A MODERN ANALYSIS OF THE EFFECTS OF SITE VALUE TAXATION**

JAN K. BRUECKNER*

ABSTRACT

Formal analysis is generally absent from the previous literature on site value taxation. This paper analyzes the impact of such a system (under which the property tax on improvements is eliminated, with the tax burden shifted toward land) using standard modern methods. Specifically, the analysis derives the long-run impacts on the level of improvements, the value of land, and the price of housing of a shift to a graded tax system (where the improvements tax rate is lowered and the land tax rate is raised). The paper also analyzes the incidence of the short-run windfall gains and losses that result from gradation of the tax system.

EVER since the publication of Henry George's *Progress and Poverty* in 1879, the possibility of using land value taxation as a source of government revenue has intrigued economists and other social commentators. While George's ideas have had little general impact, land value taxation is practiced in Jamaica and in certain cities in Australia and New Zealand. In addition, graded property tax systems (where land is taxed at a higher rate than improvements) are in use in some Canadian provinces as well as in the city of Pittsburgh and several smaller Pennsylvania communities.[1]

The literature dealing with land (or site) value taxation is vast (for an excellent bibliography, see Carmean (1980)). Most writers have been concerned with predicting the effects of a shift from a typical property tax system, where land and improvements are taxed at the same effective rate, to a system of pure site value taxation, where the improvements tax is eliminated and land is taxed at a higher rate (tax revenue is held constant). Others deal with the effects of transition to a graded system (where the improvements tax rate is lowered but remains positive), recognizing that pure site value taxation is simply an extreme case of gradation. Consensus has emerged on a number of points. First, nearly all writers agree that reduction or elimination of the improvements tax will raise the level of improvements in the long run, leading to more intensive land-use. Second, there is agreement that in the short run, windfall gains and losses will result from a movement to a graded system as tax bills rise for certain properties and fall for others.[2] Additional interest centers on the effect of site value taxation on land speculation[3] and on the problem of obtaining the accurate land value assessments required under a site value system in the absence of frequent sales of vacant land.[4] The best general discussions of these and other issues are provided by Becker (1969), Harriss (1970), and Peterson (1978).[5]

What is remarkable about this large literature is the almost complete absence of modern analysis. Most studies rely on verbal arguments or simple diagrams, and the few analytical efforts (McCalmont (1976) and Cuddington (1978)) are marred by ad hoc assumptions or misplaced emphasis. While several correct predictions have been derived without the aid of rigorous methods (the predicted increase in land-use intensity, for example), the lack of precision of past studies has led to substantial confusion on certain points. A prime example is the question of land value impacts. As is shown below, the improvements tax reduction accompanying a shift to a graded system raises land value while the corresponding land tax increase lowers value. Only two of the many previous writers in this area (Becker (1969) and Harriss (1970)) recognize the existence of these opposing effects, and both identify the net impact as ambiguous.[6] The analysis presented below shows, however, that the land value change is in fact de-

*University of Illinois at Urbana-Champaign.

terminate and has a rather surprising direction. The results of the paper therefore invalidate McCalmont's claim that "not even the direction, let alone the amount, of the change in land rent can be ascertained from theory alone . . ." (1976, p. 928). Another important question on which the literature is virtually silent is the impact of site value taxation on housing prices. Modern analysis gives an immediate answer, as will be seen below.

The remainder of this paper will elaborate on the above points by conducting an analysis of the effects of site value taxation using standard modern methods. Sections 1 and 2 investigate the long-run impacts of a revenue-preserving shift from a standard property tax system to a graded system under two different scenarios. In the first case, the graded tax system is imposed in only a small part of a housing market, so that the price of housing is unaffected. In the second case, implementation occurs market-wide, so that price effects emerge. In both cases, the analysis derives the impacts of gradation on the level of improvements and the value of land. The impact on the price of housing is also derived for the second case.

While Sections 1 and 2 assume that the price of housing is spatially uniform, Section 3 allows spatial variation. In this setting, improvements and land value vary with location, and short-run windfall gains and losses result from a switch to a graded tax system. The analysis investigates the spatial pattern of gains and losses under the assumption that the housing price contour is exogenous. The last section of the paper offers conclusions.

1. Long-run Effects With an Exogenous Housing Price

In reality, property taxes are levied on a wide variety of types of structures: residential, commercial, and industrial. Typically, the interior space in one type of structure is unsuitable for any other use. In the following analysis, this fact is ignored and the property tax base is assumed to consist of a homogeneous class of structures called "housing." In the model, housing floor space is rented at price p per square foot and is produced using inputs of capital (N) and land (ℓ) under a neoclassical constant returns technology represented by the production function $H(N,\ell)$. Since output is indeterminate under constant returns, the analysis focuses on levels of output and capital input on a per-acre-of-land basis. Housing output per acre is $H(N,\ell)/\ell = H(N/\ell,1) \equiv h(S)$, where S is capital per acre of land (hereafter improvements per acre), a measure of land-use intensity, and $h(S) \equiv H(S,1)$. Note that $h' = H_1 > 0$ and $h'' = H_{11} < 0$ by the concavity of H.

