THE DEVELOPMENT AND ANALYSIS OF FINANCIAL INDICES FOR COOPERATIVE ELEVATORS IN OKLAHOMA

by

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CHAPTER I

INTRODUCTION

Cooperatives perform many important functions in Oklahoma's agricultural marketing system. In performing these functions, Oklahoma cooperatives marketed a net volume of 192 million dollar's worth of farm products in 1963. Including intercooperative business (gross business), the value of farm products marketed by cooperatives was 300 million dollars.

Ninety-seven farmer cooperatives handled grain in Oklahoma in 1963. These cooperatives did a gross business of 191 million dollars and a net business of 90 million dollars. Eighty-two of these firms, with an estimated membership of 54,000[1], were listed as grain cooperatives by the United States Department of Agriculture. As a result of this volume of business, Oklahoma ranked 10th in the marketing of grains by cooperatives among the fifty states in 1963. In 1954 the state ranked 12th.[2]

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[1] B. L. Swanson, Statistics of Farmers Cooperatives 1962-63, United States Department of Agriculture, Farmer Cooperatives Service, General Report No. 128 (Washington 1965), pp. 47-48.

These figures must be considered conservative because the figures do not include cooperatives established out-of-state with branches in Oklahoma. The exact number of grain cooperatives in Oklahoma is not known. However, Commercial Grain Warehouses in Oklahoma, Oklahoma State University Extension Service, (Stillwater, 1965), Leaflet 54-499 includes 128 grain cooperatives.

[2] Ibid, p. 28.

Many early cooperatives were established to provide marketing outlets as the grain industry developed in Oklahoma. Where outlets already existed, cooperative elevators were often established by grain producers to reduce marketing margins; therefore making the industry more competitive. With the development of the grain industry in the state, farmers turned to cooperatives for marketing their products. As agricultural technology developed, grain producers also looked to cooperative elevators as a source of supply for many products and services necessary for profitable farming and ranching. Further, cooperative grain elevators have played an important role in the storage of government owned grain. In January of 1964, Oklahoma had 239 million bushels of off-farm commercial storage facilities approved by the U. S. Government for this purpose.[3] Of this capacity, 100 million bushels were in cooperative grain elevators.[4]

Oklahoma's cooperative grain elevators operate in a highly competitive and constantly changing environment. One important operational change, the expansion of storage facilities by cooperative elevators, was related to a large accumulation of grain stocks. The storage phase of the price support program became an important source of revenue for grain elevators. Among the cooperatives studied, 35 percent of their gross earnings was derived from storage in 1962.

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[3] Off-farm Commercial Storage Facilities for Grain, United States Department of Agriculture, Marketing Economics Division, Economic Research Service Bulletin No. 252 (Reprinted from the Marketing and Transportation Situation August 1965, Washington), p. 29.

[4] Commercial Grain Warehouses in Oklahoma, p. 29.

This situation may be reversed in the future if production is decreased or if agricultural policy is successful in decreasing the current stocks of wheat. Increases in exports may drastically reduce the amount of wheat in storage. In either case, many elevators may be forced to adjust to lower levels of operation and over-capacity could become a major problem.

Adjustments in financial organization and operation will be necessary to provide the most efficient services to the patrons. Inefficiency may result in added costs since the same output or revenue can be produced with fewer inputs or more output can be realized with the same inputs. These added costs may be reflected in a lower price which the farmer receives for his grain or a higher cost of the goods and services he buys from his cooperative.

Some of the costs of inefficiency are ultimately shifted to society through higher cost of food and fiber. Another social cost of inefficiencies in marketing agricultural production is slower economic growth if inefficient resource allocations in agricultural industries use resources that could be employed more productively elsewhere.

The efficiency of any firm is largely a function of management. In cooperative grain elevators, especially, management includes the board of directors as well as operating management. Management should be continuously searching for more effective solutions to their problems and for better tools with which to perform the function of management if the cooperatives are going to perform profitably. Financial ratio analysis which shows the relationship between two quantities or values, the subject of this study, is recognized as one of these tools.

Statement of the Problem

Management uses a variety of methods and techniques in an attempt to maintain economic efficiency. Efficient management should not make decisions at random. Inputs should be added only with consideration of the alternatives. Products and services should be added when the cooperative can benefit from these additions. Output should be retained only if the cooperative's changing environment demands the good or service. Management should also be ready to modify the volume of a product or service to meet current conditions. Inefficiencies often arise because management is unaware of the most effective tools for controlling and planning the business.

Management needs to be in frequent and intimate contact with all activities and happenings that affect the firm's operation or financial position both from within the firm and from its environment. Management must receive data from which it can evaluate these activities and project their findings into the future. These data must be current, concise, and accurate. The data must be objective, have economic meaning, and should not burden management with minute details. Financial ratio analysis is but one of the many tools which management should use in carrying out its controlling function.[5]

Financial ratios give meaning to seemingly unrelated events. The value of a financial ratio at any instant is a concise and easily interpreted evaluation of a condition existing at that time. Proper interpretation of data presented by financial ratios helps to:

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[5]Louis A. Allen, Management and Organization, (New York and London, 1958), p. 14.

(1) judge the profitability of operations during given time periods; (2) determine the soundness of financial conditions at a specified date; (3) predict future ability to meet existing or anticipated credit obligations; and, (4) develop performance trends to be used as a basis for further decision making.[6]

An understanding of the significance and use of ratios should point out financial and operational weaknesses and whether a financial condition is good, poor, questionable, or some combination of these characteristics. A limiting factor often is management. A sub-standard ratio is merely a symptom that a part of the business is inefficient. Successful management should be able to recognize these symptoms and have the knowledge, aggressiveness and ability to solve the problem which the symptoms indicate.[7]

Financial ratios should be considered only as an aid to thinking and not a substitute for it. Management must also consider such factors as : (1) current economic conditions in general and particularly the conditions within the firm's industry; (2) the outcome of pending legislation and other institutional arrangements that might influence the business; (3) technological advances in the industry; (4) changes in population and wage scales; (5) changes in source of supply, markets or marketing methods; and (6) other items which affect the interpretation of the ratios.[8]

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[6]Richard W. Schermerhorn, Financial Statement and Analysis for Agricultural Marketing Firms, University of Maryland Cooperative Extension Service Information Series No. 24 (College Park, 1964) p. 2.

[7]Ibid, p. 18.

[8]Ibid, p. 30.

To determine whether a given ratio indicates a weak condition there must be some standard against which the ratio can be compared. More than a comparison over time is necessary. A given ratio may be improving year after year and still indicate an abnormally poor condition relative to the same ratio of similar firms. Therefore, it is desirable to have standard ratios which can serve as bench-marks for comparison with a given firm's observed ratios. For some ratios general standards have been developed.[9] For other ratios standards can be developed from averages of the ratios taken from industry wide data.

It should be emphasized that these types of standards, like the ratios themselves, should be used only as bench-marks. Standard ratios for a soundly managed, well-established firm will not necessarily be adequate for measuring a new or rapidly growing firm in the same industry. The individual ratios of a firm may differ considerably from the industry averages because factors such as size, organizational structure or goals, and competition are not considered in forming the industry averages.[10] Also, because cooperatives operate in a dynamic world, it is impossible to state exactly what the numerical value of a given ratio should be for any one cooperative.

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[9]Several references are available, among them are: Henry Ponder, "A Business Study of Selected Oklahoma Cooperative Grain Elevators, 1953-1955" (unpublished M. S. Thesis, Oklahoma State University, 1958), found throughout dissertation; Clifford Alston, Agricultural Cooperatives-Analyses of Financial Statements, University of Arkansas Agricultural Extension Service Circular No. 471 (Little Rock, 1951), found throughout circular; and D. N. Donaldson and P. V. Hemphill, Operating Practices of Farmers' Cooperative Elevators in Colorado, Colorado Agricultural Experiment Station Bulletin No. 397 (Fort Collins, 1932), pp. 36-37.

[10]Schermerhorn, p. 18.

Many ratios can be computed when analyzing a firm's financial position. Each of these ratios illustrates a specific part of the firm's activities. Although each of these ratios is important in determining the specific cause of a weak financial position, management often wants a specific value which illustrates its overall financial position based on several underlying financial factors. Management has been able to look at a set of its own ratios and compare these ratios with certain standard ratios. Often these standards have been outdated or have not been established for a specific industry. Even when the standard ratios are current and for a given homogeneous industry, comparing a large set of ratios becomes cumbersome and fails to give an overall picture of the financial state of a firm. Given a standard set of ratios to compare with a single firm's observed ratios, management is faced with the problem of determining which ratios are of most importance; that is, which ratios, if improved, may be most beneficial to the cooperatives. For a firm with several sub-standard ratios, management may not know which ratio is most important in improving its financial position.

To avoid some of these shortcomings financial indices may be computed from the ratios. The indices developed give a single evaluation of a firm's overall financial condition which may be compared with a standard index value. Through the development of financial indices the important ratios will be selected and the actual importance of each ratio evaluated.

Objectives

The general purpose of this study is to develop information by which directors, managers and member-owners can evaluate the current position of their own business relative to selected comparative statistics. The statistics developed should be designed to serve as bench-marks for management in the decision making process and to determine deletious areas within the cooperative, which, if corrected, should increase efficiency.

The short run objectives of research on firm efficiency should be directed toward increasing the profits of the firm.[11] Any other objective is not likely to motivate management to utilize the findings of the research. Thus, the assumption is made that the cooperatives as economic firms are motivated toward obtaining higher earnings for the member-owners. This objective of increased earnings is based on the assumption that increases in efficiency are ultimately reflected in price advantages to agriculture and society as a whole. It is assumed that the benefits of increased efficiency are passed on to the farmer.

In an attempt to provide management with current selected comparative statistics the specific objectives of this study are:

1. to develop current standards for selected financial ratios for Oklahoma's Cooperative Grain Elevators.
2. to determine the relative importance of selected

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[11] Clarence Phillip Baumel, "Productivity of Management in Local Cooperative Elevators" (unpublished Ph. D. dissertation, Iowa State University, 1961), p. 14.

financial and operating ratios in cooperative grain elevators.

3. to develop earnings and liquidity and solvency indices which can be used to determine the relative efficiency of management's efforts in each of these areas.

Design of Study

In the chapters that follow the study which was designed to meet the above objectives is described and the findings given. In Chapter II the source of the data is given along with some of the basic computations made from the data. Chapter II is intended to give a conventional treatment of financial ratio analysis. Several industry wide mean ratio-values are given in the chapter. These ratio-values may be considered as current ratio standards which a cooperative may use to compare with its own financial ratios. A discussion of each ratio illustrating its applications and limitations is also given.

Chapter III is a digression on the theory used in making the computations necessary for the development of the indices. Factor analysis, the technique used to develop the indices, is discussed. A simple example to illustrate factor analysis is included. Chapter IV describes the ratio selection technique and presents the indices developed. These indices are standards with which a cooperative can compare its overall financial position. An analysis of each index is also given in the chapter.

Chapter V compares the ratios used in the indices. Analyses of how the ratios change as total physical assets increase is presented.

Comparisons of the indices are also made in this chapter.

Chapter VI illustrates some applications of the indices. Earnings index values are compared with liquidity and solvency index values. An analysis is made of selected cooperatives with unique index values in an attempt to determine the causes of these unique values. Earnings index values are then compared with selected firm characteristics.

CHAPTER II

THE DATA AND CONVENTIONAL FINANCIAL RATIO ANALYSIS

The purpose of this chapter is to present the data that was used in the study. A brief discussion of conventional ratio analysis is given. Applications and limitations of each ratio are discussed. The computed current standard for each ratio is also given in this chapter.

The Data

The data used in this study were obtained from the annual audits of selected cooperative firms. All of the firms were members of the Farmers Cooperative Grain Dealers Association of Oklahoma, were primarily engaged in wheat marketing, and were typical of cooperatives in the area.

Sixty-two firms were included in the study. Fifty-nine of the firms were located in Oklahoma and three were state-line cooperatives established in Texas. The majority of these cooperatives are located in the high wheat producing area of north central Oklahoma. The cooperatives market areas overlap in several locations. Thus, the cooperative elevators compete not only with each other, but also with independent grain dealers and independent commercial elevators.

The information used in the study was taken from the fiscal audits for the crop years 1962, 1963, and 1964. It was important that the audit of each cooperative be available for all three years; therefore, only

firms that were members of the Grain Dealers Association for the total period of time covered by the study were included in the study.

The principal data used in the study were the simple averages of selected variables over the three-year period. The averaging process should have removed such factors external to the firm as weather conditions and internal factors ranging from re-financing to management changes. Because average values can be affected by extreme values and may therefore be far from representative of the sample, a simple average is not necessarily the most appropriate value to use.

The data collected from the audits were selected to explore earning ability, liquidity and solvency, and other criterion for catagorizing the firms. The data obtained came directly from the balance sheets, operating statements, and trading statements. Balance sheet and operating statement data were used in developing the ratios studied. Trading statement data were used in classifying the firms.

A major limitation of the study is that the firms analyzed did not have the same fiscal year. The levels of some inputs such as accounts receivable and inventories fluctuate widely during the year. Under these conditions the financial data for two firms with different fiscal years could indicate a wide difference in the quantity of inputs even though the cooperatives might actually be using approximately the same amounts of each input. Two cooperatives having different fiscal years can be compared only with extreme care. The distribution of the fiscal year beginning dates for the firms studied is shown in Table I.

The cooperatives selected were divided into three groups according to the value of their total physical assets in an attempt to have more

nearly homogeneous groups. The three groups are: (1) small; (2) medium; and (3) large firms. Twenty-nine firms had less than $500,000 of total

TABLE I

DISTRIBUTION OF BEGINNING OF FISCAL YEAR FOR COOPERATIVES STUDIED

Beginning Date	Number of Firms	Beginning Date	Number of Firms
January	8	July	0
February	2	August	0
March	5	September	0
April	18	October	4
May	8	November	9
June	0	December	8

physical assets and were grouped as "small firms". Nineteen firms had total physical assets from $500,000 to $749,999 and were grouped as "medium firms". The "large firms" ranged from $750,000 and up in total physical assets. Fourteen firms were included in this group. The largest firm studied had total physical assets in excess of $5,000,000 while the smallest firm had less than $150,000 worth of total physical assets.

Ratio Analysis As Used in the Study

Many people have difficulty understanding and interpreting a financial audit. The manager, director, or member-owner who is not accustomed

to looking through several pages of a financial report might of necessity think in terms of a few individual figures to determine where weak points and strong points lie.

A ratio shows the relationship between two quantities and is derived by dividing one of the quantities by the other. The base is the divisor. Some ratios are multiplied by one-hundred to obtain values greater than one. An example of the ratio of gross earnings to gross sales would be computed as follows:

$$\text{Gross earning to gross sales} = \frac{\text{gross earnings}}{\text{gross sales}} = \frac{223,892}{1,660,496} \times 100 = 13.48$$

This ratio indicates that gross earnings are 13.48 percent as large as gross sales or, alternatively stated, earnings are $13.48 per $100 of gross sales.

Ratios are used because a comparison of absolute figures from financial reports will not give a true financial picture of the firm when firms are handling different volumes of business or have different amounts or combinations of assets. In all probability a firm's volume of business and facilities will not be the same over a period of years either; therefore, a ratio gives a more logical comparison of financial statement data.

The figures used in computing ratios are based on a combination of recorded facts. These figures are valued in accordance with accounting principles and their monetary size is often determined by personal judgments. The value of assets fluctuates over time due to change in the purchasing power of money. Personal judgment enters into the estimation of many items used in computing ratios. Among the items most commonly affected are inventories, reserve for bad debts, the rate and

method of depreciation, and the value to be carried on the balance sheet or transferred to the income statement.

The ratios studied were grouped according to liquidity and solvency or earnings with major emphasis on earnings ratios. Tests for earning ability measure the economic efficiency of a firm and usually are related to the return on investment or sales. Liquidity and solvency ratios were included because the maximization of earnings is no guarantee of financial health. The drive for high earnings can force cooperatives to the brink of bankruptcy because of the strain placed on the capital structure by the requirements necessary to support these drives. For example, a cooperative may be operating on mostly borrowed capital to show high earnings on net worth. But at the same time the cooperative may find itself so much in debt that outside management may be forced on it.

Liquidity ratios measure the firm's ability to meet current obligations while solvency ratios test the firm's ability to meet the interest costs and repayment schedules associated with its long-term obligations.

