Staff Papers Series

Staff Paper P89-40

October 1989

INDUSTRY AND SIZE EFFECTS IN AGRICULTURAL COOPERATIVES

Zvi Lerman

Claudia Parliament

Department of Agricultural and Applied Economics

University of Minnesota
Institute of Agriculture, Forestry and Home Economics
St. Paul, Minnesota 55108

Staff Paper P89-40 October 1989

INDUSTRY AND SIZE EFFECTS IN AGRICULTURAL COOPERATIVES

Zvi Lerman

Claudia Parliament

Visiting Professor and Assistant Professor, respectively, Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, MN 55108. This paper was written when Zvi Lerman was on sabbatical leave from Department of Agricultural Economics and Management, Hebrew University, Rehovot, Israel 76100.

This research was supported by BARD - U.S.-Israel Binational Agricultural Research and Development Foundation as part of a three year study.

INDUSTRY AND SIZE EFFECTS IN AGRICULTURAL COOPERATIVES

The objective of this study is to determine if there are important size and industry effects on financial performance of cooperatives. The analysis of a sample of 43 cooperatives over the period 1970-1987 indicates that large cooperatives are more efficient in utilization of their assets, while small cooperatives have higher profitability. The dairy cooperatives appear to be the strongest performers among the four industries studied. The food marketing cooperatives, many of which engage in value added processing, are characterized by the lowest performance measures. The most striking trend effect estimated from this sample is the decline in profitability for all industry and size categories.

Performance evaluation of cooperatives has always been a topic of considerable interest in agricultural economics, primarily because of the considerable significance of the cooperative form of organization in agriculture in both developed and developing countries. Recent studies of cooperative performance have raised some questions, however. One study has shown that the performance of cooperatives relative to investor owned firms is on the whole inconsistent with theoretical predictions. Another study, using basically the same performance evaluation measures, revealed contradictory results. This paper explores some of the factors that may have led to these inconsistencies.

Recent findings by Parliament, Lerman, and Fulton show that dairy cooperatives evaluated by standard measures of profitability, efficiency, and capital structure performed not worse and in some cases better than investor owned firms in the dairy industry over a 14 year time horizon. These results were surprising because the theory of cooperative behavior suggests that cooperatives can be expected to have inferior performance compared to investor owned firms as evaluated by these standard financial measures. Indeed, in an earlier study, Chen, Babb, and Schrader observed higher leverage and lower profitability for cooperatives than for investor owned firms, in line with theoretical predictions.

The differences in findings between the two studies may be attributable to both size and industry effects. Parliament, Lerman, and Fulton examined a sample of firms with mixed assets sizes up to $100 million, all in the dairy industry, whereas Chen, Babb, and Schrader studied "large" agribusiness firms with 1975 mean asset

size of over $143 million, drawn from five food industry groups, including the dairy industry. To explain the different findings of the two studies, it could be conjectured that (a) the performance of cooperatives changes with size; (b) the performance of cooperatives varies across industries.

The objective of this study is to determine if there are important size and industry effects on profitability, efficiency, liquidity, and capital structure of cooperatives. Such effects, if detected, may help to determine whether cooperatives should continue to emphasize growth, as has been evident in the persistence of mergers among cooperatives, and whether the cooperative form of organization is more successful in some industries than in others.

The paper is organized as follows. The next section describes the data and the methodology used in this research. The three sections that follow present the results on size effects, industry effects, and regression trends over time. Conclusions and policy implications are given in the last section.

DATA AND METHODOLOGY

The research will examine the performance of cooperatives using financial ratio analysis, a standard techniques of performance evaluation (Babb and Lang; Chen, Babb, and Schrader; Parliament, Lerman, and Fulton; Schrader, Babb, Boynton, and Lang). Financial ratios reflect the effect of strategic decisions and should reveal if differences exist among cooperatives in different size and industry categories. Table 1 presents the definitions of the four financial ratios used in this research, which measure profitability, leverage, efficiency, and liquidity on the basis of reported accounting data. A discussion of the theoretical relevance of these financial ratios for performance evaluation of cooperatives will be found in Parliament, Lerman, Fulton.

