# AN ANALYSIS OF FINANCIAL LEVERAGE FOR SELECTED MICHIGAN FARM TYPES

By

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

# INTRODUCTION

## Statement of the Problem

Price variability for agricultural products in the 1970's has been increased greatly by drastic reductions in reserves, changing government programs for numerous domestic commodities, unstable foreign demand, and devaluation of the dollar. This riskier market environment has created management problems, at least for those managers with highly financially leveraged operations. There is a need to evaluate the effects of financial leverage in an environment wrought with market risks.

This study answers for three typical Michigan farm types the following questions: 1) How do different financial leverage ratios affect profitability, equity, and ability to service debts? 2) Can prudent hedging on the commodity futures market effectively reduce the risk inherent in the use of financial leverage?

To begin, financial leverage should be explained. Financial leverage is defined as the use of borrowed funds. Favorable or positive leverage is realized when more is earned on the assets acquired with the funds than the cost of the funds. Unfavorable or negative leverage occurs when the acquired assets earn less than the cost of the funds. Moreover, the more leverage used the higher will be the rate of return to equity (positive or negative). Therefore, in order to obtain the potentially greater earnings that go with increased leverage, the owner

of the equity must accept more risk, i.e., greater uncertainty regarding outcomes.

## Financial Model

The measures used to evaluate financial performance of course influence the method of analysis. The primary measure used in this analysis is the farm's rate of change in equity or net worth. Having selected the rate equity change to measure financial performance, it is useful to define financial leverage, L, as the ratio of total farm debt, D, to total farm equity, E, where E is the difference between the value of total farm assets, A, and D.

The annual change in equity can be represented as

$$(1)\quad g = (rA-iD)(1-t)(1-c)$$

where r=rate of return on total farm assets before interest payments and taxes are subtracted

i=rate of interest charged to debt

t=tax rate on earnings and

c=propensity to consume farm earnings.

It follows that the rate of change in equity or equity growth rate is then g/E which equals

$$g' = [L(r-i)+r]K$$

where K=(1-t) (1-c), the percentage of earnings remaining after consumption and taxes [10]. Therefore, it is apparent that g' is determined by r and L, given the rate of consumption, taxation, and interest. Given this model it is convenient to briefly illustrate some of the implications of using financial leverage.

The results in Table 1 show g' for a number of values of r and L. These values are probably not unrealistic for many farms in

Table 1. Growth rates implied by alternative leverage, L, and rates of earnings, r. Propensity to consume farm earnings = 0.5, tax rate = 0.3, and the rate of interest charged to debt = 0.085.

| L \ r | 0 | .04 | .085 | .12 | .16 |
|---|---|---|---|---|---|
| 0 | 0. | 1.40 | 2.98 | 4.20 | 5.60 |
| .25 | -0.74 | 1.01 | 2.98 | 4.51 | 6.26 |
| .5 | -1.49 | 0.61 | 2.98 | 4.81 | 6.91 |
| 1 | -2.98 | -0.18 | 2.98 | 5.43 | 8.23 |
| 2 | -5.95 | -1.75 | 2.98 | 6.65 | 10.85 |

Michigan. What is interesting is the effect of leverage given the various rates of earnings on assets. First, note that in the third column when the interest rate equals the net earnings rate on assets the growth of the firm is not affected by leverage. However, when the net earnings rate on assets is less than the interest rate it is apparent that greater use of leverage results in increasingly lower equity growth rates. Furthermore, when the earnings rate on assets exceeds the interest rate the growth rate of equity increases as leverage increases. In all cases there is a dampening influence on g' due to consumption and tax payments. A reduction in either would increase g' while an increase in either would decrease g'. This example illustrates what has been stated before, namely, that higher financial leverage magnifies potential losses and gains. That is, in effect, the use of leverage increases the financial risk borne by the agricultural producer, particularly, given an unstable market environment.

## Portfolio Analysis[1]

It is not the purpose of this paper to explain or predict decision behavior in a risky environment, but merely to provide information to the decisionmaker. However, it may be useful to review Bernoullian decision theory and portfolio analysis in order to define terms better and gain some insight into how the financial manager might use this information to improve the quality of his risky decisions.

Bernoullian decision theory suggests that a decisionmaker compares alternatives in terms of utility as formed by his strength of conviction on the expected probability distribution of outcomes and on his personal valuation of the potential outcomes.

In order to simplify the utility maximizing process, efficiency criteria have been proposed to order portfolio choices into efficient and inefficient sets in risk aversion terms. The efficiency criterion we will use is the mean-variance criterion (EV). EV analysis is restricted to normal distributions of outcomes of risky choices or to decisionmaker's utility functions that are quadratic, expressing preferences only toward the mean and variance of expected returns. As long as one of these restrictions is met then the expected utility maximizing portfolio can be narrowed down to those portfolios which provide minimum variance for expected returns, i.e., the EV efficient set.

The choices in production, marketing, and investment generate many portfolio choices for the agricultural producer comprised of risky assets which can be ordered into efficient and inefficient sets. By introducing the concept of a riskless asset, that is with zero variance,

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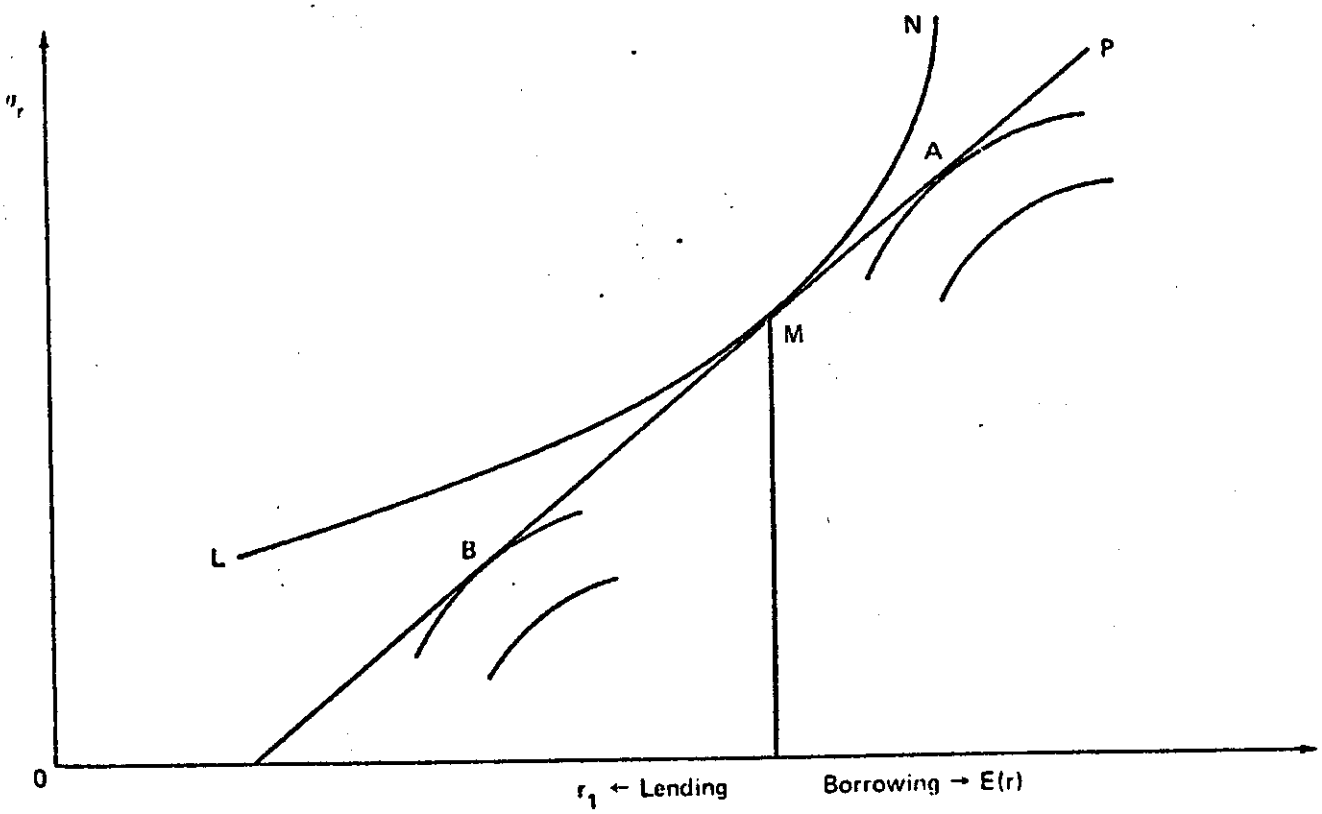
[1]This section was taken largely from Barry, P. J. and Baker, C. B., "Management of Firm Level Financial Structure." Agricultural Finance Review. 37 (February 1977).

the derivation of an EV efficient set can be carried further. Positive holdings of riskless assets denote lending, and negative holdings imply borrowing or leveraging at the risk-free rate.

