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Indicators and characteristics of financially stressed Iowa farm operators: a multivariate approach

Nancy E. Barickman
Iowa State University

Indicators and characteristics of financially stressed Iowa farm operators: A multivariate approach

by

Nancy E. Barickman

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I. OBJECTIVES AND HISTORICAL BACKGROUND

A. Objectives

Since the beginning of the 1980s farmers have operated in an economic environment very different from the 1970s. Expectations formed and financial commitments made in the 1970s now contribute to widespread financial stress among farm operators. Financial stress is a dynamic condition which is affecting many operators to differing degrees. Many farm operators under financial stress are experiencing low farm incomes which requires borrowing more money or selling assets to meet cash shortfalls. Low farm income makes it difficult to meet principal and interest payments on debt, another stressful condition. Other operators are "loaned up," and cannot borrow more money to meet cash shortfalls. Severely stressed operators face foreclosure or bankruptcy.

Financial stress is caused in part by macroeconomic events out of the control of individuals. However, this study attempts to determine if individual operators have created more financial stress for themselves through poor management, or over-aggressive expansion. As important as learning what individuals may have done to contribute to their financial problems is learning what profitable farm operators have done to be successful. This study will also attempt to determine

characteristics of operators experiencing financial difficulties to better target public programs designed to assist these people.

The objectives of the thesis are stated as follows:

1. Review financial stress indicators identified in finance and economic literature. Develop financial stress measures appropriate for farm firms.
2. Apply these procedures to an analysis of the data from the 1985 Iowa Farm Finance Survey. Special attention will be placed on studying the interrelationship between the income generating ability and the capital structure of the farm firm.
3. Explore the application of several multivariate statistical techniques to the survey data to develop an explanatory or predicting model of farm financial stress.

The first section of the thesis summarizes events leading to the agricultural financial problems of the 1980s, and describes the current financial condition of Iowa farms. The second section reviews common measures used by financial analysts. In addition, previous studies of financial stress are reviewed to identify important stress predicting variables, as well as examining statistical methods used in developing prediction models. The third section describes analytical methods employed in this study. The fourth section summarizes the results of the analyses, then compares the

results with conclusions drawn by other researchers on this topic. The final section examines the policy implications of this study.

B. Origins of Farm Financial Stress

The events leading to today's farm financial situation began in the early 1970s when the U.S. dollar was devalued and then allowed to float relative to other currencies. Throughout the 1970s the dollar continued to decline in value relative to other currencies, and foreign demand for U.S. agricultural products grew rapidly. The value of exported American crops increased at an extraordinary rate of twenty percent per year during the 1970s (Harrington, 1985). Concomitantly, U.S. farmland values increased an average of twenty percent per year. Iowa farmland values increased an average of seventeen percent per year (Barickman and Jolly, 1985).

During this period of dramatic growth in asset values and exports, farm debt also increased sharply. On average, farm debt grew more than ten percent per year during the 1970s and early 1980s (Harrington and Stam, 1985). Because land values increased at a rate faster than debt, farmers' equity also increased.

The rapid rise in farmland values provided both an incentive to invest along with the means to take on additional

debt. Lenders felt rising land values provided adequate security for loans with relatively small down payments, and they competed aggressively for this expanding farm credit market.

Beginning in late 1979, abrupt changes in monetary and fiscal policies had a catastrophic effect on American farmers. The combination of expansionary fiscal policy (reductions in taxes, and increased government deficits), along with restrictive monetary policy (controlling money supply, and allowing interest rates to seek market clearing levels), caused three effects to which agriculture has been especially sensitive.

First, stringent control of monetary growth slowed inflation. The tighter money supply caused real interest rates, which had been very low or negative during the 1970s, to jump to unprecedented levels of eight to ten percent ("A British Prescription", 1984). Because of these two effects, foreign capital was attracted to the United States which raised the value of the U.S. dollar relative to foreign currencies. Consequently, foreign and domestic demand for U.S. agricultural products declined. Supplies of farm commodities worldwide were too abundant to maintain 1970s price levels. Agricultural debt continued to grow through 1982 as many farmers borrowed to off-set low commodity prices and drought-reduced yields.

Second, in late 1981, land values, which depend on both current farm income and anticipated future income growth, began to decline. Farmers who depended on continuously rising land values for healthy looking balance sheets were pushed toward insolvency. Inflation no longer compensated for losses or cash flow shortages. Land prices in Iowa dropped nearly thirty-seven percent from their peak in 1981 to 1984. Debt considered adequately secured in 1980 may now no longer be considered secure because of the drastic declines in farmland values.

Third, as a result of the increasing farm debt and high interest rates, interest payments from the agricultural sector increased six fold from 1971 to 1981 (Chantfort, 1984). During 1970 to 1975, farmers had six dollars of net income, after interest and other expenses were paid, for every dollar of interest paid. Since 1981, they have had only one dollar of income for every one dollar of interest paid. Despite these problems, equity remains strong in the farm sector - 79 percent of its asset base. Yet agricultural debt is eight times annual net farm income, up from two times net farm income in 1970 (Harrington, 1985). Consequently, the lack of liquidity reserves is a significant problem for indebted farmer.

Sudden changes in macroeconomic policy have left farm operators struggling to adjust and wondering how to adjust to the new economic environment. Farm operators need to

understand indicators of financial well-being in order to monitor their farming operations. Determining common characteristics of financially stressed farmers may tell us who to help and how.

II. MEASURING FINANCIAL STRESS: A REVIEW OF THE LITERATURE

Business failure is an expected economic event which eliminates inefficient businesses and results in a more efficient allocation of resources. However, business failures are costly. Investors lose equity, creditors may lose principal and interest, and employees may lose jobs. Business failures may also have adverse effects on other firms in the economy (Lev, 1974; Foster, 1978).

Analysis of business failure which identifies early warning signals can help reduce the costs of failure. Likewise, analysis of firms experiencing financial stress (but which have not failed) identify characteristics and sources of financial problems. An understanding of the sources and traits of stressed firms may aid in developing public policies targeted toward helping those firms in trouble.

A. Firm Level Analysis of Financial Performance

Many empirical studies have relied on trial and error attempts to estimate prediction models because of the lack of theory about why firms fail. Since very little theoretical background has been written on the subject of financial stress and firm failure, we can only rely on the insight which

research has provided, along with some general observations about the financial characteristics of business firms.

1. Financial performance measures

Universally, managers of all businesses need to analyze financial aspects of the firm in order to evaluate profitability on investment and make efficient use of assets. Creditors and investors of a firm employ financial analysis to assess management's ability to repay debt or generate competitive returns on equity (Van Horne, 1983, p.670). To evaluate the performance and financial condition of a firm, analysts need certain tools. One of the the best known and most widely used analytical tools of financial managers is ratio analysis. A ratio facilitates better understanding of a business's financial situation because it expresses a relationship between two quantities which is sometimes easier to interpret than financial data alone.

Relatively few ratios are needed to assess the financial condition of the firm. Typically, ratios are classified according to four different economic aspects of the firm's operations (Frey and Behrens, 1981, p. 104-105). These four aspects are:

a) Profitability

b) Liquidity

c) Solvency

d) Efficiency

a. Profitability Profitability refers to the firm's ability to generate income in excess of expenses. Net income can be related to the value of the assets used to generate that income in order to measure how effectively assets are being utilized by the firm. Two common profitability ratios are the net profit margin, which is net income divided by gross sales, and return on assets, which is net income divided by total assets. The net profit margin reveals how efficiently the firm is generating income after accounting for all expenses and income taxes. The return on assets ratio tells how efficiently the firm is using its assets to generate net income.

b. Liquidity Liquidity refers to the firm's ability to meet its short term financial obligations as they fall due without disrupting the normal operation of the business. Two common liquidity measures are the current ratio, which is current assets divided by current liabilities, and working capital, which is the dollar difference between current assets and current liabilities. Both of these measures relate short-term cash obligations to the resources available to meet those obligations, thus providing insight into the cash liquidity position of the firm.

c. Efficiency Efficiency, or asset utilization, refers to the firm's ability to use its assets to generate sales. The most common efficiency measure is the turnover ratio which is gross sales divided by assets. This ratio relates the amount of

gross sales generated by the assets employed by the firm. One deficiency of using the turnover ratio alone is that it places a premium on using old equipment. If farm assets have little market value, they may be old and inefficient but they may generate a high turnover ratio.

d. Solvency Solvency refers to the extent to which nonowner funds are being used to finance the firm's assets. Solvency also is an indicator of the long-run ability of the firm to pay all obligations if the firm was liquidated. One common solvency measure is the debt-asset ratio, which denotes how much debt is financing assets. Another solvency measure is the timesinterestearned ratio which divides income before interest and taxes by the annual interest expense. This ratio evaluates the cash flow ability of the firm to meet interest payments.

Bernstein (1983) stressed the importance of examining the firm's capital structure because of the basic difference between equity and debt. Equity is the risk capital of the firm, requiring no guaranteed return. Debt, however, must be repaid and at specified times regardless of the firm's current cash flow condition. Interest, the cost of using debt capital, must also be paid under most loan agreements.

The larger the proportion of debt in the firm's capital structure, the higher the firm's resulting fixed charges and repayment commitments. These high fixed commitments increase the chances that the firm may be unable to pay interest and

principal when due. The basic risk with a levered capital structure is that the firm runs the risk of facing a cash deficiency when obligations must be met.

2. Studies of financial performance measures

Relatively few researchers have examined how well specific ratios accurately communicate information about a firm's financial condition. The following section contains a few synopses of studies which have examined the use of financial ratios as analytical tools.

In a detailed study of financial ratios, Pinches, Mingo, and Caruthers (1973) developed an empirically based classification of financial ratios as an alternative for "many ad hoc classifications systems ... for financial ratios". These authors employed factor analysis, a multivariate statistical technique, to isolate independent patterns of financial ratios. The factor analysis yielded seven classifications from forty-eight ratios examined. Surprisingly, four of the seven classifications were identical to the four traditional categories. The three other categories identified were: inventory intensiveness, receivables intensiveness, and cash position. Highly representative ratios of these four categories were cash flow to net worth, cash flow to total assets, and cash flow to sales (representing profitability). Representing efficiency was sales to assets, representing liquidity was

current assets to current liabilities, and representing solvency was debt to assets.

In an early study, Walter (1957) critiqued the practice of determining technical insolvency by examining balance sheet accounts which are stocks of assets and debts. Walter defined technical solvency as "the ability of a given business unit to meet its currently maturing obligations". Technical solvency is different from long run solvency because technical solvency is bounded by a specific time period, generally a year. Two tools Walter recommended using to examine technical solvency were a funds flow statement, and the ratio of net cash profit to sales. These tools examine flows of funds to determine whether cash inflows exceed cash outflows by a margin sufficient to protect against possible inflow reductions or outflow increases.

These studies of financial performance measures provide some background for the study of financial stress in business firms. Examination of financial structure and changes in the capital structure of a firm also provides understanding of firm financial stress.

3. Financial structure analysis

Examining the asset and debt components of the firm and how these components change over time is useful for the financial analyst. Expressing balance sheet and income statement items as percentages of total assets aids in

examining trends in the firm's activities (Van Horne, 1983, p.706-709). These statements of percentage components are called common size statements. Common size financial statements facilitate comparisons between firms of differing sizes, along with expedient examination of an individual firm's financial statement components and structural changes from year to year. Common size balance sheets are useful for analyzing farm firms because agriculture is very capital intensive. Thus, capital structure and structural changes in a farm firm may communicate important information about a farming operation.

Lev (1974) expanded on the use of common size statements by presenting the theory of decomposition analysis, a fairly efficient method of identifying structural changes in financial statements. Lev theorized that the proportional financial statement components, which are nonnegative and sum to one, could be thought of as probabilities. For instance, a dollar of assets chosen at random from a firm would have a probability, p, of belonging to a certain type of asset based on the asset structure of that firm.

Lev likened structural financial statement changes to original probabilities and revised probabilities used in information theory and entropy theory (p.18). In this case, entropy is a measure of a hypothesized tendency toward an optimal financial structure. The expected information equation for a set of events takes the form:

$$\sum_{i=1}^{n} q_i * \ln(q_i/p_i) \qquad (2.1)$$

where q_i = revised probability,

p_i = original probability.

The logarithmic transformation allows a set of probabilities to be added together. The base of the logarithm is arbitrary.

Lev applied the expected information equation to common size statements to estimate indexes of structural change because variations in the proportional relationships among financial statement components reflect significant events which are of interest to a financial analyst. Lev developed several financial statement indexes which measures capital structure changes.

One of Lev's decomposition measures is the asset index which measures the degree of change in the firm's asset structure during the period between the beginning and ending balance sheets. This index is computed as follows:

$$I_a = \sum_{i=1}^{n} q_i * \ln(q_i/p_i) \qquad (2.2)$$

where I_a = the asset decomposition measure,

q_i = the percent of total assets composed of a specific type of asset in time t,

p_i = the percent of total assets composed of a specific type of asset in time t-1, i = 1...n.

If there is no change in the relative shares of the different assets, then $I_a = 0$. Whenever q_i differs from p_i, I_a takes on the value of some positive number. The larger the number, the greater the changes in the asset structure during that time period.

The liabilities index is computed in the same manner as the asset index. Individual liability categories and net worth are represented as a percent of total assets are the q_i's and p_i's.

An overall balance sheet index is calculated from changes between the relative shares of four main balance sheet categories: nonreal estate assets, real estate assets, nonreal estate debt, and real estate debt (which includes net worth). The dollar value of each of these categories is divided by two times the value of total assets to yield four fractions which sum to one. The balance sheet decomposition measure of the second year relative to the first is:

$$I_{bs} = \sum_{i=1}^{2} \sum_{j=1}^{2} q_{ij} * \ln(q_{ij}/p_{ij}) \qquad (2.3)$$

where I_{bs} = the balance sheet decomposition measure,

i = 1 for nonreal estate portions of assets or liabilities, or i = 2 for real estate portions of assets or liabilities;

j = 1 for assets, or j = 2 for liabilities and net worth.

This index measures the degree to which the balance sheet in time t differs from the balance sheet in time t1.

The final type of decomposition index measures the deviation of a firm's financial statement from an industry-wide weighted average balance sheet at a point in time. The balance sheet deviation index is:

$$I_{ibs} = \sum_{i=1}^{2} \sum_{j=1}^{2} p_{ijc} * \ln(p_{ijc}/s_{ij}) \quad c = 1...N \qquad (2.4)$$

and

$$s_{ij} = \sum_{c=1}^{N} W_c * p_{ijc}, \quad i = 1,2;\ j = 1,2 \qquad (2.5)$$

where I_{ibs} = index of the degree to which the composition of firm c's balance sheet deviates from that of the industry,

W_c = ratio of the value of the firm's assets to the value of the industry's total assets,

p_{ijc} = each of the four balance sheet components for firm c, measured as a fraction of the firm's total assets plus liabilities,

s_{ij} = industry-wide weighted average balance sheet components.

If firm c's balance sheet composition is identical to the industry average, then $I_{ibs} = 0$. The more the individual firm's balance sheet deviates from the industry average, the larger the index number.

An important property to remember about decomposition measures is that index numbers measure distance not direction. A large index number relative to other firms in the sample indicates some type of change in the balance sheet, but the measure is unable to discriminate between changes away or toward an optimal position. Lev (1971) conducted a pair-wise comparison of failed and nonfailed firms' indexes. His results indicated that information measures for failed firms were larger than those of nonfailed firms. Of the four indexes, the balance sheet measure displayed the greatest discriminating power between failed and nonfailed firms.

B. Firm Failure Studies From Business Finance

Since financial ratios provide an efficient source of information about business firms, most studies of firm failures have relied on ratios as the primary predictors of failure. These studies of firm failure are probably the best source of information about characteristics of stressed, but nonbankrupt, firms. If a firm is stressed before it fails, and the causes the failure are understood, managers of nonbankrupt firms can take steps to avoid failure.

One of the earliest failure prediction studies was conducted by W.H. Beaver in 1967. A firm failed if it had declared bankruptcy, had defaulted on bonds, had an overdrawn bank account, or had not paid preferred stock dividends. Beaver choose 30 ratios to examine because of their popularity in the literature, their performance in previous studies, and their inclusion of a cash flow concept. The author performed several univariate analyses, and determined the cash flow-to-debt ratio was the best single predictor of financial failure. Beaver drew several interesting conclusions: not all ratios predict failure equally well, and ratios predict nonfailure better than failure.

Another milestone study was conducted by Altman in 1968. Altman's sample comprised firms which had filed a bankruptcy petition under Chapter X of the national bankruptcy act.

Altman improved upon Beaver's study by using a multivariate statistical technique, multiple discriminant analysis, which could incorporate more financial information about the firm. Of the twenty-two variables analyzed, five were selected as having the best predictive ability in a linear model. These ratios were: working capital to total assets, retained earnings to total assets, earnings before interest and taxes to total assets, market value of equity to book value of debt, and sales to total assets.

In another multivariate study, Edmister (1972) researched techniques to predict small business failure. Data for this study were drawn from Small Business Administration borrowers. Edmister used a zero-one regression technique instead of multiple discriminant analysis. Independent variables used in this research were qualitative zero-one variables based on arbitrary cutoff points within the range of the ratio. Consequently, Edmister developed a rather complex model of seven variables to predict failure. Significant variables in his model were: annual funds flow to current liabilities, equity to sales, net working capital to sales, current liabilities to equity, inventory to sales, the quick ratio, and a downtrend of the firm's quick ratio to industry average quick ratio.

The author noted that no single ratio predicted as well as a small group of ratios, independent predictors were superior to highly correlated predictors, and some ratios

which seemed insignificant by themselves added valuable information when combined with other variables. Edmister also stated, "Maximum advantage is most likely obtained by selecting one ratio for each different characteristic of the borrow's business."

C. Firm Failure Studies From Agricultural Finance

Multivariate statistical techniques have also been applied to agricultural data. Dunn and Frey (1976) applied multiple discriminant analysis to loan data from P.C.A. cash-grain farm borrowers. Loans had been classified by P.C.A. examiners as either acceptable or problem. Four loan characteristics in the model met the 95 percent significance level. They were: the debt-asset ratio, the amount of credit life insurance on the loan applicant, the amount of the P.C.A. loan to net cash farm income, and the number of acres owned.