The net-of-tax rental prices of capital and land are represented by i and r respectively, and the tax rates on improvements (capital) and land are τ and θ respectively. The gross-of-tax capital and land prices are therefore $(1 + \tau)i$ and $(1 + \theta)r$ respectively. Note that since taxes are expressed as a fraction of net rental price instead of value, conversion to value terms would require multiplication of the tax rates by the discount rate. Note also that $\tau = \theta$ will hold under a standard property tax system.

The shift to a graded property tax system is assumed to occur over a land area of size $\bar{\ell}$ (referred to subsequently as the "tax zone"). Locational advantages are absent within the tax zone, so that the housing price p is spatially uniform. Furthermore, in this section of the paper, the tax zone is viewed as representing a small portion of the relevant housing market. For example, the zone can be thought of as a single small city imbedded in a much larger metropolitan area. This means that a change in the tax system will have a negligible effect on the total supply of housing in the market, with the result that the price p can be viewed as exogenous. Finally, given that the analysis deals with the effects of a localized rather than economy-wide tax change, the net return to capital is also taken to be exogenous (the locality faces a perfectly elastic supply of capital).

Profit per acre for a housing producer operating in the tax zone is given by $ph(S) - (1 + \tau)iS - (1 + \theta)r$. The equilibrium conditions for the producer require that profit per acre is maximal and that the maximized value equals zero. The appropriate conditions are

$$ph'(S) = (1 + \tau)i \quad (1)$$

$$ph(S) - (1 + \tau)iS - (1 + \theta)r = 0. \quad (2)$$

Together, eqs. (1) and (2) determine equilibrium values of improvements per acre S and net land rent r. The impacts on S and r of changes in the tax rates τ and θ, which are used to derive the effects of a shift to a graded tax system, are computed by totally differentiating the system (1)–(2). The results are

$$\frac{\partial S}{\partial \tau} = \frac{i}{ph''} < 0 \quad (3)$$

$$\frac{\partial S}{\partial \theta} = 0 \quad (4)$$

$$\frac{\partial r}{\partial \tau} = \frac{-iS}{1 + \theta} < 0 \quad (5)$$

$$\frac{\partial r}{\partial \theta} = \frac{-r}{1 + \theta} < 0 \quad (6)$$

By increasing the cost of capital, an increase in the improvements tax rate τ reduces improvements per acre, as seen in (3). By reducing the profitability of development, the higher improvements tax also depresses land rent, as seen in (5) (rent serves to exhaust residual profit). Eqs. (4) and (6) indicate that while an increase in the land tax rate has no effect on the level of improvements, the higher θ lowers land rent. The higher tax is in fact fully capitalized, leaving $(1 + \theta)r$ unchanged.

The goal of the analysis is to derive the impacts on S and r of a revenue-preserving shift to a graded tax system. Starting with a standard tax system (where $\tau = \theta$), gradation results from an increase in θ combined with a revenue-preserving change in τ (pure site value taxation emerges when $\tau = 0$). The first step in the derivation is the computation of the derivative $\partial\tau/\partial\theta$, which gives the revenue-preserving change in τ accompanying an increase in θ. Noting that tax revenue originating from the tax zone equals $\bar{\ell}(\tau iS + \theta r)$, $\partial\tau/\partial\theta$ must satisfy $d(\tau iS + \theta r)/d\theta = 0$, or

$$\frac{\partial \tau}{\partial \theta} iS + \tau i\left(\frac{\partial S}{\partial \theta} + \frac{\partial S}{\partial \tau}\frac{\partial \tau}{\partial \theta}\right) + r + \theta\left(\frac{\partial r}{\partial \theta} + \frac{\partial r}{\partial \tau}\frac{\partial \tau}{\partial \theta}\right) = 0 \quad (7)$$

Substituting from (3)–(6) and rearranging, (7) yields

$$\frac{\partial \tau}{\partial \theta} = \frac{-r}{iS}\left\{1 - \frac{(1 + \theta)\tau\sigma}{(1 + \tau)\mu_\ell}\right\}^{-1}, \quad (8)$$

where σ is the elasticity of substitution between capital and land in housing production and μ_ℓ is land's factor share.[7]