The risk-free asset effectively increases the EV efficient set. It is useful to see this graphically in Figure 1. Consider, for example, that the risk free interest rate is $r_1$, as indicated by the intercept value in Figure 1. The optimal portfolio is determined by drawing a line in EV space from the risk-free rate, $r_1$, on the expected return axis through its tangency points with the EV set, LN, of portfolios. This line is the new efficient frontier. Note that only one portfolio of risky securities--namely M--would be considered. In other words, this portfolio now dominates all others. Any point on the straight line indicates the proportion of the risky portfolio, M, and the proportion of loans or borrowings at the risk-free rate. To the left of point M, the investor would hold both the risk-free security and portfolio M. To the right, he would only hold portfolio M and would borrow funds, in addition to his original investment funds, in order to invest in it. The farther to the right in the figure, the greater the borrowings will be. The optimal investment policy is determined by the point of tangency between the straight line in Figure 1 and the highest utility indifference curve.

This theoretic framework is useful in evaluating the effects of higher leverage on the risk-returns position of a typical firm. The kinds of portfolio adjustments required by a firm in response to changes in risk, rates of return, or wealth that cause shifts in the EV frontier can be analyzed logically. Assume that a typical farm chooses an optimal investment portfolio (choices in production, marketing, and

Figure 1. Portfolio Equilibrium for Risky and Risk-Free Assets (see text for explanation of symbols)




Source: Barry, P. J. and C. B. Baker, "Management of Firm Level Financial Structure," Agricultural Finance Review 37 (Feb. 1977).

investment) where the expected return on risky assets, $r_2$, is 15% and the risk-free rate or cost of borrowing, $r_1$, is 8%. The liquidity value of the reserved credit is assumed to be zero.

The expected return of a portfolio is given by:

$$E(r) = wr_1 + (1-w)\, r_2$$

where w is the proportion of the risk-free security that is held. If funds are loaned at the risk-free rate, w is positive; if funds are borrowed, w is negative. The standard deviation of the portfolio is

$$\sigma = (1-w)\, \sigma_2$$

Because the risk-free asset has a zero standard deviation, the portfolio standard deviation is solely dependent upon the risk of the risky portfolio.

Table 2, part A, indicates expected returns, standard deviations and coefficients of variation for returns, given a range of reasonable leverage positions and an expected standard deviation of 0.10. For example, for leverage, L, of 0.50, the portfolio's expected rate of return is

$$E(r) = -0.5\ (0.08) + 1.5\ (0.15) = 0.185 = 18.5\%$$

The expected standard deviation is

$$\sigma(r) = (1.5)\ (0.10) = 0.15 = 15\%$$

and the coefficient of variation is

$$CV(r) = \frac{\sigma(r)}{E(r)} = \frac{15}{18.5} = 81.1\%$$

It is interesting to note the effects of increasing leverage on financial risk, as indicated by the increasing coefficients of variation. Assume that the expected returns and standard deviation for a leverage of 0.75 is the utility maximizing choice of the farmer. Then, let a change in market stability increase the farmer's expected standard

Table 2. Measures of portfolio performance, by percentage, at selected leverage positions [4].

| Portfolio measures | Leverage | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0.25 | 0.33 | 0.50 | 0.75 | 1.0 | 1.5 | 2.0 | 4.0 |
| Part A: $\sigma_2$=0.10 | | | | | | | | | |
| E(r) | 15 | 16.75 | 17.3 | 18.5 | 20.3 | 22.0 | 25.5 | 29 | 43 |
| σ(r) | 10 | 12.5 | 13.3 | 15.0 | 17.5 | 20.0 | 25.0 | 30 | 50 |
| CV(r) | 67 | 74.6 | 76.9 | 81.1 | 86.4 | 91.1 | 98.0 | 103 | 116 |
| Part B: $\sigma_2$=0.12 | | | | | | | | | |
| E(r) | 15 | 16.75 | 17.3 | 18.5 | 20.3 | 22.0 | 25.5 | 29 | 43 |
| σ(r) | 12 | 15.0 | 16.0 | 18.0 | 21.0 | 24.0 | 30.0 | 36 | 60 |
| CV(r) | 80 | 89.6 | 92.5 | 97.3 | 103.0 | 109.0 | 118.0 | 124 | 140 |

deviation to 12% without affecting expected level of returns. These changes are reflected in Part B of Table 2 and indicate a shift in the EV set caused by the increase in expected standard deviation. The increase in standard deviation yields a higher level of risk for the same level of expected earnings. A leverage position which previously may have been acceptable may now impose excessive risk relative to expected returns. Therefore, as the market environment changes the farmer must revise his portfolio holdings in order to maximize his utility. That is, as the market environment becomes riskier it would be expected that the risk averse producer would reduce his leverage.

## Typical Farms

Michigan agriculture is among the most highly diversified in the nation. However, for the purposes of this study Michigan's three predominant farm types, particularly in terms of cash receipts from farm marketings, were chosen for analysis. These three predominant farm types are dairy, Saginaw Valley cash crop, and cash grain.

It is not possible to analyze every farm in Michigan. However, if the analysis is to be relevant to Michigan farms, it is necessary to consider actual farm conditions. Therefore, to provide a basis for analysis, one typical farm situation for each farm type was constructed.

The typical cash grain farm represented farms specializing in corn, soybeans, dry beans, and small grain production. These farms tend to be scattered over the southern part of the state.

Saginaw Valley cash crop farms originally tended to be small, however, many are now consolidated into larger operational units. The Saginaw Valley is a very productive farming area devoted mostly to intensively grown crops of corn, sugar beets, navy beans, and some small grains. Also, proximity to industrialized cities provides an attractive labor market.

Dairy farms, scattered throughout the state, produce about one-fourth of Michigan's cash farm marketings. The typical dairy farm situation constructed in this study represents Grade A commercial dairy farms growing their own replacements and realizing more than $50,000 in annual gross income.

The typical composition of farm resources and their uses were based primarily on averages derived from accounts kept by farmers enrolled in the TELFARM Record Program through the Cooperative Extension Service and Michigan State University, and also from interviews with extension specialists from the Department of Agricultural Economics at Michigan State University. The typical farms' resources and their organizations are shown in Table 3.

Table 3. Typical Farms

| Characteristic | Units | Cash Grain | Saginaw Valley Cash Crop | Dairy |
|---|---|---|---|---|
| Resource Situation | | | | |
| 1. Total Acres/Farm | acres | 500 | 500 | 395 |
| 2. Total farm investment | $ | 621,500 | 998,000 | 498,000 |
| a. Land | $ | 500,000 | 800,000 | 316,000 |
| b. Buildings and equipment | $ | 16,500 | 46,000 | 48,390 |
| c. Machinery | $ | 52,500 | 75,500 | 51,460 |
| d. Livestock | $ | | | 49,465 |
| e. Crops and supplies | $ | 52,500 | 76,500 | 31,680 |
| 3. Nonoverhead labor (operator, family, plus any hired labor) | hours | 3,575 | 4,580 | 7,135 |
| Organization | | | | |
| 1. Crops: | acres | | | |
| corn | | 300 | 150 | 87 |
| sugar beets | | | 100 | |
| wheat | | 50 | 100 | 27 |
| navy beans | | 75 | 150 | |
| soybeans | | 75 | | |
| corn silage | | | | 65 |
| oats | | | | 23 |
| pasture | | | | 19 |
| hay | | | | 109 |
| 2. Livestock: | | | | |
| milk cows | head | | | 65 |
| calves and heifers | head | | | 30 |

## Method of Analysis

To answer the questions posed at the beginning, a financial leverage policy was established for each typical farm and the effects of this leverage policy under postulated changes in product price levels were determined using whole farm budgeting techniques. Thus, a farm situation of a given size was analyzed at alternative combinations of debt and equity under varying price alternatives.

