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LAND APPRECIATION RATES AND ECONOMIC JUSTIFICATION OF LAND VALUES*

by

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Agricultural land values have risen at unusually high rates in recent years. The usual forces hypothesized to have influenced this market are 1) high crop prices, 2) high levels of investment funds earned in agriculture, 3) "add-on" parcel demands stemming from surplus machinery capacity, 4) non-farm investment demands, 5) increased urban demands for land and 6) anticipation of future increases in value. The objective of this analysis is to demonstrate the relationship between land appreciation and land values and to suggest methods of bringing the land appreciation force into the land valuation process.

The income capitalization method used for assets of infinite life such as land is

1) $V = \frac{Y}{r}$

where V = present value, Y = net income (net owner share or net cash rent) and r = discount rate. An infinite period of time is assumed as well as constant income, interest rates and land values. Historically, land values derived from the income capitalization method have been well below market rates (Crowly). Suggested reasons for this deviation are 1) theoretical difficulties associated with estimating land productivity or income, 2) failure

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to include benefits to "add-on" bidders (Harris and Nehring), 3) difficulties in including land appreciation benefits and 4) buyers are satisfied with lower returns for land than that derived from discount rates based upon current interest rates.

In this paper the economic benefits resulting from land appreciation are analyzed using a capital budgeting model. Capital budgeting is an alternative to income capitalization in economic analysis of land investments (Hopkin, Barry and Baker; Lee; Lee and Rask). Capital budgeting sums discounted flows arising from the use of an asset over a period of time. Income tax aspects and flow variabilities can be considered in capital budgeting. Hence, investment analyses using capital budgeting can be placed on a before-or after-tax basis. The maximum bid price for land on an after-tax basis has been investigated using capital budgeting under conditions of an amortized loan where interest costs decrease over the period of the loan (Lee).

We have assumed a framework whereby land appreciation contributes to the value of the land asset where expected annual income as a percentage of investment is less than the discount rate. However, the model is of general nature so that annual income can be assumed to be higher than the discount rate balancing depreciation in the land asset. Both before-and after-tax analysis are presented here.

On a before-tax basis, methods of purchase or loan repayment do not affect required land appreciation rates. This does not hold on an after-tax basis. An outright cash or full equity purchase is assumed in this paper for both before-and after-tax analyses. If land is purchased under an amortized loan with constant annual payments, simplification of the capital budgeting analysis becomes more difficult compared to an outright purchase since interest payments decrease and principal payments increase over the

loan payback period. Interest and principal payments must be considered separately since the former is tax deductable and the latter is not. A still different situation is a perpetual debt loan where no principal is repaid. Under such an arrangement a constant interest charge must be accounted for in the analysis. Further, in the case of an amortized loan and a perpetual debt loan, the capital budgeting analysis is dependent upon the relation between the interest rate and the discount rate.1/

Results from capital budgeting a land investment over a 20 year (n) planning period are summarized in Table 1. For example purposes, a purchase price (Co) of $2,000 per acre and a discount rate (r) of eight percent is assumed. Flows are accumulated on a discounted before-and after-tax basis. The marginal income tax rate (MTR) is set at thirty percent.2/ Net income or net cash rent (Y) is assumed constant at $110 per acre or five and one-half percent of the purchase price. Five and one-half percent of the purchase price for cropland can be considered to be representative of the current level of net cash rent (U.S. Department of Agriculture).

In Table 1 total flows are accumulated on a discounted basis throughout the 20 years. Outflows are represented by a negative sign. The original $2,000 outflow is reduced by earned income over the period. For 20 years a discounted amount of $920.00 is needed from the land sale in year 20 to match the outflow on a before-tax basis. This amount translates into $4,288.00 sale. On an after-tax basis the sale price of $6,468.95 is required. This amount is higher than the before-tax case because of income taxes on earned income and capital gains tax on the appreciated value. The determination of these required selling values and necessary appreciation rates follows from the model in equation form.

Table 1. Example 20-Year Land Capital Budgeting Model.

Year	Purchase or Sale Co	Net Income Y	Net Income After-Tax Y(1-MTR)	Accumulated Discounted Net Flow Before-Tax r = .08	Accumulated Discounted Net Flow After-Tax r = .08
0	-2000			-2000	-2000
1		110	77	-1898.15	-1928.70
2		110	77	-1803.84	-1862.68
3		110	77	-1716.52	-1801.55
4		110	77	-1635.67	-1744.95
5		110	77	-1560.81	-1692.55
6		110	77	-1491.49	-1644.03
7		110	77	-1427.31	-1599.10
8		110	77	-1367.88	-1557.50
9		110	77	-1312.85	-1518.98
10		110	77	-1261.90	-1483.31
11		110	77	-1214.72	-1450.29
12		110	77	-1171.04	-1419.71
13		110	77	-1130.59	-1391.40
14		110	77	-1093.14	-1365.18
15		110	77	-1058.46	-1340.91
16		110	77	-1026.35	-1318.43
17		110	77	- 996.62	-1297.62
18		110	77	- 969.09	-1278.35
19		110	77	- 943.60	-1260.51
20		110	77	- 920.00	-1243.99
20	4288.08 (Before-Tax)				
20	6468.52 (After-Tax)				