Inspection of (8) shows that the sign of $\partial\tau/\partial\theta$ is ambiguous, so that a revenue-preserving change in τ may involve either a decrease or an increase. The outcome depends crucially on the magnitude of the elasticity of substitution, which, for given values of τ, θ, and μ_ℓ, determines the sign of the expression in braces in (8). Inspection of (8) indicates that for σ sufficiently close to zero, $\partial\tau/\partial\theta$ will be negative, while for σ sufficiently large, $\partial\tau/\partial\theta$ will be positive. To gain an intuitive understanding of this result, the first step is to note that (8) equals minus the ratio of the derivative of tax revenue with respect to θ $(r + \theta\partial r/\partial\theta)$ and the derivative of revenue with respect to τ $(iS + \tau i\partial S/\partial\tau + \theta\partial r/\partial\tau)$. Since the first derivative is always positive (revenue is always increasing in θ),[8] the sign of $\partial\tau/\partial\theta$ depends on the sign of the latter derivative, which depends in turn on two separate effects. First, since $\partial r/\partial\tau < 0$ by (5), an increase in τ indirectly depresses revenue from the land tax, making the last term in the derivative negative. The effect of a higher τ on improvements tax revenue (captured by $iS + \tau i\partial S/\partial\tau$) is ambiguous, however, and depends on the magnitude of σ. A low (high) value of σ means that improvements tax revenue is increasing (decreasing) with τ due to weak (strong) substitution away from capital as τ rises.[9] Since a higher τ will therefore depress revenue from both the improvements and land taxes when σ is large, it follows that cancellation of the revenue gain from an increase in θ can be achieved by raising τ. As a result, $\partial\tau/\partial\theta$ will be positive when σ is large. When σ is sufficiently small, however, the increase in improvements tax revenue resulting from a higher τ dominates the decline in land tax revenue, and total revenue rises with τ. In this case, τ must fall as θ rises to keep total revenue constant.[10]

Whether $\partial\tau/\partial\theta$ is negative or positive for plausible values of σ depends on the magnitudes of the other parameters in (8). To make matters simple, suppose first that $\partial\tau/\partial\theta$ is evaluated under a standard property tax system, so that $\tau = \theta$ holds. In this case, the sign of (8) is the same as the sign of $\sigma - (\mu_\ell/\tau)$. Focusing first on land's share, published (or implied) estimates of μ_ℓ range from 20 percent to 50 percent, with most values lying in the middle or lower end of this range.[11] In addition, data compiled by the Advisory Commission on Intergovernmental Relations (1983, Table 37) show that the average effective property tax rate in the U.S. in 1981 for single family homes with FHA insured mortgages was 1.26 percent. With a value-to-rent ratio between 10 and 20 (a discount rate between 5 percent and 10 percent), this yields a τ between 12 percent and 26 percent (recall that τ is the tax rate on net rent, not value). Together, these μ_ℓ and τ values imply that μ_ℓ/τ lies between .8 and 4.2, with a plausible value falling near the middle of this range. Since published estimates of the elasticity of substitution in housing production are almost always smaller than unity (see McDonald (1981) for a survey), it follows that $\sigma - (\mu_\ell/\tau)$ is almost certainly negative, implying $\partial\tau/\partial\theta < 0$. Thus, the initial shift toward a graded tax system will require a decline in τ, as intuition would suggest. It should be noted that while this analysis does not guarantee that $\partial\tau/\partial\theta$ remains negative after τ falls below θ, such an outcome seems likely. In this case, τ falls monotonically as θ increases, reaching zero in the case of pure site value taxation.

Having computed $\partial\tau/\partial\theta$, it is now possible to derive the impacts on S and r of a shift to a graded property tax system. Since $\partial S/\partial\theta = 0$ by (4), the impact on S is simply $dS/d\theta = (\partial S/\partial\tau)(\partial\tau/\partial\theta)$. Given that $\partial S/\partial\tau < 0$ by (3), $dS/d\theta$ will be positive in the normal case where $\partial\tau/\partial\theta$ is negative. This is the outcome recognized in the earlier literature: a shift in the property tax burden toward land and away from improvements will raise the level of improvements.[12] While earlier writers were correct on this point, they never successfully analyzed the effect of gradation of the tax system on land value. The present analysis gives an immediate answer since it follows (using (5), (6), and (8)) that

$$\frac{dr}{d\theta} = \frac{\partial r}{\partial\theta} + \frac{\partial r}{\partial\tau}\frac{\partial\tau}{\partial\theta} = \frac{\Lambda r}{(1+\theta)(1-\Lambda)}, \qquad (9)$$

where $\Lambda \equiv (1+\theta)\tau\sigma/(1+\tau)\mu_\ell$ is the expression inside the braces in (8). Since $\partial\tau/\partial\theta \lesseqgtr 0$ as $1 - \Lambda \gtreqless 0$, (9) implies that

$$\frac{dr}{d\theta} \gtreqless 0 \quad \text{as} \quad \frac{\partial\tau}{\partial\theta} \lesseqgtr 0. \qquad (10)$$

In other words, land value (which is proportional to r) rises (falls) with θ in the normal (perverse) case where $\partial\tau/\partial\theta$ is negative (positive). Thus, in the normal case where gradation involves a decline in τ, land value rises. This effect is magnified as the tax burden on land increases, with land value reaching a maximum under pure site value taxation.

