Confirmations and Contradictions

New Evidence on Property Tax Capitalization

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I. Introduction

The notion of property tax capitalization was first formally developed and tested by Oates (1969). Full capitalization is said to occur when, after one controls for all other housing characteristics (structure, neighborhood, and public services), differences in housing prices exactly equal the present value of variations in expected tax liabilities. The large volume of empirical literature that followed Oates's study largely documents that property values are negatively affected by future property tax liabilities but fails to reach a consensus regarding the "extent" of such capitalization.[1]

For example, Wales and Wiens (1974), Chinloy (1978), and

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[1] The original Oates study has been criticized from both empirical and theoretical perspectives. For our purposes, the link between property value capitalization and the Tiebout hypothesis is less important and will not be dwelt on here. Instead, this paper focuses on the empirical issues involved in measuring the extent of capitalization that emerge in the original Oates study and in much of the post-Oates literature. See Brueckner (1979) for an excellent critical review and Starrett (1981) and Yinger (1982) for additional discussions of the validity of capitalization and the appropriateness of the Oates test of the Tiebout hypothesis.

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Gronberg (1979) find little significant capitalization effects; Oates (1969), King (1973, 1977), Edel and Sclar (1974), Gustely (1976), Rosen and Fullerton (1977), Dusansky, Ingber, and Karatjas (1981), Richardson and Thalheimer (1981), Ihlanfeldt and Jackson (1982), and Yinger et al. (1988) document varying degrees of partial tax capitalization; and Oates (1973), Church (1974), and Reinhard (1981) report either full or overcapitalization. The recent comprehensive study of Yinger et al. (1988) is of special interest. It documents very modest rates of tax capitalization and revises (mostly downward) the estimates of previous studies. It seems that despite the progress in the theoretical and the empirical modeling of tax capitalization, the estimates of property tax capitalization have not converged to a consensus rate.

The extent of tax capitalization not only provides insights into the Tiebout mechanism but is also an indicator of the rationality of agents in the real estate market or the degree of housing market efficiency. Empirical analyses of tax capitalization provide insights relevant to the incidence of property taxation and the applicability of Ricardian equivalence. Full capitalization implies that current real estate owners bear the entire burden of contemporary changes in expected tax liabilities, whereas partial capitalization suggests that current owners are able to pass some of the burden to future owners. Partial capitalization also implies that Ricardian equivalence in its complete and pure form is not operative.

Virtually all past empirical analyses utilize data across geographic areas for which there is variation in both tax rates and public services. The challenge is to isolate the tax rate effects from public service effects. Indeed, most previous studies struggle to overcome the potential downward bias in the tax capitalization coefficient created by errors in measuring public services and the inherent positive collinearity between those services and tax rates.

In contrast, the current study utilizes data that are uniquely suited for estimating the extent of property tax capitalization because the levels of publicly provided services are essentially fixed, whereas property tax rates vary greatly across observations. In addition, this data set also reduces potential errors in measuring effective taxes, another potential source of bias found in previous studies.[2]

Section II summarizes the primary econometric problems addressed by this paper. Section III then discusses the nature of the

[2] Properties in samples used in previous studies have been subject to nonuniform assessment practices, resulting in errors in measuring effective property tax rates. In contrast, the effective tax rates utilized in this current study are based on the ratio of actual taxes to market values, which are uniformly reassessed on an annual basis.

data set used. Section IV presents the empirical results and their implication regarding the extent of tax capitalization. Section V provides a brief conclusion.

II. The Spurious Correlation Problem

Past empirical analyses utilize either amenity or capitalization models. In amenity models, the level of property tax rates is treated as one among several attributes (amenities/disamenities) affecting home values. Amenity models employ specifications such as

$$P_j = \beta_0 + \sum_i \beta_i Z_{ij} + \beta_\tau \tau_j, \tag{1}$$

where P_j is the value of the jth property; the Z_{ij}'s are structural and locational characteristics, including measures of public services in the area; and τ_j is the annual rate of property taxation.[3] The estimated coefficient of the property tax rate, $\hat{\beta}_\tau$, purportedly measures the ceteris paribus impact of a change in the annual rate of property taxation on the value of residential property. If the current tax rate is expected to remain constant over time, then full capitalization implies that $\beta_\tau = P_j/r$, where r is some appropriate discount rate.

