A METHOD OF ECONOMIC ANALYSIS FOR DECISION MAKING BY COOPERATIVE ELEVATOR ASSOCIATIONS

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PREFACE

The scope of cooperative management is wide. Both economic and non-economic considerations are involved in decisions made at all levels. Sound economic decisions need not interfere with non-economic criteria. If anything, sound economic decisions furnish a more satisfactory framework within which individual preferences of a non-economic nature may be satisfied.

During the period of the study, the author's views as to the importance of sound economic decisions underwent several changes. The realization that non-economic considerations play a major role in decision making made the problem appear nearly insurmountable. The motives of individual farmers, directors, and managers are so diversified, both in range and intensity, that any attempt to analyze the specific process of decision making is doomed.

As the study progressed, it became apparent that sound economic decisions do not conflict with non-economic preferences, but rather supplement them. The purpose of the thesis is to set down a method of economic analysis for decision making.

The author is indebted to Professor Adlowe L. Larson who was the major advisor on the thesis. Without his encouragement, advice, and criticisms, this thesis would not have been possible.

Mr. Roy Bender, executive secretary of the Oklahoma Grain Dealers Association, contributed greatly at the outset of the project with many helpful suggestions. The cooperation of the seventeen local cooperative managers during the project was excellent - to each my sincere thanks. Thanks are also due the Chalmers and Barton Construction Company of Salina, Kansas for construction estimates.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHART

CHAPTER I

INTRODUCTION

For the past few years economists, more than ever before, have been trying to determine how management decisions are made and should be made to attain given goals. Contributions have been made by several economists, only a few of whom addressed themselves specifically to cooperatives.

Professor Frank Robotka, in his article "A Theory of Cooperation," furnished one of the more complete theoretical discussions available on this subject. The following paragraphs summarize parts of Professor Robotka's article.

First, the literature in the general field of cooperation was reviewed and contributions of both European and American authorities were recognized. Next, the points of general agreement among American economists were enumerated as follows:

1. A cooperative is an economic entity.
2. The Rochdale "principles" are applicable.
3. Vertical integration is possible only if many small units are horizontally integrated.
4. Cooperation is the opposite of competition.

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[1]Frank Robotka, "A Theory of Cooperation," Journal of Farm Economics, Vol. XXIX, No. 1 (February, 1947), pp. 94-114.

5. Cooperative membership is on a personal basis.

6. A cooperative is not an economic unit which "pursues its own independent economic career".

7. Membership is not dependent on capital contribution.

8. A cooperative does not deal with non-members.

A new firm comes into existence when a cooperative is formed. This new firm is strong enough to perform the functions desired by the membership; yet, it is weak enough that it does not interfere with the activities of the individual members.

One of the basic principles of cooperation is that participants receive services at cost. Cooperators conducting a business incur the expenses and assume the risks associated with the operation. Thus, they earn what they would have had to pay someone else for performing the operation.

The patronage refund is a device by which transactions are reduced to a cost basis. In practice, patronage dividends are underpayments for products delivered or overcharges for services rendered during the course of an accounting period. The paying of a patronage refund discharges a liability of the cooperative.

Over the years, cooperatives in the grain industry have been plagued by problems in decision making. Some of the most difficult problems have had to do with the organization of management. At one time or another every cooperative has had to decide how many directors were needed, the length of term to be served by directors, and the area of their responsibility.

Cooperatives in the wheat industry in Oklahoma have gravitated toward a standardized type of organization. The by-laws adopted by various cooperatives in the State are similar with respect to the requirements for membership, the conduct of membership meetings, director duties, officer duties, method of apportioning earnings, and amendments to by-laws. Far less homogeniety was found in the methods employed in making decisions which have an impact on the members' economic goals.

Objectives of the Study

The objectives of this study were:

1. To provide managers, directors, and members with a method of analysis applicable to decisions on expansion of major permanent assets.

2. To provide a method of price determination applicable to pricing of goods and/or services provided by the cooperative.

3. To establish the criteria for evaluating the various methods of distributing net earnings.

4. To describe other problem areas of importance to cooperative management and the relative criteria for analysis when making decisions.

The Management Problem

The new economic entity, born when a cooperative is formed, has a particular set of goals, criteria, and relevant data which influence the decision making processes.

The goals of a cooperative must be consistent with the goals of individual members, each member of a cooperative operates his farm firm to maximize profits. The farmer is interested in combining his total resources in a manner which yields the maximum profits from his operation as a whole.

If a farmer can obtain resources at cost by cooperation with other producers, cooperation is consistent with a profit motive. Thus, the goals of cooperative management are: (1) to provide members with goods and/or services at cost and, (2) to produce the quantity of goods and/or services which minimizes the average cost of production. Thus, within the limits of the demand for elevator services, the scale of plant utilized by a cooperative will be as near optimum as possible. Attainment of these goals is consistent with the least-cost combination of resources in the production process.[2]

The two types of major decisions which are required of cooperative management are scale of plant and price. Scale of plant is important because, only with an optimum scale of plant can the minimum average cost be realized. Price analysis on an enterprise basis is required to insure that services will be recieved at cost.

Short-run and long-run average cost and average revenue data are required to facilitate the making of cooperative decisions. To determine these data, the analysis must include such estimates as size of market area, maximum wheat crop produced in the area, rapidity of harvest, availability of transportation, plant specifications, and competing-firm price policy.

The theory developed and the empirical data gathered during the study and presented here represent an attempt to analyze, from an economic viewpoint, a method of decision making applicable to problems

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[2]Richard H. Leftwich, <u>The Price System and Resource Allocation</u>, (New York, 1955), p. 112.

in cooperative grain elevator management. The importance of this study is not the problems solved but the method presented by which problems may be attacked and economically-sound solutions found.

Decision-Making Practices Found in the Industry

The complexity of the mental processes underlying a single decision is so great that volumes would be required to record them. That part of the decision-making process which is jointly discussed, debated, and recorded is probably the best indicator through which insight into the individual mental processes may be attained. This section is devoted to a discussion of this recorded evidence of decision-making processes.

The records were invariably incomplete. This deficiency was corrected by querying the manager and the secretary of the board about matters which transpired on occasions when major decisions were made. One deficiency of the records is that the answers to these queries may have been biased by rationalizations.

An example of the process of decision making is the actions of members when faced with the need for additional elevator facilities. The need is usually evident to the members first. The members discuss the need with the manager, who brings the matter to the attention of the directors. The first record of discussion is usually an item in the minutes of a director meeting. At the time of the first director discussion, a committee is usually appointed to study the situation.

Committee reports almost always indicate that data on various types and sizes, brands, capacities, etc., had been collected and bids taken (never less than three bids). This report is discussed by the directors in terms of costs per unit, life of the asset, size of loan and repayment time for financing the construction, and the time when various companies could complete the construction.

The discussions by the directors might be carried out over a period of several months. Finally, the directors would arrive at a recommendation or series of alternative recommendations which would be presented to the membership for a vote.

A special meeting of the membership is then called in accordance with the by-law requirements. The manager, directors, and an expert usually speak on the benefits of the proposed change. After the talks are completed, the chairman asks for discussions from the floor. At this time, questions are addressed to the speakers, ideas are expressed by farmers as to the relative merits or demerits of the alternatives available, and matters such as financing are discussed.

The discussion period usually culminates with a motion by one of the members to accept a specific proposal as presented by the directors. The motion receives a second and a vote follows. There are few instances in which the motion does not carry.

The pitfalls, which are inherent in this system of decision making, are in general the result of a failure to analyze demand. The records of the cases studied showed no indication of an attempt being made to analyze the plant-facility requirements of the market area. A discussion of the leg capacity per hour required to handle the rate of harvest was not found in any of the minutes of director meetings. Decisions as to size of elevator facility were made without a joint effort on the part of the manager and directors to analyze the wheat production in the market area. Decisions as to size of feed mills were made without a joint effort to analyze the potential market for mill feeds.

The storage of government wheat under Commodity Credit contracts has constituted a large part of the wheat enterprise for cooperative elevators during the past few years. Therefore, the management of a cooperative elevator must decide each year how much elevator space is required to handle the grain coming in during harvest.

This decision as to space required is directly comparable to the scale-of-plant decision. The minutes of director meetings frequently indicate that a joint effort was made to analyze the production in the market area when deciding on space needed during harvest. The method used was normally accurate enough to furnish the basis for sound decisions.

The difference in the method of approach to the two decisions appears to be attributable to the differences in consequences associated with the making of an improper decision in each case. The decision as to size of elevator is made with very little conscious consideration of risk. The decision to ship government-owned wheat is made with a conscious realization that an improper decision may be very costly.

Decisions on pricing policy were entered in the minutes of board meetings of a few of the cases studied. The records usually indicated that pricing policy was the concern of the board because the cooperative had been having financial difficulties. The board's decisions on pricing were usually to increase margins. The costs involved in the handling of various items never appeared in the records as a major consideration in determining margins.

The minutes of meetings indicate that the management of cooperative elevator associations concerns itself primarily with the criteria directly associated with immediate risks. For example, when the cooperative members invest money in the construction of an elevator, they are more interested in the terms of the loan, the rate the debt would be repaid, and the solvency of the cooperative than they are in the adequacy of the facility and the cost of services furnished by the facility. Yet, the terms of the loan, the rate of repayment, and the solvency of the cooperative are directly dependent on the adequacy of the facility relative to the market area.

Information Available Prior to the Study

The number, size, and many other characteristics were known about all the cooperative elevator associations in Oklahoma prior to the time of this investigation.

In 1955 a general survey was made of all the cooperative elevators in Oklahoma.[3] This survey furnished a great deal of information used in designing the case studies for the 1956 investigation. The results of the investigation are presented in this thesis.

