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CAPITAL MIGRATION, LAND RENT CHANGES, AND SITE VALUE TAX ADEQUACY

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Introduction

The possibility of replacing the property tax with a site value (land value) tax has generated renewed interest in site value taxation in recent years. One reason for dissatisfaction with the property tax in its present form is that the part of the tax levied on capital discourages its use. Alternatively, if the entire tax were levied on site value, the distortive effect of the present tax would be eliminated.

Among the problems associated with the substitution of the site value tax for the property tax is the "adequacy" problem. That is, site value may not provide a tax base large enough to raise the amount of revenue generated by the present tax. Heilbrun [7] has provided the following analysis of the adequacy problem:

Let, V_L = Land value
V_K = Capital value
t = The effective property tax rate on land and capital value
i = The interest rate for land rent capitalization.

Heilbrun asserts that, for site value to provide an adequate base, land rents must equal or exceed the yield of the present property tax. If rents are constant over time, this condition is satisfied if,

$$V_L/i + t) \geqslant t(V_K + V_L), \text{ or}$$
$$i \geqslant t\ (V_K/V_L)$$

Almost certainly this condition is satisfied for some local tax jurisdictions but not for others. Places with relatively low effective property tax rates may find that the relatively small amount of revenue presently raised may be made up rather easily by taxing only land. Similarly, places with relatively low capital/land ratios may be able to make the substitution since the revenue lost by removing capital from the tax base is small relative to the site value base.

On the other hand, places with high values of t and V_K/V_L may find that the substitution is impossible or at least politically unrealistic. For example, if land rents are only slightly greater than the yield of the present tax, nearly 100% of these rents must be taxed away under a site value tax. This would reduce land values to nearly zero, and would require a tax rate of well over 100% on the diminished land value. Under these circumstances, it is doubtful that the site

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value tax would present a politically feasible alternative to the present tax.

Heilbrun analyzes data on capital and land value from the 1950's and concludes that most urban places with average property tax rates have little if any leeway for site value taxation. Though there is some indication that land value is a greater percentage of total property value than had been previously believed (see Manvel's 1968 study, for example), Heilbrun's pessimistic conclusion for most urban places is still probably valid, for effective property tax rates have increased since he made his observation.[1]

Site value may not provide a large enough base to warrant full substitution for the property tax immediately, but if land values are increasing at a faster rate than property tax revenue requirements, a gradual shift to site value taxation might be possible. Stone [18] has noted the importance of considering the dynamics of site value tax adequacy, and has developed a model that allows land rents to increase over time as a growing capital stock and labor force increase land productivity.

Several other writers have explored the possible effects of local substitution of the site value tax while the rest of the nation retains the present property tax. McCalmont [11] and Pollock and Shoup [16] have studied the inflow of capital that would result from the reduced tax (on capital) in the substituting locality. An interesting effect of local substitution of the site value tax and the consequent capital inflow is that the demand for land may increase, thus increasing land rents and providing more leeway for site value taxation.[2] This effect has been noted by Netzer [15], Thorndike [19], Stone [18] and McCalmont [11], though the only analysis is Thorndike's brief geometric model.

The purpose of this paper is to analyze the significance of these land rent changes in view of the problem of site value tax adequacy. To do this we use a variation of the well known Harberger [6] model, which has also been used by Mieszkowski [13, 14,], and McClure [10], among others. We examine the sensitivity of the model to various parameters and consider the rent changes that can occur in extreme cases. Then we use various parameter estimates to predict the rent changes that are likely for a typical urban locality, concluding that such changes are probably too small to provide significantly greater leeway for site value taxation and that substitution of the site value tax would impose extreme burdens on landowners.

The Model

The following differential equations describe the changes in the production and price of output X as well as the changes in factor prices that result from removing the existing tax on capital in a local economy.

(1) $$dX/X = fN\,dN/N + fK\,dK/K + fL\,dL/L$$

(2) $$dX/X = -EdX$$

(3) $$dK/K - dN/N = -s(d(k + T) - dn)$$

[1]Douglas [4] has analyzed Heilbrun's inequality using Manvel's data.