The data for this research included a sample of 43 cooperatives in four industries: 12 dairy cooperatives, 12 supply cooperatives, 14 food marketing and processing cooperatives, and 5 grain and cotton marketing cooperatives. There was some initial uncertainty as to the proper classification of grain and cotton cooperatives in the sample. Because grain marketing cooperatives also sell farm inputs to their members, it could be argued that they should be classified as supply cooperatives. Because cotton cooperatives operate on a pooling basis, it could be argued that they should be classified with the pooling food cooperatives. The uncertainty was resolved by applying multivariate discriminant analysis, which indicated that grain marketing cooperatives were distinct from the supply cooperatives and furthermore could be combined with the cotton cooperatives into one category.

TABLE 1: Financial Ratio Measures of Performance

Performance criteria	Ratio	Definition
Profitability	Rate of return on equity	Profit before tax* / Total equity
Leverage	Debt to equity	Total liabilities / Total equity
Efficiency	Asset turnover	Sales / Total assets
Liquidity	Quick ratio	Current assets / Current liabilities

* The before-tax rate of return on equity is used because of possible differences in tax treatment between cooperatives with different patronage refund policies.

In view of the results of discriminant analysis, it was decided to classify the grain and cotton marketing cooperatives as a separate, although admittedly small, category.

The cooperatives were classified by total assets into two size categories, "small" and "large." The range of mean total assets of the cooperatives in the sample was from $3 million to $911 million (averaged over the sample period). The distribution of mean asset size for the cooperatives is shown in Figure 1. For purposes of size analysis, 29 cooperatives with mean total assets up to $125 million were classified as "small" and 14 cooperatives with mean total assets of over $125 million were classified as "large." The size classification threshold was identified by an agglomerative cluster analysis of the cooperatives by mean asset size. Figure 2 presents the distribution of the 43 cooperatives by industry and by size within each industry.

The financial ratios of all the cooperatives were calculated from their audited annual reports collected for the period 1970-1987. The full 18 years of data were available for 21 cooperatives and 35 of the 43 cooperatives had a continuous 14-year time series from 1974 to 1987. The minimum number of observations was 7 years (for one cooperative only).

The time-series data were used to trace the behavior of cooperatives in different categories over time. For each observation year, the median of each of the four financial ratios was calculated separately in each industry and size category. In this way, a time series of 18 median observations was obtained for each financial ratio by industry and size categories. The median was chosen as the descriptive statistic because it is more robust to outliers than the mean, and examination of the data revealed occasional outliers.

The 1970-1987 time series of the median financial ratios were analyzed using the nonparametric Kruskal-Wallis test ("one-way analysis of variance by ranks") in order to detect significant differences among industry and size categories (Daniel). In application to the two size categories, the Kruskal-Wallis test coincides with the Wilcoxon rank-sum test. The test ranks the pooled median financial ratios in different categories and forms the sums of the ranks for the pooled sample. If the rank sums, or the average scores, are sufficiently different among the categories, the test rejects the null hypothesis that the median financial ratios are the same across categories and establishes that, with a certain probability, the industry or size categories have different median financial ratios. The average rank scores in each category can be used to rank performance. The performance ranking of the different categories over the 1970-1987 period obtained in this way was verified by Page's nonparametric test for ordered alternatives (Daniel), which uses the additional information that the 18 observations in each

