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How Much Is That Farm Really Worth—A Comparison of Three Land Purchase Decision Tools

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ABSTRACT

Volatile markets for farmland have created interest in tools that can help analyze land investments (Zimmermann, 2014). Extension specialists in several states have created some valuable decision aids that have been utilized by prospective investors, rural appraisers and real estate brokers. Agricultural educators can also use them for teaching the principles of real estate valuation.

Among the land purchase decision aids that are currently available are **KSU-Landbuy** from the AgManager.info website at Kansas State University (Dhuyvetter & Kastens, 2013), **Farmland Purchase Analysis** from the Ag Decision Maker website at Iowa State University (Edwards, 2015), and **Land Purchase Analysis** from the Farmdoc FAST tools website (University of Illinois, 2009). For convenience, they will be referred to as the AMI, ADM, and FAST models, respectively. All of these tools are Excel spreadsheets and rely on traditional capital budgeting techniques to analyze a farmland purchase decision, but they differ in some important methodological aspects.

The purpose of this article is to compare and contrast the three decision aids and discuss the implications of the different capital budgeting approaches employed in each one. Additional features contained in one or more of the three tools will be summarized as well. A case example representing a typical midwestern farmland purchase opportunity will be analyzed using each decision aid, and the results will be compared.

KEYWORDS

land, land values, capital budgeting, present value

THEORETICAL APPROACH

A synthesis of several textbooks that discuss financial analysis of investments in agriculture—including Barry and Ellinger (2012); Casler, Anderson, and Aplin (1984); and Murray, Harris, Miller, and Thompson (1983)—yields several key features that should be incorporated into a net present value model for evaluating a land purchase decision:

- Estimation of net earnings to be received from the investment, including possible non-agricultural earnings.
- A discount rate that reflects the purchaser's cost of capital, weighted by the relevant mix of debt and equity and adjusted to a real and after-tax value if the net earnings are expressed on that basis.
- The expected time horizon of the investment, which can be either finite or infinite.
- The expected terminal sale value of the land if the expected ownership period is finite.
- The expected rates at which the net earnings will be taxed as well as the tax rate on possible capital gains income that would be realized on the sale of the land at the end of a finite ownership period.
- Projected growth rates in net earnings as well as for the terminal value of the land.

Each of these elements will be discussed in detail, and the three models will be critiqued as to how they incorporate each one.

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ANNUAL NET EARNINGS

In a traditional capital budgeting approach to analyzing a long-term investment, the net cash flows expected to be generated by the investment in each future time period are discounted to their present value by dividing them by the term (1 + the discount rate) raised to a power equal to the number of periods into the future that the income will be received (Kay, 2016, p. 320). Mathematically, the process can be expressed as:

$$V = NE_1 / (1 + d) + NE_2 / (1 + d)^2 + \ldots + NE_n / (1 + d)^n \quad (1)$$

where V = present value, n = year of ownership, NE = expected net annual cash earnings to land in year n, d = discount rate.

If the expected net earnings are the same each year, the income stream is called an *annuity*. In the special case where the ownership period is infinite and the value of n extends to infinity, the annuity is called a *perpetuity*, and the net present value equation collapses to (Murray et al., 1983, p. 113):

$$V = NE / d \quad (2)$$

CALCULATION OF NET EARNINGS

For a prospective owner-operator, net earnings would be the net return that can be realized from farming the land after all production costs are paid. Cash revenue would include sales of crops and secondary products produced, payments from government support programs, and possible rental income from hunting rights or residue grazing. Cash costs would include seed, fertilizer, pesticides, fuel, repairs, hired labor, crop insurance premiums, drying, transportation, interest on operating input costs, and other cash expenditures as well as the same land ownership costs that a landlord would pay. Depreciation of machinery is not usually included because it is not a cash outlay, but it can be used as a proxy for annual cash investments for replacement of machinery. A more complete discussion of when it is appropriate to include the cost of depreciable assets in the analysis will appear later in this article.

A value for the operator's labor and management should be deducted also, even if it is not a cash outflow, to avoid capitalizing the value of these resources into the land value (Murray et al., 1983, p. 109).

Some land purchase decisions may be made by nonoperating landlords who expect to receive income from renting the land to a tenant. In all three of the decision aids a single value for the annual cash net earnings to the land can be entered. For a prospective investor interested in acquiring rental property, this could be the expected cash rent to be received minus land ownership costs such as property taxes and upkeep of fences, tile lines, terraces, and other improvements. The ADM model also allows the user to input a professional management fee that a nonoperating landowner might have to pay. Another approach is to enter the income that would be received and the costs that would be paid by a landlord under typical crop-share lease terms in the area. In this case, no operator labor cost would be included (Murray et al., 1983, pp. 103–104).