In general, farmers, in the past have avoided highly leveraged positions. But, changes in the technology of farm production and

increasing costs of capital and operating inputs have forced farmers to increase their use of borrowed capital. Many Michigan farmers, particularly the older ones still manage to limit their use of borrowed capital, and, hence, their leverage approaches 0. But, a more typical farmer might limit his debt to half the value of his equity (L=.5). In any case, a borrower who limits his use of credit to conventional lenders and debt instruments is not likely to be able to assume debt beyond the value of his equity, i.e., L=1, unless he uses a land purchase contract. With a land purchase contract he could possibly attain a value of L greater than 1, but, will probably have exhausted his credit somewhere between 1.0 and 2.0. Borrowings beyond 2.0 would probably entail higher cost lenders and it could no longer be assumed that i is a constant with respect to L. It is reasonable then to assume that for the purposes of this analysis a relevant range of L values to examine lies between 0 and 2. Therefore, the following values for L were established as alternative financial leverage policies: 0, .25, .5, 1 and 2.

Given the values of L to be used in the analysis it was then necessary to allocate the borrowings between chattel and real estate. Table 4 shows how the relative allocations were made. The real estate debt has a 20 year repayment period while the intermediate debt was to be repaid over 7 years in equal installments. Both chattel and real estate debt carried an 8.5% rate of interest. Also, a short-term loan used to cover current operating expenditures, was paid in full at an 8.5% annual interest rate at the end of the year. The interest rates reflect Production Credit Association and Federal Land Bank rates during the summer of 1977.

Table 4. Composition of Credit

| CASH GRAIN | | |
|---|---|---|
| Leverage | % of asset borrowed Chattel Credit | % of asset borrowed Real Estate |
| 0 | 0 | 0 |
| .25 | 25 | 16 |
| .5 | 45 | 32 |
| 1 | 70 | 50 |
| 2 | 90 | 69 |
| **SAGINAW VALLEY CASH CROP** | | |
| Leverage | % of asset borrowed Chattel Credit | % of asset borrowed Real Estate |
| 0 | 0 | 0 |
| .25 | 25 | 20 |
| .5 | 45 | 34 |
| 1 | 70 | 53 |
| 2 | 90 | 72 |
| **DAIRY** | | |
| Leverage | % of asset borrowed Chattel Credit | % of asset borrowed Real Estate |
| 0 | 0 | 0 |
| .25 | 25 | 19 |
| .5 | 45 | 34 |
| 1 | 70 | 52 |
| 2 | 90 | 72 |

Price and Yield Assumptions

Crop prices were allowed to vary up to 35% above and below an average for Michigan farm prices from 1974 through 1977 for each established financial leverage policy. While dairy and livestock product prices were allowed to vary up to 20% above and below average Michigan farm prices. These prices are shown in Table 5 and can be compared with what has been occurring over that past four years in Table 6. No

Table 5.

| GRAIN AND OTHER CROPS | | | | | | | |
|---|---|---|---|---|---|---|---|
| % change from 1974-77 average price | Corn | Wheat | Sugar Beets | Navy Beans | Soy-Beans | Oats | Hay |
| | $/bu. | $/bu. | $/ton | $/cwt. | $/bu. | $/bu. | $/ton |
| -35 | 1.59 | 2.02 | 18.56 | 13.14 | 3.85 | 0.98 | 28.11 |
| -15 | 2.08 | 2.64 | 24.27 | 17.19 | 5.04 | 1.28 | 36.76 |
| Average | 2.45 | 3.11 | 28.55 | 20.22 | 5.93 | 1.51 | 43.25 |
| +15 | 2.82 | 3.58 | 32.83 | 32.53 | 6.82 | 1.74 | 49.74 |
| +35 | 3.31 | 4.20 | 38.54 | 27.30 | 8.01 | 2.04 | 58.39 |

| DAIRY AND LIVESTOCK | | | |
|---|---|---|---|
| % change from 1974-77 average price | Milk | Culls | Calves |
| | $/cwt. | $/cwt. | $/cwt. |
| -20 | 7.34 | 22.40 | 24.00 |
| -10 | 8.26 | 25.20 | 27.00 |
| Average | 9.18 | 28.00 | 30.00 |
| +10 | 10.10 | 30.80 | 33.00 |
| +20 | 11.02 | 33.60 | 36.00 |

price movement relationships are implied in this study. Prices were assumed to move in the same direction and in equal proportions for illustrative purposes only. In reality, such price movements would probably not occur.

The prices for variable inputs and the variable input requirements necessary to attain the yields assumed in this study were set at those given in Enterprise Budgets for Michigan, 1977 [11]. Tables 7 and 8 summarize the prices for the variable inputs and yield assumptions used in this analysis.

Table 6. Farm Product Prices, Annual Figures and Percent Changes from (1974-1977) Averages

| Farm Product | Price/ Unit | Average '74-'77 prices | 1974 | | 1975 | | 1976 | | 1977 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | price | % change from '74-'77 average | price | % change from '74-'77 average | price | % change from '74-'77 average | price | % change from '74-'77 average |
| Grain | | | | | | | | | | |
| Corn | $/bu. | 2.45 | 2.89 | +18.0 | 2.57 | + 4.9 | 2.39 | - 2.4 | 1.93 | -21.2 |
| Oats | $/bu. | 1.51 | 1.61 | + 6.6 | 1.47 | - 2.6 | 1.48 | - 2.0 | 1.49 | - 2.0 |
| Wheat | $/bu. | 3.11 | 4.23 | +36.0 | 3.15 | + 1.3 | 2.93 | - 5.8 | 2.13 | -31.5 |
| Other Crops | | | | | | | | | | |
| Hay, baled | $/ton | 42.25 | 33.46 | -22.6 | 45.40 | + 5.0 | 41.46 | - 4.1 | 52.67 | +21.8 |
| Soybeans | $/bu. | 5.93 | 6.36 | + 7.3 | 5.15 | -13.2 | 5.51 | - 7.1 | 6.68 | +12.6 |
| Navybeans | $/cwt. | 20.22 | 29.31 | +45.0 | 17.55 | -13.2 | 18.14 | -10.3 | 15.87 | -21.5 |
| Sugar Beets | $/ton | 28.55 | 46.80 | +63.9 | 27.60 | - 3.3 | 19.80 | -30.6 | 20.00 | -29.9 |
| Dairy | | | | | | | | | | |
| Milk | $/cwt. | 9.18 | 8.56 | - 6.8 | 8.83 | - 3.8 | 9.65 | + 5.1 | 9.67 | + 5.3 |

Table 7. Costs Used in 1977 Budgets [11]

| | |
|---|---|
| **Fertilizer** | |
| Nitrogen (lb.) | $ .14 |
| Phosphorus ($P_2O_5$)(lb.) | .18 |
| Potassium ($K_2O$)(lb.) | .09 |
| **Seed** | |
| Corn (bu.) | 42.00 |
| Oats (bu.) | 4.50 |
| Barley (bu.) | 5.50 |
| Alfalfa (cwt.) | 150.00 |
| Rye (bu.) | 5.00 |
| Wheat (bu.) | 8.00 |
| Field Beans (bu.) | 34.50 |
| Soybeans (bu.) | 10.00 |
| Sugar Beets (lb.) | 5.00 |
| Potatoes (cwt.) | 8.70 |
| **Feeds** | |
| Soybean Oil Meal (ton) | 190.00 |
| Salt (cwt.) | 3.50 |
| Diacalcium Phosphate (cwt.) | 14.50 |
| Limestone (cwt.) | 4.20 |
| **Capital** | |
| Short Term Credit | 8.5% |

Other Assumptions

Straight line depreciation applied to all depreciable machinery, equipment, farm buildings, and dairy livestock. Farm buildings are depreciated over a 15 year period while all other depreciable assets are on a seven year depreciation schedule. No salvage value is assumed for any depreciable asset.

Investment credit is assumed to equal 10% of total annual depreciation.

Federal and state income taxes and social security contributions were paid in accordance with the 1977 laws.

Property was taxed at a rate of 1.5% of the estimated current market value of real estate.

