



Sensitivity to changes in leverage, long term interest rates and land values : a grain farm simulation  
by Darrell Martin Johnson

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE  
in Applied Economics

Montana State University

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Abstract:

This study evaluates the sensitivity of a grain farm's financial condition to financial variables. A cash flow simulation model is used. Long-term interest rates, land values, and leverage positions are the variables analyzed.

The model simulates financial changes over a ten-year period.

A total of 18 variable combinations are examined. Major year-to-year considerations include gross income, consumption, taxes, debt payments, and equipment replacement costs. Gross incomes are generated from historic yield trends and estimated future prices.

Findings indicate that changes in interest rates do not have a significant impact on the financial condition of the case farm.

A similar result occurred with land value changes at the lower of two leverage levels. At the higher leverage level changes in land values did substantially alter ending net worth.

A one percent increase in the interest rate caused short-term funds demanded to increase up to 8.89 percent. For all variable combinations, rates of return on total capital and net worth were low and showed little variation. Solvency problems occurred when higher values for the variables were used.

The minor effect of interest rate changes reveals the ability of the farm family to make adjustments in other areas to compensate for larger debt payments. This tendency is also shown with land value changes. The low returns and the large short-term fund demand shows the producer's inability to accumulate cash assets.

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SENSITIVITY TO CHANGES IN LEVERAGE, LONG TERM INTEREST RATES

AND LAND VALUES: A GRAIN FARM SIMULATION

by

DARRELL MARTIN JOHNSON

A thesis submitted in partial fulfillment  
of the requirements for the degree

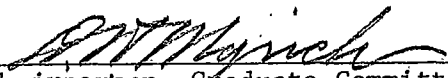
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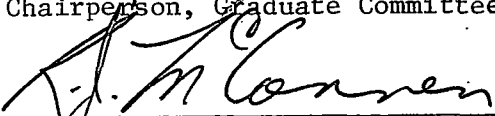
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## ABSTRACT

This study evaluates the sensitivity of a grain farm's financial condition to financial variables. A cash flow simulation model is used. Long-term interest rates, land values, and leverage positions are the variables analyzed.

The model simulates financial changes over a ten-year period. A total of 18 variable combinations are examined. Major year-to-year considerations include gross income, consumption, taxes, debt payments, and equipment replacement costs. Gross incomes are generated from historic yield trends and estimated future prices.

Findings indicate that changes in interest rates do not have a significant impact on the financial condition of the case farm. A similar result occurred with land value changes at the lower of two leverage levels. At the higher leverage level changes in land values did substantially alter ending net worth.

A one percent increase in the interest rate caused short-term funds demanded to increase up to 8.89 percent. For all variable combinations, rates of return on total capital and net worth were low and showed little variation. Solvency problems occurred when higher values for the variables were used.

The minor effect of interest rate changes reveals the ability of the farm family to make adjustments in other areas to compensate for larger debt payments. This tendency is also shown with land value changes. The low returns and the large short-term fund demand shows the producer's inability to accumulate cash assets.

## Chapter 1

### INTRODUCTION

#### THE PROBLEM

Investment decisions in agriculture, because of their long-run effects on production possibilities and capital improvements, are some of the most difficult and important decisions to be made. To evaluate alternative investments under these conditions requires accurate information on the financial history of a firm and its management as well as reasonable estimates of the prospective cash flows from each venture. It is important that proper criteria be used to analyze and evaluate the alternatives.

Traditionally, the farmer's financial position has been evaluated in terms of balance sheets and annual income statements, or some facsimile thereof, when available. Although these tools have gained wide acceptance, there are limitations to using them in evaluating firm growth alternatives. The income statement, for example, merely records revenues and expenditures over a relatively short period and then arbitrarily imputes the net returns to the fixed factors of production. This procedure may or may not reveal the actual productivity of the firm's capital, labor, and management resources. With the balance sheet, a major problem involves the realistic valuation of the firm assets.

An additional financial tool is the cash flow statement. It identifies the various sources and uses the cash in the business --

including credit transactions and family consumption -- and offers more precise information for ascertaining future cash flows from prospective operations.

In the fall of 1975 a survey of agricultural bankers was conducted in Montana in an effort to establish some background on financial statement use in the farming/ranching sector.<sup>1</sup> The results of this survey indicated that, in Montana, financial tools are not extensively used. Inconsistencies were evident in the format used for statements and in the types of information supplied. This makes early detection of cash flow problems more difficult. The survey indicated that producers, as financial managers, have a difficult time estimating changes in their year to year financial position.<sup>2</sup>

#### PURPOSE OF THIS STUDY

The ability of a particular farm firm to survive is dependent on numerous variables. These include large variances in incomes due to price and yield variations, interest rates, the farm firm's financial

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<sup>1</sup>Luft, LeRoy D. and Darrell M. Johnson, "Results of Survey of Agricultural Lenders on Financial Statements and Related Matters", Staff Paper 76-27, Agricultural Economics and Economics Department, Montana State University, 1976.

<sup>2</sup>Throughout this study producer, manager, operator and farmer are used synonymously. They all refer to the decision-maker, whether he is a paid manager, owner-operator or leasee.

position, land values, the individual producer' managerial ability and the farm's production capabilities. In Montana, dryland grain farming is highly sensitive to these variables. Consequently, their impact on the firm's success should be valuable information in the decision-making process.

There has been growing interest in recent years on the part of the non-agricultural financial community to develop a form of sensitivity analysis with which to test the impact of key variables on the ability of a business to survive. An analysis is made over an appropriately long period of time to determine the effect of operational fluctuations which are normal for that type of company and industry with respect to these variables. The analysis of past conditions is then projected into the future. The more sizable the fluctuations the less willing the lenders may be to provide financial support.

It is the purpose of this study to isolate some of the financial risks in the form of variables and to analyze their influence on the financial condition of a farm firm. In addition to the information provided by the analysis, this study will also show the effectiveness of simulation models for use in agricultural finance.

#### OBJECTIVES OF THIS STUDY

The primary objective of this study is to examine the impact of three influential variables on the financial condition of a farm firm over time. A technique of computerized sensitivity analysis is

employed as the examination tool. Used as a cash flow generator, this tool indicates the sensitivity of a farm firm to financial variables. The specific objectives are:

- 1) to develop a cash flow simulation model based on a representative farm firm patterned after existing farms in the triangle area of Montana;
- 2) to quantify the effect of price/yield fluctuations on the financial condition of this firm at various levels of land values, long-term interest rates, and leverages, using the above model; and,
- 3) to analyze the quantified results by use of a financial analysis computer program.

## Chapter 2

### HISTORICAL PERSPECTIVE

#### HISTORY OF FARM FINANCIAL MANAGEMENT

Bostwick describes financial management as the managerial process applied to financial resources.<sup>3</sup> It therefore partially overlaps the area generally conceded to farm production management. In general, production management concerns problems of resource organization for agricultural production, while financial management concerns itself with the financial means by which the acquired resources may be controlled.

These two kinds of management are separated for functional resource purposes, even though they often are not separated in practical farming situations. Research in farm financial management assumes the existence of physical resource requirements.

The financial requirements in agriculture have risen due to various economic and political forces. The resource mix, for example, has changed because of the exodus of farm labor and the introduction of capital inputs. The result has been a sharp increase in the financial needs in agriculture for both equity and borrowed funds.

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<sup>3</sup>Bostwick, Don, "Farm Financial Management Research: A Theoretical Analysis," ERS-389, Economic Research Service, USDA, November 1968, p. 1.

While the amount of farm labor in recent years has declined to less than half the 1950 level, the quantities of other inputs, notably fertilizer, have risen significantly (Figure 1). Agricultural output per man-hour has more than tripled as a result of the substitution of capital for labor during this period. Overall resource productivity has also increased. In 1973, for example, total farm output per unit of input was over 50 percent above 1950 (Figure 2).

In the ten-year period ending in 1974, the total debt outstanding in the U.S. farming sector rose from \$35 billion to \$82 billion, an overall advance of 131 percent or an average yearly increase of 8.7 percent. In recent years farm debt has grown at an even more rapid pace, rising at an annual rate of 12.8 percent in the three-year period 1972-74. At the end of 1974, real estate debt totaled \$46 billion while nonreal estate debt amounted to \$35 billion.<sup>4</sup> This increase reveals, to some extent, agriculture's past ability to acquire more capital funds. Of primary importance is agriculture's future ability to attract the necessary funds and use them effectively and efficiently.

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<sup>4</sup>Hamblin, Mary, "Bank Lending to Agriculture: An Overview," Monthly Review, November 1975, p. 17.

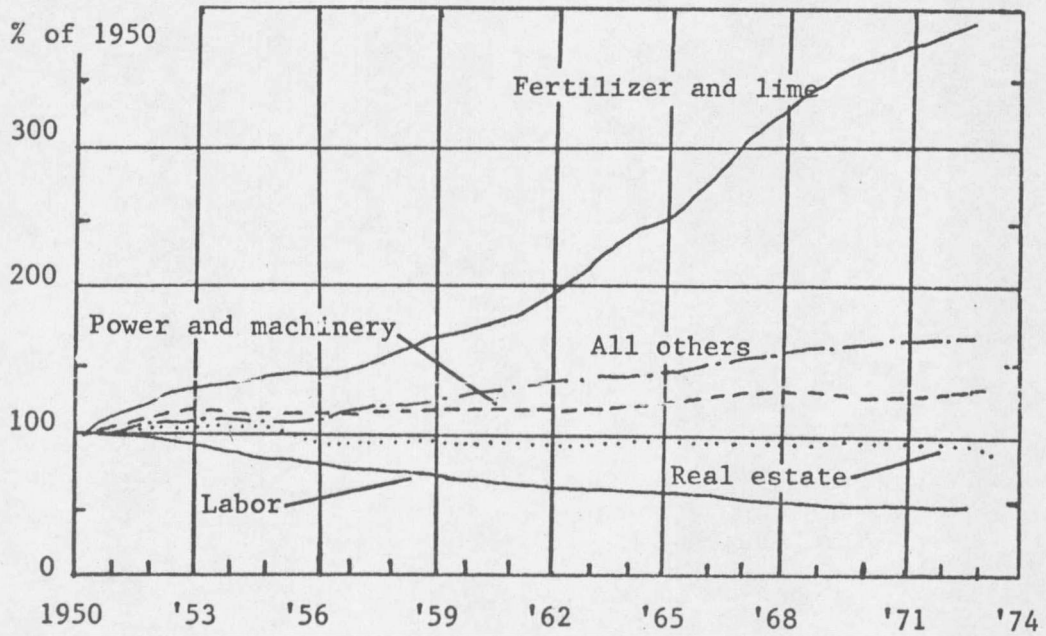


FIGURE 1: Quantities of Selected Farm Inputs, 1950-1974

Source: 1974 Handbook of Agricultural Charts, Agriculture Handbook No. 477, USDA, October 1974, p. 12.

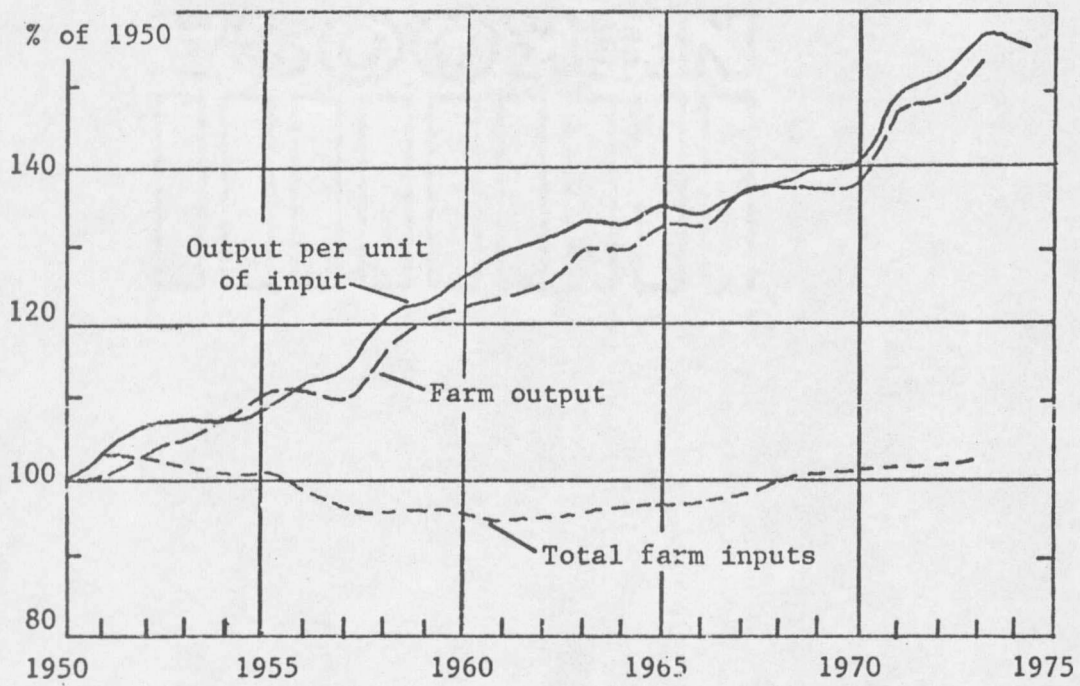


FIGURE 2: Farm Productivity 1950-1974

Source: 1974 Handbook of Agricultural Charts, Agricultural Handbook No. 477, USDA, October 1974, p. 16.

## FARM MANAGEMENT GOALS

The viewpoint of financial management is similar to that of gestalt interpretations of human behavior. Management is seen as a collection of goals, attitudes, values, experiences, expectations, learning and present action choices. The variables and relationships among all of these phenomena are germane to an understanding of financial management processes.

The goals of management are the types and quantities of utility forms desired by the manager. Logic and observational evidence both suggest that the goals set by the farm manager are usually an hierarchy of goals, attitudes, and appropriate means and often there exists a degree of logical conflict between these. The hierarchy viewed at present time,  $t$ , will not be the same when viewed from time,  $t + n$ . The greater the difference between  $t$  and  $n$ , the greater the difference that is likely to be obtained between the two goal sets. The goals that are sought over a production cycle of a year may be relatively well defined and unchanging over that span of time. The goals that are sought at the beginning of an investment cycle of 30 years may change considerably before that cycle is complete. Since the future is uncertain, it is reasonable that proximate goals are more explicitly defined and bear more weight in the decision process than distant ones. An Iowa farmer survey indicated that factors found relevant in affecting goal rankings were: age, net worth,

education, family size and the solvency ratio.<sup>5</sup>

The financial management function regarding decision-making involves investment decisions and financing decisions. In nonfarm businesses, where management and ownership often are divorced, the primary objective of management is to maximize the present value of future earnings of the ownership group. Major investment decisions for the farm businesses are made at the household-family level and are concerned with the magnitude and composition of owned assets and the business-risk mix of the firm and relate to operation and expansion strategies. They must be compatible with family-living decisions.