While the land value impact is straightforward in the perverse case (where higher values of τ and θ both serve to depress r), the outcome in the normal case is by no means obvious. In this case, a lower τ raises land value at the same time that the higher θ depresses it, yielding an apparently ambiguous net effect. The surprising implication of the analysis is that the positive effect of the lower improvements tax dominates, so that gradation unambiguously raises the value of land.

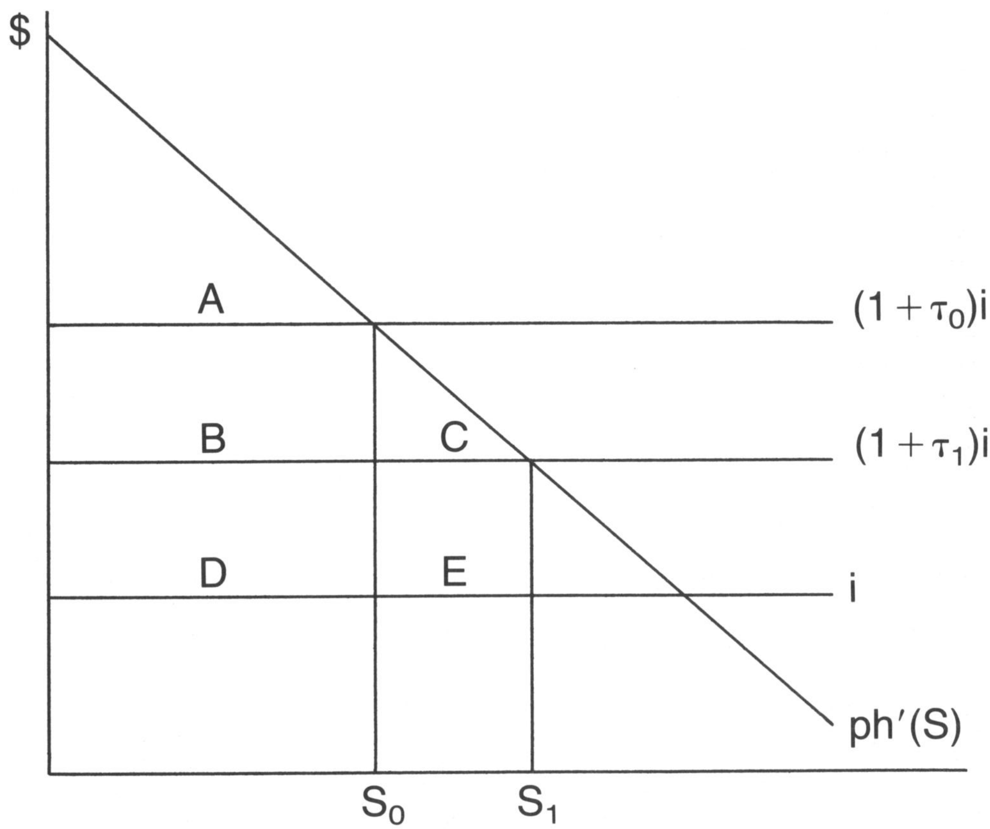
While the algebraic approach pursued

above is indispensible in identifying (and ruling out empirically) the perverse $\partial\tau/\partial\theta > 0$ case, a simple diagrammatic approach can in fact be used to derive the signs of $dS/d\theta$ and $dr/d\theta$ in the normal case.[13] Figure 1, which graphs the downward sloping curve $ph'(S)$, illustrates the effect of gradation in the case where the improvements tax rate falls from τ_0 to τ_1. Improvements tax revenue changes from $B + D$ to $D + E$ as S rises from S_0 to S_1, while gross-of-tax land cost rises from A to $A + B + C$ ($(1 + \theta)r$ equals the area under ph' minus $(1 + \tau)iS$ from (2)). Land tax revenue, which equals gross-of-tax land cost minus r, changes from $A - r_0$ to $A + B + C - r_1$. Since total revenue from the two taxes must remain constant, it follows that $B + D + A - r_0 = D + E + A + B + C - r_1$. This equality yields $r_1 - r_0 = C + E > 0$, establishing that gradation raises land value.[14] While the diagrammatic approach offers a short path to this result, it should be noted that the approach works only because of the simplicity of the present model. In the more complex model considered in the next section, where the housing price p is endogenous rather than fixed, diagrammatic analysis is not feasible.