Another multivariate agricultural study incorporated macroeconomic factors and farm characteristics into a time-series farm failure prediction model. Shepard and Collins (1982) regressed the annual rate of agricultural bankruptcies from 1910 to 1978 onto the following variables: real net income of farm operators per farm, the proportion of farm revenues from agricultural exports, the average nonfarm income per farm, average farm size, the value of farm machinery as a percent of total farm assets, the debt-asset

ratio, financial assets as a percent of total assets, real federal agricultural support payments per farm, nonfarm bankruptcy rates, and interest rates on 90-day government securities.

Ordinary least squares regression resulted in five significant variables: net farm income, agricultural support payments, farm size, leverage, and nonfarm bankruptcy rates. After several tests of the model, Shepard and Collins concluded that agricultural support payments have not induced, deferred, or reduced farm failures. They noted that the strong link between agricultural and nonagricultural bankruptcy rates indicate that federal macroeconomic policies may strongly effect farm failure rates.

In a very recent study, Lines and Zulauf (1985) used a multichotomous discrete dependent variable, debt-asset ratio categories, as the stress indicator for their study because, "...it measures the relative claim which debt has on the earnings generated by the farm's assets. The greater the debt the greater the share of earnings ... generated by the assets which must be used to service debt" (p.93). These authors are among the first to analyze farm operator survey data using a multivariate statistical technique. They used a maximum likelihood logit model to examine demographic information about Ohio farm operators collected from a 1984 survey. Independent variables the authors found significant were: the age of the operator, the amount of land owned, and gross farm

sales. Variables which were not significant were off-farm income and farm type.

D. Statistical Techniques for Failure Prediction

The literature on firm failure prediction models comprises a number of statistical techniques used in estimating these models. Since most researchers attempt to categorize firms into one or more categories of failed or nonfailed firms, the dependent variable is generally discrete. When dependent variables are discrete, a method other than ordinary least squares regression must be used because the error term is heteroscedastic (Pendyck and Rubinfeld, 1981, p.276). Two statistical methods which facilitate the use of discrete dependent variables which Collins and Green (1982) evaluated were multiple discriminant analysis and the logit (or probit) models.

The multiple discriminant analysis estimates a linear equation which assigns an observation to one of two (or more) populations. The underlying assumption of multiple discriminant analysis (MDA) is that different populations of multivariate normal random variables have different means but similar variances.

Collins and Green pointed out two assumptions of MDA which are violated when this method is used to predict bankruptcy. First, financial ratios (which are frequently

used in the model) usually are not normally distributed. Second, the variances of the variables in the bankrupt group are probably greater than the variance of the variables in the nonbankrupt group.

An alternative model is logistic discrimination. Collins and Green noted the logit model is desirable, "because the logit formulation is more robust to distributional assumptions and, in fact, arises from several possible sets of distributional assumptions." In the case of bankruptcy forecasting where the dependent variable equals zero or one, a maximum likelihood method must be used to estimate the model (see Pendyck and Rubinfeld, appendix 10.1). The maximum likelihood estimation method is more appealing than discriminant analysis whenever one of the independent variables is qualitative. A qualitative variable violates the normality assumption (Lines and Zulauf, 1985).

The probit model is very similar to the logit model, except that the probit model is based on the cumulative normal distribution. Capps and Kramer (1985) noted that the probit and logit models yield "strikingly similar results", and it typically doesn't matter which method is used. Ameniya (1981) estimated the following relationship between the probit and logit coefficients:

$$1.6\ B\ (\text{probit}) = B\ (\text{logit}).$$

E. Farm Operator Survey Analyses

Another avenue of financial stress literature developed very recently. As farm financial problems have intensified in recent years, an increasing number of states have surveyed farm operators to ascertain the extent of farm financial problems. Most of the analysis of these surveys' results rely upon univariate analysis and contingency tables.

Many farm operator surveys gathered balance sheet data and a limited amount of income statement information. In an attempt to link income to debt level, Melichar (1984, p.9) illustrated the joint impact of a farmer's debt level and the interest rate to the income rate of return on equity. Assuming a two percent income return to assets, a seven percent interest rate on debt, and a thirty percent debt-asset ratio, Melichar pointed out a farmer's income return on equity would be negative. To further illustrate financial stress, Melichar classified farm operators by debt-asset ratio categories.

Harrington attached labels to these ratio classifications. He described farm operators with debt-asset ratios over one hundred as "technically insolvent". Those operators with ratios between seventy and one hundred have "extreme financial problems". Those with debt-asset ratios between forty and seventy have "serious financial problems",

and those with ratios below forty have "no apparent financial problems".

Many survey analysts, including the USDA, have used debt-asset ratio classes as the predominant indicator of financial stress. In a recent summary of farm operator survey results, Barickman (1985) noted that the debt-asset ratio categories seemed to be the most commonly used indicator of financial stress: twelve out of twelve farm operator survey results classified farm operators by debt-asset categories.

Other measures of financial stress published in survey results included: principal and interest delinquency rates (in eight out of fifteen farm operator and agricultural lender surveys), farm operators' expectations of years left before they discontinue farming (in seven out of twelve surveys), and debt-to-net income ratio (in three out of twelve surveys). Six out of twelve survey results summarized the percentage distribution of farm operators, assets, and debt by debt-asset categories. This type of analysis provides an estimate of the intensity of financial stress.

Many finance survey analysts concluded that the debt-asset ratio increases with increasing farm size (measured by either the number of acres operated or the dollar value of gross sales), and the debt-asset ratio decreases with increasing age.

Bernstein (1983) noted an important limitation to the debt-asset ratio: it does not focus on the availability of

cash flows that are needed to service a firm's debt. In fact, as debt is repaid, the debt-asset ratio may improve, but the annual amount of cash needed to pay principal and interest may remain the same. The author pointed out the debt-asset ratio is most useful as a screening device, a means of deciding if the risk in the capital structure requires further investigation.

Income and cash flow indicators of farm financial stress were explored more deeply by Jolly, Paulsen, Johnson, Baum, and Prescott (1985). They considered farms with a negative cash flow (defined as "income over farm cash expenses plus off-farm income less withdrawals for consumption, taxes, and debt service"), and a high debt-asset ratio as "vulnerable to both solvency and liquidity problems". Farms with a positive cash flow and a low debt-asset ratio were considered financially stable. The intensity of stress was measured by the amount of debt controlled by stressed businesses, cash flow return to equity, changes in land values, and changes in financial position over time.

The authors considered the cash flow return on equity, similar to the income return on equity, an attractive indicator of financial stress because it measures the rate at which farm and off-farm earnings are increasing or decreasing equity. A negative cash flow return on equity indicates the rate at which a firm is consuming its net worth. The authors considered farms with a cash flow return on equity from -5 to

+5 percent as financially stable in the short run. A ratio of -10 to -5 percent indicated failure at a moderate rate, and firms with a cash flow return on equity of less than -10 percent faced relatively severe financial stress.

This study revealed 39 percent of the farm operators experienced a return on equity above five percent. Twenty eight percent experienced a return on equity between -5 and +5, and 33 percent experienced a return on equity below -5. In the Corn Belt, 30 percent of the farm operators have a ROE of less than -5, or a debt-asset ratio greater than 100. Nationally, 28 percent of the U.S. farm operators controlling 22 of the farm assets earned a return on equity greater than ten percent. Of these high profit assets, 57 percent were owned by large commercial farms.

In another cash flow study, USDA analysts examined data for the Roosevelt Center's Roundtable Conference (1984). They defined total cash needs as gross sales minus expenses plus off-farm income minus annual debt repayment and family living allowance. If total cash needs were negative, then the shortfall was divided by gross sales to estimate how much prices needed to increase in order to cover all cash needs. The greater the percentage increase in prices required, the greater the degree of stress the farm was estimated to be suffering. According to this study, nearly all farms with gross sales under $100,000 experienced cash shortfalls. Highly levered, larger farms also experienced cash shortfalls.

F. An Earnings Model of Financial Stress

Ultimately, economic performance (profitability) is the source of returns to repay investors and lenders for the risks they assume. Earnings (as opposed to liquidating assets, refinancing, or borrowing more money) are the most desirable and reliable source of funds to repay principal and interest. A stable trend of positive earnings is one of the best assurances that a firm is able to borrow when funds are needed, then eventually repay the debt.

"The relationship between net income and the capital invested in the generation of that income is one of the most valid and most widely recognized measures of enterprise performance" (Bernstein, 1983). The broad category of return on investment (ROI) relates income to the amount of capital needed to generate that income. Bernstein considers ROI the most reliable indicator of long-term financial health, better than common balance sheet measures.

Within the general category of ROI, the return on total assets is perhaps the best measure of operating performance of a business without regard to how the assets were financed.

In a simplified form, return on assets is calculated as:

$$ROA = [NI + I(1-t)]/[(BA + EA)/2] \qquad (2.6)$$

where ROA = return on assets,

NI = net income after taxes,

I = interest expense,

t = marginal tax rate,

BA = beginning assets,

EA = ending assets.

Net income is equal to revenues less expenses. Interest is not included in expenses because ROA is a measure of earnings to reward both debt and equity capital. The average value of assets is used because the return earned in a given period of time should be related to the assets that were available, on average, during that time period.

The return on owner's equity measures the returns accruing to the owner's investment after the interest payment on debt capital has been met. In a simplified form, return on equity is calculated by:

$$ROE = NI/[(BE + EE)/2] \qquad (2.7)$$

where BE = beginning equity,

EE = ending equity.

Melichar (1985) suggested examining farming operations based on their performance indicated by the relationship between profitability and capital structure. This can be done by examining the reciprocal relationship between the return on equity and the return on assets from the identity:

$$ROE = ROA - (i(1-t)D/A)/1 - D/A \qquad (2.8)$$

where i = interest rate on debt,

D/A = debt-asset ratio.

Return on equity is a function of the return on assets, the after tax interest rate, and the capital structure of the firm. Inversely, ROA is a weighted average of ROE and the after tax interest rate. The weights are the percent equity and the percent debt capital.

The differences between the return on equity and the return on assets isolates the effect borrowed capital has on the return to owner's equity. If ROA is greater than the after-tax interest rate, then ROE is greater than ROA, indicating leverage has a positive contribution to the firm's returns. If the return on equity is less than the return on assets, leverage has a negative effect on the firm. If the return on assets equals the after tax interest rate, if the firm has no debt, or if the firm pays no interest on debt, then leverage has no effect on the firm.

Figure 2.1 demonstrates the relationship between ROA and ROE. ROA is plotted on the horizontal axis, and ROE on the vertical axis. Four financial performance groups are then identified. Farm operators who fall into group one have positive returns on assets and equity and ROE is greater than

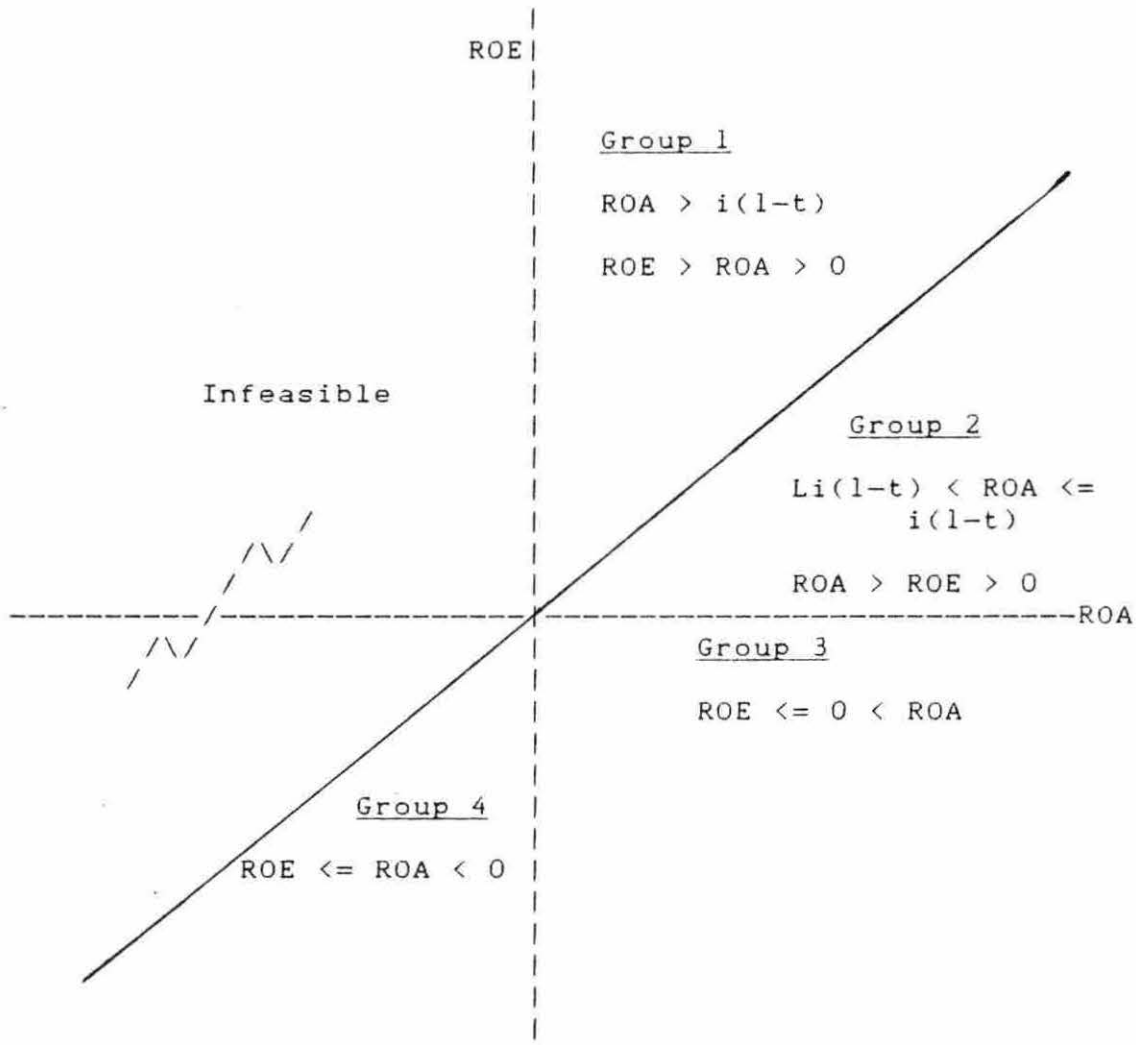

Figure 2.1 Criteria for Profitability Groups

ROA. Their plots lie above a 45 degree line intersecting the origin, meaning all operators have debt, and debt increases the return on equity. Like group one operators, group two operators also have positive returns on assets and equity, but ROE is less than or equal to ROA. For this group, debt has no effect or some adverse effects on the firm. Farm operators who fall into group three have a positive ROA, but leverage has enough of a negative influence on the firm to cause ROE to equal or fall below zero. Farm operators who fall into group four have a negative ROA, consequently, any debt they hold is a further financial imposition on the firm. When ROA is negative, it is not possible for a firm to have ROE greater than ROA.

Previous empirical studies and recent surveys suggest several types of farm operator characteristics which may predict financial stress. An empirical model of financial stress suggested is:

$$Y = f(D,F,E) \tag{2.9}$$

where Y = a financial stress indicator,

D = demographic characteristics of farm operators,

F = financial characteristics: ratios, balance sheet structure, and Lev's indexes.

E = expansion pattern characteristics.

Many economists and policymakers have wondered what types of farm operators, what financial characteristics, and what prior asset expansion behavior typifies operators most susceptible to financial problems. This question will be addressed in the remainder of the thesis by examining data from a recent farm operator survey.

III. METHODS

Concerns about the financial condition of farm operators and agricultural lenders prompted Iowa State University and the State of Iowa Department of Agriculture to cooperate in conducting the 1985 Iowa Farm Finance Survey. The survey was employed as a means of gathering financial and demographic information about Iowa farm operators in order to document the extent and severity of the financial problems facing them. Also, the survey's results could provide useful information for shaping public policy to aid financially stressed farm operators.

A. The Data

Mail surveys were sent to 4700 Iowa farmers, proportionately distributed by crop reporting district and farm size. Due to the dependence on operator response, the data cannot be considered random and may be subject to response bias. Several biases are evident when demographic characteristics of the 1985 survey respondents are compared with the same characteristics from the 1982 Census (Jolly and Barkema, 1985). Small farmers (under 180 acres) are underrepresented in the 1985 data, while medium to large size farms (180 to 1000 acres) are over-represented. Farm

Table 3.1 Selected Comparisons between the 1982 Census and the 1985 Farm Finance Survey Responses[a]

	1982 Census	1985 Survey
Farm Size (acres)	Distribution (%)	
1-9	6.9	0.1
10-49	10.7	1.1
50-179	26.8	15.5
180-499	40.1	53.7
500-999	12.9	25.2
1000-1999	11.1	3.8
2000+	0.3	0.5
Average Acreage	283	429
Age of Operator		
Under 35	22.5	5.8
35-44	19.5	16.3
45-54	22.6	26
55-64	23.9	37.8
65+	11.5	14
Average Age	47.6	53.8

[a] Jolly and Barkema, 1985.

operators under the age of thirty-five are undersampled, while farm operators over fifty-five are oversampled. Consequently, the 1985 data represent older farm operators and larger farming operations (Table 3.1), compared to the 1982 census. Of the 4700 surveys mailed out, 668 were completed and returned.

B. The Survey Instrument

The 1985 Iowa Farm Finance Survey instrument was designed to gather demographic as well as financial information about the respondents (see Appendix A). The survey instrument contained questions asking for the county in which most of the farming operation was located, operator age, number of dependents under eighteen years of age, the highest level of school the husband and wife attended, and the number of years the operator had been farming. Respondents were also asked to report gross profits, sales of breeding livestock, interest expense, depreciation, and total deductions from their 1982, 1983, and 1984 tax records.

Other questions included: the percentage of 1984 gross farm sales which came from four major agricultural products - crops, beef, pork, or dairy; the dollar amount of off-farm income earned by the husband and wife; and the number of acres owned, acres rented from others, acres rented to others, and total acres operated. The next section of the survey

instrument was designed to provide information about the timing and the amount of the farm operator's purchases of land, and machinery and equipment over the previous ten years.

