PROPERTY TAXES ON LAND AND LAND USE

by

Linette Sue Fox

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ABSTRACT

All fifty U.S. states have some form of property tax relief for agricultural land. Preferential assessment of agricultural land for property taxes distorts the like treatment of equally valuable real property. However, property taxes are administered as a part of the nation's tax system. The effect of preferential assessment for agricultural land must be evaluated within the tax system.

A formal model of land values and times of converting agricultural land to urban uses is developed in this thesis. A property tax on land, a rollback tax, an income tax, and a capital gains tax are applied to the model, and the optimal time of conversion is examined. Comparative static results are discussed by simulating the tax rates.

Property tax preferences for agricultural land, when administered in a vacuum, delay conversion to urban uses. Rollback taxes, intended to penalize conversion of land out of agricultural uses, have little effect on the allocation of land. Land rents and capital gains are effectively untaxed for land in owner-occupied housing. Property tax preferences are small in comparison with these preferences for land in owner-occupied housing; thus, the tax system's bias is to allocate more land to housing. However, land rents and capital gains are taxed for land in commercial use, allocating land to agricultural over commercial uses.

The effect of the property tax is to reduce the allocation of land to commercial uses and to mitigate the bias created by other taxes when land is converted to housing. Thus, the current tax policy does not necessarily promote an inefficient allocation of land.
CHAPTER 1

INTRODUCTION

Property Taxes

The property tax has historically been an important source of government revenue. The tax primarily funds local services such as city water and sewer systems, roads, sanitation, education, and fire and police protection. As the quality and quantity of local services has increased, the funds required to support these services has also risen. In 1948, $33 billion (1989 dollars) in property taxes were collected in the United States; in 1989 $143 billion were received.1

Although state income tax revenues and federal revenue-sharing have grown more rapidly than the increase in the total amount of property taxes, property taxes are still unpopular. They have generated much resentment for several reasons. Property taxes represent a perpetual liability, whereas income is taxed only once. Although, property taxes are paid by owners of property to provide services, the connection between incidence of any tax and the quantity, quality or distribution of services it funds is often difficult to see.2

The property tax is of particular concern to the agricultural sector because of the large investments in land and buildings for agricultural production. Political coalitions of farmers, ranchers, speculators, and urban landowners have actively
lobbied state legislatures since the mid-1950's for reduced property taxes on agricultural land. All 50 states have adopted some form of property tax relief for agricultural land, shifting the tax burden to owners of other types of property or payers of other types of taxes, given that the services remain constant. The subsidization programs reflect the diversity within the political coalitions which establish them: farmers and ranchers want property tax relief, speculators reduced holding costs, and urban landowners on the urban-rural fringe to maintain "scenic values." Thus, the underlying objectives of the government's programs may be poorly articulated.

The rationales for preserving land in agriculture by implementing tax programs are the policy makers' interpretations of the reasons developed by the political coalitions. Two of these rationales are presented along with opposing economic arguments. The first rationale is that once agricultural land is converted to an urban use, the costs are prohibitively high for reversing the conversion process. If more land is required to feed a growing population, there will be a demand for a reverse of urbanization. The second rationale is that taxes should be based on the taxpayer's ability to pay, not his wealth.

The irreversibility issue was promoted by the National Agricultural Lands Study in the 1970's. During this period, world grain prices had risen dramatically in response to shortages in drought stricken countries. Many feared that adjustments to short-term supply shocks would be substantially prolonged in the future, creating mass starvation. Agriculture would not be able to adjust to shortages as quickly
because of less agricultural land available for production as well as a greater reliance on petroleum based products.

Studies by the Soil Conservation Service (SCS) indicated that there was a marked increase in the rate of urbanization of agricultural land, thus reducing the quantity of agricultural land available. In addition, the demand for agricultural products had increased, while the ability of agriculture to respond to the growth in demand declined. Demand had risen as a result of population growth and a rise in per capita incomes in developed and developing countries. Agriculture was responsive to this increase, but agriculture was also sensitive to the price of inputs. Agriculture increasingly relied on petroleum-based inputs. The SCS projected trends indicating that, at the present rate of land urbanization, the U.S. would not be able to provide the world with food at 1976 real prices. Thus, the prevailing philosophy became that the U.S. needed to preserve agricultural land.

An opposing argument is that urbanization takes up a very small percentage of the U.S. land area; thus, irreversibility is not significant. Furthermore, the value of agricultural output may rise or fall with urbanization -- gardens produce high-valued output. At a suburban density of one household per acre (a household is considered to be four persons), the population would take up 3% of the U.S. land area excluding Alaska. The urban population currently lives on about 1.2% of the U.S. land area.

Another opposing argument is that market values reflect people's expectations of the future. Landowners perceive the potential future demand for food. If people
expect agricultural product prices to rise faster than all other goods' prices, the market value of agricultural land will increase. High-priced agricultural land is more resistant to urban expansion than low-priced land.8

The second argument for preferential treatment of agricultural land is that property taxes should be related to the income capacity not the wealth of the property owner.9 Farmers and ranchers are often seen as facing a liquidity problem. Although the tax may be only 1 or 2% of the value of the land, the amount of the tax may be large. A lower tax payment reduces the cost of farming or ranching, making it feasible for the owner to continue his agricultural operation. In some states, laws on preferential tax treatment are directed toward "saving" the family farm. For example, tax preference eligibility in Texas requires that the owner be an individual, not a corporation.10 The owner must also be in agriculture for profit; agriculture must be his primary source of income and his main occupation.

Subsidizing property taxes for agricultural land, however, imposes a burden on others. A preference destroys the equal treatment of equally valuable real property, shifting the liability from owners of agricultural land to owners of other types of property or to payers of other types of taxes.11

A second rebuttal is that there may be better alternatives than subsidizing taxes to avoid the liquidity problem faced by owners of agricultural land. As an example, a reverse mortgage would allow the landowner to borrow against the increase in the market value of his land. The funds borrowed could be used to pay the taxes on the land until the landowner sells his land. Assuming the landowner
sells his land, he will have the funds to cover the reverse mortgage payment, when he sells the land.

**The Approach of This Study**

The problem of how to treat property taxes on agricultural land might appear very easy to solve. Most economists would advocate taxing all property at its market value to promote neo-classical economic efficiency. The property tax would be neutral toward the allocation of land. Land would be bid away from agricultural interests only by users that can generate a greater rental return from that land in an alternative use; thus, everyone gains. Under this hypothesis, there is no reason for subsidizing property taxes on agricultural land or land in any other use.

Property taxes, however, are not administered as a single tax but as a part of the nation's tax system. The effect of different methods of administering these taxes must be evaluated within the tax system. A property tax subsidy for agricultural land may increase economic efficiency when the biases created by other taxes are taken into account.

If there is no foundation for subsidizing property taxes on agricultural land, the objective is to determine what is the assessed value of an asset that makes the property tax neutral. There is a growing consensus within the current literature that the market value property tax is not neutral. In chapter two, a sample of this literature is presented. Some of these authors promote an assessment method which is based on the current rental income to that land.
If the property tax based on market value is not neutral, it makes sense to examine the authors' models to determine the reason for the non-neutrality of the tax. Their results depend on land lying dormant before it is able to earn higher rental returns from an urban use. If there is not an abnormal amount of land that produces zero annual returns on the rural-urban fringe, their model does not display reality.

An alternative model which does not force dormancy is suggested in the third chapter. In this chapter there is a re-examination of the effect of different methods of administering property taxes on land. This effect may be discussed as a distortion or enhancement in the efficiency of land use from the tax alone and as a part of the tax system.

A simulation model is presented in chapter four to discuss the comparative static results. The bearing of each of the parameter values on the allocation of land between uses may be compared to the impact of other parameters. In particular, some taxes within the tax system have a greater influence on the allocation of land than others. There is a large bias in the time of conversion from changing the tax rate marginally.

The final chapter is a discussion of the models and the results obtained by using them. Conclusions are reached about current tax policy and its bias. Specifically, property tax preferences for agricultural land, taken by themselves, delay conversion to urban uses and may lead to inefficient land use. So-called "rollback taxes" which penalized conversion out of agricultural uses have little effect on
development. However, property tax preferences for agricultural land are small in comparison with the preferences granted to land used for owner-occupied housing. Because land rents and capital gains are effectively untaxed, the tax system taken as a whole biases land uses toward housing over agriculture. On the other hand, the tax system favors agriculture over commercial uses.
ENDNOTES


2 Donald A. Derr does not discuss this in detail in Use-Value Assessment of Farmland: A Bibliography (Newark: University of Delaware, 1988), Bulletin 475, iii, but a property tax funds services that benefit the taxpayer; however, the benefits accrue to each taxpayer differently.

3 Ibid, iii.

4 Department of Agriculture, Economic Research Service, State Farmland Preferential Assessment Statutes, by J. David Aiken, 4 (Lincoln: University of Nebraska, 1989), RB310.


6 Ibid, 237.

7 Ibid, 236.


CHAPTER 2

LITERATURE REVIEW

Introduction

This review will examine some of the literature on assessment and taxation practices for land. The literature is concerned with the impact of different valuation and taxation practices on the timing of conversion of land from an agricultural use to an urban use. In addition, the efficiency of land use is addressed in the presence of different assessment and taxation practices.

Alternative assessment methods for property taxes are discussed in the first section. These methods will be used in addressing Bentick's original work on taxation of land as property. A complete description of his model is developed, and the market value tax structure is added to the model. Next, a presentation of Turnbull's model is given. He incorporates the original work of Bentick into a model of the present value of a unit of land inclusive of a tax system and a tax jurisdiction. Finally, Bentick and Pogue add an alternative urban land use and different tax schemes for each of the urban uses.
Assessment Methods

There are three assessment methods for property taxation that Bentick discusses in his original work. The first method is market value. The market value is the present value of the sum of the rental returns to land in its highest valued use at each point in time. A tax on the market value of land is a conventional land-wealth tax.

An alternative method of assessing land is the best use now method. With this method land is assessed at its highest valued use at the present, without regard to any higher valued use in the future. This method reduces the payment of taxes in advance of the period in which higher rental returns are received.

The final method of assessment is current use value. Using this assessment method, there is a conscious distinction between the value of land in its current use and the market value of land. Current use value assessment is based on the current rental income regardless of the highest valued use of land at the present or in the future.

Bentick's Model

In recent literature, there is a consensus that a property tax on the market value of land will hasten the time of conversion of land from agriculture to an urban use. Bentick argues that a conventional market value tax places a heavier burden on land using investments with long gestation periods. The gestation is the period of time that it takes for land to generate higher returns from an alternative use.
During this period, land must lie dormant so there are no rental returns. Bentick assumes, without explanation, that land must lie dormant before it is converted to an urban use.

There are two reasons that a market value tax will distort the use of land: liquidity and the capitalization of the tax into the land value. When capital markets are not working well, there is a liquidity problem, because funds to pay a tax on land-wealth are unavailable in periods before the higher rental return may be obtained. However, if capital markets were functional there would be no distortion.

To understand the capitalization of the market value tax into the value of land, Bentick’s model must be presented. His model compares two mutually exclusive annuities, but the analysis may be applied to two mutually exclusive land projects. The first annuity yields an immediate and constant return of $1. The second annuity yields a higher return, $c, after some period of time. The return will be zero for some period $0 \leq T$ and $c$ thereafter. If $r$ is the real rate of interest, the present value of a $1$ annuity, $V_1$, is $1/r$, and the present value of the $c$ annuity, $V_2$, is $ce^{-rT}/r$. The critical value of $T$ may be derived by setting the present value of these two annuities equal to one another. This value is the time at which the second annuity must start paying $c$ for the present values of the two annuities to be equal:

$$V_1 - V_2 = \ln(1/e) \quad T = \frac{\ln(1/c)}{-r}.$$
When a property tax is imposed on the current rental income to each use, the net income in each use declines by the same fraction. Thus, the rental income tax does not affect the critical time. A property tax on the market value, however, does distort the critical time. Where $b$ is the tax rate and $V_1$ is the present value of the $1$ annuity (land use), the net after tax rental return is $1-bV_1$, and the value of the land is $V_1 = 1/(r+b)$.