Table 8. Yield Assumptions for Typical Farm Situations

| Product | Units | Cash Grain | Saginaw Valley Cash Crop | Dairy |
|---|---|---|---|---|
| Corn | bu/A. | 100 | 110 | 100 |
| Navy Beans | cwt/A. | 13 | 14.3 | |
| Sugar Beets | tons/A. | | 19 | |
| Wheat | bu/A. | 45 | 49.5 | 45 |
| Soybeans | bu/A. | 30 | | |
| Corn Silage | tons/A. | | | 13 |
| Oats | bu/A. | | | 60 |
| Pasture | tons hay equivalent/A. | | | 2.5 |
| Hay | tons/A. | | | 5 |
| Milk | lbs/cow | | | 14,500 |
| Calves born | cow/yr. | | | 1 |

Family living expenses were assumed to be $12,000/year for a family of five. It is not reasonable to expect consumption to remain constant for varying levels of income. However, a constant figure was deemed useful for the purposes of this study. Growth in equity was chosen essentially as a welfare proxy for evaluating the relative merits of using leverage. If total consumption were allowed to vary as income varied, growth in equity would not be as adequate a measure in comparing welfare accruing to different levels of earnings since part of the total welfare would be derived in the form of greater or lesser consumption and not simply equity growth. Therefore, to keep results on a relatively comparable basis a single consumption figure was chosen. Further, any errors resulting from using a constant consumption figure are not compounded in successive years since only one production period is being analyzed.

Data Generation

The analysis results were generated using Telplan Program No. 36. This is a computer program designed for financial long-range whole farm budgeting. The user of the program must specify the following data for the farm in order to generate the relevant financial information: base plan background, tax information, available resources, resource prices, interest rates, investment data (capital structure), miscellaneous costs and returns, output prices, enterprises, and yields. Contained within the program are the variable cost estimates for a variety of Michigan crops and livestock, and the amounts of the variable inputs required to attain the assumed yields. The variable input and cost data have been assembled and are updated regularly by extension specialists in the Agricultural Economics Department of Michigan State University. Following the previously mentioned method of analysis, 110 different whole farm budgets were necessary to attain the results of this study.

# RESULTS

The budgeting results are summated in Tables 9-11 and Figures 2-4. It is apparent that consistent with the model the degree of leverage, L, and the growth in net worth for a given price level seem to be approximately linearly related. However, the relationship is not perfectly linear since a progressive tax rate has been assumed rather than a constant tax rate. That is, as earnings increase the rate at which earnings are taxed increases also, therefore, the gains from leverage tend to be dampened somewhat, though not very perceptibly in this case. It should be noted further than though income taxes tend to reduce gains from leverage it is assumed in this study they do not reduce possible losses. This adverse tax effect occurs because firms are subject to income taxation when a profit is realized, however, they receive no compensation when a loss is incurred. In actual practice, losses can be carried forward to future years through income averaging and other federal tax law provisions.

In all cases, the graphs illustrate clearly that as leverage increases the spread between prospective gains and losses increases given market instability. Therefore, it is clear that the manager who prefers a more highly levered operation is opting for increased risk. In general, it appears then that the results from these realistic farm situations support the theoretical framework which has previously been established.

At this point some implications of a negative equity rate should be examined. Negative equity growth rates incurred due to insufficient earnings, as is the case here, imply that if the farm is to meet its financial obligations a portion of its assets must be liquidated or new borrowings procured. In either case, debt is increased relative to equity. Certainly, any depletion of assets decreases production capabilities, however, the problems associated with negative growth do not end there. Negative growth impacts in the negative sense on the farm's financial liquidity position. That is, credit depends largely on the value of the firm's assets. Therefore, it is reasonable to conclude that assets contribute to liquidity not merely in the form of potential sale but in the form of credit as well. In fact, for many assets the credit form of liquidity is more readily accessible and more likely to be used than is the sale form. Therefore, increasing debt relative to equity reduces the firm's ability to meet future financial obligations in an orderly manner. This also serves to bring out an important point regarding financial leverage which has not previously been mentioned. That is, since using financial leverage increases debt relative to equity, a trade-off exists between the prospects of increased earnings which may result from increased financial leverage and the decreased liquidity in the form of credit which is incurred. Therefore, financial leverage increases a farm's risk position not only by imposing increased costs but also by decreasing financial liquidity.

Thus far, no mention has been given to the ability of the levered producer to meet the principal loan repayment schedule. In this study it has been assumed that long term debt is to be repaid over 20 years in equal installments, intermediate credit is to be repaid over seven years

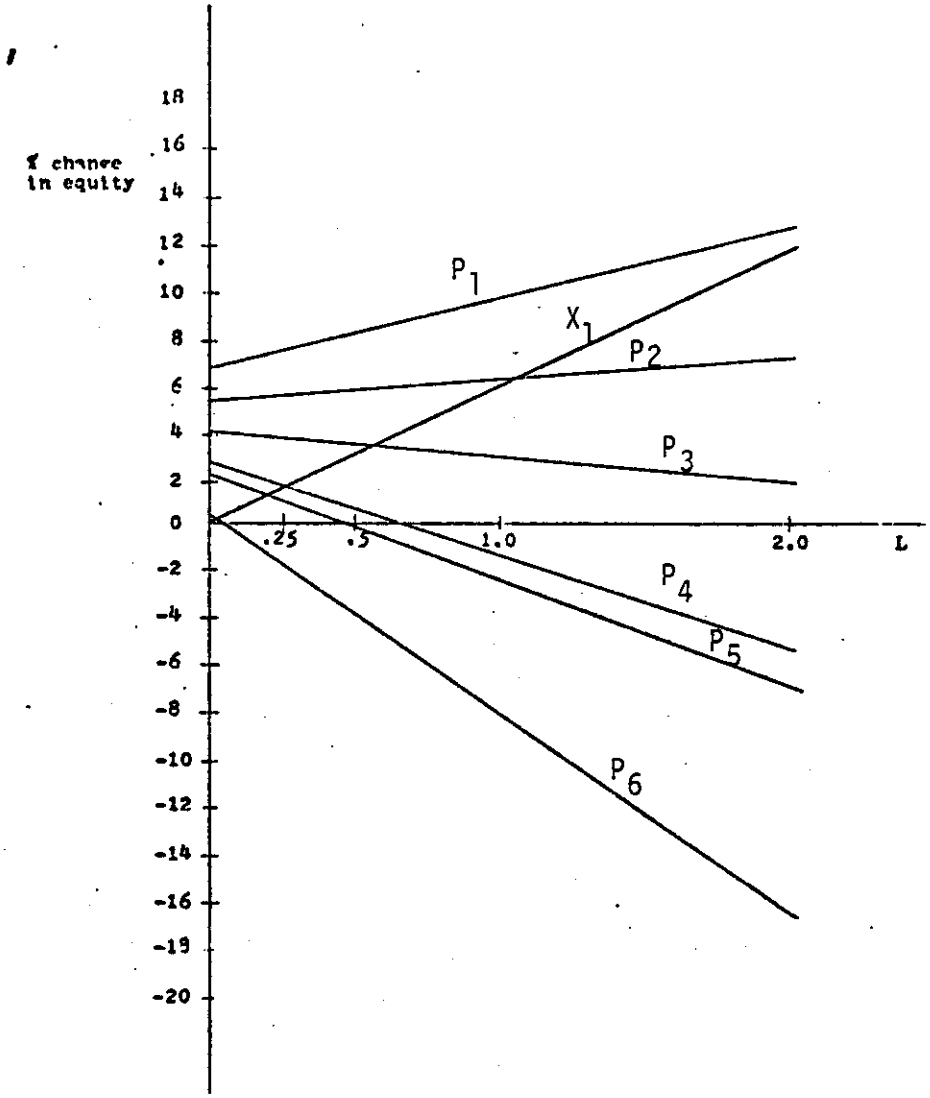
in equal installments, and short term credit is to be repaid in full within one year. Any debt repayment has a direct positive impact on changes in equity, i.e., as debt is decreased through principal repayments equity necessarily increases since equity is simply total farm assets less total liabilities. Therefore, in the absence of new financing, meeting the scheduled principal payments implies a particular percentage change in equity. This percentage change in equity required to meet the loan repayment schedule has been graphed for all three farm types in Figures 2-4. It is clear that as leverage increases the required percentage change in equity to meet the loan repayment schedule also increases. The loan repayment schedule presents then another problem faced by the financially levered producer. That is, as the manager chooses to lever up his financial position not only does his expected return become increasingly risky but also his liquidity in the form of credit is reduced, thereby impairing his ability to meet the increased loan repayment schedule during poor earnings years.

As mentioned above, the percentage change in equity required to meet the loan repayment schedule out of current earnings (it is assumed no new borrowings or appreciation of capital occur) is graphed in Figures 2-4. It is represented by a particularly dark line. Essentially, the line indicates for each level of leverage what growth rate the farmer must realize to meet the principal repayment schedules. It differs from the other lines in that no price level is assumed.