2. Long-run Effects With an Endogenous Housing Price

In this section, the tax zone is assumed to encompass the entire housing market

Figure 1



(an entire metropolitan area, for example). The assumption that locational advantages are absent is maintained, however.[15] In this case, a change in the property tax system will have an impact on the price of housing, and a market-clearing equation must be added to the previous equilibrium system (1)–(2). Letting D(p) denote the aggregate demand function for housing,[16] which satisfies $D' \leq 0$, the expanded equilibrium system consists of the earlier equations together with $\bar{\ell}h(S) = D(p)$.

The separate impacts of τ and θ on p, S, and r are derived by totally differentiating the new equilibrium system (detailed results are available on request). As before, a higher land tax is fully capitalized and has no effect on S. As a result, there is no impact on p ($\partial p/\partial\theta = 0$). A higher improvements tax once again lowers the level of improvements ($\partial S/\partial\tau < 0$), but its effect on land rent is ambiguous. The latter result is due to the fact that the improvements tax is shifted forward, raising the price of housing ($\partial p/\partial\tau > 0$). Since the higher p tends to increase the profitability of development at the same time that the higher τ reduces it, the net impact on r is indeterminate.

Eq. (7) is once again used to compute $\partial\tau/\partial\theta$. The calculation yields

$$\frac{\partial\tau}{\partial\theta} = \frac{-r}{iS}\left\{1 - \frac{\sigma[(1+\theta)\tau\epsilon + \theta(1+\tau)]}{(1+\tau)\mu_{\ell}(\epsilon-\eta)}\right\}^{-1}, \qquad (11)$$

where $\eta \equiv (p/h)(\partial h/\partial p) > 0$ is the elasticity of housing supply per acre and $\epsilon \equiv pD'/D \leq 0$ is the elasticity of housing demand. To see that the earlier solution for $\partial\tau/\partial\theta$ is just a special case of (11), note that (11) reduces to (8) when $\epsilon = -\infty$ (when p is exogenous). As in the previous case, a negative sign for $\partial\tau/\partial\theta$ is likely when the derivative is evaluated at $\tau = \theta$. This follows because the expression in braces in (11) (call it $1 - \Lambda'$) is larger than the corresponding expression in (8). Since the latter expression was shown to be positive under reasonable parameter values when $\tau = \theta$, it follows that $1 - \Lambda'$ is also positive under the same assumptions. While this implies that the initial shift toward a graded tax system will require a reduction in τ, it is again likely that $\partial\tau/\partial\theta < 0$ will continue to hold as θ rises.

Computation of the impacts of gradation proceeds as before. First, since $\partial p/\partial\tau > 0$ and $\partial p/\partial\theta = 0$, it follows that $dp/d\theta = (\partial p/\partial\tau)(\partial\tau/\partial\theta)$, which is negative when $\partial\tau/\partial\theta < 0$. Thus, the effect of gradation is to reduce the price of housing. Similarly, since $\partial S/\partial\tau < 0$ and $\partial S/\partial\theta = 0$, $\partial\tau/\partial\theta < 0$ yields $dS/d\theta > 0$. Once again, gradation raises the level of improvements per acre. The impact of gradation on land value is again computed using the first line of (9). The result is

$$\frac{dr}{d\theta} = \frac{\sigma[1+\tau(1+\epsilon)]}{(1+\tau)\mu_{\ell}(\epsilon-\eta)}\frac{r}{1-\Lambda'}. \qquad (12)$$

Since $\epsilon - \eta < 0$, $dr/d\theta$ from (12) has the sign of $-[1 + \tau(1 + \epsilon)]$ in the normal case where $1 - \Lambda' > 0$. The elasticity of housing demand ϵ therefore plays a crucial role in determining the direction of the land value impact. If housing demand is highly elastic, then $1 + \tau(1 + \epsilon)$ is negative and gradation raises the value of land. This outcome shows that an infinite demand elasticity is not required for the surprising result of the last section to emerge. The conclusion is reversed, however, when ϵ is closer to zero, in which case $1 + \tau(1 + \epsilon)$ will be positive and $dr/d\theta$ negative. In fact, a simple sufficient condition for $dr/d\theta$ to be less than zero is that housing demand is inelastic ($-1 \leq \epsilon \leq 0$). When this condition holds, gradation of the tax system depresses land value. Since there is overwhelming empirical evidence showing that housing demand is actually inelastic (see Mayo (1981) for a survey), a fall in land value appears to be the realistic outcome.

