Tax Rules, Land Development, and Open Space

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Abstract

Concern about "open space" is growing. Conservation advocates worry that private land use decisionmakers preserve too little open space. Yet private land developers are deciding on their own to preserve open space in new developments because it provides amenities to purchasers of lots. Moreover, tax provisions provide incentives for preserving more open space than would be privately optimal. Many jurisdictions have adopted "use-value assessment" standards granting favorable tax treatment to lands maintained in open space. Also, donations of open space can be deducted from income in computing tax liabilities. Both factors may be empirically important, although tax deductibility may have larger conservation effects than does use-value assessment. These conclusions raise several unanswered questions: How important are tax incentives in practice? Do they motivate enough conservation of open space? Do tax incentives target the right conservation priorities?

Key Words: income tax, property tax, tax deductions, use-value assessment, ecosystem services, open space, conservation, amenity value

JEL Classification Numbers: H23; H41; H71; R14

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Introduction

There is great concern around the nation with "open space."[1] Opponents of urban sprawl fear we are running short of open space. Advocates for the protection of biological diversity worry that wildlife habitats are being absorbed and destroyed as suburbs expand. Closely related are worries that open space provides "ecosystem services" (e. g., Daily 1997) to the developed lands around them, and that these services are lost when land is developed.

Implicit in those concerns is an argument that open space provides services whose benefits cannot be fully appropriated by private parties. Yet there has been a curious concurrence between commentators of the left and the right. Conservative writers such as Terry Anderson and Donald Leal (2001) argue that combining holdings under common ownership can "internalize" land use externalities. Liberal environmental advocates such as Gretchen Daily and Katherine Ellison (2002) also devote considerable effort to documenting the ways in which more benign land management may be in the self-interest of private landholders (see also Heal 2002). Conservatives may believe that private incentives are sufficient, while liberals see them only as a step in the right direction. Does more need to be done?

Public policies already in place are providing additional incentives to preserve open space. I focus on two. First, a number of jurisdictions have instituted "use-value assessment" for the calculation of property tax payments. The taxable value of a parcel has traditionally been determined by its "highest and best use"—that is, by its value in whatever its most profitable private use might be. In at least 47 states, however, provisions have been made whereby property taxes are assessed on the basis of actual rather than highest and best use value (Anderson and Griffing 2000).

[1] As there may be some ambiguity in the use of terms, and no compact expression is sufficiently broad, I will use "open space" to denote any form of undeveloped land, or land that is less developed than its surroundings. "Closed forest" (a forest in which the branches of adjacent trees overlap) could, for example, be open space.

The second policy involves income tax deductions for charitable contributions. The federal government, 42 states, and many localities charge income tax. A developer who subdivides, improves, and builds on land is charged income tax on the value he adds. Those who inherit large estates incur a similar tax liability and must pay taxes on the value of the estate. Charitable contributions can be deducted against income or estate proceeds in computing tax liability.

A land developer may choose to "donate" either fee-simple ownership of some portion of lands he controls or conservation easements restricting the use of such lands. His taxable income may be reduced by the value of such "donations." There have been some notable recent examples in which land sellers have claimed large deductions for donations. The developers of Spring Island in coastal South Carolina sold much of the area but donated a substantial portion to a land management trust, then claimed a tax deduction for doing so (Heal 2002). Allegheny Power, an electric utility company, recently sold a large holding in the Canaan Valley of West Virginia. Much of the land was sold for residential development, but a sizable area went to the federal government. Allegheny took a tax deduction of $15 million based on the claimed excess of the land's value over the sales price (Daily and Ellison 2002).[2]

At first glance it may not be obvious why changing either property or income tax rules would affect decisions regarding whether to preserve open space. Wouldn't a land developer earn more after taxes by devoting each hectare of his land to its "highest and best" private use? He would *if land use in one part of his holdings did not affect land value in another*. Under such circumstances the tax advantages would only induce greater preservation of open space if they swung the balance in favor of owners' intangible and idiosyncratic preferences for conservation.

There is, however, considerable evidence that land developers—particularly developers serving relatively upscale buyers at the fringes of metropolitan areas or in popular recreational areas—set aside open space within the boundaries of their developments as amenities to appeal to prospective buyers. Casual inspection of newspaper advertising reveals many instances in which planned communities have been laid out with generous open space. There may be an incentive to preserve some open space in the absence of any favorable tax treatment (see also

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[2] The Allegheny example is somewhat different, however, as the amount of the claimed deduction was represented as the value of the ecosystem services the property provided, rather than the private use value.

Heal 2002). Incentives to make such "donations" (I enclose the word in quotes, as I suppose that such donations can be self-serving) increase with favorable tax treatment.