The general survey showed that 81 cooperative associations furnished elevator services for member patrons. The elevators operated by these associations ranged in size from 9,000 to 2,045,000 bushels of elevator bin space. For comparative purposes, two major divisions were made: (1) Cooperative Associations which operated an elevator

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[3]The 1955 general survey was conducted jointly by D. G. Nelson and members of the Farmer Cooperative Service in connection with Oklahoma Experiment Station Project Number 906.

at only one geographic location were called "single-location cooperatives". (2) Associations which operated elevators at more than one geographic location were called "multi-location cooperatives". The elevator bin capacity of "single-location cooperatives" ranged from 9,000 to 970,000 bushels. The elevator bin capacity of "multi-location cooperatives" ranged from 24,000 to 2,045,000 bushels.

A further breakdown was made within the major divisions. The "single-location cooperatives" were divided into 2 classes: those with elevator bin capacities less than 225,000 bushels, and those with more than 225,000 bushels. There were 29 cooperatives in the less than 225,000 bushel capacity class and 30 cooperatives in the more than 225,000 bushel capacity class.

The "multi-location cooperatives" were also divided into 2 classes: those with elevator bin capacities less than 400,000 bushels and those with more than 400,000 bushels. There were ten and twelve cooperatives respectively in these two classes.

The average number of employees in all of the "single-location cooperatives" was 5. The range was 1 to 15. In the larger class of "multi-location cooperatives", the average number of employees was 11, the range being 2 to 28. The average number of employees in the smaller "multi-location" class was 9, the range being 3 to 23.

Other items of information on all the cooperatives in the State which were available from the 1955 general survey are: current assets, fixed assets, liabilities, long-term borrowing, member-capital, wheat sales, volume of grain stored, gross earnings, sideline volumes, labor expenses, expense for utilities, depreciation, total expenses, net savings, distribution of savings, percent membership and non-membership patronage, attendance of annual meetings, methods of membership information, employee incentive plans, methods of employee selection, methods of salary determination, community-activity participation by the managers, meetings attended during the year by the manager, schools and short courses attended by the manager or other employees, areas of authority, the number of persons and individual data on the board of directors, opinions of the managers as to strength or weakness of the present organization, personal data on employees including the manager, salaries, years of experience, job assignments, and education.

Design of Study

Given the problem area and institutional setting, the purpose of this study is to provide elevator managers, directors, and members a set of criteria for decision making and to outline a method for applying these criteria to particular problems.

The information available from the 1955 general survey of cooperative elevators in Oklahoma provided valuable information regarding many attributes of the cooperatives in the State.

Use was made of this information in selecting the associations to be used in the case studies. It was felt that selection on the basis of the information available offered 4 important advantages over random selection. First, a basis of comparison among elevators studied could be established prior to the study. Second, geographic location could be considered in making the selection at no sacrifice of the first consideration. Third, the total number of cooperative elevator associations in the State is small. Fourth, the cases selected are more likely to be representative of the industry.

Eighteen cooperatives were selected for study.[4] From the "single-location cooperatives," five associations were chosen from the less than 225,000 bushel capacity class and five were chosen from the more than 225,000 bushel class. Four associations were chosen from each class of the "multi-location cooperatives". The less than 400,000 bushel "multi-location cooperatives" and the more than 225,000 bushel "single-location cooperatives" were selected so that the firms in the two groups were as comparable as possible in such items as size, volume of business, gross earnings, and other related characteristics.

Method of Study

A case study method of investigation was used. The development and refinement of the techniques of investigation continued throughout the studies. Preliminary calls, between 30 minutes and 2 hours in duration, were made at 14 of the 18 cooperatives prior to the actual investigation. These calls were introductory; the managers were encouraged to discuss past or current problems of management. The purposes of these calls were to establish an interview approach and to determine problem areas which were of particular concern to cooperatives.

The main investigations were conducted during June, July, and August of 1956. Prior to the manager interview, approximately two hours were taken reviewing and making notes on the minutes of board meetings, auditors' reports, and office records. The information

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[4]During the course of the study, management changed at one of the 18 selected cooperatives. At the time of the major interview, the new manager had been instructed by the directors to refuse an interview.

gained from these documents was particularly helpful in furnishing a frame of reference for making the questions direct and applicable to some part of the actual business. Also, it prevented asking questions which did not apply to any part of the business.

For the manager interview, a preliminary check list of problem areas was used to direct the interview. Items in which the manager showed little interest were not pressed for answers. Problems which were of interest to the manager and which he deemed important were discussed at length. An attempt was made to determine the underlying factors involved in these problems.

Special note was taken of all major decisions which involved the recommendation of the board of directors and the vote of the membership. The decision, pertinent data, and the applicable criteria were established by reference to the notes taken from the minutes of board meetings and the statement of the manager.

The dividing lines of responsibility for performance of the association were investigated. An attempt was made to establish what the policy actually was and what the manager felt the policy should be to attain best results. In order to determine some of the practices homogeneous among organizations, a part of each interview was devoted to questions about day-to-day business of the cooperative.

Special attention was given unusual management practices found during the interviews. An attempt was made to evaluate these unusual practices within the framework of previously investigated associations. This process of evaluation was a mental one; no recalls were made to associations already studied.

Future interviews included questions which referred to the unusual practices previously encountered. The managers who were subsequently interviewed expressed opinions as to the relative desirability of the various practices. Considerations such as costs and time requirements were given special attention in determining practicability of the various practices.

The interviews in the various phases of management were oriented toward three questions:

1. What are the problems?
2. What are the criteria for making an evaluation?
3. What data are needed for the evaluation?

Concurrent to the case studies, a series of membership interviews were conducted by the Farmer Cooperative Service. They selected eight cooperatives for their interviews. From these cooperatives they drew a random sample of members plus the oldest and youngest director in terms of length of service. These interviews furnished a method of evaluating the relative importance attached to different phases of the business by manager, directors, and members.

The Restrictive and Expository Assumptions Underlying the Relevant Theory

The theory developed during the course of the research and the empirical data gathered are presented in somewhat general terms in Chapters II, III, and IV. Effects of existing institutions on this analysis are described in Chapter V.

No claim is made for the universality of the body of theory presented. It is developed as an outline to provide insight into the selection of criteria and to indicate the data required to facilitate the making of decisions by management of cooperative elevator associations.

A detailed investigation of seventeen cooperative firms revealed many economic factors which appeared to be homogeneous within the cooperative segment of the grain industry. In order to maintain the desired degree of internal consistency in the theory, certain assumptions were necessary. For clarity these assumptions are explicitly stated here.

1. Imperfect competition exists in the industry. Conditions such as location differences, service differentiation, and size of firm relative to size of industry are indicative of the imperfect competitive structure of the industry.

As increasingly larger areas are considered, the structure of the wheat elevator industry is monopoly, duopoly, oligopoly, and monopolistic competition, in that order.

A firm may exercise monopolistic control over price and output depending on the location and price policies of the nearest similar firms in all directions. The distance between firms dictates the range that quantity may be influenced monopolistically. With given distance between firms, the price policy of the other firms restricts the range over which price may be controlled monopolistically in a market. Within these limits, the firm can increase quantity by reducing price and can increase price at the expense of quantity.

As a firm attempts to attract a larger area, a point is reached where reducing price will not result in an increased quantity. This is the point where other firms find it advantageous to reduce price. At the point where the first competitor cuts price, the situation is one of duopoly. As additional competitors enter into price-cutting activities, the situation becomes one of oligopoly. Any one firm is able to increase quantity by reducing price only at prices above the competitive level. Simultaneously with price cutting, advantages may be gained by product or service differentiation. The extent to which a product possesses some unique and desirable quality, either real or imaginary, will determine which firm will draw a greater than proportionate share of the market with equal prices or will draw an equal share of the market at a higher price.

The competitive structure of the wheat elevator industry never reaches the point of pure competition. Wheat production is not sufficiently concentrated geographically for a local cooperative elevator to reach the minimum point on its long-run average cost curve. Thus, the number of buyers to which a given farmer may sell wheat is limited.

2. Perfect knowledge on the part of all elements of the industry would be desirable. A more realistic assumption would be that all segments of the industry are equally well informed as to their particular competitive situation.

3. The goal of a cooperative firm is to render some given quality and quantity of services at average cost. Alternatively, the goal of a cooperative may be expressed in terms of the goal of its members. Each member desires to maximize his individual profits.

This goal may be consistent with cooperation in production or marketing With the institutions present in the grain industry today, there is little to be gained by cooperative production quotas. The use of production quotas might be an appropriate cooperative action if the cooperatives were facing an inelastic demand for wheat. At the present time, the largest cooperative grain elevator terminal in the world, with a given and fixed supply of wheat, cannot increase total revenue by withholding some of its grain from the market. Thus, the wheat industry is one in which there is little chance of establishing production controls by cooperative action. The marketing of wheat, on the other hand, is well-adapted to cooperative action. One reason for the difference is the degree of perfection of competition in the different segments of the industry. Production tends toward perfect competition; marketing tends toward imperfect competition. Institutional factors favor cooperative marketing more than cooperative regulation of production.

4. Decisions are made at all levels to attain the goal stated above, and there are no conflicts between the goals of managers, directors, or members.

5. The technology employed by firms, both private and cooperative, is the most efficient technology available. In a later section, the implications of different technologies will be shown.

Definitions and Synonymous Expressions

To prevent possible confusion of meaning which might result from a misinterpretation of the terminology employed, the following definitions and synonymous expressions are presented here.

Bin Space - The storage capacity of the elevator. - Synonym "size of elevator".

Cooperative Manager - A salaried employee, hired by the board of directors, who has the responsibility of facilitation of cooperative business.

Demand for elevator services - The spatial demand for elevator services faced by an elevator firm. - Synonym "derived demand for elevator services".

Director - An elected representative of the member patrons, a member of the board of directors. - Synonym "member of the board," when spoken of as a group referred to as "the board".

Elevator Facility - A wheat merchandising construction with certain physical specifications, such as leg capacity and bin space.

