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CAPITALIZATION OF RESIDENTIAL PROPERTY TAXES: AN EMPIRICAL STUDY

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Introduction and Methodology

THE assumption that taxes are capitalized plays a central role in public finance theory. It would seem that the taxation of residential property offers a good opportunity to test this assumption empirically. One need simply investigate whether or not, after holding constant housing and land characteristics, a house with higher taxes sells for a lower price. Indeed there have been many attempts in the literature to estimate the extent to which residential property taxes are capitalized.[1] Many of these studies have focused on differences in tax rates existing in neighbouring communities, and have attempted to determine whether in such a setting property values are inversely related to tax rates. The major difficulty with this approach, in which tax rates in different communities are compared, is that government expenditures may also differ from one location to another and may also be capitalized in property values. It is therefore necessary to hypothesize that property values depend on both taxes and expenditures, in which case the relationship comes close to being an identity, with average property values related to average tax rates and average levels of government expenditures.[2] It is not surprising that tax rates are found in these cases to be negatively, and government expenditures positively, related to property values. However, it is not clear (two-stage least squares notwithstanding) how much of these effects can be attributed to capitalization and how much is due to the tautological nature of the problem.

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[1] See Netzer (1966) for a summary of the earlier studies and Daicoff (1967), King (1972), Oates (1969) and Smith (1966) for more recent results.

[2] The same problem, of course, arises in the case of time-series studies.

In this paper we focus on individual residential property values in one municipality only, and thus avoid the major problem discussed above since the level of general government services is the same for all property owners.[3, 4] Further, restriction to one locale does not imply that effective tax rates will be the same on all houses even though the mill rate is, of course, the same. As is the case in most cities there are wide variations in the ratio of assessed value to market value for residential properties, (even within homogeneous housing categories) thus resulting in differences in taxes paid for basically identical housing units.[5, 6] Consequently, we hypothesize a relationship of the form

$$V = XB_1 + T\gamma_1 + \mu_1 \qquad (1)$$

where V is the market value of an improved property, X is a set of house, land and location characteristics describing the property, B_1 is a vector of parameters to be estimated, T is total taxes paid, γ_1 is a parameter to be estimated that reflects the extent of tax capitalization, and μ_1 is a random disturbance with the usual properties. The interpretation of equation (1) is that holding the set of characteristics X constant, the consumer will reduce the price he is willing to pay for the house by γ_1 for every dollar increase in taxes.[7] That is, for two houses

[3] This is not strictly true due to the existence of local taxes used to provide local benefits. One could argue that both local taxes and benefits can be ignored since these effects are very specific, should be obvious to the buyer, and hence should cancel. However, this is not appropriate if local benefits have been paid for in the past yet still exist. In any event since the results presented below are not sensitive to whether or not local taxes are included, we do not pursue the point further here.

[4] Although in some cities the quality of public services may differ by income-class of neighborhood, this is clearly not a problem for the particular municipality studied here.

[5] For example, White and Hamilton (1972) found for a sample of single family houses sold in 1971 that in 7 of 9 Greater Vancouver municipalities, the highest assessment to sales ratio exceeded four times the lowest.

[6] In addition, annual individual assessment increases have been restricted to 10% beginning in 1971, thus reducing the speed with which any recognized underassessments can be corrected.

[7] This is similar to the method used by King (1972).

with the same characteristics X, the consumer will pay less for the one with higher taxes. The difficulty with this approach lies in the stochastic aspect of equation (1), and in particular in the likelihood that omitted variables will exist and be positively correlated with both V and T, thus biasing γ_1 upward. For example, any housing or land characteristic that is not included in X due to the unavailability of data, but that adds to the assessed and market value of the property, may be reflected in T (mill rate times assessed value) thus resulting in an under-estimate of the extent of capitalization, and indeed if important variables are omitted the estimate of γ_1 may even be positive.[8]

