

## Land Value Tax Revenue Potentials: Methodology and Measurement

Economists have long recognized the advantages inherent to land value taxation. In *Progress and Poverty*, Henry George was able to invoke the endorsements of Ricardo, John Stuart Mill, and other "economists of standing" (1879, rpt. 1975, pp. 422-24). Economists of all postures have continued to be attracted by the efficiency and, to a lesser extent, the equity advantages of a land value tax over the more common real estate tax on land and building. However, some have doubted that a tax on land (or site) values alone would generate sufficient revenue. For example, in Hicks's view, the Georgian claim that a "land tax would be sufficient to finance all the services of the state . . . would certainly not be true anywhere today, in view of the much wider range of duties governments are now expected to undertake" (1961, p. 357). This opinion has led to the conclusion that the "site value tax must be rejected as an outright substitute for the traditional American tax" (Heilbrun 1969, p. 78). Our task is to address this question of revenue potential: Would substitution of a land value tax for the current property tax provide sufficient revenue to support local government?

The yield of a land value tax can be analyzed in three cases of increasing complexity and realism: (1) the partial equilibrium case, (2) the general equilibrium case, and (3) the dynamic case. In the partial equilibrium case, either land prices or ground rents (gross of any land

taxes) are assumed to be unaffected by a switch to land value taxation. Possible adjustments in land prices caused by untaxing buildings can be analyzed in a general equilibrium framework. In both the partial and general equilibrium frameworks, the research question is simple: Can a land value tax generate the revenue presently required by local governments? In the dynamic case, the assumption that local government revenue requirements are fixed is relaxed and a new research question emerges: Can revenues collected solely from land keep pace with future increases in local government spending?

The purpose of this paper is to marshal and synthesize existing work on the revenue potential question, not to generate new or authoritative empirical answers. Relevant research is reviewed and synthesized using the taxonomy developed above. Emphasis is on existing measures of the revenue potential of land value taxes and, perhaps more important, the methodologies on which these measurements are based. Throughout the paper, a land or site value tax is defined as a tax on the capital value of land, i.e., as a tax on the value of the land including any value added by favorable location and by improvements attributable to public sector activities (such as the provision of roads and sewers, or water and electric services), but excluding structures. Finally, the paper focuses on urban governments in the United States.

### **The Partial Equilibrium Case**

The most naive partial equilibrium approach simply dismisses the revenue potential question, yet provides the clearest introduction (and perhaps the best answer!) to that question. This optimistic argument can be summarized in a single sentence: A change in the local tax base changes the equal yield tax rate and changes the distribution of the tax burden among taxpayers, but it does *not* change the revenue-raising potential of local governments. After all, if a community has the capacity to raise the required tax revenue under the existing system of real estate taxation, it would retain that potential under a site value system. Changing the tax "handle" from land and buildings to land alone certainly would tend to redistribute the tax burden from building owners to land owners, but that phenomenon raises equity and efficiency — not revenue potential — questions. Of course, the exclusion of buildings reduces the size of the tax base and thus forces the nominal tax rate to rise. Therefore the only relevant research question concerning the revenue potential of a site value tax is simple: By how much must the tax rate increase if buildings are untaxed and local government revenues held constant?

With the help of one simple, controversial, and crucial assumption, the solution to that research question is easy to derive algebraically. Tax revenues under the two schemes can be indicated by

$$R = t_0 (L_0 + B_0)$$

and  $R = t_s (L_s),$

where

- $R$  = required tax revenue (a constant in static analyses),
- $t_0$  = required tax rate if both land and buildings are taxed,
- $t_s$  = necessary tax rate if only land (site) values are taxed,
- $L_0$  = total land (market) values if both land and buildings are taxed,
- $L_s$  = total land (market) values if just land (site) values are taxed,
- $B_0$  = total building values if both land and buildings are taxed.

The key assumption is that the change to site value taxation does not change the *market value* of land parcels in the aggregate:  $L_0 = L_s$ . In that case, the required equal yield site value tax rate, can be shown to depend on the original tax rate and the proportion of the original total valuation in land ( $P$ ): i.e.,

$$t_s L_s = t_0 (L_0 + B_0)$$

and, since  $L_s = L_0$  by assumption,

$$t_s = t_0 \frac{L_0 + B_0}{L_0}$$

or, letting  $P = \frac{L_0}{L_0 + B_0},$

$$t_s = t_0 / P.$$

The new and higher tax rate ( $t_s$ ), when applied to all site values in the jurisdiction, provides the same tax revenue as before. The naive approach reveals no interesting questions or doubts about the revenue potential of a site value tax.

#### *Adequacy of Land Values*

Yet such doubts certainly exist. The cornerstone of these doubts is the fear that a site value tax would effectively "confiscate" private lands. Revenue potential pessimists point out that it is possible that local government revenue requirements approach, or even exceed, land rents. If site value taxes exceed gross land rents, net-of-tax land rents will be negative and economically rational private parties will no longer own land. According to the pessimists' argument, a site value tax can generate

adequate revenue only if gross land rents exceed required tax revenues; if revenue requirements exceed gross rents, the state could confiscate all land and still not support the existing level of public services with the rent proceeds on the confiscated land.

Do local government revenue requirements exceed land rents? From the pessimists' perspective, this appears to be the crucial question for assessing the revenue potential of a site value tax and the relevant partial equilibrium empirical work has centered on this question. The conflicting evidence is reviewed here, although the true controversy between the optimists and the pessimists is shown to lead directly to general equilibrium analysis.

The most prominent proponent of the proposition that the required local government tax revenues exceed land rents is probably Heilbrun (1966, pp. 150-55). Heilbrun's pessimistic conclusion is based on an ingenious "sufficiency condition" for assuring that a switch to a site value tax will not result in the confiscation of land, and on a set of extraneous estimates for key parameters.

First, consider Heilbrun's sufficiency condition. If

$N_0$  = rent on land gross of real estate taxes on land,

$L_0$  = capital value of land after capitalization of the land component of the real estate tax, or the (properly) assessed value of land under the original real estate tax,

$B_0$  = capital value of buildings after capitalization or shifting of the building component of the original real estate tax or the (properly) assessed value of buildings under the original real estate tax,

$i$  = rate of interest for capitalization of rent on land,

and  $R$  and  $t_0$  are as before, then site value taxation is not confiscatory if  $N_0 > R$ . Heilbrun's argument runs as follows:

$$N_0 = L_0 (i + t_0)$$

and  $R = t_0 (L_0 + B_0)$ .