Farmer Production - Production of wheat in the market area.

Leg capacity - The rate at which elevator machinery conveys wheat from the dump pit to the elevator bins; usually expressed as bushels per hour.

Market Area - The area from which a firm draws its patrons.

Member Patron - A farmer who does business with and owns stock of a cooperative. - Synonym "cooperator".

Merchandising Capacity - The maximum wheat crop which can be handled through a facility, given the percentage of the crop harvested during the peak day of harvest. Synonym "plant capacity".

Optimum - The economic choice which satisfies a specific set of criteria. - Synonym "correct", when related to scale of plant.

Price of Elevator Services - The price, per bushel, which a firm charges for performing elevator services. Alternatively defined, it is the discrepancy between the price received and the price paid, per bushel, by a country elevator firm. - Synonym "price of merchandising". When spoken of as a farmer cost item, it is referred to as "cost of merchandising".

Primary Market Area - The market area for elevator services.

CHAPTER II

DEMAND ANALYSIS

An integral part of an economically-sound decision by a firm is the analysis of demand. In the wheat industry, the quantity of elevator services required by an area is equal to the production of wheat in that area. The method of determining demand outlined here is based on the principles underlying location theory.

The demand estimate is needed for making scale-of-plant decisions. The correct scale of plant for a cooperative is a plant with a maximum capacity exactly equal to the maximum production in the market area. The maximum production for an area is the quantity at which the demand function approaches perfect inelasticity.

The Theory of Location

Competition may be imperfect in two respects. An imperfection may be created by the geographic location of the firm. This imperfection may be monopolistic within limited price and quantity changes.

Other imperfections in the competitive structure may be caused by product differentiation.

Within this farmework, an examination will be made of the nature and structure of the monopolistic positions of the firm. Two competing firms in a market area would locate very near each other and compete for shares of the market. When the number of firms is many, they would be dispersed over the market area so that the degree of pure monopoly of each firm would be a maximum.

A cooperative will never be located next to another cooperative of the same type. Cooperatives may locate near private firms. If the private firm is centrally located in a geographic market and is the only firm operating therein, the logical place for a cooperative firm to locate is near the private firm. Only there will the cooperative have an equal chance at the entire market. Any other location puts the cooperative at a geographic disadvantage in competing for the entire market.

The following quotation is taken from Professor Chamberlin's book, Theory of Monopolistic Competition.[5] Professor Chamberlin develops the pure spatial competition theory relevant in the explanation of why firms locate where they do. An understanding of this theory provides an insight into the reason wheat elevators are located as they are.

> "The problem of pure spatial competition is defined very simply. Just as a seller's market is large or small depending upon the price he sets, so it varies with the location he chooses. People not only buy where prices are cheapest; they also trade at the shop which is most conveniently located. The analysis of prices ordinarily assumes that the other bases of competition than that of price "remain equal"; it is now proposed to assume that prices and everything else but location "remain equal" while sellers attempt to secure a market for their goods solely by adjusting their places of business.
>
> "In its most general form, the problem is one of the locational adaptation of both buyers and sellers to each other. In any urban area, for instance, there is mutual adaptation between the distribution of shops and the distribution of population. On the one hand, buyers tend to locate, other things being equal, near the places where things are sold; on the other hand, sellers are seeking

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[5]Edward Chamberlin, The Theory of Monopolistic Competition, (Cambridge, 1938), Appendix C, pp. 208-210.

out the buyers, each trying to locate his shop so as to reduce to a minimum the inconveniences of trading with him. We may begin, however, with the assumption that the distribution of population is given, and it will appear that but little modification of it is needed. The distribution of shops is sufficiently well adapted to the needs of customers to enable them to choose their places of residence with other things primarily in view.

"The fundamental question is whether sellers (of the same commodity) will tend to concentrate at one point or to disperse over the area so as to give a maximum of convenience to the buyers. Let us begin by assuming the buyers to be uniformly distributed; and the problem will be simplified (without affecting the nature of the conclusions) by considering them as distributed along a line instead of over an area. It has been shown by Professor Hotelling[1] that, where buyers are distributed along such a line, and where there are but two sellers, these latter will, contrary to expectations, locate as close to each other as possible, instead of at the quartile points of the line where convenience to the buyers would be a maximum. In Fig. 31 (p. 184), for instance, it is seen at once that, since the market of each of the two sellers, A and B, extends half way towards the other, either one could enlarge his market by a move in that direction. (The final equilibrium point may, in fact, be defined with precision. It would be located at the center of the line, since, if it were elsewhere, the seller whose market were smaller would move to the other side of his rival, and such moves would continue until both were established at the midpoint). This is a conclusion of great importance, but Professor Hotelling is in error when he generalizes it for large numbers. He argues that "if a third seller C appears, his desire for as large a market as possible will prompt him likewise to take up a position close to A or B, but not between them," and reaches the conclusion that "as more and more sellers of the same commodity arise, the tendency is not to become distributed in the socially optimum manner but to cluster unduly." As soon as there are three, however, the one who is caught between the other two will move to the outer edge of the group, and a series of such moves, always by the one left in the center, will disperse the group. For three sellers, the outcome seems to be that two of them, say A and B, would be located at the quartile points and the third, C, at any point between them. Dispersion would go at least this far, for if we suppose either A or B to move towards the center in order to

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[1] "Stability in Competition," Economic Journal, Vol. XXXXI (1929), pp. 52-53.

enlarge his market, his place would promptly be taken by C. We may conclude that, although there might be continual shifting amongst the sellers in their attempts to occupy the best places, no buyer would ever have to travel more than 1/4 of the length of the line in order to make a purchase. Ideally he should have to travel no more than 1/6, for convenience is maximized if the three sellers are located at points which are 1/6, 1/2, and 5/6 of the distance from one end of the line to the other.

"As the number of sellers increases, they may group in twos (we have just seen that C may locate next to A or B), but any group of three or more would be broken up in the manner already described. Taking the length of the line as unity, the general conclusion for n sellers is that the space between the last sellers at either end and the ends of the line can never exceed I/n (if the number of sellers is odd, it cannot exceed $\frac{I}{n + I}$), and that the space between any two sellers can never exceed 2/n, this limit being reached only in the extreme case where sellers are grouped by twos. The distance traveled by any one buyer can therefore never exceed I/n, or twice what it would be under the ideal distribution of sellers, where it could never exceed I/2n. However, there is no more reason for the sellers grouping by twos than for their dispersing. It has been shown that where a seller finds himself between two others (as C in the example above) it is a matter of indifference at what point he locates, and if we suppose him to choose the midpoint so that the sellers are distributed at equal intervals along the line, the result is but little different from the ideal. If there are nine sellers, they will be distributed at intervals of 1/10, 2/10...9/10 along the line, compared with an ideal distribution at intervals of 1/18, 3/18...17/18. The markets of the two end sellers will be 3/20 each, of the other seven 1/10 each, compared with an ideal for all of 1/9. The distance traveled by a few buyers at the ends of the line will be 1/10 ($= \frac{I}{n + I}$); but aside from these the maximum is 1/20 ($= \frac{I}{2(n + I)}$), compared with an ideal of 1/18 (= I/2n). In summary, two sellers will concentrate at a point, but dispersion begins when there are three, and, for fairly large numbers, the distribution approximates closely the ideal which maximizes the convenience of the buyers...."

Without product differentiation the cooperative firm, located beside the private firm, would, in the long run, create competition of a type that would drive out any profits which the private firm might have made in the short run. Profit is the incentive for the private firm to stay in business. If profits are zero or negative, the private firm will go out of business in the long run.

The only private firms which will remain in business in the long run are those with location advantage or differentiated products. A private firm with the power to prevent entry by a cooperative or another private firm at a location may continue to operate at a profit over long periods of time.

The Short-Run and Long-Run Demand Function

The investigation of the economic criteria for decision making by cooperatives includes short-run and long-run analyses of both demand and costs. The short run is a time period so short that the firm is unable to vary the quantities of some resources used. These resources which cannot be varied in the short run are called fixed resources. They normally include land, buildings, heavy machinery and top management. These fixed resources determine the firm's scale of plant. The long run is a period of time long enough for the firm to be able to vary all resources including its scale of plant.[6]

The Closed Market

In the short run, farmers discontinue production when average variable cost is greater than average revenue. Farmers in a closed market will discontinue production in the short run if the price charged for some resource is so high that average variable cost is greater than average revenue. If average variable cost is less

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[6] Richard H. Leftwich, The Price System and Resource Allocation, (New York, 1955), p. 137.

than average revenue in the short run, farmers will produce the quantity of output where marginal cost equals marginal revenue. Economic profits or economic losses may occur in the short run.

In the long run, farmers will discontinue production when average total cost is greater than average revenue. Thus, the demand curve for resources in the long run lies below and to the left of the short-run demand curve. These resources may be factors used in the production process or they may be marketing services.

The theoretical difference between long-run and short-run demand for elevator services is shown in Figure 1.