Since the difficulty with the above approach lies in the omitted variables that are correlated with both T and V it would seem reasonable to proceed by considering T/V as the tax variable rather than T. This has an additional appeal in that T/V is the effective tax rate and hence has a straightforward interpretation. Therefore we hypothesize an equation of the form

$$V = XB_2 + (T/V)\,\gamma_2 + \mu_2 \qquad (2)$$

where the notation is analogous to that in equation (1).[9] Although in this form the major effects of omitted variables on T and V will probably cancel, a new problem is introduced. The inclusion of V on the right-hand side will, of course, bias the estimate of γ_2 and this bias will likely be downward, provided some of the stochastic variation is due to factors other than omitted variables.[10] For example, suppose that differences in tastes result in different V values for a fixed set of X characteristics, then, even if taxes have no effect on prices, the estimate of γ_2 will be negative and may well be significant.

The difficulty with the preceding method lies in our inability to separate the capitalization effect from the bias arising due to including V on the right-hand side. This suggests the following procedure which attempts to provide an estimate of the bias.[11] We first estimate equation (2) without the tax term

$$V = XB_3 + \mu_3 \qquad (3)$$

to obtain estimates B'_3 and σ' of B_3 and of the standard error of the equation (σ). We then construct a new series (V') as follows

$$V' = XB'_3 + \mu_4 \qquad (4)$$

where μ_4 is generated from a normal distribution with mean 0 and standard deviation σ'. Finally we estimate B_5 and γ_5 in an equation of the form

$$V' = XB_5 + (T/V')\,\gamma_5 + \mu_5. \qquad (5)$$

Under the null hypothesis of no capitalization, equations (2) and (5) will be based on the same underlying population and hence should yield estimated coefficients that are not significantly different from one another.[12] The estimate of γ_5 in equation (5) can be interpreted as the bias that results from including V' on the right-hand side. That is, γ_5 cannot be reflecting any capitalization effects since V' was generated independently of any tax effects, conditional only on X, B'_3 and σ'. Unfortunately, this result holds only under the null hypothesis, since if the null is not true then, for example, the variances of T/V' and of T/V will differ and will produce different biases in equations (2) and (5), in which case γ_5 is not an appropriate estimate of the bias in equation (2). This means that we can test only the null hypothesis of no capitalization. Nevertheless, if the null is rejected it seems reasonable to assume that our estimate of $\gamma_2 - \gamma_5$ is a better measure of the capitalization effect than γ_2. That is, we conjecture that the error introduced by the fact that the biases differ in equations (2) and (5) is probably

However, the tax variable used in the latter is the difference between the mill rate in a particular area and the lowest mill rate in all the areas, times assessed value. It is not clear to us why this particular definition is chosen.

[8] For example, King (1972) finds the tax coefficient to be positive when tax levels are used as an explanatory variable.

[9] As discussed below this particular functional form of the equation is not estimated since we would expect changes in the effective tax rate to change V by different absolute amounts depending on the level of V. In the estimations we use logarithms of variables rather than absolute levels.

[10] This bias would exist, but perhaps to a lesser extent, in studies involving different effective tax rates across communities, such as in Oates (1969).

[11] We have decided against an instrumental variables approach for two reasons. First, there do not appear to be any suitable variables to be used as instruments, and second, since we are assuming in (2) that V is a linear function of the X's it does not seem appropriate at the instrument stage to assume that T/V is a linear function of the X's (and other variables).

[12] Of course, one has more faith in this method if the sample size is larger. The results reported below are for sample sizes of about 1000, and do not appear to be sensitive to the generated normal series μ_4.

minor compared with the errors introduced in estimating the capitalization effect through either equations (1) or (2) directly.

Data and Results

The sample consists of information on approximately 1800 sales of improved residential property in 1972 for the municipality of Surrey.[13, 14] For each piece of property, data are available on the following housing characteristics: floor space, number of bedrooms, basement (6 categories), age, cash or noncash sale, pool, other buildings, carport, current replacement cost and per cent of house finished. In addition, data are available on the following land and location variables: lot size, corner lot, Port Mann location, Whiterock location, view lot and frontage rate. Only a few require comment — the frontage rate is an estimate by assessors of the average per foot value of property on the street. It is based on past sales and can be thought of as a measure of quality of the neighbourhood. Current new replacement cost is an estimate by assessors of the cost of replacing the house in current dollars. The Whiterock location variable represents land located near the ocean, while the Port Mann variable represents areas near one of the major freeways into Vancouver.

