CORNELL
AGRICULTURAL ECONOMICS
STAFF PAPER

SUCCESSFUL DAIRY FARM DEBT MANAGEMENT STRATEGIES

Jonas Kauffman
and
Loren Tauer*

July 1985

No. 85-12

Department of Agricultural Economics
Cornell University Agricultural Experiment Station
New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Cornell University, Ithaca, New York, 14853

SUCCESSFUL DAIRY FARM DEBT MANAGEMENT STRATEGIES

Jonas Kauffman
and
Loren Tauer*

SUCCESSFUL DAIRY FARM DEBT MANAGEMENT STRATEGIES

Abstract

Stochastic dominance was used to group 112 dairy farms based upon 10 years of returns to equity capital. Debt strategies of farms partitioned by first-degree stochastic dominance were similar. Second-degree efficient farms were consistently less indebted. Compared to 1974-1978, debt management during 1979-1983 was more important for high return rates.

*Kauffman is a Graduate Research Assistant and Tauer is an Associate Professor, Department of Agricultural Economics, Cornell University. The authors thank George L. Casler and Bernard F. Stanton for their comments.

SUCCESSFUL DAIRY FARM DEBT MANAGEMENT STRATEGIES

The past decade has been a period of rapid change for dairy farmers. Prices received and paid by dairymen and farm asset values have shown significant variation. Changes in the tax law and government farm policy have resulted in many new regulations and programs. In a changing environment such as this, good management is essential. A recent study of management practices on New York dairies found that while utilizing essentially the same amounts of land, labor, and capital, the farms in the top profit quintile had an average net cash farm income nearly three times that of the lowest quintile (Bratton).

An area of farm management which has become increasingly important in recent years is that of financial management, especially the management of farm debt. The use of borrowed funds permits farmers to gain control of the productive resources needed to operate a dairy farm, yet deregulation of the banking industry and variable interest rates have made the use of debt capital increasingly risky. Consequently, many farms are now under severe financial stress.

Some factors which have contributed to farm financial stress, such as variable interest rates, inflation rates, low commodity prices, and drought, are not within the control of farm managers. However, the financial management strategies of individual farmers have, to some extent, determined the severity of the financial stress they are incurring. The purpose of this paper is to examine, using farm records data, the extent to which debt strategies of farmers who are successful differ from those of less successful farmers. "Success," in this case, will be defined in terms of rates of return to equity capital.

Ever since farm business records have been collected they have been analyzed to determine what factors are associated with successful farms (Warren). Those analyses have typically been based upon one year's observations. This article extends farm business analysis to 10 years of data, realizing that the impact of management decisions may not be felt the year implemented, and that stability of farm returns over time may be as important to many farmers as the level of farm returns. The data utilized are farm records data collected annually through Cornell University's farm business management project. Data from the most recent ten-year period contain a panel of 112 farms that have participated each year from 1974 to 1983. This provides a sample, albeit non-random, of 112 farms with ten annual observations per farm. The 112 farms are located in 34 of the 55 upstate counties in New York State with a maximum of nine from any one county. Selected characteristics of these 112 farms for 1982 are compared to the average New York farm business summary farm and Census of Agriculture data in Table 1.

Table 1. Comparison of 112 Sample Dairy Farms with Dairy Farm Summary and Agricultural Census Data for 1982

	Sample	New York Dairy Farm Business Summary	Census Dairy Farms N.Y.	Census Dairy Farms U.S.
Number of farms	112	572	14,327	164,184
Average no. of cows	90	82	60	60
Milk sales	$179,408	$164,196	$ 95,354	$ 92,999
Value of land and buildings	$259,256	$229,101	$235,391	$332,108
Debt	$186,076	$194,427	N.A.	N.A.
Interest expense	$ 15,992	$ 18,650	$ 8,609	$ 9,639

N.A. = Not Available

Although characteristics of our sample are different from the comparison data, the general results should be applicable and useful to all dairy farmers.

Methodology and Analysis

Agricultural decision making often requires selection of management strategies with risky outcomes. When the utility function of a decision maker is known or can be derived from measured risk preferences, the expected utility of each alternative strategy can be calculated and the alternatives uniquely ranked according to their utility values (Anderson, Dillon and Hardaker). If it is not practical to measure individuals' risk preferences, or, as has been suggested (Robison), risk preferences cannot be measured with precision, then the expected utility theorem cannot be applied directly. However, placing certain restrictions on the utility function has made it possible to apply the expected utility theorem through efficiency or dominance criteria. Stochastic dominance is one of these efficiency criteria.

