Estimating Property Tax Capitalization: A Critical Comment

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In recent years a number of studies have appeared, investigating the capitalization of the local property tax.[1] Estimates of the extent of tax capitalization vary widely: Wales and Wiens (1974) found essentially no evidence of capitalization in Vancouver, British Columbia; Church (1974), in a study of California cities, found evidence of substantial overcapitalization. It is not surprising that some differences should be found; as I have pointed out elsewhere (King 1973, chap. 6), the amount of capitalization to be expected will depend upon the visibility and certainty of the tax as seen by the purchasers of property. Since much of the variation observed in property taxes occurs because of assessment errors which may not persist indefinitely, the basis for tax capitalization may be different from the presently observed tax. Since the accuracy and frequency of assessment varies substantially from place to place, capitalization of observed tax payments to the same extent in all jurisdictions is unlikely.

Nevertheless, it should be pointed out that the results of many studies are derived from equations in which the tax effect is misspecified. This misspecification in itself will tend to bias the estimates of tax capitalization, and the direction and magnitude of bias can easily vary from study to study. Continuing interest in the question of capitalization and in the Tiebout model for provision of local public goods makes subsequent studies a certainty; it seems useful therefore to make the misspecification explicit in the hope that it can be avoided. Because Wallace Oates very kindly made his data available to me, it is possible here to compare the results of his well-known study of capitalization and the Tiebout model (1969, 1973) with and without the misspecification. It appears that in his

[1] A partial listing includes Church (1974), Diamond (1975), Edelstein (1974), Heinberg and Oates (1970), Hyman and Pasour (1973a, 1973b), Oates (1969, 1973), Orr (1968), Pollakowski (1973), Wales and Wiens (1974). Some additional studies are described in King (1973).

case the misspecification of the tax effect has created an upward bias of about 40 percent in the estimated extent of tax capitalization.

Estimating Property Values

The very reasonable notion which is the foundation for all these studies is that the price of housing ought to reflect the dwelling's structural features, the location with respect to workplaces and shopping centers, the public services available to residents at that place, and the property tax burden. Adapting this to the data at hand, Oates writes[2]

$$V = f(T, E, Z, M, R, N, Y, P), \text{ where} \qquad (1)$$

$V =$ Median home value by town
$T =$ The effective percentage tax rate
$E =$ Annual current expenditures per pupil
$Z =$ Per capita municipal spending on all functions other than local public schools and debt service
$M =$ The linear distance in miles of the community from Midtown Manhattan
$R =$ Median number of rooms per owner-occupied house
$N =$ Percent of houses built since 1950
$Y =$ Median family income
$P =$ Percent of families in the community with an annual income of less than \$3,000.

It can (and, I believe, should) be objected that this equation is inadequate to represent the very complex bundle known as "housing." All the structural characteristics which should affect value are represented only by the number of rooms and the proxy for the age of the housing stock. Because of data limitations, there is no indication of quality variations nor of any fireplaces, swimming pools, extra bathrooms, or other special features. Variations in neighborhood quality are supposed to be represented by family income, but the interpretation of this variable is most uncertain. The instability in the estimated coefficients under different specifications noted in the exchange between Pollakowski (1973) and Oates (1973) is very likely attributable to the fact that each included variable acts as a proxy for a great many omitted but correlated variables.

Leaving such problems aside for the moment, the primary concern here is the incorrect treatment of the tax effect in equation (1). Whereas the hypothesis suggests capitalization of the tax *burden*, this equation suggests capitalization based upon the tax *rate*. In equation (1) the difference is between tV, which would represent the annual tax payment at an effective

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[2] I use Oates's formulation to facilitate later discussion. Other studies are much the same.

tax rate t on a house of value V, and t alone. The difficulty with this mis-specification is that it causes the estimated reduction in market value in response to a tax change to be independent of the value of the dwelling: the value of an expensive dwelling is reduced exactly as much as the value of an inexpensive dwelling for each unit increase in the property tax *rate*.

Using the estimated coefficients in his 1969 study, Oates calculates tax capitalization to be approximately two-thirds complete, since the value of a "typical" unit ($20,000) is apparently depressed $1,500 instead of the possible $2,260. What this overlooks is simply that, had the calculation been made for other sample values, the implications would be much different. For the highest value dwellings in his sample ($32,000) Oates's results suggest only 40 percent capitalization; for the lowest value ($14,000) they suggest 92 percent capitalization. The same calculations using Oates's revised equation (1973) suggest capitalization rates of 56 and 127 percent, respectively. The difficulty is illustrated in figure 1.

