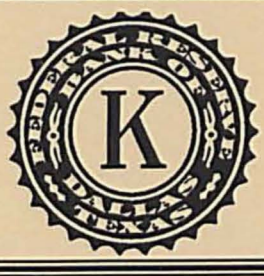

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Allocative Inefficiency and Local Government: Evidence Rejecting the Tiebout Hypothesis

by

Lori L. Taylor, Research Department
Federal Reserve Bank of Dallas

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Allocative Inefficiency and Local Government: Evidence Rejecting the Tiebout Hypothesis*

Lori L. Taylor

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Charles Tiebout (1956) hypothesized that the tendency of potential residents to "vote with their feet" creates market-like incentives for efficient government. His intriguing proposition spawned numerous economic studies that tested for efficiency in government decision-making (see, for example Oates 1969). One attractive line of research relies on hedonic estimation of the relationship between property values and the complete mix of taxes and government services. Jan Brueckner (1979, 1982) demonstrated that the partial derivatives of such a hedonic function with respect to the provision of public goods can yield the Samuelson conditions for efficient allocation of a public good.

Tests for allocative efficiency using Brueckner's approach have yielded mixed results. Using data on communities in New Jersey, Brueckner (1979) found evidence that public services are systematically over-provided. However, in a subsequent study using data on communities in Massachusetts and following a chain of reasoning he considered simpler and more reliable, Brueckner found no evidence of systematic under- or over-provision of public services and therefore could not reject the Tiebout hypothesis.[1] Steven Deller (1990b) also could not reject the hypothesis using data on communities in Maine. However, when Deller (1990a) attempted to internalize the possible spillover of benefits between smaller jurisdictions by analyzing counties in Illinois, he found evidence that governments under-provide highway and police services.

This paper modifies Brueckner's approach and applies it to data on communities in the Hartford, Connecticut Metropolitan Statistical Area (MSA). The focus on a single labor market avoids problems of interpretation that

[1] Brueckner, 1982 pp. 329.

might arise in analyses across labor markets from the interaction between property values and wages (see Roback 1982). The cross-sectional analysis relies on spatial auto-correlation techniques to control for any benefit spillovers among the coterminous jurisdictions. Furthermore, the analysis incorporates more information about community services than was available in previous studies.

The estimation reveals evidence of systematic resource mis-allocation. In particular, communities in the Hartford MSA appear to have allocated relatively too few resources to highways and education.

The Theory

Following Brueckner, assume that consumers have identical tastes toward public goods ($z_1 \ldots z_n$), housing services (q) and a numeraire private good (x). Assume further that, because individuals are mobile, in equilibrium all consumers with the same level of income can achieve the same level of utility ($\bar{u}$). Therefore, utility can be expressed as a function of income (y).

$$u(z_1, \ldots z_n, q, x) = \bar{u} = f(y). \qquad (1)$$

The consumer's budget constraint

$$y = \tau_M M_C + R + x \qquad (2)$$

reflects the fact that rental payments (R) entitle consumers to given levels of housing services and public goods, and that consumers pay taxes (τ_M) on

their stock of mobile personal property (M_C).[2] For tractability, assume that in equilibrium the consumer's new purchases of mobile personal property just offset depreciation of the property stock so that the mobile property tax payments ($\tau_M M_C$) are fixed.

It follows from the consumer's budget constraint that R must satisfy

$$u(z_1, \ldots . z_n, q, y - R - \tau_M M_C) = h(y) . \quad (3)$$

Equation 3 implicitly determines the consumer bid-rent function

$$R = R(z_1, \ldots . z_n, q; y - \tau_M M_C) , \quad (4)$$

which indicates that the house rent that is consistent with the assumed utility level $\bar{u}$ is a function of the level of public goods provided, housing services, and disposable income.

