# Estimating Agricultural Use Value for Property Tax Purposes: How do State Programs Assess Use Value?

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## 1. Introduction and Background

All fifty states in the United States provide property tax preferences for agricultural land via some form of use-value assessment.[1] By this assessment approach agricultural land is valued in its current agricultural use, not at its full market value. The intent of this policy is to provide a preferential property tax rate for agricultural land. This method of valuing agricultural land has its challenges, however. Isolating agricultural use value as distinct from other sources of land value is more complex and difficult that it would first appear. In this paper I provide a review of the methods used by various states in their application of use-value statutes for agricultural land. My intent is to review the methods used in various state programs, to provide evaluative comments on those methods, and to make suggestions for improvements in the methods used.

Gloudemans (1974, p. 1) defines use-value assessment as the assessment of property upon the basis of its value in a particular (current) use, rather than upon the basis of its market value. Most assessors use an income capitalization approach to assess agricultural use value since a market comparison approach is difficult due to the typical lack of comparable sales. Furthermore, the International Association of Assessing Officers (IAAO) standards specify that the income approach should be used for agricultural land assessment. IAAO (2008) Standard 4.6.5 directs assessors as follows (*italics* emphasis added).

> If adequate sales data are available and agricultural property is to be appraised at market value, the sales comparison approach would be preferred. However, nearly every state or province provides for use-value assessment (and usually appraisal), which significantly understates the market value for agricultural property, so the sales comparison approach is usually not applicable. Because of this limitation, *it is imperative to obtain good income data and to use the income*

[1] The fifty state summary is from Bruce and Groover (2007, p.1). Aiken (1989) provides a once-definitive overview of the full range of state farmland preferential tax statutes, which unfortunately has not been updated in recent years.

> *approach for agricultural land*. Land rents are often available, sometimes permitting the development and application of overall capitalization rates. This method, of course, also entails the estimation of normal land rents for unrented parcels. When agricultural parcels include improvements, the cost approach or sales comparison models that provide separate building values may be used to determine their value.

Hence, the standard practice in the assessment community is to estimate net income generated by agricultural land and to capitalize that income stream into use value.

This paper proceeds as follows. An overview of land value fundamentals is presented in section 2, motivating the concept of agricultural use value and its measurement. Section 3 provides six case studies illustrating the ways that states actually implement usevalue assessment for agricultural land. Finally, section 4 identifies common difficulties with use-value assessment observed in the case studies and provides summary comments on improvement of use value practices.

## 2. Fundamentals of Land Value

In this section I begin with a review the fundamentals of land value, drawing careful distinctions regarding the components of land value in order to motivate a precise view of agricultural use value. I also present simplified formulas that are used in the computation of use value and discuss the ways that states implement these formulas.

### *2.1 Components of Land Value*

Land value fundamentals have been described by Capozza and Helsley (1989) as consisting of four components: (1) agricultural land value, (2) the value of expected future rent increases, (3) the cost of conversion to developed use, and (4) the value of accessibility. Figure 1 illustrates those components in an urban spatial context. The total value of land at any given distance from the center of the city is the sum of these four components, illustrated by the upper line in Figure 1. As you move away from the central business district (CBD) in a city the value of accessibility declines with distance. The traditional land value gradient measures and reflects this fact. Once you reach the distance $z^*$ where development ends, the cost of conversion component of value drops out and the value of future expected rent increases begins to decline with additional distance. As you move out much farther from the CBD the value of land approaches the agricultural land value alone. At sufficiently distant locations from the city, there is no difference between market value and agricultural land value.

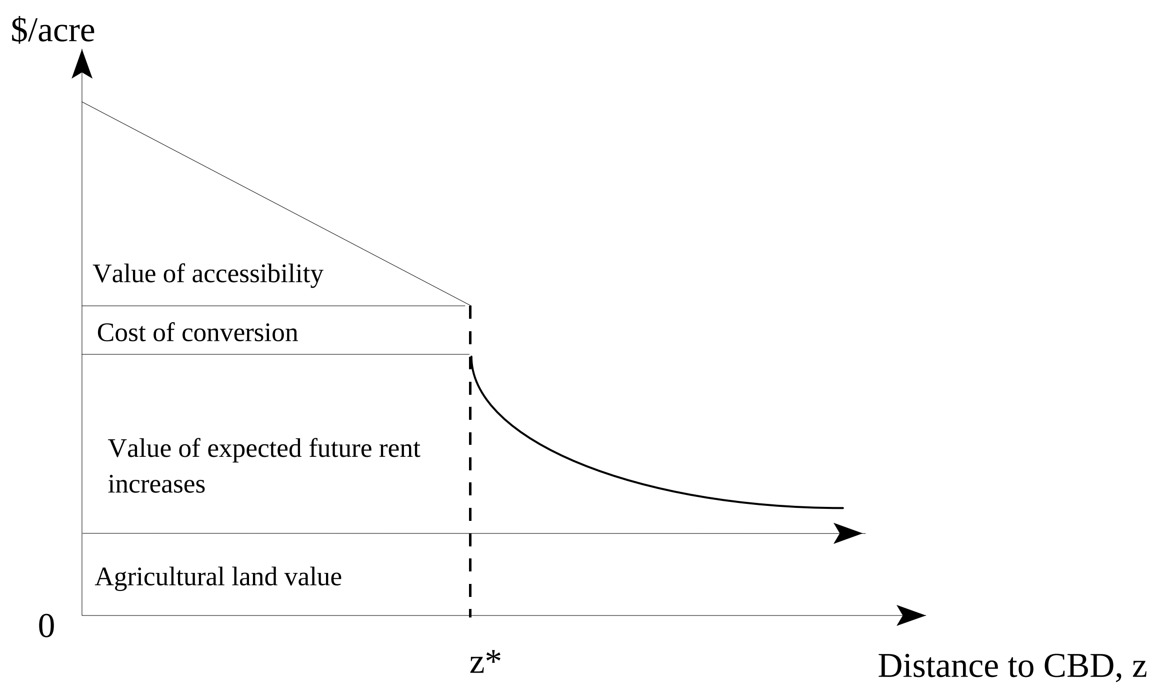


**Figure 1: Fundamentals of Land Price**

Capozza and Helsley (1989) write the price of developed land at time *t* and location *z* in an urban area, $P^d(t, z)$, as the sum of the four components listed above:

$$P^d(t,z) = \frac{A}{r} + C + \left(\frac{1}{r}\right)\left(\frac{T}{\bar{L}}\right)[\bar{z}(t) - z] + \left(\frac{1}{r}\right)\int_t^\infty R_u(u,z)e^{-r(u-t)}du. \qquad (1)$$

