Land Development and Current Use Assessment: A Theoretical Note

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This paper jointly models a landowner's decision to develop a parcel and the option to enroll that parcel in a current use assessment program. The analytical results highlight different factors that influence the effectiveness of a current use program in delaying development. The results also underscore the difficulty a local government might have in influencing the behavior of the landowner. Except for altering eligibility rules, a local government employing current use assessment has but two policy tools: a penalty for development and the property tax rate.

Key Words: current use assessment, development penalties, land-use change, pecuniary and non-pecuniary benefits, property taxation, use value

During the 20th century, state and municipal governments in the United States witnessed an ongoing conversion of agricultural land and other forms of open space to metropolitan uses. As Morris (1998) has noted, "Since 1957, every state has responded to development pressures by allowing or requiring preferential property tax treatment of farmland, and in some states other open space land.… [T]he most common policy assesses the land at its value in its current agricultural or open space use" (p. 144).

Such policies are known as current use (or use-value) assessment. With the sole exception of Michigan, every state employs some form of a current use assessment program. Because they are so widespread, we believe current use programs must be acknowledged in developing a theory that relates property taxation to land use patterns.

This study focuses on the tax treatment of properties that are first enrolled in and then later withdrawn from current use assessment. In 15 states, the landowner enjoys a lower property tax bill while the parcel is enrolled and suffers no penalty when the property is withdrawn. In seven states, however, the owner has to pay a land-use change tax if a parcel is withdrawn from current use classification. This tax is typically equal to a percentage of the property's market value at the time of withdrawal. In another 27 states, the owner pays a recapture penalty equal to the property tax savings (plus interest charges) during the years immediately prior to withdrawal from the program.[1] These variations in tax treatment suggest the need to consider how the structure of current use programs might affect the timing of development.

We use an intertemporal model to analyze a landowner's decision to develop a parcel of land enrolled in a current use assessment program. Our model highlights different factors that might affect the degree to which such a program preserves undeveloped land. The results also underscore the difficulty faced by a local government in influencing the behavior of the landowner. Except for altering eligibility rules, a local government employing current use assessment has but two policy tools: a penalty for development and the property tax rate.

The structure of our model closely follows Anderson (1993), who also models a landowner's

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[1] This descriptive survey draws upon Skjaerlund and Sinischo (1998), and interviews with various state government officials.

choice of development time (D).[2] We extend his work by adding several important features. First, we add specific functional forms to the trajectory of rents for developed and undeveloped land. While this feature makes our model more restrictive, it offers further insight into the comparative statics, which have unambiguous signs.

In addition, our model explicitly allows for the possibility that landowners value the nonpecuniary benefits of their land. This feature is central to the policy discussion on current use assessment and should be included in the model. Lawmakers justify tax benefits for agriculture and land preservation in terms of preserving family farms, the rural landscape, and areas of historic value; however, these benefits may not be reflected in market prices. To the extent such nonpecuniary values accrue to individual landowners, we wish to investigate the degree to which they affect a current use program.[3]

Most importantly, our model extends Anderson's analysis by explicitly accounting for the penalty a landowner might face for removing a parcel from a current use assessment program. This inclusion gives additional policy relevance to the model, as the penalty is the one policy variable a state government could most easily change. We add depth to this policy discussion by explicitly considering a landowner's option to enroll in a current use program, and we consider the optimal construction of penalties under such a scenario.

An Intertemporal Model of Development

In order to model the impact of current use assessment on local land use patterns, we model the behavior of a representative landowner who owns a single parcel of undeveloped land on a metropolitan fringe. A landowner must decide at what point in time, D, to develop. While undeveloped, the parcel generates a stream of pecuniary benefits, $c(t)$, and a stream of nonpecuniary benefits $n(t)$.