Implications for Cash Grain Farmers

It is interesting to note that for this typical farm situation favorable leverage is only realized at prices in excess of at least the

Figure 2. Cash Grain




$P_1$ = 135% of 1974-1977 average price level.
$P_2$ = 115% of 1974-1977 average price level.
$P_3$ = 1974-1977 average price level.
$P_4$ = 85% of 1974-1977 average price level.
$P_5$ = 1977 average price level.
$P_6$ = 65% of 1974-1977 average price level.
$X_1$ = percent change in equity required to meet principal repayment schedule out of current earnings for each level of L.

1974-1977 average price level which is considerably better than the average 1977 price level. Furthermore, it is apparent that farms with L's approximating zero are in little danger of suffering negative equity growth rates given that price levels 35% below the 1974-1977 average seem quite unlikely. Whereas, for farms with even relatively moderately leveraged positions not only is negative leverage a good possibility, but also, it is not at all unrealistic to expect negative equity growth rates to be incurred unless product prices increase considerably without the cost of inputs rising nearly as quickly. Therefore, unless the market improves substantially the highly levered farmer runs a real risk of not being able to earn sufficient income to meet financial obligations, such as debt payments, payroll, and family living needs on schedule. It should be mentioned, however, that given sufficiently high prices the highly leveraged farm could indeed realize considerable growth in excess of what could have been achieved under a more conservative capital structure. However, it seems apparent, to gamble on the prospects of high prices would come at the cost of bearing considerable risk.

The prospects for cash grain farmers to meet the loans repayment schedule using current farm earnings does not appear good. Even if price levels were to approach 1974-1977 averages the growth in equity would be insufficient to meet principal payments for leverages exceeding .5. Further, for an L=1 even a price level of 15% above the 1974-1977 average is not sufficient, and for L=2 the cash grain farmer has little hope for meeting principal payments out of current earnings. Therefore, it is apparent that even if prices are high enough such that positive or favorable leverage were realized the added growth

Table 9. Cash Grain. Percent change in net worth implied by alternative leverage, L, and price levels.

| Price level as % of average '74-'77 / L | 65 | average 1977 | 85 | average '74-'77 | 115 | 135 |
|---|---|---|---|---|---|---|
| 0 | 0.01 | 2.13 | 2.44 | 3.84 | 5.05 | 6.50 |
| .25 | -1.89 | 1.29 | 1.74 | 3.77 | 5.33 | 7.31 |
| .5 | -3.96 | 0.31 | .90 | 3.58 | 5.69 | 8.07 |
| 1 | -8.10 | -1.97 | -1.03 | 3.04 | 6.23 | 9.58 |
| 2 | -16.4 | -7.05 | -5.44 | 1.61 | 7.01 | 12.53 |

attributable to financial leverage may well be insufficient to meet the added loan repayment requirements given the assumptions in this study.

This study, besides evaluating prospects for using financial leverage, is also useful in noting how the farmer, whose situation approximates the farm situation constructed in this study, may have fared in 1977. It is apparent from Figure 2 that the 1977 price level was on the average more than 15 percent below the 1974-1977 averages. Given these low prices, firm growth, in general, was quite poor. In fact, this study would indicate that those producers with L's greater than .5 quite probably experienced negative growth rates. It is clear that those cash grain farmers with highly leveraged operations may well be experiencing severe financial difficulties probably characterized by cash flow problems associated with a deteriorated liquidity position exacerbated by increased borrowings and loan repayment commitments.

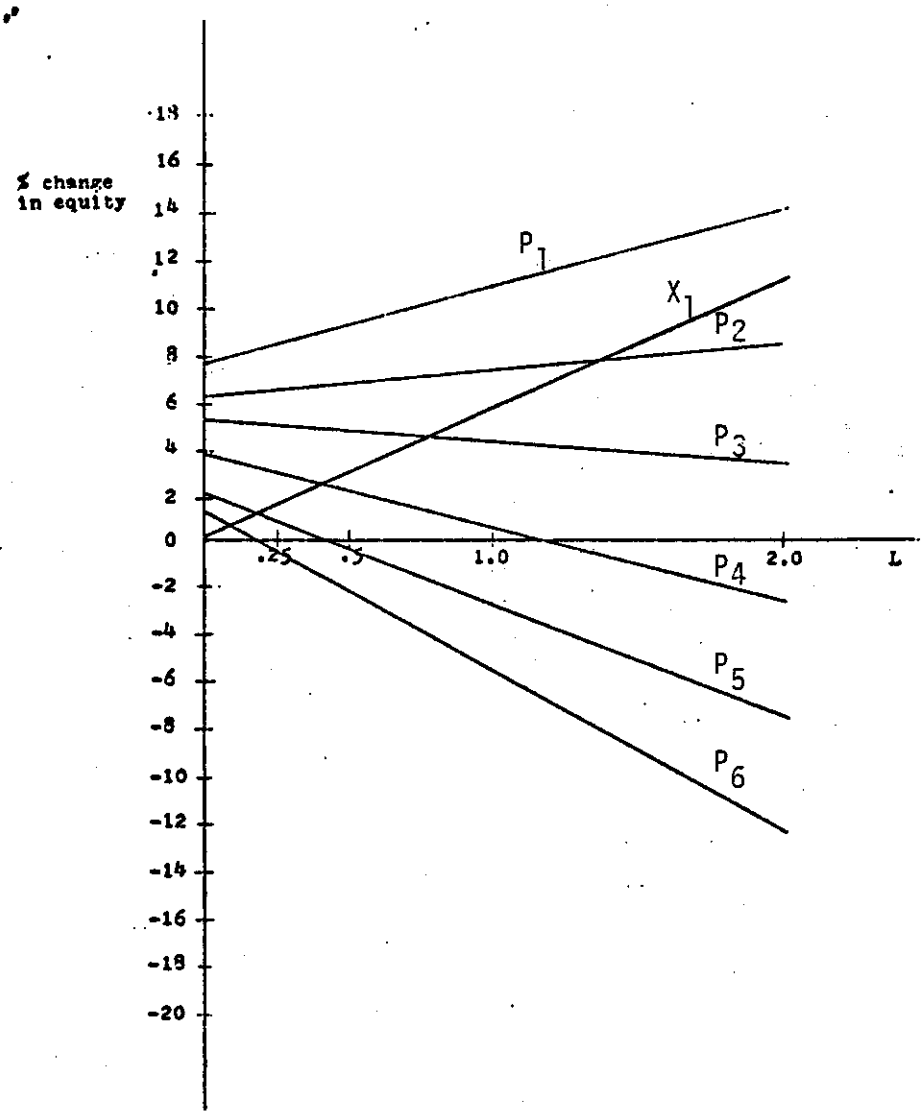
Table 10. Saginaw Valley Cash Crop. Percent change in net worth implied by alternative leverage, L, and price levels.

| Price level as % of average '74-'77 / L | 65 | average 1977 | 85 | average '74-'77 | 115 | 135 |
|---|---|---|---|---|---|---|
| 0 | 1.00 | 1.91 | 3.37 | 4.70 | 5.81 | 7.20 |
| .25 | -0.15 | 1.12 | 2.78 | 4.66 | 6.26 | 8.07 |
| .5 | -1.79 | 0.30 | 2.39 | 4.54 | 6.61 | 8.91 |
| 1 | -5.22 | -2.36 | 0.70 | 4.10 | 7.17 | 10.55 |
| 2 | -12.07 | -7.79 | -2.85 | 3.13 | 8.01 | 13.62 |

Implications for the Saginaw Valley Cash Crop Farm

It is not surprising since there exist many similarities between the Saginaw Valley cash crop farms and the cash grain farms that the prospects for using financial leverage on both farm types is somewhat similar. Therefore, much of what has been written already in this study about the cash grain farms applies to the Saginaw Valley cash crop farms as well. However, in general, the prospects for using financial leverage on the Saginaw Valley cash crop farms are to a limited degree more encouraging than is the case for the typical Michigan cash grain farms. That is, at all but the 1977 average level the percentage change in growth is comparatively better for each level of leverage on the Saginaw Valley cash crop farm situation than for the typical cash grain farm. However, again even at the 1974-1977 average price level negative leverage is incurred. Therefore, although the likelihood of suffering negative equity growth rates is not as great and the prospect of

Figure 3. Saginaw Valley Cash Crop




$P_1$ = 135% of 1974-1977 average price level.
$P_2$ = 115% of 1974-1977 average price level.
$P_3$ = 1974-1977 average price level.
$P_4$ = 85% of 1974-1977 average price level.
$P_5$ = 1977 average price level.
$P_6$ = 65% of 1974-1977 average price level.
$X_1$ = percent change in equity required to meet principal repayment schedule out of current earnings for each level of L.

realizing favorable leverage is better than for Michigan cash grain farms, the overall picture for using financial leverage advantageously seems somewhat bleak.