This result is clearly the opposite of the one reached in the earlier analysis, and the reason for it lies in the behavior of the housing price. Since p falls with θ in the present situation, a new force that reduces the profitability of development (and hence the value of land) enters the analysis. The specific results above are due to the fact that the price of housing falls faster with θ the less elastic is demand (the absolute value of $dp/d\theta$ is larger when ϵ is closer to zero). When demand is inelastic (or moderately elastic), a increase in θ leads to a sharp decline in p and a correspondingly large depressing effect on r. This effect, which was not present before, is sufficient to reverse the previous outcome and lead to a decline in land value. When demand is highly elastic, the decline in p is moderate and the depressing effect on r is not sufficiently strong to reverse the earlier positive impact, so that land value rises.

3. Short-run Gains and Losses

In long-run equilibrium, housing producers are indifferent to the features of the property tax system since profit is identically zero. Before full market adjustment occurs, however, producers can experience windfall gains or losses from a change in the tax system. The purpose of this section is to analyze the spatial incidence of such gains and losses in a model where the price of housing (and thus the levels of S and r) varies within the tax zone. The analysis focuses on the short-run case in which S and r are frozen at their equilibrium levels under the preexisting tax system.[17]

The housing price p (which is taken to be exogenous) is assumed to be a decreasing function of a single location variable x. This variable could measure radial distance to a downtown employment center (as in monocentric city models) or the distance to an amenity such as a shoreline. Spatial variation in p induces corresponding variation in S and r, with improvements per acre and land rent sympathetically declining over distance. This can be seen by totally differentiating (1) and (2), which yields $\partial S/\partial x = -(h'/ph'')(\partial p/\partial x) < 0$ and $\partial r/\partial x = (h/(1 + \theta))(\partial p/\partial x) < 0$. Spatial variation in S and r leads to spatial variation in the impact of gradation of the tax system, as will be seen below.

Since S and r are fixed in the short run, revenue and net-of-tax input costs are also fixed. As a result, gains and losses will be due entirely to changes in tax liabilities. Letting $\bar{S}$ and $\bar{r}$ denote the levels of S and r prevailing prior to the change in the tax system, the tax payment at a given location equals $\tau i\bar{S} + \theta\bar{r}$ (the x argument of $\bar{S}$ and $\bar{r}$ is suppressed). Total revenue from the tax zone is then $\bar{\ell}(\tau i\bar{S}_A + \theta\bar{r}_A)$, where $\bar{S}_A$ and $\bar{r}_A$ are the average levels of improvements per acre and land rent in the zone. Differentiation of this expression shows that for total revenue to remain constant, $\partial\tau/\partial\theta = -\bar{r}_A/i\bar{S}_A$ must hold. Using this result, the change in the tax liability at a particular location (which equals $i\bar{S}\partial\tau/\partial\theta + \bar{r}$) becomes

$$\bar{S}[(\bar{r}/\bar{S}) - (\bar{r}_A/\bar{S}_A)]. \tag{13}$$

Eq. (13) indicates that parcels with above-average ratios of land value to improvements face higher taxes as θ rises and τ falls, with taxes declining for parcels with below-average $\bar{r}/\bar{S}$ ratios. Note that if land-use is uniform within the tax zone, so that $\bar{r} \equiv \bar{r}_A$ and $\bar{S} \equiv \bar{S}_A$, then (13) is zero and the tax liability is unchanged at each location.

Since both improvements and land value are decreasing functions of x, the spatial behavior of $\bar{r}/\bar{S}$ (which provides the key to the spatial incidence of gradation) is not immediately obvious. However, since $\partial p/\partial x < 0$ and

$$\frac{\partial \bar{r}/\bar{S}}{\partial x} = \frac{(1 - \sigma)\bar{h}}{(1 + \theta)\bar{S}}\frac{\partial p}{\partial x}, \tag{14}$$

it follows that $\bar{r}/\bar{S}$ is a decreasing function of x in the realistic case where $\sigma < 1$. This in turn implies that parcels with above average (below average) $\bar{r}/\bar{S}$ ratios are found at low (high) x's. Eq. (13) then implies that parcels with low x's face higher taxes, while lower taxes are enjoyed by parcels at more remote locations. A shift to graded property tax system thus imposes short-run losses (gains) on the most (least) intensively developed parcels. This result might at first appear counterintuitive since parcels with high improvements per acre stand to gain the most from a lower improvements tax. This observation, however, ignores the fact that such parcels also have high land value, which makes an increase in θ especially burdensome. When $\sigma < 1$, the latter effect dominates and the total tax liability rises.[18]

Although the above analysis applies to a tax zone with a single type of real estate, the conclusions based on (13) apply even in the case of mixed land uses. That is, regardless of what types of property are located in the tax zone, comparison of the $\bar{r}/\bar{S}$ ratio for a given parcel to the ratio of average values for the zone tells whether taxes rise or fall for that parcel in the short run. Using this principle, the impact analyses cited earlier attempt to predict the short-run incidence of a shift to pure site value taxation for various municipalities. Typical findings show that many commercial and industrial properties would face higher taxes, while single family homes would generally benefit from lower tax bills.