We initially assume the parcel is enrolled in a current use program, so that the landowner must pay a penalty, $P(D)$, at the time of development. Once land is developed, it generates only pecuniary benefits, $u(t)$. Both before and after development, the landowner must pay a property tax, at a constant rate, τ, on the assessed value of land, $A(t)$. Thus, the owner chooses the time of development, D, to maximize the present value of a stream of payments described by:

$$(1)\quad \int_{t=0}^{t=D}\left[c(t)+n(t)-\tau A(t)\right]e^{-rt}\,dt - P(D)e^{-rD} + \int_{t=D}^{t\infty}\left[u(t)-\tau A(t)\right]e^{-rt}\,dt,$$

where r represents the discount rate, and t denotes time.

The method for determining the assessed value, $A(t)$, differs for undeveloped and developed parcels. For undeveloped parcels, the local tax authority assesses land by capitalizing the pecuniary income, $c(t)$. In other words, the assessor values the land as if the land were to forever remain undeveloped:

$$(2)\quad \text{for } 0<t<D,\quad A(t)=\int_{t'=t}^{t'\infty} c(t')e^{-r(t'-t)}\,dt',$$

where t' tracks time.[4] Developed properties are assessed according to the present value of the stream of pecuniary benefits:

$$(3)\quad \text{for } t\geq D,\quad A(t)=\int_{t'=t}^{t'\infty} u(t')e^{-r(t'-t)}\,dt'.$$

Until now, we have presented the model in full generality. In order to ensure tractable solutions, we now assume the pecuniary and nonpecuniary benefits of undeveloped land remain constant at values $\bar{c}$ and $\bar{n}$, respectively. In the spirit of Capozza and Helsley (1989), we capture the impact of metropolitan population growth by assuming the rent on developed land equals $\bar{u}<\bar{c}$ initially, and then increases according to a growth rate of g. These assumptions are represented by:

$$(4a)\quad c(t)=\bar{c} \text{ and } n(t)=\bar{n},$$

$$(4b)\quad u(t)=\bar{u}e^{gt}.$$

In addition to (4a) and (4b), we make two further assumptions. First, taxes are positive but never confiscatory, and thus the tax burden never exceeds the instantaneous return to land. Second, we assume the return on land is less than the interest rate, so that no arbitrage profits exist. Combined, these two assumptions imply:

$$(4c)\quad 0<\tau<r-g<1.$$

[2] For another related analysis of property taxation and land use, see Brueckner (2001).

[3] Lawmakers justify tax policies based on nonpecuniary benefits accruing to the public at large, not simply those accruing to the landowner. However, development decisions depend on the degree to which those benefits are internalized. We thank a referee for clarifying this point.

[4] While conceptually accurate, equation (2) simplifies. In reality, assessors do not have the perfect foresight needed to evaluate an infinite stream of payments. In fact, assessors use rules of thumb to assess properties, and there are often substantial lags between changes in market values and assessed values. We thank a second referee for this clarification.