FIGURE 1: Distribution of Mean Assets

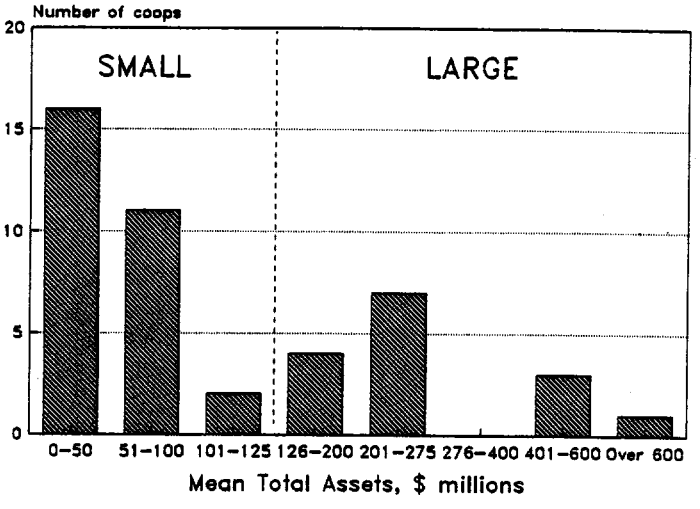
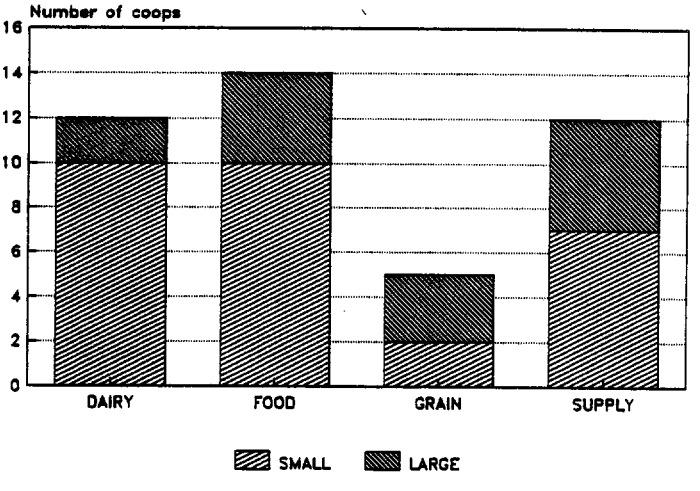


FIGURE 2: Distribution of Cooperatives



SIZE	INDUSTRY				
	Dairy	Food	Grain	Supply	Total
Small	10 (23%)	10 (23%)	2 (5%)	7 (16%)	29 (67%)
Large	2 (5%)	4 (9%)	3 (7%)	5 (12%)	14 (33%)
Total	12 (28%)	14 (32%)	5 (12%)	12 (28%)	43 (100%)

category are ordered by years. Since the Page test results confirm and reinforce the Kruskal-Wallis test results, only the latter are reported in full.

In addition to tests of the performance ranking of categories, linear regression analysis of the median time series was used in order to identify differences in financial ratio trends by size and industry.

SIZE EFFECTS

On the whole, significant size effects were observed between large and small cooperatives over the period 1970-1987. Except for the median leverage, which was not found to be significantly different for small and large cooperatives, all the other ratios were significantly different between the two size categories at 5% level of significance. The Kruskal-Wallis test results for the four median ratios by size category are presented in Table 2. The median efficiency of asset utilization was significantly higher for the large cooperatives, while the median liquidity measure was significantly higher for the small cooperatives. The median rate of return on equity was higher for the small cooperatives in 16 out of the 18 years - a highly significant difference. The Page test produced identical results.

The effect of size on profitability was also examined after removing the food marketing cooperatives from the sample. Most food marketing cooperatives operate on a pooling basis, and as a result their net income, and hence the rate of return on equity (ROE), is not comparable to the other cooperatives. The median ROE for the small non-food cooperatives was shown by both Kruskal-Wallis and Page tests to be significantly higher than that for the large cooperatives over the period 1970-1987.

To illustrate the dispersion of the ratio values in each year, the top and bottom (25% and 75%) quartiles of the financial ratios were calculated for each year for the large and the small cooperatives. The interquartile range traces a band around the median that contains 50% of the observed ratio values in the sample of cooperatives for each particular year (this band is not necessarily symmetric about the median). The interquartile range is a measure of dispersion analogous to standard deviation, but less sensitive to outliers. Examination of the interquartile range of the two size categories over time provides a visual confirmation of the Kruskal-Wallis and Page test results presented above.

TABLE 2: Kruskal-Wallis Rank Test of Median Financial Ratios of Cooperatives by Industry

Ratio	Mean score		Chi-Sq statistic	Prob > Chi-Sq*
	Small	Large		
Return on equity	25.6	14.4	5.33	0.021
non-food only	22.8	14.2	6.09	0.014
Debt to equity	17.3	19.7	0.48	0.486
Sales to assets	12.2	24.8	12.78	0.000
Quick ratio	24.4	12.6	11.25	0.000

* The probability that the Chi-Sq statistic exceeds the observed value under the null hypothesis that the median financial ratios are equal for the two size categories.