4. Summary and Conclusion

This paper has analyzed two of the principal questions treated by the previous literature on site value taxation: long-run effects and the incidence of short-run gains and losses. Long-run effects were shown to depend crucially on the relative sizes of the tax zone and the housing market. When the tax zone comprises a negligible portion of the market, gradation of the tax system leaves the price of housing unchanged while raising both the level of improvements per acre and the value of land. The positive land value impact is surprising since gradation increases the direct tax burden borne by land. When the tax zone encompasses the entire housing market, the outcome is different. In this case, gradation reduces the price of housing, again raises the level of improvements, and (under a realistic elasticity assumption) lowers the value of the land. The negative land value impact is due to the depressing effect of the lower housing price, which reduces the profitability of development. These results suggest that while a small city in a large metropolitan area will generate capital gains for landowners by grading its tax system, metropolitan-area-wide gradation will leave landowners with capital losses while benefitting the ultimate consumers of housing. It should be noted that since pure site value taxation is simply an extreme form of gradation, the above results can be used to predict the impact of such a system.

The contribution of the short-run analysis is to show that the windfall gains and losses resulting from gradation of the tax system have a rather surprising spatial incidence. Contrary to a common impression, the most intensively developed parcels suffer windfall losses in the form of higher taxes, while the least intensively developed parcels benefit from windfall gains.

In conclusion, it should be noted that while the issues addressed in this paper have been debated for decades, the results on the land value and housing price impacts of a graded tax system are new. Their existence shows that modern methods can provide answers to questions left unresolved by the less precise techniques used in earlier research in this area.

FOOTNOTES

**I wish to thank Jon Sonstelie, James Follain, Chuan Lin, and David Wildasin for comments. Errors are mine.

[1]Lent (1967) provides a complete list of countries using variants of land value taxation. Holland (1969) gives a lengthy description of the institutional aspects of Jamaica's tax system, while Breckenfield (1983) discusses Pittsburgh's system.

[2]The list of studies that attempt to quantify such impacts includes Schaaf (1970), Smith (1970), Neuner *et al.* (1974), Lusht (1975), Killoren and Casey (1981), and Stoddard and Fry (undated).

[3]See Brown (1927) for an early contribution.

[4]Many writers claim that accurate assessment is possible (see Back (1970), for example).

[5]Another concern in the literature is whether land alone is an adequate revenue base for the property tax system (see, for example, Stone (1975)).

[6]Turvey (1955) also claims that the impact of site value taxation on land values is ambiguous, but his reasoning is unclear.

[7]With the production function in intensive form, $\sigma = -h'(h - Sh')/Shh''$. Also, μ_ℓ, which equals $(1 + \theta)r\ell/pH$, can be written $(h - Sh')/h$.

[8]Using (6), $\partial\theta r/\partial\theta = r/(1 + \theta) > 0$.

[9]Using (3), $\partial\tau iS/\partial\tau = iS(1 - \tau\sigma/(1 + \tau)\mu_\ell)$.

[10]Another way of expressing this result is that a necessary (but not a sufficient) condition for $\partial\tau/\partial\theta <$

0 to hold is that the relevant range of the improvements tax "Laffer curve" is upward sloping.

[11]Direct μ_ℓ estimates can be found in Richman (1965), Gottlieb (1969), and Harriss (1970). Implied μ_ℓ estimates can be computed from data contained in the impact studies cited in the introduction.

[12]Pollock and Shoup (1977) provide an empirical estimate of the magnitude of the impact on improvements using a model which posits a value for $\partial\tau/\partial\theta$ and makes use of a particular parameterization of eq. (1).

[13]I wish to thank Jon Sonstelie for suggesting this diagrammatic approach.

[14]In order for Figure 1 to illustrate the normal case, σ must be small. This means that h″ must be large in absolute value, which implies that the ph′ curve is steep. In this case, the change in θ accompanying the decline in τ (which, by the way, has no simple representation in the Figure) will be positive, as required.

[15]Since $\bar{\ell}$ is exogenous, the analysis ignores the possibility that a change in the tax system could affect the spatial size of the city. Analysis of such an effect, which requires use of a monocentric city model, proved to be intractable.

[16]The fact that housing demand does not depend on net land rent r (which determines the income of land owners) reflects the implicit assumption that land owners are absentee, living outside the tax zone.

[17]While the longevity of housing capital implies a long adjustment period for S, the short-run impact of a new tax system on gross- and net-of-tax land costs requires some explanation. First, net-of-tax land cost (r) will not change until the property is sold (or, if the land is rented, until a new lease is negotiated). Similarly, the land tax liability (θr) will stay the same until the land is reassessed for tax purposes. Note that while the land will not be reassessed immediately, reassessment may occur prior to redevelopment (see footnote 18).