Here, for a given tax rate, the slope of the ray from the origin indicates the extent of tax capitalization. If there is no capitalization, the slope will be 45°; with capitalization, it will be less. The important point is that the proportional reduction in market value will be equal for all property values.[3] The tax effect in Oates's equation is, in contrast, constant for all values. From the figure it is apparent that whatever the true amount of capitalization, the erroneous specification will always suggest too little capitalization for high-value homes and too much for low.

It might be supposed that if indicated capitalization at one extreme is too little and at the other, too much, then a statistic based upon the average dwelling value will be about right. Unfortunately, that is not certain nor even likely. Equation (1) is misspecified, with a resulting systematic bias, and omits many variables clearly relevant to house values, notably quality measures. It is difficult to suggest how the esti-mated coefficients for the tax rate and other variables are affected, but it seems unlikely that the β indicating the downward displacement of the dashed line in figure 1 will be such that an intersection with the true capitalization line occurs directly above the median property value. Even if this accidental coincidence occurs in one study, there is no reason to expect it in others, using different samples and different variables.

Elsewhere I have examined tax capitalization in the New Haven, Connecticut, metropolitan region using an equation with a large number of variables describing the structural and neighborhood characteristics of individual single-family dwellings (King 1973). With the tax burden

[3] The market value of a house providing $B in annual housing services indefinitely, subject to an effective tax on market value at rate t, will be $V = (B/r) - (tV/r)$, where r is the rate of discount. From this it follows immediately that $V/(B/r) = 1/[1 + (t/r)]$. Therefore, for all houses the market value with tax capitalized is a constant proportion of the value in the absence of tax.
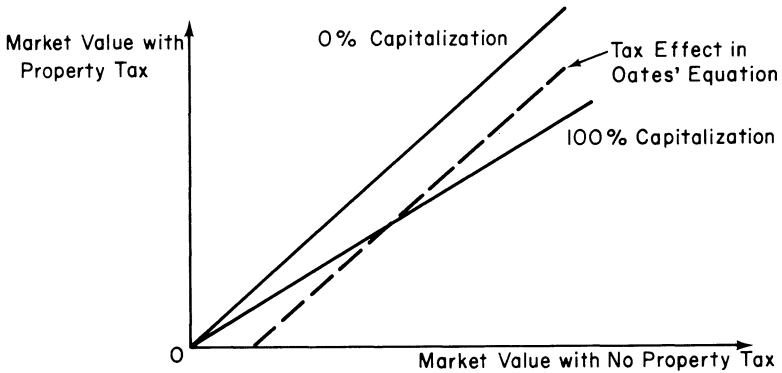
FIG. 1.—Comparison of tax effects for a constant tax rate

correctly specified the analysis suggested that capitalization of tax differentials was unlikely to be more than 30–50 percent complete. For most towns, including those studied by Oates, comparably detailed data do not exist; nevertheless, it seems useful to see what conclusions about tax capitalization might be drawn from an equation using Oates's data with the tax term properly specified.

Accordingly, I have reestimated Oates's TSLS equations from both his 1969 and 1973 papers; the only change I have made is to replace the tax rate for each town by an estimate of the property tax payment for the median value dwelling. This is obtained by applying the tax rate to the median property value.[4] With this derivation the estimated tax payment will be correlated with the error term in equation (1). Like Oates, I treat the tax payment as endogenous and use TSLS to obtain consistent estimates. The resulting estimates are shown in table 1 as equations (Ib) and (IIb). For comparison, Oates's original estimates are shown as (Ia) and (IIa).

The substitution of tax payment for tax rate causes little change in most coefficients; note, in particular, that public expenditure capitalization is about the same. However, the apparent extent of tax capitalization is considerably reduced. From equation (Ia) Oates estimated capitalization to be about two-thirds complete. Assuming, as did Oates, a 5 percent discount rate and a 40-year horizon, one finds capitalization to be about 40 percent complete in equation (Ib).[5] In equations (II) the introduction of a variable describing other municipal expenditures increases the

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[4] Partly because he found it to fit better and partly because of expected nonlinearities, Oates used the natural log of the tax rate. This transformation is not required for the tax payment variable I use.

[5] The present value of a unit stream for 40 years, discounted at 5 percent, is 17.16. The tax effect from equation (Ib) is 6.88. Therefore, 6.88/17.16 = 0.40.