It is not surprising that tax rules that, in effect, change the relative price of land retained as open space change development behavior. This explains why nonprofit conservation organizations often lobby legislatures to enact such incentives. What may be somewhat more surprising is that the incentives can be very powerful. The additional open-space preservation motivated by use-value assessment is likely to be modest, but not negligible—perhaps on the order of a 10% or 20% increase in the amount of open space preserved. Tax deductibility of conservation donations could have more powerful effects. Under even reasonable assumptions, allowing the value of conservation donations to be deducted from taxable income might double the amount of open space preserved.

The observation that incentives can have powerful effects begs three important questions. First, exactly how powerful might they be? Although plausible assumptions concerning tax and demand parameters suggest that effects could be large, the effects are not linear in marginal tax rates. Better understanding the rates developers face is important. Second, if tax incentives were, in fact, powerful, would the open-space preservation problem be "solved"—would such taxes fully internalize whatever externalities land development imposes? Finally, are tax incentives targeting the right problem? In the model presented below, tax incentives affect the decisions of land developers who are already, at least partially, "internalizing the externality." As a practical matter, this means that such incentives are affecting how particular portions of particular landscapes are developed. Conservation biologists have long debated whether systems of many small protected areas are more or less effective than single large areas. The incentives I discuss here are more likely to result in the former than the latter.

The remainder of the paper is laid out in six sections. In the first section below I provide a little more detail on property and income taxes, special treatments afforded open spaces, and proposals for expanding incentives. The next section introduces the basic model. The third, fourth, and fifth sections discuss three cases. The first is the benchmark case, with no taxes. The next shows that the outcome under use-value assessment mimics the benchmark case of no taxes. The third case discusses income tax deductibility and its implications for the retention of open space. A final section concludes with a more detailed discussion of the three questions raised above: how powerful are tax-related incentives, are they powerful enough, and are they targeting the right areas?

I. Tax Incentives and Land Use

A number of authors have addressed the impact of tax incentives on land use. An extensive literature looks at the effects (e.g., Ferguson 1988; Anderson 1993a) and costs (e.g., Anderson and Griffing 2000) of use-value property taxation. Other research considers how property and other taxes might be used to internalize the externalities arising from land use (e.g., Tideman 1990; Anderson 1993b). There has also been considerable interest in the use of income and inheritance tax deductions as conservation instruments, although it does not appear that much work in this vein has appeared in the formal economics literature.

Most researchers have focused on scenarios in which the value of a parcel of land is determined exogenously. The owner may decide what use to make of that parcel, and she may be offered tax incentives to incorporate the effects of its use on others in her own calculations. The existing land use and public finance literature typically does not regard the landowner as being able to affect the value of one parcel under her control by choosing the land use pursued on another, however.

There is a literature on such choices. Cornes et al. (1986, 1988) have considered an analogous scenario in which each of several exploiters of a common-pool resource imposes a cost on the others. They then ask what is the optimal number of competing exploiters. They balance the efficiency losses arising from the common-pool problem against those arising from concentration among sellers. The general problem has recently been revisited by Heal (2001) in the context of land development. He shows that a single monopolist would achieve a fully efficient outcome if he could price-discriminate perfectly. Contributions to this literature have not generally considered the impacts of policy measures such as tax incentives, however.

This paper differs from earlier literature in two respects, then. First, it supposes that private property owners have some incentive to preserve open space absent public policy interventions. Second, rather than focusing on identifying an *optimum optimorum*, my emphasis here is largely on empirically relevant magnitudes. Do, or could, tax rules provide strong incentives for preserving open space?

As noted in the introduction, tax rules may create significant incentives for conservation. Property tax rates are often on the order of 1% of assessed value, with assessed values often lagging market values. These rather small fractions of total property value translate into much larger fractions of the annual earnings stream generated by a property—perhaps on the order of 10% to 20%. Jurisdictions in at least 47 states allow for some form of use-value assessment in computing property tax liability. Although such provisions vary widely, common features include preferential treatment for maintaining forest, farmland, or other traditional, low-impact uses.

The U.S. federal government taxed 2001 personal income at a maximum marginal rate of 39.5%. Forty-two states also charge personal income taxes, generally at maximum marginal rates of 5% to 10%. Corporations pay federal taxes at a rate of about 35%.[3] The federal estate tax ranges from 37% on estates valued at $600,000 to 55% on those valued over $3 million. Capital gains on real property held for periods longer than a year are taxed at a rate of 20%.