The second annuity or land use does not generate a rental return until time $T$. From time zero to $T$, there is a property tax liability:

$$\int_0^T bV_2(t)e^{-rt}dt.$$ 

After time $T$, the net rental return is $c-bV_2$, and the value of the land or annuity is $ce^{-rT}/(r+b)$. Thus, the value of the land or annuity at time zero is:

$$V_2 = \int_0^T bV_2(t)e^{-rt}dt + \frac{c}{r+b}e^{-rT}.$$ 

The capitalization of the property tax into the value of the land or annuity causes the present values to decline, but not by the same proportion:

$$V_1 = \frac{1}{r+b} > \int_0^T bV_2(t)e^{-rt}dt + \frac{c}{r+b}e^{-rT} = V_2.$$ 

The second annuity or land use must pay $c$ more quickly for the present values of the two annuities or land uses to be equal.

Bentick's conclusion rests on the inability of the second annuity or land use to yield a return until time $T$ and the annuities or land uses being mutually exclusive.
The greater the rate of the tax, the more quickly an investor would need to earn the $c$ return for the present values to be equal. Thus, a market value tax appears to bias the allocation against uses which require a long gestation period. Generally, these uses are considered to be developed uses. In chapter three it will be shown that a similar result holds for land uses which require capital inputs that are taxable: property taxes based on market value assessment bias land allocation against such uses.

However, Bentick's framework may not be appropriate for land use projects. The land must lie dormant for some period of time. The landowner is unable to generate income from a land use project that generates immediate returns and convert land at some point in the future to an alternative land project that generates a higher rental return. Thus, the owner cannot use land in its best use at each point in time. Realistically, most land developments are accomplished in a very short period of time. Thus, the bias would be expected to be small.

**Turnbull's Model**

Turnbull incorporates Bentick's original work into his model. He presents the most complete model in which there are two alternative uses of land. Using his integrated approach, there is a tax system and a tax jurisdiction. Property taxes on land are a component of the nation's complete tax system. These taxes are recognized as production expenses, which are income tax deductible. Simultaneously, the market value or the current use value of land reflects a stream of net income
flows in present value terms. An increase in income taxes reduces net income and the market value or current use value of land.

A tax jurisdiction was originally added to the model by Mills. The supply of the total amount of land to the market is fixed, but the supply to competing uses is variable. Annual income from each use is a function of the land used in that specific use.

Turnbull integrates the tax jurisdiction and tax system into the framework developed by Bentick of two mutually exclusive projects. The first project renders an immediate annual rental return. The second project produces zero income at first and a higher income than project one at some point in the future. In the absence of a tax, the critical time, the time at which land must gain the higher rental return from the second use, will occur when the present value of project one equals the present value of project two.

Turnbull presents a model that incorporates a property tax on land, an income tax, an accrual capital gains tax, and debt financing. Property taxes and interest paid on the debt financed portion of each project are income tax deductible, while the accrual capital gains tax is not. The capital gains tax is administered on the increase in the market value of land each period. To complete this model, a tax jurisdiction is used. Thus, the gross rental return to each land use is a decreasing function of the quantity of land in that specific use.

The various taxes have different effects depending on the time path of the rental returns. Since the first project renders an immediate rental return, the three
annual taxes simply reduce the gross rental return each year. The land used in project two, however, yields no rental income until a time in the future, T, but it does appreciate in value between time 0 and T. Project two land generates a capital gains tax obligation and realized losses of property taxes and debt interest. The realized losses are income tax savings. If the landowner has income from other sources, the losses may reduce his income taxes.

Using this model, Turnbull reaches several conclusions. The income tax is neutral toward the time of conversion and allocation of land when it is levied alone. A property tax on land under market value assessment is non-neutral toward the allocation of land. A complete tax system, however, can affect the allocation of land between uses differently than the added sum of each tax. His basic conclusion is that an income tax is non-neutral under the tax system with a market value assessment property tax on land and debt interest expense.

The non-neutrality of the income tax enhances efficiency by attenuating the property tax bias on land when project losses are carried back to offset taxable income from prior years. Loss offsets are relevant to land in project two. This land generates a capital gains tax obligation and realized losses of property taxes and debt interest for each year that land lies dormant. If these realized losses are income tax deductible over the gestation period, land in project two generates an income tax savings; thus, the land renders a competitive after tax rate of return. Since the income tax favors projects with long gestation periods and the property tax favors
projects with quicker returns, the income tax bias offsets some of the property tax bias.

The capital gains tax favors project one over project two. This tax is an additional expense over the gestation period for project two. Since the returns and the expenses for project two are incurred in different periods, the capital gain is reduced. Thus, the capital gains tax imposes an additional expense on land in use two.

In comparing and contrasting Turnbull and Bentick's conclusions, Turnbull reaffirms the non-neutrality of a property tax based on the market value of the land. However, Turnbull does not advocate the neutrality of a property tax based on the current rental income assessment of land. If the income tax is non-neutral in the presence of a property tax, the tax system is not neutral.

In addition, the market value property tax on land favors the project with quick returns over one with a long gestation. The favoritism is enhanced if the property tax rate rises over time. However, as previously mentioned, the empirical importance of the "gestation period" is open to question.

Bentick and Pogue

Bentick and Pogue recently developed a model in which there are three alternative uses of land, but no dormant period between uses. The three alternative uses are given as agricultural, housing, and commercial. The net rent from the
commercial use of land is initially below the net rent from either the agricultural or housing use, but the rent is expected to rise above both in the future.

There are two mutually exclusive time paths for land. In the first path, land is converted from an agricultural use to a housing use to a commercial use. In the second, land is converted directly from an agricultural use to a commercial use.

For either urban use a capital investment is required. Whether the first use of land is housing or agricultural, Bentick and Pogue require the time of conversion to be the same. Furthermore, the required capital investment to convert land to the commercial use is of the same magnitude regardless of the first use of land. The first option is attractive when the period of time that land is in the housing use is sufficiently long for the present value of the difference between the housing and agricultural rentals to exceed the cost of the required capital investment.

A tax added to this model is non-neutral if the optimal strategy of investing in housing is profitable in the absence of a tax but unprofitable with it or vice-versa. The three taxes that Bentick and Pogue add to the model are a property tax on capital investment and land, a property tax on land -- referred to as a land tax -- and a realization capital gains tax. The property tax on land and capital lowers the rental return to land and capital, discouraging investment in housing. Thus, this property tax lowers the net after tax rental return to housing relative to agriculture. A tax on the ownership of capital always discourages investment.

A property tax on land alone is non-neutral when it is based on market value. Although capital investment is not taxed as property, the discount rate that Bentick
and Pogue use is \( r+b \). Now, the return to capital investment must be \( r+b \) to generate a net return of \( r \). A higher discount rate makes it less attractive to invest in housing; thus, the tax favors the option of converting agricultural land to a commercial use.

The capital gains tax that Bentick and Pogue apply is neutral. Capital gains are taxed when they are realized, i.e. when land is converted to housing or to a commercial use. However, only part of the capital gains are taxed when land is converted to housing and then to a commercial use if the tax only applies to first time urbanization. This partial tax on capital gains - a kind of development gains tax - favors the option of first converting agricultural land to housing, since the capital gains are smaller in real terms.

The general conclusion from the literature discussed is that a property tax based on market value assessment is not neutral toward the time of conversion. An income tax, however, may be neutral if it is levied alone. An accrual capital gains tax will favor a quick return project using Turnbull's model, while capital gains taxed at the time of realization may be completely neutral using Bentick and Pogue's model. A property tax on capital always discourages investment.

**Empirical Studies**

There are a few related empirical studies, but none that focus on the effects of the tax system on the time of conversion and efficiency of land use. Zeimer et. al. does an empirical analysis of factors affecting preferential property tax assessment.
for agricultural land. Young examines special interest and majority voting models in relation to preferential property taxes for agricultural land. Lockertz discusses the intensity of farmland use on the rural-urban fringe. The empirical works are related, but they are not focused on the relationship between the time of conversion and allocation of land as a function of the tax system.
ENDNOTES


CHAPTER 3

THEORY

Introduction

A formal model of land values and conversion times is developed in this chapter. The model is of the present value of a unit of land inclusive of the tax system. A single plot of land is converted from an agricultural use to an urban use. The landowner may be required to make a capital investment to make this conversion. The capital investment may include the water and sewer system, the utility lines, and/or the roads. In addition, the owner may be penalized (subsidized) for converting land from an agricultural use to an urban use. The penalty or subsidy will depend on the specific type of tax or the combination of taxes.

The tax system includes four types of taxes: a property tax, a rollback tax, an income tax, and a capital gains tax. Land and capital are both subject to a property tax. The property tax is the property tax rate for land times the assessed value of land plus the property tax rate for capital times the market value (cost) of capital. Agricultural land may be assessed at market value or current use value, while urban land is always assessed at market value. Current use value is the capitalized value of the current rents without regard to any higher rents that may be obtained in the
future from the same or an alternative use of the land. Market value is the present value of all future rental returns to land from the highest valued use of the land.

If land in agricultural use is assessed at its current use value, there will be a difference between the assessed values of land in the agricultural use and the urban use at the time of conversion. This difference may be taxed when land is converted from an agricultural use to an urban use. This tax is referred to as a rollback tax.

The rollback and property taxes are based on the assessed value of land, but the income tax is based on taxable income. Taxable income is defined to be the gross rent less the property tax and cost of capital. The rental income to homeowners is an imputed rental return that is not subject to the income tax. This tax is therefore only applied to land in agricultural and commercial uses.

The capital gains tax is also only applicable to land in the agricultural and commercial uses. The capital gains tax is a tax on the increase in the market value of the land. Two methods of taxing capital gains will be discussed. A capital gains tax may be based on realized capital gains. Using this method, the capital gains tax is a tax on the difference between the value of a unit of land at the time it is sold and the original purchase price. The alternative method is to tax capital gains as they accrue. The accrual capital gains tax is a tax on the annual increase in the market value of the land.

In the remainder of this chapter, the basic model and extensions are presented that include capital investment and different types of tax structures. The effect of capital investment and each type of tax structure is to delay, hasten, or fail to bias
the time of conversion. A delay or hastening in the time of conversion creates a cost equal to the present value of the difference between the annual rental returns in the highest valued use and the actual, lower valued use.

Property taxes are collected to provide services, such as sanitation, water and sewage services, roads, and education. The payer of the property tax usually gets a direct benefit from the services provided by funds from property taxes. For example, if the funds are used to provide a water system, the owner of land in owner-occupied housing does not have to dig a well to provide water to his place of residence.

As property taxes are increased, services are not held constant, but they are not provided equally to all land uses. There is a greater direct benefit to land in an urban use than to land in agriculture when services are increased. A sanitation system, city water and sewage, and paved roads increase the value of land in an urban use. These services may not generate a higher rental return to agricultural land, since services such as water and sewage do not generate a higher value of agricultural production.

Since the property tax cannot be considered as strictly a wealth tax that does not directly benefit the payer, a delay in the time of conversion may be socially optimal. Throughout this chapter the optimal time of conversion does not refer to a social optimum. The optimal time of conversion is the time that land is converted from an agricultural use to an urban use given the distribution of services to all types of land and the tax structure.
Thus, the cost of delaying the time of conversion is not necessarily a social loss. The cost is the present value of the difference between the rental returns to each land use over the time period of the delay. The cost of the delay is determined given the distribution of services to all types of land and the tax structure.

The direction and magnitude of the bias in the time of conversion and the cost of delaying or hastening conversion will be given for each type of tax. In addition, the cost will be given as a percentage of the capitalized value of the annual rental returns to the urban use. This value is the market value of land in the absence of any taxes. Thus, the cost will be given as a percentage of the market value of land in the absence of any taxes.

In the first section the basic model in which capital investment is not added is presented. In the second section capital investment is added to the model. In the following four sections each type of tax is discussed. Since some taxes are administered differently depending upon the urban use of the land, models of two alternative situations will be presented. Agricultural land is either converted to the housing use or the commercial use. The final section is a summary of the results from each of the preceding sections.

Basic Model

In the basic model there is neither capital investment or taxes. A single plot of land is converted from an agricultural use to an urban use. The rental return to agriculture ($R_0$) is constant. The rental return to the urban use of land ($R_1$) is
initially below the rental return to agriculture but grows to a level of rents that exceeds the rental return to agriculture. Land would be converted immediately, if the rental return to the urban use of land was initially greater that the rental return to agriculture.

The functional form for the growth in the rental returns is assumed to be exponential. One would suspect that originally the rental return to urban land is fairly constant and below the rental return to agriculture, when there is little pressure to urbanize. As population and income increase, roads become paved, permits are granted for sewer systems, and other amenities are provided, the rental return to urban land rises rapidly.

