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A COMPUTERIZED FARM LIQUIDATION
PLANNING MODEL

by

Arthur J. Greer

A DISSERTATION

Presented to the Faculty of the Graduate College

In the University of Nebraska in Partial Fulfillment

Of Requirements for the Degree of Doctor of Philosophy

Major: Agricultural Economics

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TITLE

A COMPUTERIZED FARM LIQUIDATION

PLANNING MODEL

BY

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CHAPTER I

INTRODUCTION

Need for the Study

In 1980, approximately 2,840 farms changed hands in the State of Nebraska.[1/] Fifty-seven percent of these sales were voluntary and included retirements, interest in alternative investment opportunities, and other personal reasons. The remaining sales included estate settlement (21.4%), foreclosures (2.8%), and miscellaneous reasons (18.8%).[2/] A significantly large amount of money changed hands as a result of these sales. In 1980, the average value of the farms sold in Nebraska was $192,600, which includes not only working viable farm units, but the small acreages that fall within the census definition of a farm but do not provide a living for the owner.[3/] As a result, this valuation can be considered conservative. The voluntary sale of 1,618[4/] farms in 1978 would have generated $311,626,800[5/] in gross capital income to the farm sellers, thus creating for them a set of significant management problems in terms of: (a) assuring realization of maximum disposable income from the sale, (b) provide the maximum discounted disposable income from post sale investments,

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1/ Bruce B. Johnson, and Ronald J. Hanson, Nebraska Farm Real Estate Developments, Department of Agricultural Economics Report No. 105, University of Nebraska-Lincoln, Lincoln, Nebraska, June 19, p. 12.

2/ Ibid., p. 12.

3/ Ibid., p. 20

4/ 2,840 farm sales x 57% voluntary = 1,618 voluntary sales.

5/ 1,618 farms sold x 192,600 average valuation.

and (c) accomplish both (a) and (b) within the bounds of the sellers risk preferences, personal and financial goals, general health, life expectancy, and desired life style.

The larger and more debt-free the farm, the larger the net proceeds, or gain from the sale. In addition, many of these units have been under the same ownership for many years and thus were purchased at a cost far below the present per acre price. The result is a sizable taxable gain and a large tax obligation. Careful pre-sale planning can go far in minimizing this obligation. The sale payment strategy will determine whether the tax is paid in a lump sum or in installments over time. Adequate expertise and a massive amount of literature is available to provide the farm seller with guidance in structuring the sale in such a way as to minimize income taxes. What is needed is a comprehensive model for correlating the sale payment strategy, i.e. cash or various installment arrangements, with post sale financial needs and strategies.

Installment land contracts have been a popular method of financing farm sales. These call for a down payment in the year of sale with the seller then taking a note from the buyer for the balance. Ordinarily, title remains with the seller until the contract is fulfilled at which time it then passes to the buyer. Such arrangements are attractive to farm sellers for a number of reasons. First, installment contracts provide a steady, relatively risk-free annual income. Secondly, income taxes on the sale are also paid in installments. Under the installment method of accounting, taxes are paid at capital gain rates on that portion of the principal designated

as gain, and as ordinary income on the interst. On a cash sale all income taxes are paid in the year of sale. Third, it has been the author's observation that with installment contracts the interest will generally cover the taxes each year except the year of sale when all payments are principal, and in the last year when the interest payment is quite small. As a result the principal is subject to a minimum of tax erosion.

One serious drawback of the installment land contract is that the fixed rate of interest allows no adjustments in earnings over the life of the contract to compensate for changing economic conditions. The main condition requiring adjustment in inflation. When the discount rate included a small factor for inflation, this was no problem. When inflation is considerably greater than the rate of interest earned on the land contract, the principal can be eroded at a rate great enough to completely nullify the advantages mentioned in the previous paragraph. In this instance, a seller might be better off to sell for cash, pay his taxes, and invest the returns in ways that will at least keep pace with inflation. Hence the need exists for a method of illustrating these alternatives to a potential farm seller, and also showing him a possible investment program that could help keep his principal intact.