Stochastic dominance partitions a set of alternative strategies into two sets, an efficient set and an inefficient set. First degree stochastic dominance (FSD), formalized by Quirk and Saposnik (1962) and Fishburn (1964), requires only that the utility function (U) for profit or returns (x) be monotonically increasing (strictly positive first derivative: $U'(x) > 0$), or, more simply, that the decision maker prefers more of x to less. Second degree stochastic dominance (SSD), postulated independently by Fishburn (1964), and Hammond (1968), requires the utility function not only be monotonically increasing, but also strictly concave. Therefore, the utility function must have both a positive first derivative ($U'(x) > 0$) and a negative second derivative ($U''(x) < 0$). This is equivalent to assuming that the decision maker is risk averse.

In this paper first and second degree stochastic dominance are used to separate the 112 farms into efficient and non-efficient sets. Descriptive statistics and t-tests are then used to compare financial management strategies of the successful and less successful farms. This will identify successful debt strategies for farmers who prefer more to less and those who are risk averse.

The performance measure for returns used in this paper is the rate of return to equity capital (RREQ). An annual RREQ was calculated for each farm according to the following formulas:

(1) Total farm receipts including appreciation
(-) total farm expenses excluding interest on equity capital
(-) value of operators' labor and management
= return to equity capital

(2) Return to equity capital / value of equity capital
= rate of return to equity capital (RREQ).

Complete definitions of these concepts are in Smith and Putnam.

The annual observations on RREQ for each farm were indexed by dividing each year's observation by the average RREQ of all 112 farms for that year. This procedure reduces inter-year differences due to factors outside the decision makers control and thereby lessens the likelihood of a farm being dominated due to one poor year. Each of the resulting ten annual indexed rates of return was assigned an equal probability of 1/10th. This discrete distribution of outcomes was then ordered from lowest to highest and utilized to generate a cumulative distribution function (CDF) for each farm. The CDF's were then used to determine stochastic efficiency by first and second degree criteria through the use of a modified version of a computer algorithm from Anderson et al.

To group farms by FSD, each of the 112 farm's CDF was compared to the CDF for every other farm. The stochastic dominance procedure resulted in seven farms dominating by FSD. The remaining 105 farms were further partitioned by FSD, resulting in sixteen of these farms dominating the other 89. This iterative procedure was repeated until over half of the farms were grouped. This procedure is similar to that utilized by Schurle and Williams to separate efficient and less efficient wheat farmers. The same procedure was repeated using SSD criteria. Since the efficient/less efficient distinction is binary, for purposes of comparison, farms ranked above the 50th percentile were labeled the "successful" group and those below the 50th percentile the "less successful." If a division of the farms overlapped the 50th percentile, they were included in the less successful group. With this procedure all farms in the "successful" group dominate all farms in the "less successful" group, although within the "successful" group there are farms that dominate other farms in the "successful" group. The results of the grouping for FSD and SSD are reported in Table 2.

Table 2. Groupings of 112 New York State Dairy Farms By First and Second Degree Stochastic Dominance

	Iteration Number							
Criteria	1	2	3	4	5	6	7	8
FSD								
No. in group	7	16	29	23				
Cumulative total	7	23	52*	75				
SSD								
No. in group	3	10	8	11	7	11	6	6
Cumulative total	3	13	21	32	39	50	56*	62

* Cut-off point for successful farms.

As a substitute for these stochastic dominance procedures it would have been possible to calculate the average return and variance for each of the 112 farms and use those as a criteria to separate farms into efficient and non-efficient sets. In fact, second degree stochastic dominance is consistent with that EV procedure when returns are normally distributed (Anderson et al.). However, tests for normality showed the distributions of rates of return to equity capital to be non-normal for many of the sample farms.

Factors relating to the debt strategies of the successful and less successful farms are compared in Figures 1 through 6. These figures present the average values of total debt per cow, debt/asset ratio, and interest paid as a percentage of milk sales for each year in the ten year period. Total debt includes short, intermediate, and long term debt at year end and was adjusted to 1983 values by the GNP implicit price deflator (1983=100). The debt/asset ratio reported is the ratio of total debt to total farm assets; this serves as a measure of the degree to which assets are financed by debt. Interest as a percentage of milk sales indicates the demand which interest payments are making on cash income. Years in which differences between the "successful" and "less successful" farms were found to be statistically significant for any of the factors are indicated in the figures with an asterisk. Means of the 2 groups were compared using the Student t test, with pooled variance.