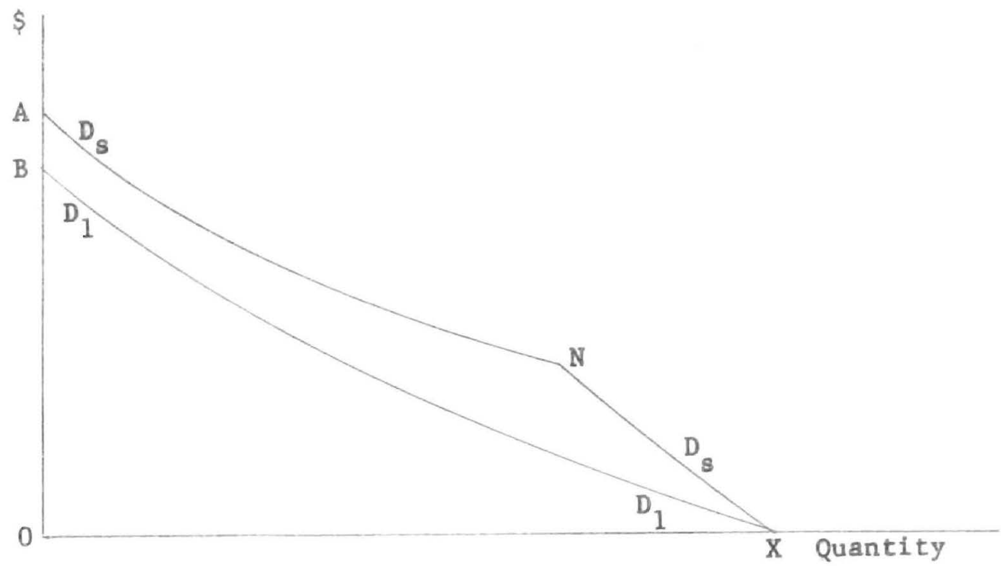

Figure 1. A Hypothetical Long-run and Short-run Demand for Elevator Services in a Closed Market

The section of the short-run demand curve $D_sD'_s$ between N and A represents the range of prices through which farmers discontinue production in the short run because of the increased price of elevator services. The section of the short-run demand curve from N to X represents the range of prices through which production increases because of increased intensity of production. The price elasticity of demand between N and X is less than that between A and N.

The long-run demand curve D_1D_1' lies below the short-run demand curve D_sD_s' and is shaped similar to D_sD_s' between A and N. The reason D_1D_1' is below D_sD_s' is because average variable cost is the criterion determining when to stop producing in the short run; average total cost is the criterion applicable in the long run.

The Open Market

The theory underlying demand analysis in an open market is more complex than a closed-market analysis. The analysis must involve the existence of competing elements, in which case the demand schedule is not dependent on the exit of firms from production. The theory of the open market explains, in general terms, why customers attach themselves to a particular firm.

The cost of marketing wheat is external to production decisions made by the farmer. From the given output the farmer desires to maximize total returns. The cost of marketing, transportation and elevator services, represents a reduction in total revenue. The farmer will sell his wheat where the reduction in total revenue is a minimum.

The Determination of a Derived Demand

Given the theory underlying farmer response to cost of marketing, the determination of derived demand for elevator services will depend on transportation rates, production, distance between competing firms, and price charged by competing firms.

For the derivation of the demand function, commercial transportation rates were used. The commercial rate for transporting wheat from the field to the country elevator is five cents per bushel, for the first five miles or any part thereof. After five miles, the rate is one cent per mile. The total transportation cost per bushel for transporting wheat various distances is a discontinuous function of the type shown in Figure 2.

The cost of transportation per mile, Figure 2, may be expressed as transportation cost per bushel by converting the abscissa from miles to bushels. This conversion is made by determining the area inscribed by a given distance. The area is determined by the equation:[7]

$$A = 2D^2 \tag{2.1}$$

where A is area and D is the distance in miles. The answer is in terms of square miles.

~~With the area determined~~ assumptions were ~~made~~ that 80 percent of the area is cropped; 60 percent of the cropped acreage is wheat. Thus, 48 per cent of the total area or 307 acres per square mile is in wheat. It was further assumed that the maximum yield per acre is 15 bushels. With these assumptions, the quantities of wheat represented by various transportation distances were determined, Table I.

The information in Table I converted into cost of transportation for additional quantities of wheat is shown in Figure 3. The function is discontinuous; each successive incremental increase in transportation cost (distance) brings in a larger than proportional increase in quantity of wheat.

[7]The reason for the use of $2D^2$ instead of πr^2 for determining area is that most of Oklahoma has a rectangular road system with section line roads one mile apart and gridded north south and east west. A farm located north east of one elevator may be nearer by road distance to another elevator yet farther in radial distance.

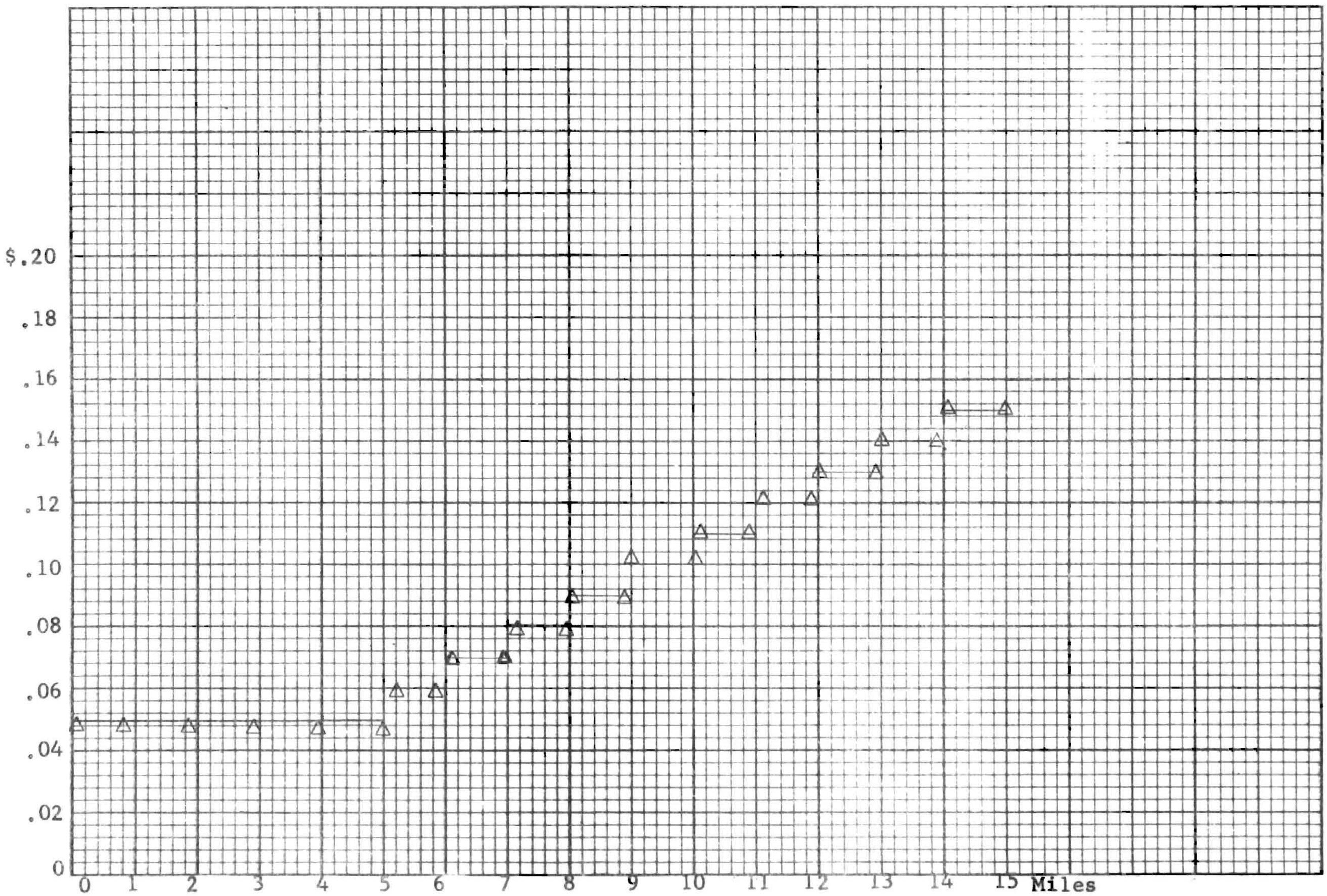

Figure 2. Commercial Transportation Rates for Transporting Wheat Various Distances

