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LAND VALUE TAXATION  
AND  
URBAN HOUSING:  
THE CASE OF PITTSBURGH  
\* \* \*  
A RESEARCH PROPOSAL

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## Introduction

This dissertation proposal is submitted in the form of a discussion paper. As such, it is a preliminary proposal, to be followed by a formal proposal once agreement has been reached with regard to its substantive aspects.

The proposed research is empirical in nature and involves a test of the effects of land value taxation on urban development in Pittsburgh. Due to data limitations, the study will focus on the relationship between land value taxation and housing development in Pittsburgh. Land value taxation generally refers to the taxation of land at rates higher than those levied against buildings and other improvements. Various unburdening and incentive effects of shifting the tax base from improvements to land will, according to theory, encourage development. In recent years, real estate tax rate changes in Pittsburgh have resulted in a steady and substantial increase in the land tax rate and fluctuations in the rate applied to improvements. It is believed that these changes are significant and should, therefore, provide an adequate basis for testing the proposition that land value taxation encourages development.

Few cities in the United States use land value taxation. Most of the cities that do employ such a tax

system are in Pennsylvania, where state law authorizes most municipalities to use non-uniform real estate taxes. A number of cities in Pennsylvania were considered as possible candidates for study. In addition to Pittsburgh, these cities included McKeesport, New Castle, and Scranton. All except Pittsburgh were eliminated from consideration due to data problems. In each of the eliminated cities, some elements of data needed for this study were simply not available and other elements were not in accessible (i.e., computerized) form. For these reasons, Pittsburgh is evidently the only city in the United States for which there is a sufficient amount of data in the right form to permit a systematic test such as the one proposed here.

The balance of this paper is divided into three parts in addition to a section of notes. The first part of the paper covers the microeconomic theory which supports the proposition that land value taxation will encourage development. Although there is some discussion in the literature of macroeconomic effects,<sup>1</sup> it is hardly relevant to the present study of land value taxation as adopted in a single, isolated city. The discussion of microeconomic theory is limited to a consideration of the efficiency or resource allocation effects of taxes on land and improvements. No attention will be given to the important equity and other issues which must be considered along with

resource allocation questions in the development of tax policy. The proposed research will not recommend any policy; instead, it will merely test an hypothesis derived from a consideration of the resource allocation effects of real estate taxes.<sup>2</sup>

The second part of this paper reviews previous empirical studies of land value taxes, including studies of both hypothetical and actual taxes. Studies of land value taxation in Pittsburgh are considered in a separate section within this part. The conclusion reached following this review of empirical work is that, to date, there has not been an adequate test of the effects of land value taxation. Clearly, there is a need for a systematic and rigorous study of the relationship between land value taxation and development. It is believed that the proposed study will constitute a significant contribution toward satisfying that need.

The third part of this paper presents an econometric model for testing the proposition that land value taxation encourages housing development in Pittsburgh. In addition, this part discusses the sources of data for the model, computation requirements, and possible problems in estimating the model's coefficients.

In summary, this proposal is for a systematic empirical analysis of an important economic idea; namely, the hypothesis that shifting the real estate tax burden from

improvements to land will encourage development.

# I. Microeconomic Theory of Land Value Taxation

## A. Resource Allocation Effects of Taxes on Land and Improvements

A tax which does not interfere with the efficient allocation of resources is said to be neutral. Given the assumption that efficient allocation of resources is desirable, the student of public finance is concerned with devising taxes which are either neutral or as close to neutral as possible. The real estate tax on improvements is not neutral because the equilibrium quantity of structural services supplied decreases as a result of increases in that tax.<sup>3</sup> A deadweight loss of welfare results because the loss of producer and consumer surplus exceeds the amount of tax collected. As shown in Figure 1 (next page), a tax on structures shifts the before tax supply curve ( $S_{S(BT)}$ ) upward by an amount equal to the tax. Before the tax, consumer and producer surpluses were equal to the areas of the triangles AEP and PEC, respectively. After the tax, consumer and producer surpluses are reduced to AE'P' and P"BC, respectively. The amount of the tax collected, P'E'BP" is less than the total loss of surplus by the amount represented by the