The ADM model allows the user to enter up to six crop budgets, which include the number of acres planted to each crop, expected yields, selling prices, other payments received, and input costs. Acres devoted to other uses such as pasture or the Conservation Reserve Program (CRP) can be included as well. Entering complete crop budgets increases the amount of information required to perform the analysis but makes it easier to analyze the sensitivity of the results to changes in any of the key variables that affect profits from crop production. The AMI model allows for three different tracts to be analyzed together in one parcel. Values are entered for "ag rent," which could come from crop production, pasture production, cash rents, or CRP payments. The per-acre values are weighted by the number of acres specified for each tract to compute an overall average.

The FAST model uses per-acre values only and simply asks for the "additional net cash flows" that will be earned from the land purchase, although a separate sheet is included in the spreadsheet for calculating the net cash flows received for up to three crop enterprises. All three models are intended to estimate the value of a land investment to a particular user, so all input values should reflect the user's own situation as much as possible.

SPECIFICATION OF THE DISCOUNT RATE

All three models start with the current market rate of interest on farm real estate loans when calculating the discount rate. This is a value that is likely to be known by persons interested in investing in farm real estate. It incorporates all three elements of the time value of money, namely alternative uses of capital, risk and uncertainty, and inflation (Casler et al., 1984, p. 47). However, few land purchases are financed solely with debt capital.

The ADM model also asks for a current rate of return on equity capital, and calculates a weighted cost of capital based on these two rates and the proportion of the purchase price to be financed with debt and equity, as follows (Casler et al., 1984, pp. 47–51):

$$d = (e \times dp) + [i \times (1 - dp)] \tag{3}$$

Where d = the discount rate, e = the rate of return earned on equity capital, dp = the percent of purchase price financed with equity (down payment), and i = the interest rate for farm real estate loans.

The return on equity capital should reflect its use in alternative investments with a similar degree of risk, such as the observed return on equity from the existing farming operation or portfolio of rented farms. The weighted cost of capital represents a cutoff rate, or the minimum acceptable rate of return for an investor (Casler et al., 1984, p. 48). If a farm property can be purchased for a price below the estimated value V, then the investor potentially will realize a rate of return higher than the discount rate.

Incorporating the opportunity cost return on equity capital causes the estimated land value to depend partially on the individual user's sources of capital, whereas using the market rate of interest only, such as is done in the AMI and FAST models, results in an estimated land value that is independent of the user's particular financial situation. Returns to equity capital are typically higher than interest rates for real estate purchases. Data from the Iowa Farm Business Association show an average return to equity earned by their members of 9% from 2005 through 2014 (Plastina, 2016). This compares to an average interest rate on farm real estate loans of 6% during the same period, as reported by the Chicago Federal Reserve Bank (2016). Thus, failing to incorporate an equity capital rate of return may underestimate the true discount rate.

The ADM model also allows the user to input a "capitalization" rate, which is simply the observed ratio of net earnings to land prices from recent sales in the same area (Murray et al., 1983, p. 9). This is sometimes called the "rent-to-value ratio." Professional appraisers generally prefer to use a capitalization rate rather than a discount rate based on the cost of capital because it simply reflects current economic returns to farmland without trying to rationalize them. It implicitly assumes that buyers will bid up the price for farmland to a level at which it generates a return on investment somewhat close to the average investor's cost of capital. Results based on both a discount rate and a capitalization rate can be calculated in the ADM model.

THE INVESTMENT TIME HORIZON AND ENDING SALE VALUE ESTIMATION

Because farmland can be assumed to produce earnings indefinitely—that is, it does not depreciate—the perpetuity formula can be applied. This is the approach used in the ADM decision aid. However, the AMI and FAST models assume that the land will be owned for a fixed number of years. In the AMI model the user can specify any period from 1 to 100 years. In the FAST model the investment is analyzed for fixed periods of 5, 10, and 30 years. At the end of the ownership period the land is assumed to be sold, creating a terminal cash inflow.

In the AMI and FAST models the user specifies an estimated beginning market value for the parcel being analyzed and an expected annual growth rate in that value, from which the models calculate a nominal market resale value at the end of the ownership period. That value is discounted to its present value and added to the sum of the discounted values of the annual net earnings. One difficulty with this approach is that the current value of the land is essentially what the user is trying to learn from the model, although recent sales in the same area may be used to indicate an approximate market value. In fact, if a higher beginning current market value is specified, the present value also increases, creating a circular effect. The perpetuity approach avoids the need to specify a beginning market value and a fixed ownership period, which may be unknown. In theory, the present value of the net earnings from the land beyond the end of the ownership period into infinity should equal its terminal market value, and the three models should give similar present values.