Capitalization models view property values as the capitalized value of future housing services net of costs. In other words, the current value of a home is taken to be the present value of net benefits (i.e., housing services minus costs) generated to home owners. This is typically generalized into estimating equations of the following form:

$$P_j = \frac{S(Z_{ij})}{\bar{\rho}_n + \beta_\tau \tau_j}, \tag{2}$$

where $\bar{\rho}_n$ is the net user cost of housing (the appropriate real, net of expenses, after–income tax discount rate), and $S(Z_{ij})$ is a hedonic function of the rental value of housing. Full capitalization implies $\beta_\tau = 1$.

Both specifications are vulnerable to spurious correlation between unexplained variation in the Z_{ij} related to public services and the tax rate, τ_j. For example, suppose that public services, Z_s, are imperfectly measured such that $Z_s = Z_m + Z_u$, where Z_m are correctly measured public services and Z_u are unmeasured services. Suppose further that higher tax rates pay for greater services (Z_s and τ_j are positively corre-

[3] On occasion, some of the variables were represented by the logarithms of the actual values.

lated). Then if Z_m is used to "control" for variation in public services in either (1) or (2) above, the unmeasured component of services, Z_u, will be positively correlated with τ_j and $\hat{\beta}_\tau$ will be biased downward.[4]

While the Oates (1969) study was criticized for inadequately controlling for variation in public services, the literature that followed Oates made only incremental improvements either by obtaining more detail on publicly provided services or by reducing variation in public services across sample observations. However, given the impossibility of measuring all the aspects of public goods output, the first strategy can be expected to only partially ameliorate the problem. The second strategy is constrained by the unavailability of data across housing markets that contain sufficient variation in tax rates without variation in services.

Another measurement problem that plagues the literature involves the use of stated tax rates in lieu of the effective tax rates (the ratios of actual taxes paid to market values) that are specified in the capitalization models. Jurisdictions often quote tax rates in terms of taxes per assessed valuation. Standard "errors in variables" biases may emerge because assessment practices can vary across locations and over time. Another aspect of this measurement error involves expectations regarding reassessments. If revaluations are accurately anticipated, property values should be affected when the expectation of the revaluation is formed, not at the time the revaluation actually takes place. Thus, estimates of tax capitalization coefficients will be biased if changes in expectations regarding future tax rates are correlated with actual taxes.[5]

III. The Data

The data set utilized in this study is uniquely suited for estimating the extent of tax capitalization because it ameliorates the two problems

[4] The value of $\bar{\rho}_n$ is also subject to measurement error since it is not directly observable. While this can also lead to biases of tax capitalization parameters, this issue is beyond the scope of this paper. See Palmon and Smith (1998) for more details of the inherent identification problem with capitalization models and Linneman and Voith (1991) for an excellent study of the user cost of owner-occupied housing.

[5] For example, if property tax rates are mean reverting, then a municipality with relatively low tax rates is more likely to request a revaluation, which would increase effective tax rates. Thus, estimates of the tax capitalization coefficient are likely to be biased downward in analyses that use current effective property tax rates as estimates for future effective rates. This problem can be ameliorated by the use of a sample in which assessed values closely correspond to market values and current effective property tax rates (or other observed variables) are good predictors of future effective tax rates.

discussed in the previous section. Micro housing market data were obtained for properties from 50 subdivisions with similar demographics and amenities located in the wooded portion of the northwest suburbs of Houston, Texas. This area is a part of the unincorporated metropolitan area in which identical public services are provided to each subdivision by Harris County and three suburban school districts; the latter have similar tax rates and provide similar levels of educational services.[6] Much of the ''public'' infrastructure, including the water and sewer systems, was built by private developers and financed through the creation of municipal utility districts (MUDs). All MUDs provide the same services. The capital expenditures were financed through the issuance of municipal bonds, and property taxes are used to pay the debt service.

Despite the similarity in neighborhoods, identical MUD services, and the close correspondence between assessed and market values, MUD tax rates vary substantially. The rates range from $2.30 to $19.00 per $1,000 of assessed valuation.[7] These differences in tax rates stem from four factors.

First, tax rates depend on the period during which MUDs were created and bonds were issued. The MUDs created in the mid 1970s were financed at interest rates of between 5 and 7 percent. In contrast, those created in the early 1980s issued bonds with yields in excess of 12 percent. Tax rates also depend on the distribution of bond maturities, the nature of the call provisions in the bond contract (e.g., the call premium and the period during which the bonds are protected from being called), and the ability of MUDs to refinance their debt.