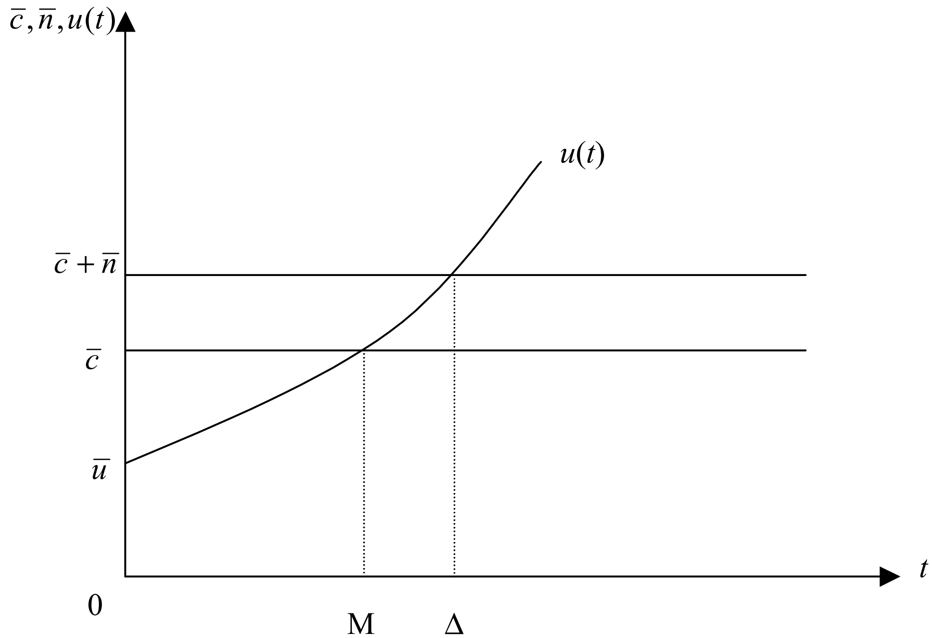

Figure 1. Trajectory of urban and rural land rents

Figure 1 represents the trajectory of urban and rural land rents ($\bar{c}$, $\bar{n}$, and $u(t)$) on the vertical axis, and time (t) on the horizontal axis. At time zero, developed land earns a rent of $\bar{u}$. Developed land rents rise, however, and at $t = M$, the rents on developed land equal the pecuniary benefit to undeveloped land. If the landowner's development decision is undistorted by taxes, then development occurs at time Δ, where $\bar{c} + \bar{n} \equiv \bar{u}e^{g\Delta}$.

Having set up our model, we are now prepared to consider factors that influence the effectiveness of a current use program. To do this, we solve the optimization problem for a landowner who participates in a current use program. We first show that $D > \Delta$, meaning that current use assessment unambiguously delays development. We then derive some comparative statics to identify how changes in the model's parameters affect D. This analysis therefore indicates conditions under which a current use program might be particularly effective at preserving land.

Once the landowner's problem is solved, the model is completed by allowing the landowner to choose whether to enroll or not (as fully described in the next section of this note). In order to make this choice, the landowner must calculate the net present value of benefits from enrollment. This last piece of the model allows assessment of the full impact of policy variables on land use patterns. In particular, we can show how changing the development penalty affects both the likelihood of enrolling in a current use program and the timing of development.

Equilibrium in the local land market is described by substituting (2) through (4b) into (1), and then solving the landowner's objective function. If the landowner participates in a current use program, then the first-order condition simplifies to:

$$(5)\quad \underbrace{\left(\left(1 - \frac{\tau}{r}\right)\bar{c} + \bar{n}\right)}_{\substack{\text{Instantaneous}\\ \text{return from}\\ \text{undeveloped land}}} - \underbrace{P'(D)}_{\substack{\text{Effect of}\\ \text{penalty}\\ \text{changing}}} + \underbrace{rP(D)}_{\substack{\text{Value of}\\ \text{delaying}\\ \text{penalty}}} = \underbrace{\left(1 - \frac{\tau}{(r - g)}\right)\bar{u}e^{gD}}_{\substack{\text{Instantaneous return}\\ \text{from developed land}}}.$$

The landowner develops at the point in time when the marginal returns to undeveloped land equal the marginal returns to developed land.

From (5), it is straightforward to verify that $D > \Delta$ when $P'(D) \le rP(D)$. To see this, let $\gamma = 1 - (\tau/r - g)$ and $\alpha = 1 - (\tau/r)$. From (4c), $\gamma < \alpha < 1$, so:

$$(6)\quad \bar{u}e^{gD} = \left[\alpha\bar{c} + \bar{n} - P'(D) + rP(D)\right]\left[\frac{1}{\gamma}\right] > \bar{c} + \bar{n}.$$

Since $\bar{c} + \bar{n} \equiv \bar{u}e^{g\Delta}$, equation (6) indicates $\bar{u}e^{gD} > \bar{u}e^{g\Delta}$. It is noteworthy that (6) holds, even if $\bar{n} = 0$. Even those landowners who gain no utility from preservation will develop later.

Equation (5) is particularly insightful for analyzing the penalties for withdrawing from current use assessment. As shown by the equilibrium condition, the penalty has two effects. First, by delaying development, the landowner gets an instantaneous gain of $rP(D)$. The larger is $P(D)$, the more important is this factor.