The federal government imposes a number of restrictions on conservation donations. The most straightforward is that they have some realistic relationship to the achievement of conservation goals. The U.S. Internal Revenue Code requires that donations serve a "conservation purpose," such as providing recreational, scenic, or other amenities to the public, or protecting natural habitat, sites of historical value, or open space (the code actually uses the term *open space* in §170(h)(4)). To assure that such objectives are, in fact, met, the code requires that donations of fee simple ownership or conservation easements be made to a "qualified" organization—that is, a bona fide conservation organization (IRC §170(h)(3)).

Certain restrictions are made on deductions. For example, sellers of conservation easements are now limited to claiming deductions amounting to no more than 30% of their adjusted gross income over a period of no more than six years. Increasing the limits allowed for such deductions, as well as providing for more favorable tax treatment of conservation donations in general, is a major concern of nonprofit conservation organizations. One major success was scored in 2001, when 1997 restrictions that allowed for the estate tax deductibility of conservation donations only in the vicinity of metropolitan areas or existing conservation reserves were removed. Provisions enacted by the various states are too numerous to discuss in detail here but often parallel federal practice.[4]

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[3] Corporations with earnings between $75,000 and $10 million pay at a 34% rate, and those with earnings in excess of $10 million pay at a rate of 35%.

[4] See, for example, proposed legislation for Iowa at http://www.legis.state.ia.us/GA/79GA/Legislation/HF/00600/HF00699/Current.html .

II. The Model

Suppose a land developer has a large property whose area we will normalize to one. He must decide what fraction of that area, call it x, to develop into residential lots. For convenience I will sometimes refer to x as the "number of lots" developed.[5] The remainder of the property, an area of size $1 - x$, will be retained as "open space."

Let us now sketch how taxes affect a developer's earnings. First, a developer may pay income tax. Suppose the developer buys (or inherits) a large property. He may be required to pay income tax on the difference between the price he paid for (or the basis at which he inherited) the property and its sales value. If we were to expand to a more general, albeit less tractable, model, we might also suppose the developer provides additional value by subdividing lots, constructing residences, and so forth, making his excess of revenue over ostensible costs greater.

The developer pays income tax at a rate t on property he subdivides and sells. Although he can deduct from his tax liability the costs of property acquisition (or the basis at inheritance), such costs will be constant relative to his eventual revenues. Acquisition costs would affect our subsequent calculations only if they were great enough to eliminate income against which deductions can be claimed. Assume for now that they are not.

The developer may be able to claim a tax deduction for whatever area of land he donates to conservation by not developing it as residential lots. Let us suppose that a donation value of D per hectare can be claimed for land not developed. I will be more explicit about the donation value below.

Land developers in the United States may be subject to two forms of taxes. In addition to income taxes, as discussed above, they may also incur property taxes. Suppose that property taxes are levied at a fraction ρ of assessed value per annum. Let the discount rate be r.

Suppose a property provides its owner with benefits in the amount b per year. I will suppose that b can be expressed in monetary terms. Suppose that the discount rate is r, and the

[5] The analysis can easily be extended to have the land developer choose both the number of lots and the size of each. The basic results of that exercise are essentially the same, although the more complicated analysis does raise the interesting issue of how well "public" open space substitutes for larger lots.

assessed value of the property is A. If b, ρ, and r remain constant over time,[6] the price of the property, P, is determined from the infinite sum

$$P = b - \rho A + (1-r)(b - \rho A) + (1-r)^2(b - \rho A) + \ldots = b - \rho A + (1-r)P$$

so

$$P = \frac{b}{r} - \frac{\rho A}{r}. (1)$$

Again, I will be more explicit about assessed value in the cases below. If assessed and actual values are the same, we would have

$$P = \frac{b}{r+\rho}. (2)$$

The "P" in expressions (1) and (2) may be the value of residential lots, which depends on the amount of open space preserved. Or it may be the value of a unit of land in an alternative use. The assessed value "A" may either depend on the highest and best use of the land—in the case of interest, residential lots—or if use-value assessment is conducted, be based on actual earnings. Similarly, the "b" in expressions (1) and (2) may reflect earnings from residential or alternative use. Suppose that the "earnings"—that is, the annual flow of satisfaction afforded, expressed in monetary terms—of a residential lot depend on the amount of land maintained in open space in the development, and write them as $b(1-x)$. Yearly earnings-per-hectare from the alternative activity will be designated b_a and will be assumed independent of land use elsewhere.[7]

A word on notation may be helpful. It will be convenient at many points below to write products in $b(\cdot)$ or its derivatives and $1-x$. To reduce clutter, the argument of b will at times be suppressed. To avoid confusion, b, b', and b'' are to be interpreted as "earnings from a unit area of land as a function of the amount of open space retained, $1-x$," "the first derivative of earnings from a unit area of land as a function…," etc. The term b_a is always a constant. The notation $b(1-x)$ will always mean "b as a function of $1-x$." Any product of $b(1-x)$ or its

[6] The analysis could be expanded to allow for possible capital gains, but nothing important would be added.