Second, MUD tax rates are influenced by the extent to which residential subdivisions within each MUD were completed. Building activity stopped in most subdivisions in Houston as a result of the regional real estate bust in the mid 1980s. Some MUDs with debt intended to be serviced by 6,000 homes have fewer than 1,500 homes.[8] In such cases, current property tax rates may be four times as high as originally expected.

Third, MUDs also vary in terms of the proportion of nonresiden-

[6] The close similarities between the Klein, Spring, and Cypress-Fairbanks school districts are reflected in both national and state test scores, the demographics of the student bodies, and the expenditure rate per student.

[7] The mean of the MUD tax rate is $7.90 per $1,000 of assessed valuation. Other property taxes total about $15 per $1,000 of assessed valuation and are very similar across observations.

[8] Some MUDs have even lower ratios of homes to lots. However, the infrastructure in these MUDs was not completed for all lots.

tial taxable property. Those with higher percentages of commercial property have lower tax rates. Finally, economies of scale make larger MUDs more efficient and, therefore, more likely, ceteris paribus, to have lower tax rates.

The data set includes neighborhoods for which non-MUD taxes and MUD services are fixed and for which non-MUD services are very similar, if not identical, across observations. Furthermore, even if there were slight variations in non-MUD public services, there is no reason to believe that they would be correlated with the large variation in MUD tax rates.

Finally, assessed values for tax purposes are updated every year and are mandated to equal market values by state law. As a consequence, stated and effective tax rates essentially equal each other. Thus, the data used in this study provide variations in effective tax rates that are not correlated with variations in public services, allowing empirical analyses to avoid the downward biases common to most of the literature.

The sample includes 501 observations of homes sold in 1989. The housing market data for 1989 were collected by the Multiple Listing Service of Houston's Board of Realtors. The data include market prices of single-family detached housing (P), structural characteristics of each property, and characteristics of the MUD associated with each property. The structural characteristics include the living area of the home in square feet (SQFT), the age of the home (AGE), and the number of baths (BATH). In addition to the information provided by the Multiple Listing Service, calculated distances to the central business district (CBD) were added to each observation. The MUD characteristics include property tax rates (τ_j), the ratio of the forecasted debt service in 1991 to the total assessment of all properties (DS/VALUE), the percentage of the tax base stemming from commercial properties (PC-COML), the residential foreclosure rate (PC-FORE), and the percentage of the MUD that is built out (BUILTOUT). Variable means and standard deviations for the various variables are reported in table 1.

IV. The Estimation of Tax Capitalization

Following the most recent trends in tax capitalization studies, we estimated the capitalization model described in equation (2) using the unique data set described in the previous section. This specification requires a predetermined estimate of $\bar{\rho}$ and a nonlinear maximum likelihood algorithm to estimate the parameters including β_τ. The hedonic expression for services in equation (2) was specified

TABLE 1

SUMMARY STATISTICS OF PROPERTY AND MUD CHARACTERISTICS

Variable	Definition	Mean	Standard Deviation	Minimum	Maximum
Price (P)	Sales price of home	$87,222	$33,405	$46,000	$225,000
SQFT	Square feet of living area	2,379.5	583.80	1,368	4,491
AGE	Age of home in years	6.9002	4.7504	0	21
BATH	Number of baths	2.4731	.4666	1.5	3.5
CBD	Distance from central business district	19.477	2.9011	12.415	25.632
Tax rate (τ)	MUD property tax rate	.0079	.0033	.0023	.0190
DS/VALUE	Forecasted debt service/ assessed value	.0087	.0040	.0021	.0255
PC-COML	Percentage commercial	.1880	.1611	.0032	.8311
PC-FORE	Foreclosure rate	.0394	.0293	0	.1374
BUILTOUT	Ratio of houses to lots	.7852	.1998	.0996	1.0000

as an exponential function of property characteristics, which, when linearized, equals

$$\log[S(Z_{ij})] = \beta_0 + \beta_1\text{SQFT} + \beta_2\text{SQFT}^2 + \beta_3\text{AGE} + \beta_4\text{BATH} + \beta_5\text{CBD}, \tag{3}$$