[2]It could be argued that if rents increase via capital in-migration, increased land productivity, etc., the local revenue requirements will increase, so that a site value tax might be required to raise *more* revenue than the present tax. While this may be the case, this paper ignores that complication, and assumes that the revenue requirement remains constant.

$$(4) \quad dK/K - dL/L = -s(d(k + t) - dl)$$
$$(5) \quad dx = fN(dn) + fK(d(k + T)) + fL(dl)$$
$$(6) \quad d(k + T) = -T$$
$$(7) \quad dL = 0$$
$$(8) \quad dN = 0, \text{ or, alternatively,}$$
$$(8') \quad dn = 0$$

Good X is produced in a generalized C.E.S. production function using labor (N), capital (K), and land (L) as inputs whose initial factor shares are fN, fK, and fL. X,N,K, and L are measured in units such that their initial prices (x, n, k + T, and l) are equal to I. (k + T and l are rental prices.)

Equation (1) results from differentiating the production function; (2) shows the demand for X, where E is the price elasticity of demand; (3) and (4) are factor substitution equations, where s is the elasticity of factor substitution. (McFadden [12] has shown that the elasticity of substitution term defined in a two factor production function is also appropriate in a generalized (three factor) C.E.S. function, and that it has the same value for any pair of factors.); (5) results from the assumption of marginal cost pricing; (6) through (8') are factor mobility equations; (6) assumes capital is perfectly mobile, so that its rental price net of the property tax (k) is determined outside the local economy. Removal of the tax (T) temporarily increases its net return to k + T, causing capital to be imported until its marginal product falls to k; (7) assumes the quantity of land is fixed; (8) assumes labor is immobile. Alternatively, (8') assumes labor is perfectly mobile and that the wage rate (n) is determined exogenously.

Our model differs from the standard Harberger model in that we remove an existing tax rather than impose a new one, and in that we add a third factor of production (land). Also, we assume prices of mobile factors are unaffected by changes inside the economy rather than using a two sector general equilibrium model that determines all prices. This "small country" assumption is appropriate for analysis of a local economy that is too small to influence factor prices determined in national markets.[3]

The model does not take into account the fact that a higher tax on land value is required to make up the revenue lost by removing the tax on capital. This is not necessary, for as long as the quantity of land is fixed, an increase in the site value tax does not affect resource allocation or gross land rents, though it does reduce land value. Most economists have assumed that the site value tax is in fact neutral, which is the main reason for preferring it to the present property tax. We maintain this assumption.[4]

The simultaneous solution of equations (1) through (8) or (8') yields the proportionate change in land rents. The solutions are,

$$(9) \quad d\ell = \frac{(E - s)\, fK\, (T)}{sfK + E\,(fN + fL)} \quad \text{, if labor is immobile}$$

[3]Mieszkowski [14] has similarly modified the Harberger model to include a third factor of production and to assume the prices of mobile factors are determined exogenously. He uses his model for a somewhat different purpose, however.

[4]Under some circumstances, this assumption is invalid. See, for example, Douglas [5].

$$(10)\quad d\mathcal{L} = \frac{(E - s)\, fK\, (T)}{s(fN + fK) + EfL} \quad \text{, if labor is mobile}$$

(9) and (10) indicate that rent changes may be either positive or negative, depending on the relative values of E and S. If E is large (relative to s), output can be increased without a significant reduction in price, increasing the demand for land and raising rents. But if E is small relative to s, there is a strong tendency to substitute the now cheaper capital for land and labor reducing the demand for land and decreasing rents. Rents rise if the "output" effect dominates, and fall if the "substitution" effect dominates.