The rise in the rental return to urban land can be attributed to three sources: a rise in population and income, a growth in government services and the dispersement of the costs of new services over all users of the service. Increases in population and income raise the demand for land for urban uses and the value of that land. The demand for urban land will also increase when growth in government services enhances the ability of land to produce services to the urban user. The full marginal cost of the services is not usually borne by the recipients; thus, the urban user is able to purchase services at a discounted rate. For example, the cost of annexing a new subdivision to the city water and sewer system is typically paid for by all users of the system.

The growth in the rental returns to urban land is expressed in an exponential growth rate functional form. The rental returns to land are growing at rate g. Thus,
the rental return to the urban use of land at a point in time, \( t \), is the initial rental return times the exponential growth:

\[ R_i(t) = R_i(0)e^{st}. \]

For a finite period of time, the exponential growth rate functional form is fairly descriptive of the actual flow of rental returns to urban land in a major metropolitan area. The rate of return for holding land in the urban use is no greater than holding high-grade bonds.\(^1\) However, the rental return to a unit of land in the urban use is also infinite when time goes to infinity.

Given that the rental return to land in the urban use grows exponentially, the present value of a single unit of land is expressed as:

\[
V(0) = \int_0^u R_0e^{-rt}dt + \int_u^\infty R_1e^{st}e^{-nt}dt.
\]

In this case, \( r \) is the real rate of interest. The time of conversion, \( u \), is the choice variable. This variable is adjusted to maximize the present value of the rental returns to each use.

Setting the derivative of the present value of a unit of land with respect to \( u \) equal to zero, the first order condition of maximization is:

\[
\frac{dV(0)}{du} = R_0e^{-ru} - R_1e^{su}e^{-ru} = 0.
\]

Thus, the optimal time of conversion, \( u^* \), is the point in time that the rental return to an urban use of land equals the rental return to agriculture:

\[ R_0 - R_1e^{su^*}. \]
On the following page, figure 1 is presented. The optimal time of conversion, $u^*$, is demonstrated as the point at which the flow of rental returns are equal for each use of land.

An example may be used to illustrate the time of conversion from agriculture to an urban use. The rental return to agriculture is arbitrarily set at $25 per year, and the initial rental return to housing at time zero is set at $15 per year. If the growth rate, $g$, is 2 percent per year, the optimal time to convert land to the urban use is 25.54 years.

**Basic Model with Capital Investment**

A single unit of land is converted from an agricultural to an urban use at a much later date at a positive capital investment, $K$. Conversion will be delayed until the rental return in the urban use less the annualized capital cost ($rK$) equals the rental return in agriculture. The first order condition is expressed as:

$$R_1e^{gu} - rK = R_0$$

This first order condition is different when a single unit of land is evaluated as opposed to many units of land. The delay is attenuated when the rental return to either the agricultural or urban use is dependent on the quantity of land in a particular use. Less units of land are employed in the urban use, when the time of conversion is delayed. Since the supply of urban land is reduced, the rental returns to urban land are increased.
FIGURE 1. BASIC MODEL

\[ R \]

\[ R_0 \]

\[ u^* \]

\[ \text{TIme} \]
The framework of the model used in this chapter is that of a single unit of land. Thus, the magnitude of the delay depends on the values of the real rate of interest and of the capital investment. If the real rate of interest is 4 percent and the landowner makes a $1,000 capital investment, the optimal time of conversion is 73.32 years.

A positive value of capital investment will always delay conversion, but this delay is efficient. The delay or hastening in the time of conversion generated by taxes, will be inefficient if the optimal time of conversion is a social optimal. The land is used in the lower valued agricultural use until the rental return to land in the urban use equals the rental return to agriculture plus the tax subsidy given to agriculture. The tax subsidy does not generate additional rental returns to the urban use of land.

Not all types of taxes will delay conversion. The effect on the time of conversion changes with different methods of administering the taxes and different combinations of taxes. In the following sections, property taxes, rollback taxes, income taxes, and then capital gains taxes are added to the model.

Basic Model with a Property Tax

Land and capital are both subject to the property tax. The assumption is made that there is an alternative investment that does not require the payment of a property tax. Thus, the discount rate is not affected by the property tax rate.
The basic model now includes the property tax on capital and the property tax on land. Capital is taxed at rate $s$, so taxes are $sK$. The property tax on the assessed value of land, $\tilde{V}(t)$, is at rate $L$, so taxes are $L\tilde{V}_i(t)$, where $i=0,1$ denotes the initial (0) agricultural use and later (1) urban use.

Thus, the present value of a unit of land is:

$$V(0) \int_0^U (R_0 - L \tilde{V}_0(t)) e^{-rt} dt + \int_0^\infty (R_1 e^{st} - L \tilde{V}_1(t) - sK) e^{-rt} dt - Ke^{-rn}.$$  

The time of conversion may again be adjusted to maximize the net present value of a unit of land.

The derivative of the present value of a unit of land with respect to the time of conversion yields:

$$R_1 e^{su} - R_0 + (r+s)K + L(\tilde{V}_1(u) - \tilde{V}_0(u)).$$

At the time of conversion, the rental return to urban land equals the rental return in agriculture, the annualized cost and property tax on the capital investment, and any additional property tax liability that may arise from differences in the assessed values of agricultural and urban land.

The property tax on capital, even without a property tax on land, will delay the time of conversion. The magnitude of the delay will depend on the quantity of capital required to convert land from an agricultural use to an urban use and the property tax rate on capital. The property tax rate on capital may be equal to or greater than the property tax rate on land. If the capital investment is $1,000, and
the property tax rate on capital is 1 percent, the time of conversion will be delayed by 7.15 years.

Overview of Assessment Methods

The additional property tax liability on land at the time of conversion will depend on the method of assessment for each use of land. The two land assessment methods are market value in each land use and the current use value for land in the agricultural use and market value for land in an urban use.

At any point in time the market value is the present value of all future rental returns net of taxes and capital expenses. At time \( u \) the market value of land is:

\[
V_1(u) = \int_u^\infty (R_1 e^{g(m)} - L \tilde{V}^*(m) - sK) e^{-r(m-u)} dm - K
\]

\[
= \frac{R_1 e^{g(m)}}{r+L-g} - \frac{(r+s)K}{r+L}.
\]

Current use value is the capitalized value of the current after tax rents regardless of any higher rents that may be obtained in the future. The current use value of land in the agricultural use at time \( u \) is:

\[
V_0(u) = \int_u^\infty (R_0 - L \tilde{V}^*(m)) e^{-r(m-u)} dm
\]

\[
= \frac{R_0}{r+L}.
\]

Market Value Assessment in Both the Agricultural and Urban Uses

The time of conversion is unaffected by the property tax on land when the assessment method is market value for both uses of land. If the property tax is based
on market value assessment of land, the tax is based on the present value of all future rental returns in the highest valued use of the land. The assessed value of the land reflects the highest valued use, regardless of the current use. At the time of conversion the property tax for land in agriculture, $L\tilde{V}_0(u)$, equals the property tax for land in the urban use, $L\tilde{V}_1(u)$.

Current Use Value Assessment in the Agricultural Use and Market Value Assessment in the Urban Use

The property tax liability will increase when land is converted from an agricultural use to an urban use under a different assessment method. This assessment method is current use value for land in agriculture and market value for land in an urban use, in which case $\tilde{V}_0(u) < \tilde{V}_1(u)$. Conversion is delayed because of an increased property tax liability at the time of conversion.

The magnitude of the delay may be discussed using the levels of the variables set in the previous examples and a one percent property tax rate for land. The time of conversion is delayed from the increased property tax liability by 16.82 years. The magnitude of the delay is the same with or without a positive value of untaxed capital investment.

The cost of delaying the time of conversion is the present value of the difference between the annual rental return in an urban use net of the capital costs and the annual rental return in agriculture. For the case in which capital investment equals zero, the cost of the delay is the thatched area of figure 2 on the top of page 36. This area is the rental return to an urban use in excess of the rental return to
FIGURE 2. PROPERTY TAX ON LAND

FIGURE 3. PROPERTY TAX ON LAND AND CAPITAL
agriculture between the no tax optimal time of conversion, $u^*$, and $u^b$. In this diagram, $u^b$ represents the optimal time of conversion when there are no taxes plus the delay in the time of conversion.

At the no tax optimal time of conversion, $u^*$, the present value of the cost of the delay is $17.40. To determine the cost of the delay, the difference between the rental returns is integrated:

$$VCD = \int_{u^*}^{u^b} (R_i e^{g t} - rK - R_0) e^{-r(t-u^*)} dt.$$

On average the cost of the delay is $3.03 per year in rental returns over the 16.82 years, when there is no capital investment. The cost of the delay relative to the capitalized value of the rental returns to the urban use of land at the optimal time of conversion, $u^*$, is 3.78%.

In the previous example, the capital investment was equal to zero. There may be a substantial capital investment to convert land. Since the total taxes on property are greater when capital investment is also taxable, the time of conversion is delayed further. In figure 3 on the bottom of page 36, $u^b$ is the optimal time of conversion given a property tax on land only. Furthermore, $u^c$ on the same figure represents the optimal time of conversion given property taxes on land and capital.

If there is a property tax on both land and capital, the cost of the delay is the dotted area of figure three. The present value of this cost is $119.30 over the 23.98 years of the delay:
\[ VCD - \int_{u^*}^{\infty} \left( R_t e^{\delta t - rK - R_0 e^{-r(u - u^*) dt}} \right) dt. \]

The magnitude of the cost is much larger when there is a required capital investment.

**Summary**

If there is a required capital investment, the property tax always delays the time of conversion. The property tax on land will only delay the time of conversion when agricultural land is assessed at current use value while urban land is assessed at market value. Property taxes on land are neutral under market value assessment for all land uses.

**Basic Model with a Property Tax and a Rollback Tax**

**Definition**

In this section, a rollback tax is added to the model. A rollback tax occurs when land being assessed at its value in agricultural use is converted to an urban use. The liability is attached to the land. Whoever owns the land at the time land changes use is responsible for the payment of the tax. If the owner of agricultural land has his land platted to sell lots for commercial or housing use, the land is no longer agricultural land, even if land is farmed. The rollback tax is paid by the original owner. If the agricultural landowner sells his land to someone that changes the use of the land, the buyer pays the rollback tax.
Regardless of who pays the rollback tax, the rollback tax was instituted to deter the conversion of land to urban uses by requiring the recapture of any property tax subsidy to agricultural land. The rollback tax is a payment of the difference between the property tax on urban land and the property tax on agricultural land for some number of years, $n$. However, the rollback tax is often administered as an interest bearing tax on the constant difference between the property taxes for each land use at the time of conversion. The owner will pay the difference between the property tax on urban land and the property tax on agricultural land at time $u$ for some number of years plus interest for the tax difference from previous years:

$$\left(\int_0^{\infty} re^{-dt}(L\tilde{V}_1(u) - L\tilde{V}_0(u))\right).$$

Since the tax is dependent on the relationship between the property taxes for each land use, the assessment method for each land use is a determinant of the effect.

**Market Value Assessment in Both the Agricultural and Urban Uses**

If market value assessment is used for the property tax base in each land use, the rollback tax does not affect the time of conversion. Market value is the present value of all future rents in the highest value use of the land. Using market value assessment, the property tax base is unaffected by the actual use of the land. Thus, the assessed value of land in agriculture equals the assessed value of land in an urban use, so the rollback tax equals zero.
Current Use Value Assessment in 
Agriculture and Market Value 
Assessment in the Urban Use

The current use value assessment of land in agriculture is not equal to the 
market value of land in housing. Somewhat surprisingly, the rollback tax does not 
affect the time of conversion. The rollback tax is capitalized into the value of the 
land at the time of conversion.

The present value of a unit of land inclusive of the rollback tax is:

\[
V(o) = \int_0^u \left[ (R_0 - L \tilde{V}_0(t)) e^{-rt} dt + \int_u^\infty (R_1 e^{r1 - LV_1(t) - sK}) e^{-r1} dt \right]
- Ke^{-ru} - \left( \int_0^\infty e^{ru} \left( (LV_1(u) - L \tilde{V}_0(u)) e^{-ru} \right) dt \right).
\]

In this model, the rollback tax is paid by the seller at the time of conversion. 
However, the time of conversion is unaffected by whether the buyer or the seller pays 
the tax.