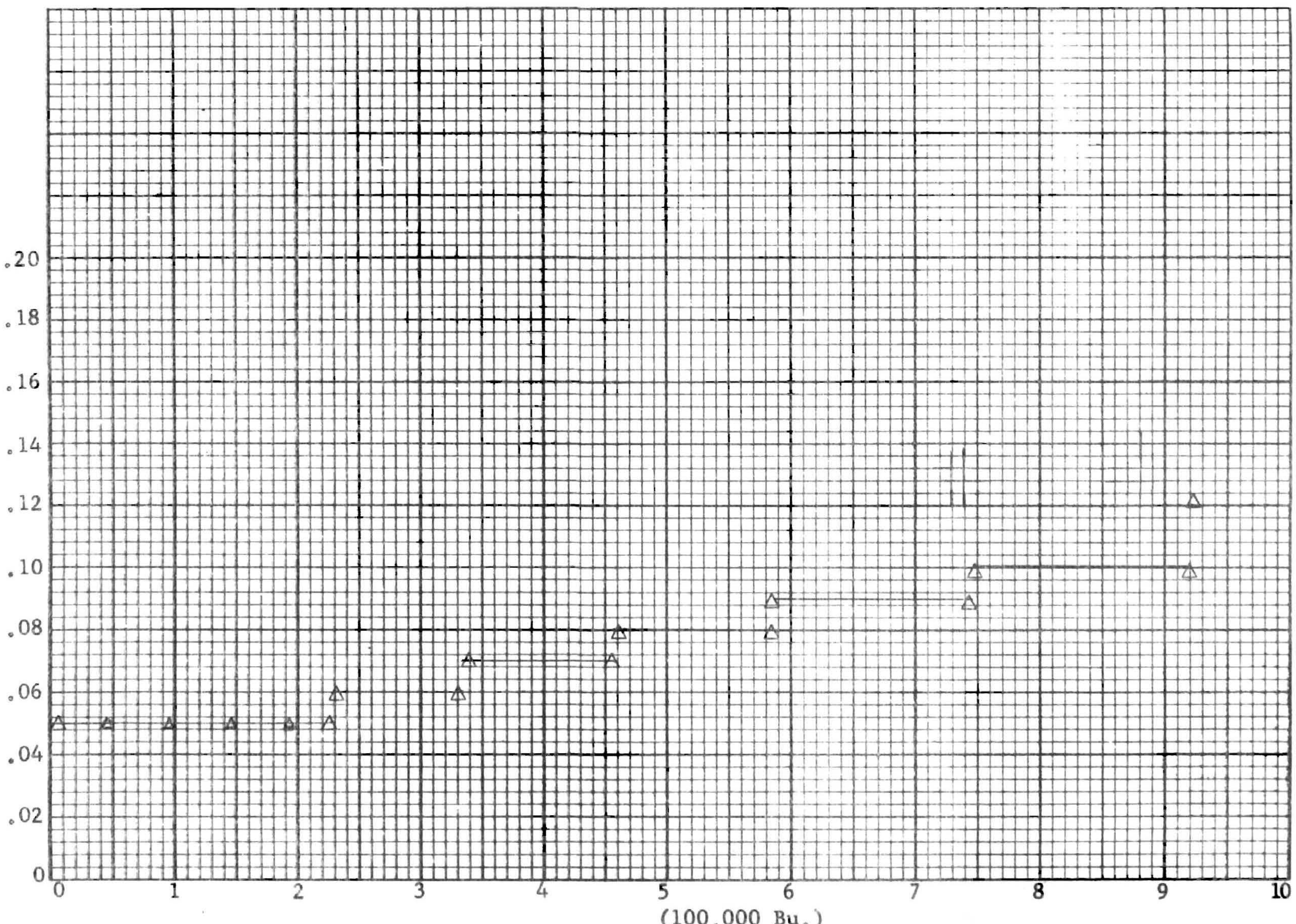

Figure 3. Transportation Cost Per Bushel of Wheat As Quantity Increases With Greater Distances

TABLE I

THE AREA AND QUANTITY OF WHEAT ATTRACTED AS THE TRANSPORTATION DISTANCE INCREASES

Transportation Distance (Mile)	Area[a] (Sq. Mi.)	Quantity of Wheat[b] (Bushel)
1	2	9,200
2	8	36,800
3	18	82,800
4	32	147,200
5	50	230,000
6	72	331,200
7	98	450,800
8	128	588,800
9	162	745,200
10	200	920,000
11	242	1,113,200
12	288	1,324,800
13	338	1,554,800
14	392	1,803,100
15	450	2,070,000

a/ It was assumed that 48 percent of the area is in wheat with a maximum yield of 15 bushels per acre.
b/ A rounded figure of 4,600 bushels per square mile was used for these computations.

A derived demand for elevator services may now be determined. The validity of a derived-demand schedule depends on the acceptability of the underlying assumptions. The demand for elevator services presented here rests on three assumptions. First, farmers respond to small differences in price. Second, the area within which demand is being determined is homogeneous. Third, the elevator services of various firms are homogeneous. A farmer located between two elevators will sell his wheat where the positive difference between the price received and the cost of marketing is a maximum. The action of farmers located along a line between two elevators can be expanded into a market area demand schedule.

A theoretical case of two elevators, A and B, located 20 miles apart and competing for the wheat produced by farmers located between them, may be developed into a schedule of demand for elevator services faced by A when B maintains a constant price. The division of the farmers along the line between elevators must be investigated when A changes the price charged for elevator services. The price range over which the demand schedule is relevant starts at the upper limit with a price so high that no farmers patronize A and a lower limit where the prices charged by A and B are equal. At the lower limit of the relevant price range, the farmers between A and B are equally divided.

If elevator B is a cooperative and has an average cost of 5 cents per bushel for providing elevator services, the price charged will be 5 cents per bushel. So long as A does not price below 5 cents per bushel, B will not change price. To simplify the analysis, it is also assumed that B can provide elevator services for any or all the farmers between A and B at 5 cents per bushel.

Elevator B will begin cutting price if A prices below 5 cents per bushel. A loss of customers would disrupt the economies of scale of B and cause more severe losses than retaliatory price cutting.

The actions of farmers between A and B, as A varies the price charged for services, are shown in Table II. Column 1 shows the price charged for services by A. Column 2 shows the cost of transportation for farmers in the marginal mile to deliver wheat to A. Column 3 is the sum of Columns 1 and 2 and represents total merchandising costs for farmers in the mile marginal to patronize elevator A. Columns 4, 5, and 6 represent for elevator B the counterparts of Columns 1, 2, and 3 for elevator A. Column 7 indicates the distance along the line between A and B which will patronize A at the various prices charged by A.

TABLE II

MARKETING COSTS PER BUSHEL FOR FARMERS
AT VARIOUS LOCATIONS BETWEEN
TWO COMPETING ELEVATORS

Elevator A Cost Per Bushel			Elevator B Cost Per Bushel			Distance Attracted by A
For Handling (Col. 1)	For Trans. (Col. 2)	Total (Col. 3)	For Handling (Col. 4)	For Trans. (Col. 5)	Total (Col. 6)	(Col. 7)
$ .05	$ .10	$ .15	$ .05	$ .10	$ .15	10 Miles
.059	.10	.159	.05	.11	.16	10
.06	.10	.16	.05	.11	.16	Indifferent
.061	.10	.161	.05	.11	.16	9
.08	.09	.17	.05	.12	.17	Indifferent
.081	.09	.171	.05	.12	.17	8
.10	.08	.18	.05	.13	.18	Indifferent
.101	.08	.181	.05	.13	.18	7
.12	.07	.19	.05	.14	.19	Indifferent
.121	.07	.191	.05	.14	.19	6
.14	.06	.20	.05	.15	.20	Indifferent
.141	.06	.201	.05	.15	.20	5
.16	.05	.21	.05	.16	.21	Indifferent
.161	.05	.211	.05	.16	.21	4
.17	.05	.22	.05	.17	.22	Indifferent
.171	.05	.221	.05	.17	.22	3
.18	.05	.23	.05	.18	.23	Indifferent
.181	.05	.231	.05	.18	.23	2
.19	.05	.24	.05	.19	.24	Indifferent
.191	.05	.241	.05	.19	.24	1
.20	.05	.25	.05	.20	.25	Indifferent

For investigating farmer actions, Columns 3, 6, and 7 are the crucial columns. When the total cost in Column 3 is greater than the total cost in Column 6, no change occurs in the distance attracted by A (Column 7). When the total cost to farmers for patronizing elevator A (Column 3) becomes greater than the cost for patronizing elevator B (Column 6), farmers in the next mile switch from A to B.

When both elevators price services at 5 cents per bushel, the market area is divided evenly between them, ten miles going to either elevator. Elevator A can increase price to 5.9 cents without losing any patrons. If A increases price to 6 cents, farmers in the tenth mile from A and the eleventh mile from B may patronize either elevator at equal costs. Farmers closer than 9 miles to A patronize A, and farmers closer than 10 miles to B patronize B. If A increases price infinitesimally above 6 cents, the division between A and B is 9 miles from A and 11 miles from B. Crucial prices for elevator A are 6, 8, 10, 12, 14, 16, 17, 18, 19, and 20 cents. At these prices a small increase in price would result in the division moving one mile nearer A. Pricing between the crucial prices is not important for the analysis; consequently, it was omitted from Column 1 of Table II.

Any starting price may be charged by B. The analysis to determine the distance attracted by elevator A at various prices remains the same. However, the range of relevant prices for A will change.

The analysis thus far has dealt with farmers along a line between two elevators. In developing Table II, an assumption was made that farmers react to a .1 cent change in price of services. Previous farmer preference studies indicate that farmers do not make adjustments to economic influences as rapidly as might be expected in a perfect-knowledge profit-maximization situation.[8] Prices paid for wheat are usually in whole-cent increments. The demand schedules derived from the information in Table II are constructed to show farmers responding to a 1 cent change in price.

The prices used in the demand schedule are taken from Column 1 of

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[8] Jerry G. West, "A Pilot Study of Farmers' Preferences for Marketing Services in Kingfisher County, Oklahoma," (Unpub. M.S. Thesis, Oklahoma State University, 1955), p. 43.

of Table II. The quantities in the demand schedule are determined by converting the distances in Column 7 of Table II into bushels by the use of Table I.

The demand, total revenue, and average marginal revenue schedules shown in Table III are derived directly from the information in Table II. The revenue schedules shown in Tables IV and V were derived in a similar manner except the price charged by B for the two situations was assumed to be 15 cents and - 3 cents per bushel respectively.

A diagrammatic solution to average and marginal revenue is used here. A different statistical solution exists for each case where a different price is assumed for elevator B. The three cases, developed in Tables III, IV, and V and shown diagrammatically in Figures 4, 5, and 6, are outlined here to show a method of demand analysis.