[7] Again, this assumption could be relaxed to allow b_a to depend on surrounding land use, but doing so would not add much to the analysis.

derivatives and its argument, $1 - x$, will be expressed by premultiplying b by $1 - x$: $(1 - x)b$, $(1 - x)b'$, etc.

Now let us consider a general statement of the land developer's objective: it is to maximize his earnings after taking income and property taxes into account. The developer is personally obligated to pay income taxes only on his own earnings. His choices may also affect the property tax burden buyers face, however, and this ought also be a consideration that enters into a buyer's decision of what to pay for a lot. Finally, whether the developer retains the open-space portion of his property for his own use or sells it to another, property taxes will affect this portion's]value.[8]

To recap, t represents the income tax rate and ρ the property tax rate. The willingness-to-pay (i.e., the price) per lot developed is $P(1\text{-}x)$. Earnings-per-hectare from the alternative activity are P_a. I will suppose that the assessed value of developed land is always the actual value, and reserve the notation A for the assessed value of land devoted to the alternative use. The notations $b(1 - x)$ and b_a represent the yearly earnings from developed land and the alternative activity, respectively. Finally, D represents the per hectare value of the tax deduction (if any) the developer claims for land he retains as open space. Thus, combining all these considerations, the developer's after-tax objective is to maximize

$$(1-t)x\frac{b(1-x)}{r+\rho} + (1-t)(1-x)\left(\frac{b_a}{r} - \frac{\rho A}{r}\right) + t(1-x)D . (3)$$

Assume for now that the developer receives sufficient income from this or other sources to take the tax deduction.

Now let us consider in turn three cases.

III. The Benchmark: No Taxes

Suppose that $t = \rho = 0$. Then expression (3) is simplified to

$$x\frac{b(1-x)}{r} + (1-x)\frac{b_a}{r} . (4)$$

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8 In very large-scale developments the rate at which property is taxed might also be endogenous. I do not consider this possibility here.

Differentiating to maximize, the developer's optimal choice of land to develop, x^*, satisfies the first-order condition

$$-x^*\frac{b'}{r} + \frac{b - b_a}{r} \geq 0, \quad (5)$$

with equality holding if $x^* < 1$. Note that b' represents the derivative of the consumer willingness-to-pay function *with respect to open space*, $1 - x$, not with respect to the number of lots, x; $b' > 0$ by assumption.

If there is an interior solution—if the landowner converts less than the entirety of his holdings to lots—the first-order condition can be rearranged as

$$\eta = \frac{b - b_a}{b}\left(\frac{1 - x^*}{x^*}\right), \quad (6)$$

where η is the elasticity of willingness to pay for a lot with respect to the area retained in open space. Note again that, the way it is defined, η is a positive number: willingness to pay is, we presume, an increasing function of the amenities provided by open space (though we might also suppose that it is increasing at a decreasing rate or more formally concave in its argument). Expression (6) is entirely analogous to the Lerner index describing the monopolist's mark-up condition. I suppose that willingness-to-pay in this case is a function of the amenities provided by open space, but it is conceivable that market power would motivate similar outcomes. If so, it might be empirically indistinguishable from my case.

IV. Land Use Choices under Use-Value Assessment

Consider next how property taxes can affect the land development choice. Property taxes are generally based on a property's highest and best use. That is, even if land devoted to, say, agriculture earns less for its owner than would the same land if it were devoted to suburban housing, the owner may still pay taxes based on the housing value assessment. That highest and best use might be determined by the value of similarly situated parcels that have been developed (but see below on the flaws of this calculation).Many jurisdictions have, however, provided "use-value assessment" exceptions (see, e.g., Anderson and Griffing 2000 and the literature they cite), presumably on the argument that land retained in low-intensity uses provides benefits to the community. Under use-value assessment provisions, a property's tax assessment is based on its earnings under its actual use, rather than its highest and best use.

Return again to the developer's after-tax objective, (3), and assume now that all assessment is conducted on the basis of highest and best use, in which case assessed value, *A* in expression (3), is $b(1-x)/(r+\rho)$, the value of a lot converted to residential use. Thus the objective becomes

$$\frac{1-t}{r}\left[\left(x-\frac{\rho}{\rho+r}\right)b(1-x)+(1-x)b_a\right].(7)$$

Obviously, the income tax rate, *t*, now makes no difference in the choice of *x*, as it multiplies all other factors and cancels from first-order condition calculations. The property tax rate, ρ, is not neutral, however. Note that assessment on the basis of highest and best use is, in this case, not strictly accurate. The real value of open space is not the ostensible opportunity cost forgone by not selling it as a residential lot. The sale of an additional lot would reduce the value of all other lots.