Results

Comparisons of the debt management strategies of farms partitioned by FSD (Figures 1, 3, and 5) show few statistically significant differences between the successful and less successful groups. While the difference in the rate of return on equity capital is highly significant (4.0% for successful farms,

Figure 1. Total Debt Per Cow on 112 New York Dairy Farms Grouped by First Degree Stochastic Dominance

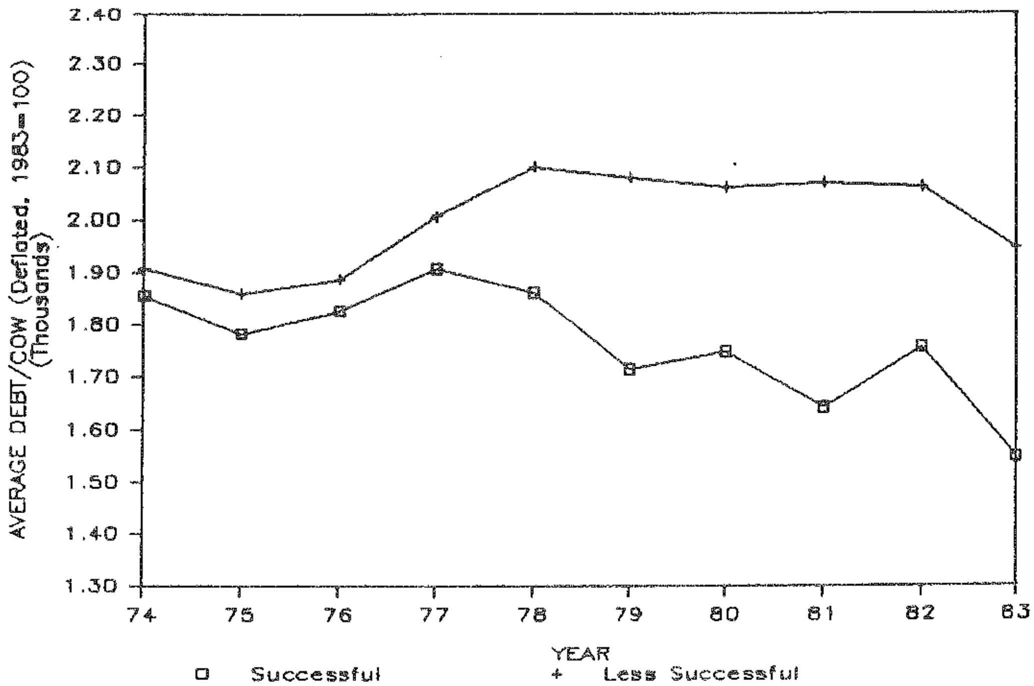
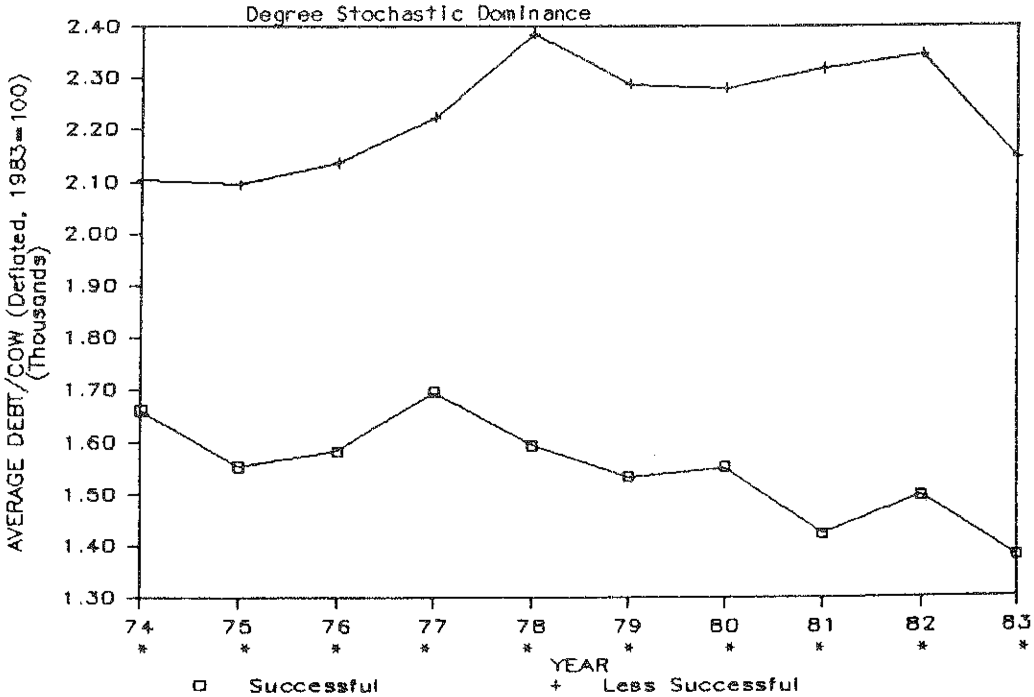