The first term in this expression, $\frac{A}{r}$ is the capitalized value of the annual agricultural rent stream, assumed to be a perpetuity. The second term $C$ is the cost of development conversion capturing the investment in capital improvements to the land. These first two terms are invariant to location. The third term $\left(\frac{1}{r}\right)\left(\frac{T}{\bar{L}}\right)[\bar{z}(t) - z]$ is the value of accessibility to the city center and depends on transportation cost $T$ and the mean lot size $\bar{L}$. This term clearly declines with distance $z$ to the CBD, depending on $[\bar{z}(t) - z]$. The final term, $\left(\frac{1}{r}\right)\int_t^\infty R_u(u,z)e^{-r(u-t)}du$, is the value of expected future rent increases that are caused by population growth in the urban area—a growth premium.

For recent estimates of agricultural land values in the United States, as well as speculation regarding future value trends, see Henderson (2009). Duffy (2009) also provides widely-cited survey estimates for agricultural land values in Iowa, where county-specific estimates provide insight regarding geographic locations and urbanization effects.

Anderson (2000a, 2000b) estimates the difference between market value and usevalue for agricultural land surrounding urban areas as illustrated in Figure 1, confirming the pattern illustrated. At the edge of a city the difference between market value and use value can be substantial, but that difference declines smoothly with increased distance from the periphery of the city central business district. At distances sufficiently far from the urban core, market value and use value for agricultural land are identical because agricultural use is the highest and best use in those distant locations. Hence, in theory the need to assess agricultural land in its agricultural use should be a non-issue in purely rural areas. At the edge of a city, however, use-value assessment may provide a substantial property tax reduction that may affect land use. By assessing agricultural land at the urban fringe at its use value rather than its market value, there may be impacts on both the timing and capital density of eventual development. Anderson (1993) analyzes those potential economic effects on land development in an urban area.

If we isolate the components of land price related to undeveloped agricultural land, and designate this price as $P^a(t,z)$ we would have the expression,

$$P^a(t,z) = \frac{A}{r} + \left(\frac{1}{r}\right) \int_t^{\infty} R_u(u,z) e^{-r(u-t)} du. \qquad (2)$$

In this case, the agricultural land price is simply the sum of the capitalized agricultural rent stream plus the expected value of future rent changes. This view of agricultural land value recognizes that the land is valuable both for its ability to generate a stream of net rent and for the possibility that future growth with increase the rent earning ability of the land. If we take a more narrow view of the agricultural land value, we can ignore the expected future rent increases due to growth and designate the agricultural land value as only the first component—the capitalized net agricultural rent. In that case,

$$P^a(t) = \frac{A}{r}. \qquad (3)$$

*2.2 Highest and Best Value*

Property tax assessment is generally conducted assuming the property is used in its highest and best use. That is, the current use of the property is irrelevant and the assessor makes an assumption concerning the use which would generate the largest net revenue conceivable. We can begin with the case where the current land use is the highest and best use, and there is no possibility for development or redevelopment in the future. This is an extreme case, but it enables us to focus on the basic mechanics of property value determination.

Assuming that the net revenue stream generated by the highest and best use is $A(t)$ and that the discount rate is $r$, we can write the estimated value of the property at time $V(t)$ as,

$$V(t) = \int_0^\infty A(u)\, e^{-r(u-t)} du. \quad (4)$$

In this expression $e$ is the exponential function used to discount the revenue stream in continuous time.

If we incorporate a property tax applied at the rate $\tau$ in the model,

$$V(t) = \int_0^\infty A(u) e^{-(r+\tau)(u-t)}\, du. \quad (5)$$

This expression indicates that with a property tax included in the model, the discount rate appropriate for use in discounting the revenue stream has two elements: an interest rate and the property tax rate.

*2.3 Agricultural Use Value*

Now, if we restrict our view of the net revenue generated by the property to the value in current agricultural use, we can denote the restricted net revenue stream as $\tilde{A}(t)$ and write the agricultural use value as,

$$\tilde{V} = \int_0^\infty \tilde{A}(u) e^{-ru} du. \quad (6)$$

This expression assumes that the agricultural land generates revenue of $\tilde{A}(t)$in perpetuity, i.e. forever. If we include a property tax applied to the land, we can write the approximation to (5) as the simple perpetuity formula,

$$\tilde{V} = \tilde{A}/(r+\tau), \quad (7)$$

where the capitalization rate is the sum of the discount rate and the tax rate: $(r+\tau)$. This equation suggests that states using an income capitalization approach should estimate net agricultural income for the numerator and use a combined interest rate plus property tax rate for the capitalization rate in the denominator.

### *2.4 Calculating Use Value*

Based on this theoretical overview of land value fundamentals, we can identify the key factors needed to properly estimate agricultural usevalue. As equation (7) indicates, we need an estimate of the net revenue $\tilde{A}(t)$, as well as an appropriately selected capitalization rate $(r + \tau)$ which is the sum of the interest rate and the property tax rate. In both cases, there are problems and complications involved. As Bunnell (1996) puts it, a simple idea becomes complicated.