Where the capital investment is zero, the first order condition may be written 
as:

\[
R_1 e^{ru} - LV_1(u) - R_0 - L \tilde{V}_0(u) + r\int_0^\infty e^{ru} (LV_1(u) - L \tilde{V}_0(u)) dt
- \left( \int_0^\infty e^{ru} (LV_1(u) - L \tilde{V}_0(u)) dt \right).
\]
At the optimal time of conversion, the rental return to the urban use of land net of the property tax must equal the rental return to the agricultural use of land net of the property tax plus the effect of the rollback tax.

The effect of the rollback tax has two parts, which are shown below to sum to zero. In the first part, the payer of the tax would desire to delay the payment of the rollback tax. When the payment of the rollback tax is delayed, the real value of the cost is reduced by the real rate of interest times the value of the tax:

\[
\begin{align*}
  r \left( \int_0^t e^r dt \right) (LV_1(u) - LV_0(u)) \cdot (u).
\end{align*}
\]

Thus, this term tends to delay the time of conversion.

This term may be rewritten as the difference between the annual returns plus the growth in the value of urban land, \( V_1'(u) \):

\[
\begin{align*}
  r \left( \int_0^t e^r dt \right) (LV_1(u) - LV_0(u)) - \\
  \left( \int_0^t e^r dt \right) L(R_1e^\alpha - LV_1(u) - (R_0 - LV_0(u)) + V_1(u)).
\end{align*}
\]

The competitive rate of return, \( r \), times the current use value of land in agriculture is equal to the annual net rental return to agriculture. This equivalence holds, because the real rents in agriculture are constant. However, the competitive rate of return times the market value of a unit of land at the time of conversion is equal to the annual net rental return to land in the urban use plus the growth in the value of a unit of land. The market value of land grows because the rental returns in the
highest valued use increase over time. Thus, the annual return to the owner of the urban land is both the rental return and the growth in the value of the land.

One must recall that the time of conversion chosen in the absence of the rollback tax say $u^b$, is defined by:

$$R_1e^{su^b}-LV_1(u^b)-R_0+LV_0(u^b)=0.$$  

Thus, the first term in the rollback tax -- the benefit of delaying conversion -- reduces to:

$$\left(\int_0^n e^{rt}\right)(LV_1'(u^b)).$$

The amount of the rollback tax rises by delaying the time at which land is converted to the urban use. Since the rental returns to the urban use are a growing function of time, the value of land in the urban use rises over time. The value of land in agriculture remains constant. The payer of the tax would desire to pay the tax sooner to avoid the additional cost of the tax on the growth in the value of land in the urban use:

$$\left(\int_0^n e^{rt}\right)(LV_1'(u^b)).$$

Since the market value of land in the urban use grows over time, the value of the rollback tax to be paid is increased by delaying the time of conversion. The owner of the land will gain by delaying conversion, because he will not pay the tax on the growth in the value of the land as a part of the competitive rate of return on
the market value of land. However, he will lose by delaying conversion, because he will pay a tax on the growth in the value of the land in the future.

Thus, the growth rate terms cancel each other out at \( u^b \). In other words, the rollback tax has no effect on the time of conversion, unless the rollback tax is larger than the difference between the market value and the current use value at the optimal time of conversion. Conversion will not take place under the last scenario.\(^3\)

**Summary**

Regardless of the assessment method used for the property tax base for agricultural land, the rollback tax is neutral toward the time of conversion. Since there is no difference in the property taxes paid if the assessment method is market value in both the agricultural and the urban uses, a rollback tax has no effect. If the assessment method is current use value for agricultural land and market value for urban land, the rollback tax is capitalized into the value of the land at the time of conversion. If the buyer of the land paid the rollback tax, the rollback tax would still be capitalized into the value of the land at the time of conversion and neutral toward the time of conversion.

**Basic Model with a Property Tax, Rollback Tax, and Income Tax**

**Applicability of the Income Tax**

In this section, an income tax is added to the model. Taxable income is the annual rental return net of the property taxes. The annual rental return to land in
commercial use is taxable income, but homeowners do not pay an income tax on the imputed rental returns. Thus, there are two separate cases: agricultural land is converted to housing, and agricultural land is converted to commercial use. If the conversion is from agriculture to owner occupied housing, only the annual net rental return from the agricultural use of land is taxed as income. If land is converted to a commercial use, the annual net rental return to land in both the agricultural and the commercial use is taxed.

The discount rate is the same for both models. The assumption is made that an alternative method of acquiring income requires the payment of an income tax. The effective discount rate is therefore the after income tax discount rate, \( r(1-I) \), where \( I \) is the income tax rate.

**Agricultural and Housing Uses of Land**

The present value of a single unit of land inclusive of taxes will depend on the second use of land. If land is converted from an agricultural to a housing use, the present value of a unit of land is:

\[
V(0) - \int_0^\infty (R_0 - L \tilde{V}_0(t))(1-I) e^{-\gamma(1-I)\mu} dt
+ \int_0^\infty (R_1 e^{st} - (1-I)(L \tilde{V}_1(t) + sK)) e^{-\gamma(1-I)\mu} dt
- Ke^{-\gamma(1-I)\mu} \left( \int_0^\infty e^{st}(1-I)(L \tilde{V}_1(u) - L \tilde{V}_0(u)) e^{-\gamma(1-I)\mu} dt \right).
\]
The annual net rental return to land in agriculture is thus lower than without the income tax. Furthermore, the rollback tax, property tax on land in housing, and property tax on capital are reduced, because the taxes are income tax deductible. The capital gains tax is not income tax deductible.

The first order condition for maximizing the present value of a unit of land yields:

\[ R_1 e^{su} - (1 - I)L \tilde{V}\_1(u) - (1 - I)(R_{0} - L \tilde{V}_0(u)) + (1 - I)(r + s)K. \]

The bias from adding an income tax is to hasten the time of conversion. The annual net rental return to land in agriculture and the annual capital investment cost are lower relative to the rental return to land in housing. This effect occurs because only the net rental return to land in agriculture is taxed. The disparity is further enhanced because property taxes on land in housing are income tax deductible.

The overall effect of the property tax, rollback tax, and income tax is dependent on the assessment method for property taxes and the parameter values. When agricultural land is assessed at its value in current use, capital investment is taxed, or both, the property tax will delay the time of conversion. The income tax functions oppositely, hastening the time of conversion.

If agricultural land is assessed at its value in current use, while land in housing is assessed at market value, the hastening of conversion by the income tax offsets the property tax bias. The optimal time of conversion is 28 years, when there is not a required capital investment and the parameter values are those discussed in previous examples. The time of conversion is delayed by 1.5 years.
Since the overall delay in the time of conversion is very small, the cost of the delay is small also. At the optimal time of conversion, \( u^* \), $1.40 is the present value of the cost of the delay. The cost relative to the capitalized value of the rental returns to housing at time \( u^* \) is less than two-tenths of one percent.

**Agricultural and Commercial Uses of Land**

In the first case, only the rental returns to land in agriculture were taxed as income. The annual net rental return is taxed in each use, when agricultural land is converted to a commercial use. The present value of a single unit of land inclusive of the property, rollback and income taxes is:

\[
V(0) = \int_0^u (R_0 - L \bar{V}_0(t))(1 - d) e^{-rt} dt
+ \int_u^n (R_1 e^{rt} - L \bar{V}_1(t) - sK)(1 - d) e^{-rt} dt
- Ke^{-rt} \int_0^n e^{-rt} dt (1 - d)(L \bar{V}_1(u) - L \bar{V}_0(u)) e^{-rt} dt.
\]

The net rental return to each land use is thus lower than without the income tax, and the present value of the land declines with an increase in the income tax rate.

The effect of the income tax on the present value of a unit of land can be understood by setting up the first order condition of maximization:

\[
R_1 e^{rt} - L \bar{V}_1(u) - R_0 - L \bar{V}_0(u) + (r + s)K.
\]
The first order condition appears to be the same as the first order condition without the income tax. The market value of land at the time of conversion is affected by the income tax rate. The growth in the value of the land is not taxed as income, but it is part of the annualized value of the land, \( r(1-I)V_1(u) = V_1'(u) + (R_1 e^{gu} - LV_1(u))(1-I) \). Thus, the value of the land at the time of conversion is:

\[
V_1(u) = \frac{R_1 e^{gu}(1-I)}{(r+L)(1-I)-g} \frac{(r+s)K}{r+L}
\]

If market value assessment is used for the property tax base, the income tax has no effect on the time of conversion. There is an income tax bias on the time of conversion when the property tax assessment method is current use value for land in agriculture and market value for land in commercial use. The market value of land in housing is a function of the income tax rate. Through the property tax bias, the time of conversion is delayed by increasing that rate.

The magnitude of the delay is significant. Using the parameter values discussed in previous examples and an income tax rate of 25%, the optimal time of conversion is 42.4 years. The delay in the time of conversion is 16.9 years from both the property and income tax bias; 7.7 years are added by the income tax.

The magnitude of the additional delay in the time of conversion is small, but the cost of the delay rises substantially. At the optimal time of conversion, \( u^* \), the present value of the cost of the delay rises from $17.40 to $51.00. Moreover, the cost
of the delay relative to the capitalized value of the rental returns to housing at time $u^*$ is 6.8%, a much greater percentage than without the income tax.

The income tax may also affect the time of conversion through the pre-tax discount rate. If a tax on income discourages saving, the pre-tax discount rate rises. Conversion will be delayed when a capital investment is required to convert land to an alternative use.

The income tax may also affect the time of conversion through the pre-tax discount rate. If a tax on income discourages saving, the pre-tax discount rate rises. Conversion will be delayed when a capital investment is required to convert land to an alternative use.

**Summary**

The income tax will affect the time of conversion differently depending on the urban use of land and the assessment method for the property tax base. If land is converted from agricultural use to owner-occupied housing, the income tax hastens the time of conversion. The time of conversion is unaffected by the income tax when the assessment method for agricultural land is market value, and land is converted from an agricultural use to a commercial use. The income tax delays the time of conversion, when the assessment method is current use value for agricultural land. An additional delay is created when the income tax increases the pre-tax discount rate, which raises the annualized capital investment cost.
Basic Model with a Property Tax, Rollback Tax, Income Tax, and Capital Gains Tax

The capital gains tax is the final tax to be added to the model. This tax is the most complex tax. The first two subsections discuss alternative methods of taxing capital gains and the different applications of the capital gains tax. Capital gains may be taxed when they are realized, which is when agricultural land is sold, or as they accrue. Furthermore, capital gains are only taxed on land in an agricultural or a commercial use.

After the methods and applications are described, a subsection is given for each combination of the method and application of the capital gains tax. If agricultural land is converted to owner-occupied housing, the capital gains on agricultural land may be taxed as they accrue or when land is converted and capital gains are realized. On the other hand, agricultural land may be converted to a commercial use. Capital gains to both agricultural and commercial land are taxed, but the capital gains on agricultural land, again, may be taxed on an accrual or realization basis.

In each of these subsections, the method and application of the capital gains tax are given, and models are stated for the present value of a unit of land. The effect of the capital gains tax is discussed for each model under alternative property tax assessment methods. The property tax assessment method is, thus, a subsection of each specific model.
Realization and Accrual Capital
Gains Taxes Defined

Capital gains are increases in the market value of assets. There are two
methods of taxing the gain in the market value of land. Capital gains may be taxed
as they accrue or upon realization, which is when the asset is sold. Each method will
have a different effect on the time of conversion.

The accrual capital gains tax is a tax on the annual increase in the market
value of land. If $V'(t)$ is the growth in the market value of a unit of land at time $t$,
and $c$ is the capital gains tax rate, $cV'(t)$ is the accrual capital gains tax. The capital
gains are unrealized to the owner of the asset because the asset has not been sold.

Since it is assumed that land can only be sold at the time of conversion, the
realization capital gains tax is only applied to land in agriculture. This capital gains
tax is a tax on the difference between the market value of land at the time land is
converted to an urban use and the original purchase price, $c(V_1(u)-V(0))$.

Applicability of the Capital Gains Tax

Capital gains are increases in the market value of an asset. Since the market
value of land is a function of time, there are taxable capital gains on land in any use.
Capital gains are taxed on land in agricultural and commercial uses, but not
(effectively) on land in owner-occupied housing. If land is converted from an
agricultural use to housing, the capital gains are not taxed after the time of
conversion. In contrast, all capital gains are taxed when land is converted from an
agricultural to a commercial use. The owner cannot, therefore, omit his liability by changing the land use.

