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Notes by M. S.

LAND VALUE EFFECTS OF
REVENUE-NEUTRAL PROPERTY TAX REFORM

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Many property tax reforms have been considered in the past. These have included site value taxation, incremental site value taxation, and taxing current property income. The reform considered here is to move away from the ad valorem tax and toward land value taxation. The precise nature of the reform considered in this paper is moving from uniform rates on buildings and land to a system of lower rates on buildings and higher rates on land so that total tax revenue is unaltered. This is **revenue-neutral** reform. The object of this exercise is to determine the impact of such reform on land prices in the short-run and very-long-run.

This paper begins with a presentation of the background demand and allocation issues necessary to develop the land value results. The next section develops the results for the short-run. The following section does the same for the very-long-run. The short-run is a period so short that there can be no change in the allocation of land, whereas the very-long-run is so long that not only can there be changes in the allocation of land but the changes are not impeded by previous improvements. One may question whether very-long-run equilibrium ever exists. The answer is that the first urban development of agricultural land should be close to very-long-run equilibrium. The final section offers some conclusions.

not orange groves.

Demand and Allocation

The demand for land is assumed to be a residual; it is what is left of the demand for developed property after subtracting the cost of development. The market price of developed property (P) is equal to the willingness to pay in the absence of taxes (D) minus the capitalized building and land value taxes.

but gets paid first

$$(1) \quad P = D - \frac{t_B B}{r} - \frac{t_L (P - B)}{r}$$

where t_B = the tax rate on building value,

B = the value of buildings per acre,

$t_B B$ = the tax on buildings,

r = the capitalization rate,

X $\frac{t_B B}{r}$ = the capitalized value of the tax on buildings per acre, no acct. of deprec.

t_L = the tax rate on land value,

X $(P - B)$ = the residual value of the land, only valid once, before bldg.

$t_L (P - B)$ = the tax on land, and

X $\frac{t_L (P - B)}{r}$ = the capitalized value of the tax on land per acre. no acct. of apprec.

Solving (1) for the price of developed property yields

$$(2) \quad P = \frac{Dr}{r + t_L} - \frac{t_B B}{r + t_L} + \frac{t_L B}{r + t_L}.$$

ok. Note apparent ass. that bldgs. are periodically replaced in prop. w/o deprec.

Subtracting the cost of buildings per acre from both sides of (2) and simplifying yields the following expression for the price of land per acre:

$$(3) \quad p = \frac{Dr}{r + t_L} - \frac{B(r + t_B)}{r + t_L}.$$

Suppose that the willingness to pay for developed property in the absence of a tax is a linear function of the quantity of such property. That is,

$$(4) \quad D = \alpha + \beta A.$$



where A = the number of acres allocated to the land use.

Substituting (4) into (3) yields the demand for land,

$$(5) \quad p = \frac{\alpha r - rB - t_B B}{r + t_L} + \frac{\beta r A}{r + t_L}.$$

If the building tax changes, the intercept of the land demand curve changes but by less than the change in the capitalized tax on buildings, and the slope does not change. The change in the intercept is

$$- \frac{(t_{B2} - t_{B1}) B}{r + t_L}.$$

where $(t_{B2} - t_{B1})$ is the change in the building tax rate. This change in the intercept is the negative of the capitalized change in total tax revenue per acre resulting from the change in the building tax rate. On the other hand, the capitalized change in the building tax is

$$+ \frac{(t_{B2} - t_{B1}) B}{r}$$

✓ The difference between these two magnitudes is in their denominators. The denominator of the change in the intercept is larger by the amount of the land tax rate. The intuition for this difference is that land price varies inversely with the building tax rate. If the building tax rate rises, the price of land and the land tax fall. So the land tax revenue is related to the building tax rate. Raising the building tax rate will, therefore, not cause total revenue to rise by the change in the rate multiplied by the value of buildings. *and v.v.*

X ? The expression for the demand for land, (5), is the essential ingredient in the derivation of the allocation of land among competing uses. The simplest case, the one considered in this paper, allows for the allocation of land between two competing uses, say, residential (denoted by the subscript R) and commercial (denoted by the subscript C). Very-long-run equilibrium requires that we set land prices equal to each other for the two land uses. Next, we can solve for the number of acres allocated to one of the uses. This result is obtained as follows:

$$\frac{\alpha_R r}{r + t_L} - \frac{r B_R}{r + t_L} - \frac{t_B B_R}{r + t_L} + \frac{\beta_R r A_R^*}{r + t_L} = \frac{\alpha_C r}{r + t_L} - \frac{r B_C}{r + t_L} - \frac{t_B B_C}{r + t_L} + \frac{\beta_C r (A_T - A_R^*)}{r + t_L}$$

$$(6) \quad A_R^* = \frac{\alpha_C r - \alpha_R r - r B_C + r B_R - t_B B_C + t_B B_R + \beta_C r A_T}{(\beta_R + \beta_C) r}$$

Short-Run Effects of Tax Reform

✓ The short-run land price effects of revenue-neutral property tax reform are ~~not~~ [?] intuitively obvious. Total land value does not change. The price of the more capital intensive use rises while the price of the less capital intensive use falls. These and other effects of this tax reform are demonstrated below by the use of a simple numerical example.

Suppose the two land uses, residential and commercial, compete for land in a taxing jurisdiction of 2,400 acres. Further suppose that the underlying demand parameters are

$$\alpha_C = 476,000,$$

$$\beta_C = -126.666,$$

$$B_C = 300,000,$$

$$\alpha_R = 312,000,$$

$$\beta_R = -6.666, \text{ and}$$

$$B_R = 200,000.$$

The tax rates are initially uniform with t_L and $t_B = .015$. The capitalization rate, r , is .045.

Substituting the magnitudes of the parameters into equation (5), the demand for residential land is found to be

$$(7) \quad p_R = 34,000 - 5 A_R .$$

Similarly, the demand for commercial land is found to be

$$(8) \quad p_C = 57,000 - 95 A_C .$$

These demand curves are illustrated by the bold lines in Figure 1. In the Figure, these demand curves intersect at an allocation of 2,050 acres to residential and 350 acres to commercial. It can be confirmed that this is the very-long-run equilibrium allocation by substituting the parameters into (6). The land price for each use would be \$23,750 in very-long-run equilibrium. This can be confirmed by substituting 2,050 for A_R in (7) or 350 for A_C in (8). Given a uniform price of \$23,750, the total value of land in the 2,400 acre community would be \$57,000,000. Building value is \$200,000 per acre times 2,050 acres for residential and \$300,000 per acre times 350 acres for commercial. Thus, aggregate building value is \$515,000,000. Tax revenue is the product of the tax rate, .015, and total property value, \$572,000,000, or \$8,580,000.

— equal at the mgn. is more realistic.

A decline in the building tax rate will cause the land demand curve for residential to shift upward by less than that for commercial. Suppose that the building tax rate declines to .004. Substituting into the intercept term of equation (5), one finds that residential demand will shift upward by \$36,666, whereas the commercial demand curve shifts up by \$55,000. These shifts are shown in Figure 1 by the lighter demand curves. The new short-run land prices would be \$60,416 for the residential use and \$78,750 for the commercial use.

unrealistic

Suppose that the tax rate on land were then increased in order to exactly compensate for the loss in tax revenue due to the decrease in the tax rate on buildings. Two questions arise. First, will the relative land prices be maintained after the tax-neutral reform but still in the short-run? That is, would the more capital intensive land users always be advantaged and the less capital intensive users always be disadvantaged by the revenue-reform? More precisely, would the price ratio stay at $\$78,750 / \$60,416 = 1.303...$? Second, what happens to aggregate land value in the short-run? Does it necessarily rise, fall, or stay constant as the result of short-run tax-neutral reform.