TABLE III

THE REVENUE SITUATION FACED BY A FIRM WHOSE COMPETITORS CHARGE $.05 FOR PERFORMING ELEVATOR SERVICES

AR Handling Charge	Distance Mi.	Area Sq.Mi.	Total Quantity Bushels	Change in Quantity Bushels	TR[a]	$TR_i - TR_{(i-1)}$[b]	Avg. MR
$ .20	1	2	9,200	9,200	$ 1,840	$ 1,840	$ .20
.19	2	8	36,800	27,600	7,000	5,160	.187
.18	3	18	82,800	46,000	14,900	7,900	.172
.17	4	32	147,200	64,600	25,000	10,100	.157
.16	5	50	230,000	82,800	36,800	11,800	.143
.14	6	72	331,200	101,200	46,400	9,600	.095
.12	7	98	450,800	119,600	54,100	7,700	.064
.10	8	128	588,800	138,000	58,900	4,800	.034
.08	9	162	745,200	156,400	59,600	700	.004
.06	10	200	920,000	174,800	55,200	- 4,400	- .025

a/ TR represents total revenue
b/ $TR_i - TR_{(i-1)}$ represents change in total revenue

TABLE IV

THE REVENUE SITUATION FACED BY A FIRM WHOSE COMPETITORS CHARGE $.15 FOR PERFORMING ELEVATOR SERVICES

(AR) Handling Change	Dist-ance Mi.	Area Sq.Mi.	Total Quantity Bushels	Change in Quantity Bushels	TR[a/]	$TR_i - TR_{(i-1)}$ [b/]	Avg. MR
$ .30	1	2	9,200	9,200	$ 2,760	$ 2,760	$ .30
.29	2	8	36,800	27,600	10,672	7,912	.215
.28	3	18	82,800	46,000	23,184	12,512	.151
.27	4	32	147,200	64,400	39,744	16,560	.113
.26	5	50	230,000	83,800	59,800	20,056	.087
.24	6	72	331,200	101,200	79,488	19,688	.059
.22	7	98	450,800	119,600	99,176	19,688	.044
.20	8	128	588,800	138,000	117,760	18,584	.032
.18	9	162	745,200	156,400	134,136	16,376	.022
.16	10	200	920,000	174,800	147,200	13,064	.014

a/ TR represents total revenue
b/ $TR_i - TR_{(i-1)}$ represents change in total revenue

TABLE V

THE REVENUE SITUATION FACED BY A FIRM WHOSE COMPETITORS CHARGE $-.03 FOR PERFORMING ELEVATOR SERVICES

(AR) Handling Change	Dist-ance Mi.	Area Sq.Mi.	Total Quantity Bushels	Change in Quantity Bushels	TR[a/]	$TR_i - TR_{(i-1)}$ [b/]	Avg. MR
$ .12	1	2	9,200	9,200	$ 1,104	$ 1,104	$ .12
.11	2	8	36,800	27,600	4,048	2,944	.08
.10	3	18	82,800	46,000	8,280	4,232	.051
.09	4	32	147,200	64,400	13,248	4,968	.034
.08	5	50	230,000	83,800	18,400	5,152	.022
.06	6	72	331,200	101,200	19,872	1,472	.004
.04	7	98	450,800	119,600	18,032	- 1,840	-.004
.02	8	128	588,800	138,000	11,776	- 6,256	-.011
.00	9	162	745,200	156,400	0	-11,776	-.016
-.02	10	200	920,000	174,800	18,400	-18,400	-.020

a/ TR represents total revenue
b/ $TR_i - TR_{(i-1)}$ represents change in total revenue

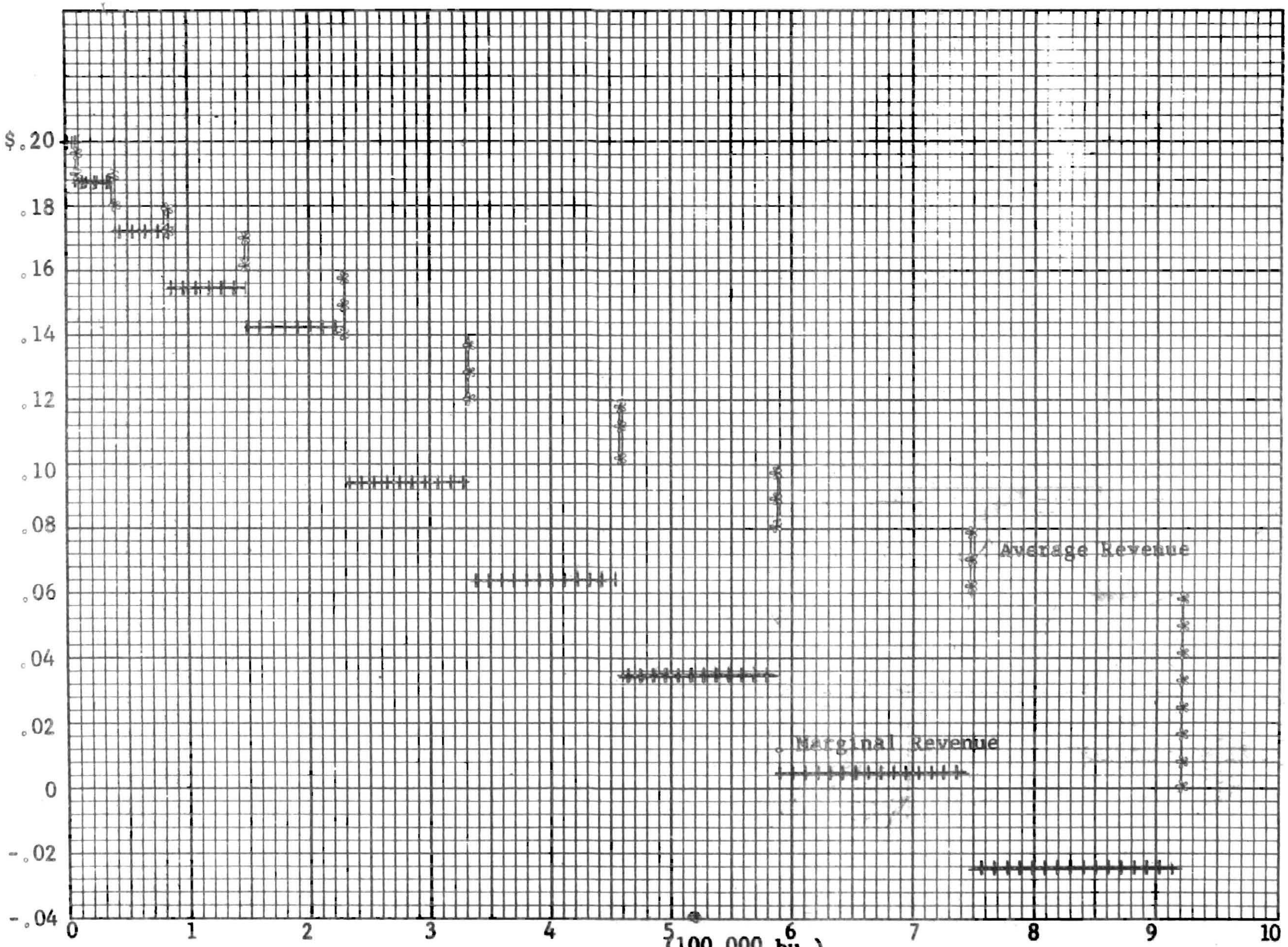

Figure 4. A Firm's Demand Curve When Competitors Are 20 Miles Away and Charge $.05 for Elevator Services

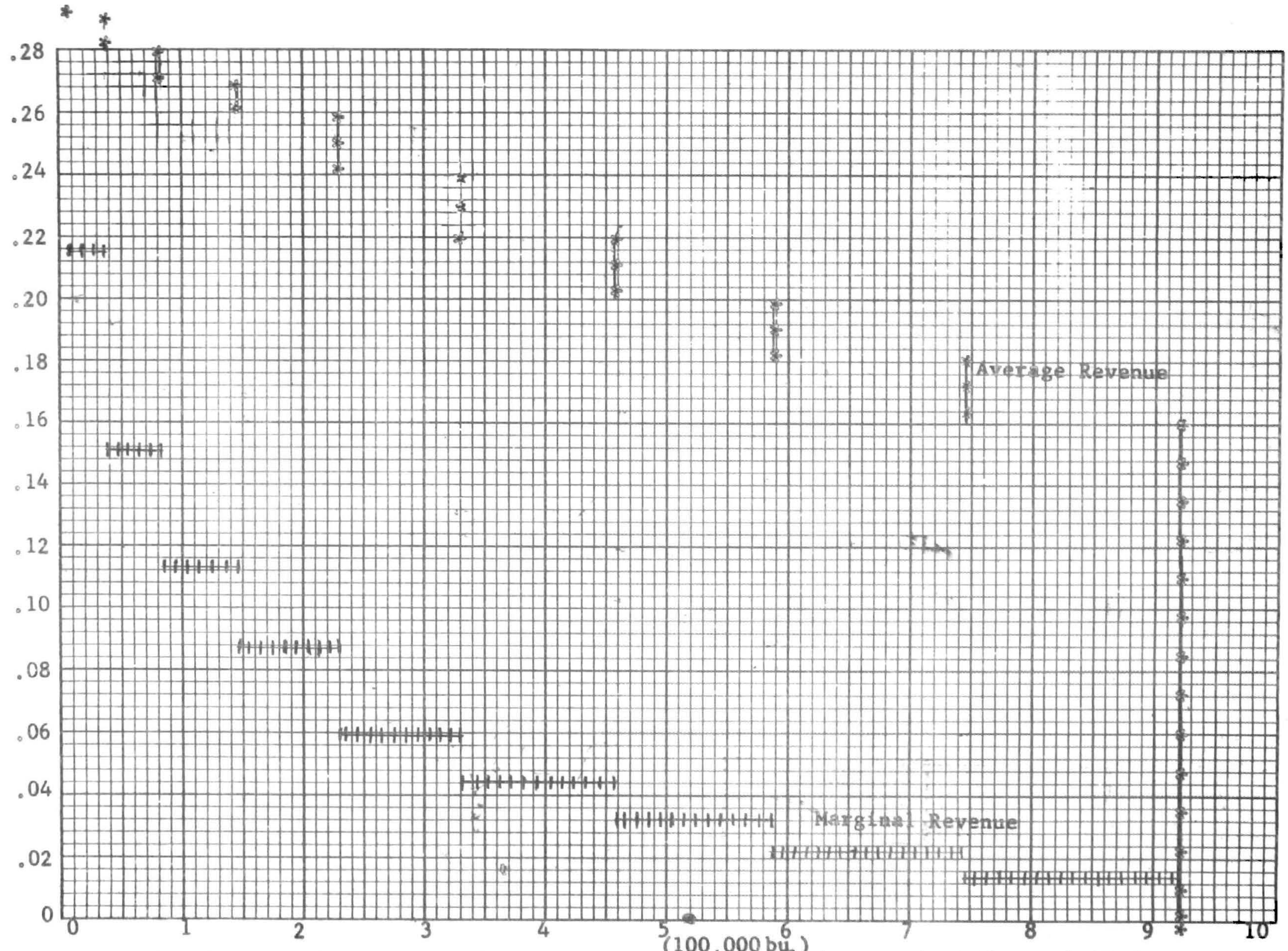

Figure 5. A Firm's Demand Curve When Competitors Are 20 Miles Away and Charge $.15 for Elevator Services