The survey also asked farm operators about the value of their real estate assets and total assets on January 1, 1984 and 1985, the amount of outstanding loan balances by type of lender on those dates, and the interest rate being paid on these loans as of January 1, 1985. One final question asked operators if they were current on principal and/or interest payments on their debts.

C. Calculations of Financial Measures

1. Cash flow calculations

The rates of return on assets and equity examined in this study are specified as operator cash flows divided by operator assets or equity. Obviously, if a farm operator owns very little of the assets used in the farming operation, the return on those assets could be highly positive or negative, due to a small asset base.

Examination of cash flow returns allows us to gauge the amount of cash being generated by assets for principal and interest repayment. A cash flow return to equity provides an estimate of a "growth rate" of equity to be reinvested in the firm.

Operator cash flow is calculated as:

$$CFROA = GS + LS - TD + DEP + INVCHA - TAX + INT(1-t) - FAMLIV \quad (3.1)$$

where CFROA = the cash flow return on assets,

GS = gross sales from agricultural products (from income tax form 1040 schedule F),

LS = sales from breeding livestock,

TD = total deductions (cash and noncash)

DEP = depreciation,

INVCHA = inventory change, which is 1985 nonreal estate asset value minus 1984 nonreal estate asset value,

TAX = personal income taxes paid,

INT = interest expense on debt,

t = marginal tax rate,

FAMLIV = family living allowance.

Cash flows for 1982, 1983, and 1984 were calculated and adjusted to 1984 dollars by the consumer price index for personal consumption. The annual estimates were averaged, then divided by the average of the 1984 and 1985 assets. No inventory change was calculated for 1982 and 1983 cash flows since balance sheet information was lacking for those years. The three year average cash flow was used to smooth out inventory fluctuations and unusual income years, especially 1983 and 1984 income from the PIK program. This three year

composite return was calculated with the assumption that the asset structure of the farm in 1982 and 1983 which generated income in those years was similar to the asset structure of the farm in 1984.

The operator cash flow for return on equity is:

$$CFROE = GS + LS - TD + DEP + INVCHA - TAX - FAMLIV \quad (3.2)$$

$$= CFROA - Int(1-t). \quad (3.3)$$

The same method of adjusting and averaging ROA cash flows was employed for ROE cash flows. The return on equity cash flow was divided by the average 1984 and 1985 net worth to calculate ROE.

Tax liabilities and family living expenditures had to be estimated in order to generate cash flows for each observation. Frey and Behrens (1981) noted unpaid farm family labor and management do not show up as an expense on the farm income statement as they typically would in another type of firm. Consequently, a proxy for unpaid family labor and management return, a family living allowance, was deducted from cash inflows. Family living allowances were based on the number of dependents the operator supported. Average living expenditures by family size were taken from the 1982, 1983, and 1984 Iowa Farm Family Living Expenditures Extension publications (Edwards, 1982, 1983, 1984).

Since most farming operations are operated as sole proprietorships, personal income taxes were computed from state and federal tax tables for the respective years, along with federal self-employment tax. Income subject to federal taxation was computed as follows:

$$TNI = GS + Offarm + (.4 * LS) - TD - (1000 * DEP) \quad (3.4)$$

where TNI = taxable net income,

Offarm = off-farm income (only in 1984 calculation).

Income subject to federal self employment tax was computed from taxable net income less sales of breeding livestock in a given year, except for the 1984 calculation when off-farm income was subtracted from taxable net income before tax computations.

Income subject to state taxation was computed as follows:

$$STNI = TNI - FT + (1000 * DEP) \quad (3.5)$$

where STNI = state taxable net income,

FT = federal taxes paid.

Iowa tax law allows a twenty dollar tax credit per dependent instead of the one thousand dollar federal deduction. The annual marginal tax rate was calculated as the

sum of the marginal federal, state, and self employment tax rates.

2. Principal repayment estimation

In order to replicate the same cash flow shortfall analysis the USDA performed, annual real estate and nonreal estate principal payments had to be estimated. Some assumptions were made about the repayment terms on individual lender categories, and the amount of nonreal estate debt which represented annual operating expenses to be paid when inventories were sold. Examining the 1984 Iowa Farm Business Summaries (Edwards, 1985), year-end operating notes represented approximately 31 percent of annual operating expenses. Consequently, 31 percent of total cash deductions were subtracted from nonreal estate debt and considered current liabilities. The remaining nonreal estate debt was assigned a repayment term of three years. Assigned repayment terms on real estate debt varied with the type of lender (Table 3.2).

3. Demographic variables

Policymakers are interested in discovering what particular demographic characteristics seem to be common among financially stressed farm operators in order to target public

Table 3.2 Assumed Remaining Years on Outstanding Real Estate Loans.

Lender	Years	Lender	Years
Bank	20	Insurance Co.	20
PCA	10	Individual	20
FLBA	25	Merch/Dealer	20
FmHA	30	CCC & Gov't	20
Other	20		

policy to needy groups. The survey data provided information about many facets of the farm family:

MNASSETS - mean 1984 and 1985 asset value which represents farm size. Many other survey results indicated larger farms are experiencing the greatest stress.

EDW, EDH - the educational attainment of the wife and husband, respectively. 1 = grade school, 2 = high school, 3 = college or vocational training. This is a proxy variable for management ability and offfarm employability.

YRSFARM - the number of years the operator has been farming. This variable reflects the experience of the farm operator. Like education, the more experience, the better the management, and the better the financial condition of the farm.

OFFARMPC - the sum of the husband's and wife's off-farm income divided by gross sales in 1984. This is a measure of how much the farm relies on off-farm income. If a farm is experiencing financial trouble, someone in the family may be working at an off-farm job to help contribute to needed income.

RENTEDPC - the percent of land operated which is rented. Generally, the more land rented, the higher the return on owned assets and equity.

FAMLIV84 - the dollar value of family living expenditures for 1984, a proxy family-size variable. The more money

spent on family living, the lower the return on equity.

Two sets of dummy variables were created for location and farm type. The farm type dummy variables were:

BEEF = 1 if fifty percent or more of the gross profits came from the sale of beef. Otherwise, BEEF = 0.

PORK = 1 if fifty percent or more of gross profits came from the sale of pork. Otherwise, PORK = 0.

DAIRY = 1 if fifty percent or more of the gross profits came from the sale of dairy products. Otherwise, DAIRY = 0.

MIXED = 1 if no individual product comprised fifty percent or more of the gross profits. Otherwise, MIXED = 0.

The CROP variable, which represents farms with over fifty percent of their gross profits coming from the sale of crops, is implied by the other four variables.

The location dummy variables were assigned to each observation based on the farming operation's location in one of the four districts (see map, Appendix B):

CENTRAL = 1 if the observation is located in a county in north central Iowa, otherwise CENTRAL = 0.

WEST = 2 if the observation is located in a county in north west Iowa, otherwise, WEST = 0.

SOUTH = 1 if the observation is located in a county in southern Iowa, otherwise, SOUTH = 0.

The EAST variable, which represents farming operations in east central Iowa is implied by the other three variables.

4. Financial variables

Variables representing financial aspects of the firm were chosen following Pinche's and Edmister's guidelines - choose one variable for each economic aspect of the firm. Financial variables calculated were:

CFMAR3 - three year cash flow margin, computed from CFROA divided by the three year mean gross sales and sales of breeding livestock, also adjusted to 1984 dollars. The higher the cash flow margin, the greater the return on equity.

TURNOVER - this is a capital efficiency measure calculated by dividing the three year mean of gross sales plus sales of breeding livestock (adjusted to 1984 dollars) by the mean of the 1984 and 1985 assets. The higher the turnover, the greater the return on equity.

MNDAR - the mean debt-asset ratio for 1984 and 1985. The higher the debt-asset ratio, the higher the fixed obligations of the firm, and the lower the ROE.

INTOSALE - the three year mean ratio of interest expense divided by gross sales plus livestock sales adjusted to 1984 dollars. The greater the interest expense relative to gross sales, the lower the ROE.

ATINT85 - the 1985 mean after-tax interest rate on debt. The lower the interest rate, the lower the interest expense (all else equal), and the higher the ROE.

CVCF - the coefficient of variation of the 1982, 1983, and 1984 farm cash flows for the farm operation. Edmister (1972) theorized that the greater the variations in income and cash flow the greater the chance of a business having financial problems.

ASSETINX - Lev's index for asset structural changes on the balance sheet. The greater the structural changes, the more likely the firm is experiencing financial stress. This is also true for the other three indexes.

DEBINX - Lev's index for debt structural changes on the balance sheet.

BSINX - Lev's index for entire balance sheet structural changes.

MEANDEV - the mean of Lev's index for how much an operator's 1984 and 1985 balance sheets deviated from the sample's mean 1984 and 1985 balance sheets.

RETOASST - the mean of 1984 and 1985 values of real estate assets divided by the mean total assets. This variable indicates the concentration of farm assets held as land. The greater the concentration of assets held as real estate (which yields a low cash return) the lower the return on equity.

NR/ASSETS - the average of the 1984 and 1985 nonreal estate debt to mean total assets. This ratio provides some insight into how the debt of the firm is structured. The more nonreal estate debt held by the firm relative to total debt, the higher the interest rate and consequent interest expense, which results in a lower ROE.

5. Expansion pattern variables

The survey data provided six expansion pattern variables which may yield some insightful information about the financial condition of the farm given past acquisition trends. If an operator expanded aggressively when land values were high, they have experienced great reductions in asset values and these operators may be servicing large amounts of debt. Also, if an operator purchased large amounts of machinery and equipment in the late 1970s and early 1980s, they too may be suffering adverse consequences of over expansion using too much debt. Variables calculated were:

NETLND1 - net land acquisitions (in acres) which occurred between 1982 and 1985, divided by total acres currently owned. This variable indicates the percentage change in the land base during that time period. Recent land purchases may indicate a farm operator is doing well financially. On the other

hand, operators who are selling land may be experiencing financial stress.

NETLND2 - net land acquisition (in acres) which occurred between 1979 and 1982, divided by total acres currently owned. Farm operators who purchased land during this time period paid record prices, and have suffered the greatest decline in values since the peak in 1981.

NETLND3 - net land acquisitions (in acres) which occurred between 1975 and 1979, divided by total acres currently owned. Operators who purchased land during this time period have probably suffered some land value declines, however, they probably paid much more reasonable prices and experienced lower interest rates over the initial years of their land loan which may contribute to better current returns on equity.

EQEXP1 - net equipment acquisitions from 1982 to 1985 divided by the mean 1984 and 1985 assets. This variable indicates the percentage change in machinery and equipment during this time period. If an operator purchased much machinery in recent years, they may be doing well financially. Machinery sales could indicate financial stress.

EQEXP2 - net equipment acquisitions from 1979 to 1982 divided by the mean 1984 and 1985 assets.

EQEXP3 - net equipment acquisitions from 1979 to 1982 divided by the mean 1984 and 1985 assets.

These variables encompassing demographic, financial, and expansion pattern characteristics of the firm were calculated for each farm operator in the data set. Next, each operator was assigned to one of the four profitability groups based upon their cash flow returns on assets relative to the cash flow return on equity described in Figure 2.1. Examination of group means of descriptive variables provides much insight into the differences between the typical farm operator of each profitability group. The following chapter summarizes the differences and similarities between profitability groups' demographic, financial, and expansion pattern characteristics.

IV. CHARACTERISTICS OF PROFITABILITY GROUPS

Many survey analysts who relied on debt-asset ratio categories also relied upon simple comparisons between group means as a way of analyzing the differences between those groups. The same technique of comparing and contrasting group means is performed in this chapter. Drawing comparisons is a simple technique, yet it yields a wealth of information. Ttests were conducted between many (but not all) of the variables' means to provide a statistical test of significant differences. A variable mean with superscript numbers in the tables designates which group means are significantly different from it. Demographic, financial statement, cash flow, and expansion pattern comparisons will be examined in this chapter.

A. Farm Operator Characteristics

Average farm operator demographic characteristics by profitability group are displayed in Table 4.1. Characteristics summarized are: family size, operator age and farming experience, educational attainment, percentage distribution of sales by type of agricultural product, acres farmed, the percent of acres rented, and proportional

distributions of operators by crop reporting district. Major differences between groups include:

1. Groups one and three have very similar demographic characteristics which are notably different from groups two or four. Groups one and three farm operators are younger, with less years of farming experience, larger families, and more education than groups two or four farm operators.
2. Group four farm operators are the oldest on average, with more years farming, smaller families, and less education than the other three group averages.
3. In all cases, sales of crops comprise over 55 percent of gross sales. Next to crop sales, groups four and two have the highest percentage of sales from beef. Groups three and one have the highest percentage of sales from pork.
4. Groups one and three farm operators operate the largest number of acres, while group one rents the largest proportion of land.
5. Group four operators farm the smallest number of acres and rent the lowest percentage of land.

Table 4.1 Farm Operator Characteristics by Profitability Groups

	Group 1	Group 2	Group 3	Group 4	Sample Mean
Family Size	3.25(2,4)	2.81(3)	3.52(4)	2.70	2.98
Years Farming	25.47(2,4)	31.31(3)	25.13(4)	32.05	29.35
Age of Operator	50.14	55.26	49.72	56.39	53.63
Wife Education[a]	2.47(2,3,4)	2.42(4)	2.40	2.26	2.39
Husband Education[a]	2.32(2,4)	2.29(3)	2.37(4)	2.17	2.28
% Gross Sales from Crops	62.60	59.25	55.95	60.77	59.58
% Gross Sales from Beef	11.47	16.25	15.50	21.31	16.49
% Gross Sales from Pork	20.63	17.16	21.12	12.51	17.66
% Gross Sales from Dairy	2.60	4.26	2.60	3.13	3.26
Total Acres Farmed	492	428	499	328	432
Acres Owned	240	270	287	231	261
Acres Rented	270	182	219	122	192
Acres Rented to Others	18	24	17	25	21
% Acres Rented	54.88(2,4)	42.52(3)	43.89(4)	37.20	44.44
% Operators in Crop Reporting District 1[b]	19.48	44.62	13.85	22.05	195
% Operators in Crop Reporting District 2[b]	25.00	39.53	13.37	22.09	172
% Operators in Crop Reporting District 3[b]	26.92	33.97	15.38	23.72	156
% Operators in Crop Reporting District 4[b]	11.11	44.44	15.97	28.47	145

[a] Educational attainment, highest level attended, 1=grade school, 2=high school, 3=college or vocational.

[b] See map in Appendix A.

B. Comparative Balance Sheets

Balance sheet information by profitability group as of January 1, 1985 is summarized in Table 4.2. Major asset and liability structural differences apparent from the table include:

1. Group four farm operators hold the smallest dollar amount of assets, and they experienced the greatest decline in nonreal estate asset values in 1984. Perhaps these operators are liquidating more inventory and equipment to meet cash flow needs.
2. Group three operators are the most highly leveraged, followed by group one operators. Group three operators hold more real estate assets than any of the other groups, and they have the highest percentage of real estate assets relative to net worth.
3. Group two contains the largest number of operators while group three contains the smallest number of operators.
4. All groups experienced a decline in net worth during 1984, apporoximately equal to the decline in Iowa land values in that year (Jolly and Barkema). Group four experienced the greatest percentage decline while group one experienced the smallest percentage decline.

Table 4.2 January, 1985 Comparative Balance Sheets by Profitability Group

	Group 1	Group 2	Group 3	Group 4	Sample Mean
			-Dollars-		
Nonreal Estate Assets	211,282	176,481	161,606	111,247	167,256
Real Estate Assets	322,231	357,261(4)	393,085(4)	271,085	341,523
Total Assets	533,511	533,741(4)	554,689(4)	382,331	508,779
Nonreal Estate Debt	51,625	44,931	112,791	39,998	58,400
Real Estate Debt	129,063	79,317	170,031	54,153	101,063
Total Debt	180,690	124,250	282,824	94,153	159,463
Net Worth	352,821	409,491	271,865	288,178	349,316
Inventory Change	9,143(2,3,4)	4,888(3,4)	-28,537(4)	-52,734	-15,441
			-Percent-		
Debt/Assets	33.86(2,3,4)	23.28(4)	50.99(4)	24.63	31.34
Nonreal Estate Debt/ Nonreal Estate Assets	24.43	25.46	69.79	35.95	34.92
Real Estate Debt/ Real Estate Assets	40.05	22.20	43.25	19.98	29.59
Real Estate Assets/ Net Worth	91.33	87.25	144.59	94.07	97.77
% Net Worth Change 1984-1985	-18.88	-18.91	-32.22	-33.58	-24.38
Number of Operators	140	272	97	159	668
% Operators	20.96	40.72	14.52	23.80	100
% Assets	22.33	43.41	16.09	18.18	100
% Debt	24.92	33.30	27.03	14.75	100

C. Comparative Common Size Statements

The common size balance sheet which shows the proportional composition of assets and liabilities by profitability group are displayed in Table 4.3, along with Lev's financial statement indexes. Some highlights of this table are:

1. Group one farm operators have the lowest percentage of real estate assets while group three has the greatest percentage.
2. Group two farm operators have the highest percentage of net worth to total liabilities of any of the groups.
3. Groups four and one farm operators have the highest asset, balance sheet change, and deviation from sample average balance sheet indexes. This means that the balance sheets from the two groups have undergone more structural change, or are more atypical than the average sample balance sheet.

Distinct differences in the type of debt held by each profitability group are evident in Table 4.4. Lender debt as a percent of the group's total debt is presented for 1984 and 1985.