Thus,  $N_0 > R$  can be rewritten as

$$L_0 (i + t_0) > t_0 (L_0 + B_0)$$

which reduces to

$$iL_0 > t_0 B_0.$$

The above version of Heilbrun's sufficiency condition makes some intuitive sense: If the tax revenue foregone by untaxing buildings ( $t_0 B_0$ ) can be made up out of existing land rents net of real estate taxes, then the re-

quired revenue certainly can be raised. Rearranging the terms yields a less intuitively pleasing, but more practical and common form of Heilbrun's sufficiency condition:<sup>1</sup>

$$i/t > B_0/L_0.$$

Determining the value of land ( $L_0$ ), even assuming that land prices would be unchanged by a switch to site value taxation, is a monumental task well beyond the scope of this paper. Instead, we summarize estimates made by Goldsmith (1962, pp. 86-87; 1956), Manvel (1968, pp. 1-14), Kurnow (1960, pp. 341-48; 1961, pp. 155-68), and Gaffney (1970, pp. 157-212). Those estimates, along with the data and methodology on which they are based, are summarized in table 3.1. Goldsmith's pioneering efforts were based on United States Census data. His national wealth approach was followed by both Kurnow and Manvel, although the latter both had access to the then newly created *Census of Government* data. Manvel's estimates differ from Kurnow's in the adjustments for some of the biases in the *Census of Government* data. Gaffney estimated total U.S. land values by extrapolating from estimates he made for the city of Milwaukee in 1965 using a cadastral survey.

These estimates of land values have not been immune to criticism. Gaffney, certainly the most forceful proponent of the adequacy of land as a base for property taxation, offers the most critical survey of existing estimates (1970, pp. 167-82). He contends that Goldsmith underestimated land value because of his reliance on FHA loan data, which has three weaknesses: (1) it omits vacant lots and unsubdivided land, (2) it is restricted to lower middle class housing, which has a relatively low land/total valuation ratio, and (3) it neglects invisible assets such as minerals. Gaffney criticizes Kurnow for assuming that building values increase in step with construction costs (which are actually partially attributable to technological change) and thereby overestimating the value of buildings. Gaffney finds Manvel's estimates to be the least biased, although he faults them for not capturing the increase in farm and mineral values; he also suggests that a larger part of Manvel's estimates of the increase in real estate value should be attributed to an increase in the value of land. Gaffney argues that a reliable estimate of urban land value would involve a complete cadastral survey of all urban land; his results indicate that such a methodology, if applied to all land, would result in much higher land values than those estimated by Goldsmith, Kurnow, and Manvel.

1. Heilbrun 1966, p. 151. Heilbrun's derivation is repeated in full in the text so that the role of a crucial implicit assumption can be explored later.

Table 3.1 Estimates of U.S. land value

Author	Data	Method	Year	Estimate (\$)
R. W. Goldsmith	Census, FHA Loan Data	Used FHA loan data for share of land in real estate. Omits vacant and undeveloped land. Used book value for corporate held lands.	1956	\$ 207 billion
E. Kurnow	1957 Census of Governments	Used Census of Governments data to derive marginal valuation and state land ratio estimates to determine land value. Excludes Alaska and Hawaii. Does not correct for assessment bias of sales assessment ratios. (Excludes public utilities.)	1922	94.8 billion
			1930	111.6 billion
			1938	94.2 billion
			1956	243.7 billion
A. Manvel	Census of Governments	Based on assessed values, adjusted by non-mapping techniques for undervaluation.	1956	282 billion
			1966	523 billion
M. Gaffney	Tax Commissioner of Milwaukee	Cadastral map contouring technique.	1965	2,386 million (Milwaukee)
				640 billion (U.S.)

While these estimates of total land values are interesting, they are of little use here even if the methodological feuds are ignored. Each of these estimates is, after all, over ten years old. Fortunately, estimates of land value per se are not required to work though either the optimist's or the pessimist's analyses of revenue potential. The key parameter is the proportion of total valuation in land ( $P$ ). Specifically, if values for the appropriate interest rate for the capitalization of the rent on land ( $i$ ) and the rate of real estate tax on the assessed value of land and buildings ( $t$ ) are

known or assumed, then the Heilbrun condition for revenue adequacy requires the ratio  $B_0/L_0$  for completeness, or its equivalent,  $(1-P)/P$ . The principal reason for including the above four estimates of land value is to provide estimates of the necessary land/buildings ratios.

What percent of total valuation does land comprise? A wide assortment of answers can be found. Goldsmith and Kurnow find  $P$  nationally to be about 25 percent; Heilbrun excludes rural land and buildings from Goldsmith's data and estimates that land makes up only about 18.5 percent of urban land (1966, p. 152). Manvel finds land to be about 40 percent of total valuation. Gaffney claims that "land value today is at least half of real estate and probably more" and, at least in Milwaukee in 1965, "60-70 percent" (1970, p. 181). The key ratio of present building values to land values ranges from 4.4 (Goldsmith/Heilbrun) down through 2.9 (Goldsmith/Kurnow) and 1.5 (Manvel) to about .5 (Gaffney).

The gist of Heilbrun's argument against the revenue adequacy of a site value tax can now be stated. Heilbrun used  $i=6$  percent and calculated the ratio of property tax revenues to full market value of property ( $t$ ) to be 1.5 percent in 1956-57; thus the  $(i/t)$  ratio was  $(.06/.015)$  or 4. Although it is greater than the  $B_0/L_0$  calculated by Goldsmith for the entire nation, this  $(i/t)$  ratio is smaller than the 4.4 "non-farm" ratio. Although recognizing that some communities could raise adequate revenues under a site value tax, Heilbrun concluded that "unless we are prepared virtually to end private ownership of rights in land by taking almost its whole rent, it is no longer feasible to substitute a land tax for the real estate tax at the present level of yield" (1966, p. 150).

One argument against Heilbrun's pessimistic conclusion is that a "wrong" (excessively low)  $B_0/L_0$  ratio was used. Another possible weakness is the reliance on nationwide aggregate data. In a recent article, Douglas (1978, pp. 217-23) deals with both of these objections by (1) using Manvel's (lower)  $B_0/L_0$  ratios and (2) working with 15 localities. He used 1971 *Census of Government* data to calculate land's share of total valuation in each of the 15 localities. Douglas also manipulated Heilbrun's sufficiency condition to show the proportion of existing land rents that would be collected by a site value tax that raised the same amount of revenue as the present property tax ( $H$ ):

$$H = \frac{t_0(L_0 + B_0)}{L_0(i + t_0)} = \frac{\text{property taxes}}{\text{gross land rents}},$$

which, in terms of the buildings/land ratio, works out to be

$$H = \frac{t_0(B_0/L_0 + 1)}{(i + t_0)}.$$

Values of  $H$  in excess of one imply that existing land rents are smaller than the required tax levy, or that the site value tax would be "confiscatory."

Douglas used local values for  $t$  and values of  $i$  of 4 percent and 6 percent to generate the results for 15 cities. His results, reproduced in table 3.2, seem to support Heilbrun's pessimistic conclusions. For  $i = 4\%$ , only 6 of the 15 cities have land rents in excess of real estate taxes. For  $i = 6\%$ , 13 of the 15 cities pass the sufficiency condition, but "at least  $\frac{3}{4}$  of land's rental value must be taxed away in order to raise the required revenue for most of the localities shown" (1978, p. 220).

