



The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

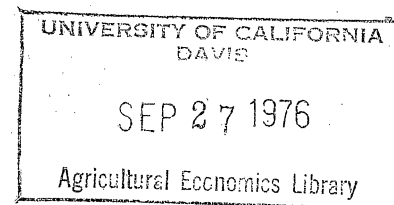
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.

Inflation
C

1976



INFLATION AND CROP PROFITABILITY:
HOW MUCH CAN FARMERS PAY FOR LAND?

Warren F. Lee and Norman Rask*

Introduction

The purchase of a parcel of farm land can be one of the most difficult investment decisions confronting farm operators. Compared to other production inputs, land is purchased infrequently and usually involves a large, long-term financial obligation. The land investment decision is especially critical today, when many are questioning the ability of farm income to support current land values at "normal" commodity prices.

Fairly stable relationships existed during the 1960's between land values, net returns to farming and the general rate of inflation (see Table 1). However, during the 1970's and especially since 1972, land prices have escalated sharply, net farm income has been very volatile at high levels and non-land production costs have increased faster than the general price level (consumer price index). These recent trends raise serious questions not only of magnitude but also direction of movement for these important determinants of how much farmers can pay for land.

* Associate Professor and Professor respectively, Department of Agricultural Economics and Rural Sociology, The Ohio State University. The authors are indebted to Bernard L. Erven, D. Lynn Forster and Edgar T. Shaudys for their helpful comments on an earlier draft. Any errors that remain are attributable solely to the authors.

Paper presented, AAER annual meetings, Penn State University, Aug. 15-18, 1976.

TABLE 1: Index of Farm Land Values Per Acre,
Net Returns to Farming, and Production Costs

Year	Consumer Price Index	<u>Index of Farm Land Values</u>		<u>Index of Farm Net Returns</u>		Index of Farm Production Costs
		U.S.	Corn Belt ^{1/}	U.S.	Corn Belt ^{1/}	
(1967 = 100)						
1960	89	69	70	94	79	92
1961	90	70	68	98	92	93
1962	91	74	70	99	92	94
1963	92	77	73	96	93	95
1964	93	82	78	86	76	94
1965	94	86	82	105	114	96
1966	97	94	92	114	119	99
1967	100	100	100	100	100	100
1968	104	107	106	99	92	102
1969	110	112	112	115	113	106
1970	116	117	114	113	99	110
1971	121	122	117	116	104	115
1972	125	132	125	149	125	122
1973	133	150	142	271	262	146
1974	148	187	185	213	149	172
1975	161	214	216	213	145	188
1976 ^{2/}	170	245	280	-	-	-

Sources: Bureau of Labour Statistics, U.S. Department of Labour, Consumer Price Index. E.R.S., U.S.D.A., Farm Real Estate Market Developments (various issues). E.R.S., U.S.D.A., State Farm Income Statistics, Supplement to Statistical Bulletin, No. 547, September 1975.

^{1/} Estimated from published individual state data for Iowa, Missouri, Illinois, Indiana and Ohio.

^{2/} Estimated.

We accept the proposition that prospective buyers must evaluate investments and make decisions based on present conditions with appropriate allowances for future anticipated trends. In this paper, we have not attempted to guess the future direction nor magnitude of these important variables, but we have developed a framework for analyzing farmland investments. A capital budgeting decision model developed by Lee for evaluating farm real estate purchases is used to test the land price sensitivity of a set of decision variables. Specific case situations are analyzed by comparing buyers with different characteristics, each facing favorable and unfavorable economic trends. These specific situations are then compared to illustrate how much farmers can afford to pay for land under specified conditions and expectations. For purposes of analysis, we are assuming a Corn Belt farm situation, although the general results and conclusions would apply to most parts of the country.

A Model for Evaluating Land Prices

The traditional formula used by real estate appraisers to estimate land values is $V = I/r$ where V is the estimated value, I is the expected residual net return to land and r is the capitalization rate (Suter, pp. 247-52). For example, if a parcel of land is expected to produce a net rental income of \$50 per acre and the opportunity cost of money is, say, 8 percent per annum, then the estimated land value is:

$$V = I/r = \$50 \div 0.08 = 625 \text{ per acre}$$

As Crowley suggests, this formula provides an accurate estimate only if three conditions are met: (1) the investment is expected to produce the same annual net rent over time, (2) the capitalization rate used to discount future net rent remains constant and (3) an infinite or very long investment time horizon is considered. Crowley goes on to show that these three conditions are rarely met and that the apparent rate of return on farmland, given by $r = \frac{T}{V}$ generally underestimates the actual rate of return.