It must be kept in mind that all farmers and ranchers are not equal in their ability to handle financial decisions. Each is unique in his attitude toward and his ability to bear risk. Further, each individual has a different conception of the time value of money. To some, an amount of money in the bank or under a mattress

is worth its face value, to others a decrease in buying power over time due to inflation is recognized. One person may wish to retire with a minimum of financial activity, another might wish to pursue an investment program that bears high risk and high potential earning.

The combined effect of risk preference, time value of money (as this is perceived by the seller) and the discount rate, may be to make an installment contract, a cash sale, or some other arrangement the most suitable to a given individual. Thus, a comprehensive sale-investment-earning strategy and evaluation model would be of significant value to persons selling their farm or ranch business, and to the people retained to advise them.

Objective of the Study

The objective of this project is to design and test a mathematical model that will organize the data from the sale of a farm or ranch, elicit and organize the pertinent personal data on the seller, and apply the relevant tax laws to complete an appropriate sale strategy and post sale investment program. The investment groups suggested by the program will come from data on file within the program and from investment data supplied by the seller. In the latter case, the investment data on file would be used as "industry guidelines" in indicating the relative riskiness of the investment programs provided by the seller.

Application of the Model

Any counselor or consultant who does a complete job of evaluating a farm or ranch sale for a client will spend a great deal of time analyzing and preparing for presentation the facts and alternatives

available. When the task is complete, he may have evaluated several sale strategies and a small number of investment options for after the sale. As a result, many farm sellers end up with a program that was designed from a very limited set of alternatives.

It is hoped that the program presented in this report will provide a means of doing a far more complete job of advising, using a great deal of information, in a relatively short time. Its use will not replace the consultant, but will expand his capability immensely. This could have significant value to the seller in terms of a more appropriate, and thus more profitable farm sale plan.

Review of the Literature

Numerous publications are available which come under the general heading of tax planning for farm real estate sales. The majority are provided by state extension services,[6/] large accounting firms, and publishers of topical law reports. Most publications of this nature are restricted to calculating the tax obligation incurred on a farm sale. In general, they appear to favor the land contract arrangement, and present ways of setting these up in order to minimize the probability of interference by the Internal Revenue Service.

A computer literature search was made of the Agricola, and

6/ An example of this type of publication is: Robert R. Smith and R.N. Weigle, Taxmanship in Buying and Selling a Farm, North Central Region Pub. #43, University of Wisconsin Extension, Madison, Wis., 1977.

ABI/INFORM files.[7/] Nothing was found that had any bearing whatever on farm sales, farm sale planning, computerized farm sale planning, retirement planning for farmers (or for anyone else for that matter), and very little on estate planning. It would appear from this that many people are concerned about entry into agriculture and decision making within agriculture, but little concern is expressed with the problems of exit from agriculture. An extensive search of the library facilities of the University of Nebraska-Lincoln produced much the same result.

7/ Agricola (National Economic Archives) and the ABI/INFORM Files include all publications of the Extension Service and Experiment Stations nationwide, plus all articles in the major Agricultural Economic academic and professional journals.

CHAPTER II

METHODOLOGY

The Mathematical Programming Procedures

Investment analysis has been approached by a number of mathematical programming methods, each with its own unique area of application. For example, Lee presented the results of studies that demonstrated the use of goal programming in financial decision analysis.[1/] This procedure is based on the assumption that the investor has definite goals in terms of earnings, capital appreciation, liquidity preference over time, and can rank these goals in order of preference. The program basically minimized the negative deviations from the set goal levels, and proceeds to satisfy each of the various goals in order of their priority ranking. A goal with the highest priority is completely satisfied before any resources can be committed the next lowest goal, and so on until all resources are exhausted. Thus, it is possible to have stated goals with lower priorities that never get fulfilled.

Goal programming problems can be solved using standard linear programming procedures. Daur and Krueger[2/] developed a finite iteration algorithm for solving general goal programming problems that could also be used on certain non-linear, integer, and stochastic

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1/ Sang M. Lee, Goal Programming for Decision Analysis, Auerbach Publishers Inc., Philadelphia, PA, 1972.