Figure 2. Total Debt Per Cow on 112 New York Dairy Farms Grouped by Second Degree Stochastic Dominance



*Means of the successful and less successful groups are statistically different at the 10 percent level for the years indicated.

Figure 3. Debt/Asset Ratio of 112 New York Dairy Farms Grouped by First Degree Stochastic Dominance

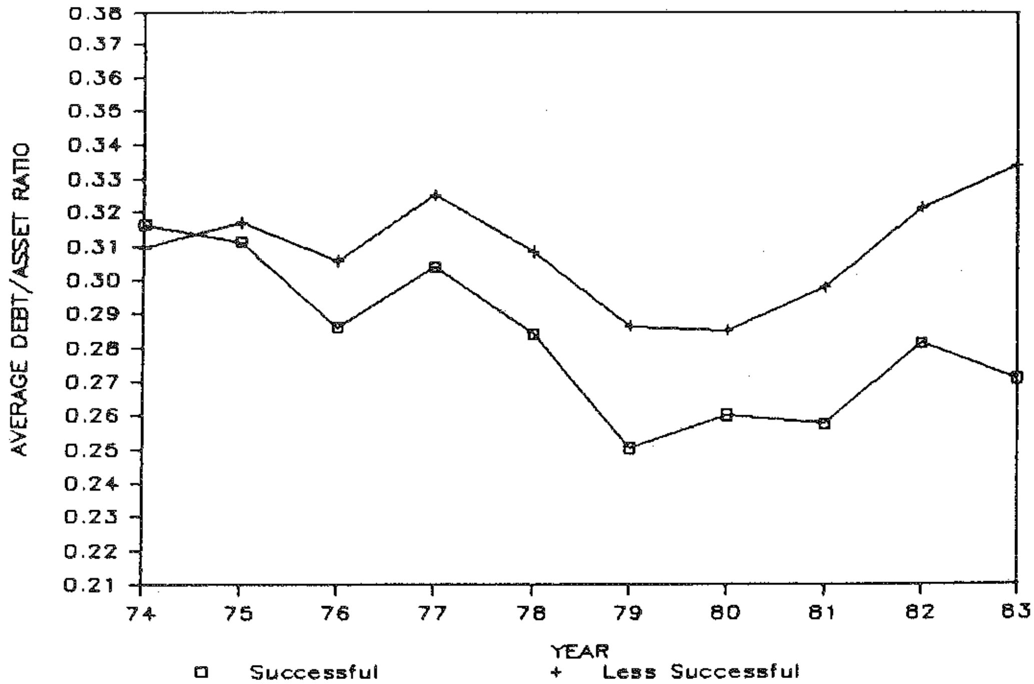
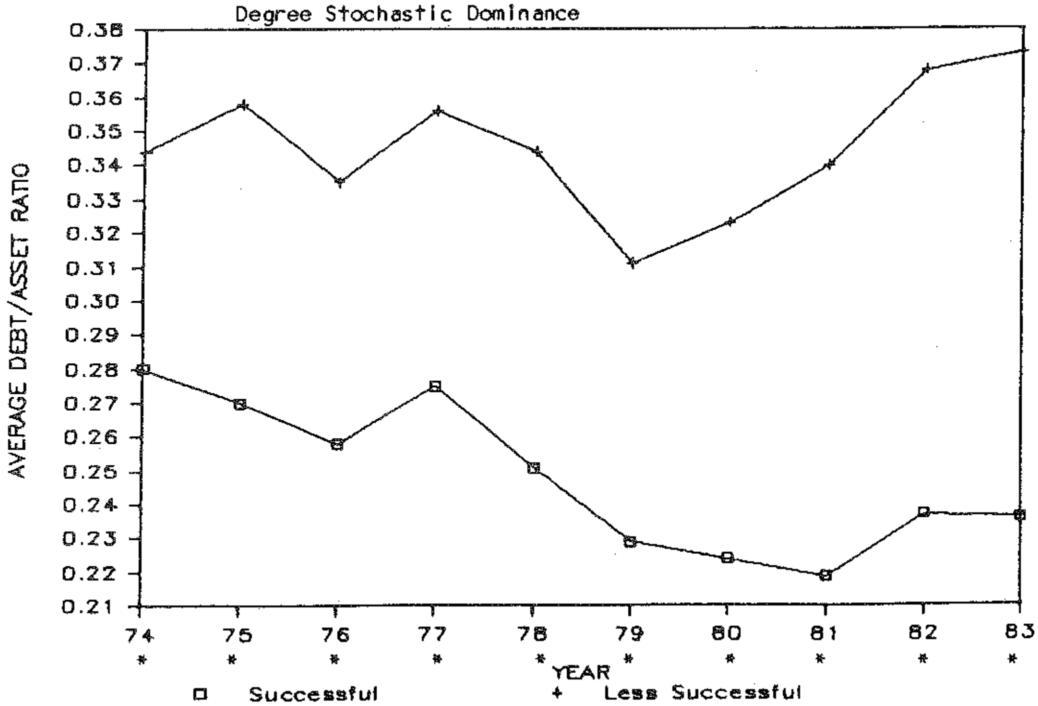