The required land tax rate can be computed once two conjectures are explained. First, the post-reform building value will be the same as the pre-reform building value. Second, the

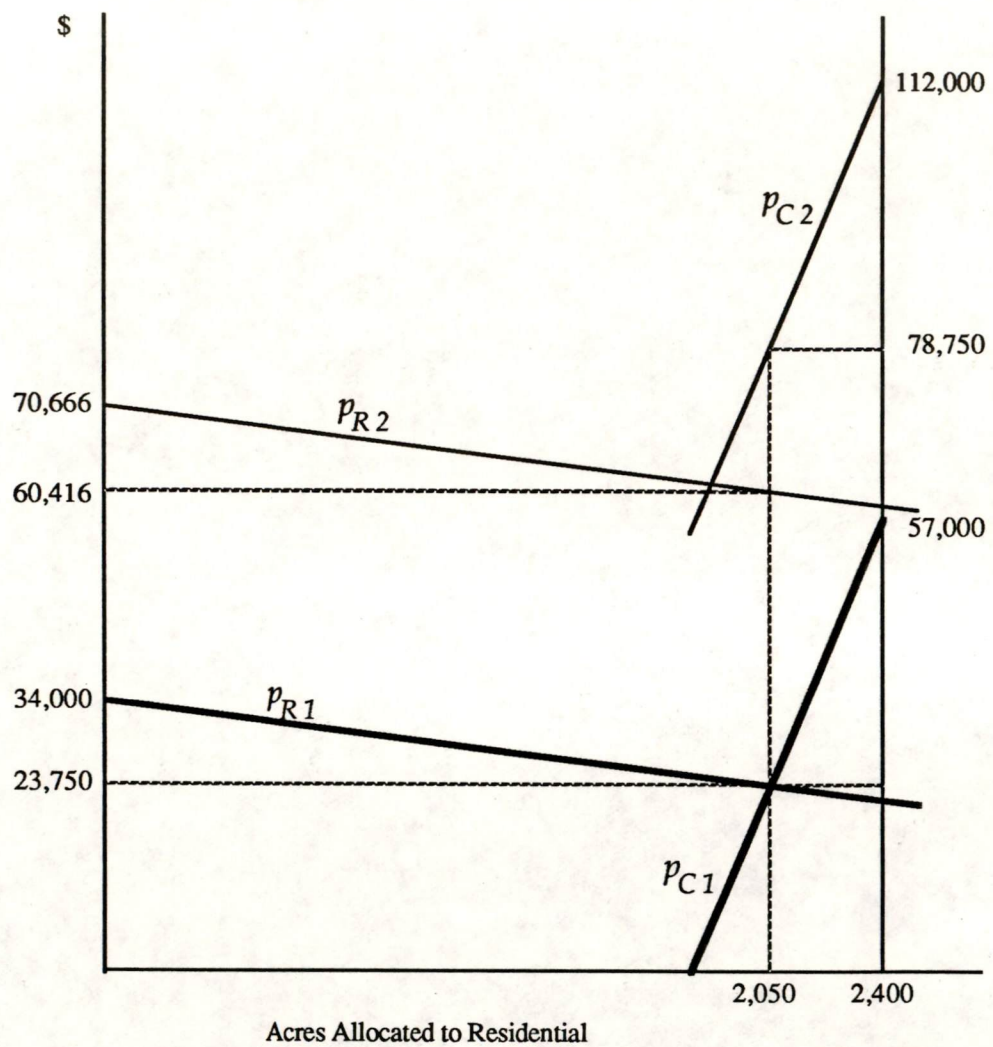


Figure 1

aggregate post-reform land value will be the same as the pre-reform land value, although the relative prices will be different. Setting the post reform revenue equal to the pre-reform revenue allow one to solve for the compensating land tax rate.

$$t_{L1} P_1 A_T + t_{B1} (B_R A_R + B_C A_C) = t_{L2} P_1 A_T + t_{B2} (B_R A_R + B_C A_C)$$

$$t_{L2} = \frac{t_{L1} P_1 A_T - (t_{B2} - t_{B1}) (B_R A_R + B_C A_C)}{P_1 A_T}$$

by assumption?

Building value will not be changed by reform in the short-run but will stay at \$515,000,000. Land value should have returned to \$57,000,000 if the capitalized tax loss from the building tax reduction is recovered by a land tax increase. Thus, one can solve for the new land tax rate as follows:

$$t_{L2} = .114385964$$

One can be assured that this rate is correct and that the conjectures underlying it are correct (i.e., for the particular numerical example) by using it to calculate land values and land tax revenue directly as follows:

$$P_{C2} = \frac{\alpha_C r - r B_C - t_{B2} B_C}{r + t_{L2}} + \frac{\beta_C r A_C}{r + t_{L2}} = 29,645.$$

$$P_{R2} = \frac{\alpha_R r - r B_R - t_{B2} B_R}{r + t_{L2}} + \frac{\beta_R r A_R}{r + t_{L2}} = 22,744.$$

$$\text{land tax revenue} = t_{L2} (P_{C2} A_C + P_{R2} A_R) = .114385964 (57,000,000) = 6,520,000$$

Given the same building costs, building tax revenue is calculated as follows:

$$\text{building tax revenue} = t_{B2} (B_C A_C + B_R A_R) = .004 (515,000,000) = 2,060,000.$$

The sum of land tax revenue and building tax revenue yields the same total tax revenue as before the reform,

$$6,520,000 + 2,060,000 = 8,580,000.$$

✓ Thus assured that given a new building tax rate of .004, the revenue neutral land tax rate would have to be approximately .114, several principles have been demonstrated. The final land prices would be \$22,744 and \$29,645 for residential and commercial, respectively. This maintains the 1.303 price ratio that existed after the building tax rate decrease but before

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the compensating land tax rate increase. So the relative land prices were not disturbed by the compensating land tax rate increase. The more capital intensive land user ended up with the higher price after the reform. Aggregate land value did not change pre-reform as compared to post-reform. It remained at \$57,000,000. Therefore, the questions may have been answered. The next natural question is whether these results are generally valid. ✓

The result that the more capital intensive user ends up with the higher land price is always true. The more capital intensive land use has the higher price after the building tax rate change but before the compensating land tax rate change. The land tax change then will cause the land demand curves to shift down proportionately to their height. More precisely, the land demand curves rotate around their horizontal intercepts as the land tax changes. Thus, the use with the higher price before the compensating land tax change would be the use with the higher price after the compensating land tax change.

The result that aggregate land value is invariant also is completely general. The amount by which aggregate land value increases as a result of the initial building tax rate decrease is exactly the capitalized value of the loss of tax revenue. This is the amount that must be recovered by the public sector through a higher land tax rate. In other words, what is gained by land users in tax savings through a lower building tax rate is completely reflected in a higher aggregate land value. So what must be gained back by the tax collector through a higher land tax rate will be reflected in an offsetting decline in aggregate land value. There will be no net change in aggregate land value with both tax rate changes in place. ✓ ✓

Shows adequacy of tax base.

Very-Long-Run Effects

Consider a tax reform package that is only revenue neutral in the very-long-run (i.e., one that produces a new long-run equilibrium allocation of land). This reform can be viewed as consisting of two steps:

- 1) The very-long-run impact of the building tax decrease
- 2) The impact of the compensating land tax increase

✓ As before, the principal question is the ultimate impact upon the value of land.

The capitalized decrease in tax revenue from just the decrease in the building tax rate, the first step, can be further decomposed into three parts:

- 1) First, there is the loss building tax revenue that is associated with the building tax rate decline in the short-run, i.e., at the initial allocation.
- 2) The second component is the capitalized gain in the building tax due to the reallocation which increases the average intensity of land use.
- 3) Third, there is the gain or loss in land tax due to the reallocation. This comes from

the change in land price at the initial allocation from before the change in the building tax rate to the new long-run equilibrium land price that emerges from the tax rate change.

These three components are expressed algebraically in the following three paragraphs.

The short-run capitalized revenue loss from a decrease in the building tax rate depends on the initial allocation, the tax rate change, and the levels of building cost for the land uses. For example,

$$(9) \quad -B_C (t_{B2} - t_{B1}) (A_T - A_{RI}^*) = \text{the loss in commercial building tax revenue, and}$$

$$(10) \quad -B_R (t_{B2} - t_{B1}) A_{RI}^* = \text{the loss in residential building tax revenue}$$

Taking the sum of equations (9) and (10) and dividing by $r A_T$ yields the capitalized total loss of building tax revenue in the short run per acre, i.e., the first component,

$$(11) \quad -\frac{B_C (t_{B2} - t_{B1})}{r} - \frac{(t_{B2} - t_{B1}) (B_R - B_C) A_R^*}{r A_T}.$$

The loss in building tax revenue from the reallocation is

$$(12) \quad -t_{B2} (B_R - B_C) (A_{R2}^* - A_{RI}^*)$$

The loss in (13) is capitalized and put on a per acre basis by dividing by $r A_T$ as follows:

$$(13) \quad \frac{-t_{B2} (B_R - B_C) (A_{R2}^* - A_{RI}^*)}{r A_T}$$

The difference in the long-run equilibrium allocations is found as follows:

$$A_{R2}^* = \frac{\alpha_C r - \alpha_R r - r B_C + r B_R - t_{B2} B_C + t_{B2} B_R + \beta_C r A_T}{(\beta_R + \beta_C)r}$$

$$-A_{RI}^* = -\frac{\alpha_C r - \alpha_R r - r B_C + r B_R - t_{B1} B_C + t_{B1} B_R + \beta_C r A_T}{(\beta_R + \beta_C)r}$$

$$(14) \quad A_{R2}^* - A_{RI}^* = \frac{(t_{B2} - t_{B1}) (B_R - B_C)}{(\beta_R + \beta_C)r}$$