2/ Jerald P. Daur and Robert J. Krueger, "An Interactive Approach to Goal Programming", Operations Research Quarterly, Vol. 28, No. 3, 1977, pp. 671-681.

applications. Regardless of the application, however, goal programming presents two serious drawbacks. First, the requirement that the investor have all his goals quantified and ranked is somewhat unrealistic. Most individuals have ideas about what they want to do, and some vague set of priorities for their goals, but these are, in general, not well defined, nor are they static.

The second drawback is that each goal must be fully satisfied before resources can be committed to the one with the next lowest ranking. There is no provision for trade-offs among the various goals that says the optimum solution will include partial satisfaction of several goals. It is conceivable then in analyzing a group of investments, the program could place all resources into a single, or a small number of top priority alternatives, when a much better result would be achieved by furhter diversification.

A second possible approach to the investment analysis problem is portfolio analysis as presented by Markowitz.[3/] This approach investigates investments in pairs by ranking them according to the co-variance of returns between the securities in each pair using a non-linear programming technique called quadratic programming. The result is an ordering of each pair (called efficient pairs) on an expected income-variance (EV) frontier. As one proceeds outward from the origin (or the intercept if one exists), income

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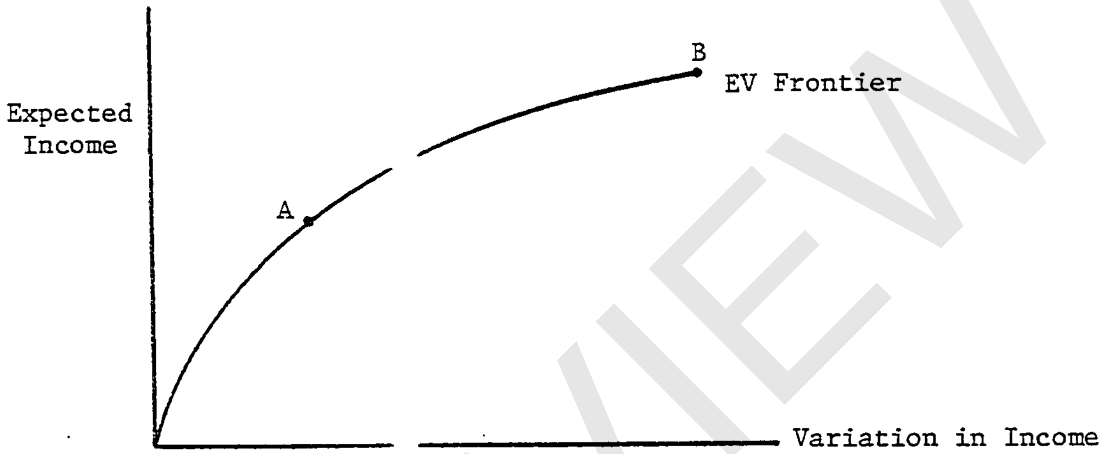
3/ Harry M. Markowitz, Portfolio Selection, Efficient Diversification of Investments, Cowles Foundation Monograph 16, New York, John Wiley and Sons Inc., 1959.

increases, as does the covariance between the securities in each pair. This is illustrated in Figure 1 below.