INCOME TAXES

All three models start with a pretax discount rate. Traditional capital budgeting techniques allow this rate to be adjusted for the erosion of net earnings due to the income tax liabilities generated. The AMI and FAST models ask for the user's marginal income tax rate (rate paid on the last dollar of net income, including self-employment tax if applicable) and adjusts the discount rate as follows:

$$d^* = d \times (1 - t) \qquad (4)$$

where d^* = the after-tax discount rate, d = the pretax discount rate, and t = the user's marginal income tax rate.

This calculation implicitly assumes that the interest paid on borrowed capital is tax deductible and thus reduces the investor's net cost of borrowing. When the discount rate is converted to an after-tax rate, the annual net cash flows must also be converted to after-tax dollars. This is done by multiplying each net cash flow by a factor equal to one minus the marginal tax rate (Kay et al., 2016, p. 323–324). Either a pretax or an after-tax approach can be employed—the key is that *both* the discount rate and the net earnings must be adjusted for tax payments, or *neither* of them should be.

When the perpetuity approach is used to calculate the net present value of the land's earnings, as in the ADM model, the need to estimate the user's marginal tax rate no longer applies. Both the discount rate and the annual net cash earnings can be adjusted to after-tax values, as shown in equation 5, but because the term "$(1 - t)$" appears in both the numerator and the denominator the terms cancel, out and the present value is independent of the marginal tax rate.

$$V = [NE \times (1 - t)] / [d \times (1 - t)] = NE / d \qquad (5)$$

As long as all the values included in net earnings are taxed at the same rate and the cost of capital also creates a tax saving based on the same rate (either from deductible mortgage interest paid or lost earnings on equity capital that could have been invested elsewhere), the above relationship holds. The exception to this case is income earned from the resale of the land at the end of the ownership period. The terminal sale value minus the original purchase price creates a capital gain (or loss), which is often taxed at a lower rate than ordinary income. In the AMI and FAST models the user inputs a separate value for the rate at which capital gains are taxed, and the terminal cash inflow is reduced by the potential tax generated. Because the ADM model does not consider the future sale of the land (ownership period is infinite), the capital gains tax question does not apply. This ignores the potential benefit that an investor could gain from the favorable tax treatment given to capital gains versus ordinary income, although there is no guarantee that this favorable treatment will always exist in the future.

GROWTH IN NET RENTS AND MARKET LAND VALUES

Another issue is how to account for anticipated increases over time in the net rents earned by a parcel of land. These could be nominal increases that come from general inflation in the economy and/or real increases caused by increased crop yields, higher selling prices such as would result from an increase in demand for the products sold, or decreased input costs. In both the AMI and FAST models, the expected net rent is calculated for each year of the expected ownership period by adjusting the initial year's net rent by an annual growth rate that is specified by the user. This produces *nominal* values for the net earnings for each year of ownership, which are adjusted for income taxes and then discounted with a *nominal* after-tax discount rate. The ADM model uses a net rent value for the initial year of ownership only. Because this occurs in time zero it is by definition a *real* value. The discount rate is likewise adjusted to a *real* value by incorporating a user-specified expected growth rate in real net earnings according to the following formula (Casler et al., 1984, p. 90):

$$1 + d^{**} = (1 + d) / (1 + g)$$
$$\text{or } d^{**} = [(1 + d) / (1 + g)] - 1 \qquad (6)$$

where, d^{**} = the real discount rate, d = the nominal discount rate, and g = the anticipated growth rate in net rent to the land.

In some applications the nominal discount rate is converted to a real discount rate by simply subtracting the anticipated growth rate from it, which gives a close approximation to the value found using equation 6 but excludes the multiplicative term (Barry & Ellinger, 2012, p. 199).

One key to correctly specifying any capital budgeting model is matching the natures of the discount rate and the future cash flows. The FAST and AMI models both use nominal net cash flows for each year of the ownership period and nominal discount rates, both adjusted for income tax effects, while the ADM model uses a real net cash flow (specified at the beginning of the ownership period) and a real discount rate, neither of which are adjusted for income taxes. Both approaches meet the consistency test between the net cash flows and the discount rate and will actually yield the same net present value for the land investment if the same inflation rate is used to adjust both the net earnings and the discount rate (Barry & Ellinger, 2012, p. 200), and all earnings are taxed at the same rate.