#### CAPITAL FINANCING IN AGRICULTURE

In the planning process, the farmer is faced with the problem of allocating a bundle of scarce resources among competing alternatives in such a way as to achieve a set of goals and objectives. As financial manager he must control the flow of financial resources through the farm firm in such a way as to insure the firm's continued existence while remaining consistent with the stated goals and objectives.

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<sup>5</sup>Warrack, A. A., "Changes over Time in Goals of Farm People," unpublished M.S. thesis, Iowa State University Library, 1963.

The financial manager may rely on retained earnings, borrowed funds, and equity funds. Agricultural investments are generally costly and involve a lengthy payback period. Since few farmers are able to meet capital outlays for new improvements wholly out of retained earnings, a majority of operators depend on borrowed funds to finance their farm businesses, and, to a lesser extent, outside equity funds.

The capital structure plays a crucial role in the success or failure of a firm. Agriculture relies heavily on debt financing. Costs incurred in borrowing include a cost for loss of liquidity, through loss of credit reserve, as well as more tangible interest costs. They also include debt aversion as well as the opportunity cost of investment funds. An optimizing borrower, with no constraints, should require funds up to the point at which the cost of borrowing one more dollar equals the marginal value product of that dollar to the borrower. If constraints are present, the borrower should use the funds available, *ceteris paribus*, for that input which returns the highest marginal value product for the last dollar invested.

Credit availability is important to the growth of the farm firm. Long-term loan limits are important in determining the rate at which the farmer can expand. Low long-term loan limits retard the rate at which an economically productive farm size can be attained. Long-term loan limits must reflect the managerial ability

of the farm operator. Too liberal credit can allow the farmer to expand beyond his capability to make debt and interest payments while maintaining a satisfactory level of family consumption expenditures. Recently researchers have devoted time toward the measurement of the impact of variables such as loan limits on the success of the farm firm.

#### REVIEW OF FIRM ANALYSIS MODELS

In the non-agricultural community, growth and merger have long been the trend of economic life. A fundamental issue in studying growth is the interrelating of the short-run production theory, involving fixed resources, and the longer run investment expansion theory, which has no fixed resources. The process of growth requires obtaining funds to purchase these resources from internal and/or external sources. All other variables, including family consumption levels, business profitability, capital markets, lender attitudes, tax management, and price and yield variability serve as constraints within which the process can operate. The two crucial aspects in considering growth are:

- 1) the concept of the decision process used, and
- 2) the handling of internal and external flows of funds.

Models developed to analyze firm growth are generally one of the following types: multiperiod linear programming, recursive

linear programming, dynamic programming, or a family of simulator models.

As an alternative to full-scale simulation, Brigham and Pappas noted that instead of using probability distributions for each of the variables in the problem, the results can be simulated by starting with best-guess estimates for each variable, then changing the values of the variables (within reasonable limits) to reveal the effects of such changes on the rate of return.<sup>6</sup> Typically, the rate of return is highly sensitive to some variables, less sensitive to others. Attention is then concentrated on the variables to which profitability is most sensitive. This technique, known as sensitivity analysis, is considerably less expensive than full-scale simulation and yet provides similar data for decision-making purposes.

Using simulation techniques, Patrick found that enterprise management ability of the farm operator (technical transformation rates) is a major factor in determining the rate of growth of the farm firm. High levels of technical efficiency resulted in high levels of farm income, net worth accumulation, and the possibility of higher levels of consumption. Improvement of the technical rates of transformation by 10 percent increased the farmer's net worth

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<sup>6</sup>Brigham, Eugene F. and James L. Pappas, Managerial Economics, Hinsdale, Illinois, Dryden Press, Inc., 1972, pp. 75-76.

about \$2,000 per year.<sup>7</sup>

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<sup>7</sup>Patrick, George F., "The Impact of Managerial Ability and Capital Structure on Farm Firm Growth," unpublished M.S. thesis, Purdue University, 1966.

## Chapter 3

### THE MODEL

#### CHARACTERISTICS OF FARMING IN HILL COUNTY, MONTANA

A great deal of variability exists in the farming conditions within the Plains of Montana.<sup>8</sup> The short growing season (average 110 days) limits the choice of crops to the cereals -- mainly wheat, barley, and oats -- and grasses which are ecologically compatible to dryland farming. The climate is semiarid, characterized by moderately low rainfall, dry atmosphere (low humidity), cold winters, hot summers and a large number of sunny days. Seasonal precipitation is highly variable over time and its distribution over the area depends on elevations and normal storm paths.

Hill County is one of seven counties that make up what is termed the "triangle area" of Montana. It is located in northcentral Montana, which is the northwestern part of the Plains of Montana. This area is predominantly agricultural, specializing in grain production. Annual precipitation generally ranges between eight and fourteen inches per year. Because of this modicum rainfall average, a cropfallow farming rotation is the ascendant agricultural

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<sup>8</sup>The Plains of Montana extends eastward from the foothills of the Rocky Mountains. This area is part of the continental slope which has a slight inclination toward the east.

practice. Winter wheat and barley are the two most widely grown cash crops.

#### CASE FARM FAMILY AND FARM

The hypothetical farm in this study consists of a manager in his forties, his wife and two teenage children. The manager was raised on a farm, has a college education, and has been farming for fifteen years. He would be classified as an "above average" manager.

The hypothetical farm is 2200 dryland acres. Each year 900 acres of winter wheat and 200 acres of barley are grown. There are 1100 acres in fallow. No livestock enterprises exist, which is a realistic assumption in this area.

#### PRODUCTION COST DATA

An enterprise cost study in Hill County was completed in early 1976.<sup>9</sup> The subsequent "typical" farm in Hill County was the result of producers answering questions about the sequence of operations, machinery performance rates, fuel consumption and typical grain storage capacity as well as the size of shops and machine sheds for dryland farms. This formed a series of costs considered typical for

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<sup>9</sup>Schaefer, Jerry M., LeRoy D. Luft and M. S. Stauber, "Enterprise Costs for Fallow, Winter Wheat and Barley in Hill County," Bulletin 1138, Montana Agricultural Experiment Station, March 1976.

an above average level of management for dryland farms in Hill County. This "above average" upward bias is assumed because of the respondents. All were quite successful farm managers, thus implying a lack of randomness in those farmers questioned.

Total winter wheat production costs are \$32.95 per acre. This is comprised of \$25.34 per acre for seeded land and \$7.61 per acre for summer fallow. Total production costs for barley are \$30.32 per acre, \$22.71 per acre for seeded land and \$7.61 per acre for summer fallow. These figures exclude an explicit cost for labor, since the family labor supply is assumed adequate to operate this business. In addition, these figures do not as yet include any real estate costs. A complete breakdown of production costs is listed in Appendix A. Appendix B contains a machinery inventory and valuation from which depreciation figures are derived in this study.

#### YIELD DATA

Data on crop yields for individual tracts of land in Montana are difficult to find. Larson analyzed Montana wheat yield characteristics for the period 1940-1964 using data from state land tracts in several counties.<sup>10</sup> However, mean yields and other statistical

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<sup>10</sup>Larson, Donald K., M. S. Stauber and O. R. Burt, "Montana Dryland Wheat Sample and Yield Characteristics," Bulletin 654, Montana Agricultural Experiment Station, February 1974.

Table 1

HILL COUNTY 20 YEAR YIELD STATISTICS PLUS  
 ARBITRARY LOW AND HIGH YIELDS TO COMPENSATE FOR  
 POSSIBLE GREATER VARIATION FROM AVERAGE

YEAR	WHEAT BUSHEL PER ACRE	BARLEY BUSHEL PER ACRE
1955	29.0	23.5
1956	26.0	22.0
1957	23.6	16.0
1958	25.5	25.0
1959	27.0	18.5
1960	27.0	15.0
1961	19.0	8.0
1962	17.0	15.0
1963	18.0	14.0
1964	21.5	17.5
1965	26.5	16.5
1966	30.0	24.0
1967	22.0	14.0
1968	27.0	20.0
1969	21.0	18.7
1970	23.9	24.0
1971	26.7	21.0
1972	20.0	20.0
1973	22.6	14.0
1974	25.0	20.0
Arbitrary Yields	5.0	5.0
Arbitrary Yields	10.0	10.0
Arbitrary Yields	15.0	15.0
Arbitrary Yields	35.0	35.0
Arbitrary Yields	40.0	40.0
Arbitrary Yields	45.0	45.0

coefficients were not computed for state land tracts in Hill County because most of the yield series were not continuous over the 1940-1964 period. Consequently, annual average yields by county, as reported by the Statistical Reporting Service, are used for yield data.<sup>11</sup> It should be noted that these averages probably have less yield variability over time than would individual observations. Variance, both in standard deviations and relative terms, of average county yields tend to be less because of the greater acreage involved and the chance of a low yield in one part of the county being offset by a high yield in another part of the county in any given year. To compensate for this, low and high yields have arbitrarily been included. The individual yield additions are five, ten, fifteen, thirty-five, forty, and forty-five bushels for both wheat and barley (Table 1).

#### PRICE DATA

The dilemma in selecting a range of prices is depicted in Figure 3. The large increase in the 1972-1975 period precludes using a meaningful historic long-term price trend. A predictive future price trend is needed for accurate income assessment.

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<sup>11</sup> Montana Agricultural Statistics, Montana Crop and Livestock Reporting Service, USDA, Vol. 6-15, 1956-1974.

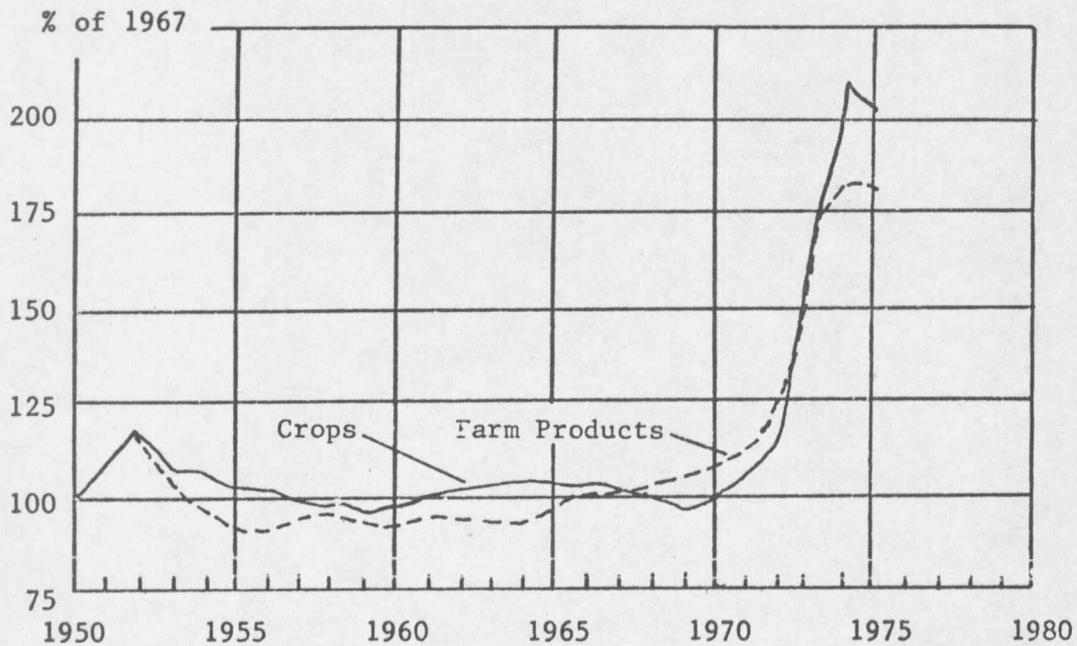


FIGURE 3: Prices Received by Farmers, 1950-1975, U.S. Average

Source: 1975 Handbook of Agricultural Charts, Agricultural Handbook No. 491, USDA, October 1975, p. 8.

Ray and Tweeten estimated crop prices two ways for the period 1975-1979.<sup>12</sup> Single-valued projections of average corn and wheat prices assuming normal crop yields and normal exports are presented in Table 2. A third row, barley prices, is included as a direct

<sup>12</sup>Ray, Daryll and Luther Tweeten, "Alternative Agriculture and Food Policy Directions for the U.S. -- With Emphasis on Continuation of Minimal Provisions of the 1973 Agriculture and Consumer Protection Act," Oklahoma Agricultural Experiment Station.

Table 2

PROJECTED FARM PRICES UNDER NORMAL CROP  
YIELDS AND EXPORTS, 1975-1979, ACTUAL 1971-1974

	1971-73 (average)	1974	1975	1976	1977	1978	1979
Corn \$/bu	1.73	3.10	2.50	2.20	2.10	2.20	2.45
Wheat \$/bu	2.37	4.10	3.40	3.00	2.70	2.65	2.65
Barley \$/bu	1.50	2.65	2.15	1.90	1.80	1.90	2.10

Source: Ray, Daryll and Luther Tweeten, "Alternative Agriculture and Food Policy Directions for the U.S. -- With Emphasis on Continuation of Minimal Provisions of the 1973 Agriculture and Consumer Protection Act," Oklahoma Agricultural Experiment Station, p. 8.

function of corn prices, based on the differences between per bushel weights. Prices are crop year averages. The price predictions are below 1974 levels for the remainder of the 1970s.