Figure 1

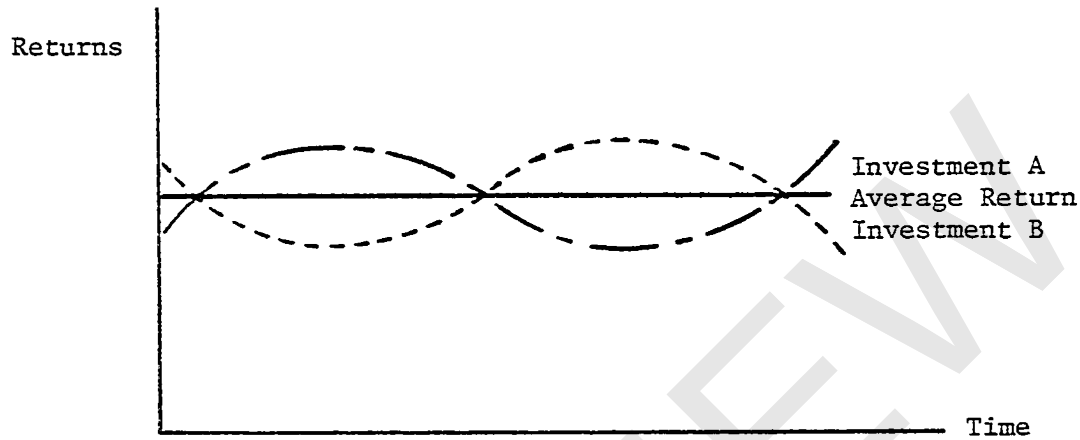
A Representative EV Frontier



The theory behind the EV frontier is that each security in an efficient pair (for example point A, Fig. 1) may display an extremely wide fluctuation in return, and thus taken individually, each security could be considered extremely risky. When placed together, however, the variations in return for two securities may be in opposite directions and thus, the average return is stable. This result is possible because a high return to one security could offset a low return on the other as illustrated in Figure 2.

Figure 2

Timing of Returns for an Efficient Pair



The highs and lows for investments A and B exactly offset each other yielding a completely stable average return over time. These two investments have a negative co-variance and would occur on an EV frontier very close to the vertical axis. As investments show a greater variation in average income (a larger co-variance), higher returns exist. In fact, the end point on the frontier is the maximum return solution that would have been the only solution if ordinary linear programming had been used.

Portfolio analysis and quadratic programming provide a sophisticated and theoretically sound approach to multiple investment analysis. There are two basic drawbacks that make this method very difficult to use. First, the computer algorithm required to handle quadratic programming can become extremely cumbersome when evaluating

a large number of investments. The method has been used successfully in the past but always with a relatively small number of securities. The program used in this report will handle a very large number of individual securities plus data collected and entered by the user; conseqently a method is required that could do this in a manageable manner for a reasonable cost in terms of computer time.

The second problem with portfolio analysis stems from the efficient pair concept. It is not difficult to establish co-variance between two securities with the proper time series data, but the computational problem becomes quite intimidating when five, ten, or more are being analyzed as a group. Further, variance and co-variance themselves are often difficult concepts for untrained individuals to understand and relate to. Thus, the model is appealing from a theoretical viewpoint, but has some severe computational and consequently cost disadvantages.

In 1971, P.B.R. Hazel proposed an alternative to quadratic programming that retained a great deal of the computational efficiency but could be handled using conventional linear programming technique with a parametric option.[4/] Hazel replaced the income variance criteria with a measure of the mean absolute deviation of returns. This approach was used by Persaud and Mapp in their work on alternative

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4/ P.B.R. Hazel, "A Linear Alternative to Quadratic and Semi-variance Programming for Farm Planning Under Uncertainty", American Journal of Agricultural Economics, No. 56, (1971), pp. 53-62.

production strategies under risk in Southwestern Oklahoma.[5/]

Hazel's measure of mean absolute deviation with the terms defined for an investment analysis model is as follows:[6/]

(a) $$A = \frac{1}{s} \sum_{h=1}^{s} \left| \sum_{j=1}^{n} (c_{hj} - g_j)\, x_j \right|$$

Where: s = the number of years data is available for the investment in question,

c_{hj} = the "holding period yield" (defined previously) per share, or per unit for the h'th period and j'th investment,

g_j = the mean holding period yield (HPY) for the j'th investment,

x_j = the level of activity in the j'th investment.

A is an unbiased estimate of the population mean absolute deviation, and is a reasonably accurage measure of uncertainty. Thus E (expected return) and A (mean absolute deviation) are the critical parameters in the selection of the efficient investment groups, and their placement on an EA frontier. This EA frontier is of the same form and general characteristics as the EV frontier described earlier.