Table 3.2. Property taxes as a percent of land rents; selected localities

Locality	$t$ (percent)	$B_0/L_0$	$H$ ( $i = 4$ percent)	$H$ ( $i = 6$ percent)
Honolulu, Hawaii	.9	1.81	.52	.37
Cook Co., Ill.	2.5	2.30	1.27	.97
Baltimore Co., Md.	3.4	2.09	1.42	1.12
Detroit, Mich.	2.4	2.44	1.29	.98
Hennepin Co., Minn.	2.1	2.03	1.04	.79
Ramsey Co., Minn.	1.9	2.28	1.06	.79
St. Louis Co., Mo.	2.0	1.92	.97	.73
New York City, N.Y.	1.9	2.28	1.06	.79
Cuyahoga Co., Ohio	2.0	2.15	1.05	.79
Franklin Co., Ohio	1.4	1.70	.70	.51
Oklahoma Co., Okla.	1.3	2.14	.77	.56
Philadelphia, Pa.	2.0	2.18	1.06	.80
Shelby Co., Tenn.	1.7	1.67	.80	.59
Harris Co., Tex.	1.5	2.00	.82	.60
Milwaukee, Wis.	4.1	2.38	1.71	1.37

Source: Douglas 1978, p. 218.

Douglas' results appear to be the best available estimates of the ratio of revenue requirements to land rent. However, even if Heilbrun's partial equilibrium framework is accepted, Douglas' results do not prove that a site value tax would fail to generate adequate revenue. A possible weakness is the reliance on Manvel's estimates of land's share of total valuation. As shown in table 3.3, the  $H$  ratio is extremely sensitive to the  $P$  and  $L$  parameters. If the buildings/land ratios of Gaffney are closest to the truth, then land rents exceed revenue requirements even if the average real estate tax rate is assumed to be 2 (or even 2.5) rather than the 1.5 used by Heilbrun.<sup>2</sup> If  $i$  is taken to be 6 or 8, "confiscation" occurs only if

2. A 2 percent real estate tax rate probably is a more reasonable approximation today. The average effective property tax rate for existing homes with FHA insured mortgages in the United States was 1.89 percent in 1975. Several states have average rates of 2.5 or more. Source: Advisory Commission on Intergovernmental Relations, *Significant Features of*

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Table 3.3. Percent of land rents required for local government revenues ( $H$ ) for selected tax rates, interest rates and building/land ratios

Interest Rates ( $i$ )	Rates ( $t$ )	Buildings/Land Ratios ( $B_0/L_0$ )			
		4.4	2.9	1.5	.5
$i = 4$ percent	1.5	1.47	1.06	.68	.41
	2.0	1.80	1.30	.83	.50
	2.5	2.08	1.50	.96	.58
$i = 6$ percent	1.5	1.08	.78	.50	.30
	2.0	1.35	.98	.63	.38
	2.5	1.59	1.15	.74	.44
$i = 8$ percent	1.5	.85	.62	.39	.24
	2.0	1.08	.78	.50	.30
	2.5	1.29	.93	.60	.36

$$H = \frac{t(B_0/L_0 + 1)}{(i + t)}$$

$$\text{Land Share } P = \frac{1}{(B_0/L_0) + 1}$$

Thus,

$P$	$B_0/L_0$	
.19	4.4	Heilbrun/Goldsmith
.26	2.9	Goldsmith/Kurnow
.40	1.5	Manvel/Neuner, et al.
.66	.5	Gaffney

the most pessimistic estimates of the buildings/land ratio are used.

In sum, present local government revenue requirements are greater than existing land rents if land is a small share of total valuation, the rate of return on land is low, and/or property tax rates are high. Conversely, land rents exceed local government revenues if land's share of value is high, interest is high, or property tax rates are low. For reasonable combinations of  $t$ ,  $i$ , and  $B_0/L_0$ , required revenues are a sizable hunk – but certainly not all – of existing land rents.

#### *A Synthesis*

But perhaps Heilbrun, Douglas, and the other pessimists are asking the wrong question. The tax base under a site value tax is *not* the value of

*Fiscal Federalism 1976-77*, vol. 2, *Revenue and Debt* (Washington D.C.: The commission, 1977), p. 107.

land under the present system of real estate taxation ( $L_0$ ); the new tax base is land values under a site value tax scheme ( $L_s$ ). The "naive" or optimistic approach asserts that land values would not change as a result of the tax switch. The pessimistic methodology makes the perhaps equally naive assertion that gross ground rents ( $G_0$ ) will not change as a result of a major change in property taxation. Yet untaxing improvements will reduce the cost of building and maintaining structures, change the relative price of land and improvements, and presumably increase the demand for sites. Market forces should cause at least part of this increased demand to be translated into higher ground rents gross of taxes.<sup>3</sup> A cornerstone of Gaffney's definitive defense of the revenue potential of a site value tax is the assertion that all of the reduction in building taxes shows up in increased ground rents: "If the tax cost of buildings falls, land rent rises by the same amount, just as earnings on common stock would rise by the amount of any fall in interest on bonds" (1970, p. 188).

The dispute over ground rents under a site value tax scheme is the crux of the revenue potential controversy. The problem can be described most precisely with a minor modification to the model used by Heilbrun/Douglas and Gaffney. As before, the original land value ( $L_0$ ) is equal to the gross rent ( $G_0$ ) discounted by the rate of return on land ( $i$ ) and the real estate property tax rate ( $t_0$ ):

$$L_0 = \frac{G_0}{i + t_0}.$$

But, in the more general case, gross ground rents under site value taxation ( $G_s$ ) are equal to the original rents plus that fraction ( $\alpha$ ) of the building tax savings ( $t_0 B_0$ ) that shows up as increased rents:

$$G_s = G_0 + \alpha(t_0 B_0).$$

Total land value under site value taxation ( $L_s$ ) is simply ground rents discounted by  $i$  plus the site value tax rate ( $t_s$ ):

$$L_s = \frac{G_s}{i + t_s} = \frac{G_0 + \alpha(t_0 B_0)}{i + t_s}.$$

3. Heilbrun recognizes the "important qualification" described here, but dismisses it by claiming that "it would, however, be imprudent . . . for any local government to bank on such an effect" (Heilbrun, 1966, p. 154). Douglas also mentions this possibility in passing (1978, p. 219).

Algebraic manipulation<sup>4</sup>, along with the equal yield restriction  $t_s L_s = t_0(L_0 + B_0)$ , allows us to express  $L_s$  in terms of  $L_0$ ,  $B_0$ ,  $t_0$ , and  $\alpha$ :

$$L_s = L_0 - \frac{(1 - \alpha)t_0 B_0}{i}$$

Verbally, land values under site value taxation are equal to the original land values reduced by the discounted value of those real estate taxes on buildings which are not borne by landowners via reduced rents.<sup>5</sup>

#### *Impact of Land Taxes on Land Values*

Suddenly the naive model appears quite sensible. If Gaffney is right and  $\alpha = 1$ , then land values are unchanged by a switch to site value taxation. If tax savings *all* go into higher ground rents, then the revenue potential of a site value tax is equivalent to the revenue potential of a real estate tax. The new tax rate must be from 3.0 to 5.4 times the old tax rate (using  $t_s = t_0/P$  and assuming  $P$  is between 19 and 66 percent), the tax burden is reshuffled among parcels (Harberger 1962), but private parties still own land — and still earn a return of  $i$  percent on their investment.