A second estimation was made with expected values of crop prices based on random yields and exports. These projected values are very near the values in Table 2. Results are shown in Table 3. Barley prices are included as a direct function of feed grain prices, based on the number of bushels of barley per ton. The variability in yields and exports in the stochastic simulation results in a wide range of prices about the expected values. The widest range in feed grain prices is from \$38.45 per ton to \$138.88 per ton (\$.92 to \$3.33 per bushel for barley) in 1979. The minimum wheat prices decline each

Table 3

PROJECTED FARM PRICES, 1976-1979,  
ASSUMING RANDOM YIELDS AND EXPORTS

	<u>Feed Grains</u> \$/ton	<u>Wheat</u> \$/bu	<u>Barley</u> \$/bu
		<u>1976</u>	
Mean	76.03	3.01	1.82
Standard deviation	15.38	.47	.27
Minimum	38.45	1.93	.92
Maximum	120.92	4.47	2.90
		<u>1977</u>	
Mean	73.29	2.74	1.76
Standard deviation	17.50	.54	.42
Minimum	38.45	1.54	.92
Maximum	126.83	5.95	3.04
		<u>1978</u>	
Mean	77.34	2.63	1.86
Standard deviation	18.06	.54	.43
Minimum	38.45	1.37	.92
Maximum	127.65	4.90	3.06
		<u>1979</u>	
Mean	82.41	2.59	1.98
Standard deviation	19.80	.54	.48
Minimum	38.45	1.37	.92
Maximum	138.88	5.84	3.33

Source: Ray, Daryll and Luther Tweeten, "Alternative Agriculture and Food Policy Directions for the U.S. -- With Emphasis on Continuation of Minimal Provisions of the 1973 Agriculture and Consumer Protection Act," Oklahoma Agricultural Experiment Station, p. 16.

year until they reach a low of \$1.37 per bushel in 1978 and 1979. The maximum wheat price is nearly \$6.00 per bushel in 1977 and 1979.

The probability distribution of feed grain prices over the projection period is nearly symmetrical around the \$70-\$80 per ton (\$1.70 - \$1.90 per bushel for barley) price range (Figure 4). Over the four year period 21 percent of the observations fall in this range.

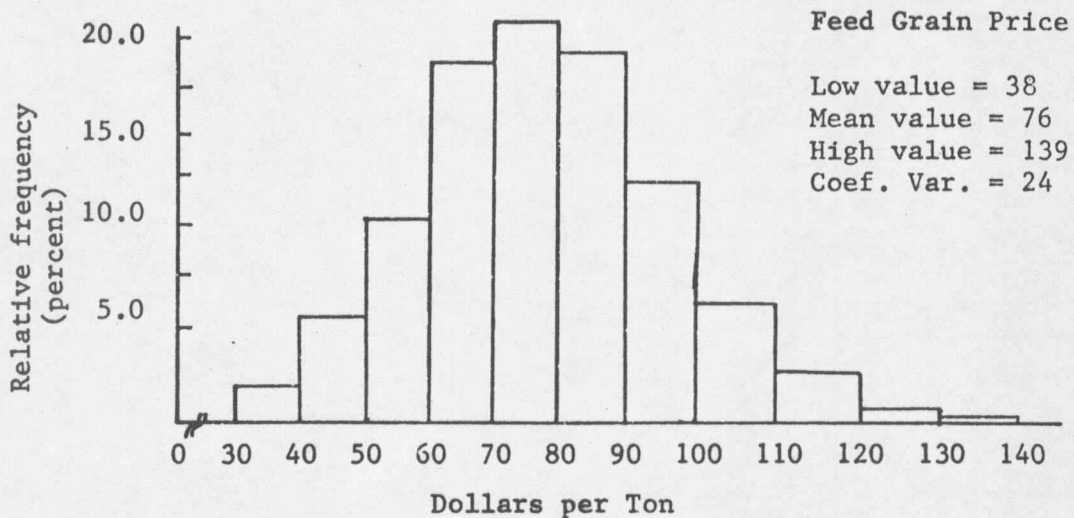


FIGURE 4: Projected Price Distribution for Feed Grains, 1976-1979

Source: Ray, Daryll and Luther Tweeten, "Alternative Agriculture and Food Policy Directions -- With Emphasis on Continuation of Minimal Provisions of the 1973 Agriculture and Consumer Protection Act," Oklahoma Agricultural Experiment Station, p. 21.

Combining price ranges, there is a 29 percent probability of feed grain prices being between \$50 and \$70 per ton and a 32 percent probability of \$80 to \$100 per ton feed grain prices (\$1.20 - \$.170 and \$1.90 - \$2.40 per bushel for barley, respectively). Seven times out of 100 feed grain prices fall below \$50 per ton and ten times out of 100 the price of feed grains exceeds \$100 per ton.

Wheat prices are between \$2.50 and \$3.00 per bushel for 36 percent of the observations (Figure 5). There is a 28 percent chance

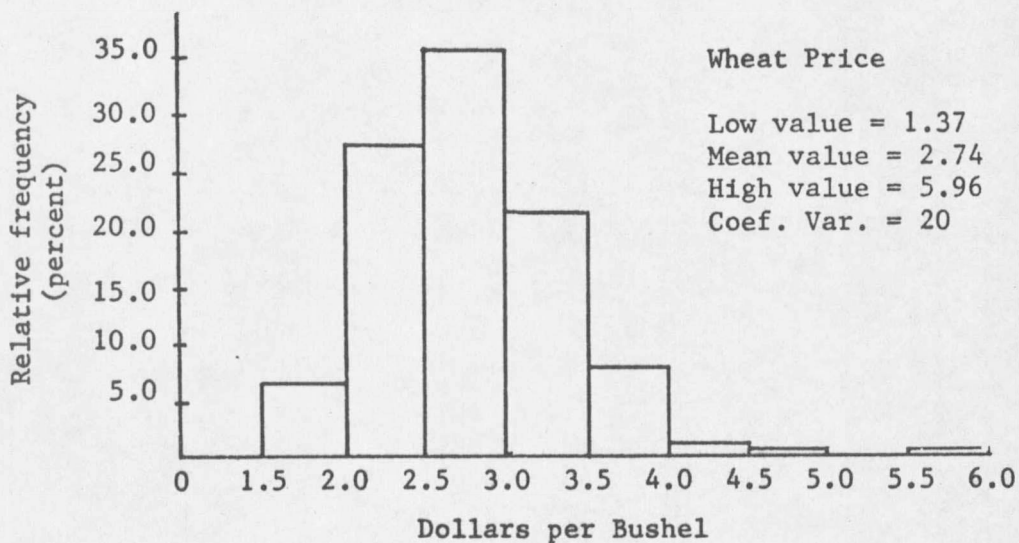


FIGURE 5: Projected Price Distribution for Wheat, 1976-1979

Source: Ray, Daryll and Luther Tweeten, "Alternative Agriculture and Food Policy Directions -- With Emphasis on Continuation of Minimal Provisions of the 1973 Agriculture and Consumer Protection Act," Oklahoma Agricultural Experiment Station, p. 21.

of wheat prices in the \$2.00 to \$2.50 per bushel range and there is a 22 percent chance of wheat prices between \$3.00 and \$3.50 per bushel. Eight times out of 100 wheat prices are in the \$3.50 to \$4.50 range but there is only one chance in 200 of prices exceeding \$5.00 per bushel.

To determine the price range used in this study a consideration must be given to the Agricultural and Consumer Protection Act of 1973. If market price falls below the crop's target price, each participating farmer is paid the difference between the target price and the market price for the first five months of the marketing year or the difference between the market price and the loan rate, whichever is smaller, for each bushel of normal production on his allotted acreage. The target prices are to be adjusted directly for changes during the preceeding year in the index of prices paid by farmers for production items (including interest, taxes and wage rates), and inversely for changes in three-year moving averages of yield. For 1976 this resulted in target price levels in Montana of \$1.28 per bushel for barley and \$2.29 per bushel for wheat.

A final consideration requires comparing Montana and U.S. average wheat and barley prices in order to see if adjustments in the above prices are necessary. A graphic comparison (Figure 6 and Figure 7) shows that the yearly averages are quite similar, not deviating

more than \$.17 per bushel for wheat and \$.19 per bushel for barley. Therefore, no price adjustments are necessary.

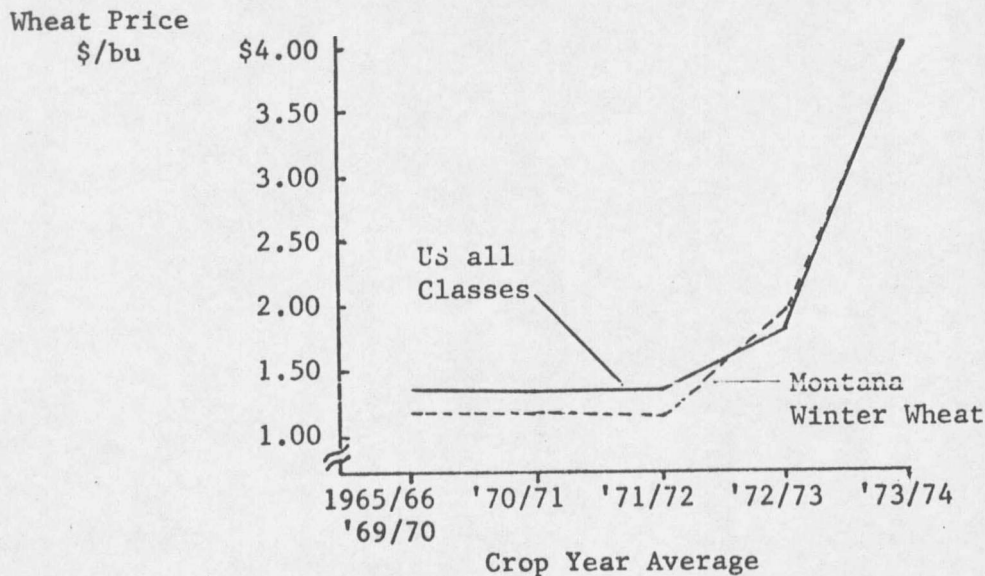


FIGURE 6: Montana and U.S. Average Wheat Prices Received by Farmers, Average 1965-1970

Source: Ryan, Mary E., "Montana Grains in the U.S. and World Grain Economics," Staff Paper 74-9, Agricultural Economics and Economics Department, Montana State University, p. 5.

To reduce the number of variables, prices and yields were combined to yield a single variable, gross income. This required making an assumption about relative price movements between wheat and barley. As Figures 4 and 5 show, both price ranges are fairly symmetrical. As Figures 6 and 7 show, wheat and barley prices have

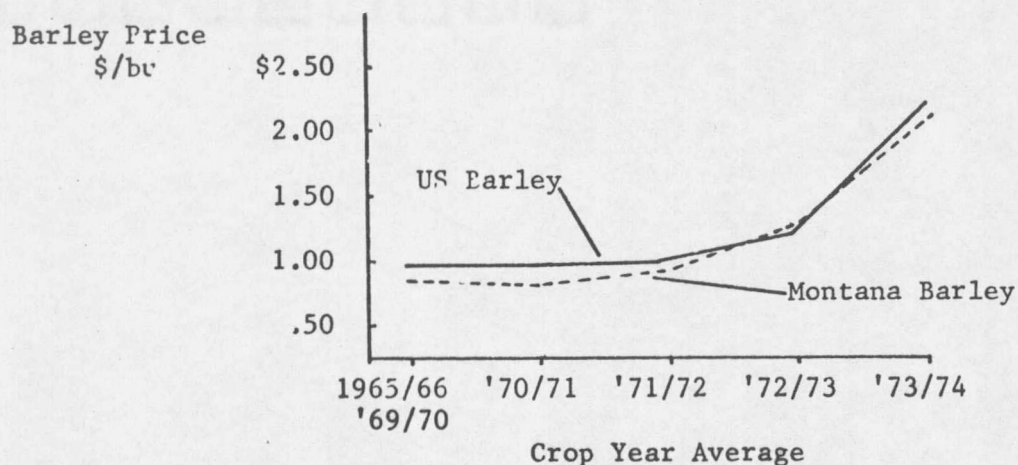


FIGURE 7: Montana and U.S. Average Barley Prices Received by Farmers, Average 1965-1970

Source: Ryan, Mary E., "Montana Grains in the U.S. and World Grain Economics," Staff Paper 74-9, Agricultural Economics and Economics Department, Montana State University, p. 5.

historically moved together. It therefore was assumed that if the mean price of one was selected, the corresponding mean price of the other was also used, and so on for deviations from their means. This is an heroic assumption but it is necessary to keep the simulation manageable. Since gross income is the variable used, this assumption tends to cancel opposite price movements of wheat and barley, making it more acceptable.

Using the stochastic probabilities mentioned earlier, 26 prices each were calculated for wheat and barley. Only prices above the 1976

target prices were allowed. Yields were combined such that when a wheat yield from a given year was used, the corresponding barley yield from that year was also used. The first wheat price was multiplied by all 26 wheat yield values. The first barley price was likewise multiplied by all 26 barley yield values. These per acre income values were then multiplied by the number of seeded acres (900 for wheat, 200 for barley). The resulting incomes for wheat were added to the corresponding incomes for barley, yielding 26 gross incomes. The procedure was then repeated for each subsequent wheat price and barley price. This generated 676 separate gross income observations. Since prices were grouped around a mean and yields were concentrated in the 20-30 bushel per acre range, the gross income observations were most heavily concentrated in a range from \$60,000 - \$80,000.

As noted previously, the production cost figures used in this study were compiled from data provided by above-average managers. It is reasonable to assume that these producers also have above-average incomes. To remain consistent with the assumptions regarding the hypothetical farm firm, the lowest 10 percent of the gross income observations were eliminated, leaving 608 income values.

#### CONSUMPTION

Consumption expenditures serve as a major capital leakage in the firm growth process, reducing the amount of farm income available

for reinvestment. Regardless of the financial success of the farm business, at least a minimum amount of money is needed for family consumption, a necessary condition for survival of the farm operation.

No literature was found on the consumptive habits and expenditures of Montana farm families. Several empirical studies have been done, however, in other parts of the United States. Brake did an empirical study that was based on a cross-section of United States farm family consumption patterns.<sup>13</sup> The consumption function is:

$$C_o = 22.96 P^{0.410} NFI^{0.590} S^{0.163}$$

where:  $C_o$  = current consumption

$P$  = ratio of current (1975) to 1961 indexes of prices paid,

$$P = 1.9667$$

$NFI$  = net income after taxes; and

$S$  = family size.