and the capitalization rate was specified as

$$\rho = \rho_n + \beta_\tau \tau_j.$$

Table 2 presents estimates from four alternative specifications of equation (2) using a nonlinear maximum likelihood algorithm (denoted as specifications 2*a*–2*d*). In order to facilitate greater comparisons with similar analyses in the literature, ρ_n was set to equal 3.0 percent (.03), following Yinger et al. (1988). Specification 2*a* uses the specification in equation (3) to estimate the value of housing services and the 1989 MUD tax rate as the property tax rate. The table presents the estimated coefficients, their standard errors, and the impact of a one-standard-deviation change in the property and MUD characteristics on the estimated value of monthly housing services (calculated at the means of the characteristics). The signs of the estimated coefficient are consistent with priors. The rental value of the average home is estimated from the parameters of the rental hedonic equation as $255 per month. This value is considerably below the actual rental rates of similar properties, likely because of the use of Yinger et al.'s 3.0 percent net user cost of capital.

The estimated tax capitalization coefficient in specification 2*a* is .617, indicating approximately 62 percent tax capitalization. While this rate is significantly below full capitalization, it is substantially larger than the capitalization rates of 15–30 percent found by Yinger et al. under similar assumptions regarding ρ_n. Specification 2*b* replaces the MUD tax rate by the ratio of MUDs' 1991 forecasted debt service to the assessed value of all properties.[9] This specification would be more appropriate than specification 2*a* if the ratio of debt services to assessed value was better than the current tax rate as a proxy for the long-term property tax rate. It also checks the robustness of our results. The estimates are similar to those in specification 2*a* (tax capitalization is estimated to equal .564). The robustness of our results to alternative specifications is also indicated by estimates of other specifications (available on request from the

[9] The amount of debt service was estimated by the MUD on the basis of the distribution of municipal bonds across maturities, interest rates, and the likelihood that call provisions will be exercised.

TABLE 2

NONLINEAR MAXIMUM LIKELIHOOD ESTIMATES OF EQUATION (2)

	Specification 2*a*		Specification 2*b*		Specification 2*c*		Specification 2*d*	
Variable	Coefficient	Impact*	Coefficient	Impact	Coefficient	Impact	Coefficient	Impact
SQFT†	.8341 (.0819)		.8728 (.0826)		.7623 (.0792)		.7531 (.0789)	
SQFT × SQFT‡	−.072 (.0150)	\$73.13	−.076 (.0152)	\$72.55	−.061 (.0145)	\$67.02	−.058 (.0144)	\$68.29
AGE	−.0208 (.0019)	−\$25.17	−.0190 (.0018)	−\$21.91	−.0188 (.0019)	−\$21.69	−.0192 (.0019)	−\$22.40
BATH	.0506 (.0240)	\$6.02	.0517 (.0244)	\$5.87	.0369 (.0231)	\$4.19	.0350 (.0230)	\$4.01
CBD	−.0047 (.0024)	−\$3.44	−.0060 (.0024)	−\$4.25	−.0139 (.0026)	−\$9.78	−.0141 (.0025)	−\$10.05
Tax rate (τ)	**.6166** **(.0961)**				**.6390** **(.1358)**			
DS/VALUE			**.5638** **(.0977)**				**.6172** **(.1225)**	
PC-COML					−.1203 (.0452)	−\$4.71	−.0956 (.0449)	−\$3.77
PC-FORE					−1.8989 (.3281)	−\$13.53	−1.8509 (.3269)	−\$13.30
BUILTOUT					−.0683 (.0527)	−\$3.32	−.1104 (.0551)	−\$5.41

NOTE.—Standard errors are in parentheses.
* The impact of a standard deviation change in the independent variables on the estimated value of monthly housing services (evaluated at the means of the independent variables).
† In thousands. The impact is reported in the next row.
‡ In 1,000 square feet by 1,000 square feet.

authors) that mirror the methodologies of other studies.[10] Together, the results suggest that spurious correlation between tax rates and public services may still be plaguing even the most recent literature, resulting in an underestimation of the extent of tax capitalization.

While the data utilized in this study virtually eliminate spurious correlation between tax rates and public services, it is possible that there remains variation in other dimensions of neighborhood quality that is incidentally correlated with tax rates. To evaluate that possibility, the data were divided into high– and low–tax rate areas. High and low tax rates appeared to be evenly distributed across school districts and neighborhood woodedness. High and low tax rates were also evenly distributed across subdivisions of various sizes and of various distances from the CBD. However, the distance to the CBD is only one measure of a neighborhood's attractiveness. A correlation between property rates and neighborhood quality might have arisen if the construction years of neighborhoods were correlated with their tax rates (as discussed above) and with the attractiveness of their location. We believe that although the first neighborhoods developed tend to be at the best available location, the correlation in our data set between the construction years and the current attractiveness of neighborhoods is not necessarily high. The reason is that the current relative attractiveness of suburban neighborhoods in this part of the Houston metropolitan area depends on their accessibility to major highways. This accessibility has changed drastically with the construction of new highways. Thus, current accessibility is vastly different from the accessibility at the time the neighborhoods in our sample were built.