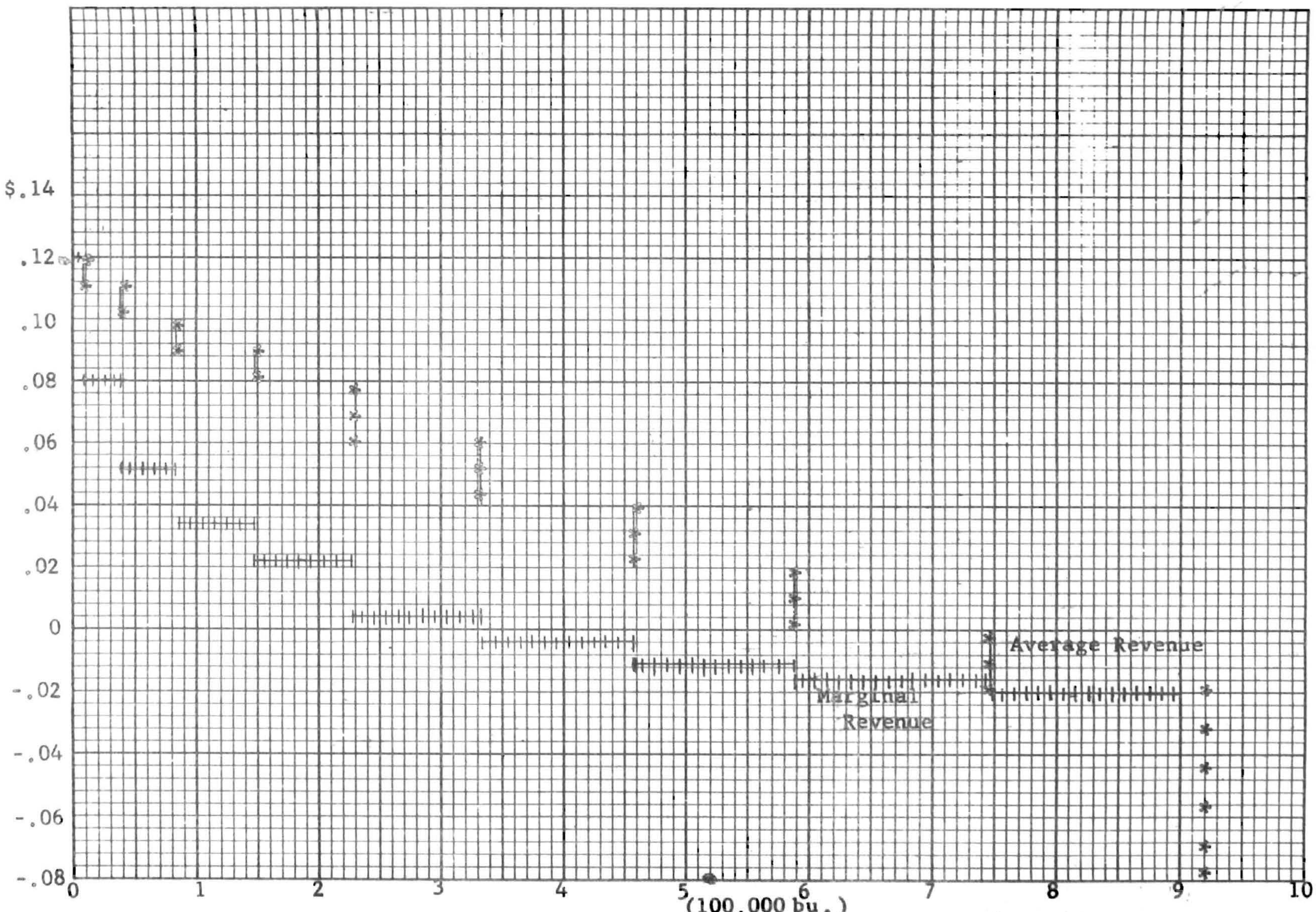

Figure 6. A Firm's Demand Curve When Competitors Are 20 Miles Away and Charge $-.03 for Elevator Services

The characteristic shape of the demand curve for elevator services (Figures 4, 5, and 6) is caused by location differences and the transportation costs associated therewith. At a price of 20 cents, all the wheat produced in the market area would be marketed through competing elevators (Figure 4). An increase of 1 mile would result from each 1 cent decrease in price up to a 5 cent decrease. Beyond a 5 cent decrease, a 2 cent reduction in price is required to increase the distance 1 mile. The increase in area for each additional mile is greater than for the previous mile (Table I). The difference in area is equal to $2D_i^2 - 2D_{(i-1)}^2$, when D represents distance. Consequently, equal incremental price decreases bring forth increasing incremental quantity increases. Thus, the demand for services decreases at a decreasing rate.

When the area of the market approaches one half the distance between competing elevators, the competitive situation becomes oligopolistic. Further price decreases by a firm would attract business from the competing firm. The remainder of the demand curve would approach a vertical line.

If all competitors recognize their secular interdependence, price-cutting activities would never occur. Each entity would realize that reducing price below the competitive level would not attract a greater quantity of grain. Instead, it would cause competitors to reduce price.

If the price charged by A is below that charged by B, the resulting division of the market depends on B's actions. If B cuts price competitively, Schedule I' of Table VI shows the results. If B does not counter with retaliatory price cutting, Schedule I is applicable.

TABLE VI

THE DIVISION OF THE MARKET THROUGH THE RANGE OF PRICES BELOW THE COMPETITIVE LEVEL

Elevator A Cost Per Bushel			Elevator B Cost Per Bushel			Distance Attracted by A
For Handling (Col. 1)	For Trans. (Col. 2)	Total (Col. 3)	For Handling (Col. 4)	For Trans. (Col. 5)	Total (Col. 6)	(Col. 7)
I With Retaliatory Price-Cutting						
$ .05	$ .10	$ .15	$ .05	$ .10	$ .15	10 Miles
.04	.10	.14	.04	.10	.14	10
.03	.10	.13	.03	.10	.13	10
.02	.10	.12	.02	.10	.12	10
.01	.10	.11	.01	.10	.11	10
.00	.10	.10	.00	.10	.10	10
I Without Retaliatory Price-Cutting						
.05	.10	.15	.05	.10	.15	10
.04	.11	.15	.05	.10	.15	Indifferent
.039	.11	.149	.05	.10	.15	11
.02	.12	.14	.05	.09	.14	Indifferent
.019	.12	.139	.05	.09	.14	12
.00	.13	.13	.05	.08	.13	Indifferent

If the competitors price for handling wheat had originally been - 3 cents (Table V and Figure 6) the market area would be evenly divided at a price of - 3 cents. There would be no way of increasing this price and maintaining quantity received without agreement (tacit or otherwise) on the part of all concerned. An attempt on the part of one firm to increase price when other firms did not make similar price increases would result in the loss of a large quantity of business and would cause the physical plant to be employed at a quantity less than its correct usage.

Summary

Use was made of location theory, transportation rates, yield estimates and competitor price policy to determine a derived demand function for elevator services.

Farmer responses to marketing costs along a line between two elevators was investigated to determine the market division. With the division of the market for various prices charged for elevator services, the derived demand schedule consisted of the price of services and the quantities represented by the production of an area inscribed by the various distances.

Underlying the division of the market is the price charged by the competing firms. Prices above the competitive price can be charged if the firm is willing to sacrifice quantity handled. Prices below the competitive price will not attract larger quantities if the competing firms also cut price.

The demand function for elevator services derived here furnishes the demand side of the analysis necessary for both cooperatives and private firms to make scale-of-plant and price decisions.

CHAPTER III

COST ANALYSIS

Like demand, cost analysis is required for making economically-sound decisions. Both long-run and short-run average cost curves are needed for the analysis. The long-run average cost curve is needed to supplement the demand analysis for scale-of-plant decisions. Short-run average cost curves are needed for determining price policy.

The Relevant Cost Theory

The distinction made between the long run and short run for the demand theory in Chapter II is also applicable for the development of cost theory. The long-run average cost curve may be thought of as a large number of alternative scales of plant. An envelope curve drawn tangent to a series of short-run cost curves constitutes a long-run cost curve.[9] A hypothetical long-run and short-run average cost situation is shown in Figure 7. The long-run average cost curve is MM'. Three of many possible short-run average cost curves are represented by AA', BB', and CC'. The proper scale of plant for a given output is the short-run average cost curve just tangent to the long-run average cost curve at that quantity of output. If

[9]For a discussion of the development of the theory underlying the characteristics and construction of long-run and short-run cost curves see Jacob Viner, "Cost Curves and Supply Curves," Readings in Price Theory, ed. G. Stigler and K. Boulding, Chicago, 1952, pp. 198-232

the output were x_1, the proper scale of plant would be AA'. If the output were x_2, BB' would be the proper scale of plant. For an output of x_3, a scale of plant of CC' would be optimum.