A large number of ratios were initially studied to insure as many logical combinations of ratios as possible. Only those ratios for which the necessary information was available in the audits could be studied. Other possible ratios were not studied because of a lack of homogenity among the firms. For example, no analysis of salaries and wages, per se, was made because of different wage rates. Many other variations in costs are not discernible. These cost differences should be recognized as a shortcoming of the study and ratio analysis in general.

Twenty-nine financial ratios were computed for each firm for the

crop years 1962, 1963, and 1964. These three annual ratios were averaged to find a mean of each ratio for each firm. The mean of each of these ratios when averaged over all firms is presented in Tables II and III. The mean ratios by size group are also presented. These ratios provide current standards to which local cooperatives can compare their own ratios. These standards partially fulfill one of the primary objectives of the study. The variance of each ratio among years was also computed and is shown in Appendices I and II.

Interpretation of the Ratios

Part I: Earnings Ratios

In Part I each of the earnings ratios computed in the study is described. What the ratio consists of, how the ratio is computed, how it is used, and the limitations of each ratio is discussed.

Gross earnings to gross sales ratios

Three gross earnings to gross sales ratios were computed. They were gross earnings to: (1) gross sales, (2) gross commodity sales, and (3) gross operating sales. The purpose of these three ratios is to show the effect of different relative sources of income and composition of sales.

Gross earnings includes all sources of income -- gross earnings on commodities (sales less cost of goods sold), operating income (income from services such as storage, cleaning, mixing, plus other services), "other additions" (interest, rents, and odds-and-ends), patronage refunds, and dividends received. The last two items were included because they are part of the overall operation and reflect certain policies and

TABLE II

EARNINGS RATIOS COMPUTED WITH MEAN RATIO VALUES FOR SELECTED OKLAHOMA COOPERATIVE GRAIN ELEVATORS, BY SIZE GROUPS, 1962-64

Ratio	Mean Ratio Values by Size Group				Ratio Relative to
	Small	Medium	Large	All Firms	
Gross earnings to gross sales	10.95	11.81	12.40	11.53	:100
Gross earnings to gross commodity sales	11.47	12.48	13.21	12.16	:100
Gross earnings to gross operating sales	4.25	3.51	2.67	3.68	:1
Gross sales to operating expense	14.26	15.57	11.21	13.95	:1
Gross commodity sales to operating expense	13.76	15.34	10.68	13.52	:1
Gross operating sales to operating expense	50.97	66.49	33.38	56.02	:100
Gross sales to fixed assets	5.45	4.60	4.34	4.95	:1
Gross sales to total assets	2.46	2.17	2.07	2.29	:1
Gross sales to net worth	3.53	2.88	2.98	3.22	:1
Gross sales to receivables	39.44	39.88	27.29	37.49	:1
Gross sales to net working capital	-4.99	-15.79	-.32	-7.07	:1
Gross sales to year end inventories	30.19	21.42	17.41	24.76	:1
Net earnings to gross sales	3.02	3.52	2.27	2.99	:100
Net earnings to commodity sales	2.75	3.61	2.36	2.91	:100
Net earnings to gross operating sales	86.12	118.43	51.47	87.68	:100
Net earnings to net worth	8.06	10.06	6.22	8.23	:100
Net earnings to total assets	6.31	7.86	4.79	6.42	:100

TABLE III

LIQUIDITY AND SOLVENCY RATIOS COMPUTED WITH MEAN RATIO VALUES FOR SELECTED OKLAHOMA COOPERATIVE GRAIN ELEVATORS, BY SIZE GROUPS, 1962-64

Ratio	Mean Ratio Value by Size Group				Ratio Relative to
	Small	Medium	Large	All Firms	
Current ratio	4.57	2.75	3.11	3.71	:1
Acid test	2.84	1.55	1.39	2.14	:1
Current assets to accounts receivable	5.05	4.30	3.31	4.41	:1
Year-end inventories to current assets	44.24	47.48	53.93	47.37	:100
Year-end inventories to net working capital	1.26	-.72	.72	.56	:1
Net worth to total assets	75.79	77.56	71.98	75.45	:100
Net worth to fixed assets	1.70	1.61	1.48	1.63	:1
Net worth to total liabilities	8.93	6.05	5.86	7.40	:1
Total assets to total liabilities	10.12	7.03	6.86	8.48	:1
Fixed assets to fixed liabilities	857.93	1,353.12	297.74	875.20	:1
Current assets to total assets	25.89	25.54	26.48	25.92	:100
Fixed assets to total assets	46.71	49.74	49.86	48.30	:100

management practices. Gross commodity sales were taken directly from the "Sales" division of the operating statement. This division includes all commodities such as grain, feed, fertilizer, gasoline, and other commodities. Operating sales are equal to operating income and are the sales of operating services. The sum of operating sales and commodity sales is total sales.

These three ratios express the relationship between gross earnings and volume of business. The ratios are significant because they show a direct measure of the margins between the buying and the selling prices determined by competitive conditions and are unaffected by actual operating expenses. These margins should be large enough to cover all expenses. While the level of gross margins frequently is affected by competitive considerations, cooperatives may be in a position to decide whether they take a larger margin and refund the difference or if they will operate with a lower margin and give the patron the benefit of the savings in their day-to-day transactions.

The mean values for these three ratios and the other earnings ratios are found in Table II. These ratio values may be used as industry wide standards. The mean ratio for gross earnings to gross sales for all firms is 11.53 : 100. This ratio value indicates that the average margin on each dollar's worth of all types of sales is 11.53 cents. The mean ratio for gross earnings to gross commodity sales for all firms is 12.16 cents for each dollar of sales. The mean gross earnings to gross operating sales ratio for all firms is 3.68 : 1 which indicates that the average gross earnings are 3.68 times as large as gross operating sales or operating income.

The mean ratio values for the three size groups also are found in Table II. These means show several important changes in the values as the size of the cooperative changes. These changes will be discussed in Chapter V.

Gross sales to operating expenses ratios

Three gross sales to operating expense ratios were calculated. They were (1) gross sales, (2) gross commodity sales, and (3) gross operating sales to operating expenses. The purpose of this breakdown was to show in more detail the relationship among the contributing factors to gross sales relative to operating expenses.

These ratios show the relationship between the cost of doing business and the volume of business. The ratios are measures by which the comparative operating efficiency of a firm may be evaluated. Normally, a high ratio is considered a favorable indicator.

Operating expenses were calculated as the total of all expenses shown on the operating statement and include "expenses" plus "other deductions". Caution must be exercised when using these ratios in comparing cooperatives because of the extraneous factors that affect the cost of doing business. An example of an extraneous factor affecting the cost of doing business would be the supply of labor which affects the wage rate the cooperative must pay. Except for this limitation, the ratios are excellent guides for indicating excessive expenses. The significance of expenses to sales ratios are that they constitute a measure of the cost of doing business. Competitive conditions cause the establishment of relatively standard prices and sales services which competing businesses must meet; therefore, the costs that vary most are the internal or

operating costs.

The mean ratio for gross sales to operating expenses for all firms is 13.95 : 1. This indicates that there are 13.95 dollars of gross sales for every dollar of operating expense. Two approaches can be used to improve this ratio: (1) increase sales per dollar of operating expense or (2) decrease operating expense for a given volume of sales. The mean ratio for gross commodity sales to operating expense for all firms is 13.52 : 1 which indicates that gross commodity sales are 13.52 times as large as operating expenses. This ratio is only slightly less than the ratio of gross sales to operating expense which indicates that gross sales are comprised mainly of commodity sales. The mean ratio for gross operating sales to operating expense for all firms is 56.02 : 100 which shows that gross operating sales are 0.56 times as large as operating expenses or that gross operating sales are slightly greater than one-half as large as operating expenses.

Gross sales to fixed assets, total assets, and net worth ratios

These ratios express the relationship of the volume of business to fixed and total assets after allowance for depreciation, and the member-owners investment. Fixed assets include only those listed under "permanent assets" on the balance sheet. Total assets were taken directly from the asset page and include all assets, current and fixed, plus other investments. Net worth was computed as the sum of the members' equities plus capital and surplus. These figures consider only tangible net worth.

These ratios are important indicators of the efficiency with which

the capital investment in the cooperative is being used. Alternatively, these ratios indicate the amount of capital that can be justified for a specified volume of business. A low ratio value may be the result of several things as: (1) too small a volume of sales; (2) too much capital in accounts receivable; (3) too much capital in slow-moving inventories, and (4) over-investment in facilities relative to the volume of business. Cooperatives with large ratio values will be in a much better condition to show favorable earnings than those with low ratios. With competition and cost tending to set limits on gross earnings per dollar of sales, advantages gained through greater efficiency in the use of capital and other assets are basic aids in improving the earning ability of the cooperative.[2]

These ratios are also indicators of the turn over rate of the investment in the cooperative. The fixed assets and total assets to gross sales ratios can show undesirable situations by being too high or too low. A high ratio value may mean a policy has been followed permitting these assets to depreciate without attempting to rebuild or repair the assets. A high ratio value would occur when the volume of gross sales is low per dollar of investment.

The ratio of sales to fixed assets is especially useful to new cooperatives and to cooperatives considering expansion. Acquisition of more facilities than are necessary for the operation of a cooperative may be just as costly as the purchase of excessively priced facilities. If cooperatives lease a large part of their fixed assets this ratio will

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[2]Ponder, p. 130.

be high; however, the operating expense ratio which reflects rental payments will likewise be higher.[3]

The mean ratio for all firms is 4.95 : 1 for gross sales to fixed assets and indicates that gross sales are 4.95 times as large as fixed assets or that for every dollar invested in fixed assets the firms have 4.95 dollars of gross sales. The mean ratio for all firms is 2.29 : 1 for gross sales to total assets and indicates that gross sales are 2.29 times as large as total assets or that there are $2.29 of gross sales per dollar of assets. The mean ratio for all firms is 3.22 : 1 for gross sales to net worth which shows that sales are 3.22 times as large as the net worth or that each dollar of member-owner investment turned over approximately 3 1/4 times during that year.

Gross sales to accounts receivable, net working capital, and year end inventories ratios.

These ratios are three miscellaneous ratios expressing relationships to gross sales. The ratio of gross sales to accounts receivable is indicative of the cooperative's policy on credit and debt collection. It is possible for a cooperative to have too rigid a credit policy, shown by an excessively high ratio; therefore, driving potential business to competitors.

Gross sales to net working capital, the excess of current assets over current liabilities, is another indicator of the efficiency of capital. This ratio shows how well the net working capital is being used to support the sales of commodities and services.

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[3] Ibid., p. 121.

A ratio of year end inventories to gross sales was computed to provide a critera for optimum inventory levels. The value for year end inventories was taken directly from that quoted as inventories under current assets on the balance sheet. Since no data on average inventories was available, plus the fact that the audits examined ended at different times of the year, this ratio can be used only with very much care. The mean for all firms is 37.49 : 1 for gross sales to accounts receivable. This ratio shows that for every $37.49 of gross sales an average of one dollar is on credit or, conversely, for every dollar of credit sales there are $37.49 of cash sales. The mean ratio for all firms is -7.07 : 1 for gross sales to net working capital indicates that sales are 7.07 times as large as working capital. The negative sign appears in the ratio because some firms had a negative working capital value. A firm with a small negative working capital will have a relatively large negative ratio. For example, for a firm having a working capital value of -$100 and sales of $10,000 the ratio would be -100 : 1. Had the firm had a working capital of -$1,000 with $10,000 of sales the ratio would have been -10 : 1. When the ratio values for the few firms that had negative working capital were averaged with the other firms the overall ratio remained negative.

The mean ratio is 24.76 : 1 for gross sales to year end inventories which shows that sales are 24.76 times as large as year end inventories. Assuming that year end inventories are similar to the cooperative's average inventory it could be stated that the inventory turned over approximately 25 times during the year.

Net earnings to gross sales ratios

Three of these ratios were examined: (1) net earnings to gross sales, (2) net earnings to gross commodity sales, and (3) net earnings to gross operating sales. This breakdown was used: (1) to examine the contribution of commodity sales and operating sales to net earnings and (2) to show the relationship of net income to volume of business. These ratios must be used with care because cooperatives must have comparable price and credit policies if the ratios are to be used as accurate guides to compare earning efficiency. Net earnings, the residual after all costs have been deducted from the receipts, are usually found as the last figure on the operating statement.

These ratios are significant because they show the outcome of all business activity. A larger ratio indicates greater financial efficiency. Maladjustments in any of the fundamental functions of the business affect the net earnings and usually will be reflected in an unfavorable net earnings to sales ratio. It is possible that one unfavorable situation may be counter-balanced by an especially favorable situation in some other function and the ratio will not be distorted. A more thorough analysis must be made with these ratios. An unfavorable ratio is a signal for a cooperative to examine its basic activities and policies, relative turnover of inventories and accounts receivable, the relationship of volume of sales to total investment, gross margins and purchasing policies, and direct expense and overhead charges.[4] Net earnings are

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[4] H. E. Larzelere, Financial Management Analysis of Farmer's Cooperatives in Michigan, Michigan State College Agricultural Experiment Station Special Bulletin No. 315 (East Lansing, 1942), pp. 60-75.

also important factors affecting membership morale.

The mean ratio for all firms is 2.99 : 100 for net earnings to gross sales and shows that for a dollar's worth of sales average net earnings are 2.99 cents. It can also be stated that net earnings are .0299 times as large as gross sales. The mean ratio for all firms is 2.91 : 100 for net earnings to gross commodity sales and is only slightly less than the mean for net earnings to gross sales. This indicates that gross sales are made up almost entirely of commodity sales. The mean ratio for all firms is 87.68 : 100 for net earnings to gross operating sales which indicates that on an average for every dollar of gross operating sales there are 87.68 cents of net earnings coming from both operating and commodity sales. Since this ratio does not indicate the relationship or the contribution each factor makes to net earnings the ratio has little value.

Net earnings to net worth and total assets ratios

The ratio of net earnings to net worth measures the relationship of income to members' equity. It indicates the degree of success with which the total investment of the members is employed. Since the ratio indicates the earning power of the cooperative in relation to invested capital, investors and potential investors are interested in it.

The net earnings to total assets ratio indicates the relationship between total assets and net earnings. This ratio demonstrates the effectiveness of the contribution of assets to net earnings. This ratio suffers the same limitations as the other ratios which use total assets to compare ratios of different cooperatives because of the variation in costs and valuation of identical assets. The ratio's greatest value is

for comparing the ratios of a given cooperative over a period of years.

The mean net earnings to net worth ratio for all firms is 8.23 : 100 and indicates that for every dollar of member equity net earnings are 8.23 cents. The mean net earnings to total assets ratio value for all firms is 6.42 : 100 which indicates that the average return on a dollar's worth of assets is 6.42 cents.

Part II: Liquidity and Solvency Ratios

In Part II each of the liquidity and solvency ratios computed in the study are described. What the ratio consists of, how the ratio is computed, how it is used, and the limitations of each ratio is discussed. The relationship of many of these ratios to earnings is also discussed.

Current Ratio (current assets to current liabilities)

This ratio is one of the most commonly used indices of financial strength. A larger ratio indicates a strong liquidity position. The ratio has value in estimating the probable ability of the cooperative to pay its current debts from presently owned assets. These assets should be available for expenditure in the form of cash as debt obligations become due.

Unless experience or comparison with similar firms proves otherwise, a satisfactory ratio standard of two to one usually indicates a reasonable margin of safety for most cooperatives.[5] With a current ratio of two to one, current assets can shrink 50 percent, current liabilities could still be met, and the solvency of the firm could be maintained.

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[5] Donaldson and Hemphill, p. 35.

Current assets in this study included all the items listed under current assets on the balance sheet. Current assets include such items as cash on hand, bank deposits, notes and various receivable, accrued storage receivables, and inventories. Current liabilities are listed under the subdivision of "current" and "accruals and reserves" in the liabilities and net worth division of the balance sheet. Accounts payable, notes payable, and taxes payable are examples.

