

Maximization of Non-Residential Property Tax Revenue by a Local Government

John F. McDonald
Center for Urban Real Estate
College of Business Administration
University of Illinois at Chicago

Great Cities Institute Publication Number: GCP-07-06

A Great Cities Institute Working Paper

February 2007



UIC



The Great Cities Institute

The Great Cities Institute is an interdisciplinary, applied urban research unit within the College of Urban Planning and Public Affairs at the University of Illinois at Chicago (UIC). Its mission is to create, disseminate, and apply interdisciplinary knowledge on urban areas. Faculty from UIC and elsewhere work collaboratively on urban issues through interdisciplinary research, outreach and education projects.

About the Author

John F. McDonald is Professor Emeritus of Economics and Director, Center for Urban Real Estate at the University of Illinois at Chicago. He may be reached at mcdonald@uic.edu.

Great Cities Institute Publication Number: GCP-07-06

The views expressed in this report represent those of the author(s) and not necessarily those of the Great Cities Institute or the University of Illinois at Chicago. This is a working paper that represents research in progress. Inclusion here does not preclude final preparation for publication elsewhere.

Great Cities Institute (MC 107)
College of Urban Planning and Public Affairs
University of Illinois at Chicago
412 S. Peoria Street, Suite 400
Chicago IL 60607-7067
Phone: 312-996-8700
Fax: 312-996-8933
<http://www.uic.edu/cuppa/gci>

Maximization of Non-Residential Property Tax Revenue by a Local Government

Abstract

The paper presents a model of the market for commercial or industrial real estate at the local level that is used to derive an equation for the property tax rate that maximizes tax revenue – given that demand for real estate at the local level is highly elastic and capital is mobile in the long run.

Keywords: Property tax; Commercial real estate
JEL classification: H71, R33, R51.

I. Introduction

Suppose that a local government has the power to set property tax rates for non-residential (commercial and industrial) property that are different from the tax rate on residential property. Most local governments do not have the power to establish different property tax rates for residential and non-residential property, but a few operate under a classification system that permits different property tax rates for different types of property. Both Arizona and Illinois have state laws that permit certain counties to establish classification systems, and Pima County in Arizona and Cook County in Illinois have done so. Beck (1983) and Wilson (1985) were among the first to model optimal property taxation in this situation, and found that the optimal tax rate is lower on property used to produce traded goods compared to the tax rate applied to housing. The purpose of this paper is to use a model of the market for commercial or industrial real estate in a local jurisdiction to solve for the property tax rate that maximizes tax revenue. The model produces a generalization of the standard result in local public finance that the change in tax collections Rev with respect to changes in the tax rate t equals the tax base B times one plus the elasticity ϵ of the tax base with respect to the tax rate; $dRev/dt = B(1+\epsilon)$.

The model pertains specifically to non-residential property. The local jurisdiction must set the property tax rate on commercial and industrial property while mindful that the demand for the services of such property may be highly elastic and the supply of structure capital may also be highly elastic in the long run. The basic result of the model is that the long-run revenue-maximizing property tax rate is equal to the capitalization rate for the type of real estate in question divided by its supply elasticity in that jurisdiction. Furthermore, the supply elasticity of commercial or industrial real estate depends crucially upon the elasticity of supply of land for that use, an elasticity that is under the control of the local jurisdiction through its land-use zoning power.

This paper is related to the extensive literature on tax competition among local governments. Tax competition was suggested by Oates (1972) and modeled formally by Beck (1983), Wilson (1985, 1986), Zodrow and Mieszkowski (1986), and many others. See Wilson (1999) for a survey of this literature and Wilson (2005) for a recent

contribution. In these models local governments maximize the utility of the representative resident under the condition that the property tax on mobile capital employed in the production of traded goods must be used to finance a portion of the local public good. Assumptions used in these models vary; the local public good may or may not be included in the production function for industrial output, land may or may not be included, residents may or not be mobile, and so on. When land is included, it is assumed to be fixed in supply. The model in this paper assumes that variations in the property tax rate on commercial and industrial property do not lead to *changes* in the amount of local public goods supplied as inputs into production, and that the supply of land for commercial and industrial use varies (and is controlled by local government). Maximization of tax revenue from this source can be justified on the grounds that more tax revenue itself can be a worthwhile goal, and the goal is operational.¹

II. The Model

The model pertains to the market for commercial and industrial real estate in small area such as a municipality that is part of a larger metropolitan area. Perfect competition prevails in input and output markets. Real estate is an input into commercial and industrial production processes, and is a function of stocks of land L and structure capital C . The real estate input is assumed to be weakly separable from other inputs such as labor and equipment. The model considers real estate firms that produce and sell an output called real estate Q . All actual or potential real estate developers of a site have the identical constant elasticity of substitution (CES) production functions with constant returns to scale, $Q = Q(L, C)$.