Substituting equation (14) for the difference in the number of acres allocated to the residential use in equation (13) yields the second component,

$$(15) \quad \frac{-t_{B2}(t_{B2} - t_{B1})(B_R - B_C)^2}{r^2 A_T (\beta_R + \beta_C)}.$$

The loss per acre in tax revenue from the land tax change in the very-long-run is the product of the very-long-run price change and the land tax rate

$$(16) \quad -(p_2 - p_1) t_{L1}$$

The capitalized loss, i.e., the third component, is found by dividing by r as follows:

$$(17) \quad \frac{-(p_2 - p_1) t_{L1}}{r}$$

The very-long-run change in land price is found by taking the difference between the two equilibrium prices.

$$(18) \quad \begin{aligned} p_2 &= \frac{\alpha_R r - r B_R - t_{B2} B_R}{r + t_L} + \frac{\beta_R r A_{R2}^*}{r + t_L} \\ -p_1 &= -\left(\frac{\alpha_R r - r B_R - t_{B1} B_R}{r + t_L} + \frac{\beta_R r A_{R1}^*}{r + t_L} \right) \\ p_2 - p_1 &= -\frac{(t_{B2} - t_{B1}) B_R}{r + t_L} + \frac{\beta_R r (A_{R2}^* - A_{R1}^*)}{r + t_L} \end{aligned}$$

The price difference depends on the difference in the long-run equilibrium allocations of land (i.e., $A_{R2}^* - A_{R1}^*$). Substituting equation (14) for this difference yields the price change in terms of parameters only.

$$(19) \quad p_2 - p_1 = -\frac{(t_{B2} - t_{B1}) B_R}{r + t_L} + \frac{\beta_R (t_{B2} - t_{B1}) (B_R - B_C)}{(r + t_L) (\beta_R + \beta_C)}$$

In the very-long-run, the impact of a revenue neutral tax reform depends on the price increase prior to the imposition of the compensating land tax increase relative to the sum of the losses represented in statements (11), (15), and (17). This is so for two reasons. First, these three loss components are the only source of tax revenue change from an initial decrease in the

building tax rate. Second, the increase required in the land tax rate to neutralize the revenue decline from the building tax rate decrease will cause the land price to decline by exactly the amount of the capitalized tax. Therefore, if the price increase is greater than the losses from the three components described above, the required price decrease will leave some price gain on net. Formally, the requirement for a price increase from revenue neutral tax reform is

$$(20) \quad p_2 - p_1 > -\frac{(p_2 - p_1) t_{L1}}{r} - \frac{t_{B2} (t_{B2} - t_{B1}) (B_R - B_C)^2}{r^2 A_T (\beta_R + \beta_C)} - \frac{B_C (t_{B2} - t_{B1})}{r} \\ - \frac{(t_{B2} - t_{B1}) (B_R - B_C) A_R^*}{r A_T}$$

Inequality (20) can be simplified substantially. One starts by solving for $p_2 - p_1$.

$$p_2 - p_1 + \frac{(p_2 - p_1) t_{L1}}{r} > -\frac{t_{B2} (t_{B2} - t_{B1}) (B_R - B_C)^2}{r^2 A_T (\beta_R + \beta_C)} - \frac{B_C (t_{B2} - t_{B1})}{r} \\ - \frac{(t_{B2} - t_{B1}) (B_R - B_C) A_R^*}{r A_T}$$

$$(p_2 - p_1) \left(\frac{r + t_{L1}}{r} \right) > -\frac{t_{B2} (t_{B2} - t_{B1}) (B_R - B_C)^2}{r^2 A_T (\beta_R + \beta_C)} - \frac{B_C (t_{B2} - t_{B1})}{r} \\ - \frac{(t_{B2} - t_{B1}) (B_R - B_C) A_R^*}{r A_T}$$

$$p_2 - p_1 > -\frac{t_{B2} (t_{B2} - t_{B1}) (B_R - B_C)^2}{r (r + t_{L1}) A_T (\beta_R + \beta_C)} - \frac{B_C (t_{B2} - t_{B1})}{(r + t_{L1})} \\ - \frac{(t_{B2} - t_{B1}) (B_R - B_C) A_R^*}{(r + t_{L1}) A_T}$$

Substituting from (19) yields

$$-\frac{(t_{B2} - t_{B1}) B_R}{r + t_{L1}} + \frac{\beta_R (t_{B2} - t_{B1}) (B_R - B_C)}{(r + t_{L1}) (\beta_R + \beta_C)} > -\frac{t_{B2} (t_{B2} - t_{B1}) (B_R - B_C)^2}{r (r + t_{L1}) A_T (\beta_R + \beta_C)} \\ - \frac{B_C (t_{B2} - t_{B1})}{(r + t_{L1})} - \frac{(t_{B2} - t_{B1}) (B_R - B_C) A_R^*}{(r + t_{L1}) A_T}$$

Multiplying both sides by $\frac{r + t_{L1}}{t_{B2} - t_{B1}}$, adding B_R , and dividing by $(B_R - B_C)$ yields

$$\frac{\beta_R}{\beta_R + \beta_C} > 1 - \frac{A_R^*}{A_T} - \frac{t_{B2} (B_R - B_C)}{r A_T (\beta_R + \beta_C)}$$

where $(t_{B2} - t_{B1})(B_R - B_C) < 0$.

Rearranging produces a result that may be helpful.

$$(21) \quad \frac{\beta_R}{\beta_R + \beta_C} > \frac{A_T - A_R^*}{A_T} - \frac{t_{B2} (B_R - B_C)}{r A_T (\beta_R + \beta_C)}$$

It is possible to solve (21) for t_{B2} suggesting that for a range of new building tax rates the revenue-neutral tax reform will produce land value increases, and for a different range, it will not.

$$(22) \quad t_{B2} > \frac{r (A_T - A_R^*) (\beta_R + \beta_C) - \beta_R r A_T}{B_R - B_C} = \frac{r (\beta_C (A_T - A_R^*) - \beta_R A_R^*)}{B_R - B_C}$$

When the condition in (22) is met and the new building tax rate is lower than the initial one, revenue-neutral tax reform will result in an increase in land value.

Computation

It is useful to illustrate these ideas by computing the results of tax changes. For example, suppose that the building tax were to decline to .004, as considered in the section on short-run results earlier in this paper. Will revenue-neutral tax reform produce an increase in land value? Condition (22) indicates that land value will decline. If land value increases, then

$$t_{B2} > \frac{r (\beta_C (A_T - A_R^*) - \beta_R A_R^*)}{B_R - B_C}$$

Substituting for the parameters above, the inequality is reversed as follows:

$$.004 < \frac{.045 (-126.666 (2400 - 2050) + 6.666 \cdot 2050)}{200000 - 300000} = .0138$$

This can be confirmed by computing the three components of revenue change and comparing their sum to the change in the land price prior to the imposition of the compensating land tax increase. The capitalized land tax loss per acre is -\$12,528 (i.e., a negative loss is a gain). The capitalized building tax loss per acre in the short-run is \$52,454. The capitalized building tax loss per acre in the very-long run is -\$679. The sum of these components is \$39,247 which is greater than the very-long-run land price increase of \$37,583. Thus land price must be driven down by an increase in the land tax by an amount equal to the difference, \$1,664, in order to replace the lost tax revenue.

The land price picture is very different if the new building tax rate is greater than .0138. For example, suppose that the building tax rate is reduced to .0143. The capitalized land tax loss per acre is -\$797. The capitalized building tax loss per acre in the short-run is \$3,338. The capitalized building tax loss per acre in the very-long run is -\$154. The sum of these components is \$2,386 which is smaller than the very-long-run land price increase of \$2,392. Thus the price of land will increase in the very-long-run by about \$6 per acre.

Abandoning the building tax

While inequality (21) is substantially simpler than (20), it still does not offer much in the way of an intuitive feel for the circumstances under which revenue-neutral tax reform will lead to an increase in the price of land. However, some insight can be gained by a simple assumption; suppose that the new building tax rate were zero so that there would be no gain in building tax revenue as a result of the reallocation. What then would be the requirement for achieving an increase in land value? Setting t_{B2} to zero in (21) yields

$$\frac{\beta_R}{\beta_R + \beta_C} > \frac{A_T - A_R^*}{A_T}$$

Multiplying both sides by $A_T(\beta_R + \beta_C)$ and rearranging terms yields a result that warrants an interpretation:

$$(23) \quad \beta_R A_R^* > \beta_C (A_T - A_R^*)$$

Here we see that the product of the initial allocation to the residential use and the slope of the underlying demand curve for residential property must be greater than the same product for commercial property if land value is to increase in the very-long-run. Multiplying both sides of (23) by $\frac{r}{p_I(r + t_{LI})}$ produces a result that may seem even more intuitively clear,

$$(24) \quad \frac{\beta_R r}{r + t_{LI}} \frac{A_R^*}{p_I} > \frac{\beta_C r}{r + t_{LI}} \frac{(A_T - A_R^*)}{p_I}$$

Inequality (23) says that the slope of the land demand curve multiplied by the ratio of the quantity of land to the price must be greater for the residential use (i.e., the less capital intensive use) than for the commercial use (i.e., the more capital intensive use). That is, the reciprocal of the price elasticity of demand for residential land must be greater than the reciprocal of the price elasticity of demand for commercial land. Put slightly differently, the elasticity of demand for commercial land must be greater than the elasticity of demand for residential land. Thus in the context of totally abandoning the building tax, i.e. $t_{B2} = 0$, an increase in the price of land requires that the commercial elasticity be greater than the residential elasticity.