The prospects for the highly levered Saginaw Valley cash crop farmer to meet the loan repayment schedule appear better than they did for the typical cash grain farmer. However, the loan repayment schedule still presents a serious problem. The analysis shows that for an L=1 the price level must exceed the 1974-1977 average price level by 8% in order for the producer to meet the principal repayment schedule using current farm earnings, while for an L=.5 the price level must at least approximate the 1974-1977 average. If prices are not sufficiently high the highly levered producer may experience serious cash flow problems.

It is interesting to note for average 1977 prices the analysis indicates that the equity growth rates for the Michigan cash grain farmer slightly exceeded those for the Saginaw Valley cash crop producer at all levels of leverage. This is probably directly attributable to the relative crop mixes and their relative crop prices. Both produced corn, wheat, and navy beans, however, the Saginaw Valley cash crop farmer produced sugar beets while the cash grain farmer grew soybeans. 1977 was a particularly poor year for sugar beet prices while soybean prices were relatively high. Therefore, overall the cash grain farmer probably realized a somewhat better return to equity. However, by no means could 1977 be construed as a particularly profitable year for either, particularly, for the highly levered producer. In fact, even at moderate levels of leverage the analysis indicated negative growth was suffered by the Saginaw Valley cash crop farmer.

As in the case of the cash grain producer, the results of this analysis tend to indicate that in today's market environment a conservative debt policy is probably advisable. Unless prices improve considerably and the costs of inputs increase at a slower rate, the return to financial leverage does not seem to warrant the risks.

Implications for Dairy Farms

Analyzing price levels for dairy farms is a complicated matter due primarily to the diversified nature of dairy farm production. On a typical dairy farm there are crop enterprises, the dairy operation which includes a breeding operation, and a beef operation consisting of culls and calves sold for butchering. Further, the dairy market tends to be stable relative to the cash crop market and bears no steady nor predictable relationship to the cash crop market. It is interesting to note, that as cash crop prices rise revenues accruing to crop sales increase, however, the cost of feed purchases increase as well. Therefore, an increase in cash crop prices can increase or decrease profits depending on the extent to which the dairy farmer sells or purchases cash crops. For the typical farm in this study an increase in cash crop prices tended to increase profits. The combinations of livestock and crop price levels used in this study in no way are meant to imply any proposed or theoretical relationship. The prices were chosen merely for illustrative purposes.

It seems reasonable to assume, given the diversified nature of the dairy farm and the relatively stable dairy market, that the market risks faced by the dairy farmer are less imposing than those borne by cash crop farmers. This analysis indicates that given 1977 input costs favorable leverage is not realized unless livestock prices (of which

milk is by far the most important) and cash crop prices exceed 1974-77 averages by 10 and 15% respectively. Therefore, even though the relatively diminished market risks would seem somewhat conducive for the use of financial leverage, the advisability of highly leveraged positions is certainly questionable.

The percentage growth in equity required to meet principal repayment for this typical dairy farm situation is greater than the equity growth required for the typical cash crop farms. This reflects the relative composition of debt for the various farm types. A greater proportion of assets for the dairy farm compared to cash crop farms tend to be in non-real estate capital. Therefore, the composition of debt on the dairy farm tends to be proportionally more in the intermediate form relative to long term than is the case for cash crop farms. Since intermediate credit by definition is repaid more quickly than long-term credit, the principal repayments for the dairy farm would not be spread over as long a period relative to the cash crop farm.

It appears from looking at Figure 4 that unless equity growth rates exceed those for average 1977 prices current earnings may well be insufficient to meet the principal repayment schedules for L's exceeding .5, which, as has been previously discussed for the other farm types, could cause serious cash flow problems.

It is interesting to note that growth rates for 1977 average prices exceed those for the 1974-1977 average prices. This is contrary to the results for the Michigan cash grain farm and the Saginaw Valley cash crop farm. The reason for this is that 1977 milk prices averaged 5.3% above 1974-1977 averages. Furthermore, even though cash crop prices for 1977 were well below 1974-1977 averages, cash crops accounted

Table 11. Dairy. Percent change in net worth implied by alternative leverage, L, and price levels.

| Price level as % of average '74-'77 / L | c=65 l=80 | c=85 l=90 | average '74-'77 | average 1977 | c=115 l=110 | c=135 l=120 |
|---|---|---|---|---|---|---|
| 0 | - 0.20 | 1.99 | 3.61 | 4.23 | 4.98 | 6.25 |
| .25 | - 2.32 | 0.89 | 3.19 | 4.06 | 5.11 | 6.84 |
| .5 | - 2.55 | -0.43 | 2.65 | 3.79 | 5.15 | 7.40 |
| 1 | - 8.81 | -3.33 | 1.39 | 3.33 | 5.08 | 8.39 |
| 2 | -17.47 | -4.15 | -1.67 | 1.23 | 5.31 | 10.14 |

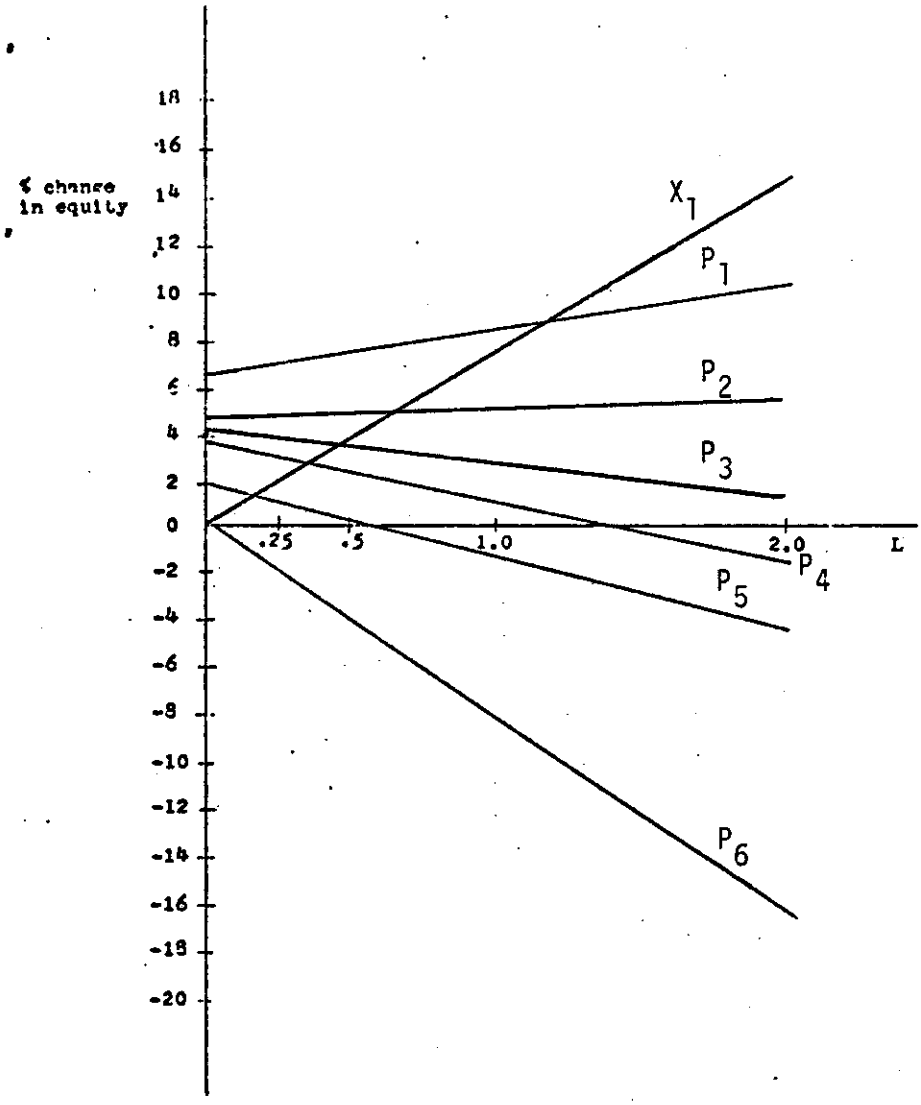
c = crop price level; l = livestock price level.

for only 15% of the total farm receipts, whereas, milk accounted for 81%. Therefore, the increased milk price more than offset the lower cash crop prices.