4. We start with two identities:

$$G_0 = (i + t_0)L_0,$$

$$G_s = (i + t_s)L_s - \alpha t_0 B_0.$$

Eliminating  $G_0$ ,

$$(i + t_0)L_0 = (i + t_s)L_s - \alpha t_0 B_0,$$

and rearranging yields

$$i(L_0 - L_s) = t_s L_s - t_0 L_0 - \alpha t_0 B_0.$$

Since, for equal yield,  $t_s = t_0(L_0 - B_0)$ ,

$$i(L_0 - L_s) = (1 - \alpha)t_0 B_0.$$

Thus

$$L_s = L_0 - \frac{(1 - \alpha)t_0 B_0}{i}$$

5. All empirical work on the redistribution of tax burden among classes of property or individuals as a result of a switch to site value taxation implicitly assumes the naive or optimistic model. Examples of this work include Neuner, et al. (1974), Smith (1970), and Schaaf (1969).

Heilbrun, Douglas, and others who profess the site value tax to be confiscatory tell a different tale. They implicitly take  $\alpha = 0$ , so a site value tax causes net-of-tax rents to fall, property values to plummet, and new tax rates that need to be very high. In the extreme case, where present land rents are exceeded by revenues from the real estate tax, an infinite site value rate would not raise enough money because no one would own land.

So what is  $\alpha$ ? Gaffney says 1: all tax savings show up in increased rents, so land market values are unchanged. Heilbrun and Douglas say 0: all taxes on buildings now must be paid through unchanging ground rents, so land values plummet. An analysis of the question takes us into the realm of general equilibrium.

### The General Equilibrium Case

The optimistic and pessimistic conclusions concerning the revenue potential of a site value tax were both based on restrictive assumptions: land values would not change or gross ground rents would not change. Both approaches involve partial equilibrium analysis of the revenue potential of a site value tax in the very short run. Alternatively, both approaches involve (extreme) assumptions about the long-run incidence of untaxing buildings. To analyze these long-run effects, and to gain further insight into the optimist/pessimist controversy, both restrictive assumptions must be relaxed thereby moving the analysis from a partial to a general equilibrium framework.

Begin by assuming that the economy is in equilibrium under the current property tax structure. Changing from a land-and-buildings tax base to a land base would be an exogenous disturbance to which the market for land, labor, buildings, and other capital will eventually adjust. After that adjustment, a new equilibrium—one with different equilibrium prices and quantities—will result. Classic comparative statistics should indicate if land prices and quantities will change, and in what direction. The relevance of such comparative statistics to the revenue potential question is obvious: we can determine whether the site value tax base (i.e., land prices) will fall (the pessimistic conclusion), remain constant (the optimistic partial equilibrium conclusion) or even rise. Much of the recent theoretical work in public finance has been dedicated to similar general equilibrium analyses of taxes (and expenditures), which indicate the final incidence of taxes and expenditures rather than their initial impact (McLure 1972, pp. 56–82). Such general equilibrium models have been used extensively to analyze the corporate income tax and also have contributed to what is dubbed “the new view” of the incidence of the property tax.

The Harberger model is an example of a simplified general equilibrium model that has been used extensively to analyze incidence. This approach is limited, however, by several of the model's assumptions. For example, it assumes that changes are all infinitely small and incidence is measured against a tax situation with no pre-existing distortions. Thus, this framework is not very helpful in analyzing a discrete change from a pre-existing non-neutral tax structure.

However, some insight into the general equilibrium effects of untaxing buildings can be gained by modifying the Harberger analysis (Schroeder and Sjoquist 1975, pp. 17-29). The general idea is to compare two equal yield tax systems, one in which land and capital are taxed, and one in which land alone is taxed. Our goal is to compare the change in land prices in the building and land property tax case to the change in land prices in the land tax case, holding revenue constant. Thus, we assume that "sufficient" revenue can be raised under a land tax in order to determine the effect of that tax on land and capital prices.

We can derive the general equilibrium effects on the price of land of untaxing buildings by using a simplified version of the Harberger model. In this model we assume that there are two goods;  $x$  and  $y$ , which are in turn produced via homogeneous production functions with two factors, land ( $L$ ) and capital ( $K$ ). Land is assumed to be fixed ( $dL = 0$ ) and capital is mobile, but fixed in the aggregate ( $dK_x = -dK_y$ ). Goods  $x$  and  $y$  are produced under perfectly competitive conditions.

The demand for  $x$  and  $y$  is specified as:

$$(1) \quad dx/x = -E_x \cdot (dP_x/P_x) + E_{xy} \cdot (dP_y/P_y),$$

$$(2) \quad dy/y = -E_y \cdot (dP_y/P_y) + E_{xy} \cdot (dP_x/P_x),$$

where the  $E$  refers to the respective own and cross price elasticities of demand. To further simplify the model, we make the following assumptions:

$$dP_K = 0 \quad (\text{therefore } K \text{ is numeraire}),$$

$$E_x E_y = 1,$$

$$E_{xy} = 0,$$

and

$$P_x, P_y, P_K, P_L = 1.$$

The production of  $x$  and  $y$  can be specified as:

$$(3) \quad dx/x = f_K \cdot \frac{dK_x}{K_x} + f_L \cdot \frac{dL_x}{L_x},$$

$$(4) \quad dy/y = g_K \cdot \frac{dK_y}{K_y} + g_L \cdot \frac{dL_y}{L_y},$$

where  $f$  and  $g$  represent output elasticities (which are assumed to sum to unity).

Substitution of factors in the production of  $x$  and  $y$  can be written as:

$$(5) \quad \frac{dK_x}{K_x} - \frac{dL_x}{L_x} = -s_x \cdot (dT_K - dP_L - dT_L),$$

$$(6) \quad \frac{dK_y}{K_y} - \frac{dL_y}{L_y} = -s_y \cdot (dT_K - dP_L - dT_L),$$

where  $s_x$  and  $s_y$  represent elasticities of substitution (assumed here to be unitary). Included in equations (5) and (6) is our representation of the current property tax. We assume that it is a uniform tax on immobile land and mobile capital in both sectors.