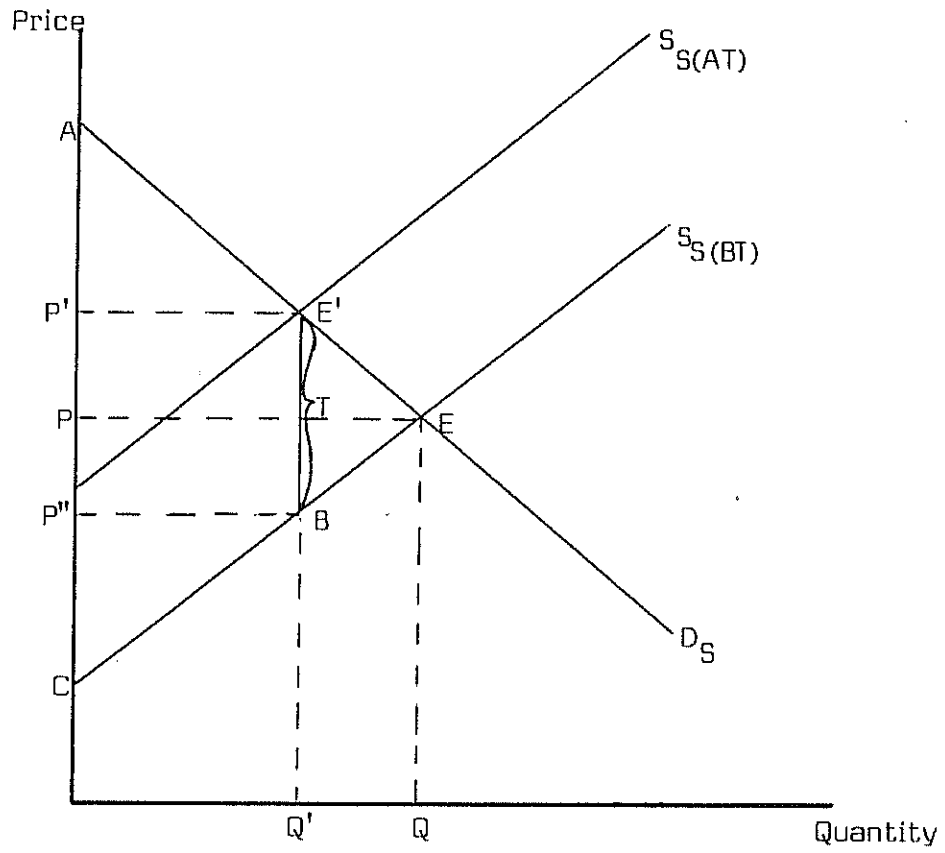


Figure 1. Effects of a tax on structures

area of triangle E'EB.

In contrast, many theorists argue that the tax on land is neutral because land is essentially fixed in supply in any given place such as Pittsburgh. This is represented by the vertical supply curve ( $S_L$ ) in Figure 2 (next page). Immediately upon imposition of the tax, the demand for land ( $D_L$ ) will decrease because the price of land will increase by the amount of the tax ( $T$ ) from  $P$  to  $P'$ . Because the supply of land remains the same, landowners must ultimately pay the tax,<sup>4</sup> with the equilibrium quantity and price determined by the intersection of the demand and supply curves. Thus the price of land services will drop from  $P'$  back to  $P$  and the net amount received by the landowner will drop to  $P''$ . Note that there is apparently no deadweight loss in this case because the amount of tax collected,  $PEFP''$ , is precisely equal to the loss of surplus (which is borne entirely by the landowner).

Thus many writers on the subject are satisfied that the land tax is neutral. Becker, for example, argues that: "Neutrality and efficiency are guaranteed by the fixity of supply of urban land."<sup>5</sup> He goes on to claim that:

If landowners were planning to produce the highest economic rent on their land, the imposition of a land value tax would in no way alter the owners' decision to carry out their plans for land use.<sup>6</sup>