This ratio should not be over-emphasized. There are dangers in relying on its use alone. An excessively high ratio may not always be indicative of good business practices. If current assets consist mainly of cash on hand, management may be tempted to invest in unnecessary items or declare unwarranted dividends. The ratio may be excessively large if there are few current liabilities. In these cases current ratios have limited value as a tool for analysis. When current assets are made up largely of inventories and accounts receivable, the ratio is good only so far as these items can be converted to cash.[6] It is possible for a cooperative to build up a large inventory which makes the ratio appear favorable. This appearance is deceiving if the stock does not move quickly. If the inventory is built up too high, or reduced too low, the value of the current ratio as an analytical tool is reduced. Cooperatives with high ratios may be holding too much of their funds in cash reserves. To the extent that capital is idle, the favorableness indicated

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[6] Ponder, p. 70.

is reduced.[7]

The mean current ratio for all firms is 3.71 : 1. This ratio and the other liquidity and solvency ratio means are found in Table III. These ratio values may also be used as industry wide standards. This ratio indicates that on an average current assets are 3.71 times as large as current liabilities, or that each dollar of current indebtedness is covered by $3.71 worth of current assets.

Acid Test (current assets less inventories to current liabilities)

Extreme caution must be exercised when using the current ratio as a standard in times of declining prices, in periods of rapid improvement in the quality and nature of competing products, or in times of changes in demand for the cooperative's inventories. These influences may make inventories salable only at lower prices, slowly salable, or even unsalable. For added protection under these conditions the acid test ratio should be used to measure the ability of the cooperative to meet current debts.

The acid test ratio, sometimes called the quick or liquid ratio, is computed by dividing liquid assets by current liabilities. The rule of thumb standard for this ratio is one to one.[8] The meaning of a ratio significantly different from this standard depends highly on the specific type of business in which the cooperative is engaged. For some coopera-

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[7]Lewis P. Jenkins, Operating Policies and Practices of Cooperative Purchasing Association in Mississippi, Mississippi State College Agricultural Experiment Station Bulletin No. 491 (State College, 1952), pp. 25-26.

[8]Donaldson and Hemphill, p. 36.

tives large inventories are necessary for their continuance. For example, a cooperative engaged in grain storage should have large inventories of grain to use its storage capacity efficiently.

The mean value for this ratio is 2.14 : 1 which indicates that liquid assets are more than two times as large as current liabilities. This value indicates a generally strong liquid position among the cooperatives studied.

Current assets to accounts receivable

Accounts receivable is one of the most important items on the balance sheet. Accounts receivable are carried at a cost and sometimes prove to be uncollectible. For this reason cooperatives should analyze the quality of accounts receivable. This ratio should be above 2.5 to one. A larger ratio would indicate a stronger financial position for the cooperative.[9]

This ratio is used to show the amounts of capital tied up in accounts receivable and it tells a great deal about the credit policy of the cooperative. A large proportion of current assets in accounts receivable results in a small amount of capital available for operating or net working capital. If the net working capital is reduced to a low amount, the advantages of cash purchases and volume buying cannot be realized.[10]

Before making a decision based on this ratio a check should be made on the items that comprise accounts receivable. Some accounts receivable may be extremely reliable, but others may be somewhat doubtful. If in

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[9]Ponder, p. 90.

[10]Jenkins, p. 26.

all probability these accounts will be paid, a larger ratio may still indicate a financially sound operation.

The mean ratio for all firms in 4:41 : 1 which indicates that current assets are 4.41 times as large as accounts receivable. Alternatively stated, accounts receivable compose less than one-fourth of the total current assets.

Year end inventories to current assets and net working capital ratios

The year end inventories to current assets ratio is an indicator of the portion of current assets that are tied up in inventories. The ratio is used to indicate excessive inventories or a shortage of other current assets. Year end inventories to net working capital is an indicator of the portion of the net working capital that is in inventories. The ratio is also used to indicate an excess or a shortage of inventories.

Average inventory would have been a better indicator than year end inventory if these data had been available. This ratio is influenced greatly by the date the fiscal year ends and should be considered when making comparisons among cooperatives.

Net working capital represents the owners' investment in current assets and is used to procure the supplies and services needed for the operation. A cooperative needs adequate net working capital for: (1) carrying on normal business, such as paying bills on time and maintaining good credit relationships; (2) taking advantage of special price opportunities; (3) expanding operations with nominal need for new capital; and (4) meeting emergencies and losses without disaster. In general, the moment the cooperative's inventories exceed the amount of net working capital, cash and receivables are insufficient to cover current

liabilities. This situation may lead to insolvency if additional funds are not forthcoming to meet maturing current obligations.[11]

The mean for all firms is 47.37 : 100 for year end inventories to current assets which indicates that inventories compose about 47.4 percent of the current assets. The mean for all firms is 0.56 : 1 for year end inventories to net working capital and indicates that inventories are slightly greater than one-half as large as net working capital.

Net worth to total assets and fixed assets ratios

These two solvency ratios express the relationship between the capital furnished by the members to the total of all capital invested and the capital invested in fixed or permanent assets. Net worth to total assets is sometimes referred to as the patrons' equity ratio and demonstrates the cooperative's ability to meet its long-term obligations. Net worth to fixed assets shows how well the fixed assets are covered by member ownership and is an alternative way of looking at liabilities to current assets.

A low net worth to fixed assets ratio may be caused by the use of outside sources of capital or a relatively low fixed assets requirement. The net worth to total assets ratio may indicate which alternative is correct. The ratio alludes to both liquidity and solvency. If net worth is high relative to fixed assets, the member-owners own their fixed assets which is a measure of solvency. Or if net worth is high compared to fixed assets, many assets may be in the more liquid current asset form and thus liquidity is measured.

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[11]Schermerhorn, pp. 21-22.

A net worth to total assets ratio value of 50 to 100 is recommended for cooperatives with a relatively large proportion of fixed assets, and a ratio of 70 to 100 is recommended for cooperatives with few assets.[12] Because of their large fixed assets most cooperatives should have a 133 to 150 : 100 ratio of net worth to fixed assets. Proportionately larger ratios are considered more favorable. Generally member-owners should attempt to provide the capital invested in fixed assets, the capital required for the extension of credit, and that portion of the investment in minimum inventories that cannot be obtained from open-book account credit. It would be an unwise use of capital if the member-owners were to provide capital which could be obtained elsewhere at a lower cost.

It can be expected that a new cooperative or one which has recently expanded its facilities will have a low ratio of net worth to total assets relative to a cooperative that has been operating a longer period of time. It is generally desirable to think in terms of continually improving the ratio by increasing the percentage of assets represented by member-owner equity.[13]

The investment in fixed assets generally decreases slightly from year to year since yearly depreciation charges on the fixed assets are greater than the capital investments in most years. Generally this trend occurs when the net worth of a cooperative is moderately increasing as net earnings accumulate and some portion of these earnings is retained

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[12] Alston, p. 11.

[13] H. E. Larzelere and R. M. King, Ratios as Measuring Sticks for Elevator and Farm Supply Organizations, Michigan State College Agricultural Experiment Station Special Bulletin No. 380 (East Lansing, 1952), pp. 22-23.

in the business. When additional funds are invested or substantial losses assumed the yearly change is more pronounced. Hence, the relationships between these two items, except in abnormal situations, usually varies relatively little from year to year.[14] Proof of this relationship can be seen in Appendix Table II.

Caution should be used when making comparisons between cooperatives with the net worth to fixed asset ratio. Differences in policies concerning rates of depreciation and the capitalization of expenditures for maintenance, replacements, and repair affect the relationship between the stated and actual value of fixed assets. Insufficient depreciation charges result in overstatement of net earnings while to capitalize replacements and repairs, which are necessary to maintain the assets, results in an understatement of net earnings.[15]

The mean ratio for all firms is 75.45 : 100 for net worth to total assets which indicates that approximately three-fourths of the total assets are owned by membership equity. This value also shows that creditors own about one-fourth of the assets in the cooperatives. The mean ratio for all firms is 1.63 : 1 for net worth to fixed assets which indicates that net worth is 163 percent of fixed assets or, alternatively, that for every dollar of fixed assets there are $1.63 of membership equity.

Net worth to total liabilities ratio

Since the invested funds (net worth) serve as a guarantee to cover

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[14] Schermerhorn, p. 24.

[15] Larzelere and King, p. 24.

the liquidation of creditor liabilities, it is evident that the larger the net worth the smaller the liabilities, and the more security creditors possess. Net worth to total liabilities, sometimes called the worth-debt ratio, measures the relationship of members' equities in the cooperative to creditors' claims against the assets of the cooperative. A high ratio is an indication of a strong financial structure.

The net worth should rarely be less than total liabilities. When this situation exists, creditors have more at stake in the business than the owners. The handicap of interest charges, especially when competitors have no such expenses, may become a critical burden. In addition, special credit terms, retention of title, or even a voice in management may be necessary to protect creditors.

When analyzing this ratio, especially if total liabilities exceed tangible net worth, it is advisable to determine the proportion of the total liabilities that are accounted for by the current liabilities. If a major portion of a firm's total liabilities are deferred liabilities (non-current), the ratio of net worth to total liabilities may be small. This relationship is true because management has a longer period in which to make plans to meet or solve its financial problems.[16]

The mean for all firms is 7.40 : 1 for this ratio which indicates that total membership investment is more than seven times as large as creditor investment. This relatively high ratio value shows a very strong financial structure among the cooperatives studied.

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[16]Schermerhorn, pp. 23-24.

Total assets to total liabilities and fixed assets to fixed liabilities ratios

These two ratios are further breakdown of assets to liabilities. The ratios should indicate how well the liabilities are supported by assets. These two ratios are to be used with the major ratios discussed above. The possibility exists that a certain range of assets to liabilities is more desirable for overall operational efficiency than are other ranges.

The composition of total and fixed assets and total liabilities has been discussed above. Fixed liabilities were taken directly from "other liabilities" on the balance sheet liabilities and net worth section of the audits. This value includes such items as mortgages payable to the Bank for Cooperatives, certificates of indebtedness, and long run notes payable.

The mean ratio value for all firms for total assets to total liabilities is 8.48 : 1. This value indicates that the total assets are 8.48 times as large as total liabilities. The higher the ratio the more solvent the cooperative.

Little can be said concerning an optimum for the fixed assets to fixed liabilities ratio. The mean ratio value for all firms is 875.20 : 1. Only moderate emphasis should be placed on this standard because of the variability among years for a given cooperative. This variability is seen in Appendix Table II. The mean does indicate that the investment in fixed assets is 875 times as large as the cooperatives' fixed liabilities. The ratio gives lenders of fixed or long term liabilities an indication of the value of the security behind their loans. If the fixed assets have a stable value, more so than other assets, creditors would

prefer as high a ratio as possible. The ratio should be used only with due consideration of the other asset-liability relationships.

Current assets and fixed assets to total asset ratios

These two ratios were used in this study mainly to analyze the breakdown of the assets within the firm. Although these ratios are not commonly used, they were calculated with the idea that they might be useful in the analyses at another point in the study. If any firm's ratios deviate greatly from the mean of these ratios it would indicate a misallocation of invested resources within the cooperative.

These ratios can be indicators of the optimum combinations of asset types when considered with the other ratio values of a cooperative. They can be used to indicate the proper balance of asset types by observing the values of these ratios among the firms having high earnings and in the optimum liquidity and solvency range.

These ratios have limitations since some of the cooperatives maintain a part of their facilities in fixed assets in order to render a service to members. It is possible for a given cooperative to have a very low fixed asset to total asset ratio or a very high current asset to total asset ratio but be neglecting an investment in a much needed service. If, on the other hand, an over-investment is made in fixed facilities, there is less capital available for operating purposes. It is also possible for a cooperative to have a low fixed asset to total asset ratio because it has failed to replace worn out equipment and facilities. This policy could lead to wastes from spoilage or losses from breakdowns which would in the long run cause added costs, customer dissatisfaction, and eventual loss of business.

The mean ratio value for all firms is 25.92 : 100 for current assets to total assets which indicates that current assets compose slightly more than one-fourth the total assets. The mean ratio value for fixed assets to total assets for all firms is 48.30 : 100 which indicates that slightly less than one-half the total assets are fixed. Current assets plus permanent assets do not total 100 percent of total assets because "investments" and "other assets" were not included in either category. Permanent assets include items such as land, buildings, and equipment.

The above ratios are the ratios that were initially computed in this study. Some of these ratios are not common tools in financial ratio analyses. An extensive list of variables increases the probability that the correct variables would be selected for the indices to be developed later in the study. An analysis of all the ratios has been given considering the fact that many cooperatives may want to make comparisons with all the ratio standards presented. If so, a source for comparisons and the meaning of the computations for each of these ratios is available.

CHAPTER III

THEORY FOR DEVELOPING FINANCIAL INDICES VIA FACTOR ANALYSIS

The role of an economic model in empirical research is to specify the important variables in a specific problem and to describe the structural relationship among these variables. Restrictions, which include manageability, necessitate the specification of only the important variables. Hence, a model often abstracts from reality. Baumol[1] says that a useful model describes an imaginary world that is sufficiently complex and similar to reality to permit one to make inferences from the data. In addition, a model should be sufficiently simple to be easily understood and also be capable of manipulation with available tools. The model should approximate the real world well enough to permit one to have confidence in the implications drawn from it.

Use of Factor Analysis to Develop Indices

Numerous variables could be considered for each of the models developed in this study. The models developed were in the form of indices. Estimation of an index with important variables excluded results in bias. To overcome this bias attempts were made to construct artificial variables as combinations of the real variables. Factor analysis is a method which

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[1] W. J. Baumol, Business, Behavior, Value and Growth (New York and London, 1959), p. 3.

may be used to handle these types of problems.

Factor analysis is a mathematical extension of correlation analysis. It is a branch of statistical theory concerned with the resolution of a set of descriptive variables in terms of a small number of categories or factors. This resolution is accomplished by the analysis of the intercorrelation of the variables. The basic data of factor analysis are a matrix of correlation coefficients of the variables to be studied. A satisfactory solution yields factors which convey the essential information of the original set of variables. The primary objective in factor analysis is to attain economy of description.

This objective should not be construed to mean that factor analysis necessarily attempts to discover the "fundamental" or basic categories in a given field of investigation.[2] While the goal of complete description cannot be reached, theoretically it may be approached practically in a limited field of investigation where a relatively small number of variables is considered exhaustive. Factor analysis gives a simple interpretation of a given body of data and thus gives a fundamental description of the particular set of variables analyzed.

The primary use of factor analysis in this sutdy is to reduce a matrix of correlation coefficients to the smallest possible number of factors which account for the interrelationship between the variables in the matrix. The relationship between the variables must be at least

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[2]Karl Holzinger and Harry Harman, Factor Analysis, A Synthesis of Factorial Methods (Chicago, 1941), p. 3.

partially a function of their common relationship to some more general dimension or dimensions.[3] Factor analysis is used in this study to derive an index from several variables where the variables are the observed financial statement ratios.

Factor analysis, or the principal component technique, is used in this study. The first principal component contains more statistical information about the variables than any other value and maximizes the variance of an index developed from the component and associated weights. It also maximizes the sum of the squared correlations between the index and the several variables or ratios. Maximum variation in the resulting index enables this index to discriminate effectively between high, medium, and low values. After the first component is determined, each succeeding principal component contains more of the residual statistical information than any other value.

Not all the variation in a matrix of correlations may be accounted for by common factors since each variable may also include some unique variance and error variance. In analyzing a matrix by factor analysis it is possible to find three types of factors: (1) common factors which usually account for relatively large proportions of the variance of particular variables, (2) a group factor present in some but not all variables; and (3) a unique or error factor which accounts for variance which is not accounted for by its relationship with other variables. Common and group factors are necessary in order to account for the

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[3]Daryl Hobbs, "Use of Factor Analysis in a Farm Management Study" (Paper presented at Symposium on "Present Use and Potential of Linear Programming and other Operations Research Techniques in Farm Management Extension", University of Missouri, Columbia, Missouri, January, 1965), p. 2.

intercorrelation of the n variables.

Using the notation $F_1, F_2, \ldots, F_m$ for the m factors accounting for the intercorrelation of the variables, and $u_1, u_2, \ldots, u_n$ for the unique factors, the complete linear expression for any variable Z_j ($j = 1, 2, 3, \ldots, n$) may be written as

$$Z_j = a_{j1} F_1 + a_{j2} F_2 + \ldots + a_{jm} F_m + a_j U_j \qquad (3.1)$$

There are n equations of this form, one for each of the n variables, or, in this study one for each ratio. Equation (3.1) can be written explicitly for the value of a variable Z_j for a particular observation i ($i = 1, 2, \ldots, N$) as:

$$Z_{ji} = a_{1i} F_{1i} + a_{j2} F_{2i} + \ldots + a_{jm} F_{mi} + a_j U_{ji} \qquad (3.2)$$

where Z_{ji} is the notation for a variable or ratio of the particular observation, in this study a particular cooperative. F_{ji} is the notation for hypothetical factors, a_{ji} is the notation for the factor coefficients or weights which are constant, and U_{ji} is the notation for the unique factors of the variable. The essential problem of factor analysis is to determine the coefficients, a_{ji}.