Despite the obvious shortcomings of the traditional income capitalization approach, the price that a prospective purchaser can afford to pay for a parcel of land is strongly influenced by his income expectations and his opportunity cost of capital. Land purchases are generally financed with borrowed capital, thus credit terms such as interest rates, down payments and the length of the loan amortization period must be taken into consideration. An important, but often overlooked variable is the extent to which anticipated annual net returns and long-term capital gains will be reduced by income taxes. A buyer's bidding position is also influenced by the length of the planning horizon, and his expectations about future trends in land prices and the rate of growth in net returns to land.

The foregoing suggests that the land purchase decision can be evaluated using standard capital budgeting procedures.^{1/} In other words,

^{1/} Capital budgeting techniques are covered in (Aplin and Casler), (Hopkin et al., Ch. 9, 10, 11) or (Nelson et al., Ch. 3).

purchasing a parcel of land is an acceptable investment alternative:

- 1) If the present value of net cash receipts is equal to or greater than the present value of the cash outlays (i.e., if the net present value is equal to or greater than zero).
- OR 2) If the yield or internal rate of return exceeds the opportunity cost of capital.

Capital budgeting is a widely accepted method of evaluating investments in short and intermediate term depreciable assets such as machinery (Aplin and Casler). Hopkin, Barry and Baker have illustrated the potential use of capital budgeting for evaluating real estate investments as well (Ch. 12).

The major cash inflows associated with an investment in real estate consist of the annual net returns to the land and the returns from selling the land at the end of the planning horizon. Cash outlays consist of the down payment, principal and interest payments on the mortgage loan and income taxes.

The annual net returns to land should be regarded as a residual return to land after all production costs except interest charges on land debt have been deducted from gross receipts. In areas where there is an active rental market, real estate appraisers generally use the net rental method (landlord approach) to estimate this residual return. In areas where renting is less common, a budgeting approach can be used. A discounted cash flow model was developed with the objective of providing

the individual land buyer with a method of evaluating a parcel of land using his particular discount rate, income expectations, credit terms and income tax situation (Lee). The following notation is used:

\bar{P} - Average price per acre from recent sales of comparable parcels.

CC - The buyer's opportunity cost of capital after taxes.

n - The buyer's planning horizon in years.

ANI - Expected annual net returns per acre before taxes.

GNI - Expected annual rate of growth in annual net returns per acre.

MTR - The buyer's marginal income tax rate (combined federal and state tax rate based on estimated taxable income after the parcel is purchased).

DP - The proportion of the purchase price paid down.

IR - The nominal rate of interest charged on the mortgage loan.

t - The amortization period on the loan.

INF - The expected annual rate of inflation in land values.

T^* - The tax rate that will apply to capital gains income in year n when the parcel is sold.^{2/}

^{2/} Since only half of capital gains income is taxable, T^* is equal to half the marginal tax rate that will apply in the year the parcel is sold. T^* was substituted for $MTR/2$ to allow for the possibility that sale of the property will result in a significantly higher taxable income, and hence, a higher than usual tax rate in year n. T^* is also influenced by special provisions in the income tax law such as those that provide for postponement of the capital gains tax when the farm is sold on a land contract. Such provisions could have the effect of reducing the value of T^* .

P* - The maximum bid price, given values for the preceding 11 variables.

The maximum bid price, P*, or the price that gives a net present value of 0, is given by:

$$\begin{aligned}
 P^* = & \left\{ \sum_{i=1}^n \frac{(1+GNI)^i}{(1+CC)^i} (ANI) (1-MTR) + \frac{(1+INF)^n}{(1+CC)^n} (P) (1-T^*) \right\} \\
 & \div \left\{ DP + (1-DP) \left[\frac{(1+CC)^t - 1}{CC(1+CC)^t} \right] \left[\frac{IR(1+IR)^t}{(1+IR)^t - 1} \right] \right. \\
 & - (1-DP)(MTR)(IR) \left[\frac{IR(1+IR)^t}{(1+IR)^t - 1} \right] \sum_{i=1}^t \frac{1}{(1+CC)^i} \left[\frac{(1+IR)^{t-i+1} - 1}{IR(1+IR)^{t-i+1}} \right] \\
 & \left. - \frac{T^*}{(1+CC)^n} \right\} \quad \underline{3/}
 \end{aligned}$$

where $t \leq n$

Although considerably more complicated than the traditional appraisal formula, this equation includes most of the major, economic variables that affect the land purchase decision.

3/ For details concerning the mathematical derivation of this equation, see (Lee).