A correlation between property tax rates and neighborhood quality might also have arisen if both were correlated with other variables. As stated above, MUD tax rates are correlated with the percentage of the area that was built out, the percentage of foreclosures in the subdivision, and the percentage of the MUD tax base that was commercial real estate. To the extent that any of these dimensions of the neighborhood also influences the value of housing services, estimates of the tax coefficients in specifications $2a$ and $2b$ will still be biased by spurious correlation. There are no strong priors, however, regarding the extent or sign of the relationship between the value of housing services and these neighborhood characteristics. For example, it may be an amenity or disamenity for the MUD to be incompletely developed. In general, MUDs were platted into sub-

[10] For example, amenity model estimates produced with these same data and using comparable assumed values for ρ_n indicate higher levels of tax capitalization than are typically found in that literature.

divisions and sections. Those MUDs with low built-out levels generally have several completely built out sections and other sections in which no building has occurred at all. This might be viewed as a negative because the complete developer plan has not been actualized or a positive because the area is left with substantial green belt areas with stands of southern pine. Similarly, all commercial development is isolated within commercial reserves so that they will not create spillover effects associated with nonconforming land uses. Thus, the extent of commercial development may be viewed as a positive consumer convenience or a negative detriment to the overall natural setting of the region.

As a precautionary measure, equation (2) was reestimated with the variables percentage built out, percentage commercial, and foreclosure rate included as arguments in the services portion of the estimating equation (reported as specifications 2*c* and 2*d* in table 2). The coefficients for percentage commercial and foreclosure rate obtained from this specification are negative and significantly different from zero; the coefficients for percentage built out are negative, but only one of them is significantly different from zero. The tax capitalization estimates are slightly higher than the estimates in 2*a* and 2*b* and equal to .639 and .617. While the null hypothesis of full capitalization can still be rejected, these alternative specifications strengthen the original findings of a tax capitalization effect that is higher than estimates found in other recent studies.

These results are contingent, however, on the use of Yinger et al.'s assumption that $\rho_n = .03$. Since the estimated capitalization coefficient in equation (2) is proportional to the assumed value of ρ_n, the use of higher values of ρ_n that have been documented in recent studies will yield greater levels of tax capitalization. For example, Linneman and Voith (1991) estimate a gross of property tax user cost of housing that is substantially higher than that assumed by Yinger et al. Their estimate of ρ_g for similar demographic groups as found in our Houston neighborhoods is approximately 9 percent. This rate corresponds to $\rho_n = .065$ if an overall 2.5 percent property tax rate is fully capitalized. Reestimation of equation (2) with $\rho_n = .065$ indicates a slight overcapitalization, but the estimates are not significantly different from those that would indicate full capitalization.[11]

[11] The slight overcapitalization of the current tax rate may reflect an expectation that a recovery from the slump in the Houston real estate market will be associated with a decrease in effective tax rates. In addition, ρ_n in our study should be somewhat smaller than in Linneman and Voith's study because the houses in our data set are somewhat newer, and thus their maintenance and depreciation rates should be lower than the corresponding rates in Linneman and Voith.

V. Conclusion

A large portion of the more contemporary tax capitalization literature infers a measure of market irrationality in that housing market participants fail to fully discount the purchase price of housing to account for variations in tax liabilities. However, the empirical results described above suggest that this recent literature continues to be plagued by spurious correlation between public services and taxes, a problem that since Oates (1969) has been a focal point of past critiques. We use data with substantial variations in taxes but without corresponding variations in public services and obtain a considerably higher degree of tax capitalization. In fact, using the discount rate estimated by Linneman and Voith (1991) along with our unique data set, we obtain empirical results from which the full capitalization hypothesis implied by both Tiebout (1956) and Ricardian equivalence cannot be rejected. Thus, our results suggest that housing market participants do, in fact, rationally discount properties burdened by higher taxes, implying that only unexpected tax changes can be passed on to new buyers of residential real estate.

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