The Revenue Potential of a Site Value Tax:

Extension and Update of a General Equilibrium Model With Recent Empirical Estimates of Several Key Parameters

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ABSTRACT. Although appealing on the consideration of efficiency, the site *(land) value tax* has been dismissed by some economists as an unviable alternative to the local real estate tax on the ground that it cannot generate sufficient revenue. From earlier work based on a general *equilibrium* model, however, a switch from a *real estate* to an equal yield *site value tax* could result in an increase in equilibrium *land prices* (and hence the site value tax base). In particular, equilibrium land prices will rise with a site value relative to a real estate tax if: $\left(\frac{L + K}{L}\right) > \frac{e_x \cdot (f_L + f_K)}{f_k \cdot s_x + e_x \cdot f_L}$. Critical to that theoretical result are the magnitudes of several parameters including the percent *land* constitutes of total *real estate value,* $\left(\frac{L + K}{L}\right)$, the elasticity of substitution, s_x, the elasticity of demand for real estate e_x, and the output elasticities, f_k and f_L. Based on recent empirical estimates of those parameters, the above stated condition holds.

I

INTRODUCTION

IN AN EARLIER PAPER, Grosskopf and Johnson discussed the methodology and measurement of the revenue potential of a site value tax (1). It is a commonly held notion that a land value tax (while appealing on efficiency grounds), is an impractical alternative to the current local real estate tax because its revenue potential is too low. In the earlier paper it is shown that that belief may indeed be false. As evidence, the authors looked at the two tax systems in a partial and

*[Shawna Grosskopf, Ph.D., is assistant professor of economics, Southern Illinois University, Carbondale, Ill. 62901.] This paper reports on further research on the revenue potential of a site value tax. For a report on our earlier study, see Shawna P. Grosskopf and Marvin B. Johnson, "Land Value Tax Revenue Potentials: Methodology and Measurement," in Richard W. Lindholm and Arthur D. Lynn Jr., eds., *Land Value Taxation: The 'Progress and Poverty' Centenary* (Madison, Wis.: Univ. of Wisconsin Press, 1980), pp. 57–91. (The latter paper is based on one we presented at a symposium of the Committee on Taxation, Resources and Economic Development, funded by the John C. Lincoln Foundation, Cambridge, Mass., and held on the campus of the Lincoln Institute, Cambridge, in September, 1978.)

American Journal of Economics and Sociology, Vol. 40, No. 2 (April, 1981).
0002-9246/81/020207-09$00.75/0

in a general equilibrium framework and found evidence which indicated that the potential size of a site value tax depends on several key parameters.

It is the purpose of this paper to extend that general equilibrium model and present some relatively recent empirical estimates of the parameters of the model to update the original results. For a discussion of the basic issues and previous work in this area as well as the derivation of the partial and general equilibrium models, the reader is referred to the original paper.

It should be noted that the property tax considered here should be defined as the urban property tax since I am excluding the cost of agricultural land and land in transition areas on the rural urban fringe. Also, the property tax I am considering is restricted to funds used by local governments to finance general functions. Thus, the revenue of a site value tax is not assumed to be a substitute for all sources of local government revenue.

In the earlier paper it was argued that previous research efforts were based on the misleading assumption that substituting a site value tax for a real estate tax at the local level will not change equilibrium prices of land (or gross ground rents). Clearly, a switch to a land tax would be a change to which the economy would adjust, eventually reaching a new set of equilibrium prices for land and capital. If land prices fall as a result of a switch to site value taxation, then the tax base falls; if land prices rise as a result of untaxing buildings, the new tax base is larger—which would imply that the revenue potential of a site value tax is larger than expected in the partial equilibrium framework where the price of land does not change. Clearly, the general equilibrium framework is the appropriate tool of analysis.

In the original paper, a modified version of the Harberger (1962) model (2) was used to trace the effects of a change from a real estate tax to a land value tax. Several simplifying assumptions were made, some of which will be relaxed here to generalize the model. The basic methodology is, however, retained and presented below. Empirical estimates of the important parameters are presented after the model.

II

THE GENERAL EQUILIBRIUM MODEL

TO APPROXIMATE the change from a real estate tax to a site value tax, two equilibrium models were constructed, both of which were originally without taxes. Then the changes from a world without taxes to: 1) a world with a real estate tax, and 2) a world with a site value tax, were derived and compared. By holding tax yields constant, one can compare land prices in the two taxed worlds and determine whether land values would fall or increase if buildings were untaxed, holding property tax revenue constant (*i.e.,* simulating the change from current real estate tax to an equal yield site value tax).