For this typical dairy farm situation 1977 average prices were not sufficiently high to induce favorable leverage. Furthermore, farms leveraged above L=1 fell well short of being able to meet principal repayment schedules out of current annual earnings. Therefore, it would appear that the more highly leveraged farms may well have experienced financial difficulties, particularly in the form of cash flow problems.

In general, it does not seem advisable to take on a leverage position above L=1. That is, even if prices increase very substantially (which does not seem likely), the ability of these typical producers to meet the principal repayment schedules is doubtful unless payments could be substantially deferred. Whether a moderate leverage position

Figure 4. Dairy




$P_1$ = 135% and 120% of '74-'77 average price levels for crops and livestock respectively.
$P_2$ = 115% and 110% of '74-'77 average price levels for crops and livestock respectively.
$P_3$ = 1977 average price levels.
$P_4$ = 1974-1977 average price levels.
$P_5$ = 85% and 90% of '74-'77 average price levels for crops and livestock respectively.
$P_6$ = 65% and 80% of '74-'77 average price levels for crops and livestock respectively.
$X_1$ = percent change in equity required to meet principal repayment schedule out of current earnings for each level of L.

would be preferable to a conservative position is dependent upon price expectations and the relative risk averseness of the dairy farmer.

## Returns to Hedging on the Futures Market

Since the beginning of the 1970's there has been heightened awareness of the market risks associated with agricultural production. As a result, there is now an increased need for risk-bearing tools which will either reduce, shift, or otherwise manage price risks, and therefore, provide increased earnings stability and eliminate some loan servicing uncertainty. Loan repayability improvement would effectively expand potential credit, and therefore, improve the producer's liquidity position. Potential market risk-bearing tools include combinations of inventory management and forward pricing and production commitments. In this study, only returns to the futures contract will be analyzed.

A futures contract consists of the producer's promise to deliver a specified quality and quantity of a commodity at a designated time, place, and price. However, a unique feature of the futures contract is that the physical commodity need not ever be delivered. That is, a futures contract to sell, for example, can be settled by buying a similar contract or by actually delivering the commodity. This feature allows those who use the futures market to protect their cash positions by hedging. Hedging is the act of taking equal and opposite positions in the cash and futures markets, in the hope that the net result will be offsetting losses and gains preventing injurious price fluctuations. It is important to note that hedging works because futures and cash prices tend to fluctuate nearly in unison and the difference between them narrows over the duration of the contract.

The agricultural producer would undertake a selling hedge. In the selling hedge the initial transaction is selling a futures contract on a commodity the producer owns or produces. Therefore, any adverse or favorable price change in the cash market is approximately offset by a correspondingly adverse or favorable change in the futures market. The producer, then to close out the contract, will buy the same contract back and sell the commodity on the cash market.

In order to investigate whether or not the farmer who utilized the futures market was able to realize added returns compared to the non-hedged farmer, a hedging strategy for the typical cash grain and Saginaw Valley farms was simulated and compared to results for the non-hedged situation. It was assumed for the hedged farm that approximately half of the anticipated crop production of corn and wheat and, in the case of the cash grain farm, soybeans was hedged. September, November, and December contracts were sold for wheat, soybeans, and corn respectively. Furthermore, it was assumed that the producer was able to hedge his respective commodities at the average between the high and low price for the duration of the contract. The basis, i.e., the relationship between cash and futures prices, was set at 45¢, 47¢, 37¢ for wheat, soybeans, and corn respectively. The contracts were closed at the beginning of the contract month and the commodities were sold at that time. The non-hedged farmer sold his corn, wheat, and soybeans on the cash market the same month as did the hedged farmer. Prices for the commodities other than corn, wheat, and soybeans were sold at average 1977 prices for both situations.

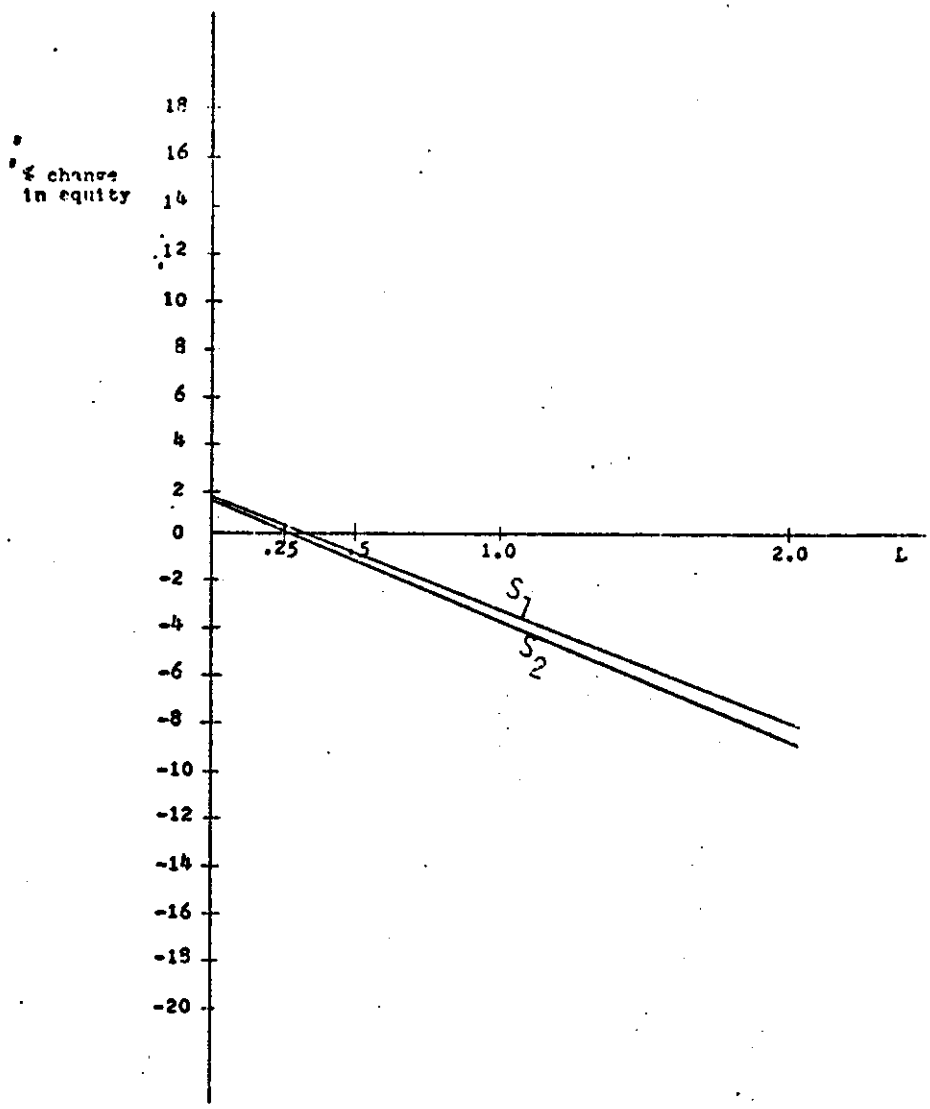
The budgeting analysis was done only for 1977 since only 1977 input prices were readily available. The results are shown in Figures

Table 12. Cash Grain. Percent change in net worth implied by alternative leverage, L, and marketing strategies given in this study.

| Strategy / L | 1977 Not Hedged | 1977 Hedged |
|---|---|---|
| 0 | 1.75 | 1.88 |
| .25 | 0.74 | 0.92 |
| .5 | -0.42 | -0.16 |
| 1 | -3.10 | -2.73 |
| 2 | -8.88 | -8.29 |

5 and 6. Both farm types unsurprisingly yielded very similar results. It appears, given this strategy, that for 1977 the hedged cash grain and Saginaw Valley cash crop producers realized a better overall price level, and, therefore, realized somewhat better equity growth or lower negative equity growth rates at all levels of financial leverage. However, in all cases the advantage to the hedged farmer for both farm types was less than .6% in equity growth. Furthermore, any advantage may have been eliminated by brokerage fees and the real and opportunity costs of margin maintenance. Therefore, in 1977, for this particular hedging strategy, the return advantages of hedging appear minimal. However, hedging does probably tend to limit the variance of anticipated earnings. That is, the producer and banker can more accurately forecast hedged farm earnings. This allows for greater certainty in loan servicing, and, therefore allows both the creditor and the farmer to make plans to ease any problems.