**Accrual Capital Gains Tax**

for Land in Agriculture Only

In this subsection an accrual capital gains tax is added to the model in which land is converted from an agricultural use to housing. The present value of a unit of land inclusive of this tax scheme is:

\[
V(0) - \int_0^u ((R_0 - L \bar{V}_0(t))(1-D) - cV'(t))e^{-r(1-D)\mu}dt \\
+ \int_0^u (R_1 e^{\mu t} - (1-D)(L \bar{V}_1(t) + sK))e^{-r(1-D)\mu}dt \\
- Ke^{-r(1-D)\mu} - (1-D)(\int_0^u (L \bar{V}_1(u) - L \bar{V}_0(u))e^{-r(1-D)\mu}du)
\]

Once land is converted to the housing use, the annual liability disappears for both the income and capital gains taxes.

The first order condition for maximizing the present value of a unit of land yields:

\[
(1-(\int_0^u e^{\mu t}(1-D)\mu)\int_0^u (R_1 e^{\mu t} - (1-D)\mu \bar{V}_1(u)) - \\
(1-(\int_0^u e^{\mu t}(1-D)\mu)(R_0 - L \bar{V}_0(u) + (r+s)K) - cV'(u)).
\]
The net rental return to land in housing must equal the net rental return to land in agriculture which includes the capital gains tax plus the net annual capital investment cost. The accrual capital gains tax is an additional cost to holding land in agriculture. The bias from adding an accrual capital gains tax is to hasten the time of conversion.

The magnitude of the bias will depend on the method of assessment for the property tax base. Market value assessment of land for both uses will result in an earlier time of conversion than current use value assessment for agricultural land and market value assessment for housing land.

**Market Value Assessment in Both the Agricultural and Housing Use.** The magnitude and cost of hastening the time of conversion are large under the current tax scheme and assessment method. With no capital investment, the first order condition reduces to $R_1e^{gu} = (1-I)R_0 - cV'(u)$. Using the same parameter values as discussed in previous examples and a capital gains tax rate, $c$, of 25%, the optimal time of conversion is 4.5 years. The bias in the time of conversion is 21 years from the income and capital gains taxes.

The cost is large when the time of conversion is hastened from 25.5 years to 4.5 years. At the optimal time of conversion, $u^*$, the present value of the cost is $171.50 over the 21 years. The cost of the hastening is nearly one quarter, 22.9%, of the capitalized value of the rental returns to housing at time $u^*$.

**Current Use Value Assessment in Agriculture and Market Value Assessment in the Housing Use.** The magnitude and cost of the hastening is considerably less
when the assessment method is current use value for agricultural land. There are
two additional tax effects created by the property and rollback taxes. The property
tax will delay the time of conversion, but the delay by the property tax will be
partially offset by the rollback tax effect.

The rollback tax is not neutral when it is combined with the accrual capital
gains tax. The rollback tax reduces the annual net rental return to housing, but the
tax does not completely reduce the annual net rental return to agriculture which
includes the capital gains tax. The gross rental return less the income and property
taxes is reduced by the rollback tax, while the capital gains tax is unaffected:

\[
(1-(\int e^{rdt}(1-d)L(R_1e^{su}-L\bar{V}_1(u)))-
(1-(\int e^{rt}(1-d)L(1-d)(R_0-L\bar{V}_0(u)))-cV'(u)).
\]

The magnitude and cost of the hastening is less than when the property tax
base does not delay the time of conversion. If the number of years of the rollback
tax is 4, the optimal time of conversion is 7.2 years. However, the accrual capital
gains tax alone affects the time of conversion by a greater magnitude, 20.8 years.
This greater level of hastening by the capital gains tax is the result of the rollback tax
decreasing the rental returns net of the income and property taxes to each use of
land without decreasing the capital gains tax.

The present value of the cost of hastening the time of conversion at time \( u^* \)
is $123.50 with the property tax bias. The cost relative to the capitalized value of the
rental returns to housing is 16.5% at the time of conversion. The magnitude and cost
of hastening the time of conversion are large, but they are significantly reduced by a property tax subsidy to land in agriculture.

**Realization Capital Gains Tax for Land in Agriculture Only**

A realization capital gains tax also hastens the time of conversion the model for agricultural land converted to a housing use. In the model, capital gains are realized at the time land is sold, which is at the time land is converted to the housing use. The present value of a unit of land inclusive of the aforementioned tax scheme is:

\[
V(0) - \int_{0}^{u} (R_{0} - L \tilde{V}_{0}(u))(1 - \delta) e^{-\gamma(1-\delta)u} dt
\]

\[
+ \int_{u}^{n} (R_{1} e^{s\delta} - (1 - \delta)(L \tilde{V}_{1}(t) + sK)) e^{-\gamma(1-\delta)u} dt
\]

\[-Ke^{-\gamma(1-\delta)u} - (1 - \delta)(\int_{0}^{\infty} e^{-\gamma u} dt)(L \tilde{V}_{1}(u) - L \tilde{V}_{0}(u)) e^{-\gamma(1-\delta)u} - c(V_{1}(u) - V(0)) e^{-\gamma(1-\delta)u}.
\]

The capital gains tax, \(c(V_{1}(u) - V(0))\), reduces the present value of a unit of land.

The first order condition for maximizing the present value of land is:

\[R_{1} e^{su} - (1 - \delta)L \tilde{V}_{1}(u) - (1 - \delta)(R_{0} - L \tilde{V}_{0}(u)) + (1 - \delta)(r + s)K - cV_{1}'(u) e^{-\gamma(1-\delta)u}.
\]

The effect of the capital gains tax is \(cV_{1}'(u) e^{-\gamma(1-\delta)u}\). From the first order condition, the net rental return to land in housing must equal the net rental return to land in agriculture plus the net annual capital cost less the effect of the capital gains tax.
The time of conversion is hastened by adding a realization capital gains tax to the model in which land is converted to housing. However, conversion is hastened by a smaller amount than with an accrual capital gains tax. Once land is converted to the housing use, the liability of the capital gains tax is gone. The realization capital gains tax is distorted by the lock-in effect. Capital gains are not taxed until the land is sold, which is when capital gains are realized. If the land increases in value, the owner will hold land longer to avoid paying the tax. The real value of the tax declines, by postponing the tax. Realization taxation mitigates the former effect, but the bias from the realized capital gains tax is to hasten conversion.

The logic proceeds as follows, owner purchases the land with the knowledge that he has committed to paying the capital gains tax at the time of conversion. The decision to convert land is made at the margin. If the owner keeps land in agriculture for an additional year, he is liable for the growth in the value of the capital gains tax. The owner of the land, however, is able to reduce the liability of the tax, because he does not pay the tax for another year. Thus, at the margin the owner pays the growth in the capital gains tax discounted back to the point at which the decision to pay the tax was made.

The direction of the effect of the capital gains tax is the same regardless of the assessment method. However, market value assessment of land for the property tax base creates a greater hastening in the time of conversion. The reason for the increased hastening with the market value property tax is that there is no property tax bias to delay the time of conversion.
Market Value Assessment in Both the Agricultural and Housing Uses. The magnitude and cost of hastening are smaller with a realization capital gains tax. The first order condition for this model is:

$$R_t e^{u-(1 - l)R_0} - e^{V'(u)}e^{-r(1-l)u}.$$  

Under the realization method of taxing capital gains, the owner must cover the cost of the tax on the capital gain at time $u$ brought back to the initial time, $cV'_1(u)e^{-r(1-l)u}$. Using the same parameter values, the optimal time of conversion is 6.9 years. The bias in the time of conversion is 18.6 years from the income and capital gains taxes, 2.3 years less than if the accrual method is used for taxing capital gains.

The cost of hastening the time of conversion is correspondingly smaller than under the accrual capital gains tax method, but the cost is still large. The present value of the cost is $138 at the optimal time of conversion, $u^*$. The cost of the hastening relative to the capitalized value of the rental returns to housing at time $u^*$ is 18.4%, a somewhat smaller percent than under the accrual capital gains tax method.

Current Use Value Assessment in Agriculture and Market Value Assessment in the Housing Use. The magnitude and cost of the hastening are considerably smaller when agricultural land is assessed at current use value. The property tax bias is to delay the time of conversion, while the capital gains tax hastens conversion:
The optimal time of conversion is 13.6 years.

The present value of the cost of hastening is $45.10. The cost is reduced by $92.90 when a property tax subsidy is given to land in agriculture. At the time of conversion, this cost is 6.01% of the capitalized value of the rental returns to housing.

**Accrual Capital Gains Tax for Land in Commercial and Agricultural Uses**

The time of conversion is hastened in the two previous models, because the capital gains on land in housing were not taxed. In this subsection an accrual capital gains tax is added to the model in which land is converted from an agricultural to a commercial use. Capital gains are taxed on commercial land. The present value of a unit of land under the current tax scheme is:

\[
V(0) - \int_{0}^{\mu} \left( (R_0 - L \tilde{V}_0(t)) (1 - I) - cV'(t) \right) e^{-r(1-I)t} dt
+ \int_{\mu}^{\infty} \left( (R_1 e^{r(1-I)} - L \tilde{V}_1(t) - sK) (1 - I) - cV'(t) \right) e^{-r(1-I)t} dt
- Ke^{-r(1-I)\mu} - (1 - I) (e^{r\mu} (L \tilde{V}_1(\mu) - L \tilde{V}_0(\mu))) e^{-r(1-I)\mu}.
\]

The capital gains tax, \(cV'(t)\), must be paid each year regardless of the use of the land.

Maximizing the present value of a unit of land with respect to the time of conversion yields:
The net rental return in housing must equal the net rental return to agriculture plus the net annual capital cost less the combined effect of the capital gains and rollback taxes. The bias from adding an accrual capital gains tax is to hasten conversion only if the property taxes to each land use are assessed differently.

**Market Value Assessment in Both the Agricultural and Commercial Use.** If there is no capital investment and the assessment method for property taxes is market value for both uses, the first order condition reduces to \( R_1e^{gu} = R_0 \). This equation is the same as the first order condition from the basic model. The capital gains tax has no effect on the time of conversion.

This result makes intuitive sense. Capital gains are taxed regardless of the use of the land. The owner cannot avoid paying the tax by holding land in a different use. In addition, he cannot reduce the payment by delaying conversion. Thus, there is no incentive to distort land use.

**Current Use Value Assessment in Agriculture and Market Value Assessment in the Commercial Use.** If the assessment method for agriculture is current use value, the accrual capital gains tax is not neutral. The first order condition is:
The capital gains tax hastens the time of conversion through the rollback tax. In the previous discussion of the rollback tax, the rollback tax was said to have two opposing effects. The real value of the tax declined by the real rate of interest times the tax, an incentive to pay the tax at a later date. The delay would create a larger tax, however, because the market value of land in housing grows over time.

The discussion of the rollback tax pointed out that the real interest rate net of income taxes times the value of land in the urban use equals the annual rental return to housing plus the growth in the value of the land:

\[ r(1-I) V_1(u) - (1-I)(R_1 e^{\delta u} - LV_1(u)) + V_1(u). \]

With a capital gains tax, the growth in the value of the land gained by the owner is the after tax growth: \((1-c)V_1'(u)\). This after tax growth does not offset the growth in the market value of the land which increases the value of the rollback tax.

The hastening in the time of conversion created by the capital gains tax partially offsets the delay created by the property and income taxes. The optimal time of conversion is reduced from 42.4 years to 34.1 years. The delay in the time of conversion is reduced to 8.6 years, 34.1 years less 25.5 years.

The cost of delaying conversion is also reduced by the capital gains tax. The present value of the cost is $15.50, a reduction of $35.50. The cost relative to the
value of the rental returns to the urban use is now very small. The percentage is only 2%, a decline of nearly 5%.