Figure 4. Debt/Asset Ratio of 112 New York Dairy Farms Grouped by Second Degree Stochastic Dominance



*Means of the successful and less successful groups are statistically different at the 10 percent level for the years indicated.

Figure 5. Interest as a Percentage of Milk Sales on 112 New York Dairy Farms Grouped by First Degree Stochastic Dominance

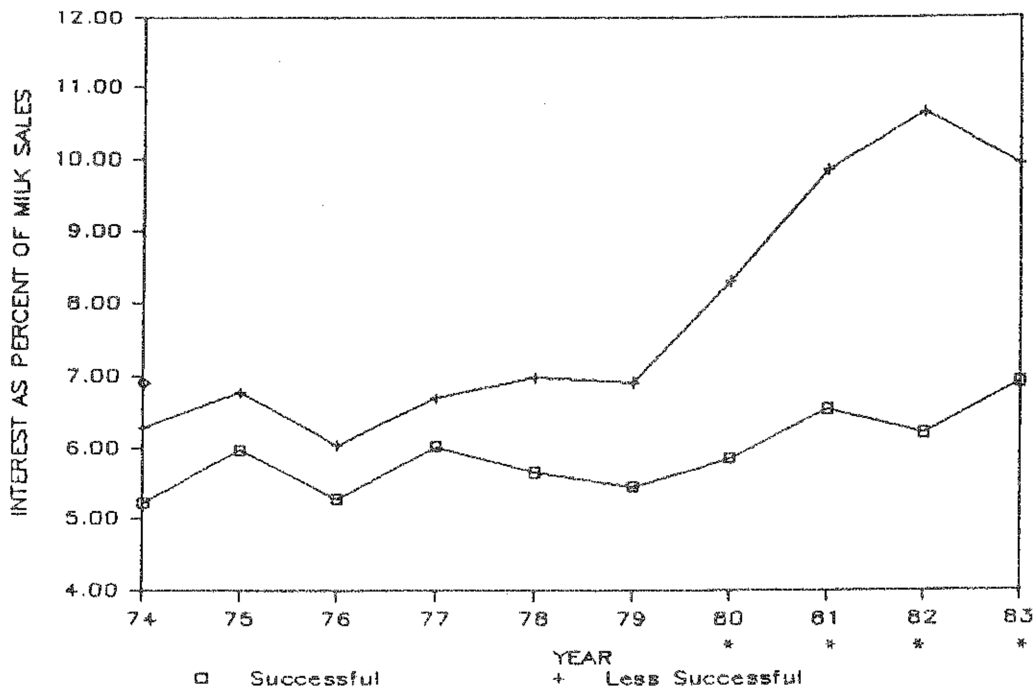
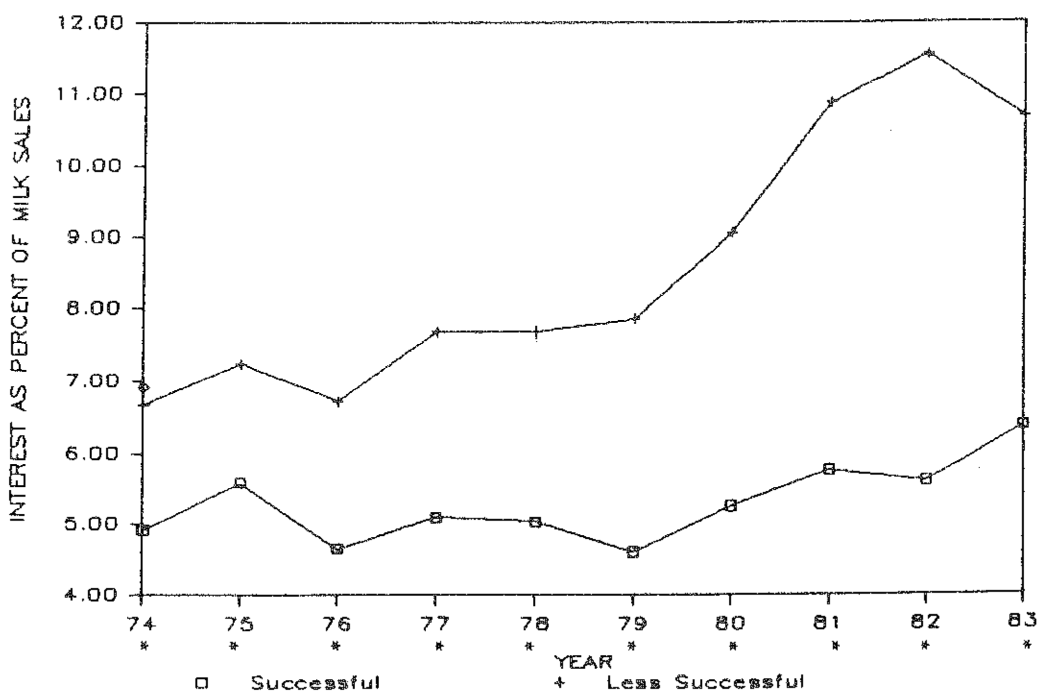


Figure 6. Interest as a Percentage of Milk Sales on 112 New York Dairy Farms Grouped by Second Degree Stochastic Dominance



*Means of the successful and less successful groups are statistically different at the 10 percent level for the years indicated.

-1.8% for less successful farms), annual debt/cow observations and debt/asset ratios show no important differences (1983 debt/cow being the only exception). Interest as a percentage of milk sales is the only variable which shows a consistent pattern of statistically significant differences between the two groups of farms. The mean values for interest/milk sales remain relatively close from 1974 to 1979, but after 1979 they diverge rapidly and are significantly different through the end of the period.

Since the separation of farms by first degree stochastic dominance analysis reveals very little difference in the debt management strategies of the successful and less successful farms, the higher rates of return on equity capital of the successful group were achieved through better performance in some aspect of management other than debt management. Those with distributions of RREQ judged superior under the first degree criterion of preferring more to less are generally as indebted as those farmers with inferior RREQ distributions, and have similar debt/asset ratios. Interest payments as a percentage of milk sales show significant differences in the later years of the period; this implies that the more successful managers are covering their interest payments, and thus debt, with larger volumes of milk sales.

Comparison of the strategies of farms separated by SSD (Figures 2, 4, and 6) illustrate many more differences between the successful (rate of return 4.9%) and less successful groups (rate of return -3.1%). Wider differences existing between the SSD successful and less successful strategies can be readily seen when compared to the FSD figures. Total debt/cow, debt/asset ratio and interest as a percentage of milk sales are significantly different in all ten years (1974 to 1983). An interesting trend to note is the greater divergence in most of the variables during the second half of the ten year period.

The addition of risk aversion as a restriction to farmers' utility functions results in substantial differences between the debt management strategies of succesful and less successful farms. Farms with superior RREQ's in the second degree stochastic dominance analysis consistently had lower total debt/cow, debt/asset ratios and interest payments as a percentage of milk sales. This implies that, for risk averse farmers, debt management strategies are an important factor in maximizing utility.