We have attempted to reach conclusions about the extent of tax capitalization by estimating equations of the form of (1), (2) and (5).[15] The results are summarized in table 1 for two classifications of houses.[16, 17] For the first class the coefficient of the tax variable is positive and almost significant in (A) and negative and highly significant in (B). Accepted at face value the former result suggests not only that there is no capitalization, but indeed that increased taxes, *ceteris paribus* result in increased house prices. The second result, on the other hand, indicates a significant capitalization effect, with a one percentage point increase in the effective tax rate reducing property values by about 5%. Of course, these results are not surprising in view of the discussion given above and the fact that about one-half of the variation in prices remains unexplained in the regressions, suggesting important omitted variables and/or substantial taste differences among consumers.[18] Consequently, neither equation can be relied on to provide accurate estimates of tax capitalization effects. Equation (C) differs from (B) in that the dependent variable has been replaced by an estimate of $\log V$ $(\log V)'$ and T/V by T/V' according to the method outlined above in equations (3)–(5). Again the coefficient of the tax variable is negative and highly significant, but by construction of the variables this is due to the spurious correlation alone, and not to any capitalization effect. Hence in order to test whether there is any capitalization effect we use the usual F-test to determine whether the coefficients of the tax variables in equations (B) and (C) differ significantly.[19] We do this by estimating an equation using all observations on $\log V$ and $(\log V)'$ and including two

[13] In order to reduce the heterogeneity of the sample, we consider here only property classified as "frontage," thus deleting "acreage" property. In addition, houses with more than one storey (of which there are relatively few) have been omitted because information on square feet of house space is not available for them.

[14] Surrey is a municipality in the Greater Vancouver area with a population of approximately 100,000.

[15] As mentioned above, the linear form is not suitable for equations (2) and (5) nor is it appropriate to include seasonal intercept dummies in such an equation since this requires all house prices to change by the same absolute amount from one quarter to the next. Consequently we have used logarithms except for the zero-one dummies, which restricts percentage differences in value to be the same for any dummy variable, and restricts elasticities of V with respect to other variables to be constant. In order to facilitate a comparison of results, all equations including (1) were estimated in this form.

[16] Houses in the first class are generally newer and of higher quality than those in the second class hence this breakdown helps to control for quality differences. A beneficial side effect is that problems of heteroscedasticity may be reduced because of the use of $\log V$ rather than V as the dependent variable. King (1972) for example, found heteroscedastic errors to be a problem when using V as the dependent variable.

[17] The full set of results is available from the authors on request.

[18] This suggests that there would be less bias in the capitalization effects if we could explain more of the variance of the dependent variable. However, this is not of much help unless the estimates provided by the two methods are very close.

[19] The F-test is not strictly appropriate even under the null hypothesis of no capitalization because of the presence of V on the right-hand side of the equations. However, this may not be serious since if the null does not hold, it seems unlikely that the biases in the two equations would be such as to lead us to accept it. To our knowledge the appropriate test statistics for this problem have not been worked out in the literature, and are beyond the scope of this paper.

tax variables on the right-hand side, one defined as T/V or T/V' according to whether the observations are from generated or actual data, and the other defined as T/V if from actual data and zero otherwise. Under the null hypothesis the coefficient of the latter variable will not differ significantly from zero since it represents the existence of an effect of taxes on value over and above that introduced by the spurious correlation. As reported in equation (D) this coefficient is not significantly different from zero, hence the null hypothesis of no tax capitalization cannot be rejected.[20, 21] We have followed this procedure several times using different normal error terms to generate $(\log V)'$ and have obtained virtually identical results.

The conclusion of no tax capitalization is the same for the second class of houses as for the first, with the test coefficient in equation (D) not significantly different from zero. There is a substantial difference between the two sets of results, however, in the size of the effective tax rate coefficient, in equations (B), (C) and (D). The explanation lies in the fact that, although the mean value of houses is much lower in the second class ($20,000) than the first ($27,000), the standard error of the equation that is used to generate the normal disturbances and hence the $(\log V)'$ values is higher for the second class than for the first. This results in a larger bias in the effective tax rate coefficient for the second class of house.

