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The Rate of Return to Investment in Agriculture and the Measurement of Net Farm Income

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Introduction

The profitability of agriculture has long been a key issue in the assessment of the general health of farming as an economic activity and in the justification of governmental activity in the farm sector. Therefore, it is important to measure the economic status of the sector as accurately as possible. Some of the most important statistics in this effort are estimates of returns to agricultural resources. These returns are conveniently separated into two broad classes: returns to human resources and returns to nonhuman capital. Agricultural economists have provided evidence on both categories of returns. This paper considers the returns to investment in nonhuman capital. An appropriate estimate of these returns under inflationary conditions is found to have important implications for the proper measurement of net farm income.

Problems in Measuring Returns

Estimates of returns to ownership of land, equipment, and financial resources in agriculture have recently been constructed and discussed by several economists; for example, Melichar, Council of Economic Advisers, Hottel and Evans, Hottel and Reinsel, and Tweeten. The approach taken in these studies is to estimate the net income attributable to equity in farm assets as a residual claimant on farm income. This net return is then

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divided by an estimate of the value of equity investment assets minus debt to obtain a rate of return. Tweeten (p. 60), for example, finds a total rate of return to farm equity of 12.3 percent per year on average during the 1960-1976 period. He then compares a similarly constructed measure of returns to equity in common stocks of U.S. corporations, which turns out to be 6.0 percent for the same period. There are (at least) two fundamental problems with existing estimates of the rate of return to investment in agriculture. First, part of the essence of family farming is that human resources—the operator's labor and management—or participants in residual returns (and losses). Yet, the papers cited above all impute a cost of operator's labor and management by means of a wage rate (operator and family labor) and percent of gross receipts (management) leaving nonhuman capital as the residual claimant on net income. Second, in addition to obstacles to specifying a fully appropriate numerator (flow of net income), there are difficulties in measuring the denominator (value of equity) suitable for estimating a rate of return.

We do not claim to have solutions for the problems in either area, but we do have some information on their quantitative significance. On the question of labor-return accounting, allocating part of the residual gains and losses to the operator's managerial returns would reduce the variability of year-to-year changes in the rate of return to equity. Perhaps more important, however, is the effect of the choice of a particular wage rate on the level of returns to equity. Table 1 shows how estimated rates of return to equity would have been affected in the 1940-1978 period if the operator's labor had been priced at the nonfarm manufacturing wage rate instead of the hired farm labor wage rate that has typically been used. The point is not that the manufacturing wage rate should have been used, but to show the

Table 1. Estimates of average returns to equity capital in farm production assets from U.S. farm production income and real capital gains, market value basis, 1940-78

Year	Rate of return as a percentage of equity capital		Reduction in rate of return to equity capital from using manufacturing wage rate
	Where operator's labor priced at hired farm wage rate 1/	Where operator's labor priced at manufacturing wage rate	
1940-44	15.2	1.6	13.6
1945-49	8.2	2.6	5.6
1950-54	5.7	-.5	6.2
1955-59	7.7	2.4	5.3
1960-64	6.4	2.5	3.9
1965-69	7.2	4.9	2.3
1970-74	13.1	11.4	1.7
1975-79	11.6	10.3	1.3

1/ Based on estimates from Hottel and Evans.

sensitivity of estimated rates of return to wage-rate assumption. Note that the difference has lessened sharply since the mid-1960's. In addition, there is substantial doubt about the appropriate labor quantity. Most studies to date have used the labor-hours data reported by the Economics, Statistics, and Cooperatives Service (ESCS) of USDA in Farm Production and Efficiency. However, these data are based on labor "requirements" per acre or per unit output, and not on survey data. Data from the quarterly farm labor survey of the Statistical Reporting Service, ESCS, while they involve problems also, suggest a farm labor force nearly 50 percent larger. For the late 1970's, the SRS data imply a reduction in the rate of return to equity of almost 2 percentage points.