Rent increases are larger and decreases are smaller when labor is mobile. By experimenting with different parameter values it is quickly ascertained that the largest rent changes that can occur result from a high value of E (or low s) and labor mobility. This may be appropriate for a local economy that is a price-taking exporter selling its entire output to a national market, or for an economy that must use all inputs in fixed proportions. If $E \to \infty$ or $s = 0$, substitution of a site value tax for the present property tax may actually leave land values unchanged. In this case, land rents will increase by an amount equal to the revenue that had been raised through the taxation of capital. The increase in rents must be fully confiscated for the site value tax to yield the same revenue as the property tax, which requires a site value rate that reduces land values to their original levels.[5] No additional burden is imposed on landowners, so adequacy is assured.

It seems unlikely, however, that this case is applicable to many localities. For the typical economy, output cannot be expanded unless price is reduced, some substitutability exists among factors, and labor mobility is incomplete. Consequently, rent increases will be less than the theoretical maximum, and substitution of a site value tax will cause land values to fall and impose additional burdens on landowners. Thus, to determine the feasibility of the site value tax substitution, we must estimate the values of the rent changes that are likely to occur.

Parameter Estimates And Rent Changes

Table 1 shows the parameter values used in calculating rent changes for a typical urban economy with an average effective property tax rate (2%). We assume that, in addition to a commercial or manufacturing sector, our economy contains a residential sector. Available data suggests it is reasonable to suppose that 50% of total rents are initially generated by each sector.[6] Values for

[5]If $E \to \infty$, the % change in rents approaches $fK\,(T)/fL = KT/L$ (since factor prices are initially 1). $KT = V_K t$, the revenue raised by taxing capital. Since $L = lL = V_L\,(i = t)$, the % change in rents is $tV_K/V_L(i + t)$. Substitution of this value for $\lambda - 1$ in equation (14) yields $V_L'/V_L = 1$ — land values remain unchanged.

[6]The percentage rent change in each sector must be weighted by the initial rent distribution in order to determine the total percentage change. A .50/.50 distribution is roughly consistent with the distributions that can be derived for selected places by combining *Census of Governments* data on the sector distribution of property values with Manvel's estimates of sector land value/property value ratios.

the elasticities of demand and substitution in housing are from Reid [17] and Koenker [8]. Factor share estimates are based on Mieszkowski [14].[7]

Table 1. Parameter Values

Parameter	Manufacturing Sector	Residential Sector
Initial Rent Distribution	.50	.50
fK	.25	.85
fN	.70	0
fL	.05	.15
E	0, 2, 10, ∞	1.00
s	1.00	.70
T	.14	.19

Values of T depend on the longevity of capital, its rate of return, and the property tax rate.[8] The elasticity of factor substitution in manufacturing is assumed to be 1.[9] Finally, we allow the elasticity of demand for the output of the manufacturing sector to take on different values, since that parameter seems most likely to be different for different localities selling different goods in different markets, etc., and since total rent changes are especially sensitive to its value.

Table 2 shows percentage rent changes in each sector and combined percentage changes for both sectors under alternative assumptions of labor mobility and immobility. The residential sector produces small positive rent changes, thus moderating the total changes that result from the sometimes large changes in the manufacturing sector. Consequently, unless the elasticity of demand for the manufactured output is extremely high, total rent increases will probably not exceed 20 percent or even 10 percent.

It seems that a necessary (but not sufficient) condition for an extremely high elasticity of demand is that the economy export virtually its entire output. Otherwise, macroeconomic effects become important for determining E. For

[7]Mieszkowski notes that labor's share of national income is about 70%. He also cites evidence that suggests the ratio of capital rents to land rents in about 5:1. This suggests that fN = .70, fK= .25, and fL= .05 are appropriate values for the business sector. Since the provision of housing *services* depends only on the land and the house (labor is used only to maintain the house), we assume fN = 0 in that sector. fK = .85 and fL = .15 result from an arbitrary adjustment of the 5:1 ratio to take account of the somewhat higher capital/land ratio in housing implied by Manvel [9].

