i > V_z\), he desires the decrease of local public goods (or the decrease of liability).

Given other variables, marginal utility of \(g\) is decreasing with increase of \(g\). There is a point where
the decrease of utility which is caused by the increase of liability is not covered. If there is such a point, given some $t_j$, a curve which increases with $g_i$ and after some point it decreases with increase of $g_i$.

4. Migration of Residents

4.1 The open city and the constant tax rate

To fix the level of utility, the urban area is assumed to be small and open. Since the area is open — there is perfect migration between it and other areas —, there will be a common level of utility throughout the system. Because the city is small, this level of utility may be treated as exogenous.

In equilibrium, land values display a pattern such that none of the identical individuals could increase their utility by changing residence. Each individual enjoys a common level of utility, $V'$, which is independent of his location:

$$V' = V(y - k(t), r, (1 + a), g_i, t_j)$$

Adjustment in land values is the mechanism by which utility is equalized over space. If jurisdiction $A_1$ is more attractive than jurisdiction $A_2$, considering the rent, the quality of the local public goods, and distance at both places, then rents at $A_1$ are bid up and rents $A_2$ fall until $A_1$ and $A_2$ become equally desirable. This process occurs throughout the metropolitan area, generating the equilibrium rent schedule. As income, transportation cost, and the quality of local public good are given, there is only one land value which brings utility, $V'$. In other words, in this case, since $V'$ is exogenously fixed, the change of the quality of local public goods gives no effect on $V'$. The increase in the quality of local public goods in some jurisdiction makes utility increase ($V_i > 0$), whereas land values change in order to hold $V'$ constant. Land values rise as being shown in Eqs. (15), so that the decrease in utility ($V_i < 0$) offsets the increase in utility ($V_i > 0$). And $V'$ is hold constant. Thus, utility of residents does not change, whereas the benefits from the increase in the quality of local public goods is capitalized into the land values.

4.2 The open city and the closed relationship between the provision of local public goods and the tax rate

Similarly to the above, land values change in order to hold utility constant. In equilibrium, a common level of utility is

$$V^2 = V(y - k(t), n_i C_i (g_i) + r, g_i, t_j).$$

$r_i$ changes to offset the effect of the increase of $g_i$ ($V_i > 0$). In this case, however, the increase in quality of local public goods is connected with the increasing liability of the residents through rent, $n_i C_i (g_i) + r_i$. Therefore, since the offset effect in the increase of rent involves a part of the increase of tax liability, $r_i$ may rise or fall or may not change according to the extent of tax liability. This is the case in which Eqs. (28) occurs. And the case of $dr_i/dg_i < 0$ corresponds to the empirical result in Oates (1969) in which he showed that high property tax rate lowered the property value.

4.3 The closed city and the constant tax rate

The object of this analysis is short-run. It does not allow migration to or from the jurisdiction. The equilibrium condition, analogous to (30), is
\[ V_i = V(y - k(t_i), r_i (1 + \alpha_j), g_0, t_i) \] (32)

for some \( V_i \) to be determined.

The equilibrium level of utility \( V_i \) is now endogenous since the jurisdiction is isolated from the rest of the system. While utility of the residents increases by an increase in \( g_0 \), the increase in \( g \) is not capitalized into land values. For, no migration occurs, so that land values cannot adjusted by residents' mobility. The aggregate land values in the jurisdiction understates the benefits from the increase in \( g_0 \). In an opposite case, namely, the case of a decrease in \( g_0 \), land values overstates the benefits from the decrease in \( g_0 \).

4. 5 Intermediate cases

Intermediate cases between the purely closed and purely open cities might in fact be more relevant for policy purposes.

In the first place, in the case of the constant tax rate, an increase in \( g \) makes both residents' utility and aggregate land values increased. However, an increase in residents' utility is not fully capitalized into land values, so that aggregate land values understate benefits. Since benefits are more capitalized into land values in the long-run situation than in the short-run, the public investment in local government becomes efficient in the long-run situation according to Brueckner's fiscal efficient condition, viz. public investment in local government is efficient so as to make the aggregate land values maximum (see Brueckner, 1979).

Secondly, the case of the closed relationship between the provision of local public goods and the tax rate is concerned. In the case where tax liability is so large by the increase in local public goods, both residents' utility and land values decreases. The decrease in residents' utility is capitalized into land values. However, since the increase in local public goods brings no benefit, the local government invests inefficiently. On the other hand, in the case which tax liability is not so large, utility of residents increases. If land values increase with the increase of utility, then benefits are capitalized into land values. In this case the local government invests efficiently.

5. Concluding Remarks

No matter whether the constant tax rate or not, the result of each case varies depending on whether the full adjustment of land values is done or not. In other words, availability of residents' mobility changes the
adjustment mechanism of land values. When the adjustment mechanism works sufficiently, the quality of local public goods is fully capitalized into property values in a small-open model. However, in the closed-city model and the open-city model with tax liability, the quality of local public goods is not fully capitalized into property values. Land values may both understate and overstate quality of local public goods.

In the intermediate cases, the quality of local public goods is somewhat capitalized into land values, but is not fully capitalized. Since, in general, we do not know whether the land value effects of the local public goods are an over- or under-estimate of its benefits, the benefits of the local public goods cannot be measured by its effects on land values. Consequently, the property tax is not considered to be a tax on beneficiary.

References


地域的公共財と資産価値に関する考察

— 都市圏モデル —

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要 約

地域的公共財の質は資産価値に完全に資本化されるという考えが住民に対して資産税を課する理論的根拠となっている。しかし、この考えについては理論的に多くの研究者によって疑問がなされられている。本考察の目的はこの考えを理論モデルを整理して再度検討することである。

都市圏モデルをまず設定し、このモデルを地域的公共財の供給水準と税率の関係を考慮したモデルに拡張する。開放型小都市モデルと閉鎖型モデルを上記の都市圏モデルによって税負担との関連で議論する。その結果、資本化は認められるものの地域的公共財の質が場合によって過大に評価されたり過少に評価される可能性があり、地域的公共財の便益評価には注意を払う必要がある。したがって、理論的には資産税を応益税とみなすことが難しいことになる。

Key Words（キー・ワード）

Local Public Goods（地域的公共財）、Property Value（資産価値）、Capitalization（資本化）、Metropolitan Model（都市圏モデル）