The advantage of the EA criterion is that it allows the EA frontier to be defined using linear programming methods by defining the variables:

5/ Tillak Persaud and Harry P. Mapp Jr., "Analysis of Alternative Production and Marketing Strategies in Southwestern Oklahoma, A MOTAD Approach," Western Research Project W-149 Technical Committee Annual Meeting Proceedings, Tucson, Arizona, Jan. 1980.

6/ Hazel, op. cit., p. 56.

(2) $$y_h = \sum_{j=1}^{n} c_{hj}\, x_j - \sum_{j=1}^{n} g_j\, x_j,$$ (for all h, h-1, --- s,),

Where: y_h = the deviation in HPY about a mean and is such that:

$$y_h = y_h^+ - y_h^-,$$

and $y_h^+,\ y_n^- \geq 0$.

This will allow the formation of the objective function:

(3) Minimize $$As = \sum_{h=1}^{s} (y_h^+ + y_h^-).$$

Because y_h^+ and y_h^- are the values of the positive and negative deviations about a mean HPY for a particular investment. It follows that:

(4) $$\sum_{h=1}^{s} y_n^+ = \sum_{h=1}^{s} y_h^-,$$

and thus leads to the final formation of the MOTAD model as:

(5) Minimize $$\sum_{h=1}^{s} y_h^-$$

Subject to: $$\sum_{j=1}^{n} (c_{hj} - g_j)x_j - y_h^- \geq 0,$$ (for all h, h-1, --- s,)

and: $$\sum_{j=1}^{n} f_j x_j = \lambda,$$ (when $\bar{0} \leq \lambda \geq \infty$,)

$$\sum_{j=1}^{n} a_{ij} x_j \leq b_i$$ (for all i, i-1, --- n,)

$x_j,\ y_h^+,\ y_h^- \geq 0$ (for all h and j)

Where: f_i = the forecasted HPY for the j'th investment,

λ = a scaler,

a_{ij} = the technical (monetary) requirements for the j'th investment activity, for the i'th resource constraint, or dollar investment limit,

b_i = the level of the i'th resource constraint.

The MOTAD technique was selected over other possible models due to simplicity of data requirements, adequacy of results, and the ease and lower cost for computer time over quadratic programming. It was selected over goal programming based on its ability to evaluate trade-offs among investments, and the elimination of the requirement of setting specific goals for the investor.

In order to fully evaluate an investment it is helpful to have an indication of the results of the decision over time. In order to do this effectively a dynamic deterministic model is needed that allows the events of a specific period to be influenced by preceding and succeeding periods, and also allows the fundamental conditions that define the scope and nature of the activities to vary. Martin and Plaxico developed and used a program of this nature to analyze firm growth and capital accumulation on Great Plains farms over time.[7/] In their report, polyperiod linear programming was used:

7/ J. Rod Martin and James S. Plaxico, Polyperiod Analyses of Growth and Capital Accumulation of Farms in the Rolling Plains of Oklahoma and Texas, Technical Bulletin No. 1381, U.S.D.A., E.S.C.S. Sept. 1967.

(1) To analyze the effects of different variables including farm operator objectives, land acquisition methods, capital rationing, and different family consumption levels or capital withdrawals on the growth of farm firms.

(2) To simulate different growth models to determine possible growth rates under different conditions of farm resource use.

(3) To determine minimum starting farm equities required to obtain specific growth rates over time.

Polyperiod programming therefore is used in this study as the means of predicting the results of the selected sale strategies and subsequent investment decisions over a period of years after the sale. Its task will be: (1) to assimilate investment data, income flows, and equity situation from the previous period; (2) make the optimal investment, consumption and savings decision for the current period; (3) print out current income, current consumption and savings levels, and current tax data; (4) and finally provide the necessary data for the next period in time.

Polyperiod programming is an extension of linear programming that allows the evaluation of change or continued activity over time. This technique may be considered internally dynamic as the activities of one period have a direct effect on the level of activities in subsequent periods. The model is static externally, however, as the basic coefficients cannot change over time by operation of the program itself. They can be changed by the operator as we will do with the risk factor, but this depends on external action that must