In estimating the appropriate denominator for calculating the rate of return, there are also problems in valuing agricultural assets. Because sufficient data are not available separately for farm owner-operators and nonfarm owners of agricultural assets, the measured rate of return combines the equity of the two groups. Thus, it pertains to returns earned by all owners of agricultural assets, not only farm operators. The main valuation problem involves determining a price for owned assets. Hottel and Evans discuss the alternatives of book value and current market value of equity. Because of appreciation over time in the real value of farm assets, market value exceeds book value as calculated by generally accepted accounting principles. The favored approach of Hottel and Evans, first worked out by Melichar, is to incorporate real capital gains in the estimated flow of returns and then divide by current market value to obtain a rate of return. The choice of method here makes a substantial difference in the measured rate of return. For 1978, the rate of return on a book-value basis is almost triple the rate of return on a market value basis (see Hottel and Evans, tables 5 and 6).

We do not explore measurement issues further in this paper. Instead we turn to difficulties that arise with respect to the economic significance of measured rates of return, even if correctly estimated.

Economic Measures of Historical Rates of Return

Two questions about the return to investment in agriculture should be distinguished: (1) What has been the rate of return experienced by those who have invested wealth in agricultural assets in the past; and (2) What rate of return can current investors in agriculture expect to receive?

A problem with the annual rate of return as calculated in the literature cited above is that it does not provide a generally meaningful answer to either question. Consider the rate of return as measured by the ratio of total 1978 returns from agricultural assets to the market value of equity in agriculture, which Hottel and Evans estimate at 10.5 percent. During the same year, the corresponding total rate of return to investment in common stocks (as represented by Standard & Poor's composite index) was 6.4 percent. 1/ Potential interpretations of these estimates are that they measure relatively high historical returns to owners of agricultural assets or else that they indicate high prospective returns. However, drawing inference about prospective levels of returns from rate of return calculations is dubious because the prices of assets adjust to both historical and prospective levels of return. If the outlook is usually favorable, the prices of assets will be bid up, yielding a lower rate of return. Thus, one would expect asset prices to adjust such that equivalently taxed assets of comparable risk would have the some prospective rate of return. One need not accept the extreme form of this position to accept the idea that asset prices incorporate expectations of future changes in returns to some extent, so that assets with higher current rates of

return are not always a better investment prospect than assets with lower rates of return.

Moreover, a 6.4 percent rate of return in 1978 is not necessarily an indication that current owners of stocks have done that well in their investments. Many owners of common stocks earned a 6.4 percent return (price gain plus real dividends) during 1978, but nonetheless have earned much lower rates of return on their investments in the period since acquisition. Similarly, the 10.5 percent rate of return to agricultural assets does not imply either better-than-average prospects for the current purchaser of the asset, or good historical performance experienced by current owners.

The 1978 rate of return conveys meaningful information about the historical rewards earned by a special set of investors: those who acquired ownership of the asset and the income from it at the beginning of 1978 and held it to the end of the year. The returns may be either realized by sale or accrued and held, but in either case the 10.5 percent pertains only to experience during the particular year. For those who held the asset before or after 1978 as well as during that year, the 10.5 percent rate of return can be quite misleading.

Thus, a recent year's rate of return does not provide an exactly appropriate indicator of historical returns to investment for the average owner of farm assets. Tweeten takes the natural step of looking at a sequence of years, 1960-1976, in the paper cited above. But his 12.3 percent figure for this period describes the actual experience only of those who acquired assets at the beginning of the period and held them to the end.

The historically most relevant question is: What has been the rate of return to investment in agriculture by the set of persons who currently own agricultural resources? The answer can only be obtained by estimating rates of return on a case-by-case basis, considering the asset-holding period for

each individual. The relevant data for the whole portfolio of U.S. agricultural investment is shown in table 2. The approach is analogous to the methods used in Fisher and Lorie to estimate rates of return to investment in common stocks (except that they report nominal, not real rates of return). To illustrate the meaning of the data in table 2, the entry of 8.5 in the 1950 row and 1979 column is that a person who invested in agricultural assets on January 1, 1950 and held the assets until December 31, 1979 would have received an annual average rate of return of 8.5 percent. 2/