This equation is based on mean values and the coefficients for  $NFI$  and  $S$  are elasticities rather than marginal propensity values. The consumption function is illustrated in Figure 8, where the amount withdrawn for consumption increases at a decreasing rate as  $NFI$  increases. For large values of  $NFI$ , the consumption function approxi-

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<sup>13</sup> Brake, John R., "Firm Growth Models Often Neglect Important Cash Withdrawals," American Journal of Agricultural Economics, August 1968, pp. 769-771.

mates a linear but positively sloped relationship. The consumption expenditure is an explicit function of disposable income in the period in which the income is derived from gross sales.

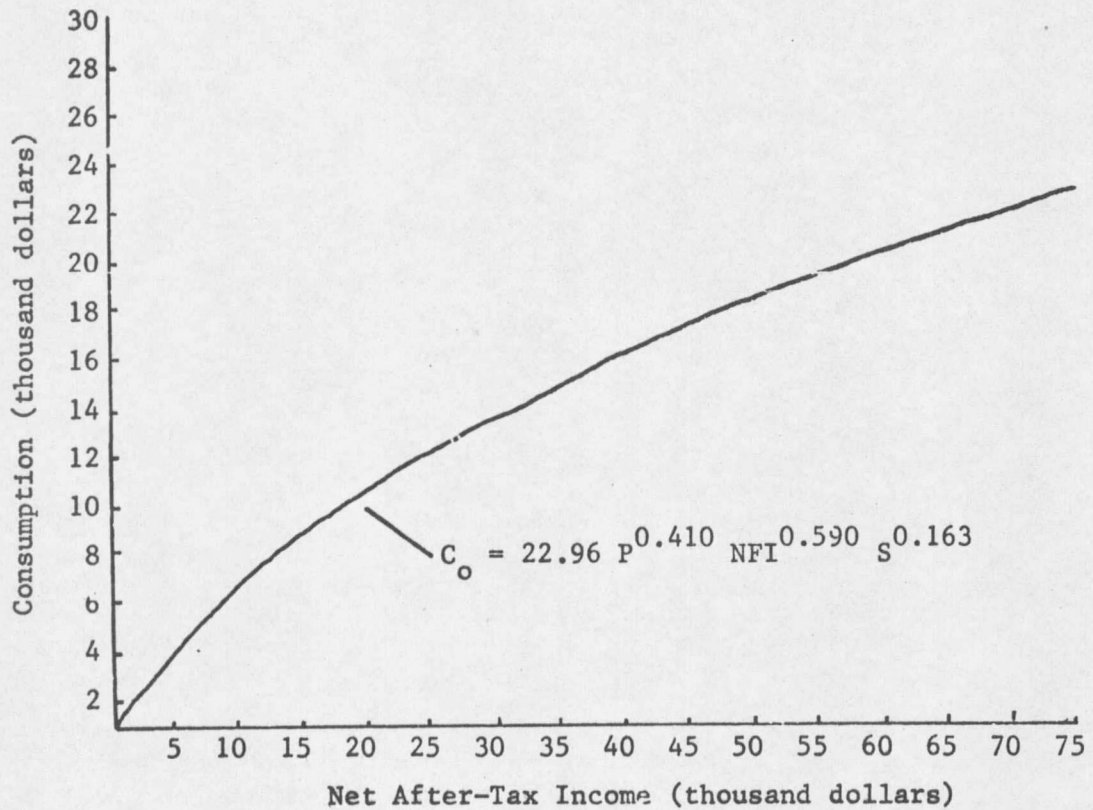


FIGURE 8: Illustration of a Consumption Function For a Family of Four, 1975

Generally, consumption expenditures are considered to lag in adjustment to yearly fluctuations in income. A further lag in the response of consumption to income is the result of the seasonal nature of farm income. For example, a typical grain farmer has most of his sales concentrated in the last quarter of the year. Therefore, income in year  $t-1$  would be more influential in determining consumption in year  $t$  than would income in year  $t$ .

The determining factor is the marketing strategy employed. This study assumed that all grain sales were transacted during the last four months of each year. To make allowance for this, consumption for the first nine months of year  $t$  is based on the net after-tax income in year  $t-1$ . For the last quarter of year  $t$ , consumption was based on net after-tax income in year  $t$ .

Brake and Holm found that a family of four with an income of \$4,000 before taxes spent almost that amount for consumption.<sup>14</sup> Above the \$5,000 income level, consumption by farm families tended to increase rather slowly. The minimum consumption expenditure required for survival in this study is \$4,500. It is increased by 4.4

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<sup>14</sup> Brake, John R. and C.R. Holm, "The Influence of Household Size and Income on Farm Family Expenditures in Michigan, 1960," Quarterly Bulletin, Michigan Agricultural Experiment Station, February 1962.

percent annually.<sup>15</sup>

In 1973, farm families in the United States spent an average of \$9,317 or \$776 per month.<sup>16</sup> An upper limit of \$1,000 per month was placed on consumption in this study. This has the effect of holding net after-tax income, upon which consumption is based, at about \$26,000.

#### CASE FARM FAMILY GOALS

It is assumed that age affects farm firm goals in the following way. A tendency of young farm operators is for physical resource expansion, specifically land and machinery. This early goal is attempted at the particular expense of family consumption.<sup>17</sup> With expansion in the resource base beyond the initial farming years, producers shift goals to increased family expenditures. This is due to the foregone comforts of earlier years plus the increasing needs of

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<sup>15</sup>For justification of this inflation rate, see page 39.

<sup>16</sup>"Farm Operator Family Living Expenditures for 1973," Crop Reporting Board, Statistical Reporting Service, USDA, September 1975.

<sup>17</sup>Bailey illustrated the critical importance to the farm family of keeping living expenses to a minimum in the early years of farming. Increasing consumption expenditures delayed the rate of growth. From: Warren R. Bailey, "Necessary Conditions for Growth of the Farm Business," Agricultural Economics Research, Vol. XIX, No. 1, January 1967.

their children. It is assumed the farmer of this study is in this latter position, having attained an acceptable farm size. The growth goal then becomes one of reducing the exogenous investment required by the farm firm.

To isolate the impact of certain variables in this study, the size of the farm and the yearly crop acreage are held constant. This is feasible if (1) the size of the firm under consideration is, under normal circumstances, adequate to provide an economically productive unit and (2) the firm is capable of sustaining a farm family in a fashion consistent with their goals and objectives.

The firm size used in this study was established from a concensus by farmers that it represented a "typical" production unit in that geographic area. A factor influencing a farmer's adjustment process to new conditions and financial success is predicated on the economies of size in agriculture. One study found that the long-run average cost curve for agriculture shows no strong tendency to rise as output increases.<sup>18</sup> Therefore, small firms have a substantial incentive to adopt new techniques and expand output to take full advantage of the lower unit costs. Further, while evidence frequently shows that there are no further cost advantages from

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<sup>18</sup> Carter, H.O. and G.W. Dean, "Cost-Size Relationships for Cash Crop Farms in a Highly Commercialized Agriculture," Journal of Farm Economics, Vol. 43, May 1961, pp. 264-277.

expanding beyond this point, output can often be increased substantially without incurring any diseconomies. This phenomenon partly explains why many smaller farmers are able to operate competitively with some of the larger ones.

#### VARIABLES TO BE ANALYZED

Three key elements are considered as to the effect they have on the financial condition of the hypothetical farm firm. The first variable is incorporated at two levels; the other two are incorporated at three different levels for all combinations of the three variables, or a total of 18 variables.

The first variable considered is indebtedness. The initial position has long-term debt as the only financial liability of the firm. It is based on total real estate value. The two initial liability levels are 25 and 50 percent.

Long-term interest rate is the second variable examined. It enters the analysis through its effect on the amortization payment that is due annually. Higher interest rates increase the amount of the payment. The three rates used are eight, nine, and ten percent.

The third variable, land value, is based on per acre real estate prices of \$200, \$250, and \$300. Included within these prices is the value of all real property except the family dwelling. In this study land values are said to be constant at these levels. They actually

are appreciated in value each year of the simulation. However, to simplify the explanation of variable combinations, land values are only quoted at their initial values.

#### SIMULATION MODEL FORMULATED

Simulation, in its methodological sense, is an abstract mathematical formulation of a real world situation. In this study this technique is used to evaluate the cash flow effect of certain exogenous variables on a particular farm firm. The following flow chart (Figure 9) serves as a guide to the simulation model.

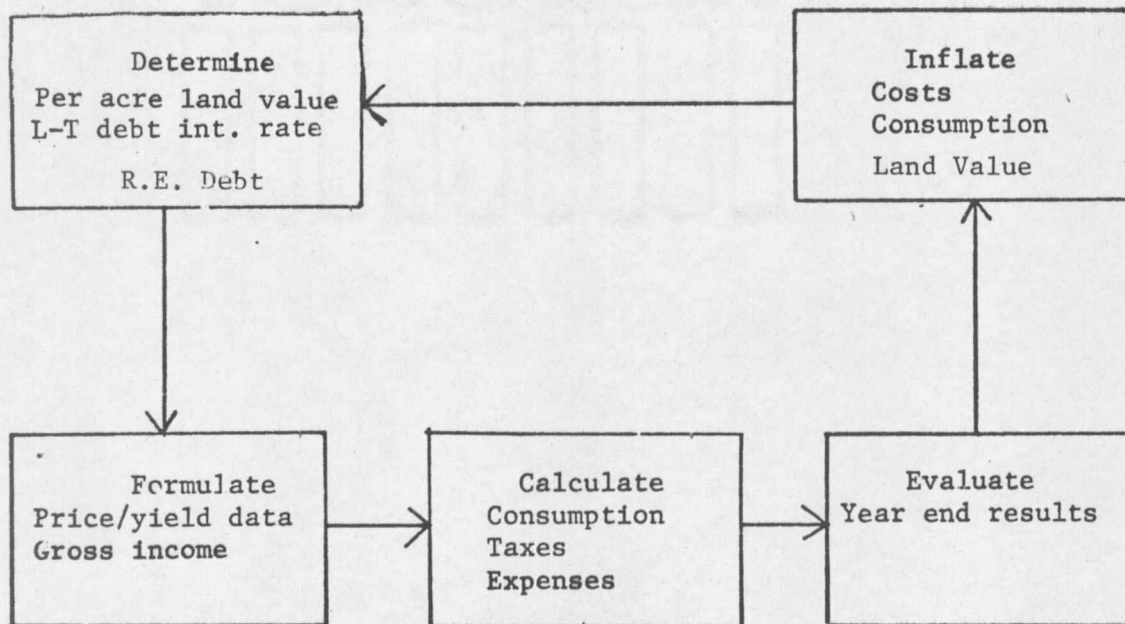


FIGURE 9: Simplified Cash Flow Simulation Flow Chart

## PROCEDURE

A computer program was written to assist in the analysis.<sup>19</sup>

It parallels the flow chart described in the previous section. After determination of a land value, interest rate, and indebtedness, the simulation was run for a ten-year period. Yearly payments necessary for the firm's short-run survival include production expenses, consumption, taxes, and all interest owed. Additional payments not necessary for short-run survival but required for long-run continuation are all debt principal payments and depreciation/replacement expense.

Consumption for the first nine months is calculated and added to the monthly production expenses. At the beginning of each month the cash balance is checked against the expense for that month. The beginning cash balance each year is the net cash income balance from the previous year. A \$300 minimum is always maintained. If the cash balance, excluding \$300, is greater than the monthly expense, the expense is deducted and the cash balance is invested in a short-term savings account at an annual percentage rate of five percent. If the cash balance is less than the expense for that month the cash balance, minus \$300, is subtracted from the monthly expense. This

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<sup>19</sup> A complete listing of this computer program can be found in Appendix C.

residual amount becomes part of an operating loan principal, which carries an annual interest charge of nine percent. For each of the first nine months this procedure is repeated.

At the end of this nine month period, a new gross income is formulated. This value is one of ten incomes in a row of an income matrix. There are 30 sets of ten income observations generated, making a 30 x 10 matrix of individual observations. Individual data observations were selected using a table of random numbers.<sup>20</sup> All data values were given an equally likely chance of occurring, and they were chosen with replacement. Taxes for the year were calculated using 1975 tax rate schedules for a married couple filing jointly, claiming two dependents. Consumption is then derived for the last three months.

The simulation proceeds through a series of checks to determine whether using any value for consumption between the minimum and the estimated value will force the cash income balance below zero. If it will, a consumptive figure is used that will make the cash income zero, unless doing so would necessitate using a value that is less than the minimum allowed. The consumption figure used is added to the taxes, long-term debt interest, operating debt interest, and

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<sup>20</sup>Snedecor, George W. and William G. Cochran, Statistical Methods, Ames, Iowa, Iowa State University Press, 6th Edition, pp. 543-546.

remaining production expenses for the year. The resultant sum is deducted from gross income. At this stage in the simulation, if the cash balance is negative, the firm has become illiquid. Illiquidity is defined as inadequate loan repayment capacity occurring when cash obligations are larger than the amount of cash available at the end of a given year. When this occurs the simulation run for this ten-year period is terminated with the financial condition being noted.

A positive difference between gross income and the aforementioned expenses continues the simulation. Operating and long-term principal payments are deducted. If there is an insufficient amount to cover these payments, the difference is carried over and has a one percent penalty assessed in addition to the regular interest charge. The cash balance becomes zero.

Depreciation/replacement expense is then considered. The depreciation period is ten years. The first year replacement cost is \$9,672. Depreciation/replacement cost is the last deduction from income before the year-end analysis. If only part of the depreciation/replacement expense can be paid before the cash balance becomes zero, it is paid and the remainder is carried over to the following year's replacement expense. The cash balance becomes zero. If the cash income balance was already zero after deduction of principal payments, the current year's depreciation/replacement expense is added to next year's replacement cost. When this

happens the firm is existing by using depreciation since it is using equipment beyond its normal replacement cycle. Should it continue to do so, the firm's survival would be in jeopardy. This would be partially reflected in the deterioration of its asset base on the balance sheet. However, the need for a larger expenditure in the future for equipment would not be readily obvious.

Year-end evaluation comprises itemizing various figures, including those described above. This gives a brief but accurate description of the changes that occur.