Table 4.3 1984 and 1985 Common Size Balance Sheets by Profitability Group

	Group 1		Group 2	
Assets	1984	1985	1984	1985
		-Percent-		
Nonreal Estate	40.23	44.47	34.05	36.68
Real Estate	59.77	55.53	65.95	63.32
Total Assets	100.00	100.00	100.00	100.00
Liabilities				
Nonreal Estate	11.84	14.56	6.21	7.94
Real Estate	19.54	21.40	9.27	10.89
Net Worth	68.62	64.04	84.51	81.17
Total Liabilities	100.00	100.00	100.00	100.00
Lev's Indexes				
Asset Index		0.0270		0.0103
Debt Index		0.7723 (2)		0.4267
Deviation Index	0.1616	0.1660	0.1080	0.1148
Average of 1984-1985 Deviation Indexes	0.1633 (2)		0.1114 (3,4)	
Balance Sheet Index	0.0854 (2)		0.0181	

Group 3		Group 4		Sample Mean	
1984	1985	1984	1985	1984	1985
32.44	33.57	36.87	35.16	29.63	32.87
67.56	66.43	63.13	64.84	70.37	67.13
100.00	100.00	100.00	100.00	100.00	100.00
17.30	23.68	8.03	12.27	8.46	11.48
23.51	28.35	8.60	11.55	16.63	19.86
59.19	47.97	83.28	76.17	74.9	68.66
100.00	100.00	100.00	100.00	100.00	100.00
0.0132		0.0592		0.0253	
0.6081		0.5167		0.5573	
0.1273	0.1672	0.1574	0.1828	0.1459	0.1648
0.1472		0.1701		0.1553	
0.0402		0.0660		0.0485	

Table 4.4 1984 and 1985 Common Size Debt Structure: Lender Debt/Total Debt by Profitability Group

	Group 1		Group 2	
Nonreal Estate Debt				
Total Assets	1984	1985	1984	1985
		-Percent-		
Bank	10.38	11.91	17.33	19.58
PCA	6.23	5.71	7.47	7.44
FLB	0.90	0.81	0.00	0.01
FmHA	0.37	0.26	0.35	0.64
Insurance Co.	0.50	0.46	1.14	1.21
Individual	1.69	1.72	1.59	1.72
Merchant	1.78	2.12	1.86	1.42
CCC & Government	2.60	4.68	2.33	3.11
Other	0.93	0.90	1.08	1.03
Total NR Debt	25.38	28.57	33.15	36.16
Real Estate Debt				
Total Assets				
Bank	4.63	4.57	3.75	4.31
PCA	0.11	0.13	1.17	1.31
FLB	25.92	25.06	32.47	30.37
FmHA	2.18	2.11	2.78	2.65
Insurance Co.	8.27	7.38	4.40	4.10
Individual	28.28	27.05	18.60	17.47
Merchant & Dealer	0.65	0.57	0.34	0.34
CCC & Government	1.09	1.51	1.25	1.24
Other	3.49	3.04	2.10	2.05
Total RE Debt	74.62	71.43	66.85	63.84

Group 3		Group 4		Sample Mean	
1984	1985	1984	1985	1984	1985
19.60	21.65	24.21	28.42	17.32	19.54
8.83	8.75	7.02	5.48	7.49	7.07
1.11	1.24	0.00	0.00	0.53	0.54
1.66	2.30	0.79	0.93	0.79	1.04
0.29	0.30	0.48	0.50	0.65	0.67
0.80	0.78	1.06	0.94	1.32	1.35
0.86	1.16	2.08	2.02	1.59	1.61
2.16	2.72	2.01	3.11	2.30	3.40
0.82	0.98	0.74	1.08	0.92	0.99
36.13	39.88	38.39	42.48	32.91	36.21
2.22	1.85	3.63	3.01	3.51	3.52
4.66	3.44	0.52	0.00	1.81	1.40
32.11	32.12	25.78	24.52	29.83	28.66
3.63	4.24	7.38	7.58	3.55	3.67
3.54	1.30	3.58	3.24	4.96	4.03
15.60	15.20	17.64	16.11	19.91	19.04
0.21	0.23	0.18	0.12	0.35	0.34
0.72	0.32	0.94	1.13	1.02	1.04
1.48	1.42	1.97	1.81	2.23	2.09
63.87	60.12	61.61	57.52	67.09	63.79

1. Group one has the greatest percentage of debt in long term real estate debt, while group four operators have the lowest percentage of debt in long term debt.
2. Group one borrowers have borrowed the greatest portion of their real estate debt from individuals, while farm operators in the other three groups borrow the greatest percentage of their real estate debt from Federal Land Bank.
3. Group three operators borrow a greater percentage of their total debt from local banks and Federal Land Bank than operators in other profitability groups.
4. Reliance on Farmer's Home Administration real estate debt increases across groups from one to four.

Debt as a percent of total lender debt by profitability group is displayed in Table C.1 of Appendix C. Also in Appendix C is Table C.2 displaying group lender debt as a percent of total assets.

Each of these tables provides a different perspective on the distribution of debt held by the different profitability groups. Nonreal estate debt as a percent of total debt declined during 1984 for all groups. However, for the overall sample, the amount of nonreal estate debt increased. Conversely, real estate debt as a percent of total assets increased during 1984 for all groups, while the amount of real estate debt declined. For all groups, both ratios of nonreal

estate debt to total assets and real estate debt to total assets increased during 1984.

D. Comparative income statements

More discriminating differences between groups are evident in income statements and cash flows for 1984 which are presented in Table 4.5 for each profitability group. Examination of comparative income statements yields the following information:

1. Group one farm operators have the highest dollar values of gross sales, the largest cash flow, the highest turnover rate, the lowest interest expense to gross sales ratio, the lowest average interest rate on debt, and the longest debt repayment schedule - generally the most favorable financial conditions of all the groups.
2. Return on assets steadily declines across profitability groups with group one having the highest ROA and group four having the lowest ROA.
3. The sample mean ROA of 3.62, is very similar to the 3.7 percent ROA calculated from the Iowa Farm Business Association data in the 1984 Iowa Farm Costs and Returns Summary (Edwards, 1985).
4. Group three farm operators have the highest interest as a percent of gross sales ratio, along with the shortest repayment term on debt.

Table 4.5 1984 Comparative Income Statements and Cashflows by Profitability Group

	Group 1	Group 2	Group 3	Group 4	Sample Mean
			-Dollars-		
Gross Sales	138,189	107,625	116,822	64,775	106,271
Sales of Breeding Livestock	4,936	2,738	3,954	1,969	3,324
Depreciation	26,709	20,446	17,092	12,545	19,685
Interest	15,848	16,320	31,185	10,398	18,441
Other Deductions	79,650	64,706	79,463	56,426	66,859
Net Income Before Tax	20,918	8,891	-6,964	-12,625	4,610
Taxes (fed, state, S.E)	8,501	4,735	1,280	1,228	4,793
Family Living Expenses	14,791 (2,3,4)	14,337 (4)	14,908 (4)	14,346	14,561
Offfarm Income	8,219	6,744	7,153	3,548	6,687
3 Year Mean Cash Flow[a]	50,091	24,181	-5,206	-25,613	13,853
			-Percent-		
Marginal Tax Rate	35.89 (2,3,4)	31.27 (3,4)	20.67	19.64	28.14
Interest/Gross Sales	11.47 (3)	16.28 (4)	26.69	16.05	17.35
Return on Assets	9.15	4.93	2.69	-4.74	3.62
Return on Equity	10.73	3.78	-3.67	-7.98	1.78
Leverage Effect (ROE-ROA)	1.58 (2,3,4)	-1.15 (3)	-6.36 (4)	-3.24	-1.84
Gross Sales/Assets	25.90	20.16	21.06	16.94	20.89
Annual Principal/Debt	7.47	7.88	10.88	8.58	8.47
1985 Average Interest Rate	10.16	10.49	11.36	11.45	10.77

[a] Average of 1982, 1983, 1984 farm cash flows. plus 1984 off-farm income.

5. Both the average before-tax and after-tax interest rates increase across groups, with group one having the lowest interest rates and group four having the highest interest rates.
6. The three year mean cash flow declines across groups also.

E. Cash flow analysis

The cash flows presented in Table 4.5 are cash flows after interest and before annual principal payments. Group cash flows after principal payments are presented in Table 4.6. Group three has the greatest cash deficit because they have the greatest commitment to nonreal estate payments. The sample average cash flow after principal payments of all farm operators in the sample is slightly negative. Although group three has the greatest cash flow deficit, group four farm operators need the greatest percentage increase in prices in order to cover cash short falls.

F. Expansion pattern analysis

Expansion pattern information provides insight into how dramatically different groups of farm operators expanded and when they expanded (Table 4.7). Relative to the number of

Table 4.6 Percent Increase in Commodity Prices Required to Cover all Cash Requirements

	Group 1	Group 2	Group 3	Group 4	Sample Mean
			-Dollars-		
Annual Cash Flow[a]	50,091	24,181	(5,206)	(25,613)	13,853
Annual Nonreal Estate Principal Payment[b]	4,780	4,743	24,415	6,702	10.184
Annual Real Estate Principal Payment[c]	5,852	3,637	8,303	2,418	4,666
Cash Surplus or Deficit	39,459	15,801	(37,924)	(34,733)	(997)
Gross Sales	138,189	107,625	116,822	64,775	106,271
Percent Increase in Sales Needed	0.00%	0.00%	32.46%	53.62%	0.94%

[a]Three year mean farm cash flow plus 1984 off farm income.
[b]Average of 1984 and 1985 nonreal estate payment.
[c]Average of 1984 and 1985 real estate payment.

Table 4.7 Farm Operator Expansion Patterns By Profitability Group

	Group 1	Group 2	Group 3	Group 4
		-Percent-		
Net Land Acre Expansion, 1982-1985[a]	8.03 (2,3,4)	1.90	-1.45 (4)	3.95
Net Land Acre Expansion, 1979-1982[a]	9.31 (2,4)	5.07 (4)	10.21	3.68
Net Land Acre Expansion, 1975-1979[a]	15.24 (2,3,4)	10.18 (2)	19.10 (4)	7.87
Net Machinery & Equipment Purchases, 1982-1985[b]	7.22	5.41	2.79	3.47
Net Machinery & Equipment Purchases, 1979-1982[b]	8.06	6.23 (3)	5.39	5.63
Net Machinery & Equipment Purchases, 1975-1979[b]	8.17	6.25 (3)	5.43	5.86

[a]Time period land purchases-sales/current acres owned.
[b]Time period equipment purchases-sales/average 1984 & 1985 assets.

acres currently owned, group three farm operators expanded the most between 1975 and 1982. However, this group has been divesting itself of some land since 1982. Group one farm operators expanded almost as much as group three, but they have continued to actively buy land since 1982.

Group one farm operators have purchased the most machinery and equipment in the past ten years relative to their total asset base. Group four has been more active purchasing machinery and equipment than land. Group three farm operators have been the least active purchasing machinery and equipment compared with other groups.

G. Relationship to Debt-Asset Categories

Since debt-asset ratio categories seem to be the most common method of classifying financially stressed farm operators, a chi-square test is useful to compare profitability group classifications with debt-asset ratio classifications. The null hypothesis to be tested is: those operators considered stressed because of their debt-asset ratio are also considered stressed because of their

Table 4.8 Profitability Classifications Compared With 1985 Debt/Asset Classifications

Number | Column % |	Group 1	Group 2	Group 3	Group 4
Debt/Assets				
0 - 10 %	25 17.86%	131 48.16%	6 6.19%	78 49.06%
11 - 40	59 42.14%	88 32.35%	32 32.99%	44 27.67%
41 - 70	42 30.00%	45 16.54%	36 37.11%	22 13.84%
70 +	14 10.00%	8 2.94%	23 23.71%	15 9.44%

Chi Square = 418.66
DF = 9
Significant at .01% level

profitability group classification. The resulting chi-square is highly significant, 418.66 (with nine degrees of freedom), so we reject the null hypothesis (Table 4.8). Debt-asset ratio categories and profitability groups classify farm operators differently.

The greatest percentage of profitability group three operators fall into the third debt-asset group. The greatest percentage of profitability group one operators are in the second debt-asset group, while the greatest percentage of profitability group two operators are in the first debt-asset ratio category. The most striking misclassification occurs where nearly fifty percent of profitability group four operators are in the first debt-asset ratio category.

The inconsistency between profitability and debt-asset ratio indicators of financial stress was suggested by Jolly et al. who noted "75 percent of the U.S. operators with negative cash flows had D/A ratios of less than 40 percent. This suggests, in part, that the D/A ratio is not a consistent measure of financial stress" (p.4).

The comparisons between profitability groups presented in this chapter point out many differences, and some interesting similarities, among profitability groups. Groups one and three possess similar demographic characteristics, while groups two and four are very similar. Group three is the most indebted, but group one also has a high debt-asset ratio.

Group one operators have the most favorable income statement of any of the groups. Groups one and two seem best able to meet all cash flow requirements (including principal payments), while group three has the greatest negative cash flow after principal payments. Group three operators have been divesting of land since 1982, while group one operators have remained active in the land market.

Although comparing group means is a simple technique, it does provide insight about the farm operators in the data set. This technique does not, however, determine which variables best predict financial stress. The next chapter focuses on the results of several multivariate linear models estimated to predict stress.

V. A MULTIVARIATE ANALYSIS OF FARM STRESS

The theory presented in this study points to three indicators of financial stress: the debt-asset ratio, the cash flow return on equity and the profitability groupings. The debt-asset ratio indicates the riskiness of the firm's capital structure. While this ratio is a good preliminary indicator, the other measures more thoroughly indicate the financial condition of the firm. The cash flow return on equity measures the rate at which cash earnings (or losses) are increasing (or consuming) operator's net worth. Thus, this rate of return better indicates the financial well-being of a farm.

The profitability groups relate cash flow return on equity to cash return on assets. Although the groupings do not capture the magnitude of returns, they do capture the relative relationship between production efficiency (return on assets) and financial efficiency (return on equity).

The data from the survey provides a wealth of information about the respondents. To determine which operator characteristics are statistically significant in predicting financial stress, two multivariate techniques are employed in this chapter. Multiple regression analysis is used to estimate a linear prediction model for return on equity, a continuous variable. Maximum likelihood logit analysis is

used for predicting placement in a profitability group, a discrete variable.

A. Ordinary Least Squares Analysis

The cash flow return on equity was used as the dependent variable in a stepwise regression computer algorithm which estimated a linear equation for this variable. In the stepwise algorithm, variables are added to the model one by one if their F-statistic meets a minimum level (.3 in this model). After a variable is added, the algorithm deletes any variables which are not significant at another minimum level (.15 in this model). The process ends when none of the variables outside the model have a sufficiently high F statistic to enter the model, and every variable in the model is significant at the minimum level to stay in the model (SAS User's Guide: Statistics, 1982 ed.).

1. Model specification

Variables representing all three characteristics of the farming operation (demographic, financial, and expansion) explained in chapter three were included in the initial list from which the computer could choose. The stepwise model-building method employed allowed the data to determine the final model.

2. Interpretation of results

The stepwise regression analysis revealed five significant variables out of the list of 26 variables available. Coefficients and standard errors of the significant variables are displayed in Table 5.1. Although the significance level for a variable to stay in the model was set at .15, all variables in the model were significant at the .05 level. The R square value was .19.

Examination of the signs on the coefficients reveals the relationship between ROE and the independent variables. Turnover was the only variable of the five with a positive coefficient. This means an increase in turnover will increase ROE. The average debt-asset ratio had a negative coefficient. This is intuitively appealing, because so many other survey analysts equated a high debt-asset ratio with high financial stress. The third significant variable chosen was real estate assets to total assets. The sign on this coefficient was also negative and consistent with expectations. The greater the concentration of assets in land, the lower the ROE. Land is typically an illiquid asset which yields a low cash return compared with current interest rates. Thus, land does not contribute to cash flow as much as nonreal estate assets which yield a higher cash return.

One of Lev's indexes - MEANDEV - entered the model as a significant variable. MEANDEV indicates how atypical an

Table 5.1 Stepwise Regression Analysis: Significant Variables, Coefficients, and Standard Errors

	Coefficients of Significant Variables (standard errors)
Intercept	0.696212
	(.155787)
MEANDEV	-1.883340
	(0.210653)
RETOASSTS	-0.69470
	(0.19095)
NETLND1	-0.441493
	(0.165090)
TURNOVER	0.634047
	(0.15482)
MNDAR	-0.00765
	(0.001403)

All variables significant at 5% level
Adjusted R square = .1803

operator's balance sheet is compared with the sample average. The negative sign on this coefficient signifies that those operators with more atypical balance sheets in 1984 and 1985 have lower returns on equity, which agrees with a fairly prevalent idea that close adherence to an industry norm is desirable.

Only one expansion variable entered the model, NETLND1, the variable indicating the net percentage change in total acres owned which occurred between 1982 and 1985. The sign on this variable is negative, which seems contrary to expectations. A negative value for NETLND1 means an operator with a high ROE may be divesting of land. However, divesting seems to be an indication of financial stress, which would be better explained by a positive sign on the coefficient. Two aspects about this variable may explain the estimated sign. One, debt acquired in recent years has been subjected to historically high interest rates. Payments in the early years of the loan are comprised mostly of interest with very little principal repayment. The high interest payments would contribute to a low return on equity. Two, within this three year period, timing of land purchases would be critical. If operators purchased land in 1982, they paid a price very close to the peak value, and now these operators are experiencing eroding land values. These operators may not be able to support the high debt against the land, and as a result they may be liquidating land.

Interestingly, three of the five variables in this model are balance sheet variables - MNDAR (mean debt-asset ratio), RETOASST (real estate asset-total asset ratio), and MEANDEV (the deviation from the industry average balance sheet index). One portrays capital structure, one portrays asset structure, and one portrays how the individual balance sheet compares with the sample average balance sheet. Obviously, balance sheet information is important in predicting financial stress. Those operators in a riskier leverage position with high debt-asset ratios and those operators with greater percentages of their assets in real estate (which has eroded in value considerably in recent years) are individuals who are experiencing financial stress.

Almost as interesting as discovering which variables proved to be significant in the model, is discovering which variables did not enter the model. None of the demographic variables proved to be significant. This means financial stress is not peculiar to a certain type of farm, or to a certain location within the state. Furthermore, farm size, educational attainment, experience, family size, amount of rented land, or off-farm income do not distinguish financially stressed farm operators.

Several financial variables thought to be significant - cash flow margin, after tax interest rate, and variation in cash flows - were not. Likewise, most of the expansion variables and most of Lev's indexes were not significant. One

would think activity in the land market from 1979 to 1982 (NETLND2) would be a significant predictor of current financial stress, but it was not.

To further understand the relative importance of the five significant independent variables in the model, each variable (both independent and dependent) was normalized by subtracting its mean and dividing by its standard deviation. These normalized variables were used to reestimate a linear regression equation with ROE as the dependent variable. The regression coefficients estimated from the rescaled variables makes it possible to compare coefficients directly (Pendyck and Rubinfeld, p.91). The magnitude of the beta coefficients provides insight onto how much the dependent variable will change given a change in one of the independent variables. For instance, a beta coefficient of .2 means that a one unit change in the independent variable will cause a .2 unit change in the dependent variable.