As implied by the above expression, it usually requires more than one factor to represent a particular variable. In accounting for the variance of a particular variable, the sum of the squares of the several common and group factor coefficients for the variable and unique and error variance are the major components and is known as communality.[4] There are m factors or principal components of the observed variables. It is assumed that these are N values of each of the n factors,

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[4] Ibid, p. 3.

corresponding to the N individuals of the sample. Frequently most of the statistical information of these variables rests in the first few principal components. If so, the components with relatively small weights can be ignored and the objective of constructing h hypothetical variables from n variables where $h < n$ can be fulfilled.

Factor Analysis Computations

It is beyond the scope of this study to give a complete description of the computational procedures involved in factor analysis. There are several sources available for this purpose.[5] Essentially the solution involves successive extraction of factors, first from the original matrix and subsequent factors from successive residual matrices, until residuals are reduced to near zero. Since the study uses only the first factor the discussion is limited to the computation of this factor.

To replace a set of standardized variables[6] by a more fundamental set of variables $F_1, \ldots, F_m$, the following procedure is used. If the factor pattern is taken to be

$$Z_j = a_{j1}F_1 + a_{j2}F_2 + \ldots + a_{jm}F_m \quad (j = 1, 2, \ldots, n) \qquad (3.3)$$

with the unique factor omitted, the communality of Z_j is then given by

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[5] Among the sources available are Gerhard Tintner, Econometrics (New York, 1950), pp. 102-114, and Holzinger and Harman, pp. 155-179. The following explanation of factor analysis follows that given by Harry H. Harman, Modern Factor Analysis (Chicago, 1960), pp. 154-157.

[6] A standardized variable is equal to the deviation of the observation from the variable mean divided by the standard deviation of the variable.

$$H_j^2 = a_{j1}^2 + a_{j2}^2 + \cdots + a_{jt}^2 + \cdots + a_{jm}^2. \qquad (3.4)$$

The idea is to reproduce the original correlations between the variables Z_j. In general, the term a_{jt}^2 indicates the contribution or weight of the factor F_t to the communality of Z_j. The sum of the contributions of the first factor F_1 to the communalities of the n variables is:

$$A_1 = a_{11}^2 + a_{21}^2 + \cdots + a_{n1}^2 = \sum_{j=1}^{n} a_{j1}^2 \qquad (3.5)$$

The first stage of the principal component method involves the determination of the first factor coefficients or weights, a_{j1}, so as to make the sum of the contribution of that factor to the total communality maximum subject to the restrictions that the correlations are reproduced by the pattern in (3.3). The conditions may be expressed as follows:

$$r_{jk} = \sum_{t=1}^{m} a_{jt}a_{kt} \qquad (j, k, = 1, 2, \ldots, n) \qquad (3.6)$$

The r_{jk} is the communality, H_j^2, of the variable Z_j. As the communality stands the variance has no maximum; that is, (3.6) could be increased infinitely by multiplying all the a_{ji}^2 by a constant greater than one. To avoid this, the variance of the variable j is maximized subject to the condition (restraint) that the sum of the squared weights is unity; that is, so that

$$a_{j1}^2 + a_{j2}^2 + \cdots + a_{jt}^2 + \cdots a_{jm}^2 = 1 \qquad (3.7)$$

To do this Lagrange multipliers[7] are particularly well adapted. This

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[7]J. Parry Lewis, An Introduction to Mathematics for Students of Economics (London, 1962), pp. 238-250.

method will be employed to maximize A_1 which is a function of the n coefficients a_{j1}, under the conditions (3.6) among all the coefficients a_{jt}. Let

$$T = A_1 - \sum_{j,k=1}^{n} \mu_{jk} r_{jk} = A_1 - \sum_{j,k=1}^{n} \sum_{t=1}^{m} \mu_{jk} a_{jt} a_{kt}, \tag{3.8}$$

where μ_{jk} are the Lagrange multipliers. The next step is to set the partial derivative of this new function T with respect to any one of the n coefficients a_{j1} equal to zero, i.e.;

$$\frac{\partial T}{\partial a_{j1}} = a_{j1} - \sum_{k=1}^{n} \mu_{jk} a_{k1} = 0 \tag{3.9}$$

and similarly set the partial derivative with respect to any of the other coefficients a_{jt} $(t \neq 1)$ equal to zero, i.e.,

$$\frac{\partial T}{\partial a_{jt}} = - \sum_{k=1}^{n} \mu_{jk} a_{kt} = 0 \tag{3.10}$$

The two sets of equations (3.9) and (3.10) may be combined as follows:

$$\frac{\partial T}{\partial a_{jt}} = \delta_{it} a_{j1} - \sum_{k=1}^{n} \mu_{jk} a_{kt} = 0 \qquad (t = 1,2, \ldots ,m) \tag{3.11}$$

where $\delta_{1t} = 1$ if $t = 1$ and $\delta_{1t} = 0$ if $t \neq 1$.

By multiplying (3.11) by a_{j1} and summing with respect to j the following equation is obtained:

$$\delta_{1t} \sum_{j=1}^{n} a_{j1}^2 - \sum_{j=1}^{n} \sum_{k=1}^{n} \mu_{jk} a_{j1} a_{kt} = 0 \tag{3.12}$$

The expression $\sum_{j=1}^{n} \mu_{jk} a_{j1}$ is equal to a_{k1} according to (3.9) and setting $\sum_{j=1}^{n} a_{j1}^2 = \lambda_1$, equation (3.12) may be written as:

$$\delta_{1t} \lambda_1 - \sum_{k=1}^{n} a_{k1} a_{kt} = 0. \tag{3.13}$$

When (3.13) is multiplied by a_{jt} and summed over t, this equation becomes

$$a_{j1}\lambda_1 - \sum_{k=1}^{n} a_{k1} \left(\sum_{t=1}^{m} a_{jt} a_{kt} \right) = 0, \tag{3.14}$$

or by using (3.6)

$$\sum_{k=1}^{n} r_{jk} a_{k1} - \lambda_1 a_{j1} = 0. \tag{3.15}$$

The expression (3.15) represents n equations, one for each value of j. The resulting system of equations for the solution of the unknown a_{j1} may be written as follows:

$$\begin{array}{lllllll}
(h^2_1 - \lambda)\, a_{11} + & r_{12}a_{21} + & r_{13}a_{31} + \ldots & r_{1n}a_{n1} & = & 0 \\
r_{21}\, a_{11} + & (h^2_2 - \lambda)\, a_{21} + & r_{23}a_{31} + \ldots & r_{2n}a_{n1} & = & 0 \\
r_{31}\, a_{11} + & r_{32}a_{21} + & (h^2_3 - \lambda)\, a_{31} + \ldots & r_{3n}a_{n1} & = & 0 \\
\ldots & \ldots & \ldots & \ldots & & \\
r_{n1}a_{11} + & r_{n2}a_{21} + & r_{n3}a_{31} + \ldots & (h^2_n - \lambda)\, a_{n1} & = & 0
\end{array} \tag{3.16}$$

where λ is a parameter independent of the a_{jt}'s.

A necessary and sufficient condition for the system of equations (3.16) to have a solution (in which not all unknowns are zero) is the vanishing of the determinant of the coefficients of the a_{jt}. That is, this system of linear homogeneous equations can have a non-trivial solution only if its determinant is equal to zero as seen below.

$$\begin{vmatrix}
(h^2_1 - \lambda) & r_{12} & r_{13} & \ldots & r_{1n} \\
r_{21} & (h^2_2 - \lambda) & r_{23} & \ldots & r_{2n} \\
r_{31} & r_{32} & (h^2_3 - \lambda) & \ldots & r_{3n} \\
\ldots & \ldots & \ldots & \ldots & \ldots \\
r_{n1} & r_{n2} & r_{n3} & \ldots & (h^2_n - \lambda)
\end{vmatrix} = 0 \tag{3.17}$$

When a simple root of the characteristic equation (3.17) is substituted for λ in (3.16), a set of homogeneous linear equations of rank (n-1) is obtained. This set of equations has a family of solutions, all of which are proportional to one particular solution. It follows from the analysis for maximizing A_1 that the factor of proportionality is

$$\lambda_1 = \sum_{j=1}^{n} a^2_{j1} = A_1. \tag{3.18}$$

Hence A_1, which is to be maximized, is equal to one of the roots of the characteristic equation, namely, the largest root λ_1. λ_1 is also the variance of the index developed from this data.

The problem is to find the coefficients, a_{j1}, of the first factor, F_1, which account for as much of the communality as possible. The largest root, λ_1, of (3.17) is substituted into (3.16), and a solution for α_{11}, $\alpha_{21}, \ldots, \alpha_{n1}$ is obtained. To satisfy the relation (3.5) these values are divided by the square root of the sum of their squares and then multiplied by $\sqrt{\lambda_1}$. The resulting quantities are

$$a_{j1} = \frac{\alpha_{j1}\sqrt{\lambda_1}}{\sqrt{\alpha^2_{11} + \alpha^2_{21} + \ldots + \alpha^2_{n1}}} \quad (j=1,2,\ldots,n) \tag{3.19}$$

which are the desired coefficients of F_1 in the factor pattern (3.3). It may be observed that these values of a_{j1} satisfy the condition (3.5) for upon squaring the expressions (3.19) and summing, there results

$$\sum_{j=1}^{n} a^2_{j1} = \frac{\lambda_1 (\alpha^2_{11} + \alpha^2_{21} + \cdots + \alpha^2_{n1})}{\alpha^2_{11} + \alpha^2_{21} + \cdots + \alpha^2_{n1}} = \lambda_1 = A_1 \qquad (3.20)$$

Having determined the coefficients a_{j1} of the first factor F_1, one could proceed to find a second factor which would account for a maximum of the residual communality. However, because only the first factor was used in the study, computation of other factors will not be discussed.

Simple Illustration of Factor Analysis and Development of an Index

To illustrate the theory and methods described above a simplified example is presented below. The example has three variables which are used to develop a scaled index.

If I is the index to be developed, it can be written

$$I = a_1X_1 + a_2X_2 + A_3X_3 \qquad (3.21)$$

where the a_j's are constants to be determined in the analysis and the X_j's are the observed variables or ratios. The matrix of correlation coefficients between the X_i, corresponding to (3.6), is

$$Z = \begin{vmatrix} 1.0000 & .5924 & .9762 \\ .5924 & 1.0000 & .5474 \\ .9762 & .5474 & 1.0000 \end{vmatrix} \qquad (3.22)$$

To obtain the weights a_j for the index a solution must be obtained for a set of equations such as (3.16) or the equivalent (3.17). If H^2_j is set equal to one, (3.16) can be simplified and rewritten for this example as

$$
\begin{aligned}
(1-\lambda)a_1 + .592a_2 + .9762a_3 &= 0 \\
.5924a_1 + (1-\lambda)a_2 + .5474a_3 &= 0 \\
.9762a_1 + .5474a_2 + (1-\lambda)a_3 &= 0
\end{aligned} \tag{3.23}
$$

where $a_1^2 + a_3^2 + a_3^2 = 1$. Equations (3.23) can be simplified to

$$
\begin{aligned}
1.0000a_1 + .5924a_2 + .9762a_3 &= \lambda a_1 \\
.5924a_1 + 1.0000a_2 + .5474a_3 &= \lambda a_2 \\
.9762a_1 + .5474a_2 + 1.0000a_3 &= \lambda a_3
\end{aligned} \tag{3.24}
$$

While these equations are necessary for a maximum solution, they are not sufficient. The necessary and sufficient conditions are discussed in detail above.

Equations (3.24) have the trivial solution $a_1 = a_2 = a_3 = 0$ and three nontrivial solutions, each with a different value of λ. The solution with the largest positive value of λ is of interest in determining the first factor. Equations (3.23) can be solved by either of two processes.

First, the determinant of the coefficients could be set equal to zero, solve for λ_1, and then solve for the a_j. In a problem with few variables, this is a reasonably simple task. Such a direct solution is time consuming and laborious without an electronic computer, especially if a large number of variables is involved.

However, it is possible to solve the equivalent equations (3.24) by an iterative procedure. The iterative process which is used in the example starts with an arbitrary set of trial values such as $a_1 = a_2 = a_3 = 1.0$. Substituting $a_1 = a_2 = a_3 = 1.0$ into (3.24) yields a second approximation of $\lambda a_1 = 2.5686$, $\lambda a_2 = 2.1398$, and $\lambda a_3 = 2.5236$. These numbers could be used as second approximations of the weights, but to

keep the numbers comparable each approximation is divided by the first, which is 2.5686. This gives a second approximation of the weights 1.0000, .8331, and .9825. This process can be continued and eventually will converge to the correct set of weights. Further iterations will not significantly change the weights. A partial worksheet for this process is as follows:

Trial values of the a_j

Trial or Iteration No.	(1)	(2)	. . . .	(5)	(6)	(7)
a_1	1.0000	1.0000	. . . .	1.0000	1.0000	1.0000
a_2	1.0000	.8331	. . . .	.7916	.7912	.7912
a_3	1.0000	.9825	. . . .	.9852	.9852	.9852

Estimates of the λa_j from (3.24) (3.25)

2.5686	2.4526	. . . .	2.4037	2.4305
2.1398	1.9633	. . . .	1.9233	1.9230
2.5236	2.4147	. . . .	2.3947	2.3946

After seven iterations the weights, a_j, are found to be 1.0000, .7912, and .9852 as presented in the last column of (3.25). The variance of this index, the value of λ, and the sum of the squared correlations between the index and the three variables is 2.4305.

The sum of the squares of these numbers ($\sum_{j=1,}^{3} a^2_j$) equals 2.5966. Since it is necessary that the $\sum_{j=1}^{3} a^2_j = 1$, each a_j must be divided by the square root of the sum of the a_j. The square root of 2.5966 is 1.6114. This gives the weights $a_1 = .6206$, $a_2 = .4910$, and $a_3 = .6114$.

The contributions of λ_1 to the variance of the standardized variables are the squares of a_j. It follows then that λ_1 explains about 39.5 percent of the standardized variation of Z_1, about 24.9 percent of the standardized variation of Z_2, and about 37.4 percent of the standardized variation of Z_3.

The index could be written

$$I = .6206Z_1 + .4910Z_2 + .6114Z_3 \qquad (3.26)$$

where Z_j is equal to x_j/s_j (x_j is $X_j - \bar{X}_j$; and s_j the standard deviation of X_j). The s_j's of the X_j's were $s_1 = 1.3298$, $s_2 = 1.0296$, and $s_3 = 1.0363$. By dividing a_j by these s_j the index can be expressed as

$$I = .4667x_1 + .4572x_2 + .5900x_3 \qquad (3.27)$$

This index would be zero for any observation having all variables equal to zero. The index can be scaled to 100 when all $X_j = \bar{X}_j$ by determining a constant K such that

$$K\left(a_1 \frac{\bar{X}_1}{s_1} + a_2 \frac{\bar{X}_2}{s_2} + a_3 \frac{\bar{X}_3}{s_3}\right) = 100 \qquad (3.28)$$

The index is scaled to 100 because this value is a convenient bench mark. The index value of 100 is then the base for juding the observed index values of the observations studied. The equation for the scaled index becomes

$$I_{scaled} = \frac{Ka_1}{s_1} X_1 + \frac{Ka_2}{s_2} X_2 + \frac{Ka_3}{s_3} X_3 \qquad (3.29)$$

In this example the mean values for the variables were: $\bar{X}_1 = 20.81$, $\bar{X}_2 = 11.05$, and $\bar{X}_3 = 10.57$. When these values are inserted into equation (3.27) the index value is 21.0377. Upon multiplying all the weights in

the equation by K, which equals 100/21.0377 or 4.7534, the following scaled index is derived.

$$I_{scaled} = 2.2185X_1 + 2.1733X_2 + 2.8046X_3 \qquad (3.30)$$

For an observation having the mean of each variable the index is

$$I_{scaled} = 2.2185\ (20.89) + 2.1733\ (11.05) + 2.8046\ (10.57) = 100.00$$ [8]

This chapter has outlined factor analysis and illustrated how it can be used to weight variables to form indices. The development of these indices has also been demonstrated. The chapter also provides the theory and computational steps used to develop the indices derived later in the thesis.