Unlike industries characterized by a few large firms, the domestic farming industry cannot directly pass on inflation spurred production cost increases. Agriculture is not a cost-plus industry in its structural make-up. Following the year-end simulation analysis, production costs, consumption constraints, depreciation/replacement costs, and land values are increased at an annual rate of 4.4 percent. This figure is a best guess estimate. It is a rate projected as the annual rise in the Consumer Price Index through 1985.<sup>21</sup>

The above pattern is replicated through year ten. At the end of this ten-year run, a new land value, interest rate and indebtedness

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<sup>21</sup>Tweeten, Luther, "Government Programs for the Farming Economy in the Great Plains," paper presented at the Seminar of Great Plains Resource Economics Committee of the Great Plains Agricultural Council, New Mexico State University, October 1974, p. 24.

are chosen and the simulation is rerun using the same gross income values. This procedure is repeated until all combinations of variables have been analyzed using the same ten income observations. Then a new set of ten income values are selected and the entire process is redone, making a total of 30 complete simulations for all possible combinations of the variables. The 30 simulations are then averaged for each variable to arrive at one set of results per variable.

## Chapter 4

### RESULTS

#### INITIAL FINANCIAL POSITION OF SIMULATED FARM

Land values, long-term interest rates, and long-term liabilities are the controlled variables in this study. However, they are not the only variables affecting outcomes. The interaction between the controlled variables, consumption, operating loan principal and interest, taxes, and equipment replacement purchases caused some adjustment in the results. For example, in a given year it was possible that a higher interest rate actually increased the ending cash balance compared to a lower interest rate due to a reduction in one of the other variables, such as consumption. While revealing all of the internal changes is not relevant to this study, it is necessary to acknowledge their importance in the yearly cash flows.

Analysis of the data produced by the simulation was aided by use of a financial analysis computer program called FINAN.<sup>22</sup> FINAN summarizes the financial changes for a farm business from year to year. It determines rates of return on farm investment and net

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<sup>22</sup>Hawkins, Richard O., and Kenneth H. Thomas, "FINAN," Economic Information Report R72-9, Minnesota Agricultural Extension Service, 1973.

worth, and computes financial well-being in terms of financial ratios.

The beginning financial position of the case farm is shown in Table 4. Net worth calculations at the 25 percent indebtedness level range from a low of \$475,200 to a high of \$640,200. With long-term indebtedness at 50 percent of the value of real estate, net worth varied from a low of \$365,200 to a high of \$475,200. The land payments associated with the various levels, amortized over 30 years, are also listed. These payments went from \$9,768 at 8 percent interest, \$200 land value, and 25 percent indebtedness to \$35,013 at 10 percent interest, \$300 land value, and 50 percent indebtedness. All variable combinations were started with the same cash balance and machinery and building inventory. Current/intermediate liabilities were zero at the beginning of the simulation.

Simulation runs involving all land value and interest rate variables at the 25 percent indebtedness level were continuously liquid. When long-term indebtedness was incremented to 50 percent of the total real estate value, some simulation runs became illiquid (Table 5). With a \$250 land value, two runs were illiquid at 9 percent interest and six were illiquid at 10 percent interest. The first time a particular run became illiquid, the year and amount needed to make it liquid were noted. All larger land value and

Table 4

## INITIAL BALANCE SHEET OF CASE FARMS, JANUARY 1

Long term loan length - 30 years  
 Years remaining on loans - 30 years

% of R.E. in debt	Land=\$200/A		Land=\$250/A		Land=\$300/A	
	25	50	25	50	25	50
<b>Assets</b>						
Land	\$440,000	\$440,000	\$550,000	\$550,000	\$660,000	\$660,000
Machinery	96,720	96,720	96,720	96,720	96,720	96,720
Cash	10,000	10,000	10,000	10,000	10,000	10,000
Buildings	<u>38,480</u>	<u>38,480</u>	<u>38,480</u>	<u>38,480</u>	<u>38,480</u>	<u>38,480</u>
TOTAL	\$585,200	\$585,200	\$695,200	\$695,200	\$805,200	\$805,200
<b>Liabilities</b>						
Long-term debt	<u>\$110,000</u>	<u>\$220,000</u>	<u>\$137,500</u>	<u>\$275,000</u>	<u>\$165,000</u>	<u>\$330,000</u>
Net Worth	\$475,200	\$365,200	\$557,700	\$420,000	\$640,200	\$475,200
<b>Amortized Payment</b>						
8%	\$ 9,768	\$ 19,536	\$ 12,210	\$ 24,420	\$ 14,652	\$ 29,304
9%	10,702	21,405	13,378	26,757	16,054	32,108
10%	11,671	23,342	14,588	29,177	17,506	35,013

Table 5

YEAR AND AMOUNT SIMULATION OBSERVATIONS BECAME  
ILLIQUID AT LOWEST VALUES OF LAND AND  
INTEREST RATES WITH INDEBTEDNESS = 50%

Land Value	Interest Rate	Year	Needed to be Liquid
\$ per acre	%		\$
250	9	10	805
250	9	10	1,043
250	10	4	2,106
250	10	5	590
250	10	8	2,133
250	10	10	1,875
250	10	10	1,029
250	10	7	531
300	9	9	201
300	9	7	634
300	9	9	799
300	9	4	1,676
300	9	3	1,706
300	9	1	905
300	10	2	179
300	10	8	1,495
300	10	5	2,344
300	10	6	520
300	10	7	3,262
300	10	6	1,538
300	10	8	1,495
300	10	9	922
300	10	1	2,781

interest rate variable combinations were not completed, since they would only become illiquid by larger amounts. The \$300 per acre land value resulted in six additional runs that became illiquid at 9 percent interest, making a total of eight runs that were not completed. At 10 percent interest, nine illiquid runs were noted, for a total of fifteen incomplete runs. The case farm in these instances was not able to absorb the increased fixed payments which occurred. Since this type of retrogradation in the financial condition of the case farm was specifically defined as being below the minimum requirement for success, the averages obtained from runs for each variable were based only on simulation runs that remained liquid over the entire ten-year period.

#### GROWTH IN NET WORTH

Net worth is a fundamental measurement tool that lends itself particularly well to comparing effects of the variables in this study. Using net worth as an analysis tool may have some limitations. However, to establish general patterns, it is accepted in financial circles for evaluation purposes.

At the 25 percent indebtedness level, a fairly consistent pattern developed for the ending net worth of averaged runs (Table 6). With land valued at \$200 per acre, net worth decreased by more

Table 6

NET WORTH STATUS OF CASE FARM UPON COMPLETION OF  
SIMULATION AND PERCENTAGE CHANGE IN ENDING NET WORTH  
PER UNIT CHANGE IN INTEREST RATES WITH INDEBTEDNESS = 25%

Long-Term Interest Rate	Land Value (\$ per acre)					
	200		250		300	
	%	\$	%	\$	%	\$
8		668,731		789,620		905,425
			-1.24		-1.43	
9		660,433		778,279		892,284
			-1.09		-1.41	
10		653,221		767,292		874,008
						-2.05

than \$7,000 per incremental increase in the interest rate. At \$250 per acre, it decreased by about \$11,000 for each increase in interest rates. For land values of \$300 per acre, it showed a little more variation between the 8 percent and 9 percent interest rates than between the 9 and 10 percent interest rates. For the first interest rate increase, from 8 to 9 percent, at \$300 land values, net worth decreased by about \$13,000, and for the second interest rate increase, net worth decreased over \$18,000. On a percentage basis, with land prices held constant, increases in the interest rate caused reductions in net worth from 1.09 percent to 2.05 percent.

The interest rate determined the size of the yearly amortized payment. In all situations, increasing the interest from 8

to 9 percent and from 9 to 10 percent meant increasing the amortized payment made each year of the ten-year period by 8.73 percent and 8.30 percent, respectively. By the completion of the simulation, these higher yearly payments were countered primarily by variable adjustments in consumption, taxes and equipment replacement, to the extent of a 1.24 percent and 1.09 percent decrease in ending net worth for land valued at \$200 per acre. Land valued at \$250 per acre caused reductions of 1.43 and 1.41 percent. With land priced at \$300 per acre, the ending net worth reductions were 1.45 and 2.05 percent.

Comparing ending net worth (Table 6) with beginning net worth (Table 4) at 25 percent indebtedness shows the net worth change that took place over the ten-year period. For land values of \$200 per acre and interest rates of 8 percent, 9 percent, and 10 percent, net worth increased by \$193,531, \$185,233, and \$178,021, respectively. Using the same interest rate order and land valued \$50 higher, net worth increased \$231,920, \$220,579, and \$209,592.

Results for indebtedness at 50 percent of the real estate value are not as conclusive due to the number of runs that were illiquid (Table 7). The \$250 land value had a greater difference between net worth figures, \$16,600 and \$27,600, as the interest rate increased, than did the \$200 land value, which had no illiquid

Table 7

NET WORTH STATUS OF CASE FARM UPON COMPLETION OF  
SIMULATION AND PERCENTAGE CHANGE IN ENDING NET WORTH  
PER UNIT CHANGE IN INTEREST RATES WITH INDEBTEDNESS = 50%

Long-Term Interest Rate	Land Value (\$ per acre)					
	200		250		300	
	%	\$	%	\$	%	\$
8		492,177		564,805		647,168
			-4.04		-2.94	
9		472,281		548,180		636,405
			-4.36		-5.04	
10		451,683		520,564		669,555
						5.21

observations. For interest rates of 8 percent, 9 percent, and 10 percent, the \$300 land value, which was based on 21, 15, and 6 complete runs, respectively, showed an even greater variation in ending net worth, decreasing by about \$11,000 and then increasing over \$33,000 for interest rate increments.

Because averages for the higher two land variables at 50 percent indebtedness were based on less than the full 30 observations, care must be taken in drawing conclusions from the results. Only the highest ten-year income groups kept the firm liquid at these variable combinations. This tended to distort the averages.

The \$200 land value at 50 percent indebtedness was based on the same number of completed observations as the 25 percent indebted-

ness was for the same land value, so some direct cross-comparisons are possible. Increments in the interest rate became more significant. Ending net worth decreased by 4.04 percent and 4.36 percent. This compares to 1.24 percent and 1.09 percent for the 25 percent indebtedness variable.

The \$250 land value showed greater variation in ending net worth, with incremental interest rates yielding net worth decreases of 2.94 percent and 5.04 percent. With the \$300 land value at 10 percent interest, only the six highest income observations remained liquid. Ending net worth changed direction, from a decrease of 1.66 percent between 8 percent and 9 percent to an increase of 5.21 percent between 9 percent and 10 percent.

Ending and beginning net worth can be compared by using Tables 7 and 4. A \$200 land value showed increases in net worth of \$126,977 at 8 percent interest, \$107,081 at 9 percent interest, and \$86,483 at 10 percent interest. A rise of \$50 in real estate prices resulted in increases in net worth of \$144,605 at 8 percent interest, \$127,980 at 9 percent interest, and \$100,364 at 10 percent interest. An additional \$50 increase yielded an increase in net worth of \$171,968 at 8 percent interest, an increase of \$161,205 at 9 percent interest, and an increase of \$194,355 at 10 percent interest.

Table 8 lists the difference between ending and beginning net worth along with the percentage change between them for an indebtedness of 25 percent. For all three land values, the percentage decreased by about the same amount when interest rates increase, ranging between 1.5 percent and 3 percent.

Table 8

INCREASE AND PERCENTAGE CHANGE IN NET WORTH  
OF CASE FARM FROM INITIAL PERIOD TO  
END OF TEN-YEAR PERIOD WITH INDEBTEDNESS = 25%

Land Value (\$ per acre)	Long-Term Interest Rate					
	8%		9%		10%	
	\$	%	\$	%	\$	%
200	193,531	140.73	185,233	138.98	178,021	137.46
250	231,920	141.59	220,579	139.55	209,592	137.58
300	265,225	141.43	252,084	139.38	233,808	136.52

Table 9 makes the same comparison when indebtedness is increased to 50 percent. The percentage figures contain more variation. They move quite closely for land values of \$200 and \$250. Percentages for these two land values vary by about 5.5 percent and 4 percent for interest rate changes from 8 percent to 9 percent and they vary by about 5.5 percent and 6.5 percent for a movement in

interest rates from 9 percent to 10 percent. The \$300 land value again shows irregularity, due to less observations, decreasing 2.27 percent from 8 percent to 9 percent interest but increasing 6.98 percent when interest rates increase from 9 percent to 10 percent.

Table 9

INCREASE AND PERCENTAGE CHANGE IN NET WORTH  
OF CASE FARM FROM INITIAL PERIOD TO  
END OF TEN-YEAR PERIOD WITH INDEBTEDNESS = 50%

Land Value (\$ per acre)	Long-Term Interest Rate					
	8%		9%		10%	
	\$	%	\$	%	\$	%
200	126,977	134.77	107,081	129.32	86,483	123.68
250	144,605	134.41	127,980	130.46	100,364	123.88
300	171,968	136.19	161,205	133.92	194,355	140.90

#### FINANCIAL SOLVENCY

Measurement of the financial solvency of a business reflects its ability to pay all of its debts if it were liquidated. Liability ratios are usually used to provide such estimates.

The equipment replacement expense was not bounded by strict limits as was consumption. Consequently, the various variable combinations had different ending equipment inventories. The

solvency positions became more variable because of this.

Total current and intermediate liabilities/assets percentage, because it excludes land values, provides a significant measure of solvency. These percentages are detailed in Table 10. Current/intermediate liabilities in this study consisted of unpaid operating loans at the end of the year. Since the initial starting position contained no current/intermediate liabilities, the case farm in all instances had incurred these liabilities during the simulation and was unable to eliminate them by the end of the ten-year period.

Table 10

TOTAL CURRENT AND INTERMEDIATE LIABILITY/ASSET  
PERCENTAGES OF CASE FARM AT END OF SIMULATION  
FOR ALL COMBINATIONS OF LAND VALUES, INTEREST  
RATES AND INDEBTEDNESSES

Interest Rate	Indebtedness	Land Value (\$ per acre)		
		<u>200</u>	<u>250</u>	<u>300</u>
8%	25%	13%	20%	31%
9%	25%	16%	24%	39%
10%	25%	19%	30%	58%
8%	50%	67%	147%	283%
9%	50%	95%	191%	349%
10%	50%	137%	295%	158%

When the indebtedness variable was 25 percent, the current and intermediate liability/asset ratio ranged from 13 percent to 58 percent, indicating that the equipment inventory had been replaced at a sufficient level to keep the firm safely solvent. With a 50 percent indebtedness variable however, the ratios increased rapidly, from 67 percent at the lowest value to 349 percent at the highest value. This means that, at the largest ratio value, an amount of money equal to three and one-half times the value of current and intermediate assets would have to be found elsewhere. This illustrates the value of ratio analysis in revealing obscured financial information. At the higher debt level of 50 percent, the solvency position has deteriorated considerably. Even though land appreciation had caused net worth to increase, the case farm at these variable levels was in a poor solvency condition.