Several writers have challenged this view with the



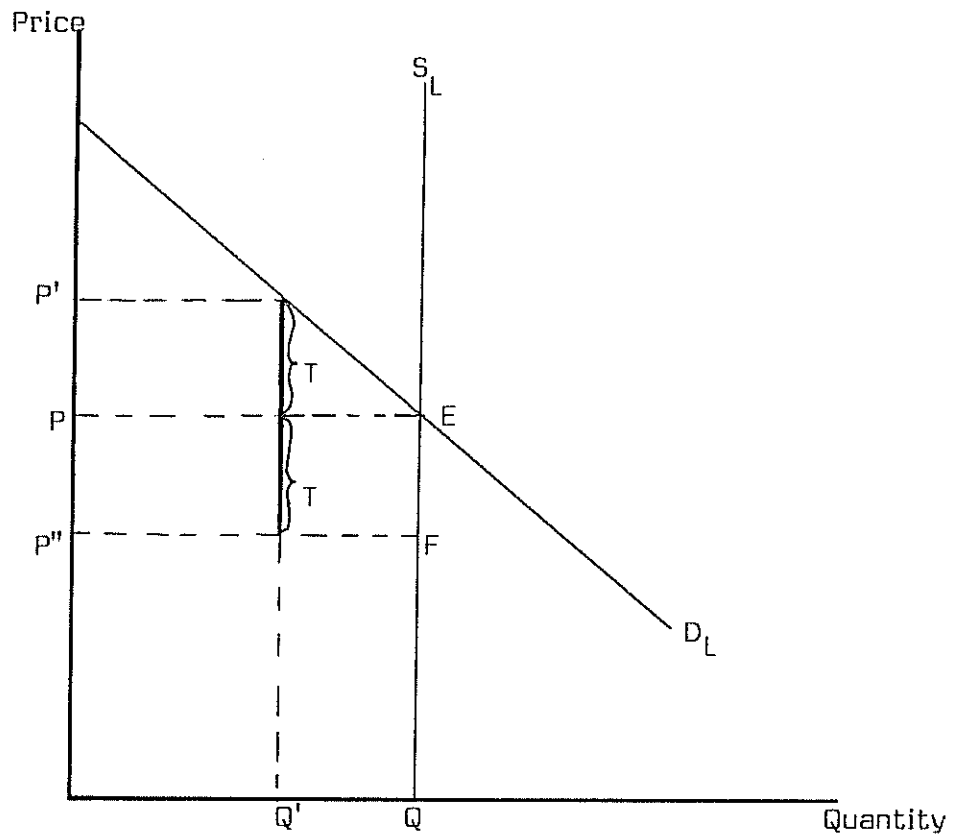


Figure 2. Effects of a tax on land

observation that the land tax has an effect on the timing and type of development.<sup>7</sup> Bentick, for example, argues:

that land taxes which are based on the current market value of land . . . divert land and saving from investment projects with a long gestation period to those which produce returns relatively quickly. This is because the market value of land reflects its future rentals, so that a tax on market value causes taxes to be levied ahead in time of the returns on which the tax is based, thus creating a liquidity problem which cannot be solved by a perfect capital market.<sup>8</sup>

Skouras attributes the misconception that land taxation is neutral to a failure to take into account the facts that optimal land uses changes over time and that land cannot be easily shifted from one use to another.<sup>9</sup>

Bentick shows how the land tax favors projects with relatively early returns by comparing two hypothetical projects.<sup>10</sup> The first project yields one dollar per year in perpetuity and has a present value of  $1/r$ , where  $r$  is an appropriate discount rate. The other project yields  $c$  dollars per year after a period,  $T$ . The present value of the second project is  $e^{-rT}c/r$ . The delayed project will be preferred if  $e^{-rT}c/r > 1/r$ . In this case the critical value of  $T$  is:

$$T' = \ln c/r$$

If a tax on land value,  $b$ , is introduced, then for the second project to be preferred, the following must be true:

$$e^{-(r+b)T}c/(r+b) > 1/(r+b)$$

In this case, the critical value of  $T$  is:

$$T'' = \ln c / (r + b)$$

It is clear that  $T'' < T'$  and, therefore, that the second project is less likely to be preferred after the tax than before.

A simple numerical example may help to clarify this point.<sup>11</sup> Assume that a site can be developed with single family houses now or an apartment building in one year. The land rent if used for single family houses would be  $s$  per year, while the rent if used for an apartment building would be  $a$  per year. Thus the development value of the land today is:<sup>12</sup>

$$V_0 = s/r$$

The development value in one year would be:

$$V_1 = a/r$$

If  $s$ ,  $a$ , and  $r$  are \$1,000, \$1,100, and .10, respectively, then the landowner has no reason to prefer one project over the other because the present value of  $V_0$  equals  $V_1$ :

$$V_0 = V_1 / 1.10 = \$10,000$$

If a land tax of  $b$  is introduced, then:

$$V_0 = s / (r + b)$$

And:

$$V_1 = a / (r + b)$$

If  $b$  equals .05, then  $V_0$  is \$6,667,  $V_1$  is \$7,333, and the

present value of  $V_1$  is \$6,377. The landowner is no longer indifferent and, instead, prefers the first project over the second.

All of this plays havoc with the assertion that the land tax is neutral in its resource allocation effects. Bentick argues that the resource cost of the land value tax is probably substantial:

When one considers the long time horizons involved in forestry, mining, and urban construction, it is likely that the resource cost of higher tax rates will be significant relative to all realistic discount rates.<sup>13</sup>

Mills comes to similar conclusions.<sup>14</sup> Skouras is more sanguine about this state of affairs:

Thus, it would seem that, as a result of the above analysis, land taxation has lost one point in that its claim of neutrality has been refuted, but has also won at least another point in that it encourages economic use of land and, more importantly, discourages waste and promotes land use and development.<sup>15</sup>

It seems counterintuitive to conclude that a tax which encourages development of urban land which would otherwise be used less intensively could result in substantial inefficiencies. Perhaps Bentick's and Mills' analyses should have taken into account those benefits of development which do not appear if one limits one's attention to the present values of development projects and streams of tax payments. Obvious omissions are the external benefits of development, specifically the effects of development

in increasing the values of adjacent sites. These external effects are substantial and could more than offset any efficiency losses resulting from early development of land.<sup>16</sup> Whether this is the case or not is an important question meriting extended treatment not possible here. Fortunately, it is not necessary to resolve this issue for the purposes of the study proposed in this paper.