The specification of the model was relatively simple and is reproduced here. Assume that there are two goods, X and Y, produced competitively via homogeneous production functions with two factors, land (L) and capital (K). In addition, assume:

A.1. $dL = 0$, land is fixed (immobile),

A.2. $dK_x = -dK_y$, capital is mobile between sectors but fixed in the aggregate,

A.3. $dP_K = 0$, capital is numeraire,

A.4. $P_x, P_y, P_K, P_L = 1$, all initial prices are set at unity,

A.5. $e_{xy} = 0$, the cross price elasticity of demand for X and Y is zero (3). Based on the Harberger model, we specify the following system of equations to describe the change in an economy moving from a no-tax situation to a real estate tax:

1] $$dX/X = -e_x \cdot (dP_x/P_x)$$ (relative demand for good X)

Where e_x refers to the own price elasticity of demand.

2] $$dX/X = f_K \cdot (dK_x/K_x) + f_L \cdot (dL_x/L_x)$$ (production function for X),

which is derived by totally differentiating the linearly homogeneous production function for X, where the f_K and f_L are output elasticities.

3] $$dK_x/K_x - dL_x/L_x = -s_x \cdot (dT_K - dP_L - dT_L)$$ (elasticity of substitution),

where s_x is the elasticity of substitution and dT_L, dT_K are the tax rates imposed on property of the two types.

4] $$dP_x = f_L \cdot (dP_L + dT_L) + f_K + (dP_K + dT_K)$$ (relation between factor and product prices).

Equations 1–4 represent the economy under the representation of a change to the current real estate tax. Assuming that the real estate tax is a uniform national tax on immobile land and mobile capital, one can write:

A.6. $dT_L = dT_K$ (uniform tax rates for land and buildings).

Equations 1–4 can be modified to represent the economy after a site value tax is imposed. The system is essentially the same as above—the only difference is the elimination of the tax on capital as seen in equations 5–8.

5] $$dX'/X = -e_x \cdot (dP'_x/P_x)$$

6] $$dX'/X = f_K \cdot (dK'_x/K_x) + f_L \cdot (dL'_x/L_x)$$

7] $$dK'_x/K_x - dL'_x/L_x = -s_x \cdot (-dP'_L - dT'_L)$$

8] $$dP'_x = f_L \cdot (dP'_L + dT'_L) + f_K \cdot (dP'_K).$$

Now the equal yield condition is imposed:

9] $$T'_L \cdot (P'_L \cdot L) = T_L \cdot (P_L \cdot L) + T_K \cdot (P_K \cdot K),$$

which, after total differentiation and accounting for assumptions A.1.–A.5. yields:

10] $$dT'_L \cdot L = dT_L \cdot L + dT_K \cdot K.$$

Simultaneous solution of Equations 1–4 yields the following equilibrium change in land prices under the real estate tax:

11] $$dP_L = -dT_L \cdot \frac{e_x \cdot (f_L + f_K)}{f_K \cdot s_x + e_x \cdot f_L}.$$

In the earlier paper, Equation 11 is eventually simplified due to the restrictions on the parameters that s_x, $e_x = 1$ and that $f_K + f_L$ sum to one. Here those restrictions are not imposed. The solution of Equations 5–8 yields the following expression for a site value tax:

12] $$dP'_L = -dT'_L.$$

Next the effects of the two taxes on land prices are compared. Specifically, we determine the relationship between dP_L and dP'_L, while holding revenue constant: Equation 10. Substituting from Equation 12 into 10:$(-dP'_L) \cdot L = dT_L \cdot L + dT_K \cdot K$. Using A.6. ($dT_K = dT_L = dT$), and rearranging yields:

13] $$dP'_L = -dT \cdot \left(\frac{L + K}{L}\right).$$

What we need to know is whether:

14] $$|\, dP'_L \,| \gtreqless |\, dP_L \,| \;?$$

Given that both systems result in an absolute fall in land prices (from the no-tax situation) (4); if $|\, dP'_L \,| > |\, dP'_L \,|$, then land prices will fall even more in the land tax case than in the real estate case. From this one can infer that land prices will fall in going from a real estate to a site value tax. On the other hand, if $| dP'_L | < | dP_L |$, land prices will rise in moving from the current property tax to a land tax.