The AMI and FAST models apply a separate growth rate to the assumed beginning market value of the land to predict its resale value at the end of the ownership period. This would be the same rate as the growth rate for annual net rent if the value of the land is based solely on its agricultural earnings. However, the FAST model allows the user to specify a rate of growth in land values that is different than the growth rate for the net rents. This could be justified if outside factors such as demands for land for development or recreational uses were expected to cause farmland values to grow faster than the income stream from farming or renting it. This assumed growth rate for land values is used to calculate the terminal value of the land at the end of the ownership period in the FAST and AMI models. See Kastens, Dhuyvetter, & Falconer (1999) for more details.

NONAGRICULTURAL EARNINGS

The AMI model incorporates an additional feature by allowing the user to specify a value for nonagricultural rents that could be earned from the land purchase. These could include fees charged for hunting rights, rent earned from a dwelling or other buildings, fees earned from an easement, or royalties collected from mineral extraction. An expected growth rate in the nonagricultural rents can be specified, which is used to inflate them over the assumed ownership period. They are then incorporated into the annual net earnings and present value of the land. In addition, a separate value for the growth rate in the nonagricultural portion of the market value of the land is estimated by allowing the user to enter an expected overall growth rate in land values, then backing out the portion of that growth rate that originates from agricultural rents. This recognizes that the nonagricultural portion of the land's value could come from both "realized" rents such as mineral royalties and "nonrealized" income such as potential for urban development. The value of this potential income is reflected in the terminal sale value of the land. For a detailed discussion of the impact of nonagricultural rents and land use on farmland values, see Kastens & Dhuyvetter (2011).

The ADM model includes an input for "other income" earned by the land but does not allow it to grow at a different rate than the agricultural income. Likewise, it does not take into account growth in farmland value due to potential for nonagricultural use. This could be a limitation in areas near urban centers but would likely not be a factor in very rural areas. The FAST model does not explicitly recognize other sources of income, though they can be included in the value specified for added cash flows.

Care must be taken when estimating the future growth rates of both annual net earnings and market land values. A net earnings growth rate that is larger than the cost of capital results in a negative value for the discount rate, which gives a negative net present value. Negative real interest rates are not unheard of but generally do not reflect long-term relationships. In periods of rapid increases in farmland values it is tempting to assume that such appreciation will continue indefinitely, but history tells a different story. Data on Iowa farmland values from 1970 through 2015 show an annual increase in the state average land value of 7.4%, but only 3.2% after adjusting for general inflation (Edwards & Hofstrand, 2010). The growth rate that is specified should equal the expected rate of general inflation plus any real growth expected in the stream of net earnings. The documentation for the AMI model shows historical values for the agricultural, nonagricultural, and overall growth rates in farmland values, which are intended to help the user choose realistic values for these variables.

FINANCING EFFECTS

Another issue concerns the use of debt capital to help finance the land purchase. How should it affect the estimated present value of the land, if at all? The ADM model uses the current interest rate that would be paid on a farm real estate loan and the rate or return on equity in its calculation of the weighted cost of capital, which is then used as the nominal discount rate. The AMI and FAST models use the interest rate on land loans solely as the pretax discount rate. Neither the AMI nor the ADM model incorporates loan payments into the yearly cash flows.

The FAST model goes further and calculates the principal and interest payments that would be due each year based on the expected purchase price, percent down payment, loan interest rate, and loan repayment term. These are subtracted from the net rents each year to find a net cash flow after making the loan payments. The tax deduction arising from the interest payments is also estimated, and its effect are incorporated into the net cash flows. The down payment (in dollars) is included as a cash outflow in year zero. The present value of the net cash flows then represents a "profit" over and above the purchase price. It is added to the expected purchase price supplied by the user to find a value that is comparable to the present value of the land estimated by the other two models.

Whether or not to include debt financing in a capital budgeting model is a question that has been discussed at length. One argument is that investing and financing are separate decisions and should be analyzed separately. Casler et al (1984, 49) that "the decision as to whether or not a business investment proposal is desirable should be separated from the decision as to how this particular project will be financed."

In the corporate finance world these decisions are usually made independently. For a typical family farm, however, the decisions of whether to buy land and how to finance its purchase are often made concurrently—that is, funds are borrowed specifically to purchase a certain tract of land. If the purpose of the analysis is to simply estimate the current market value of the land to the general populace of potential buyers, then a current market rate of interest should be used as the starting point for the discount rate, and other financing terms should not enter in. However, special terms may be available to an individual investor, such as for a beginning farmer loan from the U.S. Department of Agriculture Farm Service Agency that typically carries a below market interest rate and a longer repayment term. These values can be incorporated into the stream of net cash flows and will give a higher estimate of the present value of the land in question if the terms are more favorable than ordinary market rates. It must be remembered, however, that a part of that value is due to the below market terms of financing available to the investor, not to the characteristics of the land itself. It implies that a borrower who qualifies for special financing terms can afford to bid more for a farm than other potential purchasers, which, after all, is one purpose of offering such programs.