Differentiate (7) with respect to *x* to find the first-order condition

$$-\left(x^*-\frac{\rho}{\rho+r}\right)b' + b - b_a \begin{array}{c} > \\ = \\ < \end{array} 0 \text{ as } x^* \begin{array}{c} = 1 \\ \in (0,1) \\ = 0 \end{array}.(8)$$

Assuming equality in (8), rearranging terms, and again using η to denote the elasticity of willingness to pay for a lot with respect to the area retained in open space, I have

$$\eta = \frac{1-x^*}{x^*-\frac{\rho}{\rho+r}}\frac{b-b_a}{b}(9)$$

Now let us contrast the result derived in (8) and (9) with that under use-value assessment. Under such a system land devoted to the alternative use will be assessed at the value of the discounted stream of its earnings from the alternative use. Again, supposing that donations of open space are not deductible from income tax payments, the land developer's objective would be to maximize

$$\frac{1-t}{r+\rho}\left[xb(1-x)+(1-x)b_a\right].(10)$$

Comparing (3) with (10), it is obvious that the solution to both is the same: to develop land in the amount x^* that satisfies the first-order condition (5). This is the same result as in the benchmark case. Tax considerations do not affect land use decisions.

The first-order condition for the use-value assessment case coincides with that for the benchmark case. We can perform numerical calculations to compare outcomes in the use-value assessment case, which is the same as the benchmark outcome, (6), and the highest and best use assessment case, (9). Some intuitions can be presented by considering some special cases and approximations, however.

We can calculate the total effect of use-value assessment as follows. Comparing (6) and (9), the land use consequences of adopting use-value assessment are the same as if the property tax rate were reduced from ρ to zero. Assuming an interior solution and totally differentiating (8) with respect to ρ, we find

$$\frac{dx}{d\rho} = \frac{r/(\rho+r)^2}{2 - \left(x - \frac{\rho}{\rho+r}\right)\frac{b''}{b'}}. (11)$$

This expression will be maximized when the willingness-to-pay function is linear. In the linear case, we can calculate Δx, the change in the amount of land developed as a result of use-value assessment, given any fixed property tax rate $\bar{\rho}$ as

$$\Delta x = \int_0^{\bar{\rho}} \frac{r}{2(\rho+r)^2} d\rho = \frac{1}{2}\frac{\bar{\rho}}{r+\bar{\rho}}. (12)$$

Because (12) represents an extreme-case outcome, let us consider another that allows for at least some greater generalization. Suppose that the elasticity of willingness to pay, η, is constant over whatever range of open-space preservation is contemplated. This means that

$$b(1-x) = \beta(1-x)^{\eta},$$

for a constant β that will not appear in subsequent calculations. In this case,

$$\frac{\partial x}{\partial \rho} = \frac{r/(\rho+r)^2}{2 - \left(\frac{x - \rho/(\rho+r)}{1-x}\right)(\eta-1)}.$$

Then, adopting an obvious notation, we can say that, to a first-order approximation,

$$x(\rho) \approx x(0) + \left.\frac{\partial x}{\partial \rho}\right|_{\rho=0} \rho = x(0) + \frac{\rho/r}{2 - \frac{x(0)}{1-x(0)}(\eta - 1)}. (13)$$

Using the optimality condition, (6), that obtains when the property tax rate is zero, we can further refine (13) as

$$x(\rho) \approx x(0) + \frac{\rho/r}{\frac{2-x(0)}{1-x(0)} - \frac{b - b_a}{b}} \quad (14)$$

Speaking somewhat informally, the approximation in (14) is generally very close because ρ/r is a relatively small number (a tax rate generally on the order of 1% or less divided by a discount rate on the order of 5% or so) and land use as a function of the property tax rate is not sharply kinked. Numerical examples confirm that (14) is relatively accurate.

What might be the empirical significance of use-value assessment? Suppose that use-value assessment has been instituted and 10% of land in a new housing development is retained as open space—that is, $x(0) = 0.90$. Suppose that the price of residential lots is twice the use-value price of the remaining open space—that is, $b = 2b_a$. Then we might project that the additional amount of open space preserved would be approximately

$$\frac{0.01/0.05}{\frac{2-0.9}{1-0.9} - \frac{1}{2}} = 0.019\,.$$

The significance of such a figure depends on the interpretation one places on it. On one hand, this is only about a 2% reduction in the total area of land developed. On the other, though, it represents an increase of nearly 20% in the amount of open space retained.