The pure land tax is represented by:

$$(5a) \quad \frac{dK'_x}{K_x} - \frac{dL'_x}{L_x} = -s_x \cdot (-dP'_L - dT'_L),$$

$$(6a) \quad \frac{dK'_y}{K_y} - \frac{dL'_y}{L_y} = -s_y \cdot (-dP'_L - dT'_L).$$

We also are imposing an equal yield condition:

$$(7) \quad T'_L P'_L L = T_L P_L L + T_K P_K K,$$

which when totally differentiated and accounting for the assumptions made above, becomes

$$(8) \quad dT'_L \cdot L = dT_L \cdot L + dT_K \cdot K.$$

The relationship between factor and product prices, assuming perfect competition, becomes

$$(9) \quad dP_x = f_L \cdot (dP_L + dT_L) + f_K \cdot (dP_K + dT_K),$$

$$(10) \quad dP_y = g_L \cdot (dP_L + dT_L) + g_K \cdot (dP_K + dT_K),$$

with the land tax version:

$$(9a) \quad dP'_x = f_L \cdot (dP'_L + dT'_L) + f_K \cdot (dP'_K),$$

$$(10a) \quad dP'_y = g_L \cdot (dP'_L + dT'_L) + g_K \cdot (dP'_K).$$

The simultaneous solution of equations 1-10 results in the following:

$$(11) \quad dP_L = [-E_x dT_L (f_K + f_L)] / [E_x f_L + s_x f_K],$$

$$(12) \quad dP_x = f_K \cdot dT_K + f_L \cdot (dP_L + dT_L),$$

$$(13) \quad dP_y = g_K \cdot dT_K + g_L \cdot (dP_L + dT_L),$$

and for the equal yield land tax:

$$(11a) \quad dP'_L = -dT'_L(f_x + f_L),$$

$$(12a) \quad dP'_L = 0,$$

$$(13a) \quad dP'_y = 0.$$

It remains to be seen whether  $dP'_L \gtrless dP_L$ , i.e., whether a site value tax results in lower, equal, or higher land prices than an equal yield real estate tax in equilibrium. Simplifying equation (11) by accounting for our assumptions, we have:

$$(14) \quad dP_L = -dT_L,$$

which we must then compare to  $dP'_L = -dT'_L$ . Given  $dT_L > 0$ , it is clear that both systems result in an absolute decrease in land prices. Recalling the equal yield condition and substituting  $dP'_L = -dT'_L$ , we have:

$$(15) \quad -dP'_L \cdot L = dT_L \cdot L + dT_K \cdot K,$$

which can be rewritten as:

$$(16) \quad dP'_L = -dT \left( \frac{L + K}{L} \right).$$

Thus, whether  $dP'_L \gtrless dP_L$ , it can be equivalently stated as:

$$(17) \quad -dT \left( \frac{L + K}{L} \right) \gtrless -dT.$$

Thus, if  $\left( \frac{L + K}{L} \right)$  exceeds 1, then  $|dP'_L| < |dP_L|$  and the fall in land prices

under a site value tax will be less than under a uniform land and building tax. This in turn implies that a switch from a property tax to an equal yield land tax will result in a *rise* in land prices.

Therefore, using an admittedly naive and restrictive general equilibrium model, one can analyze the long-run impact on land prices of substituting a uniform land tax for a uniform land and building tax. This does not, admittedly, predict whether the revenues from this land tax are sufficient. Rather, this result merely indicates that the adjustment to the tax changeover could result in a broader equilibrium tax base than predicted by the pessimistic partial equilibrium approach. In terms of the previous section,  $\alpha > 0$  and perhaps  $\alpha > 1$  (Shoven and Whalley 1977, pp. 211-24).

Several caveats are paramount at this point. We have not allowed for the dynamic, but rather only for the comparative static, impact of a land tax on land prices and thus the tax base. We have ignored the potential impact of increased land development on the urban fringe. Also, and perhaps for our purposes more important, we have ignored the fact that the current tax on land and buildings is *not* a uniform tax. It is well known that there are pronounced variations in effective tax rates both by class of property and by locality. As has been convincingly argued by Mieszkowski (1972) and Aaron (1975), these differentials will result in excise effects. The direction of the revenue effect of these excise effects on the equilibrium price of land and buildings is difficult to determine *a priori*. The usual assumption is that relatively high tax areas will have capital outflows, with the relatively immobile factors and local goods bearing the burden.

Thus, if rural areas had lower taxes under a tax on land and capital, they would ultimately have higher land prices and locally traded goods prices, since these are the relatively immobile factors in the system. Under a site value tax, however, the taxed factor would be relatively immobile and the important excise effects would be from *untaxing* buildings. Therefore, cities that had relatively *higher* taxes would realize an increase in land prices, with low tax cities realizing lower land price increases. Perhaps more important excise effects would be due to differences in urban/rural taxes on improvements. In this case, cities stand to realize relatively larger land price increases due to the excise effect of untaxing buildings.

There are other reasons for assuming that a change from the current system to a land tax system of property tax will not have the simple effect of reducing the price of land. As Feldstein (1977) has demonstrated, there are income and portfolio balance effects which could conceivably result in land price increases under a land tax.

In addition, the results of relying on the "new view" in determining general equilibrium effects on prices must be considered with due consideration of the assumptions involved. One implicit assumption with far-reaching implications is that of the independence of the savings rate and the rate of return. If consumers reduce their savings rate in response to lowered rates of returns, then equilibrium capital levels will be lower and the price of land will be lower. Also, the assumption that aggregate capital in the U.S. is fixed is probably incorrect. International capital flows must be considered. However, a shift away from improvement taxation could attract international capital, and have the ultimate effect of raising land prices. Thus, most of the potential biases are in favor of higher equilibrium land prices.

The ultimate answer to the general equilibrium issue is by nature empirical. Unfortunately, limited time and the problems inherent in accurately determining capital and land values do not allow us to derive an estimate of the impact of substituting a tax on land for an equal yield tax on land and buildings, although recent breakthroughs in estimating techniques and methodology now allow such estimation. Reliable data remain the critical bottleneck.

#### *Computing General Equilibriums*

Scarf (1973) is responsible for developing a method of computing general equilibrium solutions. His technique has been employed by several economists to analyze the general equilibrium effects of taxes. The property tax has been of particular interest, although to date no one (to our knowledge) has simulated a general equilibrium change from a mixed property tax base to a land property tax base. As extraneous evidence, we will summarize the results of attempts to analyze the current property tax system using the general equilibrium approach.

Arnott and MacKinnon (1977) analyze the effects of increasing the property tax rate uniformly in a closed system. Their model is innovative in that they do not assume that land is fixed, nor that the supply of buildings is perfectly elastic. Using a "vector-sandwich" estimating technique based on Scarf's algorithm, they compare a city with no property taxes to a city with a 25 percent property tax rate. They find that tenants bear a greater burden than landlords, but that the price of land does fall. Their analysis is limited, however, by the arbitrary values chosen for parameters of the utility and cost functions, and the fact that expenditures are ignored.

Courant (1977) has also used a general equilibrium approach to analyze the excise effects of heterogeneous local tax rates, relative to the effects of uniform tax rates. He restricts the analysis to a tax on capital and assumes that land and capital are fixed in the aggregate. Thus, he compares equal yield uniform and heterogeneous property tax rate systems. His general conclusion is that landlords' income falls under the uniform tax relative to the differential system. Again, public goods (expenditures) are excluded from the model. In contrast, Polinsky and Rubinfeld (1978) explicitly include local public services in their general equilibrium model to analyze the effects of an increase in the property tax. They find that if taxes are increased while service levels are held constant, land values will fall.