Figure 3 (panels a to d) superimposes the interquartile range of small and large cooperatives for each ratio. Panel a shows that the interquartile range of the leverage ratio for the large cooperatives lies almost entirely within the interquartile range for the small cooperatives over the period 1970-1987. The overlapping interquartile ranges indicate that the median leverage is not significant different for the small and the large cooperatives.

In panel b, the interquartile range of the efficiency ratio for the large cooperatives lies within the interquartile range for the small cooperatives until about 1979, after which the top quartile value of the large cooperatives is consistently higher than the top quartile value of the small cooperatives. The graphical presentation reveals that the difference between large and small cooperatives became more pronounced over the later period 1979-1987. Large cooperatives are thus on the whole more efficient than the small cooperatives in utilizing their assets to generate sales.

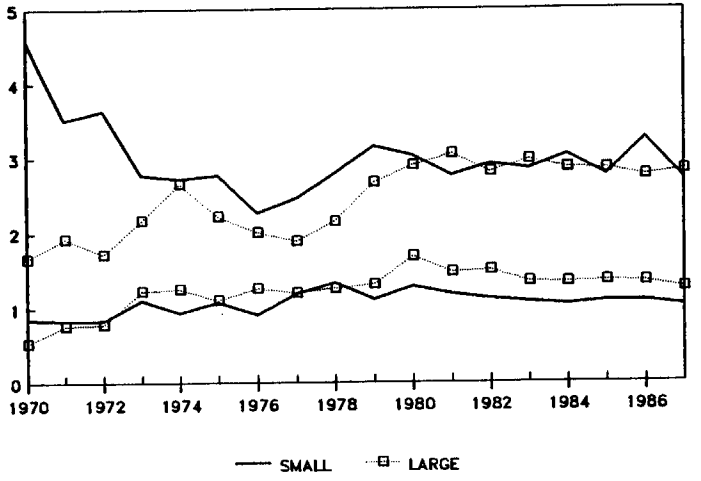
In panel c, the top quartile of the quick ratio for the small cooperatives consistently lies above the top quartile for the large cooperatives, while the bottom quartiles roughly overlap. This indicates that the quick ratio for the small cooperatives is on the whole higher than for the large cooperatives.

Panel d presents the interquartile range of the rate of return on equity for 29 large and small "non-food" cooperatives. The upper quartile of the ROE for the small non-food cooperatives lies above the upper ROE quartile for the large cooperatives in all 18 years, and the bottom quartile of the small cooperatives lies above the bottom quartile of the large cooperatives in 13 out of the 18 years. The rate of return on equity for the small cooperatives is thus on the whole higher that for the large cooperatives.

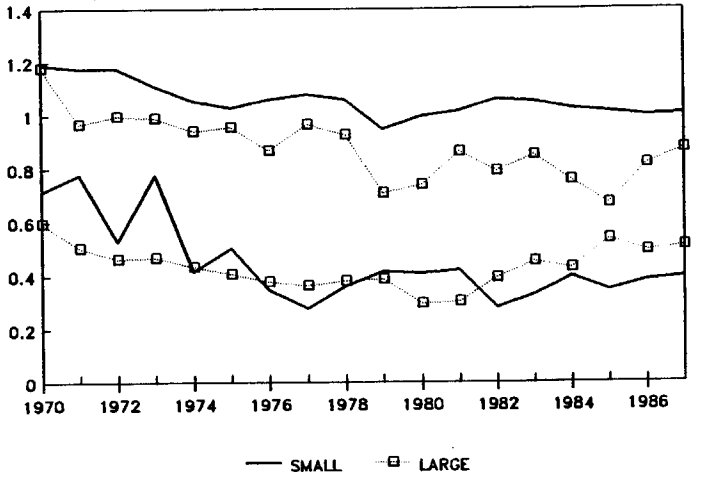
The Kruskal-Wallis test of the median time series and the visual examination of the interquartile ranges reveal significant size effects by all ratios, except leverage. The small cooperatives have a higher profitability and are more liquid than the large cooperatives. In contrast, the large cooperatives are more efficient in utilizing their assets to generate sales. The results suggest that cooperatives may enjoy scale economies in terms of efficiency, but the benefits of size do not necessarily translate into higher profitability. The higher rate of return on equity for the small cooperatives is consistent with the "small-firm effect" observed for investor owned corporations, which shows that investors in small firms usually earn higher rates of return on investment (see Levy and Lerman and references therein). With respect to liquidity, it could be hypothesized that small firms, with a relatively small asset base, maintain a higher liquidity buffer than large, asset-rich firms. By the same