The independent variables representing the balance sheet have the coefficients with the highest absolute values (Table 5.2). The coefficient with the greatest absolute value is MEANDEV, the variable which measures the degree to which the individual's balance sheet deviates from the average balance sheet. This means restructuring an individual's balance sheet to more closely resemble the norm would improve return on

Table 5.2 Beta Coefficients of Normalized Regression Variables[a]

	Standardized Coefficients	Variable Standard Deviation	Mean
Intercept	-0.03718		
TURNOVER	0.18223	0.2550	0.2544
MNDAR	-0.22839	26.49	25.7
NETLND1	-0.09839	0.1977	0.0200
RETOASSETS	-0.19753	0.2523	0.6363
MEANDEV	-0.5958	0.2807	0.1553
ROE		0.8873	-0.0497

[a]Some of the mean values presented in this table may not parallel means displayed in other tables. The mean values in this table are averages of ratios, while mean values in other tables are ratios of average values.

equity the most. The types of structural changes needed would have to be examined more closely on an individual basis. The coefficient with the next greatest absolute value is MNDAR (the mean debt-asset ratio), followed by RETOASST (real estate assets-total assets). These two variables provide some insight into ways to restructure the balance sheet in order to improve earnings: 1) reduce debt relative to assets, and 2) shift asset holdings from real estate to nonreal estate.

Two more regression equations were estimated in order to examine the predicting ability of two other variables, CFMAR3 (three year average cash flow divided by the three year average gross sales), and NETLND2 (land expansion between 1979 and 1982). CFMAR3 was added to the previously estimated model, while NETLND2 replaced the NETLND1 variable.

CFMAR3 had a positive coefficient sign (Table 5.3), and was significant at the .2 level. As cash flow to total sales increases, return on equity also increases. This model had an adjusted R square of .18, lower than the first model.

The other model estimated (Table 5.4) revealed a positive coefficient for NETLND2. Generally, most have thought land expansion in the late 1970s and early 1980s has contributed to the financial problems currently being experienced by farm operators. The sign on this variable is contrary to that hypothesis. However, NETLND2 is not highly significant (.54 level). Substitution of this variable lowered the R square to .17.

Table 5.3 Stepwise Regression Analysis: Significant Variables, Coefficients, and Standard Errors

	Coefficients (standard errors)
Intercept	0.686684.
	(.155889)
MEANDEV	-1.871265
	(0.210761)
RETOASSTS	-0.679759
	(0.191214)
NETLND1	-0.442746
	(0.165011)
TURNOVER	0.628029
	(0.154812)
MNDAR	-0.00768
	(0.001402)
CFMAR3	0.15851
	(0.012439)

Table 5.4 Stepwise Regression Analysis: Significant Variables, Coefficients, and Standard Errors

	Coefficients (standard errors)
Intercept	0.672364
	(.156359)
MEANDEV	-1.822619
	(0.211475)
RETOASSTS	-0.671349
	(0.191775)
NETLND2	-0.094883
	(0.156124)
TURNOVER	0.602756
	(0.155213)
MNDAR	-0.007923
	(0.001539)

B. Maximum Likelihood Logit Analysis

The profitability groups displayed in Figure 2.1 combine important information about the farm firm – profitability, use of debt, and net worth growth rate. A maximum lilelihood logit model was used to develop a prediction model for these groups because of the discrete dependent variable.

1. Explanation of the technique

The logit technique estimates a set of probability prediction equations based on the cumulative logistic probability function (Pendyck and Rubinfeld). The general logistic equation for a binomial dependent variable is specified as:

$$P_i = F(Z_i) = F(a + BX_i) = 1/[1 + e^{(a + BXi)}] \qquad (5.1)$$

where P_i = the probability that an observation will fall into a profitability group,

X_i = characteristic vector of the ith individual.

The logit model translates the value of variable X_i, whose value may range over the entire number line, to a probability which ranges from zero to one. Equation (5.1) may be linearized into:

$$\ln [P_i/(1 - P_i)] = BX_i + e \qquad (5.2)$$

Where e is stochastic and logistically distributed.

When the dependent variable is multichotomous instead of dichotomous, the logit represents the probability of an observation falling into one class as opposed to falling into a base reference class. For example:

$$\ln [P_2/P_1] = a_{2i} + B_{2i}X_i \qquad (5.3)$$

$$\ln [P_3/P_1] = a_{3i} + B3_iX_i \qquad (5.4)$$

$$\text{and} \quad \ln [P_2/P_3] = [a_{2i} - a_{3i}] + [B_{2i} - B_{3i}]X_i \qquad (5.5).$$

The logit coefficients are difficult to interpret because the coefficients represent the incremental effects variable X has on the logit ($\ln [P_i/P_r]$), rather than representing the effects variable X has on the probability P_i (Lines and Zulauf). Here P_r is the probability of falling into the reference class.

The logit coefficients can be translated into linear, mutually exclusive, probability equations through the following transformation:

$$P_j = e^{Zj}/(1 + \sum_{j=1}^{r-1} e^{Zj}) \qquad (5.6)$$

$$\text{where } Z_j = B_{oj} + \sum_{1}^{k} B_{jk} X_k \qquad (5.7)$$

for $j = 1...r-1$,

r = the number of response groups,

X = the characteristic variables,

k = the number of characteristic variables in the model,

B_{jk} = logit coefficient for the jth response group and the kth characteristic.

The probability of falling into the reference group, r, can be determined two ways. First, since the probabilities sum to one:

$$P_r = 1 - \sum_{j=1}^{r-1} P_j \qquad (5.8)$$

or:

$$P_r = 1/(1 + \sum_{j=1}^{r-1} e^{Zj}) \qquad (5.9)$$

To further understand how specific characteristic variables affect the probabilities of an observation falling into a specific response group, partial derivatives of the probability functions can be calculated (Hill, 1980). These partial derivatives with respect to changes in the values of X are calculated as:

$$\partial P_j / \partial X = B_j P_j (1-P_j) - B_k P_k P_j - B_l P_l P_j \qquad (5.10)$$

where j,k,l = 1...r-1, and j=k=1.

And:

$$\partial P_r / \partial X = -(B_j P_j P_r + B_k P_k P_r + B_l P_l P_r) \qquad (5.11)$$

The partial derivatives should sum to zero.

The logit partial derivatives can be interpreted similiarly to linear regression coefficients. The signs and magnitudes of the partial derivatives specifically indicate how changes in the value of X change the probability of an observation falling into a specific response group. A positive sign means an increase in X leads to an increase in the predicted probability while a negative sign means an increase in X leads to a decrease in the probability. The magnitudes of the partials indicate how much a one unit change in X changes the probability that an individual will fall into a specific group.

In order to test the significance of a logit model, an estimated chi square is calculated. The degrees of freedom are the product of the number of characteristic variables in the model (k), and one minus the number of classification groups (r-1).

2. Model specification

The maximum likelihood logit technique was used to estimate two sets of probability prediction models for the

profitability groups described in Figure 2.1. The first model included the significant variables from the stepwise regression model, along with demographic variables, and two other variables thought to be important: CFMAR3 (the three year cash flow margin), and FHADEBT (the percent of the operator's debt which is borrowed from the Farmer's Home Administration). The second model included only demographic variables and expansion pattern variables. This model would be useful to examine how well demographic variables predict financial stress.

3. Interpretation of results

The logit coefficients and the variable chi squares for the comprehensive model of both financial and demographic variables are presented in Table 5.5. The model chi square was 816.8 with 66 degrees of freedom, meaning this model was significant at the one percent level. Statistical significance of variable chi squares is indicated by the asterisks. The significant variable chi squares indicate how well the variable predicts over all the groups. On the other hand, a significant maximum likelihood coefficient indicates how well the variable predicts between the two groups indicated. For example, TURNOVER's (gross sales divided by assets) chi square is significant at the .05 level, meaning the variable is important to the overall model. The maximum likelihood coefficient of TURNOVER for $\text{Log}(P_1/P_4)$ is also

significant. This means TURNOVER is important in predicting the probility of an observation falling into group one versus group four.

All the variables which were significant in the regression model are significant in the logit model, besides a few more variables. CFMAR3, the three year cash flow margin, was highly significant. Two demographic variables were significant at the .1 level - EDW, the education attainment of the wife, and MNASSETS, the average size of the farm.

Logit coefficients were translated into probability prediction equations, and partial derivatives were calculated at the sample means and modes (Table 5.6). A typical farm operator in this sample would have a 31.52 percent probability of falling into profitability group two. The majority of the sample's observations fell into group two. Observation of the sample means in chapter four revealed a close resemblence between group two means and the overall sample mean.

Table 5.5 Variable Chi Squares, Maximum Likelihood Coefficients, and Standard Errors for the Comprehensive Logit Model

	Chi-Square	$\text{Log}(P_1/P_4)$	$\text{Log}(P_2/P_4)$	$\text{Log}(P_3/P_4)$
Intercept	5.94	-4.66501 **	-4.07334 **	-4.79069 **
(standard error)		(2.13965)	(2.01239)	(2.20144)
MEANDEV	10.77 **	-2.0636	-1.59327	1.36711
		(1.29358)	(1.33411)	(1.16108)
TURNOVER	10.16 **	2.92993 **	1.50996	-0.997588
		(1.25736)	(1.30087)	(1.61315)
MNDAR	26.68 **	-0.009880	-0.026956 **	0.0133752
		(0.00925)	(0.00906)	(0.00905)
NETLND1	6.34 *	1.39756	-0.052761	-0.652318
		(0.93759)	(0.88244)	(0.83626)
CFMAR3	167.56 **	8.04045 **	7.38036 **	3.41231 **
		(0.66285)	(0.65984)	(0.87433)
TYPE2	2.57	-0.959518	-0.026778	-0.131156
		(0.80564)	(0.66156)	(0.71484)
TYPE3	2.41	0.561369	0.663824	0.829243
		(0.53839)	(0.52635)	(0.54670)
TYPE4	2.88	-0.736507	0.500057	-0.605129
		(1.03453)	(0.79976)	(1.01804)
TYPE5	1.73	-0.239777	0.336641	0.128263
		(0.59736)	(0.54551)	(0.61532)
CRD2	0.42	-0.131981	-0.203098	-0.329134
		(0.52222)	(0.49308)	(0.53520)

CRD3	0.69	0.0195205	-0.273316	-0.108551
		(0.54670)	(0.52428)	(0.56226)
CRD4	4.11	-0.621369	0.257555	0.0453466
		(0.59189)**	(0.52536)**	(0.55861)**
OFFARMPC	5.64	2.59814	2.55564	2.82788
		(1.11679)	(1.11111)	(1.27196)
FHADEBT	1.36	-2.334	-2.58922	-0.914229
		(2.53348)	(2.50768)	(2.20751)
DEPALL	1.46	0.1939396	0.168853	0.129069
		(0.16540)	(0.15762)	(0.16421)
EDW	6.9 +	0.948927 **	0.496188	0.327645
		(0.37987)	(0.34766)	(0.37353)
EDH	4.78	-0.259579	0.295227	0.290103
		(0.38456)	(0.36045)	(0.39078)
RENTEDPC	2.12	0.996829	0.704537	0.133223
		(0.80070)	(0.74409)	(0.83100)
MNASSETS	6.73 *	9.38E-07	1.34E-06 **	1.11E-06 **
		(5.79E-07)	(5.36E-07)	(5.46E-07)
YRSFARM	5.1	0.0247077	0.0339814	-0.011555
		(0.02560)	(0.02462)	(0.02672)
RETOASST	7.52 *	-0.317775	-0.019720	2.96129 **
		(1.40713)	(1.34445)	(1.45545)

** Significant at .05 level, 3 degrees of freedom.
* Significant at .1 level, 3 degrees of freedom.

Table 5.6 Group Probabilities and Partial Derivatives Calculated at the Sample Mean Using the Comprehensive Logit Model

	Means or Modes	Group 1	Group 2	Group 3	Group 4
Probabilities		18.61%	31.52%	24.45%	25.43%
Intercept		-0.24973	-0.23648	-0.35878	0.8450
MEANDEV	0.14144	-0.28130	-0.32819	0.46913	0.1404
TURNOVER	0.25521	0.40059	0.23093	-0.43387	-0.1976
MNDAR	24.3571	-0.00052	-0.00627	0.00500	0.0018
NETLND1	0.02192	0.24444	-0.04310	-0.17999	-0.0214
CFMAR3	0.04131	0.62972	0.85849	-0.30414	-1.1841
TYPE2	0	-0.13779	0.06060	0.02149	0.0557
TYPE3	0	0.00837	0.04646	0.07648	-0.1313
TYPE4	0	-0.11335	0.19775	-0.11679	0.0324
TYPE5	0	-0.06190	0.07684	0.00866	-0.0236
CRD2	0	-0.02583	-0.03456	-0.03710	0.0975
CRD3	0	-0.02648	-0.03778	-0.03858	0.1028
CRD4	0	-0.03342	-0.03564	-0.03577	0.1048
OFFARMPC	0.23935	0.03338	-0.10711	-0.12240	0.1961
FHADEBT	0.01913	0.07835	-0.30567	-0.16371	0.3910
DEPALL	2	-0.39949	0.17509	0.12608	0.0983
EDW	2	-0.01463	0.07048	0.01346	-0.0693
EDH	2	0.11321	-0.01428	-0.01233	-0.0866
RENTEDPC	0.38931	-0.08670	0.15703	-0.01787	-0.0525
MNASSETS	553301	1.51E-01	-5.85E-02	-4.53E-02	-4.72E-02
YRSFARM	29.36	-1.47E-03	8.22E-03	-4.75E-03	-2.01E-03
RETOASST	0.63475	-0.12981	-0.23386	0.54734	-0.1837

The next most likely group the typical farm operator would fall into would be group four, followed closely by group three.

Signs on the partial derivatives provide meaningful information. For instance, if the turnover ratio increased from the mean value, the probability of the operator shifting into group one or two would increase, while the likelihood of shifting into groups three and four would decrease. If the debt-asset ratio increased from the mean, the likelihood of an individual shifting into groups three or four would increase, while the likelihood of staying in group two or shifting to group one would decrease.

In addition to a comprehensive model, a logit model of only demographic variables was estimated. This logit model had a chi square of 1249 with 60 degrees of freedom (Table 5.7) which was significant at the .01 level. With financial variables excluded, additional demographic variables appear to be significant. Equipment expansion since 1982, and between 1979 and 1982 are significant along with YRSFARM (the number of years farming).However, MNASSETS (farm asset size) was not significant.

As with the comprehensive model, the typical farm operator would have the greatest probability of falling into group two (Table 5.8). However, the probability 44.23 is greater than the probability predicted by the comprehensive model.

Table 5.7 Variable Chi Squares, Maximum Likelihood Coefficients, and Standard Errors for the Demographic Logit Model

	Chi-Square	$\text{Log}(p_1/p_4)$	$\text{Log}(p_2/p_4)$	$\text{Log}(p_3/p_4)$
Intercept	6.15 **	-1.52078	-1.02128	1.51056
(standard error)		(1.25285)	(1.05594)	(1.34354)
NETLND1	8.27 *	1.50083 *	0.19450	-0.79811
		(0.83686)	(0.74546)	(0.84812)
NETLND2	5.92	1.77726 **	1.18076	1.76233 **
		(0.78674)	(0.73189)	(0.82976)
NETLND3	1.75	0.42527	0.17550	0.62588
		(0.51713)	(0.45605)	(0.52949)
EQEXP1	14.32 **	2.39435	1.79142	-9.28362 **
		(1.74660)	(1.67028)	(3.31871)
EQEXP2	10.37 **	4.63478 **	2.29516	-1.33891
		(1.87264)	(1.81342)	(2.59873)
EQEXP3	1.32	-0.83742	-1.51518	-1.78244
		(1.44404)	(1.43253)	(2.16492)
TYPE2	1.82	-0.62479	-0.30457	-0.54080
		(0.53107)	(0.37871)	(0.53611)
TYPE3	1.49	0.51743	0.30748	0.37675
		(0.42850)	(0.39038)	(0.46728)
TYPE4	2.37	-0.79198	0.16779	-0.85345
		(0.91669)	(0.61409)	(0.94994)

TYPE5	0.92	-0.07690	0.26737	0.25104
		(0.50831)	(0.42153)	(0.55531)
CRD2	1.76	0.36368	0.19672	-0.17621
		(0.41685)	(0.36488)	(0.46988)
CRD3	1.77	0.39976	0.01040	-0.12522
		(0.42532)	(0.37602)	(0.47910)
CRD4	3.92	-0.75179	0.02278	-0.16013
		(0.46051)	(0.35276)	(0.45626)
OFFARMPC	3.82	0.03144	-0.06185	-0.78998 *
		(0.08044)	(0.09469)	(0.44026)
DEPALL	0.34	0.03526	-0.01754	0.03306
		(0.12962)	(0.11727)	(0.13978)
EDW	7.21 *	0.67545 **	0.32152	0.05075
		(0.27468)	(0.21980)	(0.29644)
EDH	3.36	-0.20779	0.21905	0.16318
		(0.28807)	(0.23975)	(0.31814)
RENTEDPC	0.99	-0.10620	-0.35654	-0.40254
		(0.50705)	(0.42425)	(0.57204)
MNASSETS	2.60	5.41E-07	5.10E-07	4.51E-07
		(3.87E-07)	(3.33E-07)	(3.97E-07)
YRSFARM	13.55 **	-0.02137	0.00530	-0.06005 **
		(0.01848)	(0.01557)	(0.02076)

** Significant at .05 level, 3 degrees of freedom.
* Significant at .1 level, 3 degrees of freedom.

Table 5.8 Group Probabilities and Partial Derivatives Calculated at the Sample Mean with the Demographic Logit Model

	Means or Modes	Group 1	Group 2	Group 3	Group 4
Probabilities		21.08%	44.23%	21.12%	3.57%
Intercept		-0.22505	-0.25125	0.41481	0.0615
NETLND1	0.02192	0.26709	-0.01739	-0.21798	-0.0317
NETLND2	0.06480	0.10712	-0.03908	0.10418	-0.1722
NETLND3	0.11952	0.02652	-0.05483	0.06895	-0.0406
EQEXP1	0.06742	0.64471	1.08595	-1.82075	0.0901
EQEXP2	0.08695	0.61671	0.25911	-0.64388	-0.2319
EQEXP3	0.08757	0.08132	-0.12915	-0.11814	0.1660
TYPE2	0	-0.05147	0.03365	-0.03383	0.0517
TYPE3	0	0.04064	-0.00759	0.01101	-0.0441
TYPE4	0	-0.10940	0.19496	-0.12261	0.0370
TYPE5	0	-0.02054	-0.00471	-0.03051	0.0558
CRD2	0	-0.01441	-0.00724	-0.02564	0.0473
CRD3	0	-0.01437	-0.00834	-0.02576	0.0485
CRD4	0	-0.01755	-0.00474	-0.02412	0.0464
OFFARMPC	0.23935	-0.04818	0.06071	-0.04400	0.0315
DEPALL	2	-0.01322	0.00009	0.01073	0.0024
EDW	2	-0.02637	0.07128	-0.02315	-0.0218
EDH	2	0.08468	-0.02419	-0.02335	-0.0371
RENTEDPC	0.38931	0.01660	-0.03097	-0.02451	0.0389
MNASSETS	553301	-1.77E-02	9.90E-03	4.73E-03	3.04E-03
YRSFARM	29.36	2.18E-03	6.92E-03	-1.05E-02	1.40E-03

Probabilities and partial derivatives were calculated for for each of the profitability group means using the two models. Group means for a few other types of operators were used to predict probabilities to examine into which groups these operators would most likely fall (see APPENDIX D).