The inverse demand function for commercial or industrial real estate in a municipality is $R = DQ^{1/e}$, where R is annual (net) rent paid per unit of Q , $e < 0$ is the elasticity of demand, and changes in D shift the demand curve. The demand elasticity faced by a small municipality in a large urban area is likely to be large. The real estate

¹ Most authors in this literature pursue the goal of maximizing the welfare of the representative resident, while Brueckner (1983) advocated the maximization of total property value in the jurisdiction and Sonstelie and Portney (1978) and Wooders (1978) studied the profit-maximizing local government.

development industry supplies commercial and industrial real estate in the municipality based on its market value according to the inverse supply function $V = AQ^{1/b}$, where V is the market price of a unit of Q , b is the elasticity of supply, and changes in A shift the supply curve. The elasticity of supply of commercial and industrial real estate depends upon the elasticity of supply of the inputs land and structure capital and upon the elasticity of substitution of capital for land. In the very long run the supply of structure capital is very large (perhaps infinitely large). The elasticity of supply of land for a particular use depends upon the value of land in other uses as well as the propensity of the municipality to permit commercial and industrial use through zoning. A critical question is whether zoning for commercial and industrial use follows market demand. The elasticity of supply of land for commercial and industrial use is likely to be an important factor determining the supply elasticity b .

The final element in the model is the link between net rent R and market value V . The market value of a unit of real estate (one unit of Q) is

$$V = (R - tV)(1-T)K. \quad (1)$$

The local property tax rate is t , T is the federal income tax rate, and K is the present value of an annuity factor (which in the case of infinite life equals $1/r$, where r is the after-tax risk-adjusted rate of return. The solution for V is

$$V = R/[t + (1/(1-T)K)]. \quad (2)$$

Denote $(1/(1-T)K) = r^*$ as the before federal income tax capitalization factor, so $V = R/(r^*+t)$.

The solution of the model for $\ln Q$ is

$$\ln Q = [eb/(b-e)][\ln A - \ln D + \ln(r^*+t)], \quad (3)$$

and the solution for $\ln V$ is

$$\ln V = [b/(b-e)]\ln A - [e/(b-e)][\ln D - \ln(r^*+t)]. \quad (4)$$

The natural log of the total market value of property VQ is

$$\ln VQ = [b(e+1)/(b-e)]\ln A - [e(b+1)/(b-e)][\ln D - \ln(r^*+t)]. \quad (5)$$

Maximization of $\ln(tVQ)$ with respect to the property tax rate t produces

$$\partial \ln(tVQ)/\partial t = (1/t) + [e(b+1)/(b-e)][1/(r^*+t)] = 0, \quad (6)$$

which yields a solution for t of

$$t_{max} = r^*(e-b)/(eb+b). \quad 2 \quad (7)$$

If the demand for commercial or industrial real estate is of infinite elasticity, the revenue-maximizing property tax rate reduces to

$$t_{max} = r^*/b. \quad (8)$$

This is the before federal tax capitalization rate divided by the elasticity of supply of commercial or industrial real estate. For example, if this capitalization rate is 0.12 and the elasticity of supply is 4.0, then the revenue-maximizing local property tax rate is 0.03; i.e., 3 percent of market value per year.³

Recall that the supply elasticity for commercial or industrial real estate in the long run depends upon the elasticity of supply of land for these uses. As Muth (1964) showed, the supply elasticity is

$$b = [\sigma(S_L e_L + S_C e_C) + e_L e_C] / (\sigma + S_C e_L + S_L e_C), \quad (9)$$

where σ is the elasticity of substitution of capital for land in the production of real estate, S_L (S_C) is the share of land (capital) in the value of real estate, and e_L (e_C) is the elasticity of supply of land (structure capital) that pertains to the local municipality. In the short run the supply elasticities of both land and structure capital are zero, but in the very long run the supply elasticity of structure capital to a small municipality is very large – perhaps infinite. With infinite supply elasticity of structure capital, the elasticity of supply of real estate reduces to

$$b = (\sigma S_C + e_L) / S_L. \quad (10)$$

The share of land in real estate is approximately 0.15 to 0.25 (with the share of structure capital of 0.85 to 0.75). There are few empirical estimates of the elasticity of substitution of capital for land in commercial or industrial real estate. The elasticity

2 The second-order condition is that $1/t^2$ (a very large number on the order of 1000) is greater than $[-e(b+1)]/(b-e)(r^*+t)^2$, a condition that holds for reasonable parameter values. The result in equation (6) is an elaboration of the standard result that the change in revenue collected Rev with respect to a change in the tax rate t is $dRev/dt = B(1+C)$, where B is the tax base and C is the elasticity of the tax base with respect to the tax rate. Write $\ln Rev = \ln t + \ln B$, and note that $d \ln Rev / dt = (1/t)(1+C)$. Since $B = Rev/t$, the logarithmic version can be converted into the standard result.