The total liability/asset percentage indicates the extent to which a business is in debt. It is a good indication, along with repayment potential, of the ability of a business to acquire additional funds. Table 11 shows the total liability/asset percentages for the case farm in its initial position and at the end of the simulation. Results show that in all cases the percentage improved from the initial financial position to the end of the simulation. Comparing the initial percentages with a random sampling of total

Table 11

TOTAL LIABILITY/ASSET PERCENTAGE OF CASE  
FARM AT INITIAL POSITION AND AT END  
OF SIMULATION FOR ALL COMBINATIONS OF  
LAND VALUES, INTEREST RATES AND INDEBTEDNESSES

Interest		Land Value (\$ per acre)					
Rate	Indebtedness	200		250		300	
%	%	Beg. %	End. %	Beg. %	End. %	Beg. %	End. %
8	25	19	14	20	15	20	16
9	25	19	15	20	16	20	17
10	25	19	16	20	16	20	18
8	50	38	33	40	36	41	37
9	50	38	35	40	37	41	38
10	50	38	37	40	40	41	35

liability/asset percentages in the triangle area indicated that they were well within the limits of the farm firms in that area. The improvement in these figures over the simulation period is, to a large extent, due to the appreciation in land values.

QUANTITY DEMANDED FOR SHORT-TERM FUNDS  
UNDER VARIOUS FACTORS

Short-term fund borrowing came about when cash balances were insufficient to meet on-going production and consumption expenses. Table 12 summarizes the averaged amounts from the simulation obser-

Table 12

TEN-YEAR TOTAL QUANTITY DEMANDED FOR SHORT-TERM FUNDS  
UPON COMPLETION OF SIMULATION AND PERCENTAGE CHANGE IN  
QUANTITY DEMANDED PER UNIT CHANGE IN INTEREST RATES

INDEBTEDNESS = 25%							
Long-term Interest Rate		Land Value (\$ per acre)					
%	\$	<u>200</u>		<u>250</u>		<u>300</u>	
		\$	%	\$	%	\$	%
8	229,948			250,905		270,283	
			2.50		3.15		8.89
9	235,838			259,068		296,656	
			3.70		3.15		7.41
10	224,893			267,487		320,411	

INDEBTEDNESS = 50%							
Long-term Interest Rate		Land Value (\$ per acre)					
%	\$	<u>200</u>		<u>250</u>		<u>300</u>	
		\$	%	\$	%	\$	%
8	295,556			302,072		323,862	
			1.96		3.33		3.67
9	301,462			312,482		325,054	
			1.58		3.31		-,325
10	306,296			323,182		323,998	

vations. Caution must again be used when interpreting data with indebtedness at 50 percent since they are not based on 30 complete observations for land values of \$250 and \$300.

In all instances except one, the total value of the loans increased with increases in the interest rate. They ranged from \$229,948 to \$320,411 at 25 percent indebtedness which, on a yearly basis, gives an average of \$22,995 to \$32,041. This is an increase of over \$9,000 per year in needed short-term funds. Percentage changes went from 2.50 percent to 8.89 percent.

At the 50 percent indebtedness level, short-term funds necessary for the case farm ranged from \$295,556 to \$325,054. The changes in funds needed with respect to interest rate changes were smaller than when indebtedness was 25 percent. This is most likely explained by noting that the larger debt loads had less cash balance carry-over from year to year. This necessitated larger operating loans for production and consumption expenses during the first nine months of each year. Since total expenses were under maximum limits, borrowed funds more often approached these limits. Consequently, land and interest rate variable changes had less of an impact.

#### RATE OF RETURN ON TOTAL CAPITAL AND NET WORTH

The time value of money is a very important and useful concept. Table 13 presents the rate of return obtained from the simulation

Table 13

## RATE OF RETURN ON TOTAL CAPITAL AND NET WORTH

Indebtedness		Return on Total Capital		Return on Net Worth	
		25%	50%	25%	50%
Land Value Interest Rate.					
\$ per Acre	%	%	%	%	%
200	8	2.93	2.24	3.48	3.03
200	9	2.88	2.12	3.35	2.60
200	10	2.83	2.05	3.23	2.15
250	8	2.98	2.35	3.54	3.01
250	9	2.90	2.28	3.39	2.70
250	10	2.82	2.22	3.24	2.17
300	8	2.98	2.45	3.53	2.14
300	9	2.92	2.41	3.38	2.96
300	10	2.85	2.53	3.16	3.49

model with the combinations of variables used in this study. Total assets and net worth of the simulated farm firm at the end of the ten-year period has been discounted at a rate of interest that will reduce the present value of the total assets and net worth to that of the firm in its initial situation. The rate of return for each

variable combination represent the actual increase in total assets and net worth.

The percentages listed show little deviation when land and interest rate variables fluctuate. At 25 percent indebtedness, return on total capital ranges between 2.82 percent and 2.98 percent. With a 50 percent indebtedness, the range is from 2.05 percent to 2.53 percent. Return on net worth shows similar tendencies. It varies from 3.16 percent to 3.54 percent at 25 percent indebtedness and from 2.15 percent to 3.49 percent.

## Chapter 5

### SUMMARY AND CONCLUSIONS

#### ABOUT THE MODEL

The case farm was simulated with 18 combinations of variables over a ten-year period. The key variables analyzed were 1) percent of real estate in debt, 2) long-term interest rates, and 3) land values. The first variable was simulated at levels of 25 percent and 50 percent debt, the second variable at rates of 8 percent, 9 percent, and 10 percent interest, and the third variable with land values of \$200, \$250, and \$300 per acre.

The model was designed to control cash inflows and outflows for a ten-year period. Grain prices and yields were combined to generate incomes, from which 30 sets of ten-year income groups were selected. The variables were simulated using these 30 sets of income groups with the resulting data being averaged for each variable.

Production expenses, consumption ranges, equipment replacement expenses, and land values were inflated annually. Depending on cash inflows for years  $t-1$  and year  $t$ , consumption varied between a required minimum amount and a maximum ceiling. Equipment replacement expense payments were determined solely on ending cash balances.

After the tenth year of each simulation run, a financial summary of the farm firm was obtained from the model. This provided a means with which to compare changes in the selected variables. The financial

summary information was analyzed by using a financial analysis computer program.

#### LIMITATIONS OF THE MODEL

Only one level of managerial ability and only a grain enterprise were considered in this study. Since the model was used to estimate the future impact of different variables, income generation was restricted by assumptions concerning price trends, yield data, and relative price movements. The income data were deterministic.

The selling strategy employed in the model was limited to the last quarter of the year. In the real world much more diversification exists. Based on price expectations and tax considerations, the marketing of produce may vary over many months.

The model lacks empirical information regarding many of the relationships considered. There is little information available to compare intrafirm actions and summarized data.

While having some limitations, the model does afford the opportunity to study the sensitivity of the farm firm to selected variables. The direction and magnitude of the influence of the controlled variables with respect to the farm firm's financial position can be explored explicitly.

## SUMMARY OF THE RESULTS

Change in net worth was one means of analyzing the impact that the controlled variables had on the case farm. Consistent patterns developed for all land values and interest rates when the indebtedness variable was fixed at 25 percent and for all interest rates when land was set at \$200 per acre and indebtedness was set at 50 percent. For these combinations, ending net worth decreased between 1.1 percent and 4.4 percent for increases in interest rates with land values held constant. For the same combinations, ending net worth increased between 34.5 percent and 41.6 percent for increments in land values with interest rates held constant.

Solvency characteristics were measured by means of current and intermediate liability/asset percentages and total liability/asset percentages. Because of the assumptions made concerning equipment replacement, it was necessary to establish these percentages in order to more accurately analyze the effects of various variable combinations.

With total current and intermediate liability/asset percentages, the case farm remained solvent for all combinations of land values and interest rates when indebtedness was equal to 25 percent of total real estate value. The range was from 13 percent to 58 percent. When indebtedness was 50 percent, the case farm experienced rapid changes in solvency conditions. It ranged from 67 percent to 349 percent,

indicating that, in many cases, current and intermediate assets were not sufficient to cover current and intermediate liabilities in the event of liquidation.

For all combinations of controlled variables, total liability/asset percentages showed either no change or a decrease from the position at the beginning of the simulation to the position at the end of the ten-year simulation period. The decrease was in a range from 0 percent change to 6 percent change.

To meet production and consumption expenses on a monthly basis, it was necessary for the case farm to acquire short-term funds whenever cash balances fell below a minimum \$300. Over the ten-year simulation period, these yearly quantities were summed to reveal the total dollar amount of operating loans for various variable combinations. For interest rate increments with constant land prices and an indebtedness of 25 percent, the results showed a range of total borrowed funds from \$229,948 for the ten-year period at 8 percent interest and \$200 land value to \$320,411 at 10 percent interest and \$300 land value. This represents a change of \$90,463. Percentage changes in short-term funds demanded for interest rate increments at constant land values ranged from 2.50 percent to 8.89 percent. Converted to an annual basis, this showed a change of \$589 to \$2,637 in the average yearly need for operating loans.

Changes in short-term funding at 50 percent indebtedness were

smaller in comparison to the previous figures. Since the totals were also considerably higher, this indicated that the case farm was borrowing amounts approaching the total production and consumption expenses for each month. The percentage changes ranged from 1.96 percent to  $-.325$  percent, while the total amounts ranged from \$295,556 to \$323,998.

Rates of return on total capital and net worth were quite low and showed little variation. Rates of return on total capital for all combinations of variables went from a low of 2.05 percent to a high of 2.98 percent. Rates of return on total net worth for all combinations of variables ranged from a low of 2.17 percent to a high of 3.53 percent.

#### CONCLUSIONS

Because of the absence of empirical information, it is difficult to check the validity of the results. However, they did show a consistent pattern with respect to variable changes. Based upon the results some conclusions can be reached.

Financial analysis provides a basis with which to measure the success of a business. When used in conjunction with simulation techniques, key variables can be analyzed. This study indicates that simulator models can be effectively used to duplicate a farm firm and obtain reasonably realistic results with respect to the impact of selected variables.

It can be concluded that interest rate increases from eight percent to ten percent do not have a significant impact on the financial condition of a farm firm. This was shown by the small percentage changes in ending net worth corresponding to increases in the interest rate.

Land values showed this same tendency. Only a maximum 5 percent change separated increases in net worth from the beginning to the end of the ten-year period when indebtedness was 25 percent. When indebtedness was 50 percent, the changes become more significant, with a maximum change of 10.5 percent.

The case farm showed an inability to maintain equipment inventories at higher values for the variables. This created solvency problems, but had little effect on the rates of return. This was due, to a large degree, to land appreciation over the period. Rates of return showed little tendency to change, and they remained low.

Different interest rates did cause short-term fund borrowing to change to a significant degree. Income variability caused greater variation at the lower debt levels. The higher debt levels responded to a lesser extent due to the increased capital drains from other expenses leaving less cash balance for production and consumption expenses at all variable levels.

The ability of a farm firm to adjust to higher interest rates and land values reveals the link between the farm family and the farm.

business. The ability to adjust was largely due to changes in consumption expenditures. Within limits, consumption expenditures countered the affect of changes in larger variables.

The case farm had low rates of return and high debt requirements. In almost all instances, the farm firm was unable to accumulate cash assets. This study used a managerial ability considered above average. Even with this assumption, demand for debt funds remained high. Total liability/asset percentages did not show much change over the simulation period. The case farm often experienced cash flow problems.

Debt financing was a necessary part of the case farm studies. This is true with agriculture in general. Producers must develop better financial analysis techniques. The availability of credit and a manager's ability to acquire it will determine the future of production agriculture. This study indicated that increases in interest rates did not significantly alter the long-run financial position of the case farm. Therefore, the credit necessary for production agriculture to continue will be available. The problem will be the individual producer's ability to acquire it.

#### RECOMMENDATIONS FOR FURTHER RESEARCH

Land values have greatly appreciated in recent years. Much of the refinancing taking place has occurred with the assumption of continuing land appreciation. Should this trend slow considerably or reverse

itself, serious implications will occur. Focus on land values and debt levels under these conditions would aid future decisions of producers and lenders.

This study was constrained by a single selling strategy and enterprise selection, and deterministic incomes. Many selling strategies and enterprises exist. Studies analyzing a farm firm's sensitivity to these variables are needed. Diversified selling strategies, with attention to product price trends and tax considerations, warrants attention. Production efficiencies have altered yield patterns and the recent past has greatly changed farm product price trends. Research is needed to evaluate the effects of these changes. Even though Montana is restricted in enterprise alternatives relative to many other states, further research is needed on enterprise analysis.

Family consumption patterns have a major effect on a farm firm's ability to be a profitable business. Research concerning this large capital leakage is necessary under a wide range of conditions, both financial and socioeconomic.

Managerial ability is a prime consideration in determining repayment potential. This study revealed cash flow problems with many variable combinations using an above average managerial ability. Many producers cannot achieve this level. Young farmers, in gaining experience, often exhibit deficiencies in various areas of farm management. Their chances of developing a farm business as a going concern are

reduced due to inexperience and high debt-to-asset ratios. Outside income is often necessary to provide adequate cash flows. Because of the importance of managerial ability, studies focusing on these considerations should be made.