[8]T is equal to the effective property tax rate (t) times the value of a a unit of capital; which is the net return (k) captalized at the rate of return (r) over a life of n years. Thus $T = t k \sum_{i=1}^{n} 1/(1+r)^i$. The differential equation model assumes k + T = 1. Substituting for k yields

$$T = t \sum_{j=1}^{n} 1/(1 + r)^j/(1 + t \sum_{j=1}^{n} 1/1 + r)^j).$$

According to IRS estimates, residential capital and business structures (about 1/3 of total business capital) last about 40 years; non-structure business capital (2/3 of total business capital) lasts about 10 years. Assuming r = .08, t= .02, and n= 40, T in the residential sector is calculated to be .19. The two kinds of business capital (n = 40 and n = 10) yield a weighted average for T in that sector of .14.

[9]Arrow, et. al. [1] estimate the elasticitv of substitution for various industries to be from .5 to 1.2. The value that we choose is not critical, since the E/s ratio is relevant for determining rent changes, and we have already assumed a wide range of values for E.

Table 2. Percentage Rent Changes

	Price Elasticity of Demand		% Rent Changes		
	Manufacturing	Residential	Manufacturing	Residential	Total
Labor Immobile	0	1	-14	6.5	-4
	2	1	2	6.5	4
	10	1	4	6.5	5
	∞	1	5	6.5	6
Labor Mobile	0	1	-4	6.5	1
	2	1	3	6.5	5
	10	1	22	6.5	14
	∞	1	70	6.5	38

example, if the reduced cost of capital lowers prices of internally produced and consumed goods, the real value of the money supply increases, lowering interest rates and increasing demand. However, money balances will probably leave the economy to seek higher interest rates, reducing or eliminating the increase in demand that would otherwise result from the falling prices, thus reducing the value of E.

It therefore seems unlikely that rent changes would exceed 10% to 20% for most places. We would be tempted to make an even stronger assertion were it not for the fact that, in developing Table 2, we neglected several factors that may lead to larger increases in some local economies. In particular, the table understates rent increases that may occur in places with higher than average property tax rates (high values of T), smaller than average residential sectors, or a low degree of substitutability among factors. We could also complicate the model by including, for example, the income elasticity of demand for housing, which would magnify output and demand increases through increasing the demand for residential land. Nevertheless, it appears that extremely large rent increases are unlikely.

Rent Changes And Adequacy

One way to judge the significance of the rent changes that are induced by the tax substitution is to compute the rent changes that would be required to preserve land values at some percentage of their present level given some degree of present adequacy. We can do this by solving equation (11) through (13) simultaneously.

$$\lambda V_L (i + t) = V_L' (i + t') \quad (11)$$
$$A = V_L (i + t)/t (V_K + V_L) \quad (12)$$
$$t'V_L' = t (V_K + V_L) \quad (13)$$

(11) states that the tax substitution has increased land rents to λ proportion of their original level, where V_L' is the new level of land value and t' is the site value tax. (12) defines the adequacy coefficient A; that is, the ratio of original land rents to the yield of the present property tax. (If $A < 1$, the present land base is too small to allow the tax substitution in the absence of rent increases). (13) requires that the site value tax generate as much revenue as the property tax. Solving for the percentage change in rents yields,

$$(14) \qquad \lambda - 1 = (V_L'/V_L)\,(i/(i + t)) + {}^1/A - 1$$

Suppose that t = 2 percent and i = 5 percent (following Heilbrun). Also assume that it is somehow determined that land values should be preserved at 75% of their present level so as not to impose an unbearable burden on landowners ($V_{L'}/V_L = .75$). If A = 1 (the present base is barely adequate), rents must increase by 54% to preserve land values at the required level. On the other hand, if A = 2, rents need increase by only 4 percent.

This example illustrates that large rent changes are unnecessary if the present land base is large enough. However, as stated earlier, the margin of adequacy in many places is probably quite low. For these places, the rent changes predicted by this paper are unlikely to provide significant additional leeway for site value taxation, notwithstanding the fact that we have no way of knowing how much of a decline in land value would be considered "too much."