Because in equilibrium the individual must be indifferent between owning and renting, the sales price of a house (S) represents the present discounted value of the after-tax stream of rental benefits.[3] Let τ_R be the tax rate for real estate and θ represent the discounting factor. Assuming that real estate is an infinitely lived asset, the sale price of a home would be

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[2] Mobile personal property is not considered in the original Brueckner model, but the characteristics of communities in the Hartford MSA make it a necessary consideration here. In many cases, more than one third of all property tax revenues come from the taxation of property (such as cars and boats) that is not real estate.

[3] This discussion ignores the differential tax treatment of renters and owners.

$$S = \frac{R - \tau_R S}{\theta} \tag{5}$$

Therefore, the aggregate value of residential property in a community with h housing units would be

$$P_R = \frac{\sum_{i=1}^{h} R(z_1, \ldots z_n, q_i; y_i - \tau_M M_{Ci}) - \tau_R P_r}{\theta}. \tag{6}$$

On the other side of the picture, the government must finance the public goods using tax revenues, intergovernmental grants and net borrowing. Balancing the budget requires that

$$\tau_P P_R + G = \sum_{j=1}^{n} C_j(z_j, v) \tag{7}$$

where $C_j(z_j, v)$ is the cost of producing z units of public good j given a population v and G is government revenues from all sources excluding taxes on residential real estate. The population factor in the cost function allows for possible congestion.

Substituting the balanced-budget equation into equation 6 yields

$$P_R = \frac{1}{\theta}\left[\sum_{i=1}^{h} R_i + G - \sum_{j=1}^{n} C_j(z_j, v)\right], \tag{8}$$

indicating that residential real estate values in a community are the discounted sum of aggregate residential rents and revenues from all sources

other than taxes on residential real estate, less the cost of producing the n public goods.

Brueckner (1982) demonstrates that differentiating equation (8) with respect to the levels of public goods provided yields the Samuelson conditions for optimal provision of public goods, assuming that the public goods do not enter the firms' production functions. Therefore, communities behave in a Pareto-efficient manner if the partial derivative of residential real estate values with respect to the provision of public goods is zero for all of the public goods provided. Assuming that the communities in the sample are sufficiently similar that most share a common tendency to under-provide, over-provide, or optimally provide certain public goods, estimating the property values hedonic specified in equation (8) yields estimates of these partial derivatives.

The Data

Data for this analysis of the communities surrounding Hartford, Connecticut come from the 1980 Census of Housing and Population, the 1977 Census of Governments and Connecticut's Equalized Net Grand List for 1980. The Equalized Net Grand List, which is compiled from the state's annual study of sales and assessments, presents estimates of the value of residential and commercial real estate and other personal property in each town.

The census of housing and population indicates the number of rooms in the median home (MEDROOMS), the age of the housing stock (STRUC39, the proportion of homes constructed before 1939), the proportion of housing units with air conditioning (AIR), the number of housing units in the jurisdiction (HOUSING) and the percentage of those units that are unoccupied (VACANTRT),

the total land area in the jurisdiction (LANDAREA), the total population in the jurisdiction (POP80), and the per capita income of the population.

The census of governments indicates the extent of local government revenues from property taxes and other sources, and the extent of community indebtedness as a share of local revenues (NETASSET).[4] The census of governments also indicates the extent of local government expenditures on education (LOCLSCHL), police and fire protection (SAFETY), health, hospital and welfare services (H&WELFARE), highway repair and construction (HIGHWAY), and any other expenditures (OTHEREXP). Any user fees or transfers from other local governments are subtracted from each of the expenditures variables as payments for services rendered.

The Equalized Net Grand List provides information on the value of residential real estate in the jurisdiction (RESVALUE), the values of non-residential real estate and taxable mobile property, and the corresponding effective tax rates. All values are adjusted for differences in assessment across jurisdictions. From this information and information from the censuses of housing and government, I construct estimates of the share of commercial property in the jurisdiction (COMMERCE), local government revenues excluding taxes on residential real estate (REVENUES) and per household income net of personal property taxes (HINCOME).

A map of Connecticut indicates the distance between each community and every other community, and between each community and the center of Hartford City (DISTANCE).