Using Equations 13 and 11 and eliminating $-dT$, one can rewrite (14) as:

$$\left(\frac{L + K}{L}\right) \gtrless \frac{e_X \cdot (f_L + f_K)}{f_K \cdot s_X + e_X \cdot f_L}. \tag{15}$$

Thus, if $\left(\frac{L + K}{L}\right) > \frac{e_X \cdot (f_L + f_K)}{f_K \cdot s_X + e_X \cdot f_L}$, then $| dP'_L | < | dP_L |$ (and v.v.).

III

EMPIRICAL EVIDENCE

WHETHER THE TAX BASE increases or decreases depends ultimately on the values of the parameters $\left(\frac{L + K}{L}\right)$, e_X, f_L, f_K and s_X. In the earlier paper, since e_X and s_X are assumed to be unity and the output elasticities sum to one, the revenue potential question depends on the value of $\frac{L + K}{L}$. In general, $\frac{L + K}{L}$ should obviously exceed unity, implying a broadening of the land tax base as one untaxes buildings. The question addressed here is whether this result holds when the parameters are not restricted.

Some hypothetical values for the e_X, s_X, f_L and f_K are presented in Table 1, along with some estimates of $\frac{L + K}{L}$ derived from previous studies (see the original paper for a discussion of those estimates).

For all the estimates of the $\left(\frac{L + K}{L}\right)$ parameter, assuming that e_X, $s_X = 1$ and that there are constant returns to scale (*i.e.,* $f_K + f_L = 1$), a switch to a land tax implies an increase in land prices (the original result). In other words, the tax base would rise as a result of a switch to a site value tax. Intuitively, as buildings are untaxed there will be a substitution toward the now cheaper capital. The higher levels of capital will increase the marginal product (and hence value) of land.

When might that switch imply a fall in land prices (*i.e.,* the commonly held view)? Still assuming constant returns to scale and an average estimate of $\frac{L + K}{L}$ of 3, land prices would fall if the elasticity of substitution is zero and f_K is less than 1/3 (see case 5). If, instead we vary the elasticity of demand and leave $s_x = 1$, e_x must be quite large for land prices to fall (see case 6).

What are, however, reasonable estimates for the price elasticity and the elasticity of substitution? Assume that the goods produced in sector X and Y are housing services, then the relevant elasticities would be the own price elasticity of demand for housing and the elasticity of substitution between land and capital in producing housing. Some recent estimates of those elasticities are summarized in Table 2.

Although most studies of the demand for housing concentrate on income rather than price elasticity, several representative figures of

Table 1

Impact of a Site Value Tax on Land Prices Based on General Equilibrium Results

	Parameter Values*						Impact on Land Prices
	$\frac{L+K}{L}$	e_x	s_x	f_K	f_L	$\frac{e_x \cdot (f_L+f_K)}{f_K \cdot s_x + f_L \cdot e_x}$	
1.	4 1/	1	1	sum to one		1	$\lvert dP_L' \rvert < \lvert dP_L \rvert$
2.	5.4 2/	1	1	sum to one		1	$\lvert dP_L' \rvert < \lvert dP_L \rvert$
3.	2.5 3/	1	1	sum to one		1	$\lvert dP_L' \rvert < \lvert dP_L \rvert$
4.	1.4 4/	1	1	sum to one		1	$\lvert dP_L' \rvert < \lvert dP_L \rvert$
5.	3.0	1	0	>2/3	<1/3	>3	$\lvert dP_L' \rvert > \lvert dP_L \rvert$
6.	3.0	>50	1	2/3	1/3	>3	$\lvert dP_L' \rvert > \lvert dP_L \rvert$
7.	3.0	.5	0	.5	.5	2	$\lvert dP_L' \rvert < \lvert dP_L \rvert$
8.	3.0	1.5	0	.5	.5	2	$\lvert dP_L' \rvert < \lvert dP_L \rvert$
9.	3.0	.5	1.2	.5	.5	.59	$\lvert dP_L' \rvert < \lvert dP_L \rvert$
10.	3.0	1.5	1.2	.5	.5	1.1	$\lvert dP_L' \rvert < \lvert dP_L \rvert$

1/ Based on estimates from Kurnow (1961) and Goldsmith (1962).
2/ Based on estimates from Heilbrun (1966).
3/ Based on estimates from Manvel (1968).
4/ Based on estimates from Gaffney (1978).