Another situation in which including financing terms can be justified is when the investor is considering two possible investments that have different terms attached to them. An example would be a farm that can be purchased only with a seller-financed installment contract with a low down payment, a low interest rate, and a higher selling price, compared to a similar farm that can be purchased only with a loan from a conventional lender that carries a higher interest rate and down payment requirement. In this case each alternative should be analyzed based not only on its economic value but also on its unique financing terms.

Incorporating the actual loan payments into the cash flow, as the FAST model does, has no effect on the present value of the land if the interest rate on the loan is the same as the one used for estimating the discount rate. The present value of the loan payments is simply the original principal borrowed, and that plus the down payment equals the initial purchase price. Thus, the percent down payment also has no effect on the net present value of the cash flows.

The ADM output also includes a financial analysis based on the user-supplied financing terms and expected purchase price and shows the estimated net cash flow after loan payments are made, the maximum loan that could be supported with the assumed net income and loan terms, and the maximum purchase price that will "cash flow" given both a constant dollar value of down payment (the buyer has a limited amount of equity) and a constant percent down payment (the lender will loan a maximum percent of the purchase price). The break-even selling prices and yields needed for each crop to make the purchase "cash flow" are also calculated and shown. All of these values are relevant only for the period that the land purchase loan is being repaid. The financial analysis is separate from the economic analysis and does not affect the estimated land value.

DEPRECIABLE ASSETS

Another question that arises with land purchase decisions is whether or not to include in the net earnings calculations fixed costs for capital assets such as machinery, storage bins, tile lines, and fences or to assume that these costs will not change as a result of the land purchase. Casler et al. (1984, 23) that "Projected cash outflows should include only those costs that will be affected by the investment proposal under consideration. Costs that will not be altered by this investment are irrelevant and should be ignored."

In the FAST and AMI models it is left to the user whether or not to consider fixed costs in the calculation of the net rent to be earned. In the ADM model the user is asked specifically to estimate the initial cost of any additional investments in machinery, buildings, or improvements that would have to be made at the time of the land purchase. An annualized cost based on the specified interest rate for a land loan and a useful life of 10 years for machinery and 20 years for other improvements is included in the budgets in place of a fixed cost for these assets. This recognizes that it is common for a new landowner to install tile, build terraces, clear brush, or make other improvements that increase the earning potential of the land but also increase the initial investment. Any impact on potential yields from such improvements should be reflected in the crop budgets.

The FAST model also asks what portion of the expected purchase price can be allocated to depreciable assets, such as fences and tile lines, and includes the tax savings that would arise from the added depreciation, including Section 179 expensing, in the net cash flows. The AMI model does not address depreciation deductions specifically, although they could be factored into the calculation of net rent to be earned from the land. The time value derived from the accelerated tax savings from Section 179 expensing or other fast depreciation methods is not captured in either the ADM or AMI model, though.

SELLING COSTS

The FAST model asks the user to estimate the closing fees involved in purchasing the land initially and selling the land at the end of the ownership period as a percent of the purchase or sale price. These values are included in the cash outflows occurring in the first and last years. The other two models do not consider these costs. Because the ADM model assumes perpetual ownership, there are no final selling costs to consider. Selling and closing costs are usually small relative to the sale price of the land, and including them has only a small impact on the estimated land value. Alternatively, the initial closing costs could simply be subtracted from the net present value of the land, since they occur at the beginning of the ownership period. Any selling costs that would occur at the end of the ownership period would have to be discounted to a net present value, however.

RESULTS

The AMI model shows the discounted present value of the land parcel, its estimated terminal sale value, the "profit" of the present value minus the estimated purchase price of the land, an estimated percent return on assets, and a return on equity based on the assumed purchase price. It also shows a complete table of yearly cash inflows and outflows, including income tax effects, for each year of the specified ownership period.

The FAST model also shows complete tables of yearly cash inflows and outflows, including income tax effects, for 5-year, 10-year, and 30-year ownership periods. It shows the expected "profitability" of the investment equal to the net present value minus the initial purchase price specified by the user as well as a percent return on investment. It also shows several breakeven values to achieve a desired return.

The ADM model shows an economic analysis that includes the expected cash revenues and expenses for each crop and the estimated net present value of the land utilizing both the discount rate (weighted cost of capital) and a user-specified capitalization rate. Values are expressed both per acre and for the entire tract of land.