APPENDICES

## APPENDIX A

## Production Costs Per Acre

Winter Wheat Variable Costs  
(excludes labor and operating interest)

Preharvest

Seed	\$ 3.42
Fertilizer	6.47
Insecticide	.35
2,4-D	1.12
Crop insurance	3.30
Pickup variable cost	.48
Misc. expense	2.00
Machinery	.96
Tractors	<u>.55</u>

\$18.65

Harvest

Machinery	<u>\$ 1.95</u>
-----------	----------------

Total Variable Costs \$20.60

Winter Wheat Fixed Costs  
(excludes interest on land,  
depreciation, and equipment)

Taxes and insurance on equipment	\$ 1.15
Taxes on land and improvements	1.49
Insurance and depreciation on land and improvements	<u>2.10</u>

Total Fixed Costs \$ 4.74

COST PER ACRE, WINTER WHEAT \$25.34



Fallow Variable Costs  
(excludes labor and operating interest)

Preharvest

Pickup variable	\$	.48
Misc. expense		.60
Machinery		.50
Tractors		<u>2.01</u>
		\$ 3.59

Harvest

0

Total Variable Costs                      \$ 3.59

Fallow Fixed Costs  
(excludes interest on land,  
depreciation, and equipment)

Taxes and insurance on equipment	\$	.43
Taxes on land and improvements		1.49
Insurance and depreciation on land and improvements		<u>2.10</u>

Total Fixed Costs                              \$ 4.02

TOTAL COST PER ACRE, FALLOW                      \$ 7.61

## APPENDIX B

## Machinery Inventory and Valuation

	Average Annual Investment*
Tractor	\$ 7060.00
Tractor (4WD)	25033.50
Pickup	3983.50
Truck (used) 16 ft.	5162.00
Truck (new) 16 ft.	8284.00
Combine (new)	24629.50
Grain auger	662.00
Grain auger	1141.50
Tool bar	4751.50
rod attachment	765.00
flextime harrow	382.50
Rock picker	2118.50
Drill 8 ft. + hitch	10112.50
Sprayer SK 300 gal.	1059.00
Grain auger PTO	1221.00
Drill fill auger	<u>353.00</u>
	\$96719.00

\* Costs computed for machinery assumes average annual investment rather than new cost. Average annual investment equals the sum of new cost plus salvage value divided by two. It represents the value of a particular machine at the midpoint of the depreciation cycle.

## Appendix C

### MONTANA GRAIN FARM SIMULATION MODEL

C  
 C  
 C  
 C THE VARIABLES USED IN THIS MODEL ARE:  
 C IREV PER ACRE LAND VALUE  
 C LVA USED TO INCREMENT LAND VALUE  
 C R LONG-TERM DEBT INTEREST RATE  
 C LVB USED TO INCREMENT INTEREST RATE  
 C DEBT PERCENT OF REAL ESTATE VALUE IN DEBT  
 C IRE REAL ESTATE DEBT BALANCE  
 C A AMORTIZATION FACTOR  
 C J YEAR  
 C IVOE MONTHLY VARIABLE OPERATING EXPENSES THROUGH SEPTEMBER  
 C IVOEB MONTHLY VARIABLE OPERATING EXPENSES, OCTOBER TO DECEMBER  
 C IVE MONTHLY IVOE+ICON2  
 C IFOE YEARLY FIXED OPERATING EXPENSES  
 C IOEP YEARLY OPERATING LOAN PRINCIPAL  
 C IOEP1 TEN YEAR TOTAL OF IOEP  
 C IOEI YEARLY OPERATING LOAN INTEREST  
 C ICUM ACCUMULATED SHORT TERM SAVINGS INTEREST  
 C LCOT USED TO STOP SIMULATION AFTER 20 ITERATIONS  
 C LDE AMORTIZED LONG-TERM LAND PAYMENT (LOP+LDI)  
 C LOP LONG TERM PRINCIPAL PAYMENT  
 C LDI TOTAL FARM INTEREST PAID (LDI+IOEI)  
 C IGI GROSS INCOME  
 C IGA GROSS INCOME (SAME AS IGI)  
 C IOUCT TOTAL CASH DEDUCTIONS (EXCLUDING DEPRECIATION)  
 C IAGI ADJUSTED GROSS INCOME FOR TAX PURPOSES  
 C IAGI1 IAGI - (STANDARD FEDERAL TAX DEDUCTION)  
 C IAGI2 IAGI - (STANDARD STATE TAX DEDUCTION)  
 C ITI TAXABLE INCOME FOR FEDERAL TAXES  
 C IFTL FEDERAL TAX LIABILITY  
 C ITI1 TAXABLE INCOME FOR STATE TAXES  
 C ISTL STATE TAX LIABILITY  
 C ISST SOCIAL SECURITY TAX  
 C ITAX TOTAL TAX LIABILITY (IFTL+ISTL+ISST)  
 C ICON1 CONSUMPTION BASED ON PREVIOUS YEARS INCOME  
 C MCON MINIMUM ALLOWABLE CONSUMPTION EXPENDITURE  
 C ICON2 MONTHLY CONSUMPTION USED FIRST 9 MONTHS (ICON1/12)  
 C ICON3 CONSUMPTION BASED ON CURRENT YEARS INCOME  
 C ICON4 CONSUMPTION FOR LAST 3 MONTHS (ICON3/4)

C ICON5 AMOUNT ICON4 MUST BE DECREASED TO KEEP NFI=0  
 C ICON6 TOTAL CONSUMPTION FOR YEAR J (ICON7+ICON4)  
 C ICON7 TOTAL CONSUMPTION FOR FIRST 9 MONTHS  
 C IDEP REPLACEMENT EXPENSE IN YEAR J  
 C IDEP4 AMOUNT SPENT ON EQUIPMENT IN YEAR J  
 C IDEP2 DEPRECIATION FOR TAX PURPOSES  
 C IDEPE ACCUMULATED REPLACEMENT EXPENSE  
 C IDEP1 SAME AS IDEPE  
 C IDEP5 TEN YEAR TOTAL AMOUNT SPENT ON EQUIPMENT  
 C NFI1 ENDING CASH BALANCE  
 C NFI2 STARTING CASH BALANCE  
 C NFI3  $NFI4 - ICON4$   
 C NFI4 OPERATING PROFIT AFTER OPERATING EXPENSES,  
 C INTEREST PAYMENTS AND TAXES  
 C NFI5  $NFI4 - NFI6$   
 C NFI6 OPERATING DEBT PRINCIPAL + LONG TERM DEBT PRINCIPAL  
 C NFI7 AMOUNT NEEDED TO KEEP FROM BECOMING ILLIQUID  
 C LDPC UNPAID OPERATING PRINCIPAL IN YEAR J  
 C LDPD UNPAID LONG TERM DEBT PRINCIPAL IN YEAR J  
 C  
 C

DIMENSION IVE(10),IGI(11)  
 INTEGER R  
 LCOT=0

C  
 C DATA READ FROM A 20X10 GROSS INCOME MATRIX  
 C  
 1 READ(1,2) IGI(J1),J1=1,10)  
 2 FORMAT(10F7.0)  
 WRITE(108,3)  
 3 FORMAT(35X,'MONTANA GRAIN FARM SIMULATED',///)  
 C  
 C SIMULATION LAND VALUES OF \$200,\$250,\$300  
 C  
 DO 8999 LVA=1,3  
 IREV=150+50\*(LVA)  
 C  
 C SIMULATION INTEREST RATES OF .08,.09,.10  
 DO 2999 L=1,3  
 R=7+1\*(L)  
 IF(R.EQ.8) A=.0888

```

IF(R.EQ.9) A=.0973
IF(R.EQ.10) A=.1061
C
C
C
SIMULATION LEVERAGES OF .25,.50
DO 2599 LVB=1,2
IF(LVB.EG.1) DEBT=.25
IF(LVB.EG.2) DEBT=.50
IRE=(2200*IREV)*DEBT
LDE=A*IRE
WRITE(108,5)IREV,R,DEBT
5 FORMAT('PER ACRE LAND VALUE= ',I3,' LONG TERM DEBT INTEREST'
*' RATE= ',I2,'%',',',I3,' PERCENT OF TOTAL LAND VALUE IN DEBT= ',F4.2)
WRITE(108,7)IRE,LDE
7 FORMAT('BEGINNING R.E. DEBT= ',I6,5X,'AMORTIZED '
*'LAND PAYMENT= ',I5,/)
NFI2=10000;MCON=4500;P=1.9667
IVOE1=1056;IVOE4=2164;IVOE5=909;IVOE6=6823;IVOE7=799
IVOE8=1718;IVOE9=10260;IVOE8=1747;IFOE=9706;IDEP=9672
ICON2=ICON3=ICON4=LDP=IDI=IDEP=IOEI=ICON5=ICON6=IDEPH=IDEPF=0
NFI1=NFI3=NFI4=NFI6=NFI7=IDEP=LDPC=LDPD=ICON7=ICON8=0
ITI=IFTL=IAGI=IGA=IAGI1=IAGI2=ISTL=ISST=IVOE=ITI1=0
IS=4;ITAX=0;NFI5=23340;IDEP2=9672
IDUCT=TFI=ICUM=IOEP1=IDEP1=IDEPF=IDEPG=0
GO 1999 J=1,10
IGA=IGI(J)
IF(NFI5.LE.0) GO TO 105
C
C
C
DETERMINING FIRST 9 MONTHS CONSUMPTION
ICON1=22.96*P***.410*NFI5***.590*IS***.163
IF(ICON1.GE.MCON) GO TO 120
105 ICON1=MCON
120 ICON2=ICON1/12
IF(ICON2.GE.1000) ICON2=1000
ICON7=ICON2*9
IVE(1)=IVOE1+ICON2;IVE(2)=ICON2;IVE(3)=ICON2
IVE(4)=IVOE4+ICON2;IVE(5)=IVOE5+ICON2
IVE(6)=IVOE6+ICON2;IVE(7)=IVOE7+ICON2
IVE(8)=IVOE8+ICON2;IVE(9)=IVOE9+ICON2
C

```

C DEDUCTING MONTHLY EXPENSES FROM PREVIOUS YEARS NET INCOME  
C MONTHLY CASH SURPLUS INCREASED AT 5% APR  
C MONTHLY CASH DEFICIT CHARGED AT 9% APR  
C

```
IF((NFI2-300).GE.IVE(1)) GO TO 150
IVE(1)=IVE(1)-(NFI2-300)
NFI2=300
DO 135 K=1,9
IOEP=IOEP+IVE(K)
135 CONTINUE
IOEI=.0675*IOEP
GO TO 500
150 NFI2=NFI2-IVE(1)
ICUM=.00417*(NFI2-300)
NFI2=NFI2+.00417*(NFI2-300)
IF((NFI2-300).GE.IVE(2)) GO TO 175
IVE(2)=IVE(2)-(NFI2-300)
NFI2=300
DO 155 K=2,9
IOEP=IOEP+IVE(K)
155 CONTINUE
IOEI=.06*IOEP
GO TO 500
175 NFI2=NFI2-IVE(2)
ICUM=ICUM+.00417*(NFI2-300)
NFI2=NFI2+.00417*(NFI2-300)
IF((NFI2-300).GE.IVE(3)) GO TO 200
IVE(3)=IVE(3)-(NFI2-300)
NFI2=300
DO 180 K=3,9
IOEP=IOEP+IVE(K)
180 CONTINUE
IOEI=.0525*IOEP
GO TO 500
200 NFI2=NFI2-IVE(3)
ICUM=ICUM+.00417*(NFI2-300)
NFI2=NFI2+.00417*(NFI2-300)
IF((NFI2-300).GE.IVE(4)) GO TO 225
IVE(4)=IVE(4)-(NFI2-300)
NFI2=300
DO 205 K=4,9
```

```

IOEP=IOEP+IVE(K)
205 CONTINUE
IGE1=.045*IOEP
GO TO 500
225 NF12=NF12-IVE(4)
ICUM=ICUM+.00417*(NF12-300)
NF12=NF12+.00417*(NF12-300)
IF((NF12-300).GE.IVE(5)) GO TO 250
IVE(5)=IVE(5)-(NF12-300)
NF12=300
DO 230 K=5,9
IOEP=IOEP+IVE(K)
230 CONTINUE
IGE1=.0375*IOEP
GO TO 500
250 NF12=NF12-IVE(5)
ICUM=ICUM+.00417*(NF12-300)
NF12=NF12+.00417*(NF12-300)
IF((NF12-300).GE.IVE(6)) GO TO 275
IVE(6)=IVE(6)-(NF12-300)
NF12=300
DO 255 K=6,9
IOEP=IOEP+IVE(K)
255 CONTINUE
IGE1=.03*IOEP
GO TO 500
275 NF12=NF12-IVE(6)
ICUM=ICUM+.00417*(NF12-300)
NF12=NF12+.00417*(NF12-300)
IF((NF12-300).GE.IVE(7)) GO TO 300
IVE(7)=IVE(7)-(NF12-300)
NF12=300
IOEP=IVE(7)+IVE(8)+IVE(9)
IGE1=.0225*IOEP
GO TO 500
300 NF12=NF12-IVE(7)
ICUM=ICUM+.00417*(NF12-300)
NF12=NF12+.00417*(NF12-300)
IF((NF12-300).GE.IVE(8)) GO TO 325
IVE(8)=IVE(8)-(NF12-300)
NF12=300