[8] For a more detailed example see James D. Cowhig, Farm Operator Level-of-living Indexes for Counties of the United States 1950 and 1959, United States Department of Agriculture Statistical Bulletin No. 321 (Washington, 1962), pp. 23-24.

CHAPTER IV

THE DEVELOPMENT AND INTERPRETATION OF INDICES

This chapter describes the ratio selection technique used to prepare the data for the development of the indices. A reduction in the number of ratios is essential for developing manageable indices. An analysis is then made of each of the indices developed, using the theory explained in Chapter III.

Ratio Selection Technique

A matrix of correlation coefficients showing the correlations of each ratio with all other ratios was determined to find the first principal component. The three year average of each ratio for each cooperative was used to determine these correlations. With a large number of ratios, many of which varied only slightly from other ratios, it was expected that several ratios would be highly correlated. High correlation of ratios was a criterion used in deleting ratios from the study for two reasons: (1) It was necessary to reduce the size of the matrix of correlation coefficients to the capacity of the computing equipment available (IBM 1410) for the factor analysis; and (2) ratios which are highly correlated are so much alike that the computations made from them would not show an important difference for the purposes of this study.

The acid ratio was found to be highly correlated with the current

ratio. The correlation coefficient between these ratios were .971, .978, .925, and .958 for small, medium, large and the average of all firms respectively. This indicates a high relationship between current assets and current assets less inventories. The acid test ratio was removed from the study because it was believed to have contained less total information than the current ratio.

The net worth to total liabilities ratio was found to differ only trivially from the total assets to total liabilities ratio. The later ratio was removed from the study with the idea that the former is a more meaningfull ratio and indicates a more accurate measure of solvency. The correlation coefficients between the ratios were .990, 1.000, 1.000, .994 for small, medium, large, and the average of all firms respectively. This comparison indicates a high correlation between net worth and total assets with no important changes in the correlation of the ratios between size groups.

The current assets to accounts receivable ratio had a correlation coefficients of .979 with the gross sales to accounts receivable ratio for the average of all cooperatives. This value illustrates the high direct relationship between current assets and gross sales. A priori expectations were that the two ratios would be highly correlated because, logically, receivables increase with sales and increased sales usually are associated with increased inventories. The correlation coefficient for the ratios in each size group. This high correlation can be explained by the fact that when ratios are averaged the correlation between current assets and gross sales is high. However, when the firms are grouped

according to size some of the "averaging affect" is lost. The correlation coefficients between the ratios for the small size group was .869, the medium size group, .893, and the large group .714. Not all current assets are items for sale; therefore,the receivables to total gross sales ratio was selected as a better measure of financial efficiency than the current assets to gross sales ratio and the current assets to accounts receivable ratio was deleted from the study.

The analysis also showed that the gross earnings to gross commodity sales ratio was highly correlated with gross earnings to gross sales. This high correlation results because in most of the firms in the study operating sales make up a small percentage of the total sales and the two ratios increase proportionately in terms of relative amounts of sales. The ratio of gross earnings to gross commodity sales was deleted from the study because it is less inclusive than gross earnings to gross sales. The correlation coefficients between the ratios were .997, .994, .993, .994 for small, medium, large and the average of all firms respectively; which for the purposes of this study show no important differences.

The ratio of gross sales to operating expense had a correlation coefficient of .986 when correlated with the ratio gross commodity sales to operating expense for the average of all firms. This high correlation results because of the small relative importance of operating sales in most firms studied and the direct relationship of the two ratios in absolute values. The correlation coefficients between ratios were .999, .967, and .999 for the small, medium, and large firms respectively. Since the ratio of commodity sales to operating sales is less inclusive than the gross commodity plus operating sales ratio, the gross commodity sales to

operating sales ratio was deleted from the study.

It was also found that the correlation coefficient between net earnings to gross commodity sales and net earnings to gross sales was .906 for the average of all firms. This high correlation results because in most firms commodity sales are relatively low as a percent of total sales. The correlations between the ratios by size groups were .803, .961, and .995 for small, medium, and large firms respectively. The low correlation for the small size group may be explained by the fact that in small firms the variations in operating sales is greater relative to gross sales. Since small firms are likely to have smaller gross sales than large firms, a slight variation in operating sales will show a relatively more pronounced effect on the gross sales. The net earnings to gross commodity sales ratio was deleted from the study because gross commodity sales plus operating sales are more inclusive than commodity sales.

Net earnings to net worth and net earnings to total assets were found to be highly correlated. This high correlation results because net worth and assets are highly correlated. The correlation coefficient was .888, .886, .955 and .896 for the small, medium, large and the average of all firms respectively. The net earnings to total assets ratio was deleted from the study because net worth gives a better measure of financial efficiency than total assets. Total assets cannot be as accurately measured.

After these reductions 13 earnings ratios and 9 liquidity and solvency ratios remained. The correlation coefficients of these 22 ratios for all firms are found in Appendix Table III. The correlation coefficients for the ratios deleted are similar to the coefficients for ratios to

which they were highly correlated. For this reason they are not presented. The earnings correlation coefficients matrix had to be reduced by two more ratios in order to fit the computing equipment available. Gross sales to year end inventory was deleted because of the lack of uniformity of fiscal year ending periods. Gross sales to fixed assets was also deleted. This ratio was removed because the remaining ratios seemed to be better indicators of economic efficiency.

With these deletions the matrices of correlation coefficients were reduced to a manageable size for the principal component analysis. These coefficients, carried out five decimal places, were used to determine the principal components. The principal component of each matrix was determined using the procedures outlined in Chapter III.[1]

The index weights for each ratio of the earnings and liquidity and solvency matrices for each size group and the average of all firms were determined. The findings showed that when 11 earning variables and 9 liquidity and solvency variables were used in the analysis some variables (ratios) contributed very little to the total index. In comparing the results of several indices, each based on a different number of variables, the index that gives the greatest variance would usually be selected. With several variables the total variance becomes quite high. It became apparent that the variance would be only slightly affected by the deletion of selected variables. Therefore, the first principal component explained less of the total variance of the standardized variables.

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[1]The program used for these computations was written by F. J. Carbato and M. Merwin of Massachusetts Institute of Technology and edited by Edgar Butler of Oklahoma State University, "Eigenvalues and Vectors of a Real Symmetric Matrix."

A decision rule was devised to delete variables that had a trivial influence on the overall index value. The rule was: Any ratio for which a ten percent deviation from the mean of that ratio would cause less than a two percent change in the scaled index would be removed from the index. The ratios meeting this standard remained in the study and will be referred to as the selected ratios throughout the remainder of the study.

The index values of the cooperatives were ranked in each firm size group and for the average of all firms. This ranking was performed for indices based on the original set of 11 and 9 variables used in computing the weights and a second ranking using only those variables and associated weights that were selected by using the decision rule. The "sign rank test"[2] was run on the differences between each pair of ranks and no significant differences at the 95% confidence level were found between any pair of ranks. Thus, the hypothesis was not rejected that the index based upon the reduced number of variables contained the same statistical information as the index developed from the original correlation coefficient matrices.

Indices for the Average of All Firms

Earnings index

The selected earnings ratios, for the average of all firms, their mean values, weights, and contributions to the scaled index are given in Table IV. The ID (identification) column gives the X_j which represents each ratio in the indices derived and throughout the study.

---

[2]Bernard Ostle, Statistics in Research (Ames, 1963), p. 468.

TABLE IV

SELECTED EARNINGS RATIOS, MEAN RATIO VALUES, WEIGHTS, AND CONTRIBUTIONS TO SCALED INDEX FOR AVERAGE OF ALL FIRMS

Ratio	ID	Mean ratio value	Weight	Contribution to scaled index
Gross sales to Operating expense	X_1	13.95 : 1	3.255	45.43
Gross sales to total assets	X_2	2.29 : 1	37.627	86.07
Gross sales to net worth	X_3	3.22 : 1	12.916	41.55
Gross earnings to gross sales	X_4	11.53 : 100	-6.335	-73.05

The first principal component of the matrix of intercorrelations of these selected ratios (λ_1), also known as the first factor, is 2.452. The total variance of the four standardized variables is 4.0. The λ_1 of 2.452 is 61.3 percent of 4.0, thus λ_1 and index developed from it explains 61.3 percent of the total variance of the four standardized variables. The second principal component (second largest root, λ_2) explained only 24.7 percent of the variation. The difference in percent of explanation between the λ_1 and the λ_2 shows that fluctuations in the four variables may be fairly well represented by one factor. λ_1 accounts for nearly two-thirds of the variance of the individual variables. It follows that λ_1 explains 22.6 percent of the standardized variation of X_1, 32.7 percent of X_2, 16.1 percent of X_3, and 28.6 percent of the standardized variation of X_4.

The equation for the scaled index is:

$$I_{AE} = 3.255X_1 + 37.627X_2 + 12.916X_3 - 6.355X_4 \qquad (4.1)$$

Gross sales to total assets (X_2) makes the largest contribution to the scaled index column of Table IV. Contributions to the scaled index are equal to the mean ratio values multiplied by the ratio's weight and the sum of each of these products is 100. Theoretically, this ratio is the most important single ratio defining earning power. Since margins are largely well established in most cooperatives by competitive forces, earning power becomes a function of volume of sales relative to total assets. With established total assets, a firm can improve its financial position by increasing its total sales, assuming costs increase less than returns. Increased sales would permit greater utilization of facilities. Excess capacity is known to be common among cooperative grain elevators. With gross earnings or margins fairly well established at an average of 11.5 cents per dollar's worth of sales, as seen by $\bar{X}_4$ (mean ratio value of X_4), the cooperative should get as many of these "units" of gross earnings as possible with its given set of assets. Any cooperative that wants to improve its financial position should concentrate on this area as long as marginal cost is less than marginal returns. X_2 contributes more to the scaled index than any other ratio. It may be conlcuded that if the cooperative can improve this ratio, i.e., increase total gross sales by a given percentage without appreciably increasing physical assets, the over all earnings index value of the cooperative can be increased more than would be possible through the same percentage increase in any other ratio. This assumes an improvement in the ratio would not weaken the firm in other areas.

Gross earnings to gross sales (X_4) gave the second largest

contribution to the scaled index. The negative sign on the weight indicates that the higher the gross earnings for a dollar's worth of sales the less profitable the firm is and the smaller the firm's scaled index value. This fact would tend to indicate that the greater the marketing margins on a dollar's worth of sales the lower the cooperative's earning position. Apparently, this inverse relationship is the result of the competitive structure of the grain marketing industry. Since prices are fairly well set by competition any price above the competitive price will cause a loss of customers. This ratio, like X_2, alludes to the necessity of maintaining a maximum volume of business. It is also possible that some cooperatives having high gross earnings per dollar of sales had these high margins as a necessary factor to cover high costs. High margins may also be caused by a desire of the directors to avoid a price war.

Gross sales to operating expenses (X_1) contributes the least of the selected ratios to the scaled index by an amount slightly less than the third largest contributor. Although this ratio makes the smallest contribution, its contribution is more than twice as large as needed to meet the minimum standards established earlier regarding the selection of ratios.

The ratio X_3, would at first seem quite similar to X_2. But the correlation coefficients between the ratios is only .638. Even though X_3 is a better measure of financial efficiency of owner-investment, X_2 gives more than twice as large a contribution to the scaled index. If a firm can increase X_3 with more ease than it can X_2, X_3's value in the index becomes relatively more important. This same analysis applies to

all ratios. The ratio that should be of most importance to the individual cooperative may be the one that can be improved the most with the least cost.

A cooperative could obtain a high ratio of gross sales to net worth by operating on borrowed capital. But this efficiency is possible only at the cost of solvency. This example illustrates the need for combining an analysis of earnings ratios with liquidity and solvency ratios.

The proper amount of solvency and liquidity a firm should have, however, is difficult to define. When considering an earnings index, the more profitable the cooperative the higher the index value, and the "better" the cooperative can be judged. High liquidity and solvency index values are not necessarily optimum as is the case with earnings index values. It is possible to be overly conservative and operate with net worth only. As a result facilities may not be maintained and opportunities for innovations might have to be passed up. Also a cooperative could be too liberal, rely on borrowed funds too much, and suddenly find liabilities greater than assets and creditors managing the cooperative. A cooperative can also be hampered by having too many, or too few, assets in a liquid form. The next section will discuss the index developed to describe a cooperative's liquidity and solvency position. It should be remembered that this index differs from the earnings index in that a high value does not necessarily indicate a desirable position.

Liquidity and solvency index

The selected liquidity and solvency ratios for the average of all firms, their mean values, weights, and contributions to the scaled index

are given in Table V.

TABLE V

SELECTED LIQUIDITY AND SOLVENCY RATIOS, MEAN RATIO VALUES, WEIGHTS, AND CONTRIBUTIONS TO SCALED INDEX FOR AVERAGE OF ALL FIRMS

Ratio	ID	Mean ratio value	Weight	Contribution to scaled index
Current ratio	X_6	3:71 : 1	10.350	38.38
Net worth to total assets	X_7	75.45 : 100	2.262	170.67
Net worth to fixed assets	X_8	1.63 : 1	72.378	117.75
Fixed assets to total assets	X_9	48.30 : 100	-3.016	-145.65
Year end inventory to current assets	X_{11}	-47.37 : 100	-1.714	-81.15

λ_1, the first principal component, of the correlation coefficient matrix of the selected liquidity and solvency ratios is 2.779. The total variance of the five standardized variables is 5.0. λ_1 and the index developed from it explain 55.6 percent of the total variation of the five standardized variables. This percentage of explanation shows that fluctuation in these five variables are only fairly well represented by the λ_1 since it explains only slightly more than one-half the total variation of the individual variables. λ_2 explains 22.6 percent of the variation; therefore, λ_1 explains approximately twice the amount of variation explained by the next largest root. λ_1 explains 19.5 percent of the standardized variation of X_6, 25.7 percent of X_7, 31.8 percent of X_8, 13.0 percent of X_9, and 10.0 percent of the standardized variation of X_{11}.

The equation for the scaled index is:

$$I_{ALS} = 10.350X_6 + 2.262X_7 + 72.378X_8 - 3.016X_9 - 1.714X_{11} \quad (4.2)$$

The contributions to the scaled index indicate that net worth to total assets (X_7) makes the largest contribution to the scaled index. This ratio is assumed to be the most important ratio defining a firm's liquidity and solvency. Again, as with the ratio making the largest contribution to the earnings index, a given percentage increase in this ratio will have a greater influcence on the index value than is possible through the same percentage increase in any other ratio.

Fixed assets to total assets (X_9) makes the second largest contribution to the scaled index. The negative sign on the weight is expected because the larger the percentage fixed assets are of total assets the less liquid the cooperative. Therefore, the smaller this ratio, the higher the value of the liquidity and solvency index.

Net worth to fixed assets (X_8) is the third largest contributor to the scaled index. This ratio appears to be quite similar to the net worth to total assets ratio (X_7). The correlation coefficient between the ratios is .771. According to the weight, the larger this ratio the greater will be the firm's liquidity and solvency index value.

Year end inventory to current assets (X_{11}) makes the next largest contribution and its weight carries a negative sign. Therefore, inventories should be as small a portion of current assets as feasible to maintain liquidity. Since inventories are generally a more "fixed" type of current assets than other current assets the negative weight seems reasonable. Again, it is possible to reduce this ratio to such a low point that the firm would be jeopardizing its financial position. If

inventories were reduced to near zero there would be little to sell and in most cooperatives empty storage bins. This action cannot be considered profitable.

The ratio of current assets to current liabilities makes the smallest contribution of the selected variables to the scaled index. However, the contribution of this ratio is nearly twice the minimum level used in selecting variables for the index. Again, it should be mentioned that even though this ratio contributes least to the scaled index it may be of much more importance if improvements can be made relatively easier than in the other ratios.

Indices by Size Groups

Indices were developed for each size group of cooperatives. Some of the analysis would be repetitive so the analysis is based on a knowledge of the above discussion.

Indices for Small Firms

Earnings index

The selected earnings ratios for the small firms, their mean values, weights, and contributions to the scaled index are given in Table VI.

λ_1 of the matrix of the correlation coefficients of these selected ratios is 2.260. Since the total variance of the four standardized variables is 4.0, λ_1 explains 56.4 percent of the total variation of these standardized variables. Although this seems low, λ_2 explains only 28.9 percent of the variation. λ_1 explains 25.3 percent of the standardized variation of X_1, 31.4 percent of X_2, 14.4 percent of X_3, and 28.9

percent of the standardized variation of X_4.