On the other hand, delaying means penalties might either rise or fall, so the landowner also pays attention to $P'(D)$. If the penalty declines over time, so $P(D) > 0$ and $P'(D) < 0$, then both the penalty and the change in penalty work toward influencing landowners to delay development.

In this context, it is interesting to note that penalties in many states *rise* over time. In the seven states where the penalty is a percentage of property values, and in the 27 other states where the penalty equals property tax savings plus interest, postponing development leads to rising penalties in our model.[5]

To understand how other factors affect the development decision, we now derive some comparative statics. Using the definitions of α and γ, and differentiating (5) with respect to $\bar{n}$, $\bar{c}$, $\bar{u}$, g, τ, and r, reveals how development time, D, changes as the model's parameters change:

$$\text{(7a)}\quad dD/d\bar{n} = \frac{-1}{\Omega} > 0,$$

$$\text{(7b)}\quad dD/d\bar{c} = \frac{-\alpha}{\Omega} > 0,$$

$$\text{(7c)}\quad dD/d\bar{u} = \frac{\gamma e^{gD}}{\Omega} < 0,$$

$$\text{(7d)}\quad dD/dg = \frac{\left[\tau + \gamma(r-g)^2 D\right]\bar{u}e^{gD}}{\Omega(r-g)^2} < 0,$$

$$\text{(7e)}\quad dD/d\tau = \frac{\bar{c}(r-g) - r\bar{u}e^{gD}}{r(r-g)\Omega} > 0,$$

$$\text{(7f)}\quad dD/dr = \frac{\left(\dfrac{\tau\bar{u}e^{gD}}{(r-g)^2}\right) - \left(\dfrac{\tau\bar{c}}{r^2}\right) - P(D)}{\Omega} < 0,$$

where $\Omega = rP'(D) - P''(D) - \gamma\bar{u}ge^{gD}$, which we know to be negative from the sufficient condition for a maximum. Under the simplifying assumption that penalties are constant and unchanging ($P = \bar{P}$ and $P'(D) = 0$), we can also show how development time changes as the penalty rises:

$$\text{(7g)}\quad dD/d\bar{P} = \frac{-r}{\Omega} > 0.$$

The first four comparative statics define the impact of changing the relative returns on land. Equations (7a) and (7b) show that increasing the relative returns to undeveloped land delays development, while (7c) and (7d) show that increasing the rents of developed land hastens development. It is worth noting that both the level and the growth rate of urban rents affect the development decision.

Comparing (7a) and (7b) also reveals an interesting insight: $dD/d\bar{n} > dD/d\bar{c}$. When a parcel is enrolled in current use assessment, development decisions are most responsive to changes in nonpecuniary values. The reason for this surprising result is that an increase in the pecuniary benefit is partially offset by an increase in assessed value. An increase in the nonpecuniary benefit, on the other hand, accrues entirely to the landowner without a change in tax burden.

The next two conditions, (7e) and (7f) are also interesting. Since current use programs allow participants to avoid the full burden of property taxes, the programs are more effective in the presence of high tax rates. Analogously, the programs are less effective under high discount rates. Current use benefits the landowner because it assesses land as if it were to be kept undeveloped forever. In other words, the landowner gains because the assessor does not account for the fact that the land could earn significant rents in a perhaps distant future. This benefit decreases if these potential future rents are discounted at a higher rate. Finally, as shown by (7g), raising penalties increases the cost of development, so enrolled parcels develop later.

While insightful, these comparative statics only give a partial analysis of a landowner's behavior because they assume participation in a current use program. We now compare these results to the comparative statics for a landowner who does not participate in current use assessment. If a landowner chooses not to participate, then land is assessed at market value, so undeveloped land is assessed accounting for the fact that, at time M, the returns to developed land will exceed the pecuniary returns to undeveloped land. The market value of land is:

[5] In some states the penalty structure is sufficiently complex to ensure that penalties decline over time, even when the penalty is a percentage of the property value. In Rhode Island, for example, the land use change tax equals 10% of market value if development occurs during the first six years of preferential classification. The percentage applied to market value declines by one percentage point annually, until no land-use change tax is levied after 15 years of classification.

