Implications of Alternative Farm Tractor Depreciation Methods[1]

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Abstract

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Responsible management and tax policy related to depreciable resources should consider the accuracy of depreciation methods in estimating current market value. This paper compares seven depreciation methods for farm tractors with respect to information required and accuracy of remaining value relative to market value. Management and policy implications are discussed.

Implications of Alternative Farm Tractor Depreciation Methods

The costs of owning and operating farm machinery play a key role in the decision- making process for farmers. Machinery operating and ownership costs may account for more than half of the costs of crop production (Kastens 1997a). Therefore, having an accurate estimate of farm machinery costs is important for producers.

Depreciation, usually the largest annual ownership cost of machinery (Langemeier and Taylor 1997), is the decline in value of an asset over time because of age, physical wear, technical obsolescence, and changes in the market supply and demand for the asset. Depreciation defined in this manner is sometimes called "economic" depreciation to distinguish it from depreciation used for income tax purposes. Because depreciation is a significant cost to farm managers and because tractors are the primary machines used on most crop farms, this paper focuses on estimating farm tractor depreciation.

Typically, farm managers and applied economists have categorized depreciation as a fixed cost. However, most crop farm machinery depreciates faster with higher rates of use, making some portion of depreciation a variable cost. Treating a portion of tractor depreciation as a variable cost may increase the accuracy of estimates of depreciation and remaining value. Numerous methods are available to farm managers. These methods require different information and procedures and yield varying estimates. Consequently, a comparison of farm tractor depreciation methods is warranted.

The purpose of this paper is to compare seven depreciation methods with respect to the information required and procedure used and to illustrate how they may differ in estimating remaining value. In addition, management and policy implications are discussed.

Depreciation Methods

Depreciation methods differ in terms of how initial depreciable value is determined, factors and calculation procedures for estimating depreciation, and difficulty of use. The remaining value of a tractor is its current market price. Annual depreciation is the difference obtained by subtracting last year's remaining value from the remaining value in the current year. Numerous factors affect the remaining value of a tractor. These factors include age, intensity of use, condition, manufacturer, size, and the market supply and demand for that tractor. Because the depreciation methods under comparison vary in many aspects, a discussion of their differences is warranted.

The seven alternative depreciation methods being compared are those of the American Society of Agricultural Engineers 1996(ASAE); Cross and Perry 1995(CP); North American Equipment Dealers Association (NAEDA, Wallace and Maloney 1997)*;* Kansas Management, Analysis, and Research (KMAR) of the Kansas Farm Management Associations (Kastens 1997b); U.S. Bureau of Economic Analysis (used to calculate National Income and Product Accounts, Fraumeni 1997); and two U.S. income tax methods (U.S. Department of the Treasury 1997a).

The ASAE (1996) depreciation formulas are based on nationwide averages for the remaining values of four classes of agricultural equipment. For tractors, the remaining value formula is:

$$RVP = 0.68(0.920)^{n} \qquad (1)$$

where RVP is the remaining value percentage of current list price, and *n* is the age of the tractor in years.

Current list price is the list price today (or in the year of sale) for the same or a comparable model tractor. To calculate the remaining value of a tractor, the current list price of the tractor is multiplied by the RVP. In addition, the average annual depreciation can be determined by subtracting the remaining value from the initial purchase price and dividing by *n*. Likewise, the average annual depreciation percentage can be computed by subtracting the RVP from 100% and dividing by *n* (Am. Soc. of Agric. Eng. 1996). New tractors typically sell for 80-90% of list price (Bowers 1994). Therefore, if initial value of a tractor is based on list price, then the average annual percentage depreciation could be computed by subtracting the RVP from 85% and dividing by *n*.

Cross and Perry in 1995 published results of an extensive study in which age, intensity of use, condition, manufacturer, size, region, auction type, net farm income, and prime interest rate were variables in estimating remaining value. Their data were auction sale prices for farm equipment reported from 1984 to 1993 in the *Farm Equipment Guide*.