Note that if x is a relatively large number—if the developer chooses to develop the great majority of land—then the ratio of $(b - b_a)/b$ does not much affect the calculation. Also, the direct use value of land maintained in open space is likely to be essentially zero in many contexts: although it may provide amenities to residents and others, farming, forestry, and pasturing are unlikely applications for many lands preserved by developers. If b_a is zero and the elasticity of willingness to pay with respect to open space preserved is constant over the relevant range, a still simpler formulation is possible.

Comparing (6) and (9) in this special case, we have

$$\frac{1-x(0)}{x(0)} = \frac{1-x(\rho)}{x(\rho) - \frac{\rho}{\rho+r}},$$

or, on rearranging,

$$\frac{1-x(\rho)}{1-x(0)} = 1 - \frac{\rho}{\rho+r}.(15)$$

The left-hand side of (15) is the ratio of land retained in open space without use-value assessment to that when there is use-value assessment. In the numerical example reported above, 80% as much land would be preserved absent use-value assessment as is preserved with it.

Table 1 reports outcomes under a variety of scenarios for the constant-elasticity-of-willingness-to-pay case. The results reported in Table 1 are exact rather than derived from the approximations employed in deriving (14) and (15). We see that the approximation afforded by taking first-order effects is relatively accurate, as is that by assuming that the alternative use value is zero.

All calculations are made under the maintained assumption that elasticity is constant. This assumption is inherently difficult to verify. We might ask, though, whether it is extreme in any sense. Recall that at least under the empirically reasonable assumptions $x > \rho/(\rho + r)$ and $b'' < 0$, the upper bound on the effect of an increase in property tax rates on land use is $(1/2)\, r/(\rho + r)^2$. Under the assumptions used in the extended example above—$b/b_a = 2$, $x(0) = 0.90$, implying $\eta = 1/18 = 0.0556$, the corresponding derivative is approximately $(1/5.40)\, r/(\rho + r)^2$. Again, one cannot say with any great certainty what the magnitudes of likely effects might be, but it is clear that one can obtain significant effects without invoking extreme assumptions: the effect in the constant elasticity case is 2.7 times less than the maximum possible effect.

Table 1

	Fraction of land developed when ratio ρ/(ρ+r) is			*Percentage decline in open space retained when ratio ρ/(ρ+r) is*	
Ratio of price of lots to price of land in alternative use	*0*	*0.10*	*0.20*	*0.10*	*0.20*
1.5	0.800	0.818	0.835	8.9	17.7
1.5	0.950	0.955	0.960	9.4	19.5
2	0.800	0.819	0.837	9.4	18.4
2	0.950	0.938	0.959	9.5	18.1
3	0.800	0.819	0.837	9.6	18.7
3	0.950	0.955	0.960	9.6	19.8

V. Income Tax and Conservation Donations

Now let us consider a case in which the income tax treatment of land set aside as open space might motivate departures from the simple condition we just derived. By inspection of (3), it is clear that if the income tax rate, t, is to affect the choice of land developed, it must be through a tax deduction; if *D* in (3) were zero, (1 – *t*) would multiply the remaining two terms and thus disappear from first-order conditions for optimization.

So let us be more specific about the nature of the deduction. The most straightforward way in which to value a donation of open space to conservation would be to assign to each acre donated the value of an acre developed and sold. This is not technically accurate: if all such lots were, in fact, to be developed and sold, the value of each would decline because their new owners would be deprived of the benefits of open space (this is, recall, the reason for which *donation* and *donor* initially appeared in quotes). Moreover, U.S. tax law prohibits donors from claiming deductions for donations from which they are major beneficiaries. These theoretical and legal niceties aside, though, it would be asking a lot of tax authorities to distinguish between purely altruistic conservation donations and more self-serving actions. Suppose, then, that a well-documented claim of the amount of land donated as open space and the price at which similarly situated land could fetch as developed lots would be accepted by the tax authorities as a legitimate deduction.

If the developer donates a conservation easement restricting himself to defined alternative activities in lieu of development, he retains rights to earnings of b_a per year. We can regard the donation of fee-simple ownership as a situation in which $b_a = 0$ and treat it in the same general fashion. Having an easement contract in hand, the developer should be able to persuade property tax authorities to institute use-value assessment, so that the taxable value of the interest he retains is

$$(1-x)\frac{b_a}{r+\rho}.$$

Thus we suppose that the value of the deduction will be

$$t(1-x)\frac{b(1-x)-b_a}{r+\rho}.$$

This makes the developer's after-tax earnings

$$[(1-2t)x + t]\frac{b(1-x)}{r+\rho} + (1-2t)(1-x)\frac{b_a}{r+\rho}.\quad(16)$$

Differentiating with respect to x and simplifying by eliminating common factors, we find

$$-[(1-2t)x^* + t]b' + (1-2t)(b-b_a) \begin{matrix} > \\ = \\ < \end{matrix} 0 \quad \text{as } x^* \begin{matrix} = 1 \\ \in (0,1) \\ = 0 \end{matrix}.\quad(17)$$