CONCLUSIONS

Revenue-neutral tax reform that causes the building tax rate to decline and the land tax rate to increase can, under certain conditions, result in the value of land rising. Short-run, revenue-neutral tax reform holds aggregate land value constant, while the prices of land to specific uses will either rise or fall. The land price effects of long-run, revenue-neutral tax reform depend upon the magnitude of the new building tax rate relative to a function of demand parameters, total land area, and the initial allocation. In the special case of eliminating the building tax entirely with revenue-neutral reform, the land price will increase if the price elasticity of demand for the more capital intensive use is greater than that of the less intensive use.

✓ Future work on the questions asked in this paper might incorporate modifications of this theory with respect to the introduction of depreciation. For example, a "one horse shay" assumption or a straight-line method would change the building tax capitalization rate and thus bring about changes throughout the paper.

F

Mason Gaffney
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11 July 89

Peter Colwell

Dear Peter:

Thanks for sending all the ORER Letters. You and Brueckner and Follain made quite a team; you and Brueckner still do. Chicoine is pretty sharp, too, and I imagine you work with him.

Your article on foreign ownership is a cut above the usual line. Sovereignty, as you note, remains with the resident voters, and sovereignty includes the right to assert various forms of eminent domain.

On the other hand the roots of eminent domain are in feudal law, which implied fealty, a personal relationship of loyalty of vassal to sovereign. Foreign ownership divides loyalty, and invites foreign invasions of sovereignty: overseas extension of our trading-with-the-enemy act; the Jewish occupation of Palestine; gunboat diplomacy; et hoc genus omne. Buying land is more than just another commercial transaction. Landownership implies political power.

In Canada, until recently, real estate as such had voting rights, meaning an alien owner of Vancouver real estate had so many votes. On the whole this didn't bother Canadians much so long as the absentees lived in Ontario. Now they live in Hong Kong, the law is repealed.

Concerning The New Homelessness, it seems too much to attribute it to rent control, for rent control is so much more the exception than the rule.

I enclose excerpts from draft I didn't give at Tahoe, re taxation of phantom gains. Comments welcomed.

Yes, I've seen Capozza's work. Seems like a straightforward fallacy of composition. The speculator is waiting for neighboring speculators to commit themselves and resolve his uncertainty. This ignores the converse, and the cumulative failure to resolve uncertainty.

Under SVT, to use self-assessment, one could restrict it to vacant land, or land on the eve of demolition. SVT itself would vastly increase the volume of the latter.

In this age of nearly standardized buildings, when one sells for \$150/sf and another for \$50/sf of floor space, looks like we have some data on location value.

On zoning, when it is necessary (assuming it is) to draw an arbitrary line and enrich landowner A and impoverish B, I would say make the zoning part of the bundle of real estate that is assessed for property tax. As to the uncertain rights to modify zoning that is a toughy, but it shows up in sales prices, so the solution is to follow the market.

I will try to be fair to technology. But may not an economist believe that inventors and engineers and innovators respond to incentives? To do otherwise is technocracy. Even Veblen, the great technocrat, believed farm machines adjusted to the Procrustean bed of speculative landholdings, rather than technology driving farm scale.

I like your idea of self-assessment as a policy tool for efficient reuse of land. I have read too much about Chiang Kai-shek to defend Taiwan (although his son CCK deplored his father's corrupt ways and evidently improved things a lot). But competition applied to government is surely good.

By the way, Taiwan updoes us one, they assess lands of government agencies!

"What is land?" you ask? "'What is truth' said jesting Pilate, and would not stay for an answer". You've already stayed through "Land as a Distinctive Factor of Production". What more can I say, but "Land is the material universe outside man and his products". "Product" I construe as marginal product, so a gold nugget picked up easily is still mostly land, w.r.t. value-added. That complicates things a little and is not my main point, just a rear-guarding action.

I agree, sort of, on the importance of security of tenure. "The magic of property turns sand into gold" quoth Arthur Young, 18th century, in support of enclosures. But there is the possessory interest and the fee or perpetual interest, and the question is whether security can be granted the first without giving up the second. It is the second that blocks entry to the market needlessly.

Hope we can join and discourse at length on these points sometime. Will urge Follain to help get you to a TRED conference.

Cordially,

Comments on Colwell.

cf. Bill Vickrey

1. Extra hi quality printing, ^{cf. Bill Vickrey} marred by absence of page nos.

2. p. 3, results are not intuitive? Seem to be so. If LV (p) is strictly resid., + ΣT const., LV shd. not change.

Cite ALTB

Physio. doctrine.

3. Also shows how much you must raise rate, to raise same rev. Rather, shows procedure for doing so - I ~~st~~ doubt the realism of his ~~find~~ example, 11%.

4. Shows adequacy of land as tax base.

5. Lacking: depn of bldgs; appren. of land. Even in very short run, tax base is derived from ~~endless~~ future flows, not treated. In last sentence, he acknowledges.

6. p. 4, wish he had resid. + comm. LV = at the mgn., rather than uniformly.

Sometimes in our preoccup. w. formal modelling, & proto-math. formulations, we forget to stay realistic.

Also, shd. have made commercial use less cap-int. than resid.

7. p. 7, principal gn. is impact on value of land. Does little to valuate purpose of reform: removing bias vs. ~~as~~ intensity + freq. of renewal; reducing public costs of sprawl & welfare; lowering barriers to entry.

Colwell, 2

2

✓ 8, As to entry barriers, use of demand curves ~~exp~~ with $E < \infty$ indicates entering bldgs. will lower entry barrier.

Wd. welcome explicit treatment of this point, which now gets buried in a flurry of eqns.



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May 30, 1989

Mason Gaffney
3040 Tyler St.
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Dear Mason:

Thank you for sending your speech. I've read it and I really enjoyed it. Some of the questions that popped into my mind while reading it were

1. Is sprawl really so bad? Don't we just want the optimal amount of sprawl (i.e., leapfrogging and low density development)? Why is the proper approach not to charge the developers the marginal cost of the impact of their activities on public facilities (e.g., through exactions)?
2. I think of land speculators as doing well by doing good (i.e., holding land out of early development and taking a risk that a better use will arise in the future). Speculation may reduce volatility. How do you serve the speculative function in a Georgist world?
3. We have both read Dr. Sun. I have thought of him as being somewhat ga ga. How can he rationalize a world of site value taxation with a world of self assessment?
4. Recently, I have had the occasion to test assessed land values (i.e., Olcott's Blue Book) as forecasts of sales prices in Chicago. I have done this for both industrial and commercial land. While the forecasts are not as bad as I would have guessed, they aren't very good either. The coefficient of determination is about 75%, but the forecasts are inefficient (Theil). How do you do land value assessments in a heavily developed market?
5. Did George sell more books than Samuelson?
6. Can you ever rationalize keeping unprofitable routes on a transit system because they make the whole system profitable?

7. You made a strong case for the primacy of the tax system in governing redevelopment of urban areas. Would the subversion of police powers (e.g., zoning, building codes, housing codes) also play a role (I realize that you mentioned rent control - by the way, I liked your rent control section but would have liked it even more if it had stressed search costs)? What role is played by eminent domain?
8. What role is played by technology? For example, manufacturing production functions have changed requiring extensive land use and cheap land. Thus, one would not contemplate redeveloping the core of urban regions for manufacturing. What portion of the decay of cities is due to natural processes and not at all related to tax policy or any other kind of policy?
9. I sometimes use the metaphor of a fairy ring to describe cities dying on the inside and growing on the periphery. Among the things that previous development does to retard redevelopment is that it requires the breakup of land into parcels that may not be optimally sized or shaped for redevelopment. Thus, I look to the elimination of the government franchise (privatization, if you like) in eminent domain as a significant, revitalizing, policy change. Self assessment is the key to this privatization. It seems to me that a pure site value tax would mess this up. You have to take buildings as well as land. How do you set the value of the buildings for the takings?
10. Did you see the 5/17/89 WSJ story on Ecorse, Michigan, "The City that Privatized Everything"? The supply side implications in that story are very strong. Lower the ad valorem property tax rate and tax revenues rise. This is very interesting to me.