The most fruitful general equilibrium approach to estimating the effects of untaxing buildings and increasing land taxes would be to use the general method outlined by Shoven and Whalley (1977). They illus-

trate a method of estimating differential tax incidence, assuming equal yield tax alternatives. Unfortunately, this approach cannot capture the excise effects that would occur if buildings are untaxed and land is then taxed at a higher rate. To balance local budgets, which already are based on differential tax rates, equal yield land taxes would necessarily exhibit interurban differentials, although property class differences technically could be eliminated within jurisdictions. The shift from an excise type tax to a relatively uniform tax would, however, have its own excise effects as discussed by Courant (1977).

### Expenditure Impacts

The revenue potential of a site value tax can be viewed in several time frames. Up to this point, we have considered the immediate effect and roughly determined that even using the most pessimistic approach and reasonable estimates of key parameters, land rents exceed revenue requirements. Thus, in a limited sense, revenue is sufficient in the short-run. After the changes in relative prices that the substitution in tax bases will cause, land values *could* rise. Thus, comparative statics suggest that the short-run value of land underestimates the base. Finally, we would like to know if land as a tax base can keep up with runaway local expenditures. That is, is the revenue elasticity of land as large as the elasticity of expenditures over time? Extremely little evidence is available on this critical issue. We will therefore summarize (1) trends in land prices and expenditures, (2) research on this issue, and (3) examples of the dynamics of the site value tax in practice.

#### *Expenditure and Land Value Trends*

There is no doubt that land prices, particularly urban and urban fringe land prices, have increased. There is also no doubt that local government expenditures have increased. As a rough indication of the relative rates of increase, some statistics are summarized in table 3.4. These figures should be viewed with great caution — as is well known, land value is probably undervalued (Gaffney 1970). In addition, these figures do not really capture the relationship between urban area expenditures and corresponding land prices, which are also considered *not* to be independent.<sup>6</sup> These figures merely give rough calculations of aggregate changes.

6. The literature on tax and expenditure capitalization is extensive. One example (which, by the way, finds *no* capitalization effects) is Wales and Wiens (1974). For a more recent example, which includes explicit measures of services (which are found to increase property values), see McDougall (1976).

Table 3.4. City government finances, 1960-1974

Year	Property Tax Revenue	Own Source Expenditure
1960	5,197	12,930
1965	6,537	17,146
1970	9,127	26,267
1971	10,041	29,364
1972	10,988	32,150
1973	11,879	34,323
1974	12,244	35,647
	Percent Change 1960-70	Average Per Year 1970-74
Total revenue	8.2	12.7
Property taxes	5.8	7.6
General expenditure	8.9	11.3

Source: U.S. Bureau of the Census, *City Government Finances*, annual.

These statistics indicate that city government expenditures from their own sources have increased over the 1960-74 period faster than property tax revenues. Total revenues, however, are roughly keeping pace, which indicates that city governments do not rely solely on the property tax to finance their operations. Thus, substitution of a land tax for the current property tax does not imply assumption of all local government financing. The increase in expenditures indicates, however, that to maintain roughly a one-third share of that total, property tax revenues *must* increase. We now turn to existing analysis of the ability of land tax revenues to maintain that pace.

#### *Studies of Dynamic Land Tax Effects*

A dynamic approach to analyzing the yield adequacy of a site value tax must take into consideration the dynamics of local urban expenditures relative to the tax base. The only analysis that explicitly analyzes the dynamic adequacy of land as a tax base is a study by Stone (1975). He uses a simple Ricardian model that includes expenditures and revenues. The dynamic element is brought into the model through the inclusion of population, which is assumed to be monotonically related to the labor supply.

Stone finds that, assuming a constant tax rate, zero income elasticity of expenditures, and unitary population elasticity of expenditures, revenues will be adequate only if capital increases at a given rate. This result is based on an extremely restrictive model. Land is assumed to be fixed, yet no allowance is made for the effect of a growing population on the real

rent of fixed land; therefore, his results are likely to underestimate the change in the tax base. He excludes the land market in his model, which is important in developing a dynamic model of land tax adequacy.

One can modify the Stone model to include a land market. First, assume his basic four equation model:

$$\begin{aligned} E &= A[N]^{\psi}[y/n]^{\psi}, \\ T &= gR \quad 0 > g > 1, \\ D &= E - T, \\ Y &= F[K, L, N], \end{aligned}$$

where

$$\begin{aligned} E &= \text{expenditures,} \\ N &= \text{population} \\ Y &= \text{homogeneous consumption good,} \\ D &= \text{deficit,} \\ K &= \text{capital,} \\ L &= \text{land,} \\ R &= \text{real rent of land,} \\ g &= \text{the tax rate.} \end{aligned}$$

Note that the public sector is basically independent of production and income if  $\psi = 0$ , which Stone assumes. Therefore, the public sector serves merely to reduce income. Stone also implicitly assumes that  $\partial R / \partial D = 0$ , which is probably *not* true. Assuming perfect capitalization, one would expect  $\partial R / \partial D < 0$ . The land market can be represented simply as:

$$\begin{aligned} L_D &= f(R, N, Y/N), \\ L_s &= \bar{L}_s, \\ L_D &= \bar{L}_s, \\ R &= R(D, N, Y/N), \end{aligned}$$

where  $L_D$  is the demand for land; and  $L_s$  is the supply of land, with the supply of land fixed at  $\bar{L}_s$ . Thus, we assume that the demand for land increases with population ( $\partial L_D / \partial N > 0$ ) and is related inversely to land prices ( $\partial L_D / \partial R < 0$ ). With supply fixed, the price of land  $R$  is demand determined. Land rent is assumed to be related to net government services as discussed above.

Assuming a balanced budget,  $D = 0$ , and  $\Phi = \Psi = 1$ , we have the following:

$$\begin{aligned} E &= AY, \\ T &= gR(N, Y/N), \\ Y &= F[K, L, N], \end{aligned}$$

substituting:

$$\begin{aligned} E &= A[F[K, L, N]], \\ T &= gR[N, Y/N]. \end{aligned}$$

Over time, growth in expenditures must equal growth in revenues to maintain the  $D = 0$  condition. Differentiating the above functions with respect to time:

$$\begin{aligned} \frac{dE}{dt} &= A \frac{dF}{dK} \frac{dK}{dt} + A \frac{dF}{dL} \frac{dL}{dt} + A \frac{dF}{dN} \frac{dN}{dt}, \\ \frac{dT}{dt} &= g \frac{dR}{dN} \frac{dN}{dt} + g \frac{dR}{dY/N} \frac{dY/N}{dt}. \end{aligned}$$

Recall that land is fixed, therefore  $dL/dt = 0$ , and in equilibrium:

$$A \frac{dF}{dK} \frac{dK}{dt} + A \frac{dF}{dN} \frac{dN}{dt} = g \frac{dR}{dN} \frac{dN}{dt} + g \frac{dR}{dY/N} \frac{dY/N}{dt}.$$