There are a number of basic definitional issues to address; the very definition of agricultural land use being the first. Only land used in commercial agricultural production, for crops or cattle, would be included. If agricultural land is intended to mean land in current agricultural production, then swamp land, forest land, or idle land would not be included. Bunnell (1996) points out that in some states such as Wisconsin the use-value statute does not specify any requirement regarding the zoning of the land. Agricultural land could qualify for use-value assessment even though it is zoned for commercial development use and specific plans for development have been submitted and approved by the planning commission. In terms of the fundamentals of land value reviewed above, the second component of land value (value of expected future rent increases) should be included in this situation. Furthermore, some use-value statutes do not include any minimum parcel size requirement, opening the possibility that small parcels may qualify for use-value assessment. In some cases those parcels may actually be primarily residential acreages in rural areas and in other cases they may be urban parcels with small gardens in the city.

In some states, such as Wisconsin, the definition of agricultural land does not include improvements. Hence structures such as farm houses, silos, and barns must be assessed separately. Separate assessment of the structures is not simple. Farm houses may be difficult to assess using the market comparison approach if few comparables are available where farm houses are sold separately from farm land. In some cases, the barns, silos and other farm structures may be economically obsolete and worthless in terms of current agricultural net income producing capability, yet retain some aesthetic value. In other cases, these structures may actually have negative value. Disentangling the value of the marginal product of structures is a classic problem in land value assessment.

Returning to the valuation equation (7) there are two basic challenges in use-value assessment. First, we need to consider the estimation of the net revenue stream. Second, we need to consider the appropriate capitalization rate.

*2.4.1 Estimating net income*

The first requirement of use-value assessment is to estimate the net income stream generated by agricultural land. In most applications states use some form of equation (7), so we need to specify an estimate of the numerator of that equation. Since that equation is a perpetuity, we need a representative estimate of annual net income generated by agricultural land. Net income is the difference between gross income generated via agricultural production and the cost of inputs used in that production. States often specify assessment methods that use estimates of agricultural productivity for various common crops as the starting point to estimate gross revenue. The assumed productivity per acre, often adjusted for soil quality, topography, and other conditions, is then used along with commodity price data to estimate total revenue. Then, assumed costs for production of those crops are netted out to derive an estimate of net income per acre of land. Several detailed examples of the way states estimate net income are included in the case studies to follow.

For land parcels that are rented, assessorssometimes begin with the annual rent paid for use of the land. But the assessor needs to assess all agricultural land parcels, whether they are rented or not. This raises the difficulty that rented parcels may systematically differ from non-rented parcels used in agriculture. Despite this complication, assessors often use rental incomes as their starting point for all parcels. Gross rents are then adjusted by deducting estimates of the cost of inputs used in producing agricultural products.

The case studies presented in Section 3 provide detailed descriptions of the methods used to estimate net income in four states. Those case studies also reveal the complex nature of the problem in applying consistent and uniform standards of valuation.

Another complication is worthy of mention, although no states take this difficulty into account. Researchers recognized early on in the adoption and application of use-value methods that the very presence of a differential method of taxation would have economic impacts. For example, Keene et al (1976) states that,

> "…in many areas…rental values are distorted by the very existence of differential assessment. Investors and developers are willing to rent out land to a nearby farmer for little more than the real property taxes attributable to the land, so as to qualify it as agricultural land in order to obtain the benefits of differential assessment. Observed rents in such situations may bear little relationship to the economic surplus attributable to the land in agricultural use. p. 35.

The essential issue here is that land rents may be systematically different in areas where use-value assessment is used. The econometric issue is that of endogeneity, which requires statistical methods of correction. We will not discuss this issue, beyond noting its existence and suggesting that future research is needed to develop methods to correct for this difficulty.

### *2.4.2 Choosing a capitalization rate*

The second major requirement involved in implementing an income capitalization approach to use value assessment is the choice of an appropriate capitalization rate. This choice is critical since it has a powerful impact on the estimated value of land. Consider a simple example of an acre of agricultural land that generates net income of $50/year. If that income stream is capitalized at 5%, the estimated value of the land is $1,000. If a higher capitalization rate is used, however, we get a much lower estimate. Using a 7% capitalization rate reduces the value estimate to $714.29, and a 10% capitalization yields a value of $500. As a general rule, the higher the capitalization rate used, the lower the use-value assessment of the land.

Many states rely on the Farm Credit Service (FCS) rate of interest as a starting point for developing their capitalization rate. FCS offers a range of loan products for farms that includes fixed rate mortgages with 10, 15, 20, and 25 year terms. For farm land in particular, FCS offers a 5-year adjustable rate mortgage and 15 and 20-year fixed rate mortgages. A Flex option is available by which the farmer is discouraged from making pre-payments during the first 3-5 years of the fixed portion of the loan period. In exchange for that commitment, the farmer receives a lower rate of interest. A penalty is charged for pre-payment based on the interest rate at the time of pre-payment. A Multiflex option is also available by which there is no pre-payment penalty. Currently, a 5-year adjustable mortgage has a 4.95% interest rate under the Flex option and a 5.05% rate under the Multiflex option. Fixed rate mortgages for 15/20 years are currently priced at 6.1%/6.45% under the Flex option and 6.2%/6.55% under the Multiflex option (http://www.e-farmcredit.com/TodaysRates/FarmRates/tabid/243/Default.aspx). FCS also provides loans for operating expenses, equipment purchases, and livestock, improvements, and facilities.

Table 1 reports capitalization rates and their computation methods for selected states, revealing a vast range of methods used by states. One common theme is to use a 5-year average FLB rate. In some cases, the capitalization rate is the 5-year FLB rate plus a property tax rate. It should be noted that the FLB rate is affected by the fact that the Federal Land Bank is a government sponsored entity (GSE) and benefits from implicit backing of the federal government.