TABLE 1

ALTERNATIVE SPECIFICATIONS OF PROPERTY VALUE EQUATION

Eq.	Constant	Log T	Tax	Log E	Log M	R	N	Y	P	Log Z
Ia	−29 (2.3)	−3.6 (3.1)	...	4.9 (2.1)	−1.3 (4.0)	1.6 (3.6)	.06 (3.9)	1.5 (7.7)	.3 (3.1)	...
Ib	−38 (2.5)	...	−6.9 (2.1)	5.7 (3.7)	−1.5 (3.7)	1.9 (3.2)	.07 (4.3)	1.7 (7.0)	.3 (2.6)	...
Ic	−39 (2.5)	...	−10.8*	5.7 (2.0)	−1.7 (4.6)	2.2 (4.3)	.07 (4.2)	1.8 (7.7)	.4 (3.8)	...
IIa	−35 (2.7)	−5.0 (3.8)	...	4.8 (2.1)	−1.1 (3.4)	1.1 (2.2)	.06 (4.2)	1.4 (7.1)	.2 (2.4)	2.7 (2.2)
IIb	−47 (2.8)	...	−12.0 (2.8)	5.7 (2.0)	−1.5 (3.5)	1.6 (2.4)	.08 (4.5)	1.8 (6.8)	.3 (2.3)	3.2 (1.9)
IIc	−46 (2.9)	...	−11.5*	5.7 (2.0)	−1.5 (3.8)	1.6 (2.5)	.08 (4.7)	1.7 (7.4)	.3 (2.5)	3.1 (2.4)

NOTE.—The variables are defined as in eq. (1). "Tax" is defined as the product of the town tax rate and the median property value. Eqq. (Ia) and (IIa) are from Oates (1969) and (1973), respectively. Eqq. (Ib) and (IIb) are the comparable equations estimated from Oates's data set with "log T" replaced by "Tax." Eqq. (Ic) and (IIc) were obtained by constraining the coefficient on tax and searching for the proportion of full capitalization which would maximize R^2. All eqq. estimated with TSLS; T, Tax, and E are endogenous; t-statistics in parentheses.
* Constrained value (see text).

apparent capitalization in both equations, to "roughly full capitalization" in (IIa) but to only 70 percent ($12.03/$17.16) in (IIb).

Although equations (Ib) and (IIb) specify the tax effect correctly, it can be argued that the tax term and the dependent variable will both be positively correlated with important omitted variables, causing an upward bias in the estimated coefficient.[6] As an alternative to these estimates, I offer (Ic) and (IIc). These are obtained by dropping the tax term from the set of independent variables in equation (1) and redefining the dependent variable as $(V - btV)$, where b is the extent of tax capitalization and is constrained to a value selected from the interval (0.1–1.0). A maximum likelihood estimate of the extent of capitalization can be obtained by varying b over the interval and reestimating, observing changes in R^2. In equation (Ic) the R^2 for this set of independent variables is maximized with capitalization constrained at 63 percent complete. In equation (IIc), containing the additional variable representing all other municipal expenditures, R^2 is maximized with capitalization at 67 percent complete.

[6] This was suggested by Wales and Wiens (1974). The force of the argument is not clear, however. In a very incompletely specified equation like (1), omitted variables are as likely to be negatively correlated with the dependent variable and tax term as positively. Thus, the extent of the bias would be uncertain. In a more fully specified equation such as I have used (1973), it is difficult to suggest significant omitted variables which might create bias.

Equations (IIb) and (IIc) agree very closely, with (IIc) actually imply-
ing slightly less capitalization than (IIb). This suggests that omitted
variables are, if anything, slightly negatively correlated with property
value causing a slight overestimate of capitalization in (IIb). The differ-
ence between (Ib) and (Ic) is much more substantial; that, however, is as
predicted by Wales and Wiens, since Z (other municipal expenditures), a
significant variable positively correlated with property value, was in fact
omitted from (Ib).

Conclusion

Many studies of property values have used a clearly incorrect specification
of the tax effect, one likely to introduce a bias of uncertain direction and
magnitude. In the one case I have been able to examine closely, it appears
that the original estimate of capitalization is about 40 percent too great.
What bias exists in other studies is quite uncertain, and I do not attempt
to imply any general pattern relevant to other studies from the present
empirical results. The principal point here is that the demonstrated
sensitivity of the results in equations (I) and (II) to the specification
choice makes it doubtful that studies using data similar to these and mis-
specifying the tax effect in the same way could yield reliable evidence
about the extent of tax capitalization. Consequently, I believe that our
knowledge of the extent of tax capitalization is very much less than is
commonly supposed.

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