```

```

IOEP=IVE(8)+IVE(9)
IOEI=.0225*IOEP
GO TO 500
325 NF12=NF12-IVE(8)
ICUM=ICUM+.00417*(NF12-300)
NF12=NF12+.00417*(NF12-300)
IF((NF12-300).GE.IVE(9)) GO TO 350
IVE(9)=IVE(9)-(NF12-300)
NF12=300
C
IOEP=IVE(9)
IOEI=.0075*IOEP
GO TO 500
350 NF12=NF12-IVE(9)
ICUM=ICUM+.00417*(NF12-300)
NF12=NF12+.00417*(NF12-300)
NF12=NF12+300
C
C LONG TERM DEBT EXPENSE CALCULATION
500 LOI=(.01*R)*IRE
LDP=LDF-LD*
C TAX COMPUTATION BASED ON 1975 TAX RATE SCHEDULES
IVOE=IVOE1+IVOE4+IVOE5+IVOE6+IVOE7+IVOE8+IVOE9
IDUCT=IVOE+IOEI+LDI+IVOEB+IFOE
IFI=IOEI+LDI
IDEP1=IDEP+IDEP
IF(J.NF.10) GO TO 530
WRITE(108,520)J,IGA,IDEP1,IDUCT
520 FORMAT(4X,'YEAR ',I2,4X,'GROSS INC= ',I6,4X,'MACH & EQUIP'
*' EXPENSE= ',I6,4X,'TL CASH DEDUCTIONS= ',I6)
530 IDEP2=IDEP2+.1*IDEPH
IAGI=(IGA+ICUM)-(IOEI+LDI+IDEP2+IVOE+IVOEB+IFOE)
C
C FEDERAL TAX: MARRIED TAXPAYERS FILING JOINT RETURNS
C
IF((.16*IAGI).GE.2600) GO TO 600
IAGI1=IAGI*.16*IAGI
GO TO 610
600 IAGI1=IAGI-2600
610 ITI=IAGI1-750*IS
IF(ITI.LE.0) GO TO 618

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```

IF(ITI.LE.1000) GO TO 620
IF(ITI.LE.2000) GO TO 622
IF(ITI.LE.3000) GO TO 624
IF(ITI.LE.4000) GO TO 626
IF(ITI.LE.8000) GO TO 628
IF(ITI.LE.12000) GO TO 630
IF(ITI.LE.16000) GO TO 632
IF(ITI.LE.20000) GO TO 634
IF(ITI.LE.24000) GO TO 636
IF(ITI.LE.28000) GO TO 638
IF(ITI.LE.32000) GO TO 640
IF(ITI.LE.36000) GO TO 642
IF(ITI.LE.40000) GO TO 644
IF(ITI.LE.44000) GO TO 646
IF(ITI.LE.52000) GO TO 648
IF(ITI.LE.64000) GO TO 650
IF(ITI.LE.76000) GO TO 652
IF(ITI.LE.88000) GO TO 654
IF(ITI.LE.100000) GO TO 656
IF(ITI.LE.120000) GO TO 658
IF(ITI.LE.140000) GO TO 660
IF(ITI.LE.160000) GO TO 662
IF(ITI.LE.180000) GO TO 664
IF(ITI.LE.200000) GO TO 666
IF(ITI.GT.400000) GO TO 668
618 IFTL=0
GO TO 690
620 IFTL=.14*ITI
GO TO 690
622 IFTL=140+(ITI-1000)*.15
GO TO 690
624 IFTL=290+(ITI-2000)*.16
GO TO 690
626 IFTL=450+(ITI-3000)*.17
GO TO 690
628 IFTL=620+(ITI-4000)*.19
GO TO 690
630 IFTL=1380+(ITI-8000)*.22
GO TO 690
632 IFTL=2250+(ITI-12000)*.25
GO TO 690

```

63\* IFTL=3260+(ITI=16000)\*.28  
GO TO 690  
636 IFTL=4380+(ITI=20000)\*.32  
GO TO 690  
638 IFTL=5660+(ITI=24000)\*.36  
GO TO 690  
640 IFTL=7100+(ITI=28000)\*.39  
GO TO 690  
642 IFTL=8660+(ITI=32000)\*.42  
GO TO 690  
644 IFTL=10340+(ITI=36000)\*.45  
GO TO 690  
646 IFTL=12140+(ITI=40000)\*.48  
GO TO 690  
648 IFTL=14060+(ITI=44000)\*.50  
GO TO 690  
650 IFTL=18060+(ITI=52000)\*.53  
GO TO 690  
652 IFTL=24420+(ITI=64000)\*.55  
GO TO 690  
654 IFTL=31020+(ITI=76000)\*.58  
GO TO 690  
656 IFTL=37980+(ITI=88000)\*.60  
GO TO 690  
658 IFTL=45180+(ITI=100000)\*.62  
GO TO 690  
660 IFTL=57580+(ITI=120000)\*.64  
GO TO 690  
662 IFTL=70380+(ITI=140000)\*.66  
GO TO 690  
664 IFTL=83580+(ITI=160000)\*.68  
GO TO 690  
666 IFTL=97180+(ITI=180000)\*.69  
GO TO 690  
668 IFTL=110980+(ITI=200000)\*.70

C  
C STATE TAX, MARRIED TAXPAYERS FILING JOINT RETURNS  
C

69# IF((.1\*IAGI).GE.1000) GO TO 700  
IAGI2=IAGI-.1\*IAGI  
GO TO 710

```

700 IAGI2=IAGI-1000
710 ITI1=IAGI2-650*IS
    IF(ITI1.LE.0) GO TO 718
    IF(ITI1.LE.1000) GO TO 720
    IF(ITI1.LE.2000) GO TO 722
    IF(ITI1.LE.4000) GO TO 724
    IF(ITI1.LE.6000) GO TO 726
    IF(ITI1.LE.8000) GO TO 728
    IF(ITI1.LE.10000) GO TO 730
    IF(ITI1.LE.14000) GO TO 732
    IF(ITI1.LE.20000) GO TO 734
    IF(ITI1.LE.35000) GO TO 736
    IF(ITI1.GT.35000) GO TO 738
718 I STL=0
    GO TO 740
720 I STL=ITI1*.02
    GO TO 740
722 I STL=20+(ITI1-1000)*.03
    GO TO 740
724 I STL=50+(ITI1-2000)*.04
    GO TO 740
726 I STL=130+(ITI1-4000)*.05
    GO TO 740
728 I STL=230+(ITI1-6000)*.06
    GO TO 740
730 I STL=350+(ITI1-8000)*.07
    GO TO 740
732 I STL=490+(ITI1-10000)*.08
    GO TO 740
734 I STL=810+(ITI1-14000)*.09
    GO TO 740
736 I STL=1350+(ITI1-20000)*.10
    GO TO 740
738 I STL=2850+(ITI1-35000)*.11
740 I STL=I STL+.1*I STL
C
C SOCIAL SECURITY SELF EMPLOYMENT TAX
C
750 IF(IAGI.GE.400) GO TO 760
    ISST=0
    GO TO 790

```

```

760 IF(I4G1*GE*1400) GO TO 770
    ISST=.078*I4G1
    GO TO 790
770 ISST=1114
790 ITAX=IFTL+ISTL+ISST
    IF(I*NF*EQ) GO TO 800
    WRITE(108,795)IFI,IOEP,IFTL,ISTL,ISST,ITAX
795 FORMAT('ITL INT PAID= ',15,3X,'ITL NEW FUNDS BOR= ',15,3X,'FED'
* ' TAX= ',15,2X,'ST TAX= ',15,2X,'SS TAX= ',14,2X,'ITL TAX= ',15)

C
C DEDUCTING MANDATORY PAYMENTS FROM GROSS INCOME
C
800 IF(NFI2*GE*0) GO TO 810
    NFI4=IGA-(ITAX+LDI+IOEI+IVOEB+IFOE)
    GO TO 815
810 NFI4=(IGA+NFI2)-(ITAX+LDI+IOEI+IVOEB+IFOE)
815 NFI6=LDP+IOEP
    NFI5=NFI4-(NFI6+IDEP+IDEPE)
    IF(NFI5*LE*0) GO TO 817

C
C DETERMINING LAST 3 MONTHS CONSUMPTION
C
ICON3=22.56*P**+.410*NFI5**+.590*IS**+.163
ICON**=ICON3/4
IF(ICON***GE*3000) ICCN**=3000
IF(ICON***GE*(MCON/4)) GO TO 835
817 ICON**=MCON/4
    NFI3=NFI4-ICON**
    IF(NFI3*GE*0) GO TO 890
    NFI3=-1*NFI3
    WRITE(108,820)J,NFI3
820 FORMAT('IN YR ',12,' THE FIRM BECAME ILLIQUID,NEEDING *',
*16,' MORE TO COVER NECESSARY EXPENSES',/,/, 'THE SIMULATION'
* ' RUN HAS STOPPED FOR ALL FURTHER VARIABLES IN THIS DATA SET',/,/)
    LCOT=LCOT+1
    IF(LCOT*EQ*20) GO TO 9999
    GO TO 1
835 NFI3=NFI4-ICON**
    IF(NFI3*GE*0) GO TO 890
    IF((NFI4-MCON/4)*GT*0) GO TO 840
    NFI7=-1*(NFI4-MCON/4)
    WRITE(108,820)J,NFI7

```

```

      LCOT=LCOT+1
      IF(LCOT.EQ.20)GO TO 9999
      GO TO 1
840  #FI3=0
      LDPC=LDPC+IDEP
      LOPD=LDPD+LDP
      IDEPE=IDEPE+IDEP
      IF(J.LT.9) GO TO 860
      WRITE(108,850)J,IOEP,LDPC,LDP,LDPD
850  FORMAT('1N YR ',I2,' NO OP PRIN ',I6,' OP PRIN DEFAULT ',
*16,' RE PRIN ',I5,' OR RE PRIN DEFAULT ',I6,' WERE MADE')
860  #FI1=0
      IDEPR=0
      GO TO 1000
C
C   PUTTING A 1% PENALTY ON OPERATING PRINCIPAL DEFAULT
C
890  LDPC=LOPC+(.01+(.01*R)*LDPC)
C
C   DEDUCTING OPERATING PRINCIPAL DEFAULT
C
      #FI1=#FI3-LDPC
      IF(#FI1.GE.0) GO TO 895
      LDPD=LDPD+LDP
      #FI8=-1*#FI1
      IDEPE=IDEPE+IDEP
      IF(J.LT.9) GO TO 892
      WRITE(108,891)J,#FI8,LDPC,IDEP,LDP,LDPD
891  FORMAT('1N YR ',I2,2X,I6,' OF PREVIOUS OP PRIN DEFAULT ',I6,
*' ) THIS YRS OP PRIN ',I6,' } RE PRIN ',I5,
*' AND TL RE PRIN DEFAULT ',I6,' WAS NOT PAID')
892  LOPC=#FI8+IDEP
      #FI1=#FI8+#FI3=IDEPH=0
      GO TO 1000
C
C   PUTTING A 1% PENALTY ON RE PRINCIPAL DEFAULT
C
895  LDPD=LDPD+(.01+(.01*R)*LDPD)
C
C   DEDUCTING RE PRINCIPAL DEFAULT
C

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```

      NFI1=NFI1-LDPD
      IF(NFI1.GE.0) GO TO 910
      NFIB=-1*NFI1
      IDEPE=IDEPE+IDEP
      IF(J.LT.9) GO TO 898
      WRITE(108,896)J,NFIB,LDPD,LDP,LDPC
896  FORMAT('IN YR ',I2,2X,I6,' OF PREVIOUS RE PRIN DEFAULT ',I6,
      *,' THIS YRS RE PRIN ',I5,' WAS NOT PAID',/,',ALL OP PRIN DEFAULT'
      *,I6,' WAS PAID BUT NOT OP PRIN FOR THIS YR')
898  LDPD=NFIB+LDP
      LDPC=IDEP
      NFI1=NFIB=NFI3=IDEPH=0
      GO TO 1000

C
C   DEDUCTING CURRENT YEARS OPERATING PRINCIPAL
C
910  IF(J.LT.9) GO TO 912
      WRITE(108,911)J,LDPC,LDPD
911  FORMAT('IN YR ',I2,2X,'ALL OP PRIN DEFAULT ',I6,' AND RE PRIN'
      *,', DEFAULT ',I6,' WAS PAID')
912  LDPC=LDPD=0
      NFI1=NFI1-IDEP
      IF(NFI1.GE.0) GO TO 920
      LDPC=-1*NFI1
      IDEPE=IDEPE+IDEP
      IF(J.LT.9) GO TO 917
      WRITE(108,915)J,LDPC,IOEP,LDP
915  FORMAT('IN YR ',I2,2X,I6,' OF THIS YRS TL OP PRIN ',
      *,I6,' , AND RE PRIN ',I5,' WAS NOT PAID')
917  LDPD=LDP
      NFI1=IDEPH=0
      GO TO 1000

C
C   DEDUCTING CURRENT YEARS LONG TERM DEBT PRINCIPAL
C
920  IFI1=NFI1-LDP
      IF(NFI1.GE.0) GO TO 925
      LDPO=-1*NFI1
      IDEPE=IDEPE+IDEP
      IF(J.LT.9) GO TO 924
      WRITE(108,921)J,LDPD,LDP,IOEP

```

```

921 FORMAT('IN YR ',I2,2X,'15,' OF TL RE PRIN ',I6,
* ' WAS NOT PAID. OP PRIN ',I6,' WAS PAID')
924 NFI1=IDEP4=0
GO TO 1000
C
C DEDUCTING EQUIPMENT REPLACEMENT COST
C
925 IF(J.LT.9) GO TO 927
WRITE(108,926)J,IDEP,LDP
926 FORMAT('IN YR ',I2,2X,' OP PRIN ',I6,
* ' AND RE PRIN ',I5,' WAS PAID')
927 LDPD=LDP=0
IF(NFI1.GE.(IDEPE+IDEP)) GO TO 930
IDEPH=NFI1
WRITE(108,928)J,IDEPH
928 FORMAT('IN YR ',I2,' EQUIP REPLACT EXP PD= ',I6)
IDEPE=(IDEPE+IDEP)-NFI1
NFI1=0
IDEPF=IDEPF+IDEPH
GO TO 1000
930 IDEPH=IDEPE+IDEP
WRITE(108,928)J,IDEPH
IDEPF=IDEPF+IDEPH
NFI1=NFI1-(IDEPE+IDEP)
IDEPE=0
1000 IF(J.LT.9) GO TO 1050
ICON6=ICON7+ICON4
WRITE(108,1025)J,ICON6,NFI1
1025 FORMAT('IN YR ',I2,' CONSUMPTION= ',I6,
* ' NET CASH BALANCE= ',I6)
1050 NFI2=NFI1
1085 IRE=IRE-LDP
IOEP1=IOEP1+IOEP
C
C INFLATING COSTS FOR NEXT YEAR
C
IVOE1=IVOE1+.04**IVOE1
IVOE4=IVOE4+.04**IVOE4
IVOE5=IVOE5+.04**IVOE5
IVOE6=IVOE6+.04**IVOE6
IVOE7=IVOE7+.04**IVOE7

```

```
IVOE8=IVOE8+.044*IVOE8
IVOE9=IVOE9+.044*IVOE9
IVOEB=IVOEB+.044*IVOEB;P=1.044*P
IFOE=IFOE+.044*IFOE;MCON=MCON+.044*MCON
IDEP=IDEP+.044*IDEP;IDEPE=IDEPE+.044*IDEPE
ICUM=IDEP=IDEI=IDEP1=0
1999 CONTINUE
WRITE(103,2000)IDEP1,IDEPE
2000 FORMAT('TOTAL TEN YEAR OPERATING PRINCIPAL= ',I6,
*5X,'TOTAL TEN YEAR EQUIPMENT REPLACEMENT EXPENSE= ',I6,/)
2599 CONTINUE
2999 CONTINUE
8999 CONTINUE
LCOT=LCOT+1
IF(LCOT*EQ*20)GO TO 9999
GO TO 1
9999 END
```

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