The CP method uses a Box-Cox flexible functional form to reflect the actual depreciation patterns inherent in different types of machinery. Separate equations for tractors 30-79 hp, 80-149 hp, and 150+ hp are used to calculate RVP. Equation (2), the reduced-form remaining value function, is based on the estimated coefficients for John Deere tractors over 150 hp, in good condition, that were sold at farmer retirement auctions in the middle Great Plains. In addition, coefficients for current, 1-year lagged, and 2-year lagged U.S. real net farm income and prime interest rate were multiplied by 1997 projected, 1996, and 1995 U.S. real net farm income and 1997 prime interest rate.

$$RVP = (1.27684 - 0.22231AGE^{0.35} - 0.00766HPY^{0.39})^{2.22222} \tag{2}$$

RVP is the remaining value percent (of current list price), AGE is tractor age in years, and HPY is the average hours of use per year (Cross and Perry 1995).

A third method of estimating depreciation and remaining value is based on comparable age and model machinery values from the North American Equipment Dealers Association (NAEDA) *Official Guide* quarterly book of values for primary farm machinery such as tractors and combines (Wallace and Maloney 1997). The NAEDA collects sales price data from its member equipment dealers and compiles them into a list of representative values for used tractors. For each tractor model, prices are listed for older tractors in that model series and previous models that are comparable in size. The result is a list of prices for each year when a specific model of tractor is produced. The differences in prices from year to year can be used to estimate annual depreciation. The book also allows users to adjust the price of used tractors according to the number of hours the tractors have accumulated and the features the tractors have.

The fourth depreciation method to be compared, KMAR, is the one used by the Kansas Farm Management Associations. A committee of KMAR economists estimated that the remaining value (salvage value) of the average 10-year-old tractor was 35%. They then used the 10-year tax-like depreciation schedule from the initial new or used purchase price (cash plus trade boot, if applicable) that came the closest to reaching the 35% salvage value in 10 years. The 100% 10-year declining balance method best arrived at the 35% remaining value (Kastens 1997b).

The fifth method of depreciation is the one used by the U.S. Bureau of Economic Analysis to measure depreciation in the National Income and Product Accounts. For farm tractors, this involves use of the declining balance method over 9 years, with a depreciation rate of 14.52% (Fraumeni 1997).

The final depreciation methods are parts of the Modified Accelerated Cost Recovery System (MACRS) and provide farm managers the means for depreciating farm tractors with the fastest and the slowest methods allowed in the U.S. tax code (U.S. Dept. of the Treasury 1997a). They are the 150% declining balance with the General Depreciation System (GDS) recovery period, and the straight line with the Alternative Depreciation System (ADS) recovery period.

Numerical Example

To illustrate how each method differs, two identical 1992 John Deere (JD) model 4960 tractors with mechanical front wheel drive (MFWD) but with 5,100 and 1,353 hours of use were selected from the classified advertisement section of the December 29, 1997 edition of the *High Plains Journal.* Thus, the remaining value of the tractors estimated by the depreciation formulas will be compared to the market value of the tractors reported in the *High Plains Journal*. The market values of the 5,100 hour and 1,353 hour JD 4960s were $52,619 and $71,217, based on the Fall 1997 NAEDA *Official Guide* ratio of the resale cash price to the retail advertised price.

All of the methods to be compared, with the exception of the NAEDA method, require a current list price or an actual purchase price. Remaining value is estimated as a percentage of either current list or actual purchase price with these methods. The 1992 NAEDA *Official Guide* shows that the estimated purchase price of the 1992 JD 4960s is $82,917. The current list price of the two tractors is $119,619. This list price is the selling price of a 1997 JD model 8300 tractor, the tractor comparable to the 1992 model 4960, converted to a list price by dividing it by 0.85.