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[4] The other sources include taxes on business real estate and mobile property, local licensing fees, intergovernmental grants and net borrowing. With the exception of Hartford City, the municipalities in the Hartford MSA did not use sales or income taxes to finance local government activities.

After obvious outliers were removed, complete data are available for 79 communities in the Hartford MSA. Because its sheer size, urban nature and use of sales taxes make it an atypical community in the MSA, Hartford City has been excluded from the analysis. Table 1 reports descriptive statistics for the variables used in this analysis.

The Estimation

Five econometric problems arise in the estimation of equation (8). First, the available data provide information on community expenditures on public services, but not on the levels of service provided. However, by inverting the cost functions

$$E_j = C_j(z_j, \mathbf{v}) \tag{9}$$

one can express the levels of service provided as

$$z_j = \hat{C}_j(E_j, \mathbf{v}) \tag{10}$$

where E_j is the level of expenditures on public good or service j. Inverting the cost functions is unappealing because it implies that all jurisdictions are equally efficient (or inefficient) at transforming money into services. However, it is a necessary evil that has been used in the previous hedonic applications of Brueckner's theoretical model. Therefore, it is the approach taken here.

Second, the estimation is vulnerable to problems of heteroskedasticity and multicollinearity. Exploratory Breusch-Pagan tests indicated that the error variance increased with POP80, HOUSING and total expenditures.

Furthermore, many of the regressors are interrelated. For example, public goods expenditures in the communities are highly correlated with each other and with population and housing. Such multicollinearity would affect estimates of standard errors and could lead to unwarranted acceptance of the Tiebout hypothesis.

Fortunately, both of these estimation problems could be addressed simultaneously. Dividing all of the variables by the square root of total expenditures reduces the Breusch-Pagan test statistic below the critical value for heteroskedasticity and substantially reduces the correlations among the regressors. For example, the Pearson correlation coefficient for the relationship between LOCLSCHL and HIGHWAY declines from .7923 to .5257. Therefore, this approach has been followed for this analysis.

Third, there may be benefit spillovers between jurisdictions that could introduce spatial autocorrelation. However, the spillover of benefits between jurisdictions should be a function of the distance between them. After all, it seems reasonable that communities are more likely to benefit from their neighbor's expenditures on police and fire protection than from the police and fire expenditures of a jurisdiction on the other side of the MSA. Therefore, techniques developed by Robin Dubin (1988) are used to test and correct for the presence of spatial autocorrelation in the data.[5]

Fourth, a jurisdiction's mix of services and taxes may be an endogenous function of community characteristics such as income. Ideally, one would want to develop a two stage model wherein expenditures and nonresidential revenues where determined prior to property values. However, there is not enough

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[5] For a complete explanation of the technique, which relies on the assumption that the spatial autocorrelation between two points is a negative exponential function of the distance between them, see Dubin.

information to separately identify the five types of expenditures and the REVENUES variable, and considerable information would be lost through aggregation. Furthermore, the spatial autocorrelation techniques do not easily generalize to multi-stage estimation. Finally, the expenditures and revenues data (which come from the 1977 Census of Governments) were gathered prior to the data on property values, incomes and housing characteristics (which come from the 1980 Census of Housing and Population and the 1980 Net Grand List). Therefore, it seems reasonable to treat the expenditures and revenues variables as exogenous.

The final econometric problem arises because economic theory provides little guidance about the functional forms for the consumer's bid-rent function and the inverse cost functions for the public goods. Therefore, I estimate equation (8) in partially reduced form

$$P = \frac{1}{\theta}[f(\epsilon_1, \ldots \epsilon_n, v, q, h, y-\tau_M M) + G \qquad (11)$$

where ϵ_j is expenditures per capita on public good (or service) j and f(•) can be either a linear or a logarithmic function.[6]

The Results

As Table 2 indicates, communities in the Hartford MSA apparently did not act in a Pareto-efficient manner during the period under study. Regardless of the form of the f(•) function, the joint hypothesis that the coefficient on all of the expenditures variables is zero is rejected at the 1 percent level

[6] Because NETASSET takes on both positive and negative values, it is not transformed when the f(•) function is estimated using natural logs.

of significance.[7] In particular, the data suggest that communities in the Hartford MSA could increase property values by raising taxes on residential property (the only element of the budget not held constant in the estimation) and using the proceeds to increase spending on education or highways.