Our office received a call from Pamela Simkin of Spiegel & McDiarmid of NYC this morning. She wanted to know what info we had on urban redevelopment. I sent a copy of your speech. I hope you don't mind.

Sincerely,



Peter F. Colwell



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May 31, 1989

Mason Gaffney
3040 Tyler St.
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Dear Mason:

I'm not going to inundate you with correspondence, but an additional thought came to me concerning your speech. I agree completely with your view of absentee ownership. If we look at apartments, absentee ownership resulted from the clientel effects forced by the income tax law. The ideal that "other" income could be sheltered substantially by paper losses in real estate was, in my view, a disastrous social experiment. It made it possible for individuals with high wages and salary income to bid more for tax shelters than those with low wages and salary income. Thus, doctors and lawyers came to be owners of apartment buildings through the device of limited partnerships. Much the same can be said of office buildings, strip malls, industrial parks, and even corporate headquarters.

Well, the TRA may have changed all this. I just haven't sorted out how. It looks to me like non-taxed sector institutions are now the clientel most likely to buy everything . . . at least everything above \$5,000,000. I couldn't understand why pension funds were doing anything at all in the real estate market prior to the TRA. Now they seem to be everywhere. If all pension funds achieve their portfolio goals for real estate, they will own all US investment grade real estate three times over (I just made this up but it has the right ring to it). I expect all this to raise the wages of property managers substantially. However, I suspect that we will feel some negative effects from this new type of absentee ownership.

Sincerely,

Peter F. Colwell

Mason Gaffney
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Riverside, CA 92503

2 June 89

Peter F. Colwell
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Dear Peter:

Your comments are most thoughtful. Even if you disagree you were moved to react, which makes me feel the talk served a purpose. I'll respond by the numbers.

1. Is sprawl bad? In the 1930s those surveying the wreckage noted there were enough lots subdivided in Florida to house the population of the whole United States, and less extreme excesses were committed simultaneously in all growing areas. For years there was no need to demonstrate that sprawl was bad. Modern training has screened out most of that bad news of the 1920s, otherwise I suspect the question would not be raised.

You are coming from a free-market position I infer, and I will gear my remarks accordingly. To the extent that sprawl results from subsidies it is bad almost by definition (except for your #6). Unneutral taxation of course results in wrong land use, too. But the problem of inefficient land speculation antedates heavy taxation and challenges ideas of efficiency in the land market. To the extent the land market is inefficient (in a meaningful sense, not the tautological one now the mode), and the dominant inefficiency promotes sprawl, that too is bad. The historical record is fairly clear I believe, but the theoretical case needs making. I base it on differential access to credit, in a market where valuations are more sensitive to cap rates than anything else, owing to perpetual future life plus expected appreciation.

Do we want the optimal amount of sprawl? Yes, by definition, but what is optimal in this case? Charging developers for their impacts is a good idea, but how about non-developers, whose impact is to divert demand outwards to marginal land? Many public costs are area-sensitive. "Delta is ready when you are" is nice for the customer, but expensive for Delta. In this case we, the paying public, are Delta. Flood-control works are a good example. When Washington pays, and the protected lands remain unused, there is waste.

Unneutral taxation that "shoots anything that moves", but gives preferential treatment to land gains (misnamed "capital" gains) adds to the problem.

Charging new developments full cost also raises questions of entitlements.

2. Richard T. Ely developed this idea in the 1920s, calling it the theory of "ripening costs". In the following debacle it was pretty well dismissed as an effort to rationalize the irrational. Perhaps that was too easy, intellectually. Our Tahoe session will raise the question at the a priori level. I enclose some thoughts on the topic, in notes on Land as a Distinctive Factor of Production. The risk is asymmetrical, resulting in a fallacy of composition.

As Nic has shown, a neutral tax does not interfere with optimal timing decisions.

3. Parts of Dr. Sun's writing may sound ga ga to us, but what is our opinion compared with 900 million Chinese? He is a power, in both Chinas. Harberger, Holland and other mainstream tax economists have taken self-assessment quite seriously, and it may have a place in a good system.

4. Olcott's values are not really "assessed". It is a private mass appraisal done with limited resources for purposes of general overview. Bankers used to call it "the guess book": but kept it on hand anyway.

The quality of land assessments, like most things, depends on how much resources go into them. By raising rates, and removing building taxes, we would assure that much more resources would go into assessment. Publishing tax maps is also an excellent device, and is practised in times and places where this is taken seriously (Copenhagen is a shining example today; Milwaukee was when Dan Hoan was mayor).

How assess land in a heavily developed market? In Milwaukee County which I studied in the 1960s there were only two municipalities which were fully built out: Shorewood and Whitefish Bay, where I lived. Whitefish Bay was considered a highly uniform residential suburb of new to middle-aged housing. The Village Board simulated the effects of a Georgist tax by buying up the occasional decadent house when its price reached down to \$14,000 or so (ah, those nostalgic prices!). Then they sold the bare land for \$8,000. They figured they recouped the loss in higher taxes in a few years. Higher taxes not just from the specific house, but the neighborhood.

The point here is that Georgist taxation speeds up renewal and provides more market data on bare land sales. I got plenty of data from Whitefish Bay.

If you want non-uniform assessments, compare the assessment of capital in its various forms. Much movable property is not assessed at all, by law or custom.

5. I excluded textbooks from my survey. They are not free market sales. The appropriate comparison is with Samuelson's Foundations of Economic Analysis.

6. Interesting point worth pursuing. Many rails have kept feeder lines open only because required by law, and closed them the minute they could, so they evidently didn't think so in those cases. But your implication is surely right, a system analysis is called for.

Where the system center is congested, the system analysis might go the other way and show the feeders are worse than otherwise shown. That is implied in your point #1 about impact fees. We have struggled hard in my town to force the inclusion of "backup costs" in impact b/c analyses, and resulting fees. It is an uphill fight, there are so many systems involved.

7. Yes, zoning is being badly handled. It should be taxed as part of land value.

8. Technology, in my opinion, should and does adapt to relative costs, rather than leading them. Subsidies to sprawl create an artificial abundance of outlying land, and resulting one-story development. Taxes on buildings are also a factor, they penalize substituting private capital for land, i.e. building upwards. Meantime we substitute public capital, untaxed, and utility capital, cross-subsidized, so cities expand horizontally.

9. LBJ's urban renewal fiasco pretty well discredited the idea that land assembly is the key to revitalizing central areas. I understand that Hiroshima and Nagasaki, on the other hand, declined their opportunity for a fresh start and went back to the old, obsolescent parcels and did rather well even so.

I don't get your meaning about eliminating eminent domain, and its relation to self-assessment. Please clarify.

If self-assessment is your major policy goal, then it is arguable that lvt raises new problems. But isn't that letting an administrative means become an end?

10. I'd like to see the WSJ story on Ecorse MI. Can you send a copy?

Thanks for sending my paper to Simkin. I know several Spiegel & McDiarmid people from Washington DC days, but no one from NYC.

I agree with your letter of 31 May. I haven't sorted out the new law either. But you left out one big clientele group, the nonresident aliens. They are exempt from U.S. capital gains taxes, generally. I presume this is generally reciprocal. Result: our nationals buy their land while theirs buy ours. Net gain: negative.

Sincerely,

Mason

LAND VALUE EFFECTS OF REVENUE-NEUTRAL PROPERTY TAX REFORM

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April 26, 1989

LAND VALUE EFFECTS OF REVENUE-NEUTRAL PROPERTY TAX REFORM

Many property tax reforms have been considered in the past. These have included site value taxation, incremental site value taxation, and taxing current property income. The reform considered here is to move away from the ad valorem tax and toward land value taxation. The precise nature of the reform considered in this paper is moving from uniform rates on buildings and land to a system of lower rates on buildings and higher rates on land so that total tax revenue is unaltered. This is **revenue-neutral** reform. The object of this exercise is to determine the impact of such reform on land prices in the short-run and very-long-run.

This paper begins with a presentation of the background demand and allocation issues necessary to develop the land value results. The next section develops the results for the short-run. The following section does the same for the very-long-run. The short-run is a period so short that there can be no change in the allocation of land, whereas the very-long-run is so long that not only can there be changes in the allocation of land but the changes are not impeded by previous improvements. One may question whether very-long-run equilibrium ever exists. The answer is that the first urban development of agricultural land should be close to very-long-run equilibrium. The final section offers some conclusions.

