2-44

Production Economics Paper No. 6215
Purdue University
August 15, 1962

EVALUATING FARM INVESTMENTS BY CAPITAL BUDGETING

by

Henry A. Wadsworth, Jr.

Presented as a Contributed Paper at the summer meetings of the American Farm Economic Association, Storrs, Connecticut, August 20-22, 1962.

EVALUATING FARM INVESTMENTS BY CAPITAL BUDGETING*

Henry A. Wadsworth, Jr.**
Purdue University

The range and intensity of possible investment alternatives available in agriculture are a cause of constant concern to the modern farmer. In order to maintain a high level of economic efficiency, he must explore these opportunities in respect to their overall effect on his business. For this task, he needs measurement tools capable of pointing out which of several investments leads to maximum profits.

Three different analytical methods were applied to a farm investment problem on a 40-cow dairy farm in New York.[1] Although this was a case study, the input-output data used were obtained from surveys of about 85 large dairy farms, with herds of 40 to 150 cows during 1959 and 1960.[2] Prices and physical production coefficients were determined, and also estimated for the period from 1960 to 1970. Input-output schedules reflected three different levels of management and various milk prices (Table 1).

This paper's purpose is to indicate that capital budgeting can be applied to farm investment decisions, particularly to herd expansion and installation of herringbone milking parlors. Conceptual problems encountered in the case study and procedures chosen will be discussed. Finally, the usefulness of the capital budgeting results will be compared with those obtained by other methods.

---

*This work was part of the research done under State Project No. 55, Department of Agricultural Economics, Cornell University, Ithaca, New York. The constructive criticism of Dr. C. D. Kearl, Project Leader, is sincerely appreciated.

**The author wishes to thank Dr. Seymour Smidt of the Graduate School of Business and Public Administration, Cornell University, for his many helpful comments. Thanks go also to Dr. L. T. Wallace of the Department of Agricultural Economics, Purdue University, for his review of early drafts.

[1]The methods included ordinary budgeting, capital budgeting, and linear programming.

[2]Detailed cost data were obtained from Farm Cost Account Records of the Department of Agricultural Economics at Cornell University.

Table 1. PERFORMANCE CHARACTERISTICS ON A NEW YORK DAIRY FARM FOR THREE MANAGEMENT LEVELS.*

Factors	Average	Good	Superior
Milk per cow	8,000 lbs.	10,000 lbs.	12,000 lbs.
Milk-feed ratio	3.5 to 1	3.3 to 1	3.0 to 1
Pounds of grain per cow	2,286 lbs.	3,030 lbs.	4,000 lbs.
Hay equivalent per cow	5.0 T.	6.0 T.	7.0 T.
Pounds of grain/heifer	700 lbs.	700 lbs.	700 lbs.
Percent cows freshing/year	80%	85%	90%
Cost of labor per month	$200	$225	$250
Cost of mulch cow per head	$250	$275	$300
Price per cwt. of milk	$4.15	$4.25	$4.435
Fertilization Rates			
Corn silage w/manure	250 lbs. 10-10-10	400 lbs. 10-10-10	600 lbs. 10-10-10
Corn grain w/manure	250 lbs. 10-10-10	400 lbs. 10-10-10	600 lbs. 10-10-10
Oats	200 lbs. 8-16-16	300 lbs. 8-16-16	400 lbs. 8-16-16
Hay	50 lbs. 0-15-30	125 lbs. 0-15-30	200 lbs. 0-15-30
Lima-Kendaia-Schoharie			
Corn silage	10 T.	12 T.	18 T. w/tile
Corn grain	45 Bu.	60 Bu.	85 Bu. w/tile
Oats	50 Bu.	60 Bu.	80 Bu. w/tile
Hay	2.0 T.	2.8 T.	4.0 T. w/tile

*These characteristics are highly subjective and were developed by the author after conferring with staff members in the departments of Animal Husbandry, Agricultural Economics, Agricultural Engineering, and Agronomy at Cornell. Survey data, research and extension experience provided the guidelines within which the characteristics were developed.

Measures of Investment Worth

Potential investments are often appraised by budgeting estimated changes in receipts and expenses and comparing profits with the costs of making changes in farm organization. Linear programming is used to determine optimum farm plans, and the changes in income associated with changes in organization. In either case, the payback period is the ordinary measure of the value of an investment. This period is the length of time required for a stream of net cash proceeds from an investment to equal the initial cash outlay of that investment. Investment decisions made in this manner are based upon some predetermined maximum allowable period of time. Investments whose payback period exceeds this maximum are rejected. Although it is the simplest and most

comprehensible, the payback period suffers from three shortcomings: (1) size of the investment is not considered, (2) cash proceeds earned after the payback date are not included, and (3) no allowance is made for an alternative use of capital.