In order to estimate the rate of return actually earned by the owners of agricultural assets in 1979, it is necessary to know how many assets have been held 1 year, 2 years, 3 years, and so forth. The appropriate rate of return could then be calculated by constructing a weighted average of the rates of return in the "1979" column of table 2. The weights would be the share of 1979 assets acquired in each earlier year. Unfortunately, the data for constructing such weights do not exist. There are data on the turnover of farm real estate that allow at least an illustrative estimate to be made. They indicate that 5 to 6 percent of U.S. real estate changed hands each year in recent years. However, a substantial fraction changed hands among parties, both of whom were already owners of agricultural assets. It seems unlikely that more than 3 percent transferred ownership to nonowners of agricultural assets. If there is 3 percent turnover each year, with no recycling of the same people in and out of the sector, then 3 percent of yearend 1979 asset owners would have acquired their assets during 1979. Thus, the 1-year rate of return is applicable to 3 percent of agricultural asset owners. Of the remaining 97 percent, 3 percent (or 2.91 percent of the final total) would have acquired their agricultural assets in 1978. Of the remaining 94.09 percent, 3 percent (or 2.82 percent of the final total)

in U.S. Farm Production Assets Acquired from 1940 Through 1979

Year Assets Acquired	Cumulative Return as a Percentage of Equity Value, for Selected Years								
	1940	1945	1950	1955	1960	1965	1970	1975	1979
1940	6.2	14.9	11.9	9.6	8.9	8.8	8.2	9.2	9.3
1941		16.7	12.4	9.8	9.0	8.9	8.3	9.3	9.4
1942		17.9	12.5	9.7	8.9	8.7	8.2	9.2	9.3
1943		15.9	11.1	8.6	8.0	8.1	7.6	8.7	8.9
1944		13.3	9.7	7.5	7.3	7.5	7.1	8.4	8.6
1945		13.5	9.1	7.0	6.9	7.2	6.9	8.2	8.5
1946			8.2	6.4	6.5	6.9	6.6	8.0	8.3
1947			9.9	6.9	6.8	7.2	6.8	8.3	8.5
1948			11.0	7.0	6.8	7.2	6.9	8.3	8.6
1949			10.5	6.3	6.4	7.0	6.6	8.2	8.5
1950			13.6	6.1	6.3	6.9	6.6	8.2	8.5
1951				4.6	5.6	6.5	6.2	8.0	8.4
1952				2.9	5.0	6.1	6.0	7.9	8.3
1953				3.4	5.4	6.5	6.2	8.1	8.5
1954				4.6	6.1	7.0	6.5	8.5	8.8
1955				7.8	6.8	7.5	6.9	8.8	9.1
1956					6.7	7.4	6.8	8.9	9.1
1957					6.4	7.4	6.7	8.9	9.2
1958					6.3	7.5	6.7	9.0	9.3
1959					3.1	6.7	6.2	8.8	9.2
1960					2.8	7.3	6.5	9.2	9.4
1961						8.2	6.9	9.6	9.8
1962						8.2	6.7	9.7	9.9
1963						8.6	6.7	9.9	10.1
1964						9.6	6.7	10.2	10.3
1965						11.9	6.6	10.4	10.5
1966							5.5	10.3	10.4
1967							4.6	10.4	10.5
1968							4.1	10.9	10.8
1969							3.5	11.8	11.3
1970							3.5	13.1	12.1
1971								15.1	13.1
1972								16.3	13.4
1973								15.8	12.8
1974								9.2	10.1
1975								13.4	11.1
1976									10.6
1977									9.0
1978									10.7
1979									10.9

would have acquired their assets in 1977. In general, if the fraction P bought in year t, then the proportion $W_{t-1} = P(1-P)$ will have bought in year t-1. Thus, P is the probability that a given dollar of asset value will be turned over, and W_{t-1} is the implied proportion of the value of assets in year t that was acquired in year t-1. In year t-2, the fraction of year t assets acquired would be

$$W_{t-2} = P\{1-[P - P(1-P)]\} = \underline{P\ (1-P)^2}$$

In year t-3,

$$W_{t-3} = P\{1-[P-P(1-P) - P(1-P)^2]\} = \underline{P(1-P)^3}.$$

By induction, the fraction of year t assets acquired in years t-n is $W_{t-n} = P(1-P)^n$. Applying this simple rule to find weights for the final column of table 2 for P = .03, we obtain weights which decline from .030 for the 1979 row to .009 in 1940. Applying the remaining 0.305 (acquired before 1940 by the assumption used) to the 1940 acquisition group, the weighted-average rate of return for 1979 owners of agricultural assets is 9.9 percent. This is, of course, a very crude estimate.