In equation form, cash outflow must equal cash inflow. In Equation (2) the left side is the present value of the cash inflows (discounted value of the investment at the end of n years plus the discounted net annual cash income). The right side is the cash outflow for the investment under an outright cash purchase in year 0.

$$2)\quad \frac{Co(1+a)^n}{(1+r)^n} + [Y]\left[\frac{1-\frac{1}{(1+r)^n}}{r}\right] = Co$$

Where a equals the annual land appreciation as a percent of the previous years value and the factor $\left[\frac{1}{1-(1+r)^n}{r}\right]$ is recognized as the annuity discount factor. Solving for a yields

$$3)\quad a = \left(\left\{1-[Y]\frac{\left[\frac{1-\frac{1}{(1+r)^n}}{r}\right]}{Co}\right\}(1+r)^n\right)^{1/n} - 1$$

Thus a is found to be 3.89% which applied to the $2,000 purchase results in a selling price of $4,288.08.

The model can also be viewed in the sense of determining what income from land is required under conditions of no land appreciation. From Equation (2) when a = o, the annual income level is found as

$$4)\quad Y = \frac{\left[Co - \frac{Co}{(1+r)^n}\right]}{\left[\frac{1-\frac{1}{(1+r)^n}}{r}\right]}$$

which is $160 or an 8% return rate which also equals the discount rate in the example.

On an after-tax basis, the flows must account for income tax effects on yearly income and capital gains tax at sale. Hence, the capital budgeting model becomes

$$5)\quad \left[Cn - \frac{(Cn - Co)\,(MTR)}{2}\right]\left[\frac{1}{(1+r)^n}\right] + \left[Y\right]\left[\frac{1 - \frac{1}{(1+r)^n}}{r}\right](1 - MTR) = Co$$

where Cn (gross selling price) = $Co\,(1 + a)^n$

Equation (5) indicates that the discounted capital gain after-taxes plus the discounted after-tax income equals the initial purchase outlay.

Solving for a yields

$$6)\quad a = \left(\frac{(1+r)^n - \left\{\left[Y\right]\left[\frac{1 - \frac{1}{(1+r)^n}}{r}\right](1+r)^n\,(1 - MTR)\right\} - \frac{MTR}{2}}{1 - \frac{MTR}{2}}\right)^{1/n} - 1$$

In the example a equals 6.04 percent or a gross selling price of $6,468.52 is required in year 20. In year 20 when the asset is either sold or valued for sale, the marginal tax rate is again assumed to be 30%. This assumption may be unrealistic if a large income is derived from the land sale particularly if sold on a non-installment basis.

Also the annual income level required under no land appreciation is $228.57 from the example found by

$$7)\quad Y = \frac{(Co)(r)}{[1 - MTR]}$$

Where a = o

Equations (3) and (6) provide a relatively easy format for analyzing required land appreciation rates. These equations can be used to analyze the influence of differing annual net incomes, discount rates, planning periods and purchase prices on the annual rate of land appreciation necessary to economically justify the investment. For instance, in Table 2 the influence of net income (as a percentage of the purchase price, Co) is analyzed under both an eight and four percent discount rate.

On a before-tax basis a trade-off exists between net income and land appreciation rates. Either a zero yearly net income and an eight percent land appreciation rate or a zero land appreciation rate and an eight percent yearly net income satisfies the model under an eight percent discount rate. Between these two conditions, table 2 indicates what income levels and land appreciation rates are required. At income levels above the discount rate on a before-tax basis, depreciation of the land investment may occur.

It can be seen that higher land appreciation rates are required under the after-tax situation relative to the before-tax case. This suggests that individuals in higher tax brackets require a greater land appreciation rate than those in lower tax brackets. This agrees with the results from Harris and Nehring.

It can be seen that appreciation rates are highly responsive to discount rates. As we have seen in the before-tax case, if the annual net income return rate (based on Co) equals the discount rate, the land appreciation rate must equal zero. That is, when net income equals opportunity costs (assuming opportunity costs are represented by the discount rate), land values are not required to appreciate for the investment to be economically justifiable.

The consideration of appreciation rates in the economic justification of land purchases ignores liquidity problems particularly under large land loans and repayment schedules. That is, land appreciation will not normally generate cash to meet short-term obligations unless the land is sold. However, land appreciation may increase available credit to help alleviate liquidity problems.

Table 2. Land Appreciation Rates Necessary To Economically Justify Land Purchase at Varying Net Incomes (n=20)(outright cash purchase).

	Land Appreciation Rate-Percent			
Net income	r = 8%		r = 4%	
(% of Co)	Before-tax	After-tax	Before-tax	After-tax
0	8.00	8.70	4.00	4.48
2.0	6.83	7.87	2.36	.29
4.0	5.34	6.90	0.00	1.77
6.0	3.30	5.73	-4.43	- .40
8.0	0.00	4.23		-4.03
10.0	-11.6	2.18		
12.0		-1.20		

FOOTNOTES

1/ The after-tax capital budgeting analysis of the three situations (outright purchase, amortized loan and perpetual debt loan) where the interest rate does and does not equal the discount rate under constant and changing land incomes are presented in Helmers and Watts.

2/ The authors are aware that a thirty percent marginal tax bracket does not exist, however, thirty percent was chosen for convenience.

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