**Table 1: Capitalization Rates used by Selected States in Computing Agricultural Use Value**

| ***State*** | ***Capitalization Rate Computation*** |
|---|---|
| Arizona | FLB rate + 1.5% |
| Illinois | 5-year average FLB rate |
| Indiana | Computed from Chicago FRB real estate loan and operating loan interest rates |
| Iowa | 7% |
| Kansas | 5-year average FLB rate + add-on of at least 0.75% and not more than 2.75% (determined by Director of Property Valuation) + county average property tax rate<br><br>Legislature specifies that above computation must be at least 11%, but not more than 12% (in 2002) |
| Louisiana | Max{12%, calculated rate}, where calculated rate = risk free rate + 2.33% risk component + .16% non-liquidity component |
| Maryland | Computation in 1999: 9% - 2% for inflation + 5% for capital market imperfection + 1% effective property tax rate = 13% |
| Massachusetts | 5-year average FLB rate |
| Mississippi | Min{10%, calculated rate} |
| New Mexico | Cap rate is established for 5-year period of use, based on FLB and PCA rates |
| North Dakota | 12-year trimmed average of St. Paul FLB rate, computed by omitting highest and lowest rates, averaging remaining 10 years rates |
| Ohio | 60% of Average Farm Credit Services 15-year interest rate + 40% of |

| | |
|---|---|
| | previous 5-year average interest rate on equity |
| Oklahoma | 65% of 5-year average FLB rate + 17.5% of 5-year average second mortgage rate + 17.5% of 5-year average CD rate + county effective tax rate |
| Oregon | 5-year average FLB rate + effective property tax rate |
| South Carolina | FLB rate + effective local tax rate + risk adjustment of 15% + 0.3 percent for non-liquidity |
| Texas | Max{10%, FLB rate + 2.5%} |
| Utah | 5-year average FLB rate |
| Virginia | 10-year average of Agricultural Credit Association interest rate + 10-year average of effective true property tax rate + risk adjustment (optional) |
| West Virginia | Riskless rate + risk adjustment + non-liquidity adjustment + management rate + statewide effective property tax rate |
| Wisconsin | Max{11%, 5-year average of 1-year ARM agricultural loan rates + municipal tax rate} |
| Wyoming | 5-year average Omaha FLB rate |

Source: Kansas Department of Revenue (2000), supplemented with the author's additions for Indiana, Kansas, Ohio, Virginia, and Wisconsin.

Beyond this simple approach, the table indicates some states go to great lengths is make further adjustments, only some of which might be considered appropriate. The Kansas Department of Revenue (2000) report concludes that, "The diversity in procedures is disturbing from the standpoint of estimating use value."

In order to consider the appropriate capitalization rate to use, we must review the essential components that comprise market interest rates. In general, the components of market interest rates include the risk-free rate plus one or more of the following factors:

- Inflation premium (*IP*)
- Default risk premium (*DRP*)
- Liquidity premium (*LP*)
- Maturity risk premium (*MRP*)

We can write the interest rate $r$ as the sum of the risk free $r^*$ rate plus the four premiums listed above:

$$r = r^* + IP + DRP + LP + MRP. \qquad (8)$$

As we think of the appropriate capitalization rate to use for use-value assessment, we need to ask, "Which of these premium components are appropriate to include in a capitalization rate?" The essential issue is to identify the most relevant discount rate to use when computing the discounted present value of the net income stream generated by agricultural land, as in equations (5-7).

First, consider whether to use a real or nominal discount rate to capitalize the net income stream. That is, should we include an inflation premium ($IP$)? An important rule for selecting the proper discount rate is recognize that if the income stream in the numerator is expressed in nominal terms, then the discount rate in the denominator must also be nominal. That means if the net income stream includes inflation, so should the discount rate. On the other hand, if the numerator net income is expressed in real terms, the discount rate should also be real and not include an inflation component.

In the case of a simple perpetuity, as in equation (7), the numerator is a fixed annual return so the discount rate $r$ should be a real rate, with no inflation component included. If we were to assume the net income stream is subject to annual growth at the rate $g$ per year, as in the classic Gordon growth model used in valuing stocks, then the appropriate discount rate would be$(r + g)$. This method is typically not used in valuing agricultural land, however, since the assumption of a fixed rate of growth is unrealistic.

If the net income stream is nominal and includes terms covering several years, then the discount rate should incorporate both the risk-free interest rate and the expected rate of inflation over a period of time corresponding to the terms in the numerator. In examining the capitalization rates used by the states in Table 1, it is essential to match the time horizon used in the net income measure in the numerator with the time horizon of the discount rate in the denominator. There are numerous examples in this table of inconsistent matching of nominal and real quantities used in the computation of use value.

Another factor to consider is the term structure of interest rates. Generally speaking, the nominal interest rate rises with the term of a loan, with longer term loans having higher interest rates than shorter term loans. Another way of saying this is that the yield curve rises at a decreasing rate. In valuing agricultural land, especially using a perpetuity formula, we would expect to use a long-term rate. Many states use a 5-year average of published rates in order to smooth over short-term interest rate fluctuations. But, this 5-year smoothing of the interest rate in the denominator does not necessarily match the time horizon used in computing the net income stream in the numerator.

The default risk premium (*DRP*) is generally incorporated in the interest rate used as the starting point for the capitalization rate. Since most states begin with an FLB or FRB interest rate, the *DRP* is already included in the interest rate. The lending entity has already assessed the risk of default and priced that risk into the loan interest rate.

A real asset such as agricultural land is not as liquid as a financial asset for which a ready market exits. To the extent that the risk-free interest rate $r^*$ reflects the return on a liquid financial asset such as a long-term Treasury bill, and therefore includes no liquidity premium, addition of a liquidity premium may be appropriate for agricultural land valuation.

Finally, a maturity risk premium (*MRP*) may be appropriate in the valuation of agricultural land. The reason for this adjustment lies in the long life of the land. The value of a long-lived asset declines sharply when interest rates rise. Since land is so long-lived, the risk of rising interest rates in the future lowering the value of the land asset should be taken into account. The difficulty with incorporating this adjustment, however, is that it will vary over time in direct proportion with the interest rate. If we look to the T-bill market for guidance on this adjustment, it would appear that the *MRP* for a 30-year T-bill rate has been approximately 1-3% in recent years.