Demand and Allocation

The demand for land is assumed to be a residual; it is what is left of the demand for developed property after subtracting the cost of development. The market price of developed property (P) is equal to the willingness to pay in the absence of taxes (D) minus the capitalized building and land value taxes.

$$(1) \quad P = D - \frac{t_B B}{r} - \frac{t_L (P - B)}{r}$$

where t_B = the tax rate on building value,

B = the value of buildings per acre,

$t_B B$ = the tax on buildings,

r = the capitalization rate,

$\frac{t_B B}{r}$ = the capitalized value of the tax on buildings per acre,

t_L = the tax rate on land value,

$(P - B)$ = the residual value of the land,

$t_L (P - B)$ = the tax on land, and

$\frac{t_L (P - B)}{r}$ = the capitalized value of the tax on land per acre.

Solving (1) for the price of developed property yields

$$(2) \quad P = \frac{D r}{r + t_L} - \frac{t_B B}{r + t_L} + \frac{t_L B}{r + t_L}.$$

Subtracting the cost of buildings per acre from both sides of (2) and simplifying yields the following expression for the price of land per acre:

$$(3) \quad p = \frac{D r}{r + t_L} - \frac{B (r + t_B)}{r + t_L}.$$

Suppose that the willingness to pay for developed property in the absence of a tax is a linear function of the quantity of such property. That is,

$$(4) \quad D = \alpha + \beta A.$$

where A = the number of acres allocated to the land use.

Substituting (4) into (3) yields the demand for land,

$$(5) \quad p = \frac{\alpha r - r B - t_B B}{r + t_L} + \frac{\beta r A}{r + t_L}.$$

If the building tax changes, the intercept of the land demand curve changes but by less than the change in the capitalized tax on buildings, and the slope does not change. The change in the intercept is

$$- \frac{(t_{B2} - t_{B1}) B}{r + t_L},$$

where $(t_{B2} - t_{B1})$ is the change in the building tax rate. This change in the intercept is the negative of the capitalized change in total tax revenue per acre resulting from the change in the building tax rate. On the other hand, the capitalized change in the building tax is

$$+ \frac{(t_{B2} - t_{B1}) B}{r}$$

The difference between these two magnitudes is in their denominators. The denominator of the change in the intercept is larger by the amount of the land tax rate. The intuition for this difference is that land price varies inversely with the building tax rate. If the building tax rate rises, the price of land and the land tax fall. So the land tax revenue is related to the building tax rate. Raising the building tax rate will, therefore, not cause total revenue to rise by the change in the rate multiplied by the value of buildings.

The expression for the demand for land, (5), is the essential ingredient in the derivation of the allocation of land among competing uses. The simplest case, the one considered in this paper, allows for the allocation of land between two competing uses, say, residential (denoted by the subscript R) and commercial (denoted by the subscript C). Very-long-run equilibrium requires that we set land prices equal to each other for the two land uses. Next, we can solve for the number of acres allocated to one of the uses. This result is obtained as follows:

$$\begin{aligned} \frac{\alpha_R r}{r + t_L} - \frac{r B_R}{r + t_L} - \frac{t_B B_R}{r + t_L} + \frac{\beta_R r A_R^*}{r + t_L} &= \frac{\alpha_C r}{r + t_L} - \frac{r B_C}{r + t_L} - \frac{t_B B_C}{r + t_L} + \frac{\beta_C r (A_T - A_R^*)}{r + t_L} \\ (6) \quad A_R^* &= \frac{\alpha_C r - \alpha_R r - r B_C + r B_R - t_B B_C + t_B B_R + \beta_C r A_T}{(\beta_R + \beta_C) r} \end{aligned}$$

Short-Run Effects of Tax Reform

The short-run land price effects of revenue-neutral property tax reform are not intuitively obvious. Total land value does not change. The price of the more capital intensive use rises while the price of the less capital intensive use falls. These and other effects of this tax reform are demonstrated below by the use of a simple numerical example.

Suppose the two land uses, residential and commercial, compete for land in a taxing jurisdiction of 2,400 acres. Further suppose that the underlying demand parameters are

$$\alpha_C = 476,000,$$

$$\beta_C = -126.666,$$

$$B_C = 300,000,$$

$$\alpha_R = 312,000,$$

$$\beta_R = -6.666, \text{ and}$$

$$B_R = 200,000.$$

The tax rates are initially uniform with t_L and $t_B = .015$. The capitalization rate, r , is .045.

Substituting the magnitudes of the parameters into equation (5), the demand for residential land is found to be

$$(7) \quad p_R = 34,000 - 5 A_R .$$

Similarly, the demand for commercial land is found to be

$$(8) \quad p_C = 57,000 - 95 A_C .$$

These demand curves are illustrated by the bold lines in Figure 1. In the Figure, these demand curves intersect at an allocation of 2,050 acres to residential and 350 acres to commercial. It can be confirmed that this is the very-long-run equilibrium allocation by substituting the parameters into (6). The land price for each use would be \$23,750 in very-long-run equilibrium. This can be confirmed by substituting 2,050 for A_R in (7) or 350 for A_C in (8). Given a uniform price of \$23,750, the total value of land in the 2,400 acre community would be \$57,000,000. Building value is \$200,000 per acre times 2,050 acres for residential and \$300,000 per acre times 350 acres for commercial. Thus, aggregate building value is \$515,000,000. Tax revenue is the product of the tax rate, .015, and total property value, \$572,000,000, or \$8,580,000.

A decline in the building tax rate will cause the land demand curve for residential to shift upward by less than that for commercial. Suppose that the building tax rate declines to .004. Substituting into the intercept term of equation (5), one finds that residential demand will shift upward by \$36,666, whereas the commercial demand curve shifts up by \$55,000. These shifts are shown in Figure 1 by the lighter demand curves. The new short-run land prices would be \$60,416 for the residential use and \$78,750 for the commercial use.

Suppose that the tax rate on land were then increased in order to exactly compensate for the loss in tax revenue due to the decrease in the tax rate on buildings. Two questions arise. First, will the relative land prices be maintained after the tax-neutral reform but still in the short-run? That is, would the more capital intensive land users always be advantaged and the less capital intensive users always be disadvantaged by the revenue-reform? More precisely, would the price ratio stay at $\$78,750/\$60,416 = 1.303\dots$? Second, what happens to aggregate land value in the short-run? Does it necessarily rise, fall, or stay constant as the result of short-run tax-neutral reform.

The required land tax rate can be computed once two conjectures are explained. First, the post-reform building value will be the same as the pre-reform building value. Second, the

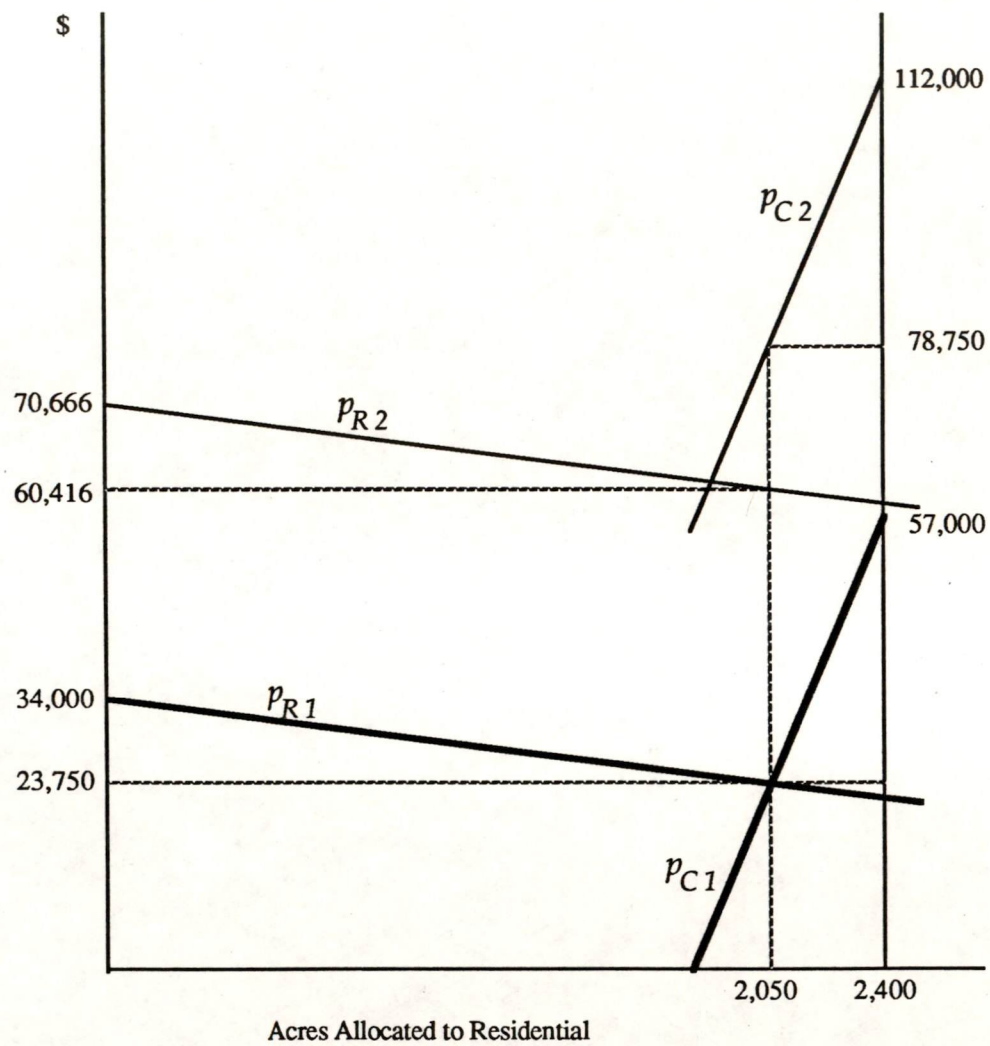


Figure 1

aggregate post-reform land value will be the same as the pre-reform land value, although the relative prices will be different. Setting the post reform revenue equal to the pre-reform revenue allow one to solve for the compensating land tax rate.