Yield is another measure of investment worth. It represents the interest rate which an investor could afford to pay, in order to finance an investment with borrowed money. Investment decisions are made by comparing yield with the cost of capital. Opportunities are considered to be acceptable if their yield is greater than the cost of capital. Yield will lead to correct decisions, but as an analytical tool it is inferior to the capital budgeting technique because: (1) it neglects to consider size of the investment, (2) mutually exclusive investments require a pair by pair comparison, and (3) it is more difficult to handle.

The present value method has not often been applied to agricultural investments. This method requires the use of present value tables to discount the value of money received in the future to its value at the present time. In so doing, certain economic concepts are woven into the analysis. This method is, therefore, often more appealing to the economist as a basis of decision making because: (1) future income that may never materialize is accounted for by decreasing each future year's present value a constant percentage of the previous year, (2) alternative uses for money necessitate that an opportunity cost of capital be selected, (3) the subjective time preference of people for money is recognized.

Cost of Capital

Determining the cost of capital was the initial and most difficult problem. It is fundamental in the use of both yield and present value as measures of investment worth. Bierman and Smidt suggest the use of a weighted average of the

returns needed to obtain sufficient equity and debt capital as an appropriate cost of capital.[3] This procedure may be relevant for incorporated non-agricultural businesses since they can obtain capital from the sale of stocks and bonds. However, since these sources of capital are not usually available to farmers, determining their cost of capital poses a problem.[4]

The return to an investment in farm real estate was considered as the most likely opportunity cost that could be applied for a New York farmer. The index of the value of agricultural real estate in New York has risen about four percent per year since 1950.[5] At recommended rental rates of one percent of the value of farm real estate per month, most owners of farm property can realize three to six percent after paying for real estate taxes, insurance, and property maintenance.[6] This would produce a range of from seven to ten percent return on investment. Under the circumstances, eight percent was chosen as an average rate.

Capital Budgeting Used in Actual Situation

Capital budgeting is a specialized form of ordinary farm budgeting. This approach stresses the relevancy of the sum of income after tax, depreciation, and non-taxable income for farm investment decision making. In addition, annual cash flows are recognized to be major determinants of the changes in farm organization that a farmer can hope to undertake successfully.

---

[3] The Capital Budgeting Decision, Bierman and Smidt, The Macmillan Company, New York, 1960.

[4] Although not specifically discussed here, the cost of personal sacrifice, the on-farm and off-farm investment opportunities available to the farmer, and comparison of different risks must all be assessed.

[5] Current Developments in the Farm Real Estate Market, October 1961, Economic Research Service, USDA, Washington, D. C.

[6] Experience on New York Cost Account Dairy Farms indicated that these costs could be expected to range from six to nine percent of the value of the real estate.

In this case, the analytical procedure emphasized anticipated operation under existing tax laws (Table 2). Cash receipts included all income necessarily reported for income tax purposes. Half of the value of livestock raised and sold was omitted due to capital gains provisions. Cash operating expenses excluded depreciation and expenditures for new buildings or equipment. Present assets in buildings and equipment were depreciated on a straight line basis. Depreciation on new buildings and equipment was taken as rapidly as legally possible. First year depreciation on new equipment was at the allowable twenty percent rate in addition to double straight line computed for a ten year period. Successive year's depreciation was taken at the double straight line rate until expected salvage value at the end of the ten year period was reached. New buildings were also depreciated at double straight line over a twenty year period, until salvage value at the end of the ten year period was reached.

Taxable income was obtained by subtracting cash expenses, present and added depreciation from cash receipts. A tax rate of .2 was applied to taxable income. Another possible way would be to further reduce taxable income by number of dependents and personal expenses and then apply the graduated tax schedule. The relevant cash flows or funds available to the farmer for capital expenditures and family living are the sum of income after tax, depreciation, and value of livestock sales not subject to tax. A benchmark situation was calculated by similar analysis on the farm prior to any change in farm organization. Added cash flows were obtained by subtracting the benchmark flows from the relevant cash flows after changes were initiated. These net or incremental flows were discounted by the use of present value tables at six, eight, and ten percent interest, i.e., the relevant opportunity rates for agriculture in the area studied. The present value of the investment at the end of ten years was also obtained. The same procedure was followed in handling all the investment alternatives considered.

Table 2. CAPITAL BUDGETING APPLIED TO A HERRINGBONE PARLOR INVESTMENT DECISION FOR A 40-COW FARM UNDER GOOD MANAGEMENT IN NEW YORK.