### B. Effects of Shifting Taxes from Improvements to Land

At least two effects of shifting the tax burden from improvements to land have already been identified. One is the effect of increased land taxes, which should encourage earlier development of land due to the increased holding costs borne by landowners. The second is the unburdening effect of decreasing the tax rate on improvements. Becker lists four effects of a shift to land value taxation, two of which correspond to those mentioned.<sup>17</sup> A third effect is the fixed-cost effect, which refers to the fact that the land value tax is independent of the degree of improvement of a site. It is difficult to see how this could encourage development, however, because it is in this respect that the land tax is neutral.

Worthy of more attention is what Becker calls the

Table 3

Property Tax Rates, City of Pittsburgh, 1978-1984 \*  
(in mills)

<u>Year</u>	<u>Land</u>	<u>City Structures</u>	<u>County</u>	<u>School District</u>
1978	49.5	24.75	21.375	29
1979	97.5	24.75	19.365	29
1980	125.5	24.75	23	29
1981	125.5	24.75	28	41
1982	133	32	29	36
1983	151.5	27	29	36
1984	151.5	27	29	40

\*Note: This table is continued on the following page.

Sources: Pittsburgh City Treasurer's Office (city and school district rates), County of Allegheny Deed Registry and Records Management Office (county rates), and Pittsburgh Code, Chapter 265 ("Exemptions for Residential Improvements").

Table 3  
(continued)

Property Tax Rates, City of Pittsburgh, 1978-1984  
(in mills)

<u>Year</u>	<u>Adjusted Combined City and School District Structure Rate</u>	<u>Total Effective Structure Rate</u>	<u>Total Land Rate</u>
1978	53.75**	75.125**	99.875
1979	53.75**	73.115**	145.865
1980	40.38	63.38	177.5
1981	49.4	77.4	194.5
1982	51.09	80.09	198
1983	47.33	76.33	216.5
1984	50.34	79.34	220.5

\*\*Note: The three-year abatement for new improvements and new construction went into effect in 1980.

an effect on development. The largest changes in the effective rate for improvements were the drop in 1980 from 7.3115 percent to 6.338 percent and the increase in 1981 from 6.338 percent to 7.74 percent (see Table 3).

### C. Potential Problems

In addition to the potential problems already discussed, there are the standard problems encountered in regression analysis, namely, multicollinearity, heteroscedasticity, and autocorrelation. Multicollinearity--the presence of an exact or approximately exact linear relationship among some or all of the explanatory variables--is not likely to be a problem in theory as each of the four explanatory variables would seem to have an independent influence on the dependent variable. Despite this, multicollinearity can arise in the data and cause imprecise estimation of the parameters because it results in large standard errors of the estimators. Therefore, it will be necessary to test for this problem and take remedial measures, if needed.<sup>84</sup>

Heteroscedasticity is a violation of the assumption that the error terms (the  $u_{ij}$ 's) all have the same variance. Heteroscedasticity may result in t and F statistics which exaggerate the significance of a model's parameters. This



may be a problem in the present model due to the different sizes and characters of the wards of Pittsburgh. According to Gujarati:

It should be noted that the problem of heteroscedasticity is likely to be more common in cross-sectional than time-series data. In cross-sectional data, one usually deals with members of a population at a given point in time, such as individual consumers or their families, firms, industries, or geographical subdivision, such as state, county, or city, etc. Moreover, these members may be of different sizes, such as small, medium, or large firms or low, medium, or high income.<sup>85</sup>

Here again, it will be necessary to test for this problem and, possibly, take remedial steps.<sup>86</sup>

A final problem is autocorrelation, or correlations among the error terms. Autocorrelation makes the usual  $t$  and  $F$  tests of significance unreliable. Detection of autocorrelation in the proposed model will be particularly difficult because correlation can occur spatially as well as temporally. As Cliff and Ord note:

The problem of determining whether geographical data are spatially autocorrelated is fundamentally different from measuring autocorrelation in stationary time series. This is because the variate in a time series is influenced only by past values, while for a spatial process dependence extends in all directions.<sup>87</sup>

Although there are statistics which test for spatial autocorrelation,<sup>88</sup> they are rather complex and unwieldy. Instead, graphical methods will be used to test for both spatial and temporal autocorrelation. Spatial autocorrelation can be detected by analyzing maps of ward

residuals for each year, while temporal autocorrelation can be detected by graphing each ward's residuals against time.<sup>89</sup> Although these graphical methods are somewhat crude, they are also simple and have the advantage of providing information which can suggest remedial measures.