**Realization Capital Gains Tax for Land in the Agricultural Use and Accrual Capital Gains Tax for Land in the Commercial Use**

Both the accrual and realization capital gains taxes are added to the model in this subsection. Land is converted from an agricultural use, where capital gains are taxed on a realization basis, to a commercial use, where capital gains are taxed on an accrual basis. Realistically, capital gains on agricultural land are not taxed until land is sold. The assumption is that agricultural land is sold at the time of conversion; thus, the capital gains tax is paid at this time. Capital gains on commercial property, however, are typically taxed annually; as they accrue. The present value of a unit of land under this tax scheme is:

\[
V(0) = \int_{0}^{\infty} (R_0 - L \tilde{V}_0(t)) (1-I) e^{-r(1-d)u} dt \\
+ \int_{u}^{\infty} ((R_1 e^{st} - L \tilde{V}_1(t) - sK) (1-I) - cV'(t)) e^{-r(1-d)u} dt \\
- Ke^{-r(1-d)u} - (1-I) \int_{0}^{\infty} e^{ru} dt (L \tilde{V}_1(u) - L \tilde{V}_0(u)) e^{-r(1-d)u} \\
- c(V_1(u) - V(0)) e^{-r(1-d)u}.
\]

The first order condition yields:

\[
(1-I)(R_1 e^{su} - L \tilde{V}_1(u)) - (1-I)(R_0 - L \tilde{V}_0(u)) + (1-I)(r+s)K \\
- cV'_1(u)e^{-r(1-d)u} + cV'_1(u).
\]
The net rental return to land in housing equals the net rental return to land in agriculture plus the net capital investment cost less the realization capital gains tax effect plus the accrual capital gains tax effect. The capital gains taxes have opposing effects. The effect of the accrual capital gains tax is larger than the realization capital gains tax, so the net capital gains tax effect is to delay the time of conversion.

The effect of the combination of the capital gains taxes makes intuitive sense. The capital gains tax on a realization basis affects the time of conversion two ways. Since the realization capital gains tax is only relevant to land in agriculture, this capital gains tax hastens the time of conversion. The hastening in the time of conversion by this capital gains tax is partially mitigated by only taxing the capital gains when they are realized.

The effect of the accrual capital gains tax is to delay the time of conversion. Since this capital gains tax is only applied to land in the commercial use, the owner of the land would delay converting land to avoid the additional tax. The accrual capital gains tax cannot be mitigated, because it is an annual liability. At the time of conversion the capital gains taxes will overall delay the time of conversion.

**Market Value Assessment in Both the Agricultural and Commercial Uses.**
The magnitude and cost of the delaying are not very large. The first order condition without required capital investment is:

\[(1-J)R,e^{gu}-(1-J)R_0-cV_1(u)e^{-r(1-de)+cV_1(u)}.\]
The rental return in housing must equal the rental return to agriculture plus the fraction \((1-e^{-\tau (1-D_u)})\) of the capital gains tax effect. Using the same parameter values as in previous examples, the optimal time of conversion is 33.1 years. The bias in the time of conversion is 7.6 years from the capital gains taxes.

Since the delay is for only a short period of time, the cost of the delay is small. At the optimal time of conversion, \(u^*\), the present value of the cost is $12.30. This cost is 1.64% of the capitalized value of the rental returns to the commercial use.

**Current Use Value Assessment in Agriculture and Market Value Assessment in the Commercial Use.** The magnitude and cost of the delay grow significantly when the assessment method for land in agriculture is changed to current use value. There is now a property tax bias which delays the time of conversion in addition to the capital gains tax bias. From the first order condition, the net rental return to the commercial use must equal the net rental return to agriculture plus the capital gains tax effect. This effect may be expressed as:

\[
(1-D)(R_1e^{\theta_u}-L\bar{V}_1(u))-(1-D)(R_0-L\bar{V}_0(u)) - cV'_1(u)e^{-\tau(1-D_u)} + cV'_1(u).
\]

The optimal time of conversion is 49.6 years, a delay of 24.1 years.

The magnitude of the delay has increased therefore enlarging the cost of the delay. The present value of this cost is $91. This tax scheme on land converted to a commercial use produces the largest cost from changing the time of conversion.
Summary

The capital gains tax affects the time of conversion differently depending on the urban use of land. The reason for this dependence is that capital gains are not taxed if land is in the housing use. The capital gains tax always hastens the time of conversion when agricultural land is converted to a housing use. If land is converted from an agricultural use to a commercial use, there will either be no bias, a delay or a hastening in the time of conversion. There is no bias in the time of conversion, with the accrual method for taxing capital gains and market value assessment as the property tax base for all uses of land. The addition of an accrual capital gains tax on all land uses will hasten conversion when current use value assessment is used for agricultural land assessment. Capital gains may be taxed on an accrual or realization basis when land is in agriculture. The realization basis of taxing capital gains will always delay conversion over the accrual basis.

Chapter Summary

Many models have been presented in this chapter. To help summarize the material, the conversion times and costs of delaying or hastening the time of conversion are given for land converted to housing under various tax systems and with the base parameter values on page 67. On page 68, the same information is reported for land converted to a commercial use.

There are some general conclusions that may be drawn from the many models. In the absence of any taxes or a required capital investment, land will be
converted from an agricultural use to an urban use when the rental return to the urban use has grown to equal the rental return in agriculture, 25.5 years from the initial time period. Taxes or capital investment may affect the time of conversion.

A unit of land is converted from an agricultural to an urban use at a much later time when there is a required capital investment. Capital investment does not distort the allocation of land between alternative uses.

Capital investment always delays the time of conversion, but different taxes will have different effects. The four types of taxes discussed in this chapter are: a property tax, a rollback tax, an income tax, and a capital gains tax. In addition, there are alternative methods of taxing property and capital gains and different applications of the income tax and the capital gains tax to distinct urban uses of land.

Both land and capital are considered property. If the capital investment is taxed, the property tax will delay the time of conversion. The property tax on land is neutral, if the assessment method is market value for all land uses. If land in agriculture is assessed at its value in current use and land in the urban use is assessed at market value, the property tax on land delays the time of conversion. In Tables 1 and 2 the time of conversion is shown to be delayed to 34.7 years at a cost of $17.40.

The rollback tax was designed to recover lost tax revenue from any property tax subsidy to agricultural land. This tax is always neutral toward the time of conversion when there is not an accrual capital gains tax. As the rollback tax is administered, the time of conversion is not affected by the tax regardless of whether
the buyer or seller pays the tax or the assessment method for the property tax base. Thus, the time at which land would be converted to an urban use remains 34.7 years.

The income tax may be neutral toward the time of conversion, but it may also affect the time of conversion. The income tax will have different effects depending on the urban use of the land and the assessment method for the property tax base for agricultural land. If land is converted from an agricultural to a housing use, the imputed rental return to land in housing is not taxed as income. The time of conversion, as listed in Table 1, is thus hastened by the income tax.

If land is converted from an agricultural to a commercial use, the rental returns to both uses are taxable income. The income tax does not affect the time of conversion when the assessment method for the property tax base is market value in both uses. The income tax will delay the time of conversion to a degree expressed in Table 2 in addition to the property tax bias when current use value assessment is used for agricultural land.

The capital gains tax is also dependent on the application of the tax -- land in housing is effectively exempt from the capital gains tax. Since capital gains taxes are avoided by having land in the housing use, land is converted from agriculture to housing at an earlier date. The hastening of the time of conversion will hold regardless of the methods of assessment for property taxes or of taxing capital gains. The effects of each of the models are reported in Table 2.

The hastening in the time of conversion is mitigated by assessing agricultural land at its value in current use or by taxing capital gains on a realization basis. The
magnitudes of the hastening in the times of conversion are given in the last four models. The cost of hastening is largest with an accrual capital gains tax and market value assessment for property taxes.

If land is converted from an agricultural to a commercial use, the capital gains are taxed in both land uses. There is no bias in the time of conversion when the accrual method is used for taxing capital gains and market value assessment is used for the property tax base for both land uses, as reported in Table 2. The capital gains tax will hasten the time of conversion, by changing the assessment method for the property tax base to current use value for land in agriculture. If the realization method is used for taxing capital gains in agriculture, conversion is delayed.

In Tables 1 and 2, different tax scenarios are stated with their respective times of conversion and costs of delaying and hastening conversion. The first model is the basic no tax scheme. In the next three models, a property tax, rollback tax, and income tax are added to the model. The last four models compare alternative methods of applying the capital gains in conjunction with different property tax systems. The capital gains tax has many different effects and magnitudes of effects depending on the various methods of administering the tax.
Table 1. Conversion Times and the Cost of Delaying or Hastening the Time of Conversion to Housing Using Various Tax Systems and the Base Parameter Values.

<table>
<thead>
<tr>
<th>Tax System</th>
<th>u</th>
<th>Cost of Delay (Hastening)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Taxes</td>
<td>25.5</td>
<td>0.00</td>
</tr>
<tr>
<td>Property Tax On Land CUV/MV*</td>
<td>34.7</td>
<td>17.40</td>
</tr>
<tr>
<td>Property Tax On Land CUV/MV Rollback Tax</td>
<td>34.7</td>
<td>17.40</td>
</tr>
<tr>
<td>Property Tax On Land CUV/MV Rollback Tax</td>
<td>28.0</td>
<td>1.40</td>
</tr>
<tr>
<td>Property Tax On Land CUV/MV Rollback Tax</td>
<td>28.0</td>
<td>1.40</td>
</tr>
<tr>
<td>Property Tax On Land MV/MV Income Tax-Agriculture Only</td>
<td>4.5</td>
<td>171.50</td>
</tr>
<tr>
<td>Property Tax On Land MV/MV Income Tax-Agriculture Only</td>
<td>4.5</td>
<td>171.50</td>
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<tr>
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<td>7.2</td>
<td>123.50</td>
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<tr>
<td>Property Tax On Land MV/MV Income Tax-Agriculture Only</td>
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<td>123.50</td>
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<tr>
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<td>138.00</td>
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<tr>
<td>Property Tax On Land MV/MV Income Tax-Agriculture Only</td>
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<td>138.00</td>
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<td>13.6</td>
<td>45.10</td>
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<tr>
<td>Property Tax On Land MV/MV Income Tax-Agriculture Only</td>
<td>13.6</td>
<td>45.10</td>
</tr>
</tbody>
</table>

*CUV/MV- Current use value assessment for agricultural land and market value assessment for housing land.
Table 2. Conversion Times and the Cost of Delaying or Hastening the Time of Conversion to a Commercial Use Using Various Tax Systems and the Base Parameter Values.

<table>
<thead>
<tr>
<th>Tax System</th>
<th>u</th>
<th>Cost of Delay (Hastening)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Taxes</td>
<td>25.5</td>
<td>0.00</td>
</tr>
<tr>
<td>Property Tax On Land CUV/MV*</td>
<td>34.7</td>
<td>17.40</td>
</tr>
<tr>
<td>Property Tax On Land CUV/MV Rollback Tax</td>
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<td>17.40</td>
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<td>51.00</td>
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<tr>
<td>Income Tax On All Land Uses</td>
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<td></td>
</tr>
<tr>
<td>Property Tax On Land MV/MV</td>
<td>25.5</td>
<td>0.00</td>
</tr>
<tr>
<td>Income Tax On All Land Uses Capital Gains Tax-Accrual</td>
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</tr>
<tr>
<td>-All Land Uses</td>
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<td>Income Tax On All Land Uses Capital Gains Tax-Accrual</td>
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<tr>
<td>-All Land Uses</td>
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<tr>
<td>Property Tax On Land MV/MV</td>
<td>33.1</td>
<td>12.30</td>
</tr>
<tr>
<td>Income Tax On All Land Uses Capital Gains Tax-Real/Accrual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-All Land Uses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property Tax On Land CUV/MV Rollback Tax</td>
<td>49.6</td>
<td>91.00</td>
</tr>
<tr>
<td>Income Tax On All Land Uses Capital Gains Tax-Real/Accrual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-All Land Uses</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*CUV/MV- Current use value assessment for agricultural land and market value assessment for land in the commercial use.
ENDNOTES


2This point is first mentioned by David E. Wildasin in "More on the Neutrality of Land Taxation," National Tax Journal 35 (1982):105.

3The second order condition for the rollback tax is:

$$\frac{\partial^2 V(0)}{\partial u^2} - [1 - L(\int e^{rt} dt)] \frac{-g(r-g)R_t e^{gu}}{r-g+L}.$$ 

If the first term of the expression is negative, the second order condition is positive. Thus, a minimum value of the unit of land is found not a maximum. Conversion in this case would never take place. Otherwise, the time of conversion is invariant with the rollback tax.
CHAPTER 4

SIMULATION MODEL

Introduction

The effect of each tax and capital investment on the time of conversion was addressed in the previous section. The bias in the time of conversion was inefficient when the bias was created by a tax or a tax scheme. The magnitude of the effect and the cost of hastening or delaying the time of conversion was stated for a given set of parameter values.

Two models of land values are simulated in this chapter to determine the effect of changing the parameter values. The comparative static results are reported for a model in which land is converted from an agricultural use to housing and for a model in which land is converted from an agricultural use to a commercial use. There is a complete discussion of these two models in the next section.