What is striking about the capitalization rates listed in Table 1 is the variety of definitions and the very ad hoc nature of the rate computations. Some states have a computed rate, subject to a limitation; either a maximum as in the case of Louisiana and Texas, a minimum as in the case of Mississippi, or both a maximum and a minimum as in the case of Kansas. Some include a risk adjustment or a liquidity adjustment, but the size of these adjustments appears to be completely ad hoc. Several states, such as Ohio and Oklahoma, make an assumption about the underlying financing of the land and tries to take the capital structure of the land asset into account, but do so in a rigid way assuming all land is financed identically (Ohio assumes 60% debt, 40% equity, and Oklahoma assumes 65% first mortgage debt, 17.5% second mortgage debt, and 17.5% equity).

The capitalization rate must also include a measure of the effective property tax rate that applies to agricultural value. It is important that this rate be an effective tax rate, not a nominal tax rate. An effective tax rate is the product of the nominal tax rate and the assessment ratio (use value divided by market value). Most of the state descriptions of their use-value assessment methods do not specify whether the property tax rate included in the capitalization rate is a nominal or effective rate.

With this background in theory in hand, we now turn to consider six case studies of states' use-value assessment methods.

## 3. Case Studies

### *3.1 Indiana*

Each acre of agricultural land has a base rate for its use-value assessment. Table 2 below lists the base rates for recent and upcoming years.

**Table 2: Indiana's Base Land Value Rates**

| **Year** | **Base Rate ($/acre)** |
|---|---|
| Prior to 2003 | 495 |
| 2003-2005 | 1,050 |
| 2006 | 880 |
| 2007 | 880 |
| 2008 | 1,140 |
| 2009 | 1,200 |
| 2010 | 1,250 |
| 2011 | 1,290 |

Source: Purdue University (2010).

Prior to 2003 the base rate was negotiated. The State Tax Board set the base rate in consultation with an agricultural advisory council. That council was comprised of agricultural leaders in the state, state and local government officials, and others. Under this regime, the base rate was in reality a negotiated rate by the interests represented on that council. The base rate was set at $450/acre in the 1979-80 reassessment and was raised to $495/acre in the 1989-90 reassessment. It remained at $495/acre with the 1995-96 reassessment. Starting with the market value reassessment of 2002-03 an income capitalization method was employed. That method used a four year average of data over the period 1996-99 and resulted in a base value of $1,050/acre more than doubling the base rate and causing tax payments on agricultural real property to rise by 15.5%. Starting in 2001, the state required assessors to update property assessments annually. This statute did not require annual reassessment, but it did require annual updates for years between reassessments.

The base rate in 2010 is computed by capitalizing cash rent incomes and operating net incomes for each year, averaging these two measures for each year to obtain an average market value in use. The cash rent measures are taken from the Purdue Agricultural Economics Report which provides land values and rents. An estimated value of average property tax payments per acre is taken from the Department of Local Government Finance and subtracted from the cash rent measures. To obtain estimates of net operating income, data on crop yields, prices, and costs are obtained and an average net income is estimated. That net income is then converted into land value using a capitalization rate taken from the Chicago Federal Reserve Bank's real estate loan and operating loan interest rates.

Then, a six year moving average of these two measures is computed to smooth out fluctuations in income over time. Starting in the year 2011, however, the averaging process will drop the highest of the previous six values in the computation of the average net income. This mean is called an Olympic average in the Indiana documents, presumably because Olympic scores in some sports are computed by throwing out the smallest and largest values, computing the mean from the remaining judges' scores. Apparently, the original proposed legislation would have dropped the lowest and highest values in the six-year moving average, but by the time the bill passed it simply dropped the highest value. In this case, the computation is a form of asymmetric trimmed mean which clearly biases the average downward. A typical trimmed mean is computed by dropping both small and large outliers in the data in a systematic way. For example, a 5% trimmed mean is computed by dropping the smallest and largest 5% of the observations, computing the mean from the remaining 90% of the data. The Indiana practice cannot be called a trimmed mean. Rather, it is a truncated mean that systematically biases the computed use value downward.

The use-value of agricultural land begins with the base rate and then is adjusted using two factors. First, the base rate is multiplied by a soil productivity factor $S$, where $0.50 \leq S \leq 1.28$, which captures the influence of the soil productivity on the income earning capacity of the land. This factor is computed by Purdue University Department of Agricultural Economics. Theproduct of the base rate and the soil productivity index yields the so-called *adjusted rate*. The adjusted rate is then adjusted again using an *influence factor*, denoted $I$, which captures percentage reductions in value due to features of the land that specifically reduce its productivity. The influence factor takes on values, $0 \leq I \leq 1$.

Thus, the usevalue of an acre of land in Indian can be expressed as the product of the base rate multiplied by the soil productivity index and the influence factor, $V = aSI$.

Using this formula for land in the year 2010 converts the base land value of $1,250 to use values that range from a high of approximately $1,600/acre for land with the maximum soil productivity and no influence factors reducing its value, to a minimum of approximately $125/acre for land with the minimum soil productivity index and the maximum influence factor of $I$ = 0.80.

Furthermore, special programs exist for particular land uses such as classified forest land, wildlife habitats, and windbreaks, under which their assessed values may be set to $V$ = $1/acre.

In addition to use-value assessment for agricultural land, the state adopted a further property tax reform in 2008 that created property tax caps. Starting in 2009 the tax bill on farm land was limited to 2.5% of gross assessed value. That cap is tightened to 2% in 2010 and subsequent years. The result is that an acre of land with soil productivity factor $S$ = 1 and no reduction due to the influence factor would have a base value of $1,250 and a tax bill of $25 (2% of $1,250).