## Notes

1. See, for example, Arthur P. Becker, "Principles of Taxing Land and Buildings for Economic Development," in Land and Building Taxes: Their Effect on Economic Development, ed. Arthur P. Becker (Madison: University of Wisconsin Press, 1969), pp. 36-44.
2. Some general, policy-oriented discussions of land value taxation can be found in: Arthur P. Becker, "Arguments for Changing the Real Estate Tax to a Land Value Tax," Tax Policy 37 (1970): 15-31; Arthur P. Becker, ed., Land-Value Taxation and Contemporary Economic Thought (Milwaukee: Boulder Conference Committee, 1964); Becker, "Principles of Taxing Land and Buildings," pp. 11-47; Mason Gaffney, "An Agenda for Strengthening the Property Tax," in Property Tax Reform, ed. George E. Peterson (Washington, D.C.: The Urban Institute, 1973), pp. 65-84; Mason Gaffney, "Property Taxes and the Frequency of Urban Renewal," in 1964 Proceedings of the Fifty-Seventh Annual Conference on Taxation, ed. Walter J. Kress (Harrisburg, Pa.: National Tax Association, 1965), pp. 272-285; Mason Gaffney, "Land Rent, Taxation, and Public Policy," Papers of the Regional Science Association 23 (1969): 141-153; Donald G. Hagman, "Land-Value Taxation," in Windfalls for Wipeouts: Land Value Capture and Compensation, ed. Donald Hagman and Dean Misczynski (Chicago: Planners Press, 1978), pp. 399-421; C. Lowell Harriss, "Property Taxation: What's Good and What's Bad About It," American Journal of Economics and Sociology 33 (1974): 89-102; James Heilbrun, Real Estate Taxes and Urban Housing (New York: Columbia University Press, 1966); James Heilbrun, "Reforming the Real Estate Tax to Encourage Housing Maintenance and Rehabilitation," in Land and Building Taxes: Their Effect on Economic Development, ed. Arthur P. Becker (Madison: University of Wisconsin Press, 1969), pp. 63-79; H. Philip Howorth, "Site Value Taxation: A Solution to Allocation Problems in the Taxation of Real Estate," Massachusetts Law Quarterly 47 (1962): 28-36; R. W. Lindholm, "Land Taxation and Economic Development," Land Economics 41 (1965): 121-130; David B. McCalmont, "Differential Taxation of Site Values and Structures," Southern Economic Journal 43 (1976): 924-936; Dick Netzer, Economics of the Property Tax (Washington, D.C.: The Brookings

Institution, 1966); Dick Netzer, "Impact of the Property Tax: Effect on Housing, Urban Land Use, Local Government Finance," in Municipal Needs, Services and Financing: Readings on Municipal Expenditures, ed. W. Patrick Beaton (New Brunswick, N.J.: Center for Urban Policy Research, 1974), pp. 151-178; Dick Netzer, "The Property Tax and Alternatives in Urban Development," Papers and Proceedings of the Regional Science Association 9 (1962): 191-200; A. R. Prest, The Taxation of Urban Land (Manchester, U.K.: Manchester University Press, 1981); and A. H. Schaaf, "Some Uncertainties About the Desirability of Site Value Taxation," Tax Policy 37 (1970): 33-41. Papers emphasizing the relationship between real estate tax policy and land use planning include: Clyde E. Browning, "Land Value Taxation: Promises and Problems," Journal of the American Institute of Planners 29 (1963): 301-309; George W. Carey, "Land Tenure, Speculation, and the State of the Aging Metropolis," Geographical Review 66 (1976): 253-265; Comment, "Municipal Real Estate Taxation as an Instrument for Community Planning," Yale Law Journal 57 (1947): 219-242; Orlando E. Delogu, "The Taxing Power as a Land Use Control Device," in Urban Land Use Policy: The Central City, ed. Richard B. Andrews (New York: Free Press, 1972), pp. 209-216; Mason Gaffney, "Land Planning and the Property Tax," Journal of the American Institute of Planners 35 (1969): 178-183; Donald G. Hagman, "Land-Use Planning Through Taxation," Current Municipal Problems 6 (1965): 343-360; Donald Hagman, "The Single Tax and Land-Use Planning: Henry George Updated," UCLA Law Review 12 (1965): 762-788; Charles E. Harris, "Site Value Taxation: Economic Incentives and Land Use Planning," Harvard Journal on Legislation 9 (1971): 115-155; Alan E. Land, "Toward Optimal Land Use: Property Tax Policy and Land Use Planning," California Law Review 55 (1967): 856-897; and Leonard C. Moffitt, "Planning and Assessing Practice," Land Economics 42 (1966): 371-378.