The third section is divided into subsections by specific parameter. For each parameter, there is a justification of the base level used, where the base level may be questionable. At this point, an alternative level is suggested. The change in the time of conversion is determined from using the alternative level in both models. For each model, there will be a change in the cost of hastening or delaying
conversion. The absolute value and change in the cost are discussed. These results are summarized in the fourth section.

Models for Simulation

The two models that are simulated include all of the taxes. There is no tax on "self-production" as opposed to production for others. Thus, a model is presented which includes the imputed rental returns and capital gains to owner-occupied housing. The income and capital gains taxes only apply to the urban use when land is converted to a commercial use.

In addition, the method of taxing capital gains is not the same for both models. For the model in which agricultural land is converted to housing, the capital gains are taxed when they are realized. This method is an accurate reflection of the landowner who sells a small acreage to someone to subdivide and pays a capital gains tax. If agricultural land is converted to a commercial use, the capital gains are taxed as they accrue regardless of the use of the land.

The other option within the tax system is which assessment method to use for the property tax base. All states have some form of property tax subsidy for agricultural land.\(^1\) Thus, the assessment method for agricultural land is current use value, while the assessment method for urban land is market value.

The structure for each of the two models is summarized below. When land is converted to housing, there is a property tax based on current use value for land in agriculture and market value for land in housing, a rollback tax, an income tax on
agricultural rents, and a realization capital gains tax for land in agriculture. Where land is converted to a commercial use, there is the same type of property tax, a rollback tax, an income tax on all rental returns and an accrual capital gains tax for all uses of land.

Simulations

The results of the simulations are given for each of the two models discussed in this section. The parameters used in the simulations are the tax rates, capital investment, rollback tax years, real rate of interest, growth rate and initial rental return to urban land. For each parameter in both of the models, the effect of the change in the value of the parameter is discussed as a bias or lack of bias in the time of conversion and the absolute value and change in the cost of the bias in the time of conversion. The base and alternative values of each parameter are discussed within the text and presented in Table 3 on the following page.

Each of the increases in the parameter values will change the time of conversion. Table 4 on page 80 summarizes the effects of the increased parameter values on the time of conversion of land to housing. Table 5 on page 81 does likewise for the conversion of land to a commercial use.

Property Tax Rate on Land

The base value for the property tax rate on land is given as 1%. This value is a rounded average from the representative rates of taxation on residential,
Table 3. Parameter Values for Simulation.

<table>
<thead>
<tr>
<th>Description</th>
<th>Base</th>
<th>Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Tax Rate on Land</td>
<td>.01</td>
<td>.02</td>
</tr>
<tr>
<td>Income Tax Rate</td>
<td>.25</td>
<td>.30</td>
</tr>
<tr>
<td>Capital Gains Tax Rate</td>
<td>.25</td>
<td>.30</td>
</tr>
<tr>
<td>Capital Investment</td>
<td>0</td>
<td>1000</td>
</tr>
<tr>
<td>Property Tax Rate on Capital Investment</td>
<td>0</td>
<td>.01</td>
</tr>
<tr>
<td>Number of Years of Rollback Tax</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Real Rate of Interest</td>
<td>.04</td>
<td>.05</td>
</tr>
<tr>
<td>Growth Rate of Urban Rental Returns</td>
<td>.02</td>
<td>.025</td>
</tr>
<tr>
<td>Rental Return to Urban Land at $t=0$</td>
<td>15</td>
<td>16.58</td>
</tr>
</tbody>
</table>
agricultural, and commercial property. The representative rates of taxation are 1.31%, 0.77%, and 1.90%, respectively.²

In each model the property tax on land delays the time of conversion, because agricultural land is assessed at its value in current use. The time of conversion is delayed even more when the property tax rate is raised from 1% to 2%. If the model used is agricultural land converted to housing, the change in the time of conversion is 12.8 years (Table 4). The delay nearly equals the hastening effect of the income and capital gains taxes; therefore, the absolute cost of the overall delay in the time of conversion is $.20, almost awash.

If the model used is agricultural land converted to a commercial use, the change in the time of conversion is much less -- only 4.7 years (Table 5). The cost of the delay is increased by $23.30 to $33.80. The increase in the property tax rate moves the time of conversion away from the optimal.

**Income Tax Rate**

The income tax rate is increased from 25% to 30%. The effect of increasing the income tax rate is consistent with the effect of adding an income tax. Where land is converted to housing, the income tax hastens conversion. Thus, an increase in the income tax will enhance the effect, by an additional 6.2 years in this case. The hastening increases the cost by $73.30 to $118.40, the largest absolute cost reported on Table 4. Where land is converted to a commercial use, the income tax delays the time of conversion by an additional 1.2 years, as noted on Table 5. The delay increases the absolute value of the cost to $19.70.
Capital Gains Tax Rate

Capital gains are currently taxed at the same rate as ordinary income. The capital gains tax rate is thus increased from 25% to 30%. The capital gains tax hastens the time of conversion, regardless of the urban land use. Where land is converted to housing, the capital gains tax will enlarge the bias in the time of conversion by 4.4 years. The cost of hastening will grow to $92.90. The change in the cost is substantial compared to the change associated with increases in other parameter values in Table 4. The cost associated with the bias in the time of conversion increases when land is converted to housing, but decreases when land is converted to a commercial use. The delay is decreased by 1.1 years, and the cost drops to $11.90. This set of parameter values generates the smallest cost, a fact that is readily visible from Table 5.

Capital Investment

When the base values were used, land was converted to an urban use without any capital investment. If roads are paved or a water and sewer system are added, there is a capital investment. The value of the amenities will vary by their quantity and quality. A required capital investment will always delay the time of conversion.

Using a value of $1,000 of capital investment, land is converted from an agricultural use to housing 59.4 years later. Although there is a delay in the time of conversion, the delay is efficient. There is not a cost of delaying. If the capital investment is taxed at the same rate as other property, 1%, the time of conversion is delayed another 7.7 years. The tax on capital is inefficient, but the delay does not
offset the hastening by the income and capital gains taxes. Furthermore, the change in the time of conversion from both the capital investment and the tax on capital investment is not reflective of the change in the cost of the hastening; thus, the cost is unreported in Table 4.

When land is converted from an agricultural use to a commercial use, the time of conversion is delayed by 47.8 years. If capital investment is taxed, the delay is increased by 7.1 years. The delay in the time of conversion is increased when a tax is levied on capital investment.

**Rollback Tax Years**

All rollback taxes are for at least two years excluding the year of conversion. Since most rollback taxes are for 3, 4, or 5 years, excluding the year that land is converted, the base number of years for the rollback tax is 4 years. The alternative value is 5 years.

The rollback tax has no effect on the time of conversion when land is converted to housing, but it does hasten the time of conversion when land is converted to a commercial use. The hastening is only .2 years -- the smallest change described in Table 5. The cost of the delay is reduced by $.60 to $14.90 per unit of land.

**Real Rate of Interest**

The base value is 4% for the real rate of interest. Corporate bond yields, deflated by the GNP deflator, have averaged 2.68% over the period of 1947-1990.
The average is 3.65% for the period of 1965-1990 and 6.48% for the period 1980-1990. The median, 3.65%, was rounded to 4%.

When the real rate of interest is increased to 5%, the time of conversion is hastened regardless of the urban use. Increases in the real rate of interest reduce the annualized rental returns to land in the urban use less than the annualized rental returns to land in the agricultural use. This disparity arises because the after tax real rate of interest times the value of land in each use equals the annual rental return plus the growth in the value of the land, but the current use value of land in agriculture does not grow over time. Furthermore, only the rental return in each year is discounted by the real interest rate. Since the growth in the value of the land is not discounted by the real interest rate and is only relevant to land in the urban use, the annualized rental return to land in the urban use is discounted less by a rise in the real rate of interest.

The time of conversion is further hastened by an increase in the real rate of interest when agricultural land is converted to housing. The change in the time of conversion is 2.3 years. However, there is not a cost associated with an increase in the market price of funds, r. Thus, changes in the time of conversion alone are presented in the tables. The hastening in the time of conversion mitigates the delay when agricultural land is converted to a commercial use. The hastening is again small, 3.7 years.
Growth Rate of Returns to Urban Land

The base value is 2% for the growth of the returns to housing. According to Kau and Sirmans, the rate of return for land in the urban use is comparable with the return to holding long-term high-grade bonds. Two percent is a reasonable estimate of this growth rate.

If the growth rate rises from 2% to 2.5%, the time of conversion is hastened. The rental return to the urban use grows by a greater percent each and every year. With the value of the rental returns to urban land growing by a greater percent, the rental return to urban land equals the rental return to agricultural land in less time.

The time of conversion is hastened by an additional 2.6 years when land is converted to housing. Contrary to increases in other parameter values reported in Table 4 that hasten the time of conversion, the total cost is actually reduced by an increase in g. When the growth rate rises, the no tax optimal time of conversion changes. Thus, the cost of hastening at the new optimal time of conversion is $33.10, a reduction of $12.00.

If agricultural land is converted to a commercial use, the optimal time of conversion is hastened by 2.9 years. Normally, the hastening would offset the overall delay of the model, but the no tax optimal time of conversion is changed by an increased growth rate. The cost is enlarged by $14.40 to $29.90.

Rental Return to the Urban Use

The time of conversion will either be unaffected or hastened by this change in the initial time. If agricultural land is converted to a commercial use, there is no
change in the time of conversion. The lack of change is caused by the capital gains
tax being a constant over time. The owner is unable to delay the payment of the
accrual capital gains tax or get rid of the payment by changing the use of the land.

If capital gains are taxed on a realization basis, the tax liability depends on the
original purchase price (or basis). Changes in the basis may be simulated by simply
increasing the initial rental value in an urban use. For example if the initial rent in
an urban use is $16.58 instead of $15.00, this is equivalent to the initial purchase
having been made 5 years later ($15 \times e^{0.25 \times 5} = 16.58$). Because the time of conversion
is closer, the initial owner will pay more for the property and have a higher basis.

The simulations indicate that a higher basis hastens the time of conversion. Because the owner has a higher basis, there is a lower capital gains liability. Since
the amount of the capital gains tax is less, the incentive to delay the payment is
reduced. Thus, the realization capital gains tax has a greater effect on the time of
conversion, an additional 3.5 years. As reported in Table 4, the cost of the hastening
is increased by $36.10 to $81.20.

Of course if capital gains are taxed as accrued, the issue of basis does not
arise. Thus, the results in Table 5 show that changing the time of the initial purchase
has no effect on the conversion time.
Table 4. Effects of Changing Tax Rates and Other Parameter Values (Land is Converted to Housing).

<table>
<thead>
<tr>
<th>Description</th>
<th>u Change In</th>
<th>Cost of Delay Change In</th>
<th>(Hasten) Absolute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Tax Rate on Land (.01,.02)</td>
<td>12.8</td>
<td>-45.3</td>
<td>0.2</td>
</tr>
<tr>
<td>Income Tax Rate (.25,.30)</td>
<td>-6.2</td>
<td>73.3</td>
<td>118.4</td>
</tr>
<tr>
<td>Capital Gains Tax Rate (.25,.30)</td>
<td>-4.4</td>
<td>47.8</td>
<td>92.9</td>
</tr>
<tr>
<td>Capital Investment (0,1000)</td>
<td>59.4</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Capital Investment with Tax (0,1000) (0,.01)</td>
<td>67.1</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Rollback Tax Years (4,5)</td>
<td>0.0</td>
<td>0.0</td>
<td>45.1</td>
</tr>
<tr>
<td>Real Rate of Interest (.04,.05)</td>
<td>-2.3</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Growth Rate of Housing Return (.02..025)</td>
<td>-2.6</td>
<td>-12.0</td>
<td>33.1</td>
</tr>
<tr>
<td>Return to Housing at t=0 (15,16.58)</td>
<td>-3.5*</td>
<td>36.1</td>
<td>81.2</td>
</tr>
</tbody>
</table>

*Reported net of the five years that must pass for rental returns in housing to rise to $16.58 from $15.

(Note: The representative case is a realization capital gains tax for agricultural land only, a rollback tax, an income tax on agricultural land only, and a property tax on all uses of land.)
Table 5. Effects of Changing Tax Rates and Other Parameter Values (Land is Converted to a Commercial Use).