CASE EXAMPLE

Table 1 shows the base example values that were entered into all three models. The present value of the land that was obtained from the ADM model was used as the beginning market value of the land in the other two models so as to eliminate any effect from buying the land at a price higher or lower than its present value from earnings, only.

Table 1. Example base values assumed for land valuation comparisons

Net earnings to land, $ per acre per year	$300
Expected annual % increase in agricultural net cash flows	3.0%
Expected annual % increase in farmland values	3.0%
Number of years land will be owned	30
Expected annual interest rate on farm real estate loans	6.00%
Current rate of return earned on equity capital	6.00%
Purchaser marginal income tax rate	43%
Purchaser capital gains tax rate	15%
Expected purchase price is set equal to the net present value calculated by ADM	$10,300

Table 2 compares the results that were obtained. The estimated land values, before considering income taxes, were identical for the ADM and AMI models (line 1) at $10,300 per acre. The FAST model gives a slightly lower result because its annual net earnings are not inflated by the growth factor until year two, whereas in the AMI model they are inflated beginning in year one. This effect was observed for all the scenarios tested except the zero growth scenario (lines 3 and 4), where no inflation took place.

When income taxes are subtracted from the cash flows (line 2), the estimated land value for the AMI model is about 27.5% higher than before. Most of this increase is due to the tax rate applied to the capital gains realized at the end of the ownership period being lower than the ordinary income tax rate. The FAST model gave a slightly lower after-tax value than the AMI model due to the one-year lag in applying the growth rates to earnings and the terminal land value.

If zero growth in annual net earnings and market land values is assumed (line 3), the pretax estimates for land values are the same for all three models, $5,000 (equal to the net earnings of $300 divided by the pretax discount rate of 6%). The same values are obtained after both the net earnings and the discount rate are adjusted to after-tax values (line 4), confirming that in the absence of a growth rate in net earnings, adjusting for tax rates has no effect on the net present values.

If a higher growth rate is assumed, say 5% annually, the estimated land values increase rapidly (line 5). Again, without income taxes considered, all three models give identical values except for the aforementioned lag in the year that the FAST model begins to apply the growth rate. When the 5% growth rate results are adjusted for income and capital gain taxes (line 6), the AMI and FAST values balloon to over $50,000, again illustrating the effect of favorable taxation of capital gains.

The length of the ownership period assumed has little or no effect on the estimated land values when income taxes are not considered (compare line 7 results with a 10-year ownership period to line 1 values). If income taxes are included (line 8), a shorter ownership period yields a lower land value because fewer capital gain dollars are generated (compare line 8 with a 10-year life to line 2 with a 30-year life).

In line 9 the capital gains tax rate is assumed to be the same as the ordinary income rate. In the AMI model the land value was $1,501 lower than in line 2 as a result, showing the effect of

Table 2. Example results from the three models, $ per acre

	ADM	AMI	FAST
1. Estimated land value (pretax)	$10,300	$10,300	$10,127
2. Estimated land value (after-tax)	$10,300	$13,132	$12,991
3. Estimated land value with 0% growth rates (pretax)	$ 5,000	$ 5,000	$ 5,000
4. Estimated land value with 0% growth rates (after-tax)	$ 5,000	$ 5,000	$ 5,000
5. Estimated land value with 5% growth rates (pretax)	$31,500	$31,500	$31,129
6. Estimated land value with 5% growth rates (after-tax)	$31,500	$50,464	$50,152
7. Estimated land value with 10-year ownership (pretax)	$10,300	$10,300	$10,225
8. Estimated land value with 10-year ownership (after-tax)	$10,300	$11,182	$11,133
9. Estimated land value if capital gains tax rate is equal to ordinary income tax rate (after-tax)	$10,300	$11,631	$11,490
10. Purchaser borrows 50% of the purchase cost at a 6% interest rate for 30 years	$10,300	N.A.	$12,991
11. Purchaser borrows 50% of the purchase cost at a 4% interest rate for 30 years	$15,450	N.A.	$16,942

favorable treatment of capital gains. The FAST model also produced a value that was $1,501 lower with only 10 years of land appreciation instead of 30 years.

Finally, in line 10 the effect of incorporating financing terms into the annual cash flows is shown. As long as the interest rate at which the investment is financed is the same as the assumed market rate, the present value is not affected in the ADM and FAST models (compare to line 1). The AMI model does not allow this calculation. When the rate of interest on a possible loan is lowered from 6% to 4%, however, with a 50% down payment assumed, the estimated land values increase to $15,450 in ADM and $16,942 in FAST (line 11). These values illustrate the premium a buyer who can qualify for such a low-interest loan could afford to pay for the example farm.