Using equation (1) the ASAE method yields an RVP of 0.448 for both tractors. Multiplying the RVP by the current list price of $119,619 results in a market value of $53,610 for both tractors (Table 1). Applying equation (3) given an average annual depreciation (AAD) of $5,861 for each tractor.

$$\text{AAD} = (\text{Purchase Price - RV})/\text{Age} \qquad (3)$$

According to equation (2), the CP method yields RVPs for the tractors with 5,100 hours and 1,353 hours of 0.563 and 0.640, respectively. The corresponding remaining values are $67,342 and $76,610. The AADs are $3,115 for the 5,100-hour tractor and $1,261 for the 1,353-hour tractor.

To use the NAEDA method, one needs to look up the base value (in 1997) of a 1992 John Deere 4960. The Fall 1997 *Official Guide* lists average 1992 4960 models with 2,000 hours for $65,683. However, that edition of the *Official Guide* required an adjustment of $3.20/hour for each hour less than or greater than 2,000. Also, a $6,000 adjustment must be added for the MFWD option (Wallace and Maloney 1997). Therefore, the 5,100-hour tractor has a value of $61,763, and the 1,353 hour tractor has a value of $73,753 according to the NAEDA method.

The KMAR method using a 100% 10-year declining balance yields an RVP of 0.59 ($[1 - 0.10)^5]$) for both 5-year-old tractors. With an initial new purchase price of $82,917, the remaining value of both tractors would be $48,921. The constant 14.52% annual depreciation rate of the U.S. Bureau of Economic Analysis method resulted in a remaining value of $37,841 for each tractor.

Calculation of remaining value associated with the two U.S. income tax depreciation methods is based on the assumption that no Section 179 deduction was taken and use of the half-year convention (U.S. Dept. of the Treasury 1997b). The RVPs after 5 years are 0.306 when the 150% declining balance with GDS method is used and 0.55 when the straight line with ADS method is used (U.S. Dept. of the Treasury 1997a). These methods result in market values of $25,397, and $45,604, respectively.

Management Implications

The seven alternative depreciation methods offer farm managers several different options to estimate the economic depreciation of their tractors. Practically, the choice of economic depreciation method often may be viewed as a tradeoff between simplicity and accuracy. Farm managers most likely would prefer to use the economic depreciation method that requires the least amount of time and information to use and most accurately estimates remaining value. Accurate measures of remaining value and annual depreciation are needed to measure asset values on market value balance sheets, to measure cost of production on accrual basis income statements, to construct enterprise budgets, and to evaluate strategies for acquiring machinery services.

Because U.S. tax laws allow large depreciation deductions early in the life of a tractor, the economic depreciation is most likely less than the tax depreciation for that tractor. As a result, farm managers also must consider the tax management implications when estimating economic depreciation. They should select the tax depreciation method that would maximize the present value of after-tax income. This is especially important when evaluating strategies for acquiring machinery services.

For the two-tractor example used in the previous section, the NAEDA method provided the most accurate economic depreciation and remaining value for the 5-year-old tractor with 1,353 hours, whereas the ASAE method was the most accurate for the tractor with 5,100 hours. On average, these two methods were the most accurate. As expected, the methods used for income tax purposes overstated economic depreciation and, therefore, underestimated remaining value.

Although the example suggests that the NAEDA and ASAE methods predict remaining value closest to actual market value, they may not be the most suitable methods for all farm managers. For example, farm mangers may not have access to the NAEDA *Official Guide* or the ASAE or Cross and Perry formulas. Therefore, they may prefer or find it less costly to use the simple KMAR or tax methods. Because the NAEDA method is based on comparable sales, it likely will be very useful for estimating current tractor prices but less useful for estimating future prices. Also, because this paper considers only one size and brand of tractor, farmers may find that another method is more accurate for their tractors.