It is interesting to note that no government service appears to have been systematically over-provided. Therefore, the data support the notion that residents have a taste for all types of government services -- including transfer payments such as health and welfare services -- and are willing to tax themselves accordingly.

The analysis also provides some evidence that benefit spillovers between jurisdictions are inconsequential. When a linear functional form is used to estimate f(•), a likelihood ratio test detects spatial autocorrelation that is significant at the 5 percent level, but correcting for the spatial autocorrelation has no qualitative effect on the results (see Table 2). When a logarithmic functional form is used to estimate f(•), a likelihood ratio test fails to detect any spatial autocorrelation. While it may imply only that the spatial autocorrelation takes on a different from than assumed in the analysis, this result is consistent with Dubin's analysis of housing values in which she found that spatial autocorrelation decayed in less than 2 miles. The communities under study here are generally more separate than that.

Comparisons with Previous Analyses

The implication that public services are systematically under-provided

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[7] The F-Statistics for the joint hypothesis are 7.07 and 6.31 (with 5 and 51 degrees of freedom) for the linear and logarithmic functional forms, respectively. The Likelihood Ratio for the linear functional form with spatial autocorrelation (which is distributed as a chi-square random variable with 5 degrees of freedom) is 78.02.

in the Hartford MSA is inconsistent with most of the previous applications of Brueckner's theoretical model. Three factors may explain those inconsistencies. First, the communities analyzed here come from a single labor market while the previous analyses have included communities from multiple labor markets within a single state. Because differences in amenities such as public services can be capitalized into wages as well as property values (see Roback, 1982), including more than one labor market in the previous studies may have biased the estimates of the relationship between property values and public services, and will have muddled the interpretation of their results.[8] Therefore, inconsistencies between this study and previous studies may reflect specification errors in the earlier work.

Second, this analysis has been simplified to use aggregate residential property values as the dependent variable rather than aggregate total property values as in most of the previous applications (Brueckner 1982, Deller 1990a, 1990b). Because business property values are independent of government services (by assumption), the coefficients on government services and the implications for the Tiebout hypothesis should be unaffected by the choice of dependent variable. However, including business property in the dependent variable adds noise to the estimation that might affect the coefficient estimates in small samples. Furthermore, any variable used to control for variations in business property values (such as the number of firms) unnecessarily reduces the degrees of freedom.

The third factor that may explain differences between this study and previous studies is the treatment of mobile personal property. Although there

[8] In particular, if some of the benefits of government services are capitalized into wages, then maximizing property values need not lead to the Samuelson conditions for the efficient allocation of public goods.

is no reason to believe that local amenities are capitalized into the value of mobile property like boats or cars, the differences between real estate and personal property are not addressed in the previous analyses. Adjusting the analysis to accommodate the distinction leads this study to use different measures of the dependent variable, household income, and local government revenues net of property taxes. Some of the differences between this analysis and previous analyses may result from those refinements in the choice of variables.

Conclusions

This analysis suggests that, given the existing housing stock, governments in the Hartford, Connecticut MSA did not act efficiently during the latter part of the 1970s. In particular, the estimation indicates that real estate values in the MSA could have been increased by increasing taxes on residential real estate and using the proceeds to provide more education and highway services. The governments' systematic inefficiencies may reflect the problems of planning in an uncertain inflationary environment, rather than an outright rejection of the Tiebout hypothesis, but this piece of evidence also casts some doubt on the short-term impact of voting with your feet.