FIGURE 3. Interquartile Range of the Financial Ratios by Size Category, 1970-1987

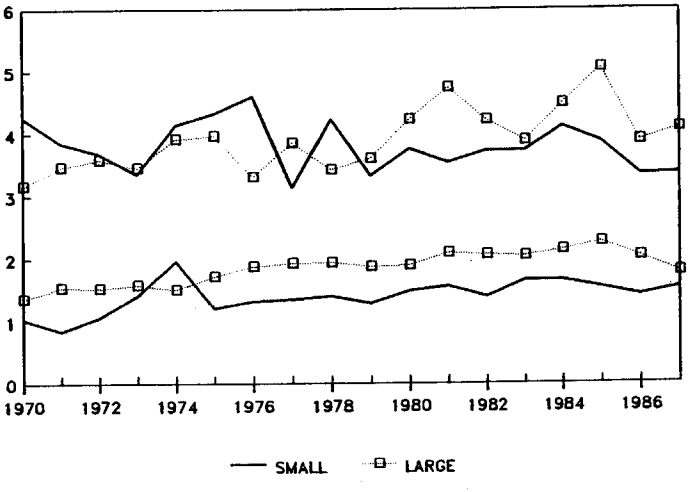
(a) DEBT TO EQUITY



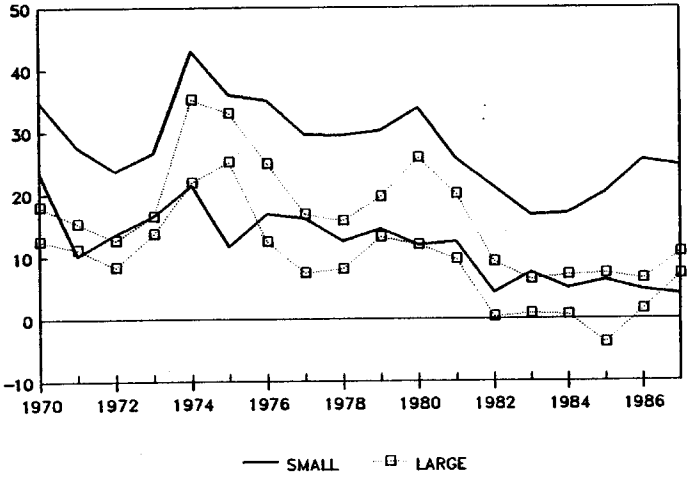
(c) QUICK RATIO



(b) SALES TO TOTAL ASSETS



(d) RATE OF RETURN ON EQUITY (NON-FOOD)



token, it could be argued that small cooperatives would have a lower leverage than the large, more secure cooperatives. However, the results indicate that there are no significant differences in capital structure between small and large cooperatives. Further research of the size effects on liquidity and leverage for both cooperatives and investor owned firms is required.

INDUSTRY EFFECTS

Clear industry effects were found for all the median financial ratios by the Kruskal-Wallis and Page tests. The Kruskal-Wallis test results (Table 3) show that the industry effects were significant at 1% level. The statistical test results are visually confirmed by the time series graphs in Figure 4 (panels a to d). As it was not practicable to superimpose the interquartile ranges for the four industries, the graphs in Figure 4 only plot the median ratios by industry over the period 1970-1987.

The leverage ratio (panel a) was found to be the highest for the food marketing cooperatives and the lowest for the supply cooperatives, with the dairy and grain cooperatives lying in the middle. Except for the initial period 1970-1974, the dairy cooperatives exhibited a lower leverage than the grain cooperatives.

The four industries are also clearly differentiated by efficiency (panel b). Dairies have the highest efficiency, followed by grain and supply cooperatives in this order, with the food marketing cooperatives at the bottom of the ranking.

Liquidity is the highest for dairy and supply cooperatives, which both have relatively high quick ratios near the level of 1.0 (panel c), while food and grain cooperatives have relatively low quick ratios around 0.5. The Kruskal-Wallis test indicates that the differences in the quick ratio are not significant only between the food and grain cooperatives.