(8) for $0 < t < M$,

$$A(t) = \int_{t'=t}^{t'=M} c(t')e^{-r(t'-t)}\,dt' + \int_{t'=M}^{t'\to\infty} u(t')e^{-r(t'-t)}\,dt',$$

where M is defined so that $c(M) \equiv u(M)$.

Using (8) instead of (2) to solve the landowner's problem reveals the optimal choice of development time:

(9) $$\bar{c} + \bar{n} = \bar{u}e^{gD}.$$

Since Δ is defined so that $\bar{c} + \bar{n} \equiv \bar{u}e^{g\Delta}$, this landowner develops at $D = \Delta$. If the landowner does not enroll in current use assessment, then taxes do not distort the development decision.

In order to distinguish the development times of the enrolled landowner and the non-enrolled landowner, we use D to denote the former and Δ to denote the latter. Solving the comparative statics for Δ [by differentiating (9)] and comparing the results to (7a)–(7f) reveals some interesting differences between the landowner who participates in a current use program and the one who does not:

(10a) $$d\Delta/d\bar{n} = \frac{1}{g\bar{u}e^{g\Delta}} > 0,$$

(10b) $$d\Delta/d\bar{c} = \frac{1}{g\bar{u}e^{g\Delta}} > 0,$$

(10c) $$d\Delta/d\bar{u} = \frac{-1}{g\bar{u}} < 0,$$

(10d) $$d\Delta/dg = \frac{-\Delta}{g} < 0,$$

(10e) $$d\Delta/d\tau = 0,$$

(10f) $$d\Delta/dr = 0.$$

The directions of change in (10a)–(10d) match (7a)–(7d). Changing the relative returns from developed and undeveloped land affects both enrolled parcels and non-enrolled parcels in similar ways. One notable exception comes from comparing (7a) and (7b) to (10a) and (10b). Because $dD/d\bar{n} > dD/d\bar{c}$, enrolled parcels delay development disproportionately in response to a change in the nonpecuniary value. If a parcel is not enrolled, then $d\Delta/d\bar{n} = d\Delta/d\bar{c}$, and the landowner reacts equally to changes in either the pecuniary or nonpecuniary value. The reason the non-enrolled landowner reacts identically to changes in pecuniary and nonpecuniary values is that at Δ (where $\Delta \geq M$), the assessed value depends only on the developed value of land. Neither $\bar{n}$ nor $\bar{c}$ affect the landowner's tax burden at the margin.

A final interesting contrast arises from comparing (7e) and (7f) to (10e) and (10f). The parameters τ and r only affect enrolled parcels. Thus, variations in these parameters change the relative effectiveness of a current use program in preserving undeveloped land.

Choosing to Enroll in a Current Use Program

Having described optimal development under current use assessment and under market-value assessment, we now turn to describing a landowner's choice to participate in a current use program. The net benefit, $B(D)$, to the landowner who participates in such a program and develops at time D consists of the present value of tax savings, $S(D)$, minus the present value of the penalty, minus the present value of net foregone rents, $R(D)$, from Δ to D. Thus,

(11) $$S(D) = \underbrace{\tau\left\{\int_{t=0}^{t=M}\left[\frac{\bar{c}}{r}\left(1 - e^{-r(M-t)}\right) + \frac{\bar{u}}{(r-g)}e^{rt}e^{(g-r)M}\right]e^{-rt}\,dt + \int_{t=M}^{t=D}\frac{\bar{u}e^{gt}}{(r-g)}e^{-rt}\,dt\right\}}_{\text{Tax burden under market-value assessment}} - \underbrace{\int_{t=0}^{D}\frac{\tau}{r}\bar{c}e^{-rt}\,dt}_{\text{Tax burden under current-use assessment}},$$

(12) $$R(D) = \int_{\Delta}^{D}\left(\bar{u}e^{gt} - \bar{c} - \bar{n}\right)e^{-rt}\,dt,$$

and

(13) $$B(D) = S(D) - P(D)e^{-rt} - R(D).$$

Comparing (13) to (7g) gives insight into the issues a tax authority faces in structuring a penalty. From (13), we know that as penalties increase, the benefits to the landowner decline. Therefore, participation in current use programs also declines. However, from (7g), we know that increased penalties on enrolled parcels delay development. In constructing a penalty, a tax authority must trade off preserving enrolled parcels against lower participation. This tradeoff becomes more evident as we consider the penalties that states actually use.