Application

"Basic Case" Example

The input data for the "basic case" represent budgeted 1976 cost and income data for Corn Belt farms. Annual inflation rates for net returns and land values are set at five percent, a value that closely approximates pre-1972 rates (Table 1). A first mortgage loan for 75 percent of the purchase price at 10 percent interest is assumed. Again, these approximate 1976 Corn Belt values. The loan is repayable in equal annual installments over a 25 year period.

The income stream from the investment will be subject to a 30 percent marginal tax rate and the capital gains tax will amount to 25 percent of capital gain when the property is sold at the end of the 25 year planning horizon. The investment must yield a minimum after-tax rate of return of 10 percent per annum.

The input data for the "basic case" can be summarized as follows:

\bar{P} = \$1000 per acre.

CC = 0.10.

n = 25 years.

ANI = \$70 per acre per year.

GNI = .05 per annum.

MTR = 0.30.

DP = 0.25.

IR = 0.10 percent per annum.

t = 25 years

$INF = .05$ per annum.

$T^* = 0.25$.

The solution for the maximum bid price, P^* , given these values for the 11 input variables is

$P^* = \$1,172$ per acre.

In other words, under these assumptions farmers can bid up to \$172 per acre above average price of comparable farm sales in this area and still earn the required 10 percent after-tax rate of return.

Sensitivity Analysis

The "basic case" was used as a point of departure for examining the response of the maximum bid price to changes in the 11 input variables. The range over which each variable was examined reflects either the entire possible range (e.g., 0 to 1 for the down payment) or a reasonably comprehensive range (e.g., .06 to .14 for the rate of interest on the mortgage loan). In every case, values for all variables other than the one being examined were fixed as specified in the "basic case."

Table 2 summarizes the sensitivity of the maximum bid price to changes in the input variables. In general, the three variables related to expected returns have the greatest effect on the maximum bid price. As INF is increased from 0 to 12 percent per annum, the maximum bid price increases from \$966 to \$2,344 per acre. P^* is also very responsive to changes in values of expected annual net income per acre (ANI) and

TABLE 2: Sensitivity of Maximum Bid Price (P*) to
Changes in the Input Variables

Input Variable	Range of Values of Input Variable	Corresponding Range in Maximum Bid Price (P*)
<u>A. Terms of mortgage financing</u>		
Interest Rate (IR)	.06 - .14 per annum	1423 - 976
Down payment (DP)	0 - 1.0	1262 - 964
<u>B. Opportunity cost of capital (CC)</u>		
	.06 - 0.14 per annum	1647 - 885
<u>C. Land prices and inflation</u>		
Average price of land (\bar{P})	\$500 - \$1500 per acre	1026 - 1317
Expected rate of inflation in land values (INF)	0 - 0.12 per annum	966 - 2344
<u>D. Income and tax variables</u>		
Income per acre (ANI)	\$ 30 - \$110 per acre	669 - 1674
Growth in net income per acre (GNI)	-.03 - .05 per acre	727 - 1172
Marginal tax rate (MTR)	0 - 0.4	1274 - 1126
Capital gains tax (T*)	0 - 0.25	1233 - 1172
<u>E. Time horizon and loan amortization period</u>		
(n,t)	10 - 40 years	1058 - 1251

the expected rate of growth in net income per acre (GNI). The buyer's opportunity cost of capital (CC) is also an important determinant of the bid price. A prospective buyer who is content with a 6 percent after-tax rate of return on his investment can bid up to \$1,647 per acre. However, the maximum price that corresponds to a 14 percent rate of return is only \$885 per acre.

The terms of financing appear to be fairly important. High down payments and/or high interest rates cause significant decreases in the maximum bid price. As the interest rate (IR) is increased from 6 percent to 14 percent per annum, the maximum bid price drops to \$916 from \$1,423 per acre. A purchaser who can borrow the full amount of the purchase price at 10 percent per annum can bid up to \$1,262 per acre while the buyer paying cash can earn the 10 percent opportunity cost of capital only if he can buy the parcel for \$964 per acre. This leverage effect will occur only if the opportunity cost of capital exceeds the after-tax rate of interest on the mortgage. In the basic case, the after-tax cost of capital is 10 percent and with a 30 percent tax rate, the after-tax rate of interest on the loan is 7 percent. Thus, for values of CC less than 7 percent, P^* would be highest for a cash purchase ($DP=1$). In addition to the tax deductability of the interest payments, inflation also encourages the use of credit because the value of the land and the income are increasing while the loan is being repaid with "inflated dollars."

Some variables used in the analysis apparently have a comparatively minor effect on the maximum bid price. The value of P^* is relatively insensitive to changes in the marginal tax rate (MTR) because the annual net returns are largely offset by tax deductible interest payments on the mortgage loan. The small response of P^* to changes in the capital gain tax rate (T^*) occurs because the tax liability is discounted from 25 years into the future.