For comparative ease, group means, modes, and probabilities calculated with the comprehensive model are summarized in Table 5.9. This model seems to best predict the occurance of an individual falling into group four, followed by group one. However, all probabilities are highest for the appropriate group. The model seems least able to predict the occurance of a typical group three operator falling into group three.

Probabilities calculated using the demographic model are summarized in Table 5.10. This model predicts that the typical operator from each profitability group will most likely fall into group one. The result is consistent with the results from the regression model in that demographic characteristics do not appear to indicate financial stress as well as the financial characteristics of a farm operator.

Along with profitability group means and modes, values for other operator categories were tested. The other categories were operators who had been active in the land market at different times in the past ten years, new farm operators, and operators who have more than ten percent of their debt with Farmers Home Administration (Table 5.11).

Table 5.9 Comparative Probabilities Calculated from Profitability Group Means and Modes with the Comprehensive Logit Model

	Group 1	Group 2	Group 3	Group 4
MEANDEV	0.1633	0.1114	0.1472	0.1701
TURNOVER	0.3537	0.2359	0.2211	0.2170
MNDAR	31.99	16.32	43.92	19.45
NETLND1	0.0759	0.0173	-0.0384	0.0190
CFMAR3	0.5158	0.3590	0.2317	-1.2098
BEEF	0	0	0	0
PORK	0	0	0	0
DAIRY	0	0	0	0
MIXED	0	0	0	0
CENTRAL	1	0	0	0
WEST	0	0	0	0
SOUTH	0	0	0	0
OFFARMPC	0.2105	0.1920	0.1287	0.4559
FHADEBT	0.0114	0.0107	0.0371	0.0287
DEPALL	2	2	2	2
EDW	3	2	2	2
EDH	2	2	2	2
RENTEDPC	0.5054	0.3538	0.3914	0.3466
MNASSETS	567,912	579,775	621,333	453,643
YRSFARM	25.47	31.31	25.13	32.05
RETOASST	0.5783	0.6481	0.6714	0.6392
		- Percent-		
PROB. 1	65.05	32.98	22.90	0.00
PROB. 2	31.47	55.55	28.08	0.02
PROB. 3	2.80	8.00	34.42	2.13
PROB. 4	0.68	3.47	14.60	97.84

Table 5.10 Comparative Probabilities Calculated from Profitability Group Means and Modes with the Demographic Logit Model

	Group 1	Group 2	Group 3	Group 4
NETLND1	0.0759	0.0173	-0.0384	0.0190
NETLND2	0.0918	0.0452	0.1602	0.0160
NETLND3	0.1395	0.9854	0.2046	0.0856
EQEXP1	0.0951	0.6828	0.3591	0.0681
EQEXP2	0.0140	0.0805	0.0592	0.6762
EQEXP3	0.1218	0.0805	0.6398	0.8372
BEEF	0	0	0	0
PORK	0	0	0	0
DAIRY	0	0	0	0
MIXED	0	0	0	0
CENTRAL	1	0	0	0
WEST	0	0	0	0
SOUTH	0	0	0	0
OFFARMPC	0.2105	0.1920	0.1287	0.4559
DEPALL	2	2	2	2
EDW	3	2	2	2
EDH	2	2	2	2
RENTEDPC	0.5054	0.3538	0.3914	0.3466
MNASSETS	567,912	579,775	621,333	453,643
YRSFARM	25.47	31.31	25.13	32.05
		-Percent-		
PROB. 1	40.11	59.00	45.82	78.48
PROB. 2	24.91	0.12	2.83	2.04
PROB. 3	24.17	34.55	28.50	12.34
PROB. 4	10.81	6.33	22.84	7.14

Table 5.11 Comparative Probabilities Calculated from Special Group Means and Modes with the Comprehensive Logit Model

	Buy Since 82	Sell Since 82	Buy 79-82	Buy 75-79	Operate < 15 yrs	FmHA Debt >10%
MEANDEV	0.0704	0.0792	0.0925	0.0756	0.2354	0.1502
TURNOVER	0.2287	0.1563	0.2393	0.2317	0.3535	0.2624
MNDAR	29.11	41.55	41.35	36.00	35.43	44.37
NETLND1	0.3229	-0.4472	-0.0226	0.0089	0.0483	-0.0424
CFMAR3	0.2159	0.1232	0.0146	0.0601	-0.0083	-0.0202
BEEF	0	0	0	0	0	0
PORK	0	0	0	0	0	0
DAIRY	0	0	0	0	0	0
MIXED	0	0	0	0	0	0
CENTRAL	0	1	1	1	0	0
WEST	0	0	0	0	1	0
SOUTH	0	0	0	0	0	1
OFFARMPC	0.0732	0.0993	0.1166	0.1664	0.2536	0.1432
FHADEBT	0.0104	0.0304	0.0232	0.0186	0.0317	0.2592
DEPALL	2	2	2	2	4	4
EDW	2	3	3	2	3	2
EDH	2	2	2	2	3	2
RENTEDPC	0.3424	0.3758	0.4419	0.4129	0.5662	0.3974
MNASSETS	789,131	668,456	831,471	784,983	398,924	461,493
YRSFARM	26.40	28.41	25.10	26.31	11.03	23.23
RETOASST	0.6903	0.7079	0.6936	0.6795	0.5421	0.6237
			-Percent-			
PROB. 1	36.69	15.84	23.60	18.52	22.84	4.33
PROB. 2	36.83	26.45	20.76	26.00	16.61	11.60
PROB. 3	15.50	39.02	31.44	27.95	38.23	38.14
PROB. 4	10.98	18.70	24.20	27.52	22.33	45.93

Net buyers of land since 1982 are most likely to be in groups one or two. As real estate assets to total assets increases, the probability of an individual falling into group three increases, while the probability of shifting into groups one or four decreases.

Net sellers of land since 1982 are most likely to be in group three. As real estate assets to total assets increases, the probability of an individual staying in group three increases. As the debt-asset ratio (MNDAR) increases, the probability of an individual shifting to groups one or two decreases.

Net buyers of land between 1979 and 1982 are most likely group three farm operators. These operators are also currently divesting themselves of land. The more land being sold, the greater the probability of the operator being in group three. The larger the farm (designated by MNASSETS), the greater the probability of an individual shifting into group one.

Net buyers of land between 1975 and 1979 are either group three, four, or two operators. This farm operator characteristic has little distinguishing ability based on the evenness of the probabilities calculated. Current activity in the land market seems to better distinguish between profitability groups.

Farm operators with less than fifteen years experience are most likely group three operators. As operator age

increases, the probability of an individual shifting to group two increases. As the education level of the husband increases, the probability of the operator shifting to group one increases. As off-farm income increases, the probability of an individual shifting to group four or group one increases.

Those operators with Farmers Home Administration debt comprising over ten percent of their debt are most likely to be group four or group three operators. As cash flow margin increases, the probability of an individual shifting to group two increases most dramatically, followed by the increased probability of being in group three then group one.

C. Summary

The linear stress prediction models estimated in this chapter reveal that financial characteristics of farm operators best predict financial stress. Demographic characteristics have little discriminating ability. The linear regression model indicated that restructuring the balance sheet and improving turnover would help improve return on equity. The comprehensive logit model revealed that group three operators are the most likely to be divesting of land. Group three operators were also the most typical buyers in the land market between 1975 and 1982. Farm operators with less than fifteen years experience would most likely fall into

profitability group three. Farmers Home Administration borrowers would most likely be group four operators.

VI. CONCLUSIONS AND POLICY IMPLICATIONS

The objectives of this study were to examine indicators of financial stress outlined in the theory or used in other studies. Measures of financial stress for the farm firm were examined and developed. Once an indicator (or indicators) was determined, the data from the 1985 Iowa Farm Finance Survey was examined and used to develop several multivariate stress prediction models.

A. Significant Findings in the Reasearch

The results from the analysis of this survey data provide important considerations for future agricultural policy. Decomposing the sample of farm operators by profitability group reveals that only twenty percent of the farm operators (who comprise group one) seem to be financially sound. These operators are making a very acceptable cash flow return on assets (9.15), and their use of debt enhances their return on equity (10.73).

Group two farm operators, who also seem to be financially sound, are earning an average return on assets of 4.93 which is half of group one's average return. This group has the lowest average debt-asset ratio of all the groups, yet the debt they hold does not positively contribute to the firm's return on equity which is 3.78 percent. Their return on

equity is positive, although it is only a third of group one's ROE. Profitability seems to be the main problem for these farming operations.

Group three farm operators earn a positive return on assets (2.69), but this return is only a third of the return earned by group one. The extensive amount of debt held by this group aggravates their low production efficiency problem, creating a negative return on equity. This group comprises fifteen percent of the operators in the sample, but 27 percent of the sample's debt in held by these operators. Profitability and excessive amounts of debt seem to be the main problems for this group.

Group four farm operators (who comprise nearly 24 percent of the sample) earn a negative return on assets (4.74). Like group two, this group reports a low debt-asset ratio, but any debt held by these operators is a hindrance to the firm. Poor production efficiency is the initial problem for this group, then any financial inefficiency further aggravates their problems.

B. Critique of the Research Methods

The 1985 Iowa Farm Finance Survey provided cross-sectional, time-series information about many aspects of farming operations in the state. The three year average of income and expenses helped smooth out fluctuations which could

have distorted the results. Likewise, two years of balance sheet information allowed obeservation of changes during the year.

The data analysis could have been improved by examining 1982 and 1983 balance sheets. With this information, rates of return on assets and equity would have been more accurate. Calculations were made on the assumption that the capital structure of the farms in 1983 was the same as it was in 1984. The study focused on cash flow rates of return, ignoring the contribution of capital gains on land which is recognized as an important part of earnings from agricultural assets.

Inventory changes could be more accurately estimated if information on crop and livestock inventories, operating debt, and machinery sales had been specified. Despite these shortcomings in the data, the survey provided a very good profile of Iowa farm operators.

The stepwise regression and the maximum likelihood logit analysis revealed many interesting results. The logit model allowed for the use of a discrete dependent variable, but the computer algorithm is expensive to use, and the results are difficult to interpret.

In retrospect, Lev's indexes did not reveal enough accurate or discriminating information given the complexity of the calculations. A longer time-series of balance sheets may have improved the discriminating power of Lev's indexes. However, Lev's method is not very robust, as it does not work

for negative net worths or when the initial debt or asset balance is zero.

An important prediction variable was not included in the study since the survey did not provide such information. A variable measuring macroeconomic influences would probably have improved the predicting power of the multivariate models. Although this variable would have provided greater insight into the reasons for financial stress, it is also difficult to determine which variable could have been used.

C. Inferences for Public Policy

Overall, forty percent of the operators in the sample are losing net worth. Only twenty percent of the operators are doing well financially. Eighty percent of the operators in the sample earn returns on assets below the after-tax interest rate. The identity that expresses the relationship between ROA and ROE implies at least four courses of action public policy could address: increase ROA, decrease the after-tax interest rate, decrease debt relative to assets, or combine any of these actions. The stepwise regression model indicated that reducing debt relative to assets would best improve ROE. However, groups two and four farm operators do not seem to hold excess amounts of debt, consequently, a debt adjustment policy may be only marginally helpful. Group three operators

would benefit from a debt reduction policy providing a principal writedown or forgiveness.

The after tax interest rate for groups two, three, and four substantially exceeds the return on assets generated by these groups. Interest rate subsidities or increased tax deductibility of interest expense may help group two operators the most. Yet group two would need a 32 percent decrease in their after tax interest rate (all else equal) in order for debt to benefit their farming operation. Group three and four operators would also benefit from assistance from high interest rates, yet their problems are more difficult to solve.

Overall, improved profitability, meaning production efficiency, would benefit the majority of farm operators in this sample. Profitability would be improved by increasing income from assets employed. Improved income comes from better prices, higher productivity, and reduced expenses. Improved operator management, marketing, and production skills would contribute to improved profitability.

D. Future Research Needs

This survey data tell us profitability is a problem which needs to be addressed for eighty percent of the farm operators in this sample. The survey data also tell us twenty percent of the operators in the sample seem to be making acceptable

returns. Yet, the study of the data provide very few clues as to why group one operators are doing so well compared to the other three groups. Comparisons between the demographic and expansion pattern characteristics of groups one and three yield many similarities, yet group one is experiencing a very acceptable return on equity while group three is experiencing losses.

Bernstein makes an insightful comment, "The earnings of an adequate or superior return on funds invested in an enterprise depends first and foremost on the resourcefulness, skill, ingenuity, and motivation of management." Group one operators must be commended for earning such favorable returns despite the unfavorable macroecomonic environment in which they are operating. The next step for research: explore why group one operators are doing so well. Based on future findings, techniques to improve the profitability of other farm operators can be implemented.

Future research could be conducted by examination of individual farm operations which are identified as being group one operations. Careful studies of other time-series, cross-sectional data, such as the Iowa Farm Business Association data, may reveal management practices which contribute to improved profitability.

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APPENDIX A: THE SURVEY INSTRUMENT

1985 IOWA FARM FINANCE SURVEY

Dear Farm Operator:

Financial problems are continuing to have widespread effects on Iowa agriculture. This survey will provide important information that will enable us to continue tracking financial conditions in Iowa and help our farmers and farm leaders make informed decisions. A good response is necessary to obtain accurate data. Due to the sensitivity of financial data there is no identification on your report. Please complete this questionnaire and return in the enclosed envelope by March 15, 1985. Thank you for your cooperation.

Sincerely,

Lee R. Kolmer, Dean
College of Agriculture
Iowa State University

Robert H. Lounsberry
Iowa Secretary of Agriculture

1. In what county is most of your farming operation located? _____

2. What is your age? _____

3. How many dependents are you supporting (including yourself)? _____

4. How many of these dependents are under 18 years? _____

5. What is the highest level of schooling that you have attended (check one)?
   Wife: ___ Grade School ___ High School ___ College or Vocational
   Husband: ___ Grade School ___ High School ___ College or Vocational

6. How many years have you been farming? _____

7. From your tax records (1040F and form 4797) or farm accounts, please supply the following information on your farm income and expenses for the last three years.

	SOURCE	1982	1983	1984*
Gross Profit	(line 31-1040F)			
Sale of breeding stock	(4797)			
Interest	(line 34-1040F)			
Depreciation	(line 53-1040F)			
Total Deductions	(line 55-1040F)			

8. *actual or estimated

   Approximately what percent of your 1984 gross farm sales came from each of these sources?

   Crops..... _____%
   Beef..... _____%
   Pork..... _____%
   Dairy..... _____%
   Other _____ (Specify) ..... _____%
   Total..... 100%

9. How much off-farm income did you and your spouse earn in 1984?
   Wife.....$ _____
   Husband....$ _____

10. How many acres do you:
    A. Own..... _____acres
    B. Rent From Others..... _____acres
    C. Rent to Others..... _____acres
    Total Land You Operate (Item A + B - C)..... _____acres

11. How many acres of land did you purchase or sell:

	Purchased	Sold
During the last three years? (1982-1984).....	_____	_____acres
4 - 6 years ago? (1979-1981).....	_____	_____acres
7 - 10 years ago? (1975-1978).....	_____	_____acres

12. How many dollars worth of machinery, buildings or equipment did you purchase or sell:

	Purchased	Sold
During the last three years? (1982-1984)...$	_____	_____
4 - 6 years ago? (1979-1981).....$	_____	_____
7 - 10 years ago? (1975-1978).....$	_____	_____

13. From your financial statements for the last two years what was the market value of the farm assets that you own?

	Jan. 1984	Jan 1985
Total real estate (land and buildings).....$	_____	_____
Total Assets.....$	_____	_____

14. Please give your outstanding loan balances by type of lender for the last two years. Try to estimate the average interest rate on the loans as of January 1985.