Interestingly, the initial margin of adequacy and the rent changes that result from the tax change are not independent. As stated previously, a locality is more likely to find its present land base large enough if its property tax rate and V_K/V_L. ratio are low. Such a place would presumably have a low T and fK/fL, which would reduce the magnitude of what might otherwise be large rent increases. A small, rural locality would seem most likely to have a low t and V_K/V_L. Despite the low T and fK/fL this implies, its rent increases may still be fairly large if it produces and exports a high proportion of agricultural goods. Substitution of the site value tax might be feasible in this sort of locality.

However, a large urban economy would probably have too high a property tax and capital/land ratio to provide much if any initial leeway. Furthermore, if it does not devote an extremely high proportion of its resources to highly competitive exports, it will probably have a value of E too low to produce large rent changes. Substitution of the site value tax would, in this case, reduce land values to an unacceptable level.

A Concluding Note: Opportunities For Partial Substitution

For years urban areas have worried about the consequences of the out-migration of capital. A site value tax could reverse or at least slow this trend. Unfortunately, places where the site value tax might be considered most desirable are the places least likely to find it feasible. Nevertheless, an urban locality may benefit by partial substitution — reducing but not eliminating the tax on capital, and increasing the tax on land value.

This might be accomplished by gradually increasing the tax on site value to absorb the increases in value that would otherwise occur. The extra revenue would allow a gradual reduction in the tax on capital, the size of which would depend upon the expansion of the capital base and the land rent changes that would result from the capital inflow. This would seem to be an attractive topic for future research.

REFERENCES

1. Arrow, K.J.; H.B. Chenery, R.M. Solow, and B.S. Minkers, "Capital-Labor Substitution and Economic Efficiency," *Review of Economics and Statistics* 43 (1961), 225-250.

2. Census of Governments, "Taxable Property Values and Assessment-Sales Price Ratios," 2 (1), *Taxable and Other Property Values,* 1972.

3. Census of Governments, Taxable Property Values and Assessment-Sales Price Ratios, 2 (2), *Assessment-Sales Ratios and Tax Rates,* 1972.

4. Douglas, R.W., Site Value Taxation and Manvel's Estimates, *The American Journal of Economics and Sociology,* (2) (1978), 217-223.

5. Douglas, R.W., "Lands Taxation, Neutrality, and Risk Aversion," *Public Finance Quarterly* 7, (2) (1979), 231-237.

6. Harberger, A.C., "The Incidence of the Corporate Income Tax," *Journal of Political Economy* 3 (1962), 215-240.

7. Heilbrun, J., *Real Estate Taxes and Urban Housing* New York: Columbia University Press, 1966.

8. Koenker R., "An Empirical Note on the Elasticity of Substitution Between Land and Capital in a Moncentric Housing Market," *Journal of Regional Science* 2 (1972), 299-305.

9. Manvel, A., *Trends in the Value of Real Estate and Land,* Washington: National Committee on Urban Problems, 1968.

10. McClure, C., Taxation, Substitution, and Industrial Location, *Journal of Political Economy* 1 (1970), 112-132.

11. McCalmont, D.B., Differential Taxation of Site Value and Structures, *Southern Economic Journal,* 43, (1) (1976), 924-936.

12. McFadden, D., Constant Elasticity of Substitution Production Functions, *Review of Economic Studies* 2 (1963), 73-77.

13. Meiszkowski, P., "On the Theory of Tax Incidence," *Journal of Political Economy* 3 (1976), 250-262.

14. ——, "The Property Tax: An Excise Tax or a Profits Tax," *Journal of Public Economics* 1 (1972), 73-95.

15. Netzer, D., *Economics of the Property Tax,* Washington: Brookings Institute, 1966.

16. Pollock, R.L. and D.C. Shoup, "The Effect of Shifting the Property Tax Base from Improvement Value to Land Value: An Empirical Estimate," *Land Economics* 53 (1) (1977), 67-76.

17. Reid, M., *Income and Housing,* Chicago: University of Chicago Press, 1962.

18. Stone, G.W. Jr., "Revenue Adequacy of Land Value Taxation," *Southern Economic Journal* 3 (1975), 442-449.

19. Thorndike, S., "Some Theoretical Aspects of Building Tax Burdens on Landowner," *Land Economics* 1 (1970), 59-67.