Let us further condense notation by abbreviating $\tau = t/(1 - 2t)$. Then, if there is an interior solution,

$$\eta \;=\; \frac{b - b_a}{b}\frac{1 - x^*}{x^* + \tau}. \quad (18)$$

It is worth emphasizing that the qualification "if there is an interior solution" is not to be taken lightly. There may be cases in which the corner solution of developing an entire property is privately optimal. Casual empiricism suggests they are not unknown.[9]

Absent tax deductibility of donations but assuming use-value assessment, the developer would make the same land use decisions as if he were not taxed at all. Note that I am assuming use-value assessment. If the developer has in fact bound himself to use land in a conservation-compatible fashion, he will likely be able to make the case to property tax authorities that it should be assessed on that basis.

How significant might the tax deductibility of conservation donations be? By assuming use-value assessment and comparing situations with and without income tax deductibility, it is as if the income tax rate were varied from zero (no tax deductibility of conservation donations) to its actual rate, t (full deductibility). Comparing the optimal land use conditions (9) and (18), it is apparent that income tax deductibility and use-value assessment have similar effects. It is not necessary to go through the corresponding calculations in great detail, then, as they have already been reported above.

To see the effects of such changes, suppose that the first-order condition (17) is satisfied as an equality, rearrange slightly using the abbreviation τ, and differentiate totally with respect to τ, to find

$$\frac{dx^*}{d\tau} \;=\; \frac{-1}{2 - (x^* + \tau)b''/b'}. \quad (19)$$

If we make the reasonable assumption that $b(1 - x)$ is concave in open space—buyers will pay more to have more open space, but their willingness to pay declines after a point—$\partial x/\partial t$ could vary from –½ to zero. The former limit is reached if the willingness-to-pay function is linear in open space, the latter if it is sharply kinked.

9 It can also be shown that the opposite corner solution is, at least in theory, possible. It results at marginal tax rates in excess of 50%. A developer might find donating the entirety of his holdings preferable to developing any and donating the rest.

Thus the maximum possible magnitude of the effect of tax deductibility when the actual tax rate is $\bar{t}$ would be determined as

$$\Delta x = -\frac{1}{2}\frac{\bar{t}}{1-2\bar{t}} .(20)$$

Since x must be between zero and one, even relatively modest tax rates *could* induce some substantial change in area conserved.

Let us again work out approximate results for the constant elasticity case. Then we have, again in an obvious notation,

$$x(\tau) \approx x(0) + \left.\frac{\partial x}{\partial \tau}\right|_{\tau=0} \tau = x(0) + \frac{\tau}{2 - \frac{x(0)}{1-x(0)}(\eta - 1)} .(21)$$

Using the optimality condition, (6), that obtains when the property tax rate is zero, we can further refine (21) as

$$x(\rho) \approx x(0) + \frac{\tau}{\frac{2-x(0)}{1-x(0)} - \frac{b - b_a}{b}} .(22)$$

Let us work out another simple example. Suppose, as above, that 90% of land would be developed if there were use-value assessment and no tax deductibility, and that developed land provides twice the earnings of undeveloped land. Finally, suppose that the marginal income tax rate is 1/3, so that $\tau = t/(1 - 2t) = 1$. Then

$$\frac{1}{\frac{2-0.9}{1-0.9} - \frac{1}{2}} = 0.095 .$$

Note the more general principle. At least under situations in which the first-order approximations in (14) and (22) are accurate, the impact of tax deductibility on open-space conservation relative to that of use-value assessment is approximately $\tau r/\rho$ times greater.

As above, if the value of land in alternative use were zero and the elasticity of willingness to pay were constant, we would have

$$\frac{1 - x(\tau)}{1- x(0)} = 1+\tau .(23)$$

Table 2 reports the results of several examples for the constant elasticity case similar to those reported in Table 1. Note, as expected, that the approximations employed in deriving expressions (22) and (23) are reasonably accurate, and that the numerical effects of income tax deductibility are considerably higher than those of use-value assessment. The latter result arises entirely from the assumption that the income-tax-determined ratio $\tau = t(1 - 2t)$ is substantially higher than the property-tax-determined ratio $\rho/(\rho+r)$.

