FURTHER EVIDENCE ON THE CAPITALIZATION OF PROPERTY TAXES

A CASE STUDY OF UPPER DUBLIN TOWNSHIP

Moshe Cohen*

INTRODUCTION

There exist numerous previous tax capitalization studies that have used inter-commnunity comparisons to estimate the price effect of property tax variations.[1] By doing so, these studies may inadvertently (but wrongly) attribute a spectrum of other price effects, such as differences in public services, external and locational effects, to property tax variations. This study will examine the effects of variations in the property tax within a small homogeneous geographical area, Upper Dublin Township, Pennsylvania, in which significant variations in public services are not likely to exist, and, therefore, differences in prices are not attributable to locale or differences in public services. Hence, this study is distinguished from many previous works in its intra-community emphasis. It is based on a detailed body of data on individual properties, their attributes and actual selling prices. It focuses upon the submarket microeconomic factors affecting price, the capitalization of property taxes, and the intra-community interpretation of the Tiebout approach. The market value equation is estimated by an hedonic approach, with RATIO (assessment/market value) as one of the explanatory variables. In brief, our analysis indicates the existence of tax capitalization, both reasonable in size and statistically significant.

THE DATA

Our data consist of 348 observations of residential properties in Upper Dublin Township.[2] Each observation contains data about the property's sale value and tax assessment as well as a complete description of housing and land characteristics. These data were obtained from Montgomery County Board of Assessment. All properties represent actual "arms length" sales for 1970-1972. Socio-economic variables were obtained from the 1970 census. Overall, it is a

comprehensive list of variables that includes, housing attributes, neighborhood variables, social characteristics and tax liability.

THE EMPIRICAL MODEL

Our theoretical model of market value is an hedonic[3] model, using housing attributes, which are observable, as the independent variables:

$$V_i = Q(SZ_i, QL_i, L_i, TXD_i) \qquad i=1....348$$

Where:

V_i is the market value of the ith property.

SZ_i is a vector of size attributes.

QL_i is a vector of quality attributes.

L_i is a vector of neighborhood and external attributes.

TXD_i is the deviation from the mean RATIO in the communtiy

Our model consists of a reduced form equation for the determination of value. Supply is treated as relatively inelastic, and the housing market is assumed to be in long run equilibrium.[4] These assumptions are necessary to avoid identification problems, and they are plausible in the context of our small homogeneous housing market. Empirically we have chosen a semi-logarithmic regression equation because it allows for interaction among the explanatory variables (as would be expected in housing market analysis) and produces better estimates than those generated by the linear form. We used the following equation form for the empirical analysis:

$$V = e^{a0 + \sum_{i=1}^{m} a_i x_i + \mu}$$

This is our basic estimation equation. The estimating techniques used were two stage least squares (T.S.L.S) and ordinary least squares (O.L.S.). We preferred the T.S.L.S procedure because, we believe, on theoretical grounds, property values and taxes are interdependent and simultaneously determined. Therefore, O.L.S will tend to produce inconsistent estimates because of simultaneity bias.

THE EMPIRICAL FINDINGS AND INTERPRETATION OF THE RESULTS

The best estimate of the market value equations, using T.S.L.S and O.L.S, are presented below. Equations 1 to 4 are consistent with our theoretical expectations, the explanatory variables are highly significant and R^2 are about .8.

TABLE 1: Property Value As Determined By Housing Attributes and Tax Liability

Regressions of LMV. The Method Is T.S.L.S For Equations 1-2 and O.L.S for Equations 3-4.*

Independent Variable	Equations			
	1	2	3	4
Intercept	8.912	9.296	8.835	9.039
	(42.56)	(35.59	(45.56)	(50.38)
RATIO	---	-0.003462	---	-0.002264
		(-4.843)		(-22.26)
NRMRT	-0.0003123	---	-0.0002447	---
	(-12.66)		(-25.78)	
FLAR	0.0003332	0.0003037	0.0003185	0.0002388
	(14.89)	(6.222)	(15.63)	(9.305)
AGE	-0.002990	-0.003125	-0.00271	-0.002569
	(-5.854)	(-4.836)	(-5.782)	(-5.471)
LLTSZ	0.1099	0.1207	0.1219	0.1288
	(5.200)	(5.336)	(6.298)	(6.912)
BATH	---	0.05499	---	0.074
		(2.868)		(5.637)
QBT	-0.8148	---	-0.08743	---
	(-4.598)		(-5.321)	
GARAG	-0.05947	-0.06135	-0.06329	-0.05704
	(-6.015)	(-5.501)	(-6.918)	(-6.232)
PN	---	0.000525	---	0.05704
		(0.222)		(-4.001)
R	0.8221	0.7910	0.8424	0.8485

The predetermined excluded variables are:

For equation 1	For equation 2
TME	TME
PN	PRCD
BATH	PR

* The number in parenthesis indicates the t ratio.

Where:
LMV = The natural logarithm of the property's market value.
RATIO = The ratio of the current assessment to market value multiplied by 100.