Analysis of Bidding Potential According to Buyer Characteristics

Four levels of possible economic trends (inflation) are considered for each of six buyer characteristic situations to study their relative bidding positions.

Economic Trend Levels

The two variables considered here are the expected annual growth rates in net returns (ANI) and land values (INF). Both have been at historically high levels since 1972. These two variables are related over time in that high net returns are very quickly capitalized into increased land values; however, while net returns are highly volatile from year to year, land values present a more uniform growth pattern over time and are notably sticky to down side movements in response to declining net returns. This behavior conditions the establishment of trend levels for the analysis. First, recent history would indicate

that land prices are not likely to experience an absolute decline over the life of an investment. Thus, a lower boundary for INF is set at 0. On the other side, it is reasonable to assume that land value increases cannot maintain present levels over a 20 to 40 year period. An 8 percent growth rate was selected for the boundary on the high side.

For the net return variable it is conceivable that a return to more normal world production levels, and hence a build up in world food supplies, coupled with a continued increase in non-land production costs could lead to a slightly negative trend in net returns when compared to present high levels. A lower boundary for growth in net returns is established at minus three percent and the high boundary was set plus at five percent.

Four specific trend alternatives were evaluated:

	<u>I</u>	<u>II</u>	<u>III*</u>	<u>IV</u>
Annual rate of growth in net returns (GNI)	-.03	.00	.05	.05
Annual rate of inflation in land values INF	.00	.03	.05	.08

* Basic Case values

Farm Real Estate Buyer Characteristics

Bidders for farm land enter the market representing a broad spectrum of financial positions ranging from the initial land acquisition with

little equity, through add-on purchases by established farmers. Correspondingly, they bring to the investment decision different levels of operating efficiency (income generating potential), planning horizons, income levels (tax obligation) and initial equity positions (down payment). While each individual investor will have a unique set of circumstances, it was possible to specify six general cases that span most individual situations. Characteristics of the six cases examined are shown in Table 3.

Case A portrays the young farmer making his initial land purchase. It is assumed that this purchase would be of modest size, therefore some size, related operating diseconomies would exist. The buyer would be at an early stage in his productive career and therefore would have a longer planning horizon. The smaller size would also result in less income, therefore, a lower tax bracket. Three sub-categories are specified for this initial purchase situation based largely on source of additional income. In Case A1, income from the farm operation alone must support the purchase entirely and a low tax bracket is assumed. In Case A2, off-farm income will increase the tax rate above that assumed in Case A1. In Case A3, additional land rented will result in some size economies. However, a modest size operation is still assumed and some income reduction from the basic case occurs. The marginal tax rate is the same as in Case A2.

TABLE 3: Relative Bidding Potential for Assumed Real Estate Buyer Situations

	Initial Land Purchasers			Absentee Landlord	"Basic Case"	Add-On Established Operator
	No Addi- tional Sources of Income	Additional Off-Farm Income	Additional Income as Tenant on Other Land			
<u>Variables^{a/}</u>	<u>Case A1</u>	<u>Case A2</u>	<u>Case A3</u>	<u>Case B</u>	<u>Case C</u>	<u>Case D</u>
Planning horizon	30	30	30	20	25	20
Income per acre (ANI)	\$ 50	\$ 50	\$ 60	\$ 60	\$ 70	\$ 75
Marginal tax rate (MTR)	.10	.20	.20	.35	.30	.35
Down payment	.20	.20	.20	.25	.25	.25
Loan Amortization period (t)	30	30	30	20	25	20
<u>Economic Conditions</u>	<u>Maximum Bid Price (\$ Per Acre)</u>					
I GNI = -.03, INF = 0	\$404	\$393	\$461	\$484	\$521	\$569
II GNI = 0, INF = .03	575	565	653	681	734	787
III GNI = .05, INF = .05	976	960	1108	1010	1172	1169
IV GNI = .05, INF = .08	1244	1249	1397	1169	1470	1454

^{a/} Variables not shown were as specified in the basic case (\bar{P} = \$1,000, CC = .10, IR = .10, and T^* = .25).

Case B describes the situation of an absentee landlord. Size is assumed adequate for "normal" operational efficiency. Some reduction in income is expected to result from separation of management and operation. A higher marginal tax rate and shorter planning horizon are assumed.

Case C is the "basic case" described earlier. It assumes a complete farm purchase of adequate size representing "normal" or "average" conditions for all variables. Case C would represent an established farmer changing farms or a new entrant with sufficient equity to purchase an economic sized unit.