A Difficulty in the Measurement of Farm Income

In the table 2 data, the returns shown are total returns, including both current net returns and real capital gains. It is misleading, especially in an inflationary economy, to attach any meaning to current receipts separately. It would be analogous to evaluating a common stock solely on the basis of dividends paid. The special problem under inflation is that one of the elements of cost used to obtain net return from gross revenue is interest costs. But when inflation is anticipated, the interest rate increases by a premium determined by the anticipated rate of inflation. The Fisherian theory of the nominal interest rate being the sum of an unobserved "real" rate and the expected rate of inflation has been widely used to

explain the failure of accelerating monetary growth to drive down interest rates as Keynesian theory predicts.

In terms of income accounting, the inflation premium in interest rates adds to costs of capital but does not add to current receipts. The returns which justify paying higher interest rates under inflation occur in the form of asset price appreciation. Therefore, it is conceptually inappropriate to charge against current revenues the full amount of interest payments to obtain net farm income, as the USDA farm income statistics currently do. In 1979, the USDA estimated $6.40 billion in interest costs on $72.2 billion in farm real estate debt, which implies a rate of interest of 8.9 percent. The relevant real rate of interest is probably in the range of 3 to 4 percent (see Tweeten, pp. 59-64). This suggests that at least 4.9 percentage points of the estimated 8.9 percent interest charge in USDA net farm income calculation represents anticipated inflation and should not be counted against gross receipts in estimating net farm income. Applying this rate to both real estate and non real estate debt, a proper accounting would add about $137 x .049 = $3.54 billion or $1,341 per farm to U.S. net farm income in 1979. The distortion will be even larger in 1980, since nominal interest rates and debt have both continued to rise.

Summary

This paper has considered three problem areas in the measurement of returns to agricultural assets. First, measuring returns as a residual creates inevitable choices among alternative procedures, none of which are exactly suitable, and which make a substantial quantitative difference. Second, annual rates of return, even if properly measured, have a quite limited economic meaning. They are not altogether suitable either as a

historical indicator of how agricultural investors have fared or as a prospective indicator of how current investors will fare. Third, in an inflationary environment, current USDA measurement procedures result in a substantial understatement of net farm income because the inflation premium in interest costs is charged against current income flows.

The latter two of these problem areas can be dealt with by exercising sufficient care and judgment in the use of currently available data. Improvement in the first area, however, requires investment in the statistical information base of a magnitude not likely to occur in the near future. Therefore, measurement of the rate of return to agricultural investment will remain on a somewhat shaky foundation, and the estimates must be used with caution.

Footnotes

1/ The 6.4 percent return is based on dividends paid plus the real gain in the market value of the Standard & Poor's index. The real gain is obtained by deflating the index by the consumer price index (CPI). Thus, the S&P index actually rose by 10.5 percent in 1978, which together with a dividend yield of 5.3 percent amounts to a 15.8 percent nominal rate of return. Subtracting the CPI increase 9.4 percent generates the 6.4 percent real rate of return. It is usual to report the rate of return on financial assets in terms of nominal values, and not in real terms. If this approach were to be taken for returns to agricultural assets, the CPI increase would have to be added back to Hottel and Evans' 10.5 percent to obtain a 10.5 + 9.4 = 19.9 percent nominal rate of return to agricultural assets. It is this rate of return that is most nearly comparable to reported rates of return on bonds, savings accounts, or other financial assets.

2/ The returns include both current income flows and real capital gains. For details of the calculation procedure, see Hottel and Evans.

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