### *3.2 Iowa*

The Iowa Real Property Appraisal Manual describes the assessment of agricultural land value as follows:

> Iowa law provides that in assessing agricultural realty, the actual value shall be based on its productive and net earning capacity capitalized at a rate specified in the Iowa Code. The law further provides that in counties in which a modern soil survey (1949 and later) has been completed, the results of such a survey must be considered in determining the productive and net earning capacity of agricultural property.

The Iowa manual states that agricultural land values vary based on four factors: (1) productivity, (2) buildings, (3) location, and (4) other factors. A primary tool used in valuation is the soil map which records both soil and erosion characteristics of the land and is thereby said to reflect the productivity of the land. In addition, weather conditions including average temperatures and precipitation by region are taken into account. The manual states that, "Each soil mapping unit is assigned a corn suitability rating, (CSR), and the ratings provide an index for comparing all soil mapping units in the state." Furthermore, adjustments are made to land values based on special considerations not directly incorporated in the CSR ratings. On balance, the Iowa manual describes a valuation computation process very similar to the Indiana case described above.

The CSR is intended to capture the productivity of the land, but the Iowa manual recognizes a number of other factors that may affect (reduce) land value:

- Isolated small areas
- Areas where proper drainage is absent
- Areas subject to overflow by streams
- Areas covered by scattered timber or brush
- Areas that are heavily timbered

In assessing the value of buildings on agricultural land, the Iowa manual specifies that, "In order to determine a productivity value for agricultural buildings and structures, assessors must make an agricultural adjustment to the market value of these buildings and structures by developing an "agricultural factor" for the assessors' jurisdictions." The manual further specifies that, "The agricultural factor for each jurisdiction is calculated as the product of the ratio of the productivity and net earning capacity value per acre...over the market value of agricultural land within the assessing jurisdiction." An example given in the manual indicates that a building with a market value of $500,000 and an agricultural factor of 30% has a productivity value for the building of $150,000. This practice would appear to be hard to justify on economic grounds. Why the productivity factor for buildings would be identical to that of agricultural land is unclear.

Smoothing of assessments occurs as well. Assessments for 2011 are determined by averaging the market values of land over the three year period 2007-2009. Starting in 2013, a five-year average of market values will be used in determining the agricultural factor.

A further issue arises in the assessment of the portion of a farm used as a residence. The Iowa manual specifies that, "An assessor shall not value a part of the land as agricultural real estate and a part of the land as if it is residential real estate." As a consequence, the residential portion of the property is assessed in less than its highest and best use as well.

### *3.3 Kansas*

The Kansas use value methodology is exemplary in its comprehensiveness and completeness, according to the IAAO cited in Kansas Department of Revenue (2000). All agricultural land in Kansas is required to be viewed and inspected by the county or district appraiser at least once every six years. Valuations are required both on the basis of fair market value and use value for every parcel, although the fair market values are not used in any way to determine use values according to the Kansas Department of Revenue. Agricultural land is classified by USDA soil type and productivity for each type of land is determined within each county or homogeneous region using an 8-year moving average. Commodity prices are also computed using an 8-year moving average. Net income is then computed for each land classification in each county. For land that is not owner operated the rental contract for the landlord/tenant on a crop-share basis is used. The landlord's share is used as a starting point to isolate net income.

Kansas statues specify an unusual method for computing the capitalization rate. Net income is capitalized using a capitalization rate that is the sum of, "…the contract rate of interest on new federal land bank loans in Kansas on July 1 of each year averaged over a five-year period…plus a percentage not less than .75% nor more than 2.75%, as determined by the director of property valuation." The specific purpose of the discretionary add-on is unclear.

### *3.4 Ohio*

The Ohio program is known as the Current Agricultural Use Value (CAUV) program, in effect since 1973. Under the terms of this program, farmers can enroll their land and receive use-value assessment indefinitely as long as the land remains in agricultural use. If the land is taken out of agricultural use, recoupment taxes in the amount of the use-value tax savings from the previous three years are applied as a penalty.

Use value is determined by computing the farm's projected gross income due to agricultural production minus projected non-land production costs to obtain net income. The estimated net income is then capitalized into value using a capitalization rate.

Projected gross income is estimated by assuming typical cropping patterns for the land's soil types on the farm. The state's 3080 different existent soil types have been collapsed into six prototypical cropping patterns for this purpose. Average statewide crop yields over the past five years are applied to each acre's assumed cropping pattern. Average crop prices over the past five years are then applied to the production estimates per acre on the farm.

Non-land production costs are then subtracted from the projected gross income. Five-year averages of input costs are used for, "…seed, fertilizer, fuel oil, grease, repairs, drying fuel, and electricity costs, fuel for trucking, labor charges, and machinery and equipment charges."Each of these costs is estimated using Ohio Crop Enterprise Budgets that are published by The Ohio State University Department of Agricultural, Environmental, and Development Economics.

The capitalization rate is computed from two sources: (1) the average Farm Credit Services interest rate applied to a loan of 60% of assets, payable over a 15 year term, and (2) the previous five year's average interest rate applied to the remaining 40% of assets in equity. These two factors are used to compute a weighted average capitalization rate.

This method of computing the capitalization rate has several flaws. First, it assumes a 60-40 split in the debt-equity finance of farmland, which is not necessarily appropriate for any given farmland parcel. Second, the debt portion is forward looking as the Farm Credit Services interest rate anticipates the real interest rate and the inflation rate over the next 15 years, but the equity portion is backward looking as it is computed as the average the previous five years interest rates.

### *3.5 Virginia*

Virginia requires that agricultural land be valued based on the productive earning ability of the land, as determined by capitalization of either cash rents or net incomes of like real estate. In reality, rental markets are thin and data is scarce for computing use value via cash rent capitalization. Hence, Virginia typically uses the income capitalization approach in valuing agricultural land. We consider the Virginia case in some detail as it is representative of the prototypical farm method used in several states.