TABLE 1. — ESTIMATED TAX COEFFICIENTS FOR VARIOUS EQUATIONS

House Class I	Equation			
Variable	A	B	C	D
Log Tax	.011 (1.9)			
Tax/V		−.055 (8.0)		−.055 (10.8)
Tax/V'			−.057 (8.3)	
(Tax/V) · d				−.0026 (.8)
Dependent	$\log V$	$\log V$	$(\log V)'$	$\log V$ & $(\log V)'$
R^2	.55	.53	.51	.52
N	914	914	914	1828
House Class II	**Equation**			
Variable	A	B	C	D
Log Tax	.048 (2.4)			
Tax/V		−.161 (19.0)		−.178 (−26.4)
Tax/V'			−.199 (20.0)	
(Tax/V) · d				.0002 (.1)
Dependent	$\log V$	$\log V$	$(\log V)'$	$\log V$ & $(\log V)'$
R^2	.49	.63	.67	.65
N	902	902	902	1804

Notes: $d = 1$ if actual observation, and 0 if generated observation. Numbers in parentheses are parameter to standard error ratios. The other variables included in equations A-D are those listed in the text as well as dummies indicating the quarter of the year in which the sale occurred. The estimated equations are available from the authors on request.

The finding of no tax capitalization is at odds with the usual assumption made in public finance, and it is interesting to consider some possible reasons. The most obvious is that buyers either do not shop around enough to establish that there are differences or do not recognize housing values when encountered. The latter seems quite likely since it is indeed difficult for the individual to determine how much more he should pay for a house that differs from another only in terms of a lower tax bill, with the calculation presumably involving his discount rate and a comparison of expected time periods of holding the houses, expected resale values and expected future tax payments for the two houses.

Nevertheless, even if all future years are ignored it would seem likely that buyers would pay more if only for the advantage of a lower tax payment in the current year.[22] One con-

[20] The same conclusion holds under different assumptions about the exact definition of taxes — in particular whether or not local taxes and/or the homeowner's grant are subtracted from gross taxes. The homeowner's grant of $180.00 per year (in 1972) can be applied by the resident owner of a property against the taxes on that property.

[21] The same result is obtained when testing whether equations (B) and (C) differ significantly from one another as a whole.

[22] This assumes that the buyer does not expect tax assessments to be unusually high in the future as an attempt by the authorities to offset low assessments in the past.

ceivable explanation is that buyers do not trust their own judgement on a house in the face of what appears to be an abnormally low tax assessment. They might assume that they had misjudged the house and consequently might be unwilling to pay anything more for the benefit of lower taxes. Alternatively it might be argued that capitalization effects based on one year only would be of such a small order of magnitude as to make their influence difficult to estimate.

Conclusion

Most previous studies of property tax capitalization suffer from two drawbacks. First since differences in government expenditure as well as taxes may cause property values to differ, it is necessary to hypothesize that values depend on both factors, thus making their effects hard to isolate. Second, a spurious correlation which works in favour of accepting the capitalization hypothesis, is introduced when the effective tax rate is used as the explanatory tax variable because the dependent variable appears in the denominator of the effective tax rate. On the other hand, if the tax level (rather than the rate) is used as the explanatory variable, then it is very likely that there will be a bias toward rejecting the capitalization hypothesis due to the presence of omitted variables that are positively correlated with both the tax level and the house value.

In this paper we avoid the first problem by considering sales of houses in a single municipality, with variations in taxes arising due to variations in assessments for basically identical houses. We attempt to avoid the second problem through a technique that enables us to estimate the bias on the effective tax rate coefficient, and hence isolate the capitalization effect.

Following this procedure, we test two classes of houses using various definitions for the tax variable, and in no case can we reject the null hypothesis of no capitalization. On the other hand, without the correction for spurious correlation the apparent capitalization effect is highly significant and substantial.

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