$$t_{L1} p_1 A_T + t_{B1} (B_R A_R + B_C A_C) = t_{L2} p_1 A_T + t_{B2} (B_R A_R + B_C A_C)$$

$$t_{L2} = \frac{t_{L1} p_1 A_T - (t_{B2} - t_{B1}) (B_R A_R + B_C A_C)}{p_1 A_T}$$

Building value will not be changed by reform in the short-run but will stay at \$515,000,000. Land value should have returned to \$57,000,000 if the capitalized tax loss from the building tax reduction is recovered by a land tax increase. Thus, one can solve for the new land tax rate as follows:

$$t_{L2} = .114385964$$

One can be assured that this rate is correct and that the conjectures underlying it are correct (i.e., for the particular numerical example) by using it to calculate land values and land tax revenue directly as follows:

$$p_{C2} = \frac{\alpha_C r - r B_C - t_{B2} B_C}{r + t_{L2}} + \frac{\beta_C r A_C}{r + t_{L2}} = 29,645.$$

$$p_{R2} = \frac{\alpha_R r - r B_R - t_{B2} B_R}{r + t_{L2}} + \frac{\beta_R r A_R}{r + t_{L2}} = 22,744.$$

$$\text{land tax revenue} = t_{L2} (p_{C2} A_C + p_{R2} A_R) = .114385964 (57,000,000) = 6,520,000$$

Given the same building costs, building tax revenue is calculated as follows:

$$\text{building tax revenue} = t_{B2} (B_C A_C + B_R A_R) = .004 (515,000,000) = 2,060,000.$$

The sum of land tax revenue and building tax revenue yields the same total tax revenue as before the reform,

$$6,520,000 + 2,060,000 = 8,580,000.$$

Thus assured that given a new building tax rate of .004, the revenue neutral land tax rate would have to be approximately .114, several principles have been demonstrated. The final land prices would be \$22,744 and \$29,645 for residential and commercial, respectively. This maintains the 1.303 price ratio that existed after the building tax rate decrease but before

the compensating land tax rate increase. So the relative land prices were not disturbed by the compensating land tax rate increase. The more capital intensive land user ended up with the higher price after the reform. Aggregate land value did not change pre-reform as compared to post-reform. It remained at \$57,000,000. Therefore, the questions may have been answered. The next natural question is whether these results are generally valid.

The result that the more capital intensive user ends up with the higher land price is always true. The more capital intensive land use has the higher price after the building tax rate change but before the compensating land tax rate change. The land tax change then will cause the land demand curves to shift down proportionately to their height. More precisely, the land demand curves rotate around their horizontal intercepts as the land tax changes. Thus, the use with the higher price before the compensating land tax change would be the use with the higher price after the compensating land tax change.

The result that aggregate land value is invariant also is completely general. The amount by which aggregate land value increases as a result of the initial building tax rate decrease is exactly the capitalized value of the loss of tax revenue. This is the amount that must be recovered by the public sector through a higher land tax rate. In other words, what is gained by land users in tax savings through a lower building tax rate is completely reflected in a higher aggregate land value. So what must be gained back by the tax collector through a higher land tax rate will be reflected in an offsetting decline in aggregate land value. There will be no net change in aggregate land value with both tax rate changes in place.

Very-Long-Run Effects

Consider a tax reform package that is only revenue neutral in the very-long-run (i.e., one that produces a new long-run equilibrium allocation of land). This reform can be viewed as consisting of two steps:

- 1) The very-long-run impact of the building tax decrease
- 2) The impact of the compensating land tax increase

As before, the principal question is the ultimate impact upon the value of land.

The capitalized decrease in tax revenue from just the decrease in the building tax rate, the first step, can be further decomposed into three parts:

- 1) First, there is the loss building tax revenue that is associated with the building tax rate decline in the short-run, i.e., at the initial allocation.
- 2) The second component is the capitalized gain in the building tax due to the reallocation which increases the average intensity of land use.
- 3) Third, there is the gain or loss in land tax due to the reallocation. This comes from

the change in land price at the initial allocation from before the change in the building tax rate to the new long-run equilibrium land price that emerges from the tax rate change.

These three components are expressed algebraically in the following three paragraphs.

The short-run capitalized revenue loss from a decrease in the building tax rate depends on the initial allocation, the tax rate change, and the levels of building cost for the land uses. For example,

$$(9) \quad -B_C (t_{B2} - t_{B1}) (A_T - A_{R1}^*) = \text{the loss in commercial building tax revenue, and}$$

$$(10) \quad -B_R (t_{B2} - t_{B1}) A_{R1}^* = \text{the loss in residential building tax revenue}$$

Taking the sum of equations (9) and (10) and dividing by $r A_T$ yields the capitalized total loss of building tax revenue in the short run per acre, i.e., the first component,

$$(11) \quad -\frac{B_C (t_{B2} - t_{B1})}{r} - \frac{(t_{B2} - t_{B1}) (B_R - B_C) A_R^*}{r A_T}.$$

The loss in building tax revenue from the reallocation is

$$(12) \quad -t_{B2} (B_R - B_C) (A_{R2}^* - A_{R1}^*)$$

The loss in (12) is capitalized and put on a per acre basis by dividing by $r A_T$ as follows:

$$(13) \quad \frac{-t_{B2} (B_R - B_C) (A_{R2}^* - A_{R1}^*)}{r A_T}$$

The difference in the long-run equilibrium allocations is found as follows:

$$A_{R2}^* = \frac{\alpha_C r - \alpha_R r - r B_C + r B_R - t_{B2} B_C + t_{B2} B_R + \beta_C r A_T}{(\beta_R + \beta_C)r}$$

$$-A_{R1}^* = -\frac{\alpha_C r - \alpha_R r - r B_C + r B_R - t_{B1} B_C + t_{B1} B_R + \beta_C r A_T}{(\beta_R + \beta_C)r}$$

$$(14) \quad A_{R2}^* - A_{R1}^* = \frac{(t_{B2} - t_{B1}) (B_R - B_C)}{(\beta_R + \beta_C)r}$$

Substituting equation (14) for the difference in the number of acres allocated to the residential use in equation (13) yields the second component,

$$(15) \quad \frac{-t_{B2} (t_{B2} - t_{B1}) (B_R - B_C)^2}{r^2 A_T (\beta_R + \beta_C)}.$$

The loss per acre in tax revenue from the land tax change in the very-long-run is the product of the very-long-run price change and the land tax rate

$$(16) \quad -(p_2 - p_1) t_{L1}$$

The capitalized loss, i.e., the third component, is found by dividing by r as follows:

$$(17) \quad \frac{-(p_2 - p_1) t_{L1}}{r}$$

The very-long-run change in land price is found by taking the difference between the two equilibrium prices.

$$(18) \quad \begin{aligned} p_2 &= \frac{\alpha_R r - r B_R - t_{B2} B_R}{r + t_L} + \frac{\beta_R r A_{R2}^*}{r + t_L} \\ -p_1 &= - \left(\frac{\alpha_R r - r B_R - t_{B1} B_R}{r + t_L} + \frac{\beta_R r A_{R1}^*}{r + t_L} \right) \\ p_2 - p_1 &= - \frac{(t_{B2} - t_{B1}) B_R}{r + t_L} + \frac{\beta_R r (A_{R2}^* - A_{R1}^*)}{r + t_L} \end{aligned}$$

The price difference depends on the difference in the long-run equilibrium allocations of land (i.e., $A_{R2}^* - A_{R1}^*$). Substituting equation (14) for this difference yields the price change in terms of parameters only.