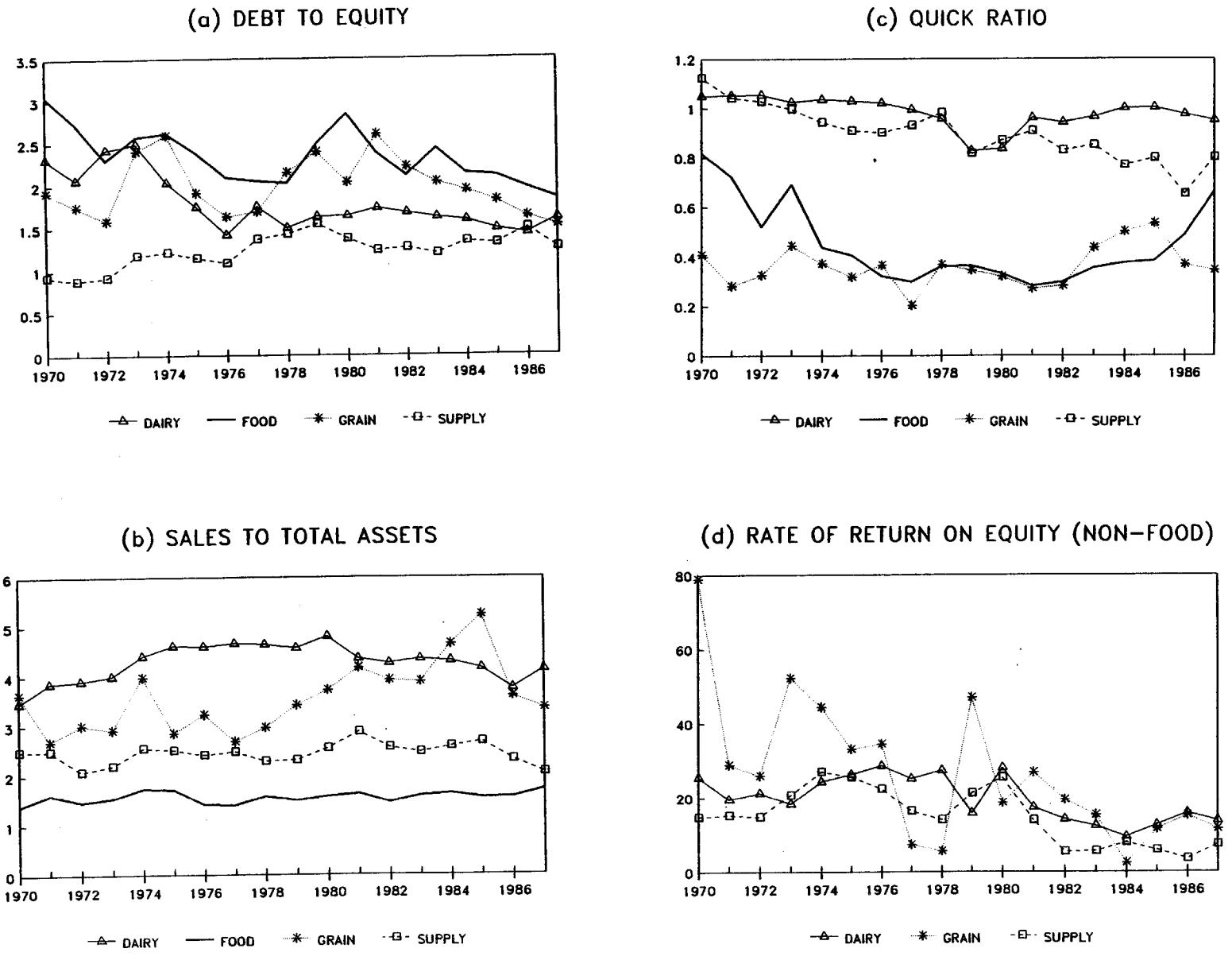
The median rate of return on equity is much higher for the food marketing cooperatives that operate on a pooling basis that for the nonpooling cooperatives in the other industries. This is due to the fact that the net income figure used in calculating the rate of return on equity is not comparable and gives a spurious result for the food cooperatives. It is meaningful to compare only dairy, grain, and supply cooperatives on this ratio. When the food cooperatives are removed from the sample (panel d), no significant differences in ROE are found between dairy and grain cooperatives, but both show significantly higher ROE than the supply cooperatives (although only at 10% level of significance).