SUMMARY

Table 3 summarizes and compares the important characteristics of the three land valuation models. All three models appear to correctly follow the traditional net present value capital budgeting techniques for evaluating investment opportunities. However, the fact that farmland is a nondepreciable asset with an infinite productive life presents some unique considerations:

1. Using the perpetuity model (ADM) simplifies the calculations to be made and reduces the number of input values the user must provide.
2. The current market rate of interest on farm real estate loans can be used to represent the general cost of debt capital for purchasing farmland. However, the opportunity cost of equity capital should also be incorporated into the discount rate, with each rate weighted by its relative use.
3. Assuming that all net earnings are taxed at a consistent rate over time eliminates the need to adjust cash flows and the discount rate to after-tax values, as is done in the ADM model. The marginal income tax rate will not affect the present value of the land, so the user need not provide an estimate of it. However, the effects of the special tax treatment given to capital gains income (in AMI and FAST) and the accelerated write-off available for depreciating certain portions of a land investment (in FAST) are not captured.
4. Either nominal or real values can be used for the expected net earnings and the discount rate as long as both are expressed on the same basis. An expected growth rate in net earnings can be incorporated into the analysis by using it to inflate the annual cash flows (nominal values), including the terminal sale value of

Table 3. Comparison of the key features of the three decision aids

Key Features	Ag Decision Maker	AgManager.Info	Farmdoc FAST Tools
Net earnings	Net earnings from crops or expected cash rent (real values)	Net agricultural rent, adjusted annually by growth rate (nominal values)	Added net cash flows, adjusted annually by growth rate (nominal values)
Crop yields, prices, input costs	Included, or can use cash rent	Not included	Not shown, but can use budget worksheet
Discount rate	Weighted cost of capital is adjusted for growth rate (real rate)	Real estate loan interest rate is adjusted to after-tax rate (nominal rate)	Real estate loan interest rate is adjusted to after-tax rate (nominal rate)
Ownership period	Infinite	Fixed from 1 to 100 years	Fixed at 5, 10, and 30 years
Earnings stream	Perpetuity	Fixed term annuity	Fixed term annuity
Income taxes	Not included—assumes all net earnings are taxed at the same rate	Net earnings and discount rate are both adjusted to after-tax values	Net earnings and discount rate are both adjusted to after-tax values
Capital gains taxes	Land is not sold; no capital gain is realized	Capital gains realized and taxed at end of ownership	Capital gains realized and taxed at end of ownership
Land value growth	Same as earnings growth rate	Independent of agricultural earnings growth rate	Independent of agricultural earnings growth rate
Nonagricultural land use	Nonagricultural income can be included	Net returns and growth in nonagricultural land value can be included	Not included
Financing terms and loan payments	Separate analysis, not included in net earnings	Not included in net earnings	Included in annual cash flows and present value
Depreciation deductions	On investment in new improvements	Not included	Can be included for tax effects
Investment in new improvements	Can be included	Not included	Not included
Closing costs	Not included	Not included	Included
Selling costs	Not applicable (no sale)	Not included	Included

the land, or to reduce the discount rate from a nominal to a real value. The effects are the same on a pretax basis.

5. Incorporating loan payments into the stream of net cash flows should not affect the economic value of the land. The investment decision and the financing decision are independent except in cases where special terms are available. However, below market loan terms can be incorporated to show how the ability to bid for land by an individual who qualifies for them is affected.

CONCLUSIONS

For the majority of cases all three models give similar results when the same input values are used. However, each model has special characteristics

Table 4. Advantages and disadvantages of the three valuation models

Ag Decision Maker Model

Advantages

- Detailed crop budgets make sensitivity analysis for crop yields, selling prices, and inputs costs convenient.
- No assumptions are needed regarding income tax rates, the beginning market value of the land, or the expected ownership period.
- Inclusion of costs for investments in machinery and improvements is optional.

Disadvantages

- Favorable tax treatment of realized capital gains or depreciable portions of the real estate purchase is not taken into account.
- Earnings growth rates exceeding the discount rate give negative results.

AgManager.Info Model

Advantages

- User can specify any ownership period.
- Value of favorable tax treatment of capital gains is included.
- Value of nonagricultural earnings from land and a differential growth rate for the agricultural and nonagricultural components are explicitly recognized.

Disadvantages

- Calculation of net earnings from agricultural production must be done outside the model.
- A beginning estimate of the market value of the land is required to calculate the terminal sale value.

FAST Tools Model

Advantages

- Three different ownership periods are compared.
- Value of favorable tax treatment of capital gains is included.
- The effects of financing terms are included in the net present value analysis.
- The tax effects from the depreciable portion of the investment are recognized.
- Closing and selling costs are included.
- Several breakeven values are calculated.