The first step used in computing use value in Virginia is to develop a composite or typical farm for each jurisdiction (county or city) participating in the use-value program. This is accomplished by compiling Census of Agriculture county-level data on the total number of farms and acreage used in production of each crop. Composite farm acreage is computed for each crop. The acreage for each crop in a county is divided by the number of farms in the county. If that ratio is at least one, the crop is included in the composite farm. For example, Bruce and Groover (2007) provide the composite farm computation for Prince Edward County which had 395 farms and 1,430 acres in corn production. The ratio is 1,430/395 = 3.6202, which is rounded up to the nearest integer, 4. Thus, the Prince Edward County composite farm has 4 acres of corn. Similar computations are conducted for alfalfa, hay, wheat, and barley. The total acreage for the Prince Edward County composite farm is 39 acres.

The second step in Virginia's process is to compute net return budgets for each crop grown on the composite farm. An annual per-acre net return is derived for each crop grown.

Enterprise budgets are computed using Virginia Farm Management crop budgets and input costs from numerous sources. Annual crop net-returns are determined. Then, the annual net-return budgets are computed using a 7-year moving Olympic average. That is, over the 7-year period, the lowest and highest year net returns are omitted and the mean of the remaining 5 net returns is computed. If a net return is negative, its value is truncated at zero.

The final step in computing usevalue is to calculate a single estimate of net return for the crops grown on the county's composite farm. A weighted average of crop net returns and composite farm acreages is computed. The resulting figure is called the Estimated Net Return. For Prince Edward County, Bruce and Groover (2007) report the Estimated Net Return from cropland harvested as $18.20/acre. It is this value that is then capitalized into use value.

In determining the productive capability of the land, Virginia relies on a land classification scheme summarized in Table 3.

**Table 3: Virginia Land Classification**

| Land Classification | Description | Virginia Land Capability Class Index |
|---|---|---|
| Class I | Soils have few limitations that restrict use | 1.50 |
| Class II | Soils have some limitations that reduce the choice of plants or require moderate conservation practices | 1.35 |
| Class III | Soils have severe limitations that reduce the choice of plants or require special conservation practices, or both | 1.00 |
| Class IV | Soils have very severe limitations that restrict the choice of plants, require very careful management, or both | 0.80 |
| Class V | Soils are subject to little or no erosion but have other limitations impractical to remove that limit their use largely to pasture, range, woodland, or wildlife food and cover | 0.60 |
| Class VI | Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover | 0.50 |

| | | |
|---|---|---|
| Class VII | Soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife | 0.30 |
| Class VIII | Soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply or to aesthetic purposes | 0.10 |

Source: Bruce and Groover (2007).

The income earning capability of land is adjusted based on its income generating ability relative to Class III land, which is the reference land quality. The scale given in the Virginia land capability class index is cardinal. That is, the expected net income from Class I land is 1.5 times that expected from Class III land, and so on.

A further adjustment is made by calculating a composite soil index factor for a jurisdiction. The jurisdiction is comprised of a number of acres of land of each type. Hence, a weighted average of the land productivity indices in Table 4 is computed, where the weights are the relative quantities of land of Classes I-IV in the jurisdiction.

**Table 4: Virginia Land Productivity and Soil Index Factor Computation**

| Land Class | Crop acreage | Productivity Index | Weighted acreage |
|---|---|---|---|
| I | 418 | 1.50 | 627 |
| II | 21,273 | 1.35 | 28,719 |
| III | 10,617 | 1.00 | 10,617 |
| IV | 6,557 | 0.80 | 6,557 |
| TOTAL | 40,504 | | 45,519 |

Source: Bruce and Groover (2007) Appendix C, p. 24.

On the basis of the total acreage and total weighted acreage in Table 3, the Soil Index Factor is computed as, Total Weighted Acreage / Total Acreage = 45,519/40,504 = 1.15. This index indicates that the land in Prince Edward is, on average, of quality level 1.15, or 15% more productive than Class III reference land.

Bruce and Groover (2007) indicate that the capitalization rate used in Virginia is the sum of a property tax component and an interest rate component. In some cases, the capitalization rate can also include a risk-of-flood component as well. Table 5 provides an example of Virginia's computation method.

**Table 5: Virginia Example of Capitalization Rate Computation**

| Capitalization Rate Component | Value | Source |
|---|---|---|
| Interest rate component | 0.0761 | 10 year average of long term interest rates charged by the various Agricultural Credit Associations serving Virginia |
| Property tax component | 0.0043 | 10 year average of the effective true tax rates reported by the Virginia Department of Taxation |
| Rate without risk | 0.0805 | Sum of above two components |
| Risk component | 0.0040 | 0.05 times rate without risk |
| Rate with risk | 0.0845 | Sum of above two components |

Source: Bruce and Groover (2007), Appendix C, page 24.

Using the capitalization rates without and with risk provide two distinct estimates of value. For example, Bruce and Groover (2007) illustrate that for an acre of land in Prince Edward with an estimated net annual return of $18.20, the use value computed using the capitalization rate without risk is $226.17 ($18.20/.0805) while the use value taking risk into account is $215.40 ($18.20/0.0845). A footnote in the Bruce and Groover example indicates that the capitalization rate with risk incorporated, "…should only be used when the soil has poor drainage that is not remedied by tilling or drainage ditches or when the land lies in a floodplain." Beyond explaining when to use the risk-adjusted rate, there is no indication of how to determine the size of the risk adjustment. On the issue of risk, Bruce and Groover (2007) provide the following insightful commentary:

> Agricultural enterprises are subject to numerous risks. However, the risks associated with input costs, crop yields, and prices received are adequately accounted for by the net-return component since these risks occur on an across-the-board basis and do not reflect individual land-risk situations. The two primary types of risks are related to rainfall, either a shortage or an excessive amount. An important difference between the two is that the risk associated with drought *is not* land-related while the risk associated with excessive rainfall *is* land-related. The risk of drought is assumed to be distributed uniformly within a jurisdiction and, therefore, does not warrant special attention. Because the risk associated with an excessive rainfall is land-related, it can vary within a jurisdiction. The risk associated with excessive rainfall is lower crop yields caused by flooding…Because this risk is borne by specific areas lf land within a jurisdiction, a special use-value estimate based on a capitalization rate reflecting the risk of flooding is calculated.
>
> The size of the risk component will vary depending on the period over which a total crop loss is expected on lands subject to the effects of flooding. Use-value methodology assumes that a total crop loss will occur once every 20 years. Therefore, the land's capitalization rate is increased by 5 percent.