Case D typifies an established owner-operator who is purchasing an add on unit. Some gains in size economies are assumed along with a shorter planning horizon and a higher marginal tax rate, compared to Case C.

Results

Interpretation of the results (Table 3) should be based on relative changes in the maximum bid price (P^*) between specific case situations rather than on absolute values. The estimated maximum bid prices in Table 3 demonstrate that anticipated future trends in land values and net returns to farming should have crucial impact on the current economic value of land. Depending on buyer characteristics, there is a two and one-half to a three-fold increase from the least favorable to the most favorable economic trend assumptions. Farm buyer situations also can

create differential bidding potentials, though these differences become narrower on a percentage basis under favorable economic trends. Regardless of economic trends, however, established farmers and those able to purchase complete economic units (Cases D and C respectively) are clearly in a superior bidding situation. Farm transition data for the Corn Belt confirm this potential. In 1975, for example, 70 percent of the units purchased were added to established operations. An additional 22 percent were complete farm units and only 8 percent were purchased as part-time units (Farm Real Estate Market Developments).

This analysis, however, does not explicitly account for the important issue of buyer behavior or more specifically, his ability to bear risk and thus his willingness to support high land prices in the face of uncertain future trends in net returns, and land values. Harris and Nehring have developed a similar model that does include variability in income per acre, the buyer's initial wealth position, and degree of risk aversion, along with many of the variables included here. Their conclusions are generally similar to ours, although they note that "...the largest farms may not have the greatest bidding advantage after all. A combination of higher marginal tax rate and diseconomies of size may cause (census) Class 0 farmers to have a lower maximum bid price than either Class I or Class II farmers" (p. 168).

The results in Table 3 also fail to explain recent Corn Belt land sales in the \$2,500 to \$3,000 per acre range. Presumably, such prices

are based on a more optimistic outlook, so, the established operator case (Case D) was changed to reflect a favorable outlook over a shorter time horizon. The time horizon (n) and loan repayment period (t) were set at 10 years. The cost of capital (CC) was reduced to 8 percent and equal growth rates were assumed for net income per acre (GNI) and land prices (INF). Values of all other variables are as specified in Case D (Table 3). Values of GNI (=INF) were then increased to yield values of P* in the \$2,500 to \$3,000 per acre price range.

The results indicate that while farmers who pay \$2,500 to \$3,000 for Corn Belt land may be overly optimistic in view of long run trends, their assumptions are by no means unrealistic in view of the recent past. A 15 percent per annum rate of growth in both net returns and land prices produces a maximum bid price of \$2,529. At 18 percent, the maximum bid price is \$3,168. In other words, even when the "going price" is only \$1,000 per acre, bid prices approaching \$3,000 per acre can be justified on expected values of GNI and INF that are considerably less than actual values since 1972.

Concluding Observations

This modest attempt to synthesize the position of a prospective farmland buyer in a capital budgeting framework indicates that expectations regarding future economic trends and financial position at time of purchase are major determinants of the maximum bid price. We agree with

Harris and Nehring: "The issues of ownership and control cannot be completely resolved until more accurate and complete specifications of the important parameters are made" (p. 169).

REFERENCES

1. Alpin, Richard D. and George L. Casler, Capital Investment Analysis Using Discounted Cash Flows, Columbus: Grid, Inc., 1973.
2. Crowley, William D., "Actual Versus Apparent Rates of Return on Farmland Investment," Agricultural Finance Review, Vol. 35, October 1974, pp. 52-57.
3. Harris, Duane G. and Richard F. Nehring, "Impact of Farm Size on the Bidding Potential for Agricultural Land," American Journal of Agricultural Economics, 58:2 (May 1976) pp. 161-169.
4. Hopkin, John A., Peter J. Barry and C. B. Baker, Financial Management in Agriculture, Danville: Interstate Printers and Publishers, Inc., 1973.
5. Lee, Warren F., "A Capital Budgeting Decision Model for Evaluating Farm Real Estate Purchases," Canadian Farm Economics, 11:3 (July 1976).
6. Nelson, Aaron G., Warren F. Lee and William G. Murray, Agricultural Finance, 6th ed., Ames: Iowa State University Press, 1973.
7. Suter, Robert C., The Appraisal of Farm Real Estate, Danville: The Interstate Printers and Publishers, Inc., 1974.
8. U.S. Department of Labour, Bureau of Labour Statistics, Consumer Price Index.
9. U.S.D.A., E.R.S., Farm Real Estate Market Developments, various issues.
10. U.S.D.A., E.R.S., State Farm Income Statistics, Statistical Bulletin, No. 547, Supplement, September 1975.