Year	Cash Receipts	Cash Expenses	Present Depreciation	Added Equipment Depreciation	Added Building Depreciation	Taxable Income	Tax (.2)	Income After Tax	Income After Tax plus Depreciation and non-taxable Livestock Sales	Less Benchmark	Added Cash Flow
B	$19,104	$12,062	$2,390			$4,652	$ 930	$3,722	$6,937		
1	19,104	11,201	2,390	$1,440	$206	3,867	773	3,094	7,955	$6,937	$1,018
2	19,104	11,201	2,390	512	186	4,815	963	3,852	7,765	6,937	828
3	19,104	11,201	2,390	409	167	4,937	987	3,950	7,741	6,937	804
4	19,104	11,201	2,390	327	150	5,036	1,007	4,029	7,721	6,937	784
5	19,104	11,201	2,390	262	135	5,116	1,023	4,093	7,705	6,937	768
6	19,104	11,201	2,390	50	122	5,341	1,068	4,273	7,660	6,937	723
7	19,104	11,201	2,390	0	97	5,416	1,083	4,333	7,645	6,937	708
8	19,104	11,201	2,390	0	0	5,513	1,103	4,410	7,625	6,937	688
9	19,104	11,201	2,390	0	0	5,513	1,103	4,410	7,625	6,937	688
10	19,104	11,201	2,390	0	0	5,513	1,103	4,410	7,625	6,937	688
									End value of investment		$2,000

$6,887 Present value of cash flows at 6%.
$6,219 Present value of cash flows at 8%.
$5,647 Present value of cash flows at 10%.
$6,063 Capital cost of investment.

Results

Most agricultural investments can be considered to be conventional, since the capital expense occurs first and the cash proceeds follow in one or more succeeding periods. Use of the capital budgeting technique is appropriate only if the returns are measureable in monetary terms, and the objective is the comparison of the net returns from investment alternatives.

The cost of adding a double-4 herringbone parlor to a stanchion barn was computed at $6,063. Of this, $4,000 was for milking equipment and the remainder for the building and holding area. A farmer with average management ability would reject such an investment if capital budgeting were employed in his decision (Table 3). The farmer with good management could profitably make the investment if his cost of capital were six or eight percent. The superior manager would find the change advantageous at all three interest rates.

Another investment alternative studied was the expansion of herd size from 40-to 60 cows under existing technology. This investment cost would be $16,668 including cows, a new silo, and additional barn space. Results obtained from using the present value technique indicate this is a poor investment alternative for the average or good manager at any of the three interest rates. A farmer with superior management ability would find this to be a worthwhile opportunity.

If in addition to herd expansion, the farmer changed technology by installing a herringbone parlor, the present value of the added cash flows at six percent would exceed the anticipated cost of $22,531. At higher interest rates the present values of the flow would be less than the cost and would lead to rejection of the alternative. Even at six percent, the values are so close that any change warrants further study.

It is worthwhile mentioning that alternative ways of calculating depreciation can influence the decision. The investment in herd expansion and a herringbone parlor would be rejected if the equivalent amount of depreciation were

Table 3. RESULTS OBTAINED BY CAPITAL BUDGETING CERTAIN NEW INVESTMENTS FOR A CONVENTIONAL 40-COW DAIRY FARM IN NEW YORK.

Description of New Investment	Cost of Investment	Present Value of Added Cash Flows		
		6 percent	8 percent	10 percent
Technological Change				
Herringbone parlor with average management.	$6,063	$6,007	$5,294	$4,770
Herringbone parlor with good management.	6,063	6,887	6,219	5,647
Herringbone parlor with superior management.	6,063	7,771	7,024	6,384
Herd Expansion and Technological Change				
Herd expansion to 60 cows with good management.	$16,668	$7,691	$6,733	$5,925
Herd expansion to 60 cows and a herringbone parlor with good management.	22,531	22,581	20,246	18,249
Herd expansion to 60 cows and a herringbone parlor with good management. Equivalent added depreciation taken by ordinary straight line method.	22,531	22,369	19,992	17,961

taken evenly over a ten year period. The difference is relatively small, but does indicate that the discounted flows are higher in those circumstances where the major portion of depreciation is taken early in the life of the investment.

The analysis presented here dealt with capital budgeting (present value) as applied to dairy farm investments of herd expansion and changing technology. However, the technique can be applied to any farm investment decision using monetary criteria. In conclusion, this technique may well lead to better management investment decisions than is possible with other methods, because in combining relevant economic principles with actual financial operations for a farm, more factors relevant to the decision are included.