We now model two common types of penalties that, in our view, also identify the lower and upper bounds for reasonable penalties. The former is to have no penalty, as is the policy in 15 states. The latter is a recapture penalty equal to the property tax savings plus interest charges. This approximates the policy of another 27 states.

If a state charges no penalty for development, then $B(D) = S(D) \; ! \; R(D)$, and it is straightforward to verify that $B(D) > 0$. To see this, recall that the enrolled landowner retains the possibility of developing at Δ. Since $R(\Delta) = 0$, and $S(\Delta) > 0$, then $B(\Delta) > 0$. Given Δ is not the optimal time to develop, we know that $B(D) > B(\Delta) > 0$.

If the tax authority charges no penalty, then all landowners would enroll. In contrast, if the penalty requires a repayment of tax savings plus interest, then $P(D)e^{!rt} = S(D)$, meaning that $B(D) < 0$. With this penalty, no parcels would enter current-use classification. At the time of development, the landowner must forfeit all the tax benefits of the program, but is not reimbursed foregone rents.

Clearly, the modeling of both of these penalty structures is stylized. With no penalty, the model predicts that current-use programs would become universal. With a penalty equal to tax savings plus interest, the model predicts the program would generate no enrollment. In reality, some states with no penalties nonetheless have low enrollment rates. States that recapture tax savings still have enrolled parcels. The former might be explained by informational and transactions costs associated with enrollment. Overlapping policies for agricultural assistance might also mean that landowners already get a similar tax benefit without needing to enroll their parcels. The latter might be explained because many states charge only the tax savings during the years immediately prior to withdrawal from the program, which would make actual penalties smaller than we model them.

By abstracting from these features, however, the model shows that even simple penalty structures create drawbacks for a tax authority attempting to influence development decisions. With no penalty, a tax authority offers reductions even to owners who delay development very little. By recapturing all the tax savings, the tax authority would leave no incentives for landowners to enroll.

Conclusion

This note set out to develop a simple model of land use when a landowner has the option to enroll in a current use assessment program. The resulting model produces several interesting insights.

For example, if landowners enjoy nonpecuniary benefits from occupancy of undeveloped land, then they will delay development for a time, even though land conversion is implied by the "highest and best use" criterion. While current use programs postpone development even without nonpecuniary benefits, development decisions are most responsive to changes in nonpecuniary benefits. Furthermore, the comparative static results show current use programs to be especially effective when tax rates are high or when discount rates are low.

A particularly interesting feature of our model comes from considering the effects of land conversion penalties. For enrolled parcels, a current use assessment program most effectively postpones development by featuring penalties that decline over time. Many state programs, however, feature penalties that rise. A deeper understanding of the role of penalties comes from considering a landowner's decision to enroll in a current use program. Here, we contrast two common types of penalties and show that one could induce universal enrollment while the other could lead to no participation in the current use program.

These results are both insightful and important. Many communities continue to implement policies that ignore the model's key insights, so this type of analysis has immediate relevance. However, we believe the main value of the model is as a framework for additional research, both empirical and theoretical.

Empirically we have identified specific testable implications that now require verification. More generally, we want to renew interest in the relationship between current use programs and patterns of land use.

In terms of producing additional theoretical research, many interesting features of land use could easily be added to this framework. For example, the model could account for the role of current use assessment on liquidity-constrained landowners or on landowners who intend to keep their parcels undeveloped in perpetuity. The model also abstracts from other important features such as uncertainty, both over land prices and over tax policy, and the irreversibility of development decisions.

Through this note, we hope to provide a starting point for accounting for current use assessment in analyses of property taxation and land use.

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