The equation for the scaled index is:

$$I_{SE} = 3.475X_1 + 32.361X_2 + 8.967X_3 - 5.554X_4 \qquad (4.3)$$

TABLE VI

SELECTED EARNINGS RATIOS, MEAN RATIO VALUES, WEIGHTS, AND CONTRIBUTIONS TO SCALED INDEX FOR SMALL SIZE FIRMS

Ratio	ID	Mean ratio value	Weight	Contribution to scaled index
Gross sales to operating expense	X_1	14.26 : 1	3.475	49.55
Gross sales to total assets	X_2	2.46 : 1	32.361	79.61
Gross sales to net worth	X_3	3.53 : 1	8.867	31.65
Gross earnings to gross sales	X_4	10.95 : 100	-5.554	-60.83

Liquidity and Solvency

The selected liquidity and solvency ratios for small firms, their mean values, weights, and contributions to the scaled index are given in Table VII.

λ_1 of the matrix of the correlation coefficients for these selected ratios is 2.222, thus explaining 74.1 percent of the total variation of the three standardized variables. λ_1 quite well explains the fluctuations in the variables since it accounts for nearly three-fourths of the total variance of the individual variables. λ_1 explains 28.5 percent of the standardized variation of X_7, 43.7 percent of X_8, and 27.8 percent

TABLE VII

SELECTED LIQUIDITY AND SOLVENCY RATIOS, MEAN RATIO VALUES, WEIGHTS, AND CONTRIBUTIONS TO SCALED INDEX FOR SMALL SIZE FIRMS

Ratio	ID	Mean ratio value	Weight	Contribution to scaled index
Net worth to total assets	X_7	75.79 : 100	2.34	177.36
Net worth to fixed assets	X_8	1.70 : 1	78.94	134.21
Fixed assets to total assets	X_9	46.71 : 100	-4.53	-211.52

of the standardized variation of X_9.

The equation for the scaled index is:

$$I_{SLS} = 2.340X_7 + 78.944X_8 - 4.528X_9 \qquad (4.4)$$

Indices for Medium Firms

Earnings index

The selected earnings ratio for medium firms, their mean values, weights, and contributions to the scaled index are given in Table VIII.

λ_1 of the matrix of the correlation coefficients for the selected ratios, 2.563, accounts for 64.1 percent of the total variation of the four standardized variables. λ_2 explains only 17.5 percent of the variation. The fluctuations in the four variables are fairly well represented by λ_1 which accounts for nearly two-thirds of the total variance of the individual variables. λ_1 explains 31.5 percent of the standardized variation of X_2, 25.5 percent of X_3, 24.9 percent of X_4, and 18.2

TABLE VIII

SELECTED EARNINGS RATIOS, MEAN RATIO VALUES, WEIGHTS, AND CONTRIBUTIONS TO THE SCALED INDEX FOR MEDIUM SIZE FIRMS

Ratio	ID	Mean ratio value	Weight	Contribution to scaled index
Gross sales to total assets	X_2	2.17 : 1	28.322	61.43
Gross sales to net worth	X_3	2.88 : 1	19.093	55.05
Gross earnings to gross sales	X_4	11.81 : 100	-3.946	-46.57
Net earnings to net worth	X_5	10.06 : 100	2.993	30.10

percent of the standardized variation of X_5.

The equation for the scaled index is:

$$I_{ME} = 28.322X_2 + 19.093X_3 - 3.946X_4 + 2.993X_5 \qquad (4.5)$$

Liquidity and solvency index

The selected liquidity and solvency ratios for medium firms, their mean values, weights, and contributions to the scaled index are found in Table IX.

λ_1 of the matrix of correlation coefficients for these selected ratios is 3.116 and explains 51.9 percent of the total variation of the six standardized variables. λ_2 explains only 24.9 percent of the total variation so it may be concluded that λ_1 is by far the best determinate of variation. λ_1 seems to explain a low percentage of the total amount of variation, but it is not as poor as it appears. This index

TABLE IX

SELECTED LIQUIDITY AND SOLVENCY RATIOS, MEAN RATIO VALUES, WEIGHTS, AND CONTRIBUTIONS TO SCALED INDEX FOR MEDIUM SIZE FIRMS

Ratio	ID	Mean ratio value	Weight	Contribution to scaled index
Current ratio	X_6	2.75 : 1	8.719	23.94
Net worth to total assets	X_7	77.56 : 100	1.753	135.96
Net worth to fixed assets	X_8	1.61 : 1	57.483	92.49
Fixed assets to total assets	X_9	49.73 : 100	-2.921	-145.28
Current assets to total assets	X_{10}	25.54 : 100	2.562	65.43
Inventory to current assets	X_{11}	47.48 : 100	-1.528	-72.54

has the largest number of selected ratios of any index in the study. When the number of variables is increased, the total variation of the index is also increased. Therefore, it is possible for this root to explain more actual variation than a root explaining a much larger percentage of the total standardized variation of fewer variables. λ_1 explains 11.0 percent of the standardized variation of X_6, 21.0 percent of X_7, 30.2 percent of X_8, 18.6 percent of X_9, 8.0 percent of X_{10}, and 11.1 percent of the standardized variation of X_{11}.

The equation for the scaled index is:

$$I_{MLS} = 8.719X_6 + 1.753X_7 + 57.483X_8 - 2.921X_9 + 2.562X_{10} - 1.528X_{11} \quad (4.6)$$

Indices for Large Firms

Earnings index

The selected earning ratios for large firms, their mean values, weights, and contributions to the scaled index are given in Table X.

TABLE X

SELECTED EARNINGS RATIOS, MEAN RATIO VALUES, WEIGHTS, AND CONTRIBUTIONS TO SCALED INDEX FOR LARGE SIZE FIRMS

Ratio	ID	Mean ratio value	Weight	Contribution to scaled index
Gross sales to operating expense	X_1	11.21 : 1	9.608	107.71
Gross sales to total assets	X_2	2.07 : 1	74.560	154.27
Gross earnings to gross sales	X_4	12.40 : 100	-13.058	-161.97

λ_1 of the matrix of the correlation coefficients of these selected ratios is 2.490, thus the index explains 83.0 percent of the total variation of the standardized variables. λ_2 explains 9.9 percent of the variation. Therefore, λ_1 explains the variation in the variables extremely well. λ_1 explains 33.5 percent of the standardized variation of X_1, 34.3 percent of the X_2, and 32.2 percent of the standardized variation of X_4.

The equation for the scaled index is:

$$I_{LE} = 9.608X_1 + 74.560X_2 - 13.058X_4 \qquad (4.7)$$

Liquidity and solvency index

The selected liquidity and solvency ratios for large firms, their mean values, weights, and contributions to the scaled index are given for large firms in Table XI.

TABLE XI

SELECTED LIQUIDITY AND SOLVENCY RATIOS, MEAN RATIO VALUES, WEIGHTS, AND CONTRIBUTIONS TO SCALED INDEX FOR LARGE SIZE FIRMS

Ratio	ID	Mean ratio value	Weight	Contribution to scaled index
Current ratio	X_6	3.11 : 1	7.265	22.61
Net worth to total assets	X_7	71.98 : 100	.997	71.76
Net worth to fixed assets	X_8	1.49 : 1	39.914	59.59
Fixed assets to total assets	X_9	49.86 : 100	-1.083	-54.00

λ_1 of the correlation coefficient matrix for these variables is 2.730 and explains 68.3 percent of the total variation of the four standardized variables. λ_2 explains only 24.8 percent of the variability. Therefore, λ_1 explains the fluctuations in the variables fairly well since it accounts for better than two-thirds of the total variation of the individual variables. λ_1 explains 25.5 percent of the standardized variation of X_6, 29.1 percent of X_7, 34.0 percent of X_8, and 11.4 percent of the standardized variation of X_9.

The equation for the scaled index is:

$$I_{LLS} = 7.265X_6 + .997X_7 + 39.914X_8 - 1.083X_9 \qquad (4.8)$$

This chapter has in part fulfilled the second and third objectives of the study. Objective number two has been partially fulfilled by presenting the ratios that were selected as being important by the standards established earlier. Objective number three has been partially fulfilled with the presentation of the indices to be used later in evaluating the overall earnings and liquidity and solvency of the cooperatives.

CHAPTER V

COMPARISON OF SELECTED FINDINGS

The purpose of this chapter is to compare and summarize the various indices described in the previous chapter. How and why these indices differ will be discussed.

Comparison of Selected Ratio Means

The medium size cooperatives had the highest ratio mean, Table XII, for total sales to operating expense (X_1). Via this criterion the medium size group had the highest operational efficiency. It is hypothesized that the small firms were too small for certain economies of scale and the large firms were suffering diseconomies of scale. The small group's $\bar{X}_1$, mean value of the X_1 ratio, is 8.4 percent less than the medium group's $\bar{X}_1$ and the large group's $\bar{X}_1$ is 28.0 percent less than the medium group's $\bar{X}_1$. The big difference then is between the large group and the other two groups. This difference would indicate that the cooperatives with large total physical assets have a greater cost associated with each dollar of gross sales than the other groups; alternatively stated, sales are relatively lower per dollar of operating expense for large firms. This difference could be the result of excess capacity, an over-abundance of goods and services provided that are underused, or that managerial ability does not increase proportionally with the increase in complexity associated with large operations. Although this ratio is best among the medium

TABLE XII

COMPARISON OF SELECTED RATIO MEANS*

Item	ID	Mean Ratio Values by Size Group: All Firms	Small	Medium	Large
Earnings ratios					
Gross sales to operating expense	X_1	13.95	14.26	(15.57)	11.21
Gross sales to total assets	X_2	2.29	2.46	2.17	2.07
Gross sales to net worth	X_3	3.22	3.53	2.88	(2.98)
Gross sales to net worth	X_4	11.53	10.95	11.81	12.40
Net earnings to net worth	X_5	(8.23)	(8.06)	10.06	(6.22)
Liquidity and solvency ratios					
Current ratio	X_6	3.71	(4.57)	2.75	3.11
Net worth to total assets	X_7	75.45	75.75	77.56	71.98
Net worth to fixed assets	X_8	1.63	1.70	1.66	1.49
Fixed assets to total assets	X_9	48.30	46.71	49.73	49.86
Current assets to total assets	X_{10}	(25.92)	(25.89)	25.54	(26.48)
Year end inventory to current assets	X_{11}	47.37	(44.24)	47.48	(53.93)

*Values in parenthesis were not used in the index because they did not meet the contribution standards established. These values are included for comparison purposes.

firms, it did not meet the contribution standards established for it to become a variable in the medium firms' earnings index. This index is the only earnings index that does not contain this particular variable. The medium firms' index does contain the variable net earnings to net worth (X_5), which is not found in any other earnings index. This change in variables cannot be explained by high correlation as the two ratios have an inter-correlation value of .36. X_1 failed to meet the necessary standards for becoming an index variable for the medium size group by only a slight margin.

The small firms had the most desirable ratio of gross sales to total assets (X_2) which appears in all earnings indices. This ratio value indicates that the efficiency with which the physical assets are used is greatest among small cooperatives. There appears to be a trend toward lower ratio values as the size of firm increases. The medium firms' $\bar{X}_2$ is 11.8 percent less than the small firms' $\bar{X}_2$ and the large firms' $\bar{X}_2$ is 17.5 percent less than the small firms' $\bar{X}_2$. This trend would indicate that financial efficiency of investment decreases as total assets increase. The reasons for this trend could lie in excess capacity among large cooperatives or that cooperatives with fewer assets must find multipurpose uses for their facilities.

The ratio of gross earnings to net worth (X_3) was included in all indices except the earnings index for the large firms. This ratio is highest among the small cooperatives which indicates that: (1) these firms use more credit to finance their business thus giving them an inaccurate picture of financial efficiency; or, (2) the smaller investment associated with the small firms is used more productively and therefore yields a greater return per dollar of investment. It is shown by $\bar{X}_2$ that

the small cooperatives also have the largest gross sales to total assets ratio. This value would seem to indicate that the latter of the two alternatives is correct. The medium firms' $\bar{X}_3$ is 18.7 percent less and the large firms' $\bar{X}_3$ is 15.7 percent less than the small firms' $\bar{X}_3$ which indicates that the largest differences are between the small firms and the other two size groups.

There is an obvious trend in the gross earnings to gross sales ratio (X_4) which appears in each earning index. The small firms had the lowest $\bar{X}_4$ value. The medium firms' $\bar{X}_4$ is 13.3 percent larger than the small firms' $\bar{X}_4$. Since gross earnings on a dollar of sales can be increased only by (1) increasing prices or, (2) a reduction in the cost of goods purchased (prices paid), it can be concluded that one of these effects, or a combination of both, is responsible for the changes in the ratio means among the groups. Competition tends to set both prices paid and received. The hypothesis may be made that higher margins were necessary to compensate for the decrease in efficiency as shown by X_1 and X_2. A large firm should be able to operate on a smaller margin and cover fixed expenses by maintaining volume; therefore, this hypothesis apparently is invalid for the cooperatives studied.

Previous analysis showed that the weight of X_4 in the earnings indices was negative. The negative value indicates that within limits the smaller the ratio the more prone to high earnings the firm is. This weight alludes to the fact that the high gross earnings come from high margins to cover high costs and, in turn, reduces volume of business in a competitive market. This analysis can be carried to the net earnings to gross sales ratio which was computed but did not meet the standards required for an index variable. Net income to total sales was 3.02 : 100

in the small size group, 3.52 : 100 in the medium group, and only 2.27 : 100 in the large group. Gross earnings to total sales is highest among large cooperatives and net earnings to total sales is lowest among these same firms. This analysis is further evidence of some inefficiencies in the large cooperatives.

Net earnings to net worth (X_5) meet the standards used in selecting the index variables for the medium firms only. The mean value of this ratio, $\bar{X}_5$, was highest for the medium firms and therefore expressed the greatest return per dollar of member-owner investment. The value of $\bar{X}_5$ for the small size firms was 19.9 percent less than for the medium firms and 38.1 percent less than the medium firms' value for the large firms. The medium firms' values for $\bar{X}_5$ and $\bar{X}_1$ are the largest, followed by the small firms' ratios with a moderate reduction in both $\bar{X}_5$ and $\bar{X}_1$, and a larger decrease in both mean ratios for the large cooperatives. The correlation coefficients between these two ratios at the individual cooperative level are .292, .130, and .622 for average of all firms, small, medium, and large firms respectively. However, the correlation between the three pairs of ratio mean values is .938.

It is possible that the high mean net earnings to net worth ratio (X_5) in the medium size group reflects the fact that firms in this size group use more credit in financing their operations than the other firm size groups, thus making the net worth relatively low, and giving an overstated mean ratio. Net worth to total assets (X_7) shows that this hypothesis is not valid. The medium firms have the highest percent of net worth to total assets and the large firms have the lowest, meaning that the large firms uses more credit than the other size groups. This difference indicates that the already low $\bar{X}_5$ ratio for large cooperatives

"overestimates" true earning capacity. This analysis is further substantiated by the fact that the mean ratio value of net worth to total liabilities is 10.73 : 1 among small firms, 6.05 : 1 among medium firms, and 5.86 among large firms. A comparison of these ratio means shows a definite trend to more credit financing as the total assets increase.

The current ratio (X_6) used in all the liquidity and solvency indices except the small firms indicates that firms in the small group are in the most solvent position. The value of $\bar{X}_6$ for large firms is 31.9 percent less than for the small firms. $\bar{X}_6$ for the medium firms is 39.8 percent less than it is for the small firms. These differences indicate that medium firms have the fewest liquid assets covering their current liabilities. The data do not give any explanation for the change in the ratios although X_1 shows that relatively less of the small firm's current assets are in inventories.

Net worth to total assets (X_7) used in each liquidity and solvency index has been discussed earlier. The three means do not vary greatly. The medium firms have the highest $\bar{X}_7$ indicating the highest degree of solvency. The small firms' X_7 is 2.3 percent less than the medium firms' $\bar{X}_7$ and large cooperatives' $\bar{X}_7$ is 7.2 percent less than medium firms' $\bar{X}_7$.

Net worth to fixed assets (X_8) is highest among the small firms, 5.4 percent less among medium firms, and 12.2 percent less among large firms. The ratio meets the established standards for use in each liquidity and solvency index. The mean ratio values show a definite trend downward as total assets increase. This trend could be caused by net worth to total capital being relatively high among small firms and declining as total assets increase, fixed assets being relatively small among small firms and increasing, or a combination of these two forces

working together. This trend can be substantiated, at least partially, by comparing X_7 and X_9. The trend of these means indicate that the small firms are more solvent.