TABLE 3: Kruskal-Wallis Rank Test of Median Financial Ratios of Cooperatives by Industry

Ratio	Mean score				Chi-Sq statistic	Prob > Chi-Sq*
	Dairy	Food	Grain	Supply		
Return on equity	29.4	62.5	33.2	20.9	40.3	0.000
non-food only	29.4	--	32.2	20.9	5.0	0.081
Debt to equity	34.8	57.1	44.1	10.0	48.8	0.000
Sales to assets	60.4	9.5	48.4	27.7	28.5	0.000
Quick ratio	59.2	21.6	15.8	49.4	54.6	0.000

* The probability that the Chi-Sq statistic (the large-sample approximation of the Kruskal-Wallis statistic) exceeds the observed value under the null hypothesis that the median financial ratios are equal for the four industry groups.

FIGURE 4: Median Financial Ratios by Industry, 1970-1987



In summary, on an unweighted multiobjective scale, the dairy cooperatives appear to be the strongest performers among the four industries, with top scores by efficiency and liquidity and second by leverage and profitability. The food marketing cooperatives are the weakest performers, with lowest scores by leverage, efficiency, and liquidity. The supply and grain cooperatives each rank first by one measure: the supply cooperatives are the strongest by leverage, the grain cooperatives by the rate of return on equity. The complete scores are summarized in Table 4.

TRENDS

The nonparametric rank tests of the median time series made it possible to identify differences and establish performance rankings across industry and size categories, but did not provide information on trends of the financial ratios over time. Cursory visual examination of the time series reveals pronounced trends, such as the decline over time of the leverage ratio in the dairy industry. To identify trends, ordinary least-squares regression was run for each ratio on time by industry and size category. The regression results are reported in Table 5. The table only identifies the insignificant coefficients, because most coefficients were significant at 10% level. The R-square of the trend regressions which had significant coefficients ranged from a low of 0.24 to a high of 0.81, with most of the values (11 out of 16) over 0.40.

The most striking trend effect is the estimated significant decline in rate of return on equity for all industry and size categories. The grain and food cooperatives showed the steepest decline in the estimated rate of return on equity. The trend regression for the food cooperatives has less explanatory power and lower significance because of the large variability in the rate of return on equity due to pooling in the food marketing cooperatives. The estimated ROE of the dairy and supply cooperatives declined at a much lower rate over time. The ROE declined at approximately the same estimated rate for the grain and food cooperatives on the one hand and for the dairy and supply cooperatives on the other. The estimated negative slope coefficient for large and small cooperatives was virtually the same, indicating that the rate of decline in ROE was not affected by size.

Food and dairy cooperatives, which initially had relatively high leverage, showed a pronounced decline in the estimated leverage over time. Supply cooperatives, with initially the lowest leverage, slightly increased their estimated debt levels over time, yet in 1987 they still had the lowest leverage among the four industries. The leverage of the grain cooperatives did not show a significant trend. It might be conjectured that the highly

TABLE 4: Multiobjective Performance Scores of Cooperatives by Industry, 1970-1987 (1 = Lowest, 4 = Highest)

	Profitability*	Leverage**	Unweighted Efficiency	Liquidity	Score
Dairy	3	3	4	4	3.50
Food	--	1	1	1.5	1.17
Grain	4	2	3	1.5	2.63
Supply	2	4	2	3	2.75

* No profitability score was assigned to the food industry because most food marketing cooperatives are pools.

** Leverage scores are assigned in the inverse order of the numerical values of the leverage ratio, because low leverage is considered superior to high leverage due to the lower associated risks.