This is the most careful statement of risk incorporation in use-value assessment methods that this author found in the literature. It makes the general case that most risk elements are automatically incorporated in the proper estimation of representative net income in the numerator of equation (4). Beyond that, land-specific risk adjustments may be justified, such as the risk of flooding as discussed above, but to do so properly would require more than an ad hoc 5% adjustment.

### *3.6 Wisconsin*

Wisconsin is an interesting case due to the state's recent change in policy approach. Previously, Wisconsin relied on a circuit-breaker mechanism on its state income tax to provide property tax relief to agricultural land owners willing to agree to not develop their land (as does Michigan). That situation changed in 1995, however, with a switch to a use-value assessment regime. According to the Wisconsin statutes adopted in 1995, a Farmland Advisory Council (FAC) is charged with the responsibility of computing per acre land values for agricultural land, based on rental income. That Council also computes a 5-year average of the FLB interest rate to use as a capitalization rate.

The 1995 legislation froze agricultural land assessments at their 1995 levels for the years 1996 and 1997. A phase-in period moving to use value began in 1998, but the FAC directed the Department of Revenue to end the phase-in period and move completely to use value in the year 2000. Wisconsin law now specifies that, “shall be assessed according to the income that could be generated by its rental for agricultural use.” (Wisconsin Department of Revenue (2010) p. 3).Five-year averages are used for land productivity and commodity prices. A 50-50 crop-share lease arrangement is assumed, so the estimated net income is reduced by 50%. Localized municipal capitalization rates are computed and used to capitalize estimated net rental income into use value. Two components are included in the capitalization rate: an agricultural loan rate for a medium-sized one-year adjustable mortgage, ARM, (obtained from a survey of federal land credit association, FLCA, and agricultural credit association, ACA, offices in Wisconsin) and a local property tax rate.

Wisconsin is unusual in that it requires the computation of a 5-year average of the effective rate for a 1-year adjustable rate mortgage (ARM). This requirement differs from most states in that it is very short term (one year), and in addition the rate is modified based on the stock requirement of the FLCA or ACA providing the loan. Since these institutions are cooperatively owned by their borrowers, loans are subject to stock purchase requirements. The effective interest rate in Wisconsin is computed net of the stock purchase requirement. For example, a borrower obtaining a $100,000 loan at 9% interest may be required to purchase

$2,000 in stock, a 2% stock requirement, with the net proceeds of the loan being $98,000. According to Wisconsin statutes, the effective interest rate must be computed as 9%/[1-.02] = 9.18%. This computation inflates the interest rate as it implicitly assumes that the dividend rate paid on the stock is zero.

Furthermore, Wisconsin limits the rate of change in use value each year. For each category of agricultural land, increases and decreases in use value are limited to the prior year's percentage change in the statewide equalized value. Wisconsin Administrative Code, Section 18.09. Those changes in statewide equalized value are computed omitting both agricultural land value and new construction.

## 4 Summary and Conclusions

This paper has provided an overview of the theory and methods used to implement use-value assessment for agricultural land in the United States. Based on the five state case studies reviewed, there are several areas where use-value assessment methods need to be improved. First, there are serious issues related to the definition of use-value to consider. While farmers want use-value assessment to narrowly account for the net income earned from producing commodities on their land, the reality is that agricultural land produces far more than just crops. Wildlife habitat, amenity benefits, and other products are jointly produced along with corn, soy beans, and other crops. Lynch and Duke (2007) catalogue these and a number of other economic benefits of farmland preservation. Incorporation of economic benefits beyond the net income generated from raising crops would raise assessed values, however, and diminish the property tax preference provided to farmland. While this may be appropriate in theory, in practice it would be difficult to implement due to the complexity of estimating the value of non-crop products produced, and the likely political resistance from owners of farmland.

Second, the methods used to estimate net income need to be simple and accurate. At present, many states use non-transparent or inaccurate methods with the apparent purpose of understating net income (e.g. biased net income averages). Most states use moving averages of productivity and prices by commodity type. That approach is relatively straightforward and justified, but in some cases the implementation of this method is idiosyncratic. States should provide clear, unbiased, and simple methods for the computation of both income and costs. The prototypical farm method seems especially vulnerable to inaccurate assumptions. There are also high costs related to the complex methods of net income computation used in some states. Farm states in particular, go to great lengths to account for numerous small complexities in the estimation of net income streams, with no apparent cost-benefit sense of how much complexity is actually justified. It is understandable that a transparent sense of completeness and accuracy is necessary for widespread voter support of the property tax system, but the minutely detailed adjustments in classification or net income estimation implemented in some states hardly seems justified.

Finally, there are problems to resolve in the selection of appropriate capitalization rates used in use-value assessment. States should carefully review their income capitalization methods to assure a logically coherent approach is being used and consistently applied. At present a wide variety of methods are used by the states in specifying how the capitalization rate is to be chosen. Many of the methods used are ad hoc, with no particular theoretical basis. There is often an inconsistency between the time horizon used in computing the net income stream in the numerator and the discount rate used in the denominator. In some cases, the computed capitalization rates are subject to arbitrary adjustments, and/or maximum or minimum limits set by the state's legislature or property tax statutes. Implicit assumptions regarding the capital structure of land ownership (debt/equity) are also often arbitrary. Some of the methods used are obviously intended to inflate the capitalization rate in order to lower the estimated use value.

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