NRMRT = The deviation of a RATIO from the mean RATIO for our sample of properties multiplied by 10.

FLAR = Floor area in square feet

AGE = 1973-date of construction of a house.

LLTSZ = The natural logarithm of the size of the lot in square feet.

BATH = Number of bathrooms.

QBT = Number of bedrooms divided by number of bathrooms.

GARAG = An index indicating availability and type of garage. (GARAGE takes lower value as availability of garages increases).

PN = Proportion of non white households in a census block.

TME = Age of the sale measured as number of months that elapsed since the first sale in the sample was made.

PRCD = An index indicating the condition of the property.

PR = Proportion of rented properties in a census block.

CAPITALIZATION OF TAXES

Our study provides empirical substantiation of a microeconomic, intracommunity Tiebout hypothesis. According to this view, a household will maximize its utility by choosing an appropriate residential community in terms of among other things the best available "package" of taxes and public services. In addition, within the chosen residential community, one would expect that variations in taxes and/or public services should be capitalized into value. (In our study as mentioned earlier, public services within the community are relatively non-variable). In each equation a tax variable was introduced to measure the effect of deviations in the ratio[5] on property values. The variables used were RATIO and NRMRT. They were highly significant, and support our contention that higher taxes are capitalized so as to lower property values.[6]

We computed the capitalization rate for the different equations, our computations suggest a capitalization rate of about 5 percent.[7] A capitalization

rate of 5 percent implies that a tax differential of 1 dollar will generate 20 dollars differential in property value. In Table 2 we present our computed capitalization rates. They were computed around the data sample means, using the mean RATIO of .2066, effective tax rate of .026 and mean value (LAMT) of 10.42.

Table 2: The Capitalization Rates Computed from Value Equations of Table 1[8]

Equation #	Method	Capitalization Rate %
1	T.S.L.S	4.2
2	T.S.L.S	3.7
3	O.L.S	5.6
4	O.L.S	5.7

It is important to note that in our analysis it is assumed that the tax differentials will continue forever and that the expected life of the property is infinite. In theory, the price reduction resulting from a tax differential is the present value of the stream of future expected tax differentials as perceived by the purchaser. (Clearly, these differentials may not necessarily be fixed over an infinite future time horizon. In that case our observed capitalization rates are higher than the rate used by the purchaser of a home). To test the validity of our assumptions we recomputed our capitalization rate by splitting the sample into two classes of properties; Those properties with shorter than average expected life. This split in the sample was achieved by taking, on one hand, properties where AGE was less than ten years and, on the other hand, properties where AGE was greater than ten years. For the older properties, the coefficient of the tax variable (RATIO, NRMRT) was negative, statistically significant, but relatively small when compared to the coefficient for the newer properties. This implies a smaller decline in price for older homes for a given deviation in RATIO. While this result is true for all LMV equations, as an example we will present the results for splitting the sample for equation 2 only in Table 1.

Equation 5: Property Value as Determined by Housing Attributes and Tax Liability, Regression of LMV. (The Method is T.S.L.S for properties Ten or more years old).

$$LMV = 9.008 - 0.0025612\ RATIO + 0.0002227\ FLAR - 0.0017412\ AGE + 0.14250\ LLTSZ$$
$$(19.61)\quad (-1.719)\quad (3.480)\quad (-2.673)\quad (4.831)$$
$$+ 0.059512\ BATH - 0.0031561\ PN - 0.06777\ GARAG \qquad R^2=0.8667$$
$$(2.281)\quad (-0.524)\quad (-5.260)$$

Equation 6: Property Value as Determined by Housing Attributes and Tax Liability, Regression of LMV. (The Methos is T.S.L.S for Properties that are less than Ten Years of Age).

$$LMV = 9.582 - 0.0040637\ RATIO + 0.000314\ FLAR - 0.02118\ AGE + 0.11311\ LLTSZ$$
$$(16.66)\quad (-4.317)\quad (3.963)\quad (-1.593)\quad (1.764)$$
$$+ 0.046738\ BATH - 0.0027645\ PN - 0.020345\ GARAG \qquad R^2=0.2159$$
$$(1.060)\quad (-1.057)\quad (0.709)$$

Computation of the capitalization rates for equations 5 and 6 reveals that a 1 percent increase in RATIO will produce $725 and $1600 respective declines in the values of the mean old and new properties. Since newer properties are more expensive on the average than old homes, the average tax liability will increase by $50.65 for new properties and by $36.14 for old properties. This results in a decrease in property values of 20 times the tax increase for old properties and 31.6 times the tax increase for new properties (capitalization rates of 5.0% and 3.2% respectively).[9]

In summary, this study provides further evidence of capitalization of property taxes within a local jurisdiction. The magnitude of the capitalization rate reinforces previous empirical findings, and our analysis of capitalization rate differentials by age is consistent with the theory of finance.

FOOTNOTES

*The author wishes to thank Professor Robert Edelstein for his guidance and helpful comments. Of course, the author is responsible for any remaining errors.