[18]It can be shown that the qualitative results of this analysis also hold for the medium-run case, where land is reassessed for tax purposes at its value in new development. In this case, S is frozen at $\tilde{S}$ and net-of-tax land cost is frozen at $\tilde{r}$, but the land tax liability is given by θr, where r comes from the solution to (1)–(2) with S freely variable.

REFERENCES

Advisory Commission on Intergovernmental Relations (1983), *Significant Features of Fiscal Federalism, 1981–82 Edition* (ACIR: Washington, D.C.).

Back, Kenneth (1970), "Land Value Taxation in Light of Current Theory and Practice," in Daniel M. Holland, ed., *The Assessment of Land Value* (University of Wisconsin Press, Madison): 37–54.

Becker, Arthur P. (1969), "Principles of Taxing Land and Buildings for Economic Development," in Arthur P. Becker, ed., *Land and Building Taxes: Their Effect on Economic Development* (University of Wisconsin Press, Madison): 11–47.

Breckenfield, Gurney (1983), "Higher Taxes That Promote Development," *Fortune,* August.

Brown, Harry G. (1927), "Land Speculation and Land-Value Taxation," *Journal of Political Economy* 35 (June): 390–402.

Carmean, Patricia, A. (1980), *Site Value Taxation* (International Association of Assessing Officers, Chicago).

Cuddington, John T. (1978), "Estimating Impacts of a Property Tax Reform," *Land Economics* 54 (August): 362–372.

George, Henry (1879), *Progress and Poverty* (Modern Library, New York).

Gottlieb, Manuel (1969), "Site Value Taxation and Urban Renewal, Part I," *Assessors Journal* 4 (July): 3–27.

Harriss, C. Lowell (1970), "Transition to Land Value Taxation: Some Major Problems," in Daniel M. Holland, ed., *The Assessment of Land Value* (University of Wisconsin Press, Madison): 213–251.

Holland, Daniel M. (1969), "A Study of Land Taxation in Jamaica," in Arthur P. Becker, ed., *Land and Building Taxes: Their Effect on Economic Development* (University of Wisconsin Press, Madison): 239–286.

Killoren, D. J. and Casey, J. M. (1981), "Comparison Study of St. Louis City Real Estate Taxes with Site Value Taxes Producing Equal Revenues using 1980 Assessed Valuations," unpublished paper, Public Revenue Education Council, St. Louis.

Lusht, Kenneth (1975), "Redistribution of Tax Burden upon Adoption of Site Value Taxation in Nonmetropolitan Jurisdictions," *Assessors Journal* 9 (January): 23–33.

Mayo, Stephen K. (1981), "Theory and Estimation in the Economics of Housing Demand," *Journal of Urban Economics* 10 (July): 95–116.

McCalmont, David B. (1976), "Differential Taxation of Sites and Structures," *Southern Economic Journal* 43 (July): 924–936.

McDonald, John F. (1981), "Capital-Land Substitution in Urban Housing: A Survey of Empirical Estimates," *Journal of Urban Economics* 9 (March): 190–211.

Neuner, Edward J., Popp, Dean O., and Sebold, Frederick D. (1974), "The Impact of a Transition to Site Value Taxation on Various Classes of Property in San Diego," *Land Economics* 50 (May): 181–185.

Peterson, George E. (1978), "Differential Taxation of Land and Improvement Values," in *Technical Aspects of the District's Tax System* (U.S. Government Printing Office, Washington, D.C.): 193–232.

Pollock, Richard L. and Shoup, Donald C. (1977), "The Effect of Shifting the Property Tax Base from Improvement Value to Land Value: An Empirical Estimate," *Land Economics* 53 (February): 67–77.

Richman, Raymond L. (1965), "The Theory and Practice of Site Value Taxation in Pittsburgh," in *Proceedings of the Fifty-Seventh Annual Conference on Taxation, 1964* (National Tax Association, Harrisburg): 259–271.

Schaaf, A. H. (1969), "Effects of Property Taxation on Slums and Renewal: A Study of Land-Improvement Assessment Ratios," *Land Economics* 45 (February): 111–117.

Smith, Theodore R. (1970), "Land Value Versus Real Property Taxation: A Case Study Comparison," *Land Economics* 46 (August): 305–313.

Stoddard, G. E. and Fry, G. A. (undated), "Immediate Effects of Further Grading Pittsburgh's Property Tax on the Tax Bills of Different Classes of Property," unpublished paper, Pittsburgh Department of City Planning.

Stone, Gerald W. (1975), "Revenue Adequacy of Land Value Taxation," *Southern Economic Journal* 41 (January): 442–449.

Turvey, Ralph (1957), *The Economics of Real Property* (Allen and Unwin, London).