$$(19) \quad p_2 - p_1 = - \frac{(t_{B2} - t_{B1}) B_R}{r + t_L} + \frac{\beta_R (t_{B2} - t_{B1}) (B_R - B_C)}{(r + t_L) (\beta_R + \beta_C)}$$

In the very-long-run, the impact of a revenue neutral tax reform depends on the price increase prior to the imposition of the compensating land tax increase relative to the sum of the losses represented in statements (11), (15), and (17). This is so for two reasons. First, these three loss components are the only source of tax revenue change from an initial decrease in the

building tax rate. Second, the increase required in the land tax rate to neutralize the revenue decline from the building tax rate decrease will cause the land price to decline by exactly the amount of the capitalized tax. Therefore, if the price increase is greater than the losses from the three components described above, the required price decrease will leave some price gain on net. Formally, the requirement for a price increase from revenue neutral tax reform is

$$(20) \quad p_2 - p_1 > -\frac{(p_2 - p_1) t_{L1}}{r} - \frac{t_{B2} (t_{B2} - t_{B1}) (B_R - B_C)^2}{r^2 A_T (\beta_R + \beta_C)} - \frac{B_C (t_{B2} - t_{B1})}{r} \\ - \frac{(t_{B2} - t_{B1}) (B_R - B_C) A_R^*}{r A_T}$$

Inequality (20) can be simplified substantially. One starts by solving for $p_2 - p_1$.

$$p_2 - p_1 + \frac{(p_2 - p_1) t_{L1}}{r} > -\frac{t_{B2} (t_{B2} - t_{B1}) (B_R - B_C)^2}{r^2 A_T (\beta_R + \beta_C)} - \frac{B_C (t_{B2} - t_{B1})}{r} \\ - \frac{(t_{B2} - t_{B1}) (B_R - B_C) A_R^*}{r A_T}$$

$$(p_2 - p_1) \left(\frac{r + t_{L1}}{r} \right) > -\frac{t_{B2} (t_{B2} - t_{B1}) (B_R - B_C)^2}{r^2 A_T (\beta_R + \beta_C)} - \frac{B_C (t_{B2} - t_{B1})}{r} \\ - \frac{(t_{B2} - t_{B1}) (B_R - B_C) A_R^*}{r A_T}$$

$$p_2 - p_1 > -\frac{t_{B2} (t_{B2} - t_{B1}) (B_R - B_C)^2}{r (r + t_{L1}) A_T (\beta_R + \beta_C)} - \frac{B_C (t_{B2} - t_{B1})}{(r + t_{L1})} \\ - \frac{(t_{B2} - t_{B1}) (B_R - B_C) A_R^*}{(r + t_{L1}) A_T}$$

Substituting from (19) yields

$$-\frac{(t_{B2} - t_{B1}) B_R}{r + t_{L1}} + \frac{\beta_R (t_{B2} - t_{B1}) (B_R - B_C)}{(r + t_{L1}) (\beta_R + \beta_C)} > -\frac{t_{B2} (t_{B2} - t_{B1}) (B_R - B_C)^2}{r (r + t_{L1}) A_T (\beta_R + \beta_C)} \\ - \frac{B_C (t_{B2} - t_{B1})}{(r + t_{L1})} - \frac{(t_{B2} - t_{B1}) (B_R - B_C) A_R^*}{(r + t_{L1}) A_T}$$

Multiplying both sides by $\frac{r + t_{L1}}{t_{B2} - t_{B1}}$, adding B_R , and dividing by $(B_R - B_C)$ yields

$$\frac{\beta_R}{\beta_R + \beta_C} > 1 - \frac{A_R^*}{A_T} - \frac{t_{B2} (B_R - B_C)}{r A_T (\beta_R + \beta_C)}$$

where $(t_{B2} - t_{B1})(B_R - B_C) < 0$.

Rearranging produces a result that may be helpful.

$$(21) \quad \frac{\beta_R}{\beta_R + \beta_C} > \frac{A_T - A_R^*}{A_T} - \frac{t_{B2} (B_R - B_C)}{r A_T (\beta_R + \beta_C)}$$

It is possible to solve (21) for t_{B2} suggesting that for a range of new building tax rates the revenue-neutral tax reform will produce land value increases, and for a different range, it will not.

$$(22) \quad t_{B2} > \frac{r (A_T - A_R^*) (\beta_R + \beta_C) - \beta_R r A_T}{B_R - B_C} = \frac{r (\beta_C (A_T - A_R^*) - \beta_R A_R^*)}{B_R - B_C}$$

When the condition in (22) is met and the new building tax rate is lower than the initial one, revenue-neutral tax reform will result in an increase in land value.

Computation

It is useful to illustrate these ideas by computing the results of tax changes. For example, suppose that the building tax were to decline to .004, as considered in the section on short-run results earlier in this paper. Will revenue-neutral tax reform produce an increase in land value? Condition (22) indicates that land value will decline. If land value increases, then

$$t_{B2} > \frac{r (\beta_C (A_T - A_R^*) - \beta_R A_R^*)}{B_R - B_C}$$

Substituting for the parameters above, the inequality is reversed as follows:

$$.004 < \frac{.045 (-126.666 (2400 - 2050) + 6.666 \cdot 2050)}{200000 - 300000} = .0138$$

This can be confirmed by computing the three components of revenue change and comparing their sum to the change in the land price prior to the imposition of the compensating land tax increase. The capitalized land tax loss per acre is -\$12,528 (i.e., a negative loss is a gain). The capitalized building tax loss per acre in the short-run is \$52,454. The capitalized building tax loss per acre in the very-long run is -\$679. The sum of these components is \$39,247 which is greater than the very-long-run land price increase of \$37,583. Thus land price must be driven down by an increase in the land tax by an amount equal to the difference, \$1,664, in order to replace the lost tax revenue.

The land price picture is very different if the new building tax rate is greater than .0138. For example, suppose that the building tax rate is reduced to .0143. The capitalized land tax loss per acre is -\$797. The capitalized building tax loss per acre in the short-run is \$3,338. The capitalized building tax loss per acre in the very-long run is -\$154. The sum of these components is \$2,386 which is smaller than the very-long-run land price increase of \$2,392. Thus the price of land will increase in the very-long-run by about \$6 per acre.

Abandoning the building tax

While inequality (21) is substantially simpler than (20), it still does not offer much in the way of an intuitive feel for the circumstances under which revenue-neutral tax reform will lead to an increase in the price of land. However, some insight can be gained by a simple assumption; suppose that the new building tax rate were zero so that there would be no gain in building tax revenue as a result of the reallocation. What then would be the requirement for achieving an increase in land value? Setting t_{B2} to zero in (21) yields

$$\frac{\beta_R}{\beta_R + \beta_C} > \frac{A_T - A_R^*}{A_T}$$

Multiplying both sides by $A_T(\beta_R + \beta_C)$ and rearranging terms yields a result that warrants an interpretation:

$$(23) \quad \beta_R A_R^* > \beta_C (A_T - A_R^*)$$

Here we see that the product of the initial allocation to the residential use and the slope of the underlying demand curve for residential property must be greater than the same product for commercial property if land value is to increase in the very-long-run. Multiplying both sides of

(23) by $\frac{r}{p_I (r + t_{LI})}$ produces a result that may seem even more intuitively clear,

$$(24) \quad \frac{\beta_R r}{r + t_{L1}} \frac{A_R^*}{p_1} > \frac{\beta_C r}{r + t_{L1}} \frac{(A_T - A_R^*)}{p_1}$$

Inequality (23) says that the slope of the land demand curve multiplied by the ratio of the quantity of land to the price must be greater for the residential use (i.e., the less capital intensive use) than for the commercial use (i.e., the more capital intensive use). That is, the reciprocal of the price elasticity of demand for residential land must be greater than the reciprocal of the price elasticity of demand for commercial land. Put slightly differently, the elasticity of demand for commercial land must be greater than the elasticity of demand for residential land. Thus in the context of totally abandoning the building tax, i.e. $t_{B2} = 0$, an increase in the price of land requires that the commercial elasticity be greater than the residential elasticity.

CONCLUSIONS

Revenue-neutral tax reform that causes the building tax rate to decline and the land tax rate to increase can, under certain conditions, result in the value of land rising. Short-run, revenue-neutral tax reform holds aggregate land value constant, while the prices of land to specific uses will either rise or fall. The land price effects of long-run, revenue-neutral tax reform depend upon the magnitude of the new building tax rate relative to a function of demand parameters, total land area, and the initial allocation. In the special case of eliminating the building tax entirely with revenue-neutral reform, the land price will increase if the price elasticity of demand for the more capital intensive use is greater than that of the less intensive use.

Future work on the questions asked in this paper might incorporate modifications of this theory with respect to the introduction of depreciation. For example, a "one hoss shay" assumption or a straight-line method would change the building tax capitalization rate and thus bring about changes throughout the paper.