Fixed assets to total assets (X_9), used in the liquidity and solvency index for all size groups, is lowest among the small firms indicating the highest degree of liquidity. The medium and large firms' X_9 are 6.5 and 6.7 percent larger, respectively. This comparison shows that fixed assets are slightly lower in small firms, as suggested above, and that there is no real difference in the proportion of fixed assets to total assets in the medium and large size groups.

Current assets to total assets (X_{10}) was used in only the medium firms' liquidity and solvency index. When including the non-used $\bar{\bar{X}}_{10}$'s, large cooperatives would have to be considered more liquid than the other size groups, with medium cooperatives the least liquid. Because grain in storage is a current asset and with the high volume of grain in storage among large cooperatives these firms are likely to be more liquid than small cooperatives. The small firms' $\bar{\bar{X}}_{10}$ is 2.2 percent less and the medium firms' $\bar{\bar{X}}_{10}$ is 2.3 percent less than the large firms' $\bar{\bar{X}}_{10}$.

Year end inventory to current assets (X_{11}), used in only the average and medium group's liquidity and solvency index, shows a definite trend as the total assets increase. Small cooperatives have the smallest $\bar{\bar{X}}_{11}$, while the medium firms' $\bar{\bar{X}}_{11}$ is 7.3 percent larger and the large firms' $\bar{\bar{X}}_{11}$ is 21.9 percent larger. This trend is likely to be true because of the relatively larger storage facilities among cooperatives with large total assets. Since grain in storage is an inventory the ratio is large among the large firms.

The above analysis explains how the selected mean ratio values differ. Also included are several hypotheses as to why the ratios differ. Probably more important to the overall study, the analysis demonstrates the interrelationship of the ratios used in ratio analysis. The analysis indicates that ratios should not be studied without analyzing the factors producing or associated with the ratio values.

Comparison of Contribution of Each Ratio to Scaled Index

The purpose of this section is to compare the contribution made by each variable in the various indices. These comparisons will summarize much of the analysis made earlier dealing with the importance of the various ratios. The values given in the Table XIII are the percentages each ratio contributes to the total absolute contribution of the index. The total absolute contribution is equal to the sum of "Contributions to Scaled Index", as seen in Chapter IV, regardless of the sign of the contribution. The number in parentheses in front of each ratio is that ratio's rank of relative important in the scaled index.

In Table XIII no one ratio makes the largest contribution to the index for all size groups. Gross sales to total assets comes the closest by being the largest contributor for three of the four earnings indices. Among the more interesting changes in the earnings indices is the fact that X_4 makes the largest contribution to the large firms' scaled index but the fourth largest contribution to the next smaller size group. Also, X_5, although not appearing in any index except the medium firms' earnings index makes the second largest contribution to that index.

In the liquidity and solvency indices the current ratio makes the

TABLE XIII

PERCENTAGE OF ABSOLUTE CONTRIBUTION OF EACH SELECTED RATIO TO SCALED INDEX

Item	ID	Percentage Contribution by Size Group			
		All Firms	Small	Medium	Large
Earnings ratios					
Gross sales to operating expense	X_1	(3) 18.5	(3) 22.4	-	(3) 25.4
Gross sales to total assets	X_2	(1) 35.0	(1) 35.9	(1) 31.8	(2) 36.4
Gross sales to net worth	X_3	(4) 16.9	(4) 14.3	(3) 24.6	-
Gross earnings to gross sales	X_4	(2) 29.6	(2) 27.4	(4) 15.5	(1) 38.2
Net earnings to net worth	X_5	-	-	(2) 28.1	-
Liquidity and solvency ratios					
Current ratio	X_6	(5) 6.8	-	(6) 4.5	(4) 10.9
Net worth to total assets	X_7	(1) 30.3	(2) 33.9	(2) 25.4	(1) 34.5
Net worth to fixed assets	X_8	(3) 20.9	(3) 25.7	(3) 17.3	(2) 28.7
Fixed assets to total assets	X_9	(2) 25.8	(1) 40.4	(4) 12.2	(3) 26.0
Current assets to total assets	X_{10}	-	-	(1) 27.1	-
Year end inventory to current assets	X_{11}	(4) 15.4	-	(5) 13.5	-

smallest contribution of the contributing ratios in each of the indices for which it is included. Fixed assets to total assets, the most important ratio in the small firms' index, makes the fourth largest contribution in the medium firm's index. Current assets to total assets makes the largest contribution to the medium firm's indices but does not appear in any other index.

This chapter has compared the various standards developed in the preceeding chapters. The importance of each ratio to each index has been discussed. The analyses has shown that the ratios which comprise an index vary among the size groups and, also, that the importance of the ratios also change among the size groups.

CHAPTER VI

APPLICATION OF INDICES

The purpose of this chapter is to apply the indices developed in the previous characters to some actual data which has been the purpose for developing the indices. This analysis should demonstrate how local elevator managers can use these indices. Once the indices are applied to actual data more general interpretations can be made regarding earnings maximization.

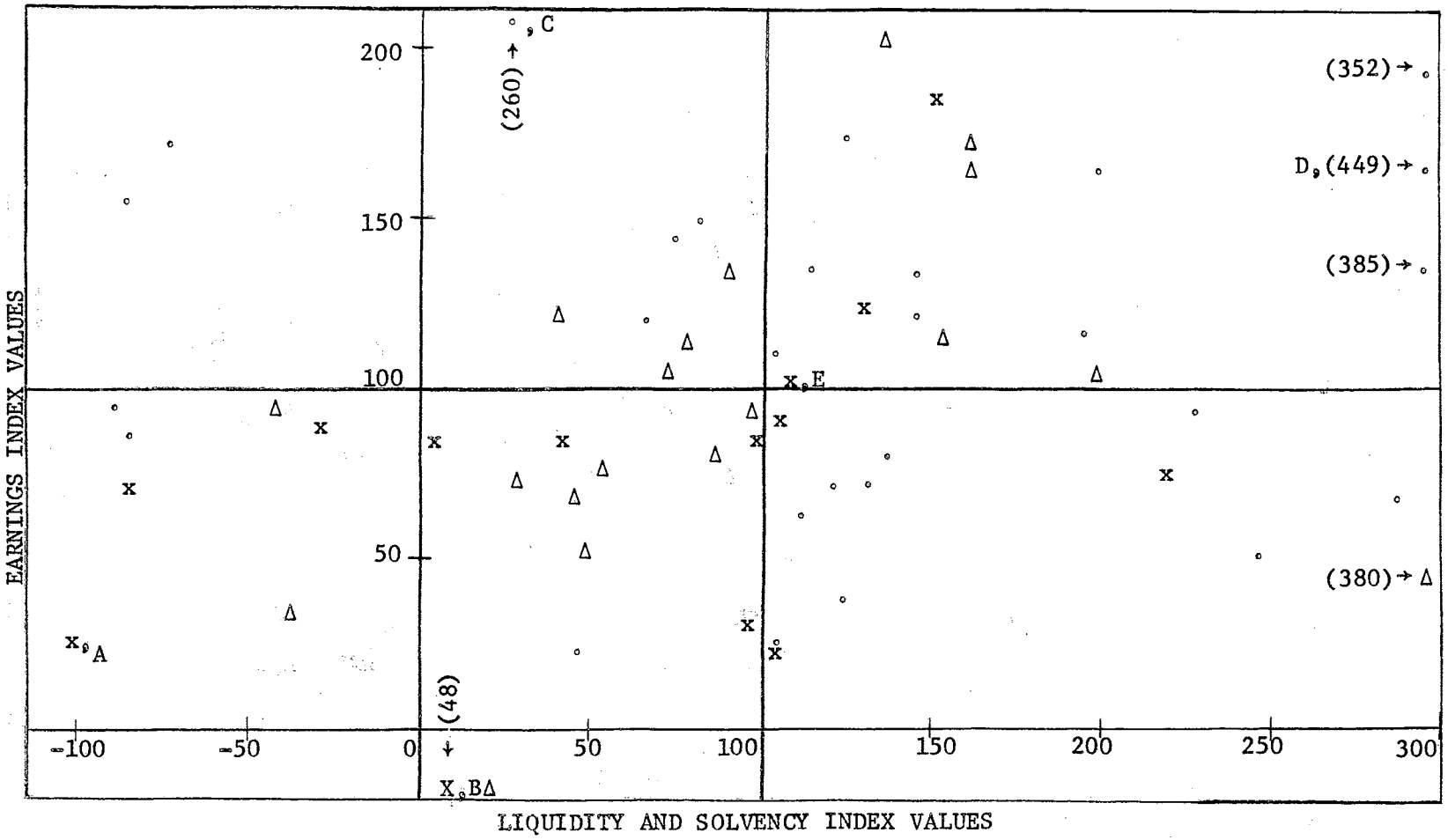
Earnings Indices Compared with Liquidity and Solvency Indices

The average indices were applied to the 62 cooperatives used in the study. By "applied" is meant that the selected ratio values of each firm were multiplied by the ratio's index weight and this product added to the product of all other ratio values and weights in the appropriate index which results in the index value for the firm. Once this calculation was done the earnings index value of each firm was plotted against the firm's liquidity and solvency index value. The results are presented in Figure 1.

Figure 1 indicates some general trends. The data points show more variation among liquidity and solvency indices than among earnings index. In general firms with extremely weak liquidity and solvency indices have greater earnings than those firms with liquidity and solvency index values in the range minus 30 to plus 30. At the index value of about 50

Figure 1

EARNINGS INDEX VALUES PLOTTED AGAINST LIQUIDITY AND SOLVENCY INDEX VALUES, ALL FIRMS VIA AVERAGE INDICES*



* ∘ = Small firms, Δ = Medium firms, x = Large firms

for liquidity and solvency the earnings values tend to increase as liquidity and solvency increases and continue to do so up to an approximate index value of 170 for liquidity and solvency. From this point there seems to be a downward trend beyond the 300 liquidity and solvency level. Beyond this level there are too few data points to make any concrete statements regarding the relations of earnings to liquidity and solvency.

The data points indicate that except for a few extreme observations earnings are low at extremely low and extremely high liquidity and solvency values. On an average earnings are highest when liquidity and solvency is in the 120 to 170 index range. This range would appear to be the optimum range of liquidity and solvency to maximize earnings.

Analysis of Selected Individual Cooperatives

The first cooperative having an extreme index value is identified as firm "A". It has a liquidity and solvency index value of -113 and an earnings value of 30 in Figure 1. This data point is the lowest liquidity and solvency value and among the lowest earning values of the firms studied. Firm A had a low current ratio which was only two-thirds of average due primarily to a high "trade accounts payable". This ratio and the following ratios for each selected firm can be found in Table XIV. Cooperative A is heavily indebted to the Bank for Cooperatives which reduces its net worth to total assets to two-thirds the average for that ratio. The cooperative is highly engaged in the grain storage business which requires high fixed assets. The fixed assets to total asset ratio for firm A is 32.1 percent higher than the mean ratio for all firms and with a negative weight causes a large reduction in the index. With the

TABLE XIV

COMPARISON OF RATIO MEANS FOR SELECTED COOPERATIVES

Item	Ratio Mean, All Firms	Firm A	Firm B	Firm C	Firm D	Firm E
Earning Ratios						
Gross sales to operating expense	13.95	8.71	5.44	19.10	23.99	13.66
Gross sales to total assets	2.29	1.54	1.10	4.11	2.69	2.33
Gross earnings to gross sales	11.53	15.37	20.09	7.23	7.58	11.25
Gross sales to net worth	3.22	3.17	1.55	6.87	2.78	2.73
Liquidity and Solvency Ratios						
Current ratio	3.71	1.27	3.34	2.22	9.08	2.73
Net worth to total assets	75.45	48.93	71.33	61.02	96.70	85.71
Net worth to fixed assets	1.63	.77	1.20	1.30	3.61	1.56
Fixed assets to total assets	48.30	63.81	59.50	46.92	26.87	55.05
Year end inventory to current assets	47.37	58.27	54.92	51.77	25.48	41.69

large volume of grain in storage a larger than average percent of the total current assets are in inventories which reduces the index.

Gross sales to operating expense for firm A were only two thirds the mean for the ratio for all firms. Gross sales to total assets were only slightly greater than half the mean ratio value for all firms. Gross earnings to gross sales were one-third larger than the mean which reduced the index value. Gross sales to net worth were slightly below normal. This ratio could be expected to be near normal because of the high percentage of borrowed capital.

Firm B, also identified in Figure 1, had the lowest earnings index value with a value of minus 49. The firm showed a total net loss of $25,500 on a $877,900 investment in one year. The cooperative had slightly below average net worth to total assets and net worth to fixed assets ratios. Fixed assets to total assets and year end inventories to current assets were 23.2 percent and 15.9 percent higher than the averages. These respective ratios account for the low liquidity and solvency. The extremely low earnings index results from the fact that gross sales to operating expense is 61.0 percent below the mean for this ratio. The ratio of gross sales to total assets for firm B is less than one half the mean for this ratio for all firms. Gross sales to total assets for firm B is less than one half the mean for all firms for this ratio. The ratio of gross earnings to gross sales for firm B is nearly twice as large as the mean ratio for all firms which reduced the index. Gross sales to net worth for firm B is less than one-half the mean ratio value for all firms to again reduce the index value.

Firm C, also identified in Figure 1, had the highest earnings index

value, 260, and liquidity and solvency ratio of 25. All the ratios with a positive weight were slightly low and the ratios with a negative value were slightly high among the liquidity and solvency ratios. Among the earnings ratios, gross sales to operating expense were 36.9 percent above the mean. Gross sales to total assets were 79.7 percent above this ratio's average. Gross earnings to gross sales were 59.4 percent below the average for the ratio and gross sales to net worth were more than twice the mean ratio for gross sales to net worth.

Firm D, also identified in Figure 1, had the highest liquidity and solvency position with a value 449. Since the audits for this cooperative stated that not all the accounts balanced, the accuracy of this index value should be questioned. Current liabilities were less than $7,000 with only $1.00 of fixed liability compared to a total capital value of $288,000. The current ratio was 144.7 percent larger than the mean current ratio for all firms; net worth to total assets was 28.2 percent greater than this ratio's mean for all firms; and net worth to fixed assets was 121.9 percent greater than the mean of the ratio for all firms. Fixed assets to total assets and year end inventories to current assets were relatively low. One reason for this low value is that the firm's buildings and equipment were more than half depreciated from their original book value.

Firm D also had a relatively high earnings index value as seen in Figure 1. The firm showed high operating and financial efficiency with a gross sales to operating expense ratio which was 72.0 percent above this ratio's average, gross sales to total assets were 17.6 percent above the ratio's average, gross earnings to gross sales were 34.3 percent

below average, and gross sales to net worth 13.6 percent lower than the ratio's average. This last ratio value can probably be explained by the strong capital position of the firm.

Firm E had an index value for both indices closer to the mean of each index than any other cooperative. Each of the firm's ratio values follow quite closely to the standard for each ratio as seen in Table XIV.

The above analysis is quite brief. The management of each of these firms should be able to explain "why" certain unique ratios exist in their cooperative. Much of this information is not found in the annual audits of the firms.

Comparison of Earnings Index with Firm Characteristics

The purpose of this section is to illustrate some of the characteristics of cooperatives with high earnings as judged by the indices developed in the study. Ten characteristics of each firm were analyzed. After each firm was analyzed by the characteristics or variables, the observations were recorded and ranked. These variables were classified into divisions according to natural breaks in the observations recorded. This explains the unequal number of divisions of each variable. The earnings index rank was computed for each cooperative in each division of all the variables. The index rank is the rank of each index value when placed in an array. A rank of one shows the highest earning power and the cooperative with the least earning power has the rank value of 62. The mean rank value of the firms in each division of each variable is the value used in the following analysis and is found in Table XV.

The total sales division with the highest mean rank value is the

division with the smallest total sales. This would indicate that firms selling fewer dollar's worth of sales tend to be more efficient with their volume of sales and therefore show larger earnings. There is no definite trend in the rank values for the various sizes of total sales. Firms in the large-medium division of total sales have the lowest rank mean indicating the least profitable volume of business.