3 A result very similar to equation (7) holds for a sales tax. In a basic model of demand and supply, the sales tax that maximizes revenue is $(e-b)/(eb+b)$.

would appear to vary by sector; higher for office buildings and lower for retail and industrial property. Empirical estimates for the office sector by Clapp (1979, 1980) and McDonald (1981) indicate an elasticity of substitution of 1.0 to 1.2. Empirical results by Fallis (1979) and McDonald (1981) provide a value of σ the manufacturing sector of 0.70 to 0.77, and McDonald (1981) reported a range of values of σ for retailing and wholesaling of 0.28 to 0.50. Assuming that the share of land is 0.20 (and the share of structure capital is 0.80), then the elasticity of supply of real estate in the very long run is

$$b = 4\sigma + 5e_L. \quad (11)$$

For example, if $\sigma = 0.75$, then $b = 3 + 5e_L$ and $t_{max} = r^*/(3+5e_L)$. The revenue-maximizing property tax rate depends inversely upon the elasticity of supply of land for commercial or industrial use. The greater is the willingness of the municipality to provide land for commercial or industrial use, the lower will be the revenue-maximizing property tax rate.

III. Conclusion

The paper has derived an equation for the revenue-maximizing local property tax rate on commercial or industrial property. The formula can be used to estimate the revenue-maximizing tax rate so that a comparison can be made with the actual tax rate. For example, McDonald and Yurova (2006) report a property tax rate of 4.36 percent on industrial property in Cook County, Illinois in 2004.⁴ Dye, McGuire, and Merriman (2001) reported average tax rates of 5.52 percent on commercial property and 5.78 percent on industrial property in Cook County for 1990, compared to 2.54 percent on average for both types of property in the neighboring counties. The classification system in Cook County is used to impose a higher property tax rate on commercial and industrial property than on residential property. The basic result in this paper is that $t_{max} = r^*/b$ if the demand for industrial real estate is perfectly elastic. If capital is perfectly

⁴ Empirical results obtained by McDonald and Yurova (2006) show that the property tax differential between Cook County and its neighbor DuPage County of 2.6 percent (4.37 – 1.67) was fully capitalized into property values. The hypothesis of perfectly elastic demand for industrial real estate could not be rejected in the data on industrial properties from these two counties.

mobile, then $t_{max} = r^*/(3+5e_L)$. Even if Cook County is fully developed (which it is not) and is unwilling to provide more land for industrial use (which it certainly is not), the property tax rate implied is not greater than $r^*/3$. If the elasticity of supply of land is a modest 0.2, then the implied property tax rate is not greater than $r^*/4$. Real Estate Research Corporation (2005) reported that capitalization rates for industrial real estate were around 9 percent from 1995 to 2003, and then fell to about 8 percent in 2004, which suggests a long-run revenue-maximizing tax rate of about 3 percent to 2.67 percent at most. It would appear that the imposition of such a high property tax rate on industrial property is not in the long-run interests of Cook County.

References

- [1] Beck, J (1983) Tax competition, uniform assessment, and the benefit principle, *Journal of Urban Economics*, 13, pp. 127-46.
- [2] Brueckner, J (1983) Property value maximization and public sector efficiency, *Journal of Urban Economics*, 14, pp. 1-15.
- [3] Clapp, J (1979) The substitution of land for other inputs, *Journal of Urban Economics*, 6, pp. 122-34.
- [4] Clapp, J (1980) Production with land and nonland factors, *Journal of Urban Economics*, 8, pp. 32-46.
- [5] Dye, R, McGuire, T and Merriman, D (2001) The impact of property taxes and property tax classification on business activity in the Chicago metropolitan area, *Journal of Regional Science*, 41, pp. 757-78.
- [6] Fallis, G (1979) Factor substitution, employment density, and suburbanization, *Journal of Urban Economics*, 6, pp. 156-73.
- [7] McDonald, J (1981) The substitution of land for other inputs in urban areas, *Papers, Regional Science Association*, 47, pp. 190-211.
- [8] McDonald, J and Yurova, Y (2006) Are property taxes capitalized in the selling price of industrial real estate? *Appraisal Journal*, 74 (in press).
- [9] Muth, R (1964) The derived demand for a productive factor and the industry supply curve, *Oxford Economic Papers, New Series*, 16, pp. 221-34.
- [10] Oates, W (1972) *Fiscal Federalism*. New York: Harcourt Brace Jovanovich.
- [11] Real Estate Research Corporation, 2005 *RERC Real Estate Report*, Chicago: Real Estate Research Corporation.
- [12] Sonstelie, J and Portney, P (1978) Profit-maximizing communities and the theory of local public Expenditure, *Journal of Urban Economics*, 5, pp. 263-77.
- [13] Wilson, J (1985) Optimal property taxation in the presence of interregional capital mobility, *Journal of Urban Economics*, 18, pp. 73-89.
- [14] Wilson, J (1986) A theory of interregional tax competition, *Journal of Urban Economics*, 19, pp. 296-315.
- [15] Wilson, J (2005) Welfare-improving competition for mobile capital, *Journal of Urban Economics*, 57, pp. 1-18.
- [16] Wooders, M (1978) Equilibria, the core, and jurisdiction structures in economies with a local public good, *Journal of Economic Theory*, 18, pp. 328-48.
- [17] Zodrow, G and Mieszkowski, P (1986) Pigou, Tiebout, property taxation, and the underprovision of local public goods, *Journal of Urban Economics*, 19, pp. 356-70.