3. The term "structural services" is used because it allows for a common, albeit abstract, unit of measurement which takes into account all qualitative and quantitative aspects of structures.
4. Netzer writes (Economics of the Property Tax, p. 33): "It is generally agreed that taxes on the value of bare land--the sites themselves exclusive of applications of reproducible capital in the form of grading, fertilizer, and the like--rest on the owners

of the sites at the time the tax is initially levied or increased. The tax cannot be shifted because shifting is possible, under reasonably competitive conditions, only if the supply of sites is reduced. But the supply of land is, for all practical purposes, perfectly inelastic. Individual landowners will not respond to an increase in land taxes by withdrawing their sites from the market, since doing so will not affect their tax liability. Indeed, their only chance of reducing the burdensomeness of the tax relative to their income streams is to seek to raise the latter by encouraging more intensive use of the sites they own. Collectively, landowners cannot reduce the stock of land: if individual landowners wish to liquidate in the face of higher taxes, they must sell the sites to other owners."

5. Becker, "Principles of Taxing Land and Buildings," p. 33.
6. Ibid.
7. See: Roy W. Bahl, "A Land Speculation Model: The Role of the Property Tax as a Constraint on Urban Sprawl," Journal of Regional Science 8 (1968): 199-208; Brian L. Bentick, "The Impact of Taxation and Valuation Practices on the Timing and Efficiency of Land Use," Journal of Political Economy 87 (1979): 859-868; Richard W. Douglas, Jr., "Site Value Taxation and the Timing of Land Development," American Journal of Economics and Sociology 39 (1980): 289-294; David E. Mills, "The Non-Neutrality of Land Value Taxation," National Tax Journal 34 (1981): 125-129; Donald C. Shoup, "The Optimal Timing of Urban Land Development," Papers of the Regional Science Association 25 (1970): 33-44; A. Skouras, "The Non-Neutrality of Land Taxation," Public Finance 33 (1978): 113-134; and Roger S. Smith, "The Effects of Land Taxes on Development Timing and Rates of Change in Land Prices," in The Taxation of Urban Property in Less Developed Countries, ed. Roy W. Bahl (Madison: University of Wisconsin Press, 1979).
8. Bentick, p. 860.
9. Skouras, p. 115.
10. Bentick, pp. 861-863.
11. For this example, continuous compounding will be abandoned for the sake of simplicity.

12. Douglas (pp. 289-290) distinguishes between the development value and market value of land. The former is the value of land to a developer, while the latter (p. 290): "depends upon whether selling now or later is more profitable (that is, on which strategy has the higher present value)."
13. Bentick, p. 864.
14. Mills, pp. 127-128; however, Douglas argues that the land tax may be neutral in effect due to assessment practices. The findings of non-neutrality assume a tax which is based on land value while Douglas suggests that a use value tax would be more realistic. Use value is based on the income which a property does or could generate in a given period while land value is the present value of the stream of future land rents. It seems doubtful that Douglas' view of assessment practice is actually more realistic than the standard view. See Richard M. Douglas, Jr., "Land Taxation, Neutrality, and Risk Aversion," Public Finance Quarterly 7 (1979): 231-237.
15. Skouras, p. 129.
16. See Mason Gaffney, "Adequacy of Land as a Tax Base," in The Assessment of Land Value, ed. Daniel M. Holland (Madison: University of Wisconsin Press, 1970), pp. 195-197.
17. Becker, "Principles of Taxing Land and Buildings," pp. 24-30.
18. Ibid., p. 25.
19. Ibid., pp. 35-36.
20. At the same time, the yield of the tax,  $L_b$ , approaches  $E$ , because  $L_b = E_b / (r + b)$  and, as  $b$  approaches infinity,  $b / (r + b)$  approaches 1.
21. Becker, "Principles of Taxing Land and Buildings," p. 35.
22. Ibid., p. 30.
23. Gaffney, "Adequacy of Land," pp. 187-192.
24. Hagman, "The Single Tax and Land-Use Planning," p. 779.