The mean ranks of the net earnings divisions have no trend. Since net earnings are measured in absolute amounts a cooperative having a high net earnings value is not necessarily highly profitable by the index developed in the study. The index has the power, through ratios, to take a high net earnings value and relate it to inputs which gives a much more accurate picture of earning ability. For example, a cooperative with net earnings among the highest one-sixth for the cooperatives may have a net earnings to total investment ratio among the lowest one-sixth of the cooperatives for a ranking of these ratios.

High gross earnings appear to show low earning ranks as is indicated in Table XV. This relationship has been discussed before.

The mean rank values for the storage income as a percent of total income criterion fluctuate with no definite trend. The firms with the extremely high percentage of income from storage have uniquely high mean index value with the large-medium firms having a relatively low mean rank. However, the cooperatives with slightly less activity in storage seem to have the highest earning power.

No important differences can be found with the grain service income variable among the first four divisions. If a statistical measure could be used it would likely show no significant differences among the four

TABLE XV

MEAN EARNINGS RANK FOR DIVISIONS OF SELECTED FIRM CHARACTERISTICS FOR COOPERATIVES STUDIED

Total Assets (in 1000's)

Division	No. of firms	Rank
146 - 500	29	27.3
501 - 750	19	32.3
751 - 5060	14	39.1

Total Sales (in 10,000's)

Division	No. of firms	Rank
26 - 70	8	25.4
71 - 90	10	32.8
91 - 115	14	27.9
116 - 160	10	41.4
161 - 210	12	31.5
211 - 751	8	31.6

Net Earnings (in 1000's)

Division	No. of firms	Rank
-26 - 7	6	36.2
8 - 19	8	23.9
20 - 40	18	31.2
41 - 55	13	34.2
56 - 100	12	28.8
101 - 253	5	39.0

Gross Earnings (in 1000's)

Division	No. of firms	Rank
18 - 50	12	21.1
51 - 89	12	21.7
90 - 119	13	37.5
120 - 149	7	33.9
150 - 199	10	35.3
200 - 832	8	40.9

TABLE XV (continued)

Storage Income as a Percent of Total Income

Division %	No. of firms	Rank
0 - 19	11	29.0
20 - 29	14	32.9
30 - 39	7	20.1
40 - 49	17	38.8
50 - 59	9	32.4
60 - 100	4	18.2

Grain Service Income as a Percent of Total Income

Division %	No. of firms	Rank
0 - 4.9	16	28.0
5 - 9.9	14	30.1
10 - 13.9	13	29.1
14 - 19.9	9	31.1
20 - 35	7	41.7

Grain Sales as a Percent of Commodity Sales

Division %	No. of firms	Rank
43 - 59	16	38.4
60 - 69	17	46.2
70 - 79	11	36.8
80 - 89	10	26.9
90 - 100	8	19.2

Net Grain Income as a Percent of Total Income

Division %	No. of firms	Rank
-8 - 9	11	43.4
10 - 19	14	43.9
20 - 29	15	30.7
30 - 44	10	18.0
45 - 68	12	16.3

TABLE XV (concluded)

Petroleum Sales as a Percent of Commodity Sales			Petroleum Income as a Percent of Total Gross Income		
Division %	No. of firms	Rank	Division %	No. of firms	Rank
0%	29	21.4	0%	27	27.1
1 - 5	10	29.0	1 - 9	10	26.3
6 - 9	11	31.7	10 - 19	14	34.1
10 - 21	12	41.7	20 - 29	6	43.2
			30 - 50	5	43.8

divisions. The division with the largest percentage of income from grain services has the best rank mean. The hypothesis may be made that where a large percentage of income comes from grain services the equipment and facilities become varied to an extent that the cost of providing these services runs high. The hypothesis may also be made that there is under-employment of much of the investment. Further analyses of this is food for thought for more research study.

There is a definite trend to less earning ability as the percentage of petroleum sales to total commodity sales increases. The cooperatives with no petroleum sales had the best earning mean rank value and those with the highest percentage of total sales from petroleum sales had the poorest mean earning rank. Petroleum income as a percent of total income indicates that the two lowest and two highest divisions of this variable have about equal mean earning ranks. There appears to be a general trend toward lower earning power as the percentage of petroleum income to gross income increases.

With the exception of the first division a very definite trend to higher earning power is indicated as grain sales to commodity sales increases. The same trend can be seen in grain income as a percent of total income. The mean earning rank for the highest division of each of these variables are among the highest found in any of the variables studied. This high value should indicate the importance of grain sales and income relative to the rest of the firm's business. The 19.2 rank among the grain sales variable is by far the best for that variable and is found where grain sales comprise 90-100 percent of the commodity sales. A rank of 16.3 is at the end of a trend towards higher earning

ability as grain income increases as a percent of total income.

To summarize this analysis a hypothetical model cooperative will be constructed with some absolute values. This cooperative would have less than $500,000 of total physical assets. Total sales would be about $700,000 per year. Storage income should make up at least 60 percent of the total income and other grain services should be minimized as a percent of total income. The model cooperative should not have a petroleum sideline. The cooperative must try to deal in grain sales as much as possible, preferably at least 90 percent of its commodity sales should be from grain sales with at least 40 percent of its total income coming from these transactions.

The above analysis does not account for interaction among the variables studied. Before any concrete statement regarding a model firm can be made this would have to be known. This interaction could be an area for further study. The chapter does give illustrations of the use of the indices developed. Several deductions were made when the earnings index values of the cooperatives were compared with the cooperatives divided into groups according to certain selected criteria.

CHAPTER VII

SUMMARY AND CONCLUSIONS

The objective of this study was to help cooperative grain elevator management evaluate the cooperative's current position by providing it with comparative statistics. The statistics were in the form of financial ratio standards and indices. The data for the study came from the fiscal audits for the 1962, 1963, 1964 crop years of selected cooperatives belonging to the Farmers' Cooperative Grain Dealers Association of Oklahoma. Twenty-nine ratios were computed for each of sixty-two cooperatives for each of the three years studied. A three year average ratio for each of the twenty-nine ratios for each firm was computed. These averages can be used as current industry wide standards against which individual cooperatives may compare their own ratios.

The selected cooperatives were divided into three groups, small, medium, and large, according to the book value of their total physical assets. Standard ratios and indices were computed for each of these groups in addition to the comparative statistics computed for all cooperatives as a unit.

Major emphasis was placed on earnings ratios. Liquidity and solvency ratios were also included because the maximization of earnings is no guarantee of financial health. Tables II and III summarize the standards determined for each ratio studied.

Factor analysis was used to develop indices based on a few selected ratios such that the indices would convey all the essential information as indices which included all possible ratios. This was done for manageability and simplicity of manipulation of the indices developed.

The indices computed were then scaled to 100. Index values of 100 became the industry wide standard against which the individual cooperatives can compare their own index values.

From the indices the conclusion was reached that since margins are relatively set, earning power becomes largely a function of volume of sales relative to operating expense, total assets and net worth. To maximize earnings, operating expense, total assets, and net worth should be as low as possible given a level of gross sales.

Gross earnings to total gross sales should be as small as possible for high earnability. The conclusion was drawn that the greater the marketing margin on a dollar's worth of sales the lower the cooperative's earning position. Two hypotheses were made regarding why this was true: (1) since cost of goods sold are fairly well set by competition, high margins means high prices to customers which can cause loss of business to competitors and excess capacity of assets; (2) high margins are necessary to cover high costs resulting from inefficient operation.

Net earnings to net worth should be as high as possible with the restriction that credit financing be low or that member-owned investment (net worth) makes up an adequate portion of the total investment so as not to unduly affect the value of this ratio.

The selected liquidity and solvency ratios indicate current assets to current liabilities, net worth to total assets, net worth to fixed assets,

and current assets to total assets should be maximized for a high liquidity and solvency position. Fixed assets to total assets and year end inventories to current assets should be minimized to maintain sound liquidity and solvency. The ratios to be maximized and those to be minimized should be done so within limits as overly high liquidity and solvency can be as detrimental as a weak liquidity and solvency position.

A comparison of the ratio means by size groups showed that total gross sales to operating expense was highest among the average size cooperatives. The magnitude of these ratios indicates that the small cooperatives lacked slight economics of scale possessed by the medium size cooperatives and that large diseconomies of scale appeared in the large size group. Total gross sales to total assets was highest among the small firms and showed a trend toward lower ratio values as total assets increase. This trend indicated diseconomies of scale in both the medium and large groups relative to the small size group. The trend can be the result of excess capacity and/or general inefficiency among the larger firms. Total gross sales to net worth was also highest among the small cooperatives' mean ratios.

The small size group had the best gross earnings to gross sales ratio. The analysis indicated that this ratio should be minimized. A trend to higher margins appears as total assets increased. With the decrease in efficiency as shown by the total gross sales to operating expense and total assets ratios, it was hypothesised that these high margins are necessary to compensate for this inefficiency. The study also found that even though gross earnings to gross sales was highest among the large firms net earnings to gross sales was lowest among these same firms.

Earnings index values of the cooperatives studied were plotted against liquidity and solvency index values. It was found, with few exceptions, that when liquidity and solvency is low earnings are also low. As liquidity and solvency reach a certain high, earnings fall.

The study indicated that the average earnings index value was highest among the samll firms and lowest among the large firms. Average earning index values also decreased as total gross earnings increase. The mean earnings index value was highest when storage income made up 60 percent or more of the total income. The study disclosed a trend to lower earnings as grain service income increased as a percent of total income with the highest earnings among cooperatives deriving less than five percent of their total income from grain services. It was concluded that many of the facilities and equipment necessary for these services were underemployed.

When petroleum sales as a percent of commodity sales and petroleum income as a percent of total gross income increase, the mean earnings index value decreased with a very definite trend. The mean earnings index value was emphatically highest when the grain sales were 90-100 percent of commodity sales. A strong trend to higher earnings was also found as grain income as a percent of total income increases with the highest earning value among cooperatives with grain income making up the cooperatives sutdied those showing the highest earnability dealt primarily in grain business and these transactions were the chief source of their income.

Hopefully, this study will open areas for further study. Among these should be a study of the same type made among other industries. The same standards should be computed in a later time period for the same cooperatives. Both of these studies should then be compared with standards set forth in the present study. This same type of study should be conducted among privately owned grain elevators and comparisons made with this study.

One of the major limitations of this study is that the accounting periods varied among the cooperatives. It would be desirable for a study to be conducted among cooperatives having nearly the same accounting periods or a method devised to correct the bias resulting from this lack of homogenity.

Much of the analysis of this study has alluded to higher earning power among cooperatives with fewer total physical assets relative to large scale cooperatives. A study should be conducted to analyze in more detail the validity of this hypothesis. Research should also be undertaken concerning the importance of and economic feasibility of various sidelines conducted by the cooperatives. Such a study should investigate the interaction among sidelines and other activities leading to high earnings.

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APPENDIX

APPENDIX TABLE I

STANDARD DEVIATIONS OF EARNING RATIOS COMPUTED FOR SELECTED OKLAHOMA COOPERATIVE GRAIN ELEVATORS, 1962-1964

Ratio	Standard deviation by size group				Standard deviation among years for all firms
	Small	Medium	Large	All Firms	
Gross earnings to gross sales	3.01	2.85	2.94	2.96	.69
Gross earnings to gross commodity sales	3.36	3.38	3.69	3.46	.71
Gross earnings to gross operating sales	4.41	2.55	.77	3.40	.19
Gross sales to operating expense	4.50	6.11	4.07	5.11	1.94
Gross commodity sales to operating expense	4.40	5.99	4.00	5.05	1.94
Gross operating sales to operating expense	25.92	32.46	18.40	27.05	8.73
Gross sales to fixed assets	2.01	1.40	1.66	1.82	.27
Gross sales to total assets	.54	.45	.53	.53	.18
Gross sales to net worth	1.31	.60	.88	1.09	.25
Gross sales to receivables	28.80	19.68	13.61	20.53	22.93
Gross sales to net working capital	167.32	162.99	59.88	146.67	18.70
Gross sales to year end inventories	27.14	7.30	7.01	20.14	2.18
Net earnings to gross sales	2.46	1.22	1.60	2.01	.15
Net earnings to gross commodity sales	2.02	1.22	1.70	1.79	.27
Net earnings to gross operating sales	67.65	117.93	45.54	84.11	8.95
Net earnings to net worth	7.38	3.23	5.49	6.10	1.87
Net earnings to total assets	4.31	2.97	3.99	3.99	1.25

APPENDIX TABLE II

STANDARD DEVIATIONS OF LIQUIDITY AND SOLVENCY RATIOS COMPUTED FOR SELECTED OKLAHOMA COOPERATIVE GRAIN ELEVATORS, 1962-1964

Ratio	Standard deviation by size group				Standard deviation among years for all firms
	Small	Medium	Large	All Firms	
Current ratio	3.61	1.71	1.98	2.93	.99
Acid test	2.59	1.10	.76	2.03	.73
Current assets to accounts receivable	8.76	2.34	1.90	6.26	1.21
Year end inventories to current assets	13.24	9.67	12.41	12.53	2.80
Year end inventories to net working capital	3.12	8.33	1.65	5.03	1.12
Net worth to total assets	17.19	11.72	15.57	15.32	.54
Net worth to fixed assets	.63	.43	.42	.53	.05
Net worth to total liabilities	10.73	6.94	9.27	9.42	.53
Total assets to total liabilities	10.67	6.96	9.27	9.41	.78
Fixed assets to fixed liabilities	1331.33	2557.29	1094.78	175.62	420.27
Current assets to total assets	7.19	4.97	8.86	6.95	.37
Fixed assets to total assets	8.82	6.63	8.83	8.26	1.15

APPENDIX TABLE III

CORRELATION COEFFICIENTS FOR SELECTED RATIOS FOR COOPERATIVES STUDIED

Ratios	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
Current ratio (1)	1.00	.05	.58	.54	.79	.27	.23	.11	.06	-.11	-.27	.07	.14	.03	-.26	.32	-.16	-.08	-.19	.27	-.39	.42
Year-end inventories: net working Cap. (2)		1.00	.12	.15	.05	.10	.20	.22	.15	.01	-.12	.02	.09	-.05	.08	.01	.71	.08	-.17	.04	-.01	-.04
Net worth: total assets (3)			1.00	.77	.70	.40	.23	.11	.18	-.13	-.21	.05	.29	.30	.63	.18	.17	-.03	-.26	.49	-.38	.13
Net worth: fixed assets (4)				1.00	.65	.40	.65	.31	.23	-.01	-.25	.08	.21	.08	-.30	.23	.22	.35	-.75	.48	-.33	.03
Net worth: total liabilities (5)					1.00	.30	.24	.10	.07	-.12	-.20	.11	.19	.12	-.33	.21	.09	-.02	-.26	.48	-.28	.10
Gross sales: operating expense (6)						1.00	.44	.53	.29	-.06	-.64	.34	.22	.38	.11	.21	.03	.07	-.20	.42	-.29	.27
Gross sales: fixed assets (7)							1.00	.84	.35	.13	-.45	.21	.01	-.21	.45	.32	.24	.56	-.81	.21	-.12	.05
Gross sales: total assets (8)								1.00	.34	.14	-.60	.28	-.01	-.22	.64	.29	.23	.38	-.50	.12	-.02	.13
Net earnings: net worth (9)									1.00	-.17	.13	.31	.72	.25	.01	-.01	.13	.34	-.13	.05	-.11	-.01
Gross earnings: gross operating sales (10)										1.00	-.17	.25	-.29	-.54	.23	-.05	.03	.20	-.15	.10	.11	-.08
Gross earnings: gross sales (11)											1.00	-.22	.34	.20	-.31	-.23	.01	-.05	.24	-.22	.17	.35
Net earnings: gross operating sales (12)												1.00	.26	-.23	.24	.01	.04	.09	-.01	.05	-.18	.06
Net earnings: gross sales (13)													1.00	.40	-.21	-.03	.11	.10	.04	.12	-.15	-.05
Gross operating sales: operating expense (14)														1.00	-.43	.03	.01	-.22	.19	.12	-.19	.02
Gross sales: net worth (15)															1.00	.05	.08	.35	-.20	-.23	.28	-.04
Gross sales: receivables (16)																1.00	-.02	-.09	-.16	.23	-.23	.37
Gross sales: net working capital (17)																	1.00	.28	-.31	.09	.16	-.59
Current assets: total assets (18)																		1.00	.53	.05	.22	-.42
Fixed assets: total assets (19)																			1.00	-.29	.03	.19
Fixed assets: fixed liabilities (20)																				1.00	-.19	.10
Year-end inventories: current assets (21)																					1.00	-.60
Gross sales: Year-end inventory (22)																						1.00

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