An example is leverage or debt/asset management. The debt/asset ratio is a leverage measure currently popular when discussing degree of financial stress and potential farm survival. During the 1970s a high leverage ratio was attractive to farmers because of low real interest rates and appreciation of farm assets. During the early 1980s that scenario has reversed. Successful farms, whether measured by FSD or SSD (Figures 3 and 4) decreased their debt/asset ratio over this period. There was no statistical difference in this ratio for FSD successful and less successful farmers, although the numerical difference widened over the 10 year period and in future years statistical differences may develop. The successful SSD farmers had a significantly lower debt/asset ratio than the less successful SSD farmers. What this implies is that during the entire 10 year period, not just the last 5 years, a high degree of leverageness was a high risk strategy which did not produce higher rates of return on equity.

Conclusions

An important conclusion which can be drawn from this analysis concerns the relative importance of debt management over the years covered by the study. The results of both the first degree stochastic dominance (FSD) and second degree stochastic dominance (SSD) analysis seem to indicate that it was the strategy for the second half of the sample period, 1979-1983, which was relatively more important in determining "successful" rates of return to equity capital. This coincides with the increased risk and financial stress placed on farmers as a result of the variable interest rates, and higher real interest rates, common after 1979. It would appear that the years after 1979 were those in which "the cream rose to the top" in terms of dairy farmers' abilities to successfully manage their finances. One implication which this conclusion holds for future financial management strategies is that farmers should not become complacent with the status quo and assume that current trends (e.g. high interest rates) will continue indefinitely. Being alert to changing circumstances, or even better, attempting to anticipate them can be very important to a farmer's success.

Another implication of this study becomes evident when a comparison is made between the successful groups of farms from the FSD and SSD analyses. Aversion to risk often results in decision makers sacrificing higher expected returns in order to lower the variance of those returns. However, in this study, strategies preferred by risk averse managers (SSD) achieved a higher mean rate of return to equity capital (4.9%) for the ten year period than strategies for managers who were not necessarily risk averse (FSD) (4.0%). It would appear, then, that aversion to risk can be a beneficial attribute in managing debt to produce high rates of return on equity capital.

Finally, analyzing more than one year of farm summary data allows determining whether a management strategy is consistently successful for different production and economic environments, and thus provides greater insight than does the analysis of a single year's data. The use of stochastic dominance also allows analyzing those data on a basis consistent with economic theory rather than on an ad hoc basis.

REFERENCES

Anderson, Jock R., John L. Dillon, and J. Brian Hardaker. Agricultural Decision Analysis. Ames: The Iowa State University Press, 1977.

Bratton, C.A. "Dairy Management Practices and New York Dairy Farm Incomes," A.E. Res. 84-6, Department of Agricultural Economics, Cornell University, 1982.

Fishburn, P.C. Decision and Value Theory. New York: Willey, 1964.

Hadar, Josef, and William R. Russell. "Rules for Ordering Uncertain Prospects." The American Economics Review, 59 (1969): 25-34.

Hammond, J.S. "Towards Simplifying the Analysis of Decisions Under Uncertainty Where Preference Is Nonlinear." D.B.A. Thesis, Harvard University, 1968.

Hanoch, G., and H. Levy. "Efficiency Analysis of Choices Involving Risk." Review of Economics Studies, 36 (1969): 335-346.

Quirk, J.P., and R. Saposnik. "Admissibility and Measurable Utility Functions." Reviews of Economic Studies, 29 (1961): 140-146.

Robison, Lindon J. "An Appraisal of Expected Utility Hypothesis Tests Constructed from Responses to Hypothetical Questions and Experimental Choices." American Journal of Agricultural Economics, 64 (1982): 367-375.

Schurle, Bryan W., and Jeffrey R. Williams. "Application of Stochastic Dominance Criteria to Farm Data." Paper presented at the American Agr. Econ. Assoc. Meetings, Utah State University, August 1-4, 1982.

Smith, Stuart F. and Linda D. Putnam. "1983 New York Dairy Farm Business Summary." A.E. Res. 84-10, Department of Agricultural Economics, Cornell University, 1984.

Warren, S. W. "Forty Years of Farm Management Surveys." Journal of Farm Economics 27 (1945):18-23.

Whitmore, G.A., and M.C. Findlay. Stochastic Dominance. Lexington, Massachusetts: D.C. Heath and Company, 1978.