25. Ibid.
26. Ibid., pp. 784-787.
27. Eli Schwartz and James E. Wert, An Analysis of the Potential Effects of a Movement Toward a Land Value Based Property Tax (Albany, N.Y.: Economic Education League, 1958).
28. Ibid., p. 35.
29. Mary Rawson, Property Taxation and Urban Development: Effects of the Property Tax on City Growth and Change (Washington, D.C.: Urban Land Institute, 1961).
30. A. H. Schaaf, "Effects of Property Taxation on Slums and Renewal: A Study of Land-Improvement Assessment Ratios," Land Economics 45 (1969): 111-117.
31. Ibid., p. 116.
32. Steven Cord, "The Role of the Graded Tax in Urban Redevelopment: A Case Study of Lancaster, Pa.," American Journal of Economics and Sociology 29 (1970): 323-327.
33. Theodore R. Smith, "Land Value Versus Real Property Taxation: A Case Study Comparison," Land Economics 46 (1970): 309-310.
34. Edward J. Neuner, Dean O. Popp, and Frederick D. Sebold, "The Impact of a Transition to Site-Value Taxation on Various Classes of Property in San Diego," Land Economics 50 (1974): 181-185.
35. Edwin Chester, "The Site Value Tax: Its Potential Effect on Urban and County Land Values in North Carolina," Carolina Planning 2 (1970): 46-48.
36. Steven C. Bourassa, "Land Value Taxation and Residential Land Use in Central Philadelphia," Proceedings of the Middle States Division, Association of American Geographers 16 (1982): 35-37.
37. Richard Pollock and Donald Shoup, "The Effect of Shifting the Property Tax Base from Improvement Values to Land Value: An Empirical Estimate," Land Economics 53 (1977): 67-77.
38. Ibid., p. 75.

39. Ibid., p. 76.
40. Heilbrun, Real Estate Taxes and Urban Housing, p. 117.
41. George E. Lent, "The Taxation of Land Value," International Monetary Fund Staff Papers (March 1967), pp. 89-121.
42. John J. Hulten, "Hawaii's Modified Property Tax Base Law," in 1969 Proceedings of the Sixty-Second Annual Conference on Taxation, ed. Stanley J. Bowers (Columbus, Ohio: National Tax Association, 1970), pp. 52-85.
43. Ibid., p. 60.
44. Ray W. Archer, Site Value Taxation in Central Business District Redevelopment (Washington, D.C.: Urban Land Institute, 1972), pp. 24-37.
45. Ibid., pp. 32-33.
46. W. A. V. Clark, The Impact of Property Taxation on Urban Spatial Development (Los Angeles: Institute of Government and Public Affairs, University of California, 1974), pp. 32-75.
47. Ibid., pp. 76-111.
48. Ibid., pp. 101 and 104.
49. Carey, "Land Tenure," pp. 254-260.
50. John McCulloch, "Site Value Rating in Johannesburg, South Africa," in The Taxation of Urban Property in Less Developed Countries, ed. Roy W. Bahl (Madison: University of Wisconsin Press, 1979), p. 263.
51. Edward J. Mathis and Charles E. Zech, "An Empirical Test: The Economic Effects of Land Value Taxation," Growth and Change 13 (October 1982): 2-5.
52. Donald A. Coffin and Michael A. Nelson, "An Empirical Test: The Economic Effects of Land Value Taxation-- Comment," Growth and Change 14 (July 1983): 44-46.
53. Ibid., p. 45.
54. Steven B. Cord, "Taxing Land More Than Buildings: The Record in Pennsylvania," in The Property Tax and Local Finance, ed. C. Lowell Harriss (New York:



Academy of Political Science, 1983), pp. 172-179.

55. A number of studies of land value taxes were not mentioned in this section because they would not have added anything significant to the discussion; they include: Harry Gunnison Brown et al., eds., Land-Value Taxation Around the World (New York: Robert Schalkenbach Foundation, 1955); F. H. Finnis, "Site Valuation and Local Government," Canadian Tax Journal 11 (1963): 118-126; Hagman, "Land-Value Taxation," pp. 404-421; C. Lowell Harriss, "Land Taxation in Taiwan: Selected Aspects," in The Taxation of Urban Property in Less Developed Countries, ed. Roy W. Bahl (Madison: University of Wisconsin Press, 1979), pp. 191-204; Robert O. Harvey and W. A. V. Clark, "Controlling Urban Growth: The New Zealand and Australian Experiment," The Appraisal Journal 32 (1964): 551-558; Albert T. Henley, "Land Value Taxation by California Irrigation Districts," in Land and Building Taxes: Their Effect on Economic Development, ed. Arthur P. Becker (Madison: University of Wisconsin Press, 1969), pp. 137-145; Daniel M. Holland, "A Study of Land Taxation in Jamaica," in Land and Building Taxes: Their Effect on Urban Development, ed. Arthur P. Becker (Madison: University of Wisconsin Press, 1969), pp. 239-286; Han Liang Huang, The Land Tax in China (New York: AMS Press, 1968 [reprint of 1918 edition]); and O. St. Clare Ridsen, "A History of Jamaica's Experience with Site Value Taxation," in The Taxation of Urban Property in Less Developed Countries, ed. Roy W. Bahl (Madison: University of Wisconsin Press, 1979), pp. 247-261.
56. This historical account is based on Percy R. Williams, "Pittsburgh's Pioneering in Scientific Taxation" and "Pittsburgh's Pioneering in Scientific Taxation, II," American Journal of Economics and Sociology 21 (1962): 37-56 and 209-223. These two articles--along with "Pittsburgh's Experience with the Graded Tax Plan" and "The Graded Tax in the Redevelopment of Pittsburgh," American Journal of Economics and Sociology 22 (1963): 149-172 and 251-262--were also published as The Pittsburgh Graded Tax Plan: Its History and Experience (New York: Robert Schalkenbach Foundation, 1963).
57. "Pittsburgh Expands Its Incentive Tax by 48 Mills," Incentive Taxation [Tujunga, Ca.: Henry George School], January-February 1979, pp. 1-2.
58. Pittsburgh City Treasurer's Office and Allegheny County Deed Registry and Records Management Office.