Under the Stone formulation of expenditure growth assuming  $\Psi = 0$ , one would have:

$$A \frac{dN}{dt} = g \left( \frac{dR}{dN} \frac{dN}{dt} + \frac{dR}{dY/N} \frac{dY/N}{dt} \right).$$

If  $A = 1$ , and zero population growth is expected in urban areas (actually, current trends indicate negative population growth), then under the Stone expenditure model, a balanced budget is no problem. In fact, if capital grows, that is, if there is increasing  $Y/N$ , a surplus will result. If expenditures grow with income, the budget will be balanced if

$$\frac{dY}{dK} \frac{dK}{dt} = g \frac{dR}{dY/N} \frac{dY/N}{dt}.$$

Under the assumption that moderate capital accumulation occurs, that the demand for land is income elastic, population growth is zero, and that the marginal product of capital falls as it is added to fixed land and labor, revenue adequacy should be less difficult than in the original Stone formulation. His result is shown graphically in Figure 3.1.

As population increases (assuming  $K$  constant), rent (and potential revenue) increases, whereas per capita expenditures remain constant. Unfortunately, the model is unstable, in that population cannot meaningfully exceed  $N_2$ . By allowing capital to increase, the average and marginal products will shift out. Given Hicks's neutral progress and  $\sigma=1$ , the relative shares of capital and labor should remain constant as population and capital increase. If per capita expenditures remain constant and land returns are demand determined (with population elasticity = 1), a dynamic balanced budget can easily be maintained. However, given identical population elasticities of revenues and expenditures (and a beginning balanced budget), nonzero income elasticities will determine the dynamic fiscal status. If the income elasticity of demand for land is less than one, a deficit will eventually result.

Note that this model is extremely oversimplified. There is a distinct bias in the results in that land revenues are expected to cover all expenditures, whereas our original contention is merely that land taxes should at least equal current property tax revenues. In a dynamic context, it is clear that intergovernmental revenues have grown as a percentage of total revenues. If that trend continues, land taxes would have to finance a smaller share of expenditures over time.

#### *Examples of the Adequacy of Site Valuation Taxation in Practice*

As our last piece of evidence concerning the yield adequacy of a site value tax, we appeal to practical examples of this type of taxation. There

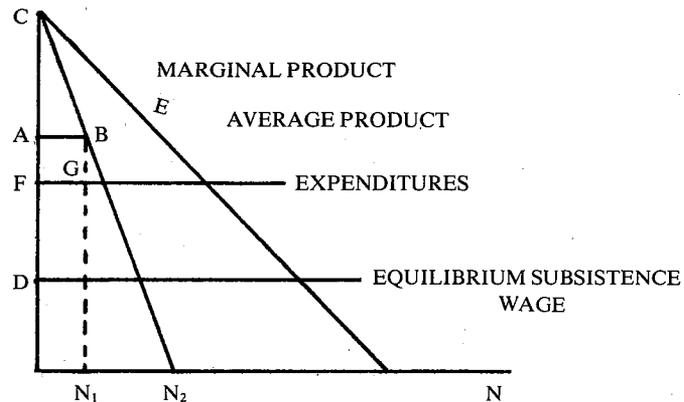


Figure 3.1. Dynamic Equilibrium in a Ricardian World

$CAB$  = return to land (and maximum land tax revenue)

$ABDE$  = profits

$ODEN_1$  = wages

$OFGN_1$  = total expenditures

are many examples of countries that rely at least in part on land taxes. For the purpose at hand, we restrict the examples to those where urban areas rely on site value taxation (or taxation on unimproved land values) as their sole source of property tax. This does not presume that all local revenue is derived from the property tax. However, George Lent (1974) has conveniently summarized the developing countries that use an urban site value tax. His results are reproduced in table 3.5.

Table 3.5. Countries with site value taxation

Country	Description of Tax System
Barbados	The annual value system was replaced by a tax on site value by the Valuation Act, 1969; it was planned to be put into effect in 1972.
Republic of China	Tax on the unimproved value of land is based on self-assessment; a separate tax at higher rates is imposed on vacant and under-improved land. A highly graduated Land Value Increment Tax is also imposed on increases in value over a 10-year period, and at time of sale.
Greece	Municipalities with a population over 20,000 are authorized to levy an annual tax on the value of unimproved land within the town plan area. The tax is graduated with a person's total holdings.
Iraq	The urban land tax is based on the market value of unimproved land located within cities. In 1970 the rate was 5 percent. (There is also a real estate tax based on gross annual income derived from all real estate holdings.)
Jamaica	Jamaica converted to a site value tax by a law enacted January 18, 1957; the transition was interrupted in 1962, leaving a dual capital value and site value system in operation.
Kenya	All municipalities and most towns and county councils tax site values.
Tanzania	Urban council areas tax only unimproved values although they are authorized to tax improvement as well. Specified townships in district council areas levy house taxes, and Zanzibar employs a tax on net rental value.
Trinidad and Tobago	The Valuation of Land Act, 1969, provided for replacement of the annual value system by one based on modified site value; improvements are taxed only when they have a high ratio to land value. The new tax is expected to be implemented in 1974.

Source: G. E. Lent 1974, pp. 45-72.

It is reassuring that these are examples of site value taxation which are apparently viable. In most of these cases, however, other sources of revenue supplement the proceeds of the land tax. Also, as Woodruff and Ecker-Racz suggest in reference to Australia and New Zealand, "as a revenue producer, the land tax was never impressive" (1969). They attribute this problem to low rates and numerous exemptions. Exemptions were cited by the United Nations Secretariat (1975) as a major problem in maintaining revenue in developing countries. Holland also suggests that exemptions and low rates resulted in a land tax with low elasticity in Jamaica (1969).

It should also be stressed that the general equilibrium price changes discussed in the second section of this paper could be negligible if indeed the tax rates involved were low. Also, the efficiency effects usually cited in terms of encouraging land development could also be mitigated by low rates and exemptions. In Pittsburgh, a city that has a system in which land is taxed at twice the rate of buildings, R. L. Richman (1965) found little in the way of development effects, a condition which he attributed to differential tax rates and the assessment of land at its current rather than potential value.

The analysis here has ignored these issues in that the assumption was made that a site value tax would consist of a tax on the potential value of all land with no exemptions. This assumption, while extending the tax base, is probably not realistic. Implementation of site value taxes traditionally has included exemptions. Nevertheless, the existing evidence on site value taxation in practice indicates that this type of property tax is a viable source of revenue for urban areas.

### Conclusion

The dynamic analysis of the revenue adequacy of site value taxation is positive on the whole. Trends in city expenditures cast some doubt on the ability of a site value tax to act as sole revenue source, but that is not the question at hand. As a substitute for the revenue provided by the existing property tax, there is a greater likelihood that revenues would be adequate. Theoretical evidence indicates that, given relatively fixed land (as is characteristic of older cities "locked in" by suburbs), land prices should increase at least as fast as expenditures. This does not take into consideration the possibility of rising expenditures due to deterioration of the "environment" in cities, i.e., the fact that needs may increase over time. However, a more rigorous analysis of the dynamic relationship of revenues and expenditures awaits a definitive statement of the way in which expenditures grow in cities. The last piece of evidence available on

the long-run revenue capacity of site value taxation is empirical. Site value taxation has weathered the test of time in countries all over the world.