TABLE 5: Trend Regression of Median Financial Ratios by Industry and Size, 1970-1987

	Profitability	Leverage	Efficiency	Liquidity
INDUSTRY				
Dairy	-0.74	-0.05	0.01#	-0.01
Food	-2.35##	-0.04	0.01#	-0.01##
Grain	-2.48	-0.01#	0.07	0.00#
Supplly	-0.93	0.02	0.00#	-0.02
SIZE				
Small	-1.02	-0.04	-0.03	-0.02
Large	-1.00	0.03	0.03##	-0.01

# indicates not significant at 10% level;

indicates not significant at 5% level.

leveraged food and dairy cooperatives benefited from erosion of their fixed-rate debt in the inflationary period 1973-1980: their equity component increased through unrealized capital gains, driving the leverage ratio down over time. This conjecture requires further research.

The efficiency ratio did not exhibit pronounced trends either by industry or by size. Most of the estimated trend regression coefficients were not significantly different from zero, and the two statistically significant coefficients were close to zero.

The quick ratio exhibited a slight but significant downward trend over time in most categories. The estimated rate of decline was very similar across size and industry categories.

CONCLUSIONS

One of the persistent trends among cooperatives is growth through mergers and acquisitions. The findings of this study indicate that although larger cooperatives improve their efficiency through economies of scale, the higher efficiency of asset utilization does not translate into higher profitability. This suggests that the benefits of mergers may be overemphasized.

Analysis of the four industries reveals that among cooperatives dairies are overall the strongest performers, ranking high by profitability, leverage, efficiency, and liquidity. This strong performance may be due to the government guaranteed milk prices.

The food cooperatives are the weakest performers by measures of efficiency and capital structure. In a recent study of two regional agricultural cooperatives in Israel (Yacobi), it was found that the cooperative engaging in value-added food processing had significantly higher leverage and lower efficiency than the cooperative that limited its activities to raw produce marketing. Most US food cooperatives engage in value-added processing and marketing of consumer products. The Israeli analogy, however limited, reinforces the opinion that manufacturing of value added consumer products may not be a particularly suitable activity for cooperatives, despite the seductive allure of forward integration. Cooperatives do not always have the managerial expertise and the financial resources required to successfully penetrate the consumer food markets.

Grain, cotton, and supply cooperatives have generally limited their activities to raw produce marketing and input purchasing. These are the typical activities that cooperatives are traditionally established to handle. The performance of these cooperatives by all measures is superior to that of food cooperatives engaging in value

added processing. Thus, insofar as the performance of dairy cooperatives may be influenced by indirect government support, these research findings seem to strengthen the view that cooperatives should limit their value-added processing operations and restrict their scope to traditional activities.

The most disturbing result of this study is the estimated significant decline of profitability for all industry and size categories over time. While there is no immediate explanation of this phenomenon, it paints a bleak picture for the future of the cooperatives. This trend should not be allowed to go unnoticed and a research effort is justified in order to determine its causes.

REFERENCES

Babb, E.M., and M.F. Lang. 1985. "Implication of Comparative Performance of Cooperatives and Investor Owned Firms." Farmer Cooperatives for the Future: NCR-140 Research on Cooperatives and Extension Committee on Organization and Policy Published Proceedings. Department of Agricultural Economics, Purdue University, West Lafayette, IN.

Chen, K.-S., E.M. Babb, and L.F. Schrader. 1985. "Growth of Large Cooperative and Proprietary Firms in the US Food Sector." Agribusiness, vol. 1, no. 2, 201-210.

Daniel, W. W. 1978. Applied Nonparametric Statistics, Houghton Mifflin, Boston.

Levy, H. and Z. Lerman. 1985. "Testing P/E Filters by Stochastic Dominance Rules." Journal of Portfolio Management, vol. 11, no. 2, 31-40, Winter.

Parliament, C., Z. Lerman, and J. Fulton. 1989. "Performance of Cooperatives and Investor Owned Firms in the Dairy Industry." University of Minnesota, Department of Agricultural and Applied Economics, St. Paul, MN, Staff Paper P89-33.

Schrader, L.F., E.M. Babb, R.D. Boynton, and M.G. Lang. 1985. "Cooperative and Proprietary Agribusinesses: Comparison of Performance." Purdue Agricultural Experiment Station Research Bulletin 982, Purdue University, West Lafayette, IN.

Yacobi, U. (1989) A Comparative Study of Two Regional Cooperative Enterprises in the Negev, MSc Thesis, Department of Agricultural Economics and Management, Hebrew University, Rehovot, Israel [in Hebrew, with English summary].