59. Ibid.
60. Edward F. Daume, "A Critical Analysis of the Operation of the Pittsburgh Graded Tax Law," Annals of the American Academy of Political and Social Sciences 148 (1930): 145-156.
61. Ibid., p. 151.
62. Thomas C. McMahon, "The Operation of the Graded Tax in Pittsburgh," Annals of the American Academy of Political and Social Sciences 148 (1930): 139-144.
63. Ibid., p. 143.
64. J. P. Watson, The City Real Estate Tax in Pittsburgh (Pittsburgh: Bureau of Business Research, University of Pittsburgh, 1934).
65. See Comment, "Municipal Real Estate Taxation," pp. 233-234.
66. Percy R. Williams, "Pittsburgh's Progress in Tax Reform, Resulting in Tax Relief and Encouragement of Real-Estate Improvement," Congressional Record 81 (1937): 5943-5945.
67. Williams, "Pittsburgh's Pioneering" and "Pittsburgh's Pioneering, II."
68. Williams, "Pittsburgh's Experience."
69. Williams, "The Graded Tax."
70. David C. Harrison, "Housing Rehabilitation and the Pittsburgh Graded Property Tax," Duquesne Law Review 2 (1964): 213-243.
71. Raymond L. Richman, "The Theory and Practice of Site-Value Taxation in Pittsburgh," in 1964 Proceedings of the Fifty-Seventh Annual Conference on Taxation, ed. Walter J. Kress (Harrisburg, Pa.: National Tax Association, 1965), p. 260.
72. Dan Sullivan et al., The Pittsburgh Property Tax: Preliminary Review and Findings of 1979 Land Rate Increase (New York: Center for Local Tax Research, 1979).
73. Henry O. Pollakowski, Adjustment Effects of a Tax

on Land: The Pittsburgh Case (Cambridge, Mass.: Lincoln Institute of Land Policy, 1982).

74. Ibid., p. 5.
75. Ibid.
76. Ibid., p. 21.
77. Stanley W. Hamilton, "Measuring Change in House Prices," in Recent Perspectives in Urban Land Economics: Essays in Honour of Richard U. Ratcliff and Paul F. Wendt, ed. Michael A. Goldberg (Vancouver, B.C.: Urban Land Economics Division, Faculty of Commerce and Business Administration, University of British Columbia, 1976), p. 65.
78. Ibid., p. 66.
79. Ibid.
80. Ibid., p. 67.
81. This will require a trip to Pittsburgh.
82. A tape of this file has been obtained at a considerable discount (\$300 in lieu of the regular price of \$1500) courtesy of Pittsburgh City Councilman Bill Robinson, a proponent of land value taxation.
83. When the ordinance was approved (1980), the ceilings were \$19,086 per dwelling unit for improvements and \$51,300 per unit for new construction. Pittsburgh Code, Chapter 265, §§ 265.03(b) and 265.04(b).
84. See, for example, Damodar Gujarati, Basic Econometrics (New York: McGraw-Hill, 1978), pp. 171-188.
85. Ibid., p. 196.
86. Ibid., pp. 193-212.
87. A. D. Cliff and J. K. Ord, Spatial Autocorrelation (London: Pion Press, 1973), p. 2.
88. Ibid., pp. 87-104.
89. On the latter method, see Gujarati, pp. 232-235.

## Addendum

The model given on p. 27 omitted an important variable: construction costs. Construction costs will be used in two ways: (1) they will be used to adjust the building permit values for inflation and (2) they will be included in the model as an additional independent variable ( $B_j$ ). The data are given in Table 4 below.

Table 4  
Residential Building Cost Index Numbers  
for Pittsburgh

<u>Year</u>	<u>Index</u>
1978	100.0
1979	110.2
1980	117.3
1981	125.5
1982	136.8
1983	147.5
1984	155.2

Source: Derived from Boeckh Building Cost Index Numbers  
(January/February issues for the years listed).