In the short run, site value taxation can indeed generate revenue equal to that of the current property tax in urban areas. In the longer run, however, untaxing buildings will cause a change in relative prices, which will in turn change the value of the tax base. Thus, by relaxing the partial equilibrium assumption that prices remain constant, we show that land prices could well increase after adjustment to change. Thus, our general equilibrium result is that the tax base could increase as a result of untaxing buildings and taxing land at a uniform rate. The dynamic issue of whether revenues from site value tax can keep pace with urban expenditures is difficult. Given a number of assumptions that are quite conservative, a site value tax can keep pace. Therefore, our revenue conclusion is that taxing land instead of land and buildings will not, in itself, cause cities to find themselves with financial difficulties. This conclusion is tentative, however, in that our analysis was limited by assuming the land tax would be administered properly (i.e., land would be assessed at potential value with no exemptions), and implemented at a uniform rate. Further research efforts are needed. Efforts in terms of current land value estimates based on cadastral maps, general equilibrium estimates following the approach used by Shoven and Whalley, and dynamic modeling which integrates a model of government expenditures, are all important in answering the question posed at the outset of this paper, whether site value taxation can finance local government activity.

#### References

- Aaron, Henry. 1975. *Who Pays the Property Tax?* Washington, D.C.: The Brookings Institution.
- Arnott, Richard J., and James G. MacKinnon. 1977. "The Effects of the Property Tax: A General Equilibrium Simulation." *Journal of Urban Economics* 4: 389-407.
- Courant, Paul N. 1977. "A General Equilibrium Model of Heterogeneous Local Property Taxes." *Journal of Public Economics* 8: 313-27.
- Douglas, Richard W. 1978. "Site Value Taxation and Manvel's Land Value Estimates." *The American Journal of Economics and Sociology* 37: 217-23.
- Feldstein, Martin. 1977. "The Surprising Incidence of a Tax on Pure Rent: A New Answer to an Old Question." *Journal of Political Economy* 85: 349-60.
- Gaffney, Mason. 1970. "Adequacy of Land as a Tax Base." In *The Assessment of Land Value*, ed. Daniel M. Holland, Madison: Univ. of Wisconsin Press.
- George, Henry. 1879. Reprint 1975. *Progress and Poverty*. New York: Robert Schalkenbach Foundation.
- Goldsmith, Raymond W. 1956. *Study of Saving in the U.S.*, vol. 3. Princeton: Princeton Univ. Press.

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- Goldsmith, Raymond W. 1962. *The National Wealth of the U.S. in the Postwar Period*. Princeton: Princeton Univ. Press.
- Harberger, A. C. 1962. "The Incidence of the Corporate Income Tax." *Journal of Political Economy* 70: 215-40.
- Heilbrun, James. 1966. *Real Estate Taxes and Urban Housing*. New York: Columbia Univ. Press.
- Heilbrun, James. 1969. "Reforming the Real Estate Tax." In *Land and Building Taxes: Their Effect on Economic Development*, ed. Arthur P. Becker, Madison: Univ. of Wisconsin Press.
- Hicks, Ursula. 1961. *Development from Below*. Oxford: Oxford Univ. Press.
- Holland, Daniel M. 1969. "A Study of Land Taxation in Jamaica." In *Land and Building Taxes*, ed. Arthur P. Becker, Madison: Univ. of Wisconsin Press.
- Kurnow, Ernest. 1960. "Land Value Trends in the U.S." *Land Economics* 36: 341-48.
- Kurnow, Ernest, et al. 1961. *Theory and Measurement of Rent*. New York: Chilton Co.
- Lent, G. E. 1974. "The Urban Property Tax in Developing Countries." *Finanzarchiv* 33: 45-72.
- McLure, Charles E. 1972. "A Diagrammatic Exposition of the Harberger Model with One Immobile Factor." *Journal of Political Economy* 80: 56-82.
- Manvel, Allen O. 1968. "Trends in the Value of Real Estate and Land." In *Three Land Research Studies*, no. 12: 1-14. Washington, D.C.: National Commission on Urban Problems.
- McDougall, G. S. 1976. "Local Public Goods and Residential Property Value: Some Insights and Extensions." *National Tax Journal* 29: 436-37.
- Mieszkowski, Peter M. 1972. "The Property Tax: An Excise Tax or a Profits Tax." *Journal of Public Economics* April: 73-97.
- Neuner, Edward J., Dean O. Popp, and Frederick D. Seabold. 1974. "The Impact of a Transition to Site-Value Taxation on Various Classes of Property in San Diego." *Land Economics* 50:181-85.
- Polinsky, Mitchell A., and Daniel L. Rubinfeld. 1978. "The Long-Run Effects of a Residential Tax and Local Public Services." *Journal of Urban Economics* 5: 241-62.
- Richman, Raymond L. 1965. "The Theory and Practice of Site-Value Taxation in Pittsburgh." In *1964 Proceedings of the Fifty-Seventh Annual Conference on Taxation*. Harrisburg, Pa.: National Tax Association.
- Scarf, H. E., and T. Hansen. 1973. *The Computation of Economic Equilibria*. New Haven: Yale Univ. Press.
- Schaaf, A. H. 1969. "Effects of Property Taxation on Slums and Renewal: A Study of Land-Improvement Assessment Ratios." *Land Economics* 45:111-17.
- Schroeder, Larry D., and David L. Sjoquist. 1975. *The Property Tax and Alternative Local Taxes*. New York: Praeger.
- Shoven, J. B., and J. Whalley. 1977. "Equal Yield Tax Alternatives." *Journal of Public Economics* 8: 211-24.
- Smith, Theodore. 1970. "Land Versus Real Property Taxation: A Case Study Comparison." *Land Economics* 46: 304-13.

- Stone, Gerald W. 1975. "Public Spending, Land Taxes and Economic Growth: An Empirical Analysis of the Adequacy of Land as a Tax Base." *The American Journal of Economics and Sociology* 34: 111-26.
- U.N. Secretariat. 1975. "Site-Value Taxation in Developing Countries." In *Readings in Taxation in Developing Countries* ed. Oldman and Brin, pp. 470-76. Baltimore: Johns Hopkins Press.
- Wales, T. J., and E. G. Wiens. 1974. "Capitalization of Residential Property Taxes: An Empirical Study." *Review of Economics and Statistics* August: 329-33.
- Woodruff, A. M., and L. L. Ecker-Racz. 1969. "Property Taxes and Land Use Patterns in Australia and New Zealand." In *Land and Building Taxes*, ed. Arthur P. Becker, Madison: Univ. of Wisconsin Press.