Table 1

Descriptive Statistics

Variable	Mean	Standard Deviation
RESVALUE	274774.30	201050.51
DISTANCE	21.97	12.45
LANDAREA	30.12	13.59
STRUC39	28.12	13.20
MEDROOMS	6.21	0.37
AIR	40.68	13.85
HINCOME	24282.81	3783.25
NETASSET	-45.82	39.10
VACANTRT	7.27	7.21
COMMERCE	22.30	11.98
HOUSING	5407.94	5400.44
POP80	14647.92	14342.54
SAFETY	658620.25	1045467.60
H&WELFARE	129518.99	210867.19
HIGHWAY	459746.84	458323.07
LOCLSCHL	4578392.41	4003500.98
OTHEREXP	1954455.70	3088630.08
REVENUES	4977871.08	5791824.88

Table 2
Regression Results

	Model A	Model B	Model C
Intercept	18.64	33.39	-1021.46
	(30.31)	(29.64)	(179.39)
DISTANCE	1099.35 *	1379.23 *	6.37
	(538.67)	(616.24)	(3.93)
LANDAREA	-189.31	-270.54	-0.64
	(356.70)	(376.83)	(4.50)
STRUC39	-142.75	-270.95	-0.23
	(412.47)	(435.38)	(4.82)
MEDROOMS	-44665.21 *	47779.03 *	16.78
	(11056.50)	(10141.32)	(37.58)
AIR	267.61	-110.75	-8.62
	(658.00)	(696.42)	9.23
HINCOME	9.56 *	10.57 *	134.67 *
	(2.08)	(2.01)	(20.02)
NETASSET	106.67	136.82	112.78
	(140.43)	(135.69)	(96.80)
VACANTRT	1320.50	840.60	-12.12 *
	(902.73)	(889.70)	(4.36)
COMMERCE	52.07	-206.17	-8.93 *
	(671.40)	(623.45)	(4.49)
HOUSING	45.08 *	45.04 *	182.93 *
	(15.52)	(14.65)	(19.91)
POP80	-9.19	-9.26	-113.17 *
	(4.90)	(4.74)	(21.41)
H&WELFARE	0.04	0.10	3.35
	(0.08)	(0.08)	(2.37)
HIGHWAY	0.11 *	0.09 *	16.24 *
	(0.03)	(0.03)	(4.61)
SAFETY	-0.05	-0.06	5.74
	(0.03)	(0.03)	(3.35)
LOCLSCHL	0.05 *	0.05 *	89.00 *
	(0.01)	(0.01)	(17.39)
OTHEREXP	0.02	0.01	14.31
	(0.01)	(0.01)	(5.37)
REVENUES	-0.03 *	-0.03 *	0.01
	(0.01)	(0.01)	(0.01)
R-Square	.8040	.7946	.9034
Maximum Likelihood	-789.45	-786.57	-733.55

Model A = f(•) function linear.
Model B = f(•) function linear; corrected for spatial autocorrelation.
Model C = f(•) function logarithmic.

Standard errors are in parentheses. An asterisk indicates that the variable is significantly different from zero at the 5 percent level.

References

Brueckner, Jan K. (1982), "A Test for Allocative Efficiency in the Local Public Sector," Journal of Public Economics 19: 311-331.

Brueckner, Jan K. (1979), "Property Values, Local Public Expenditure and Economic Efficiency," Journal of Public Economics 11: 223-245.

Deller, Steven C. (1990), "An Application of a Test for Allocative Efficiency in the Local Public Sector," Regional Science and Urban Economics 20:395-406.

Deller, Steven C. (1990), "Pareto-Efficiency and the Provision of Public Goods Within a Rural Setting," Growth and Change (Winter) 30-39.

Dubin, Robin A. (1988), "Estimation of Regression Coefficients in the Presence of Spatially Autocorrelated Error Terms," The Review of Economics and Statistics 70(3): 466-474.

Oates, Wallace A. (1969), "The Effects of Property Taxes and Local Spending on Property Values: An Empirical Study of Tax Capitalization and the Tiebout Hypothesis," Journal of Political Economy November/December: 957-71.

Roback, Jennifer (1982) "Wages, Rents and the Quality of Life," Journal of Political Economy 90 (December): 1257-1278.

Tiebout, Charles, (1956), "A Pure Theory of Local Expenditure," Journal of Political Economy 64: 416-424.

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