*$\frac{L+K}{L}$, ratio of total value of real estate to land values.

e_x, own price elasticity of the demand for housing.

s_x, elasticity of substitution between land and capital in the production of housing.

f_L, f_K, output elasticities of land and capital.

NOTE: e_x and s_x are entered as absolute values in the calculations since the sign was already accounted for in the model.

Table 2

Summary of Estimates of the Price Elasticity of the Demand for Housing (e_x) and the Elasticity of Substitution in the Production of Housing (s_x)

Source of Estimate	Data and Functional Form	e_x	s_x
DeLeeuw (1971)	1960 Census data,	-.7 to -1.5 (rental housing)	
Straszheim (1973)	1965 San Francisco data, hedonic linear function	-.462	
Carliner (1973)	1971 Panel of Income Dynamics data, log linear form	0 to -.8 (renters) (homeowners)	
Gerking and Boyes (1980)	1970 BLS and Commerce data for SMSAS, Box-Cox estimation	-.25 to -.62 (homeowners) .17 to -1.36 (renters)	
Muth (1971)	1966 FHA data, CES function		.5
Koenker (1972)	1964-66 Ann Arbor data, linear homogeneous function		.71
Sirmans, et. al. (1980)	1956 FHA data for Santa Clara County, VES function		.827
Färe and Yoon (forthcoming)	1956 FHA data for Santa Clara County, WDI function		0 to 1.2

e_x for housing are presented here. The classic reference is DeLeeuw (1971) who estimates a range of −.7 to −1.5 for rental housing based on 1960 Census data. More recent evidence is presented by Straszheim (1973) based on a hedonic approach which results in a price elasticity of −.462 for a bundle of housing services. Carliner (1973) estimates the price elasticity of housing between 0 and −.8. Using a Box-Cox estimation, Gerking and Boyes (1980) find e_x to vary between −.17 to −1.36. The overall range for the price elasticity based on these studies is therefore between 0 and −1.5.

The elasticity of substitution between land and capital in the production of housing was estimated at about .5 by Muth (1971), based on a constant elasticity of substitution (CES) production function. Using 1964–1966 data from Ann Arbor, Koenker (1972) estimates s_x as .71. Sirmans et al. (1979), used a variable elasticity of substitution (VES) production function and found a higher elasticity of substitution of .827 (using data from Santa Clara County). Based on the same data, Färe and Yoon (1980) have used a weak disposability of inputs (WDI) production function and found a range of s_x between 0 and 1.2. On the whole, these estimates range from 0 to 1.2 for s_x.

Based on this extraneous evidence cases 7–10 have been added to the results in Table 1. Setting e_x and s_x equal to their largest and smallest estimated values from Table 2, the mixed elasticity term ranges from .59 (case 9) to 2 (cases 7 and 8), if $\frac{L + K}{L}$ is assumed to equal 3 or more.

IV

SOME CAVEATS—AND A CONCLUSION

BEFORE CONCLUDING that the general equilibrium results show that a land tax would generate sufficient revenue to substitute for the local property tax, several caveats are in order. First, the results of the general equilibrium case merely indicate that (based on available empirical estimates) a tax changeover could result in a broader equilibrium tax base than the one predicted by the partial equilibrium case.

Second, there are obvious limitations of using this type of general equilibrium approach (some of which have already been mentioned). One of the more important restrictions is the fact that the excise effects of the property tax have been ignored by assuming uniform tax rates (5). Even assuming that the change would be to a uniform land tax implies that excise effects would arise due to untaxing buildings which were taxed at differential rates across jurisdictions. This would imply relatively larger increases in land prices in areas which formerly had relatively high taxes on structures. This possible bias, however, reinforces the basic result that a switch to a site value tax will not necessarily result in a fall in land prices.

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NOTES

1. Grosskopf and Johnson, *loc. cit.*
2. For a critique of that model, see McLure (1974).
3. This allows presentation of the model in terms of one good only.
4. Recall that $dP_L = -dT'$.
5. For example, see Mieszkowski (1972) or Aaron (1975).

Examining the Federal Reserve

A UNIQUE GUIDE that places the activities of the Federal Reserve in the context of the working financial markets, *In the Name of Money* by Paul DeRosa and Gary H. Stern, describes in detail the central bank's open market operations and traces its effect on market interest rates (New York: McGraw-Hill, 172 pages, $16.95).

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