	Real Estate			Non-Real Estate		
Type of Lender	Jan, 1984	Jan, 1985	Int. Rate	Jan, 1984	Jan, 1985	Int. Rate
Bank	_____	_____	____	_____	_____	____
Prod. Credit Assn.	_____	_____	____	_____	_____	____
Federal Land Bank	_____	_____	____	_____	_____	____
Farmers Home Adm.	_____	_____	____	_____	_____	____
Insurance Company	_____	_____	____	_____	_____	____
Individual	_____	_____	____	_____	_____	____
Merchants/Dealers	_____	_____	____	_____	_____	____
CCC, Other Gov't.	_____	_____	____	_____	_____	____
Other	_____	_____	____	_____	_____	____
Total Debt	_____	_____		_____	_____	

17. Are your debt payments current?..... Yes No

A. Real Estate Debt.....	Principal.....	____	____
	.....Interest.....	____	____
B. Building/Machinery Loans.....	Principal.....	____	____
	.....Interest.....	____	____
C. Operating Loans.....	Principal.....	____	____
	Interest.....	____	____

APPENDIX B: CROP REPORTING DISTRICT MAP

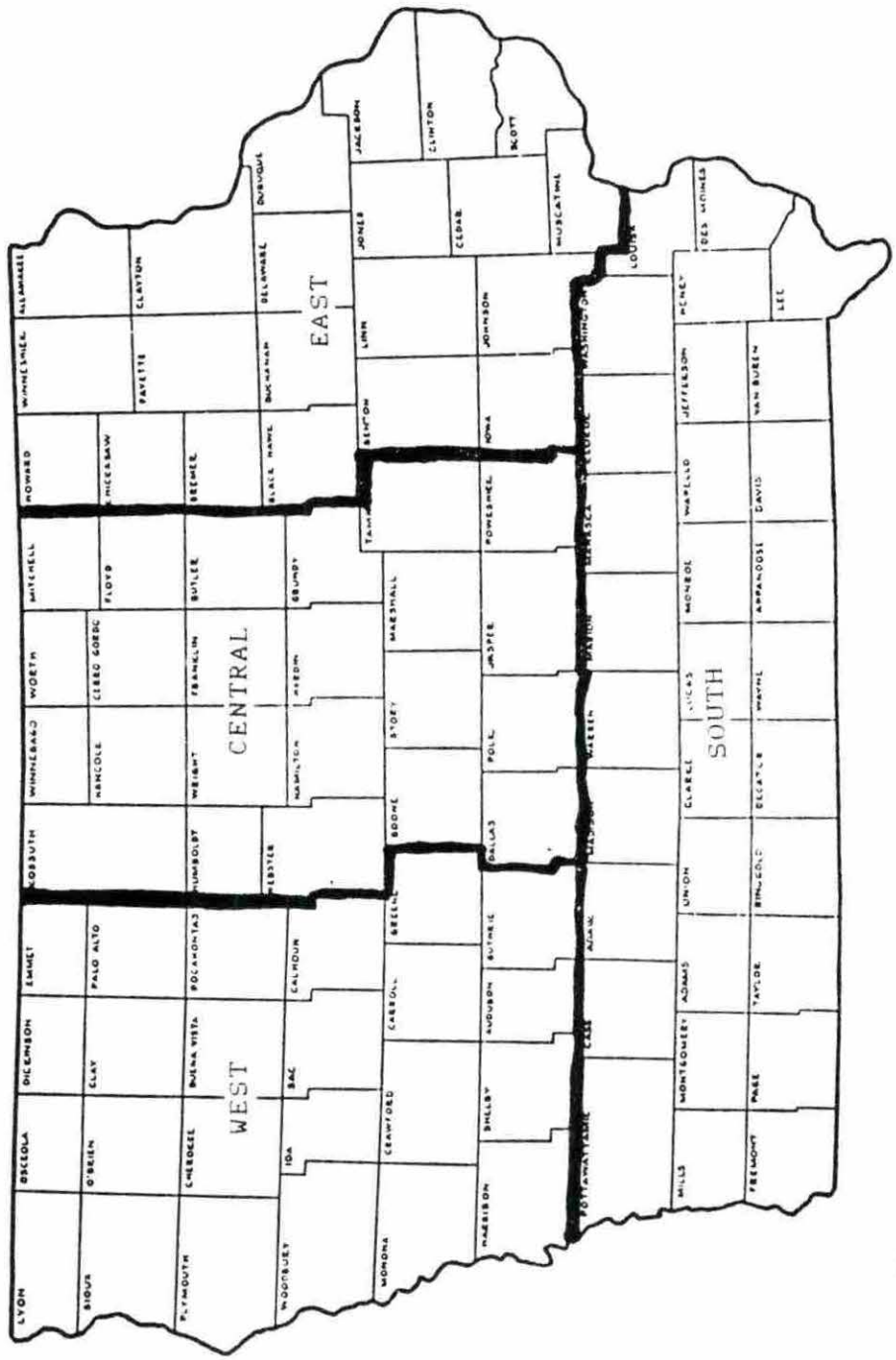

Figure B.1 Map of Iowa Crop District Locations

APPENDIX C: ADDITIONAL COMMON SIZE FINANCIAL STATEMENTS

Table C.1 1984 and 1985 Common Size Debt Structure: Group Lender Debt as a Percent of Total Lender Debt

	Group 1		Group 2	
Nonreal Estate Debt				
Total Lender Debt				
	1984	1985	1984	1985
Bank	14.24	12.27	33.34	28.73
PCA	19.77	20.34	33.23	34.18
FLB	40.38	38.32	0.00	0.00
FmHA	11.20	8.28	14.72	10.89
Insurance Co.	18.28	17.18	58.49	54.98
Individual	30.59	28.99	40.36	38.26
Merchant	26.59	25.47	38.96	37.32
CCC & Government	26.87	17.66	33.73	22.16
Other	23.95	21.58	39.01	35.15
Total	18.33	16.18	33.56	29.64
Real Estate Debt				
Total Lender Debt				
Bank	31.35	30.41	35.62	34.55
PCA	1.40	1.76	21.61	27.12
FLB	20.65	20.88	36.28	36.68
FmHA	14.60	13.72	26.05	24.46
Insurance Co.	39.64	47.34	29.59	35.33
Individual	33.75	34.28	31.13	31.62
Merchant & Dealer	43.91	44.70	31.91	32.48
CCC & Government	25.51	24.17	40.92	38.77
Other	37.11	38.50	31.27	32.44
Total	26.43	27.00	33.21	33.92

Group 3		Group 4		Total Sample Dollar Amount	
1984	1985	1984	1985	1984	1985
31.91	27.50	20.52	17.68	$17,091,081	$19,831,929
33.25	34.20	13.75	14.15	7,386,684	7,180,749
59.62	56.57	0.00	0.00	520,000	548,000
59.39	43.92	14.69	10.86	777,963	1,052,076
12.46	11.71	10.77	10.12	639,125	679,912
17.21	16.31	11.84	11.22	1,298,102	1,369,612
15.21	14.57	19.24	18.44	1,566,673	1,635,269
26.52	17.43	12.88	8.46	2,265,090	3,447,253
25.25	22.75	11.78	10.62	905,631	1,005,064
30.98	27.35	17.13	15.13	32,449,842	36,749,364
17.84	17.30	15.19	14.74	3,461,700	3,568,694
72.77	91.33	4.21	5.29	1,780,284	1,418,582
30.38	30.71	12.69	12.83	29,407,057	29,087,283
28.85	27.10	30.50	28.65	3,502,820	3,729,253
20.16	24.08	10.61	12.68	4,887,734	4,092,753
22.11	22.46	13.01	13.22	19,632,181	19,329,139
16.82	17.13	7.36	7.49	347,728	341,565
19.96	18.91	13.61	12.90	1,001,210	1,056,777
18.66	19.36	12.95	13.44	2,202,102	2,123,017
26.87	27.45	13.49	13.78	66,142,406	64,746,572

Table C.2 1984 and 1985 Common Size Debt Structure: Lender Debt/Total Assets by Profitability Group

	Group 1		Group 2	
Nonreal Estate Debt				
Total Assets				
	1984	1985	1984	1985
Bank	2.89	4.04	3.35	4.56
PCA	1.73	1.93	1.44	1.73
FLB	0.25	0.27	0.00	.00
FmHA	0.10	0.09	0.07	0.15
Insurance Co.	0.14	0.15	0.22	0.28
Individual	0.47	0.58	0.31	0.40
Merchant	0.49	0.72	0.36	0.33
CCC & Government	0.72	1.59	0.45	0.72
Other	0.26	0.30	0.21	0.24
Total	7.05	9.68	6.40	8.42
Real Estate Debt				
Total Assets				
Bank	1.29	1.55	0.72	1.00
PCA	0.03	0.04	0.23	0.31
FLB	7.20	8.49	6.27	7.07
FmHA	0.61	0.72	0.54	0.62
Insurance Co.	2.30	2.50	0.85	0.95
Individual	7.86	9.16	3.59	4.07
Merchant & Dealer	0.18	0.19	0.07	0.08
CCC & Government	0.30	0.51	0.24	0.29
Other	0.97	1.03	0.40	0.48
Total	20.73	24.19	12.90	14.86

Group 3		Group 4		Sample Mean	
1984	1985	1984	1985	1984	1985
8.17	11.04	4.20	7.00	4.22	5.93
3.68	4.46	1.22	1.35	1.83	2.15
0.46	0.63	0.00	0.00	0.13	0.16
0.69	1.17	0.14	0.23	0.19	0.31
0.12	0.15	0.08	0.12	0.16	0.20
0.33	0.40	0.18	0.23	0.32	0.41
0.36	0.59	0.36	0.50	0.39	0.49
0.90	1.39	0.35	0.77	0.56	1.03
0.34	0.50	0.13	0.27	0.22	0.30
15.06	20.33	6.66	10.46	8.02	10.99
0.93	0.94	0.63	0.74	0.86	1.07
1.94	1.75	0.09	0.00	0.44	0.42
13.39	16.38	4.47	6.04	7.27	8.70
1.51	2.16	1.28	1.87	0.87	1.11
0.48	0.66	0.62	0.80	1.21	1.22
6.50	7.75	3.06	3.97	4.85	5.78
0.09	0.12	0.03	0.03	0.09	0.10
0.30	0.16	0.16	0.28	0.25	0.32
0.62	0.72	0.34	0.44	0.54	0.63
26.63	30.65	10.69	14.16	16.34	19.36

APPENDIX D: LOGIT ANALYSIS OF SPECIFIC TYPES OF FARM OPERATORS

Table D.1 Comprehensive Logit Model Partial Derivatives
Calculated at the Group 1 Mean

	Means or Modes	Group 1	Group 2	Group 3	Group 4
Probabilities		65.05%	31.47%	2.80%	0.68%
Intercept		-0.13953	0.11870	-0.00952	0.0303
MEANDEV	0.16325	-0.16786	0.06681	0.08875	0.0123
TURNOVER	0.3537	0.37515	-0.26537	-0.09373	-0.0160
MNDAR	31.9897	0.00303	-0.00391	0.00078	0.0001
NETLND1	0.07587	0.34040	-0.29173	-0.04270	-0.0060
CFMAR3	0.51584	0.25500	-0.08437	-0.11849	-0.0521
BEEF	0	-0.21027	0.19181	0.01413	0.0043
PORK	0	-0.02336	0.02094	0.00649	-0.0041
DAIRY	0	-0.25880	0.26394	-0.00745	0.0023
MIXED	0	-0.12576	0.12056	0.00489	0.0003
CENTRAL	1	-0.00805	0.00528	-0.00071	0.0035
WEST	0	-0.00673	0.00380	-0.00072	0.0037
SOUTH	0	-0.01685	0.01278	0.00021	0.0039
OFFARMPC	0.21052	0.11604	-0.10726	-0.01403	0.0053
FHADEBT	0.01136	0.29963	-0.29276	-0.01763	0.0108
DEPALL	2	-0.61289	0.55391	0.04812	0.0108
EDW	3	-0.06345	0.06442	0.00101	-0.0020
EDH	2	0.15002	-0.13314	-0.01198	-0.0049
RENTEDPC	0.50535	-0.20567	0.20391	0.00214	-0.0004
MNASSETS	567912	2.3E-01	-2.0E-01	-1.8E-02	-4.4E-03
YRSFARM	25.4728	-6.8E-03	7.4E-03	-6.1E-04	-7.1E-05
RETOASST	0.57825	-0.04423	-0.03538	0.08024	-0.0006

Table D.2 Comprehensive Logit Model Partial Derivatives
Calculated at the Group 2 Mean

	Means or Modes	Group 1	Group 2	Group 3	Group 4
Probabilities		32.98%	55.55%	8.00%	3.47%
Intercept		-0.15850	0.06167	-0.04849	0.1453
MEANDEV	0.11140	-0.20027	-0.07610	0.22580	0.0506
TURNOVER	0.23585	0.39726	-0.11959	-0.21775	-0.0599
MNDAR	16.32	0.00240	-0.00544	0.00244	0.0006
NETLND1	0.01733	0.33576	-0.24007	-0.08251	-0.0132
CFMAR3	0.35903	0.33506	0.19776	-0.28887	-0.2440
BEEF	0	-0.20371	0.17499	0.01684	0.0119
PORK	0	-0.01940	0.02423	0.01672	-0.0215
DAIRY	0	-0.23843	0.28528	-0.04732	0.0005
MIXED	0	-0.11805	0.12135	0.00080	-0.0041
CENTRAL	0	-0.01098	-0.00230	-0.00370	0.0170
WEST	0	-0.00996	-0.00432	-0.00366	0.0179
SOUTH	0	-0.01984	0.00353	-0.00215	0.0185
OFFARMPC	0.19199	0.10627	-0.10941	-0.02861	0.0317
FHADEBT	0.01065	0.27078	-0.31652	-0.02156	0.0673
DEPALL	2	-0.59428	0.50008	0.06881	0.0254
EDW	2	-0.05668	0.07243	-0.00305	-0.0127
EDH	2	0.14800	-0.11383	-0.01680	-0.0174
RENTEDPC	0.35379	-0.18995	0.21560	-0.01465	-0.0110
MNASSETS	579775	2.2E-01	-1.8E-01	-2.6E-02	-1.1E-02
YRSFARM	31.31	-5.9E-03	8.9E-03	-2.4E-03	-6.2E-04
RETOASST	0.64814	-0.06902	-0.14096	0.21811	-0.0081

Table D.3 Comprehensive Logit Model Partial Derivatives
Calculated at the Group 3 Mean

	Means or Modes	Group 1	Group 2	Group 3	Group 4
Probabilities		22.90%	28.08%	34.42%	14.60%
Intercept		-0.18413	-0.05967	-0.32008	0.5639
MEANDEV	0.14723	-0.36963	-0.32121	0.62522	0.0656
TURNOVER	0.22113	0.49880	0.21298	-0.60204	-0.1097
MNDAR	43.9201	-0.00107	-0.00610	0.00640	0.0008
NETLND1	-0.0384	0.30153	-0.03745	-0.25230	-0.0118
CFMAR3	0.23172	0.67607	0.64370	-0.57671	-0.7431
BEEF	0	-0.15733	0.06895	0.04861	0.0398
PORK	0	-0.00893	0.01782	0.07879	-0.0877
DAIRY	0	-0.11448	0.20681	-0.12688	0.0345
MIXED	0	-0.07408	0.07100	0.01532	-0.0122
CENTRAL	0	-0.01831	-0.01427	-0.03200	0.0646
WEST	0	-0.01850	-0.01639	-0.03316	0.0680
SOUTH	0	-0.02669	-0.01405	-0.02867	0.0694
OFFARMPC	0.12874	0.06718	-0.06339	-0.13309	0.1293
FHADEBT	0.03714	0.13803	-0.22125	-0.16793	0.2512
DEPALL	2	-0.46829	0.18449	0.21249	0.0713
EDW	2	-0.02348	0.05607	0.01072	-0.0433
EDH	2	0.12568	-0.02942	-0.03784	-0.0584
RENTEDPC	0.39136	-0.10162	0.14608	-0.01756	-0.0269
MNASSETS	621333	1.8E-01	-6.4E-02	-7.9E-02	-3.3E-02
YRSFARM	25.13	-1.3E-03	8.0E-03	-5.9E-03	-8.1E-04
RETOASST	0.67144	-0.22776	-0.29177	0.66842	-0.1489

Table D.4 Comprehensive Logit Model Partial Derivatives
Calculated at the Group 4 Mean

	Means or Modes	Group 1	Group 2	Group 3	Group 4
Probabilities		.00%	0.02%	2.13%	97.84%
Intercept		-0.00020	-0.00076	-0.09996	0.1009
MEANDEV	0.17011	-0.00009	-0.00031	0.02854	-0.0281
TURNOVER	0.21702	0.00013	0.00029	-0.02083	0.0204
MNDAR	19.445	0.00000	-0.00001	0.00028	-0.0003
NETLND1	0.01903	0.00006	-0.00001	-0.01362	0.0136
CFMAR3	-1.2098	0.00034	0.00141	0.07118	-0.0729
BEEF	0	-0.00004	.00000	-0.00274	0.0028
PORK	0	0.00002	0.00012	0.01730	-0.0175
DAIRY	0	-0.00003	0.00010	-0.01263	0.0126
MIXED	0	-0.00001	0.00006	0.00268	-0.0027
CENTRAL	0	-0.00002	-0.00009	-0.01117	0.0113
WEST	0	-0.00002	-0.00010	-0.01173	0.0119
SOUTH	0	-0.00003	-0.00010	-0.01166	0.0118
OFFARMPC	0.45588	-0.00002	-0.00021	-0.02654	0.0268
FHADEBT	0.02865	-0.00005	-0.00047	-0.04606	0.0466
DEPALL	2	-0.00011	0.00003	0.00270	-0.0026
EDW	2	0.00001	0.00009	0.00684	-0.0069
EDH	2	0.00004	0.00006	0.00605	-0.0061
RENTEDPC	0.34664	-0.00001	0.00014	0.00278	-0.0029
MNASSETS	453643	4.3E-05	-8.0E-09	-8.9E-07	-4.2E-05
YRSFARM	32.05	1.0E-08	6.6E-06	-2.4E-04	2.3E-04
RETOASST	0.63922	0.00000	-0.00002	0.06180	-0.0618

Table D.5 Demographic Logit Model Partial Derivatives
Calculated at the Group 1 Mean

	Means or Modes	Group 1	Group 2	Group 3	Group 4
Probabilities		40.11%	24.91%	24.17%	10.81%
Intercept		-0.40971	-0.13003	0.48579	0.0540
NETLND1	0.07587	0.41847	-0.06554	-0.30349	-0.0494
NETLND2	0.09179	0.13809	-0.06284	0.07960	-0.1548
NETLND3	0.13954	0.02394	-0.04735	0.06291	-0.0395
EQEXP1	0.09512	1.29619	0.65484	-2.04149	0.0905
EQEXP2	0.01404	1.01383	0.04681	-0.83293	-0.2277
EQEXP3	0.12177	0.12305	-0.09243	-0.15426	0.1236
BEEF	0	-0.06722	0.03802	-0.02021	0.0494
PORK	0	0.05705	-0.01687	0.00037	-0.0405
DAIRY	0	-0.12428	0.16192	-0.08974	0.0521
MIXED	0	-0.02615	0.00538	-0.02711	0.0479
CENTRAL	1	-0.01812	0.00169	-0.02374	0.0402
WEST	0	-0.01815	0.00101	-0.02393	0.0411
SOUTH	0	-0.02269	0.00399	-0.02115	0.0398
OFFARMPC	0.21052	-0.05848	0.05481	-0.03034	0.0340
DEPALL	2	-0.02078	0.00277	0.01491	0.0031
EDW	3	-0.02858	0.05357	-0.01348	-0.0115
EDH	2	0.12455	-0.03635	-0.04877	-0.0394
RENTEDPC	0.50535	0.02474	-0.02169	-0.03216	0.0291
MNASSETS	567912	-2.6E-02	1.2E-02	1.1E-02	4.6E-03
YRSFARM	25.4728	5.3E-03	4.6E-03	-1.1E-02	1.4E-03