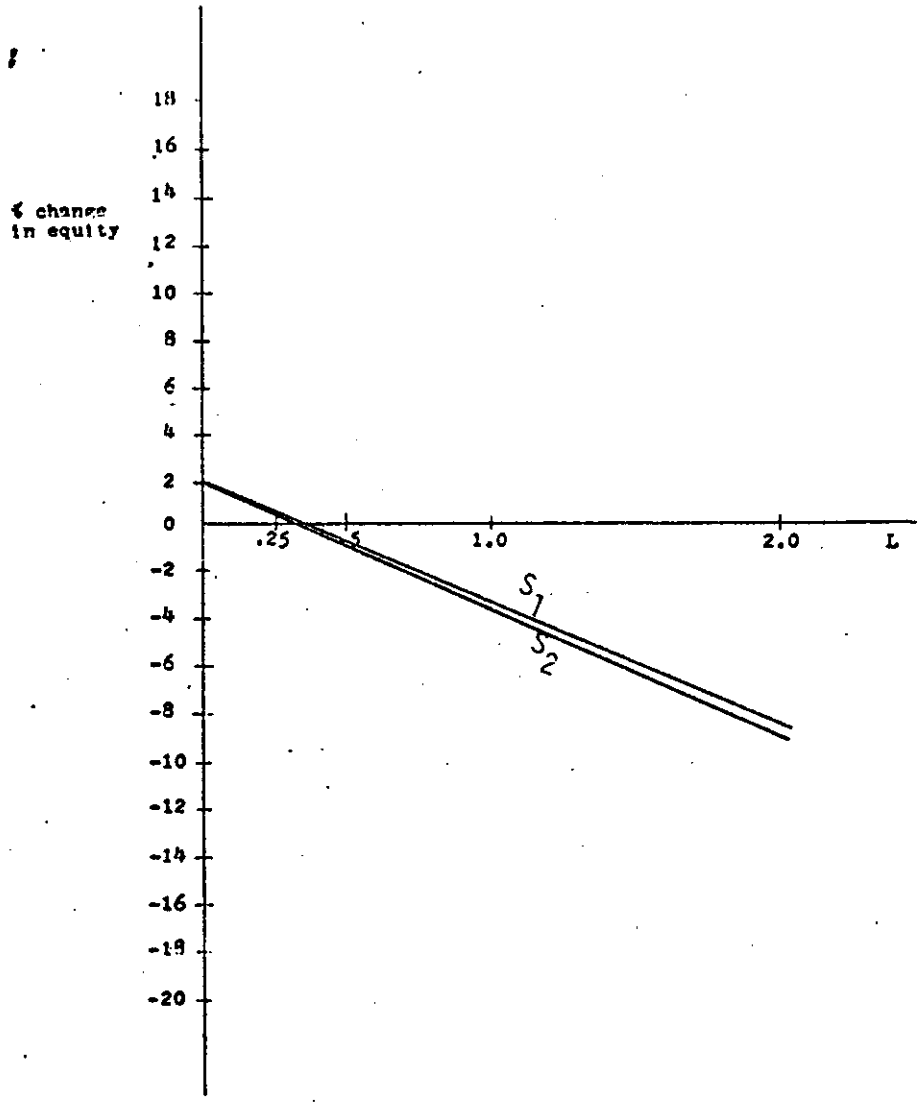
Figure 5. Cash Grain. 1977 Hedged Strategy vs. Non-hedged Strategy (see text for explanation of respective strategies)




$S_1$ = 1977 hedged strategy

$S_2$ = 1977 non-hedged strategy

Figure 6. Saginaw Valley Cash Crop. 1977 Hedged vs. Non-hedged Strategy. (see text for explanation of respective strategies)




$S_1$ = 1977 hedged strategy

$S_2$ = 1977 non-hedged strategy

Table 13. Saginaw Valley Cash Crop. Percent change in net worth implied by alternative leverage, L, and marketing strategies given in this study.

| Strategy / L | 1977 Not Hedged | 1977 Hedged |
|---|---|---|
| 0 | 1.82 | 1.90 |
| .25 | 0.79 | 0.91 |
| .5 | -0.36 | -0.17 |
| 1 | -3.14 | -2.86 |
| 2 | -8.96 | -8.55 |

Prices that producers would have realized under the same strategy assumptions for the hedged and non-hedged farms are listed in Table 14. In 1974 the hedged farmer would have realized higher corn and wheat prices had he not hedged those commodities. In 1975 hedging would have yielded higher prices for all three commodities. And, in 1976 both hedged corn and wheat prices were favorable to the non-hedged prices. As has already been shown, hedged prices for 1977 were somewhat more favorable. It would seem then, that given these results, over the past four years the hedged producer using this strategy may have realized a very slightly better overall return to equity. However, with such a small sample, to generalize beyond this would be precarious.

Regardless of whether or not prudent hedging increases returns on investment, its principal advantage is that it hopefully reduces market risk and uncertainty somewhat. A more comprehensive study would

Table 14. Hedged versus non-hedged prices in cents/bushel where the hedged price is the midpoint of the range in futures prices for the duration of the futures contract.

| | (1) | (2) | (1)-(2) |
|---|---|---|---|
| Contract | Futures Price Less the Basis | Cash Price | Price Difference |
| 1974 | | | |
| wheat, Sept. | 412 | 442 | -30 |
| soybeans, Nov. | 776 | 733 | +43 |
| corn, Dec. | 285 | 316 | -31 |
| 1975 | | | |
| wheat, Sept. | 361 | 350 | +11 |
| soybeans, Nov. | 490 | 435 | +55 |
| corn, Dec. | 257 | 222 | +35 |
| 1976 | | | |
| wheat, Sept. | 321 | 268 | +53 |
| soybeans, Nov. | 559 | 611 | -52 |
| corn, Dec. | 225 | 213 | +12 |
| 1977 | | | |
| wheat, Sept. | 232 | 187 | +45 |
| soybeans, Nov. | 535 | 552 | -17 |
| corn, Dec. | 198 | 191 | + 7 |

analyze income variability associated with the hedged versus the non-hedged farm.

## General Implications and Recommendations

The prospects for the typical farms analyzed in this study using financial leverage successfully in the present market environment does not seem good. In all cases examined better than 1974-1977 average prices were required to realize any favorable leverage effects. This tends to indicate that agricultural producers experiencing higher financial leverage and lower liquidity run a serious risk of incurring equity losses and increased difficulties in debt service and meeting other financial obligations.

What makes this situation even more serious is the 1978 outlook for farm incomes. Demand is anticipated to expand reflecting population growth and increased incomes. However, the added consumption from these higher incomes will be spent primarily on non-agricultural products, hence, exerting little upward price pressure on farm products. Unless world grain production is considerably depressed, farm prices likely will hover near current levels. Furthermore, continued inflation of prices paid by farmers suggests little change in net farm income [9].

From the results of this study the 1977 picture did not appear good. This is not surprising, considering that total United States net farm income was lower in 1977 in terms of farmers' purchasing power than it had been any time since the Great Depression. The outlook for 1978 would suggest even more deterioration of the farmer's purchasing power [9].

Farmers may find credit somewhat tighter in 1978. Interest rates will probably tend to rise. Rural banks, particularly, may not be able to supply increased farm credit due to an already high ratio of agricultural loans to their deposits. And, in general, creditors will be cautious due to the present depressed state of farm earnings [5].

Therefore, the outlook seems to indicate that the market and credit environment requires an especially great need for keen financial and market risk management. And, as this study indicates, a conservative capital structure seems particularly warranted with emphasis on maintaining a strong liquidity position.

Now, possibly more than ever, it is crucial for the agricultural lender and borrower to explore opportunities for reaching mutually beneficial arrangements which reduce risks for both. In essence, credit

and borrowing provisions need to be made responsive to the variability in cash flows. That is, a need exists to provide deferral or advance payments on loan obligations depending upon the relative magnitude of the cash flows.

Agricultural producers should consider seriously exploiting programs in marketing and production that might effectively absorb some of the risks faced by farmers. Only hedging on the futures market was briefly analyzed in this study. However, a number of other opportunities certainly exist.

This study has concentrated on equity growth through farm earnings. However, it should be mentioned that increasing land values have constituted a considerable portion of equity growth in the agricultural sector. Therefore, land appreciation can be credited with significantly expanding the farm asset base for borrowings. It is questionable whether or not land values will continue to increase rapidly. If land values do not increase markedly in the future farmers will lose what has been an expanding source of credit liquidity which suggests even greater potential liquidity problems.

It should be noted that to generalize the results from the typical farm situations analyzed in this study to somewhat dissimlar situations may be dangerous. However, hopefully the results presented here are at least indicative for a segment of the farming sector.

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