[1]See Oates (1969), King (1973), Orr (1968), and Hyman and Pasour (1973). For intra-community tax capitalization analysis, see Edelstein (1974) and Smith (1970). We believe that this study represents a research improvement because of its relatively detailed data base, and intra-community emphasis. Furthermore, our statistical methodology avoids the potential problem of simultaneity bias by using two stage least squares.

[2]Upper Dublin is located in Montgomery County, Pennsylvania. Two separate tapes were used in the preparation of our sample data. The first tape contained a complete description of all properties in Upper Dublin Township as used by assessors. The second tape included sales transaction information (including assessment) for Montgomery County. The Montgomery County sales-transaction tape was used to separate Upper Dublin transactions for which we had property description information. The final result was a body of data for Upper Dublin containing sales and assessment information as well as a description of those properties sold.Properties for which non-bona fide sales were listed or other significant data were lacking were deleted from the analysis. Our final data sample consisted of 348 observations for which information was available on the following variables: Parcel number, number of bedrooms, number of bathrooms, number of garages, property condition, construction date, neighborhood code, value trend, neighborhood age, floor area, lot size, date of deed, sale price, and assessment. Socio economic information includes: Racial mix, and percentage of rented and crowded housing units in a census block.

[3]See Lancaster (1966) for the theoretical justification for the hedonic approach. For empirical work with hedonic indeces see Griliches (1961) and Dhrymes (1967). The price of a house in a competitive market should be the present value of the net flow of services it is expected to provide. The quantity and the price of these services are non observable, therefore we have chosen to relate the price of a house to observable attributes of the housing stock.

[4]See Johnston (1972) pp. 352-356 and Edelstein (1974).

[5]In the Commonwealth of Pennsylvania legal equity requires uniform ratios of assessment to market value regardless of use, age, ownership, etc.

[6]See Oates (1969) and Sabella (1974). We should emphasize that our study is within one jurisdiction and higher taxes on individual properties in general, are not expected to imply higher level of public services.

[7]Wicks, Little and Beck (1968) obtained similar capitalization rate.

[8]Since there is a positive correlation between the variable RATIO and the residuals, one would expect that the simultaneity bias may produce less negative coefficient for RATIO in the O.L.S equation implying higher capitalization rate.

9

A test of the equality of the coefficients for the different regression equations was performed to examine whether the split represented structural effects. Our results indicate that the hypothesis that market value determination of new and old properties is represented by different structural forms cannot be accepted at the 95% level for all equations. For the appropriate F test see Bolch and Huang pp. 140-146.

REFERENCES

Bailey, M., R. Muth, and H. Nourse, "A Regression Method for Real Estate Price Index Construction," Journal of the American Statistical Association, 58 (1963), 933-942.

Black, D. E., "The Nature and Extent of Effective Property Tax Variation Within the City of Boston," National Tax Journal, 25, (1972), 203-210.

Bolch, B. and Huang, C. "Multivariate Statistical Methods for Business and Economics," (N.J. Prentice-Hall, 1974)

Dhrymes, P., "On the Measurement of Price and Quality Changes in Some Consumer Capital Goods," American Economic Review, (1967), 57, 501-518.

Edelstein, R., "The Determinants of Value in the Philadelphia Housing Market," Review of Economics and Statistics, (1974), 56, 319-328.

Griliches, Z., "Hedonic Price Indexes for Automobiles: An Econometric Analysis of Quality Change," Staff Paper No. 3 in The Price Statistics of the Federal Government, National Bureau of Economic Research (1961).

Johnston, J., Econometric Methods, Second edition (new York: McGraw-Hill, 1972).

Kain, J. and J. Quigley, "Measuring the Value of Housing Quality," Journal of the American Statistical Association, (1970), 56, 532-548.

King, T., Property Taxes Amenities, and Residential Land Values, (Cambridge Mass.: Ballinger, 1973).

Lancaster, K., "A New Approach to Consumer Theory," Journal of Political Economy, (1966), 74, 132-157.

Mieszkowski, P., "The Property Tax: An Excise Tax or a Profit Tax?," Journal of Public Economies, (1972), 1, 73-96.

Oates, W., "The Effects of Property Taxes and Local Public Spending on Property Values: An Empirical Study of Tax Capitalization and the Tiebout Hupothesis," Journal of Political Economy, (1969), 77, 957-971.

Oldman, O. and H. Aaron, "Assessment - Sales Ratio Under Boston Property Tax," National Tax Journal, (1965), 18, 36-49.

Orr, L., "The Incidence of Differential Property Taxes on Urban Housing," National Tax Journal, (1968), 21, 172-180.

Sabella, E. "The Effects of Property Taxes and Local Public Expenditures on Sales Price of Residential Dwelling," Appraisal Journal, (1974), 42, 114-125.

Smith, S., "Property Tax Capitalization in San Francisco," National Tax Journal (1970), 23, 177-194.

Tiebout, C., "A Pure Theory of Local Expenditures," Journal of Political Economy, (1956), 64, 415-424.

Wicks, J., R. Little and R. Beck, "A Note on Capitalization of Property Tax Changes," National Tax Journal, (1968), 21, 263-266.