Disadvantages

- A beginning estimate of the market value of the land is required to calculate the terminal sale value.
- Cost of equity capital for the potential buyer is not included.
- Growth rates in earnings and land value are not applied until the second year.

that may make it the preferred tool in certain situations, as summarized in Table 4.

The ADM model is the most user-friendly of the three. It does not require the user to make assumptions about the beginning market value of the land, marginal tax rates, or the number of years the land will be owned. However, it does not take into account the potential tax advantages of favorable capital gains treatment or fast write-off depreciation. It would be most appropriate for the farm operator who is looking to purchase bare cropland to add to an existing operation with the intention of farming it indefinitely and is not highly concerned with the potential for capturing capital gains from a future sale.

The AMI model does the best job of considering the effects of nonagricultural uses on the value of land, so it has an advantage for regions where this is an important factor in the land markets. It is accompanied by detailed documentation about the conceptual basis for the model as well as historical data by state on annual returns to farmland and growth in farmland values. Because the expected length of ownership is specified by the user, the AMI model is especially useful for investors who would consider selling the land after a relatively short time period in order to capture the gain in market value and its tax advantage.

The FAST model is the most appropriate for situations in which the interest rate that the individual user pays for borrowed funds differs from the market rate, where the financing terms are tied to the purchase of a particular parcel and where a significant portion of the sale price of the land is represented by assets that qualify for tax depreciation deductions.

An ideal model would incorporate the features of all three of the models discussed. While this would allow it to address a wider range of situations, it would also add to the number of input values required, some of which may be hard to estimate. It is up to the designer to evaluate these trade-offs. Finally, it should be remembered that all three models provide only a general estimate of land values based on the user's assumptions about long-term costs and returns, and actual selling prices will vary greatly.

REFERENCES

Barry, P. J., & Ellinger, P. N. 2012. *Financial management in agriculture*. (7th Ed.). Upper Saddle River, NJ: Prentice Hall.

Casler, G. L., Anderson, B. L., & Aplin, R. D. 1984. *Capital investment analysis using discounted cash flows*. (3rd Ed.). New York: Wiley.

Chicago Federal Reserve Bank. 2016. AgConditions. https://www.chicagofed.org/research/data/ag-conditions/index

Dhuyvetter, K. C., & Kastens, T. L. 2013. *KSU-Landbuy.xls*. AgManager.info Decision Tools, http://www.agmanager.info/Tools/default.asp

Edwards, W. M. 2015, November. *Evaluating a land purchase decision: Economic analysis*. Information file C2-76, Iowa State University Ag Decision Maker, http://www.extension.iastate.edu/agdm/wholefarm/html/c2-76.html

Edwards, W. M. 2015, November. *Farmland purchase analysis*. Decision file C2-70, Iowa State University Ag Decision Maker, http://www.extension.iastate.edu/agdm/decisionaidswd.html#llv

Edwards, W., & Hofstrand, D. 2010, May. *Returns to farmland ownership*. Ag Decision Maker newsletter, Iowa State University, http://www.extension.iastate.edu/agdm/articles/edwards/EdwMay10.html

Kastens, T. L., & Dhuyvetter, K. C. 2011, August. *Valuing and buying U.S. farmland with a consideration of non-ag features*. Publication AM-KCD-2011-18, Department of Agricultural Economics, Kansas State University, http://www.agmanager.info/valuing-and-buying-farmland-consideration-non-ag-features

Kastens, T. L., Dhuyvetter, K. C., & Falconer, L. 1999. *Farmland ownership*. Texas Agricultural Extension Service, Texas A&M University System, http://ageco-ext.tamu.edu/files/2013/10/rm5-14.pdf

Kay, R. D., Edwards, W. M., & Duffy, P. A. 2016. *Farm management*. (8th Ed.). New York: McGraw-Hill.

Murray, W. G., Harris, D. G., Miller, G. A., & Thompson, N. S. 1983. *Farm appraisal and valuation*. (6th Ed.). Ames: Iowa State University Press.

Plastina, A. 2016, January. *Financial performance measures for Iowa farms*. File C3-33, Ag Decision Maker, Iowa State University, http://www.extension.iastate.edu/agdm/wholefarm/html/c3-55.html

University of Illinois. 2009, February. *Land purchase analysis*. Farmdoc FAST Tools, http://www.farmdoc.illinois.edu/pubs/FASTtool.asp?category=invest

Zimmermann, J. 2014, March. *Calculating NPV takes the guesswork out of farmland purchases*. Ag Advance.com, http://agadvance.com/issues/mar-2014/calculating-npv-takes-guesswork-out-of-farmland-purchases.aspx