<table>
<thead>
<tr>
<th>Description</th>
<th>( u ) Change In</th>
<th>Cost of Delay Change In</th>
<th>(Hasten) Absolute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Tax on Land (.01,.02)</td>
<td>4.7</td>
<td>23.3</td>
<td>33.8</td>
</tr>
<tr>
<td>Income Tax Rate (.25,.30)</td>
<td>1.2</td>
<td>4.2</td>
<td>19.7</td>
</tr>
<tr>
<td>Capital Gains Tax Rate (.25,.30)</td>
<td>-1.1</td>
<td>-3.6</td>
<td>11.9</td>
</tr>
<tr>
<td>Capital Investment (0,1000)</td>
<td>47.8</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Capital Investment with Tax (0,1000) (0,.01)</td>
<td>54.9</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Rollback Tax Years (4,5)</td>
<td>-0.2</td>
<td>-0.6</td>
<td>14.9</td>
</tr>
<tr>
<td>Real Rate of Interest (.04,.05)</td>
<td>-3.7</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Growth Rate of Urban Return (.02,.025)</td>
<td>-2.9</td>
<td>14.4</td>
<td>29.9</td>
</tr>
<tr>
<td>Return to Urban Land at ( t=0 ) (15,16.58)</td>
<td>0.0*</td>
<td>0.0</td>
<td>15.5</td>
</tr>
</tbody>
</table>

*Reported net of the five years that must pass for rental returns in the commercial use to rise to $16.58 from $15.

(Note: The representative case is an accrual capital gains for land in both uses, a rollback tax, an income tax on rental returns to land in both uses, and a property tax on all uses of land.)
Summary

The comparative static results were addressed by simulating two different models in this chapter. The first model was a representation of the tax scheme on agricultural land that is converted to housing. This tax scheme included a property tax, a rollback tax, an income tax on rental returns to agricultural land, and a realization capital gains tax for the agricultural use. The property tax assessment method was current use value for land in agriculture and market value for land in the urban use.

The second model represented a typical tax scheme on land that is converted from an agricultural use to a commercial use. The tax scheme is a property tax, a rollback tax, an income tax to all land uses, and an accrual capital gains tax on all land uses. The property tax assessment method is the same as that for land converted to the housing use.

The simulations of the tax rate parameters had the expected comparative static results. When land is converted to the housing use, the property tax bias is to delay conversion. Thus, raising the property tax rate increases the delay in conversion. Income and capital gains are not taxed on land in housing. The time of conversion is hastened, when these taxes are applied to land in agriculture -- to an even greater degree when tax rates are increased.

If agricultural land is converted to a commercial use, the property and income tax both delay conversion. The time of conversion is delayed even further by
increasing the property or income tax rate. In contrast, the capital gains tax hastens the time of conversion; thus, a larger tax rate increases the hastening. The rollback tax is also relevant in this model. If the number of years that the rollback tax is applied is increased, the time of conversion is hastened, a very counter-intuitive result.

Capital investment and a tax on capital investment will always delay the time of conversion, regardless of the model. If there is a required capital investment, land will not be converted to the urban use until the rental returns to the urban use have grown to compensate for the annualized capital investment cost. The delay from a tax on the capital investment is inefficient. A property tax on capital distorts the use of the land.

Raising the real rate of interest will hasten the time of conversion regardless of the urban use. The annual rental returns in the future are more heavily discounted when this rate is increased. However, the growth rate of the value of the land is not decreased by this amount. The owner will want to convert land to an urban use at an earlier date.

The no tax optimal time of conversion is changed, by raising the growth rate of land in the urban use or increasing the initial value of the urban rents. If the growth rate is increased, the time of conversion will always be hastened, but relative to the no tax optimal time of conversion it is delayed. The cost of the bias is thus reduced when land is converted to housing and increased when land is converted to a commercial use.
If the rental return to land in the urban use is raised to equal the value that would be attained in the initial scenario five years later, the bias in the time of conversion will depend on the urban use. If the urban use is commercial, there will be no bias in the time of conversion net of the five years that it took to raise the rental returns to urban land to equal the new value. Changing the urban use to housing, there is a hastening in the time of conversion. The hastening is created by the capital gains tax. The capital gains tax is the difference between the market value at the time of conversion and the original purchase price. If the original purchase price is larger, there is less incentive for the owner to delay the tax.
ENDNOTES

1Department of Agriculture, Economic Research Service, State Farmland Preferential Assessment Statutes, by J. David Aiken, 4 (Lincoln: University of Nebraska, 1989), RB310.


5Ibid, 368.

CHAPTER 5

DISCUSSION AND CONCLUSIONS

This chapter is a summary of the effects of taxing property under different assessment methods and with alternative models. In addition, the current property tax policy may be evaluated alone or within a tax system. Several limitations to the study are discussed, and suggestions are made for future research.

The objective of this study is to determine the effect of a property tax on the time of converting land from an agricultural use to an urban use. Previous work has indicated that a property tax on land is non-neutral when the tax is based on market value assessment. The result is contradictory to the neoclassical efficiency argument.

Using Bentick's original model, the property owner makes the decision to employ land in project one, which renders an immediate return, or project two, which generates a higher return some time in the future. His decision is based on what time in the future project two can generate the higher return. If this model is applied to land, project two is a use of land in which there is a dormant period. The owner will choose to employ land in project two if the urban rental return is generated at a time in the future that makes the present value of land in the urban use greater than the present value of land in agriculture. The owner does not have
the choice of generating returns from agriculture for the period prior to the time at
which the higher, urban, rental return is rendered.

If a property tax based on market value assessment is levied, the owner is
more likely to employ his land in the first project, which generates immediate
returns. The owner would pay a property tax based on the present value of all rental
returns during the period in which the annual rental return is zero if he employed
land in the second project. The liability in the period before the rental returns
become positive is a disincentive for the owner to employ land in project two.

It is unlikely that a landowner will leave land dormant for a long period of
time. The decision of an agricultural landowner on the rural-urban fringe is one of
when to convert land, not if land should be converted. Using the model presented
in this thesis, the landowner chooses the time of conversion to maximize the present
value of a unit of land.

A property tax based on the market value of land is neutral, when it is applied
to the model presented in this thesis. If land is taxed on the present value of the
rents in the highest-valued use of land, the actual use of land does not affect the
value of the tax. Thus, the property tax based on market value is neutral toward the
time of conversion.

If the property tax is based on current rental income, the tax will simply
reduce the gross rental return to any use of land. Bentick advocates the property tax
based on current rental income as the only neutral property tax. Tax policy,
however, has never administered property taxes based on current rental income.
Current tax policy is for the assessment of agricultural land to be the capitalized value of the current rents and the assessment of urban land to be market value. This tax policy is non-neutral using either model.

In chapter one of this thesis, there is a discussion of the political support for agricultural property tax subsidization. None of the supporting reasons, however, were economic reasons. The property tax subsidy distorts the allocation of land, reducing economic efficiency as predicted by either model.

The analysis of the property tax, so far, has been of the tax alone, but, as Turnbull discussed, the property tax is a part of the nation's tax system. When the property tax becomes a part of the tax system, there are economic incentives for the subsidized property tax on agricultural land. A property tax administered under current tax policy may enhance efficiency by offsetting biases created by other taxes.

If agricultural land is converted to owner-occupied housing, neither the imputed rental returns nor the capital gains are effectively taxed. Since the liability for each of these taxes is permanently removed when land is employed in housing, the owner has an incentive to convert land to housing more quickly. The bias to hasten the time of conversion created by the income and capital gains taxes may be partially offset by a property tax that delays the time of conversion. The combination of the income, capital gains, and property taxes creates less of a bias than the income and capital gains taxes alone when land is converted to housing.
Not all land, however, is converted to housing. If land is converted to a commercial use, rental income and capital gains are taxed. The current property tax policy creates a delay in the time of conversion; thus, an inefficiency.

If market value assessment were the property tax base for all uses of land, the time of conversion would be unaffected when land was converted to the commercial use. The property tax, income tax, and accrual capital gains tax are all neutral. Only the property tax would be neutral if land were converted to housing. The time of conversion would be hastened by the income and capital gains taxes.

The text of this thesis discusses a few additional areas, such as the difference between realization and accrual capital gains taxes and the effect of a rollback tax. A realization capital gains tax may be applied to land in agriculture. The tax hastens the time of conversion by administering a capital gains tax on a realization basis, but to a smaller degree when land is converted to the housing use. If land is converted to housing, a one-time capital gains tax (to the seller) is levied; whereas, if land is converted to a commercial use, some form of capital gains tax is levied in all uses. The capital gains tax effect is diminished on the agricultural land when the tax is levied on a realization basis, but not on the commercial land, thus conversion is delayed.

The rollback tax is only significant when there is a property tax subsidy for agricultural land and an accrual capital gains tax for agricultural land. The rollback tax tends to enhance the capital gains tax effect. This tax, however, is always neutral if administered alone.
With the information presented, one would like to be able to make a policy judgment. Does current property tax policy reduce economic efficiency? A property tax subsidy for agricultural land will offset some of the bias created by the income and capital gains tax subsidies to homeowners. Land on the urban-rural fringe is typically converted to owner-occupied housing. However, the property tax subsidy to agricultural land biases the time of conversion of land to a commercial use. Less land is currently converted to a commercial use. Even with current use value assessment for agricultural land, there is too much land allocated to housing, but too little land allocated to commercial uses.

If the property tax subsidy for agricultural land was removed, the optimal time of conversion of agricultural land to a commercial use would be the same with or without the tax system. The bias in the time of conversion to housing is enhanced by removing the property tax subsidy. Thus, there is a trade-off; by increasing efficiency in the conversion of land to a commercial use, one decreases the efficiency in the conversion of land to housing.

Furthermore, the optimal time of conversion may not be the social optimal. The services provided by property taxes may generate more benefits to urban land - especially land in housing -- than to agricultural land. A change of property tax policy could decrease efficiency for this reason.

The model presented in this thesis, however, could be expanded. Using this model, land has alternative uses to which different tax schemes may be administered, but land is converted to an urban use and remains in that use permanently. Bentick
and Pogue present a model in which the owner chooses between converting land to housing and redeveloping the land to a commercial use and simply converting land to a commercial use.

There are several peculiar features of Bentick and Pogue's model. Whether land is redeveloped or not, the time of converting land to a commercial use is the same and the capital cost for converting land is the same. There is no reason to believe that these values must be the equal. Redevelopment may be more costly when there is a substantial amount of demolition required.

Furthermore, the landowner's decision is to convert land to housing only if the rental returns from housing are significantly larger than those in agriculture for a given time period to cover the capital costs of conversion. It would be more likely for land to be converted from agriculture to a commercial use sooner than conversion from housing to a commercial use would occur, expanding the time period. The limit on the time period is the reason that a market value property tax distorts the decision of the landowner.

A third peculiarity is that the rental returns to all uses of land are constant. Chicoine reports that the value of land in housing near Chicago is growing very rapidly even after the time of conversion.\(^1\) Albeit the value of the land may rise as the time of conversion to the commercial use is approached, while the rental return remains constant, it is still unlikely that the rental return to housing will not increase over time.
The model presented in this thesis could be expanded to incorporate the alternative uses of land. The owner would maximize the present value of a unit of land by choosing when to convert land to housing and again to a commercial use. Since owner occupied housing is heavily subsidized by income and capital gains taxes, one would expect that current property tax policy would enhance efficiency, by decreasing the bias to hasten conversion from agriculture to housing. Unfortunately, the income and capital gains tax bias will keep land in housing for longer than the optimal amount of time. There is, thus, a delay in the time of conversion from housing to a commercial use.

There are other aspects of the model that could be investigated. One anomaly is that the present value of a unit of land to the owner is not the market value to the purchaser when there is a capital gains tax. The owner will choose to maximize the present value of a unit of land for himself, not the market value to the purchaser. The market value function is not a nicely formed continuous function, which becomes a problem when the function is used inside the present value function.

Another anomaly is associated with the rollback tax. This tax was always demonstrated as a tax to the seller, but it was explained that the rollback tax could be administered to either the buyer or the seller. If the model includes both a rollback tax on the buyer and a capital gains tax, one would assume that the rollback tax would decrease the value of the capital gains tax. The rollback tax, however, in this combination has no effect on the time of conversion.
Although there are several areas that could be investigated, the basic point of this thesis is that the market value property tax on all land does not distort land allocation. The tax demonstrates neo-classical efficiency when administered alone. However, policy makers should be discouraged from taxing agricultural property at its market value, since the property tax on land is levied within a tax system that includes income and capital gains taxes. The inefficiency created by the tax subsidies to land in housing would be exacerbated by taxing all land at market value.
ENDNOTES

REFERENCES CITED
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