Policy Implications

Large differences exist between the most accurate methods for estimating economic depreciation of the example tractors, ASAE and NAEDA, and the current U.S. tax methods. Consequently, in an era of federal budget reductions, the idea of making depreciation deductions follow a pattern more consistent with reductions in economic value may develop into policy to reduce potential tax advantages to farmers who purchase tractors (Hansen and Lee 1991). One way to adjust the current tax laws to reflect more accurate depreciation over the life of an asset is to allow farm managers to deduct tractor depreciation as a variable cost based on hours of use. As a result, farmers probably would lose the opportunity to take accelerated depreciation deductions.

The most obvious losers of a change that would reduce deductions in the early years of a depreciable asset's useful life would be farmers, because they would not be able to deduct a depreciation expense that often is greater than economic depreciation and, therefore, would lose interest earned on tax savings. Furthermore, farmers who did not use their tractors heavily would have low depreciation deductions, thereby lowering the incentive to purchase new tractors. The demand for new tractors might decrease, and the demand for used tractors might increase. This indicates that farm equipment manufacturers also would lose because of a change in policy. On the other hand, the government would gain if the tax policy changed, because it would collect more revenue earlier and, therefore, would save interest costs.

The probability of a reduction in depreciation allowances passing into law is low. For policy makers, specification of tax laws that govern depreciation will consider goals such as encouragement of investment, satisfaction of clientele, and effective relationships with other policy makers. Lawmakers probably would not be willing to confront a powerful farm (and nonfarm) lobby to pass a new tax law that could have negative impacts on agriculture and other businesses. Regardless, a better understanding of machinery depreciation will foster a better understanding of policy actions.

Conclusion

Farmers need an accurate representation of farm tractor depreciation in order to measure asset values, to measure costs of production, to construct enterprise budgets, and to evaluate strategies for acquiring machinery services. Many methods to estimate depreciation and remaining value are available to farmers, but they differ as to the information that is needed to use them, calculation procedures used, and accuracy in estimating remaining value. With current U.S. tax rules, depreciation for tax purposes usually will differ substantially from economic depreciation. Therefore, farmers usually will need to use economic depreciation methods to measure depreciation costs and machinery values, while recognizing the tax implications associated with machinery purchases and sales.

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Table 1. Depreciation Methods, 1993 through 1997 Depreciation, Remaining Value at the End of 1997, and Actual Market Value in December 1997 for 1992 John Deere 4960 Tractors with 5,100 and 1,353 Hours of Use.[a]

Depreciation Method	Depreciation 1993 through 1997		Remaining Value at End of 1997				Average % of Actual
	5,100 hrs.	1,353 hrs.	5,100 hrs.		1,353 hrs.		
	$	$	$	% of Actual	$	% of Actual	
American Society of Agricultural Engineers	29,307	29,307	53,610	102	53,610	75	89
Cross and Perry	15,575	6,307	67,342	128	76,610	108	118
North American Equipment Dealers Association	21,154	9,164	61,763	117	73,753	104	111
Kansas Management, Analysis and Research	33,996	33,996	48,921	93	48,921	69	81
U.S. Bureau of Economic Analysis	45,076	45,076	37,841	72	37,841	53	28
U.S. Tax, 150% Declining Balance MACRS, GDS[b]	57,520	57,520	25,397	48	25,397	36	42
U.S. Tax, Straight Line[b] MACRS, ADS	37,313	37,313	45,604	87	45,604	64	76
Actual Market Value	30,298	11,700	52,619	100	71,217	100	100

Table 1. Continued

[a] In order to logically have 5 years of depreciation for each method, we assumed that the tractors were ordered in late 1992 and delivered in January 1993.

[b] The modified Accelerated Cost Recovery System (MACRS) consists of two systems used to calculate depreciation for U.S. income tax purposes: the General Depreciation System (GDS) and the Alternative Depreciation System (ADS).

Of the alternatives available under current tax laws, the 150% declining balance method using GDS takes the most depreciation earliest in the asset's useful life, and the straight line method using ADS takes the most depreciation latest in the asset's useful life. Calculations for U.S. income tax methods were based on the half-year convention and no Section 179 deduction.