Table D.6 Demographic Logit Model Partial Derivatives
Calculated at the Group 2 Mean

	Means or Modes	Group 1	Group 2	Group 3	Group 4
Probabilities		59.00%	0.12%	34.55%	6.33%
Intercept		-0.67505	-0.00080	0.65203	0.0238
NETLND1	0.01733	0.52560	-0.00051	-0.48650	-0.0386
NETLND2	0.04515	0.06980	-0.00059	0.03572	-0.1049
NETLND3	0.98535	-0.02484	-0.00036	0.05476	-0.0296
EQEXP1	0.68279	2.47033	0.00443	-2.58814	0.1134
EQEXP2	0.08051	1.39240	0.00003	-1.24854	-0.1439
EQEXP3	0.08046	0.16188	-0.00050	-0.23171	0.0703
BEEF	0	-0.04067	0.00031	0.00520	0.0352
PORK	0	0.04814	-0.00016	-0.02041	-0.0276
DAIRY	0	-0.01772	0.00115	-0.03162	0.0482
MIXED	0	-0.00945	0.00009	-0.02177	0.0311
CENTRAL	0	-0.00478	0.00005	-0.02112	0.0259
WEST	0	-0.00494	0.00005	-0.02148	0.0264
SOUTH	0	-0.00962	0.00007	-0.01632	0.0259
OFFARMPC	0.19199	-0.02158	0.00041	-0.00564	0.0268
DEPALL	2	-0.02619	0.00002	0.02388	0.0023
EDW	2	-0.00205	0.00035	0.00415	-0.0024
EDH	2	0.12996	-0.00029	-0.10088	-0.0288
RENTEDPC	0.35379	0.03205	-0.00012	-0.04852	0.0166
MNASSETS	579775	-2.6E-02	7.7E-05	2.2E-02	4.0E-03
YRSFARM	31.31	1.2E-02	3.2E-05	-1.5E-02	1.3E-03

Table D.7 Demographic Logit Model Partial Derivatives
Calculated at the Group 3 Mean

	Means or Modes	Group 1	Group 2	Group 3	Group 4
Probabilities		45.82%	2.83%	28.50%	22.84%
Intercept		-0.56155	-0.02058	0.51468	0.0675
NETLND1	-0.0384	0.47429	-0.00769	-0.36021	-0.1064
NETLND2	0.16023	0.19572	-0.00480	0.11748	-0.3084
NETLND3	0.20463	0.02156	-0.00575	0.07058	-0.0864
EQEXP1	0.35912	1.78355	0.09324	-2.21895	0.3422
EQEXP2	0.05918	1.29565	0.01383	-0.89667	-0.4128
EQEXP3	0.63982	0.04457	-0.01645	-0.24161	0.2135
BEEF	0	-0.08053	0.00410	-0.02615	0.1026
PORK	0	0.07526	-0.00130	0.00671	-0.0807
DAIRY	0	-0.08733	0.02180	-0.07184	0.1374
MIXED	0	-0.04819	-0.00052	-0.04337	0.0921
CENTRAL	0	-0.03738	-0.00084	-0.03836	0.0766
WEST	0	-0.03813	-0.00096	-0.03905	0.0781
SOUTH	0	-0.04142	-0.00051	-0.03458	0.0765
OFFARMPC	0.12874	-0.05560	0.00693	-0.02881	0.0775
DEPALL	2	-0.02406	0.00029	0.01738	0.0064
EDW	2	-0.00205	0.00799	0.00314	-0.0091
EDH	2	0.14353	-0.00406	-0.05673	-0.0827
RENTEDPC	0.39136	0.00562	-0.00387	-0.05201	0.0503
MNASSETS	621333	-2.6E-02	1.4E-03	1.4E-02	1.1E-02
YRSFARM	25.13	7.8E-03	6.3E-04	-1.2E-02	3.9E-03

Table D.8 Demographic Logit Model Partial Derivatives
Calculated at the Group 4 Mean

	Means or Modes	Group 1	Group 2	Group 3	Group 4
Probabilities		78.48%	2.04%	12.34%	7.14%
Intercept		-0.38677	0.00014	0.31326	0.0734
NETLND1	0.01903	0.32762	-0.01811	-0.23218	-0.0773
NETLND2	0.01599	0.11055	-0.00928	0.01554	-0.1168
NETLND3	0.08555	0.00839	-0.00487	0.02607	-0.0296
EQEXP1	0.06814	1.27479	0.02080	-1.24062	-0.0550
EQEXP2	0.6762	0.87561	-0.02493	-0.59948	-0.2512
EQEXP3	0.83715	0.05545	-0.01237	-0.10790	0.0648
BEEF	0	-0.04826	0.00527	0.00278	0.0402
PORK	0	0.04597	-0.00308	-0.01013	-0.0328
DAIRY	0	-0.05376	0.01816	-0.01604	0.0516
MIXED	0	-0.02531	0.00111	-0.00978	0.0340
CENTRAL	0	-0.01905	0.00056	-0.00954	0.0280
WEST	0	-0.01941	0.00050	-0.00969	0.0286
SOUTH	0	-0.02199	0.00091	-0.00728	0.0284
OFFARMPC	0.45588	-0.03361	0.00658	-0.00279	0.0298
DEPALL	2	-0.01651	0.00085	0.01141	0.0042
EDW	2	-0.00410	0.00572	0.00127	-0.0029
EDH	2	0.09475	-0.00684	-0.04832	-0.0396
RENTEDPC	0.34664	0.00960	-0.00278	-0.02252	0.0157
MNASSETS	453643	-1.8E-02	1.7E-03	1.0E-02	6.0E-03
YRSFARM	32.05	5.7E-03	2.6E-04	-6.5E-03	5.2E-04

Table D.9 Comprehensive Logit Model Partial Derivatives
Calculated For Net Buyers of Land Since 1982

	Means or Modes	Group 1	Group 2	Group 3	Group 4
Probabilities		36.69%	36.83%	15.50%	10.98%
Intercept		-0.26073	-0.04382	-0.12966	0.4342
MEANDEV	0.07037	-0.34182	-0.16991	0.38744	0.1243
TURNOVER	0.22874	0.53329	0.01237	-0.38355	-0.1621
MNDAR	29.11	0.00059	-0.00570	0.00385	0.0013
NETLND1	0.32292	0.36886	-0.16386	-0.16193	-0.0431
CFMAR3	0.21586	0.67636	0.43582	-0.43171	-0.6805
BEEF	0	-0.21180	0.13090	0.03893	0.0420
PORK	0	-0.00646	0.03124	0.03880	-0.0636
DAIRY	0	-0.20422	0.25040	-0.06593	0.0198
MIXED	0	-0.10848	0.10339	0.01122	-0.0061
CENTRAL	0	-0.02424	-0.01360	-0.01225	0.0501
WEST	0	-0.02417	-0.01601	-0.01263	0.0528
SOUTH	0	-0.03473	-0.01036	-0.00952	0.0546
OFFARMPC	0.07315	0.08499	-0.10590	-0.06952	0.0904
FHADEBT	0.01040	0.20498	-0.30647	-0.08248	0.1840
DEPALL	2	-0.61863	0.37422	0.15137	0.0930
EDW	2	-0.04063	0.07053	0.00356	-0.0335
EDH	2	0.16403	-0.07609	-0.03283	-0.0551
RENTEDPC	0.34239	-0.16307	0.19138	-0.00801	-0.0203
MNASSETS	789131	2.3E-01	-1.4E-01	-5.7E-02	-4.0E-02
YRSFARM	26.4	-3.9E-03	8.6E-03	-3.5E-03	-1.2E-03
RETOASST	0.69025	-0.16003	-0.17700	0.38765	-0.0506

Table D.10 Comprehensive Logit Model Partial Derivatives Calculated For Net Sellers of Land Since 1982

	Means or Modes	Group 1	Group 2	Group 3	Group 4
Probabilities		15.84%	26.45%	39.02%	18.70%
Intercept		-0.15516	-0.10265	-0.43133	0.6891
MEANDEV	0.07916	-0.29278	-0.36457	0.61720	0.0402
TURNOVER	0.15625	0.38890	0.27396	-0.57421	-0.0887
MNDAR	41.55	-0.00101	-0.00621	0.00657	0.0006
NETLND1	-0.4472	0.22878	-0.00148	-0.23612	0.0088
CFMAR3	0.12318	0.55171	0.74681	-0.44644	-0.8521
BEEF	0	-0.11866	0.04851	0.03084	0.0393
PORK	0	-0.00422	0.02005	0.09413	-0.1100
DAIRY	0	-0.08171	0.19056	-0.15008	0.0412
MIXED	0	-0.05398	0.06229	0.01060	-0.0189
CENTRAL	1	-0.01588	-0.01882	-0.04420	0.0789
WEST	0	-0.01617	-0.02107	-0.04590	0.0831
SOUTH	0	-0.02237	-0.01976	-0.04213	0.0843
OFFARMPC	0.09933	0.04624	-0.06010	-0.15142	0.1653
FHADEBT	0.03039	0.09257	-0.21324	-0.19749	0.3182
DEPALL	2	-0.35271	0.12563	0.16982	0.0573
EDW	3	-0.01518	0.05459	0.01478	-0.0542
EDH	2	0.09618	-0.01225	-0.02007	-0.0639
RENTEDPC	0.37579	-0.07233	0.13417	-0.02496	-0.0369
MNASSETS	668456	1.3E-01	-4.2E-02	-6.2E-02	-3.0E-02
YRSFARM	28.41	-7.1E-04	7.8E-03	-6.3E-03	-8.4E-04
RETOASST	0.70788	-0.17885	-0.31044	0.70511	-0.2158

Table D.11 Comprehensive Logit Model Partial Derivatives Calculated For Net Buyers of Land From 1979 to 1982

	Means or Modes	Group 1	Group 2	Group 3	Group 4
Probabilities		23.60%	20.76%	31.44%	24.20%
Intercept		-0.28609	-0.12884	-0.42061	0.8355
MEANDEV	0.09246	-0.39544	-0.25024	0.55178	0.0939
TURNOVER	0.23926	0.52831	0.16996	-0.53097	-0.1673
MNDAR	41.3527	-0.00145	-0.00482	0.00538	0.0009
NETLND1	-0.0226	0.30297	-0.03458	-0.24085	-0.0275
CFMAR3	0.01457	0.83493	0.59748	-0.34279	-1.0896
BEEF	0	-0.16197	0.05117	0.04467	0.0661
PORK	0	0.00717	0.02758	0.09376	-0.1285
DAIRY	0	-0.11240	0.15786	-0.10843	0.0630
MIXED	0	-0.06925	0.05876	0.02346	-0.0130
CENTRAL	1	-0.03029	-0.02060	-0.04443	0.0953
WEST	0	-0.03117	-0.02276	-0.04641	0.1003
SOUTH	0	-0.03953	-0.02097	-0.04220	0.1027
OFFARMPC	0.11655	0.04210	-0.07077	-0.15772	0.1864
FHADEBT	0.02315	0.08530	-0.21374	-0.22927	0.3577
DEPALL	2	-0.47466	0.14350	0.20477	0.1264
EDW	3	-0.01365	0.05074	0.02385	-0.0609
EDH	2	0.13511	-0.01686	-0.02715	-0.0911
RENTEDPC	0.44188	-0.09121	0.11993	0.00199	-0.0307
MNASSETS	831471	1.8E-01	-4.9E-02	-7.4E-02	-5.7E-02
YRSFARM	25.1	-8.1E-04	6.3E-03	-4.7E-03	-8.3E-04
RETOASST	0.69357	-0.21429	-0.19775	0.63774	-0.2257

Table D.12 Comprehensive Logit Model Partial Derivatives Calculated For Net Buyers of Land From 1975 to 1979

	Means or Modes	Group 1	Group 2	Group 3	Group 4
Probabilities		18.52%	26.00%	27.95%	27.52%
Intercept		-0.25980	-0.21083	-0.42720	0.8978
MEANDEV	0.07557	-0.30550	-0.30654	0.401	0.1140
TURNOVER	0.23174	0.42113	0.22192	-0.46239	-0.1807
MNDAR	36	-0.00089	-0.00568	0.00516	0.0014
NETLND1	0.00888	0.24725	-0.03005	-0.19991	-0.0173
CFMAR3	0.06013	0.68133	0.78474	-0.26558	-1.2005
BEEF	0	-0.13673	0.05060	0.02522	0.0609
PORK	0	0.00981	0.04041	0.08969	-0.1399
DAIRY	0	-0.10391	0.17567	-0.12008	0.0483
MIXED	0	-0.05904	0.06700	0.01378	-0.0217
CENTRAL	1	-0.02735	-0.03082	-0.04491	0.1031
WEST	0	-0.02814	-0.03368	-0.04682	0.1086
SOUTH	0	-0.03510	-0.03197	-0.04367	0.1107
OFFARMPC	0.16641	0.03005	-0.09282	-0.14476	0.2075
FHADEBT	0.01857	0.06654	-0.26825	-0.20449	0.4062
DEPALL	2	-0.39718	0.14513	0.14491	0.1071
EDW	2	-0.01160	0.06231	0.01988	-0.0706
EDH	2	0.11398	-0.00999	-0.01217	-0.0918
RENTEDPC	0.41288	-0.08001	0.13838	-0.01094	-0.0474
MNASSETS	784983	1.5E-01	-4.8E-02	-5.2E-02	-5.1E-02
YRSFARM	26.31	-1.0E-03	7.4E-03	-4.8E-03	-1.5E-03
RETOASST	0.67946	-0.14867	-0.22023	0.59656	-0.2277

Table D.13 Comprehensive Logit Model Partial Derivatives Calculated For Operators Farming < 15 Years

	Means or Modes	Group 1	Group 2	Group 3	Group 4
Probabilities		22.84%	16.61%	38.23%	22.33%
Intercept		-0.24929	-0.08305	-0.46543	0.7978
MEANDEV	0.23542	-0.42255	-0.22920	0.60416	0.0476
TURNOVER	0.35353	0.54610	0.16135	-0.58724	-0.1202
MNDAR	35.43	-0.00189	-0.00421	0.00573	0.0004
NETLND1	0.04832	0.30521	-0.01889	-0.27270	-0.0136
CFMAR3	-0.0083	0.83899	0.50056	-0.36473	-0.9748
BEEF	0	-0.15661	0.04101	0.05450	0.0611
PORK	0	0.00135	0.01800	0.10467	-0.1240
DAIRY	0	-0.09591	0.13561	-0.11035	0.0707
MIXED	0	-0.06621	0.04757	0.02985	-0.0112
CENTRAL	0	-0.02660	-0.01450	-0.04949	0.0906
WEST	1	-0.02736	-0.01618	-0.05176	0.0953
SOUTH	0	-0.03560	-0.01484	-0.04689	0.0973
OFFARMPC	0.25355	0.04889	-0.05068	-0.17815	0.1799
FHADEBT	0.03171	0.09103	-0.16479	-0.26459	0.3383
DEPALL	4	-0.46409	0.11127	0.24094	0.1119
EDW	3	-0.01325	0.04056	0.02894	-0.0563
EDH	3	0.13068	-0.01352	-0.03308	-0.0841
RENTEDPC	0.56624	-0.08409	0.09896	0.00939	-0.0243
MNASSETS	398924	1.8E-01	-3.8E-02	-8.7E-02	-5.1E-02
YRSFARM	11.03	-2.8E-04	5.4E-03	-5.0E-03	-2.7E-04
RETOASST	0.54210	-0.25342	-0.19169	0.69840	-0.2533

Table D.14 Comprehensive Logit Model Partial Derivatives Calculated For Operators With FHADEBT > .1

	Means or Modes	Group 1	Group 2	Group 3	Group 4
Probabilities		4.33%	11.60%	38.14%	45.93%
Intercept		-0.09369	-0.18237	-0.87295	1.1490
MEANDEV	0.15019	-0.10007	-0.21356	0.42713	-0.1135
TURNOVER	0.26241	0.13028	0.18431	-0.35057	0.0360
MNDAR	44.37	-0.00049	-0.00331	0.00451	-0.0007
NETLND1	-0.0424	0.06894	0.01643	-0.17465	0.0893
CFMAR3	-0.0202	0.23969	0.56562	0.34565	-1.1509
BEEF	0	-0.03745	0.00788	-0.01391	0.0435
PORK	0	0.00623	0.02857	0.15699	-0.1918
DAIRY	0	-0.02303	0.08177	-0.15273	0.0940
MIXED	0	-0.01374	0.03006	0.01932	-0.0356
CENTRAL	0	-0.01032	-0.02427	-0.09582	0.1304
WEST	0	-0.01073	-0.02615	-0.10042	0.1373
SOUTH	1	-0.01266	-0.02619	-0.09877	0.1376
OFFARMPC	0.14321	0.00207	-0.05471	-0.24114	0.2938
FHADEBT	0.25920	0.00279	-0.15392	-0.39139	0.5425
DEPALL	4	-0.10795	0.02434	0.06482	0.0188
EDW	2	0.00013	0.03542	0.05214	-0.0877
EDH	2	0.03304	0.01268	0.03971	-0.0854
RENTEDPC	0.39736	-0.01650	0.06768	0.00454	-0.0557
MNASSETS	461493	4.1E-02	-5.0E-03	-1.7E-02	-2.0E-02
YRSFARM	23.23	2.0E-05	4.0E-03	-4.2E-03	2.1E-04
RETOASST	0.62365	-0.04779	-0.13320	0.69912	-0.5181