Table 2

	Fraction of land developed when tax rate is			*Percentage increase in open space retained when tax rate is*	
Ratio of price of lots to price of land in alternative use	*0*	*1/6*	*1/3*	*1/6*	*1/3*
1.5	0.800	0.756	0.631	22.1	84.7
1.5	0.950	0.937	0.901	26.1	96.9
2	0.800	0.756	0.623	22.1	88.4
2	0.950	0.938	0.901	24.5	98.0
3	0.800	0.754	0.616	23.1	92.0
3	0.950	0.938	0.900	24.7	99.0

VI. Conclusion

Let me first summarize results. As one would expect, both allowing developers to claim income tax deductions for land retained as open space and assessing property taxes based on a parcel's actual rather than highest and best use value lead to the preservation of more open space. Two other results may be more interesting. First, the empirical significance of the tax deduction effect may be substantially greater than that of the use-value assessment effect. Second, both effects, and the tax deduction effect in particular, could be large enough to make a very substantial difference in the amount of open space retained in the landscape.

Of course, exactly what constitutes a substantial difference may lie in the eye of the beholder. The effects derived in numerical examples above are generally not large when *expressed as a fraction of total area developed*. Is this the right way to look at the problem? The alternative is to consider the effect on the total area *conserved*. There we see that it may not be unreasonable to suppose that allowing developers to deduct the value of conservation donations would substantially increase those donations. Some conservation experts mention a goal of something on the order of 10% land conservation over large areas (e.g., Balmford et al. 2001). The deductibility of donations might bring the total closer to that long-term objective.

Several caveats and qualifications have appeared in notes and parenthetical remarks in the text above. I will emphasize one and add a few more in concluding. The one to emphasize is that corner solutions are possible and appear to be likely in many instances. I will simply note that the fact that private developers often do not choose to develop the entirety of the properties under their control testifies to the empirical relevance of the interior solutions I have assumed above.

One rejoinder that might be made to this last observation is that land is not homogeneous, and that developers may not be incorporating amenities so much as they are simply not selling worthless land. Casual empiricism suggests this is not wholly correct. There surely is some element of selection involved, but the results I have presented are intended to be indicative rather than authoritative.

The last issue concerns an implicit assumption above. I have argued that the numerical results derived under the assumption of constant elasticity are not "extreme." The magnitude of tax-induced effects could be a lot bigger. They could also be a lot smaller. Inspection of the derivatives in expressions (11) and (19) above suggests that tax-induced effects would be small if the willingness-to-pay function were sharply kinked. This would be the case if homebuyers were, beyond a certain point, satiated in their taste for open space.

Let me return in concluding to the three questions raised above. First, how powerful are tax-related incentives? The discussion immediately above suggests that they may be very important, and would only *not* be important if there were a kink in willingness to pay of the type just described, which seems unlikely. More work is required as the specific tax circumstances of parties liable for such taxes, and particularly, of consequences of existing vagaries of the tax code (for example, limitations on the percentage of income that can be claimed for deductions). The models developed here suggest that such work could be important.

The second question is, are existing tax incentives powerful enough? Do they fully rectify the potential externality problems? Open space may provide far-reaching public goods. Thus, it is difficult to say whether enough open space will be preserved with existing and contemplated tax incentives. Perhaps all one can say now is that this is a political rather than an economic question, and the body politic must decide whether tax incentives are an appropriate way to achieve its goals.

That observation leads to the final question: Do tax incentives target the right areas? Here the answer may depend on certain technical considerations with which economists are not necessarily well versed. There has been a long-running argument in the conservation biology literature on the "SLOSS" question (see, e.g., Connor and McCoy 2000): Are conservation needs best served by preserving a Single Large, Or Several Small reserves? Although the debate appears not to be fully resolved, the view espoused by ecologist John Terborgh (1999), among others, has gained many adherents: the only conservation worthy of the name is the preservation of areas large enough to sustain all natural processes of evolution. To Terborgh and others of this view, "conservation" means preserving areas large enough to sustain viable populations of large predators. Such areas can be quite large. It goes without saying that the creatures at the top of the food chain would need to be protected from humans, and it is almost equally likely that humans would need to be protected from them. Housing developments are unlikely to be happy homes for both people and pumas.

It is not entirely clear what the taxpaying public wants. Habitat for large predators? Safe and accessible areas for weekend recreation? Scenic vistas? Protection from floods and erosion? Existing incentives provide a combination of these things, but since such incentives appear to be strongest in relatively densely populated areas, they may not be providing as strong an inducement to preserve the large wilderness areas some would prefer. Again, it seems that the larger the area over which the benefits of open space are preserved and enjoyed, the less effective will be tax-based incentives.

The provisional conclusion of this analysis is, then, that tax incentives may have a substantial impact on open-space preservation choices. The remaining questions are first, exactly how powerful is the potential impact; second, is society content with this degree of "correction" in private land use decisionmaking; and finally, are these incentives directed toward the most pressing conservation priorities?

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