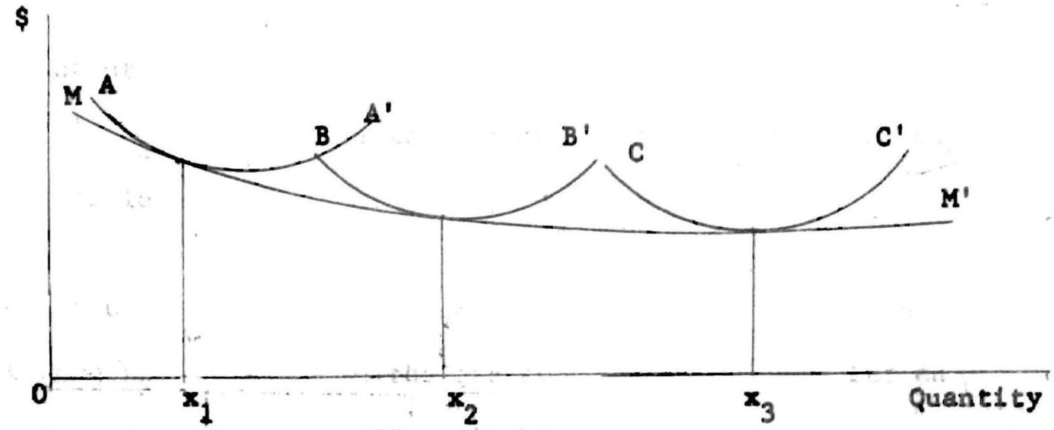

Figure 7. Hypothetical Long-run and Short-run Average Cost

The Cost of Producing Elevator Services

The physical handling of wheat lends itself to increasing economies of large scale production. Because of the geographic distribution of wheat production, full advantage cannot be taken of the potential economies of handling. Thus, the minimum point on the long-run average cost curve would never be realized.

The short-run average cost curves end at the point where they join the long-run average cost curve. To the right of the point of intersection of the short-run and long-run average cost curves, the two curves are identical. However, with a given scale of plant, it is impossible to operate to the right of this intersection in the short run. Consequently, the wheat elevator industry is characterized by increasing economies of large scale production and limited spatial demand.

The Derivation of the Long-Run Cost Function

Cost budgets for various size elevator facilities were used in estimating the long-run cost function. The synthetic approach was used in determining the cost used in the budgets. Historical data available on size and specifications of elevators, cost of construction, and cost of operations were sufficient for estimating a long-run cost function.

However, a cost function derived from historical data is technically incorrect. The relevant cost function for merchandising wheat should show the minimum cost at which various quantities of wheat can be merchandised. The elevators making up the historical data do not have the correct combinations of bin space and leg capacity to provide technically efficient merchandising services.

Therefore, the elevator specifications used were technically efficient on the basis of the assumptions made. It was assumed that farmers harvest 2/9 of the crop during the peak day of harvest. The elevator required by an area must have bin space and leg capacity sufficient to handle the harvest. The optimum ratio of bin space to leg capacity depends on the availability of the transportation facilities for moving the wheat from the country elevator to the terminal markets. Elevator specifications were developed under the assumption that transportation facilities are available within one day of the time needed.

The specifications of the elevators for the synthetic budgets are shown in Appendix A. The ratio of leg capacity to bin space was higher for the smaller facilities. The reason for the difference is that harvesting of wheat in low-production areas tends to be more sporadic than in high-production areas.

The facilities budgeted were: 20,000, 50,000, 100,000, 200,000, and 300,000 bushel elevators. The assumption as to rate of harvest and availability of transportation made it possible to establish the size of harvest which could be merchandised through each of the above elevators. These quantities are: 90,000, 225,000, 450,000, 900,000, and 1,350,000 bushels respectively.

The cost budgets including the cost items, the rate at which computed, and the source of the data are shown in Table VII. The secondary source data used for these cost estimates are not directly applicable to elevators with the specifications shown in Appendix A. However, they do represent the best available estimates.

The total cost and merchandising capacities shown in Table VII were assumed to be representative of five points on a long-run total cost function. Three types of statistical functions were fitted to the data by the method of least squares. The three models considered were: (1) linear model, (2) second degree polynomial, and (3) a logarithmic function. The results of the statistical fits are shown in Table VIII.

From the alternative functions, the second degree polynomial was chosen as the model to employ where cost estimates were required in the analysis. This choice was made on the basis of goodness of fit, ease of operations, and compatibility with theory. The logarithmic function fulfilled all the requirements except the last. A significant positive intercept can be expected if comparable techniques of merchandising are employed over the

TABLE VII

SYNTHETIC COST BUDGETS FOR VARIOUS SIZE ELEVATOR FACILITIES IN OKLAHOMA

Item	Bin Capacity (Bushels) 20,000	50,000	100,000	200,000	300,000
Merchandising Capacity (Bu.)	(90,000)	(225,000)	(450,000)	(900,000)	(1,350,000)
Depreciation (elev. & mach.)	$1,394.00	$1,970.00	$3,121.00	$4,788.00	$6,424.00
Depreciation (ofc. & scales)	550.00	550.00	550.00	550.00	550.00
Insurance (E&M)	76.00	104.00	164.80	252.80	339.20
Insurance (O&S)	66.00	66.00	66.00	66.00	66.00
Property Tax (E,M,D,S)	780.90	1,041.20	1,561.80	2,315.30	3,055.10
Railroad Lease	46.70	46.70	46.70	46.70	46.70
Bonds & Licenses	80.00	110.00	135.00	166.25	191.25
Managers Salary	2,803.20	2,940.00	4,900.00	5,250.00	5,600.00
Bookkeepers Salary	1,000.00	2,000.00	3,000.00	3,000.00	3,000.00
Elevator Man's Salary	3,100.00	3,260.00	3,840.00	4,100.00	4,300.00
Seasonal Labor Salary	300.00	600.00	900.00	1,200.00	1,500.00
Utilities	882.58	1,889.57	3,540.91	5,000.00a/	7,000.00a/
Audit & Legal	280.00	320.00	350.00	380.00	400.00
Directors Fees	375.00	375.00	375.00	375.00	375.00
Repairs & Maint.	39.00	150.00b/	262.00	292.00	320.00
Office Supplies	45.00	75.00	150.00	295.00	420.00
Int. on Capital	1,564.00	2,210.00	3,502.00	5,372.00	7,208.00
Misc. Exp.c/	1,500.00	1,600.00	1,700.00	1,800.00	1,900.00
Total Expense	14,927.38	19,371.22	28.262.71	35,414.05	42,927.75

a/ Extrapolated estimates
b/ Interpolated estimate
c/ Postage, telephone, telegraph, dues, subscriptions, advertising, annual meeting expense, gifts, yard improvement, research, bank charge, travel expense, office fuel, payroll tax, and other expenses

TABLE VII

SYNTHETIC COST BUDGETS FOR VARIOUS SIZE
ELEVATOR FACILITIES IN OKLAHOMA

Rate at which Computed	Source
33 year depreciation	Contractor estimates
20 year depreciation	1955 & 56 construction
.16/100 in permanent assets	FCS #12[d/]
.60/100 in permanent assets	FCS #12
1.37/100 on net fixed assets	FCS #12
Yearly charge by RR(Range $12-$130)	Audits
20 cents per bu. of space bonded - bonding rate $5/100 to $10,000; $2.50/1000 to $25,000 and $1.25/1000 after $25,000 Mgr. $50 Bond and $10 Warehouse license	FCS #12 and Audits
60% for 20 and 50,000 bu. and 70% for 100,000 and over	Survey 1955
1/3 for 20,000, 2/3 for 50,000 and full time for 100,000 and over	Survey 1955
Avg. Survey figures for comparable associations	Survey 1955
Avg. Survey figure for comparable associations	Survey 1955
Avg. Survey figure for comparable assns.	Survey 1955
Avg. figures for comparable associations	Audits
$5 per director per meeting 15 meetings	Survey 1956
Rate indicated by FCS #12	FCS #12
Rate indicated by FCS #12	FCS #12
80% of cost is borrowed at 04.25% interest expense will decrease rate indicated by FCS #12	FCS #12
Avg. Non-itemized additional expense	Audits

d/ T. E. Hall, W. K. Davis, and H. L. Hall, New Local Elevators, Service Report 12, May, 1955.

entire range of quantities.

TABLE VIII

THE RESULT OF STATISTICAL FIT TO THE MODELS CONSIDERED[a/]

Model	a	b_1	b_2	R^2
Linear	15,129.38	.02164	---	.0963
Second Degree Polynomial	12,001.60	.03722234	.0000000108	.9902
Logarithmic Function	2.19432	.39661	---	.9898

a/ Appendix Tables B, C, and D show the least squares computations.

For use in the marginal criteria scheme of decision making by private firms, long-run average and marginal cost functions are better adapted than the long-run total cost function. To convert the long-run total cost function

$$T.C. = \$12,000 + .03722x - .0000000108x^2 \qquad (3.1)$$

into average cost, divide the function by x. The resulting average cost function is

$$A.C. = \frac{\$12,000}{x} + .03722 - .0000000108x. \qquad (3.2)$$

The long-run marginal cost is the slope of the long-run total cost function or the first derivative.[10] The function marginal to the total cost equation (3.1) is

$$M.C. = .03722 - .0000000216x. \qquad (3.3)$$

These functions may be evaluated for any quantity of wheat within the range of the data to determine the long-run total, average, and marginal cost of handling that quantity of wheat. The average cost, thus obtained at any point, is the minimum average cost for performing that quantity of elevator services and

[10] Gerhard Tintner, Mathematics and Statistics for Economists, (New York, 1954) p. 97.

represents the terminal point on the short-run average cost curve for the scale of plant which should be built by a cooperative to handle that quantity of wheat. The average cost function was evaluated for a series of points within the range of the data and is presented in Appendix E.

The corresponding long-run marginal cost schedule may also be determined by evaluating the marginal cost function. The evaluation of a series of points on the long-run marginal cost function is shown in Appendix F.

Graphs of the long-run average cost and long-run marginal cost functions are shown in Figure 8; they are labeled LAC and LMC respectively.

Short-Run Average and Marginal Costs

The marginal-criteria decisions can be simplified by investigating cost for only those plants which represent handling capacities corresponding to the discontinuous points on the demand curve. For the demand data in Table III, the short-run average and marginal cost curves were investigated for plants with maximum capacities of 82,800, 147,200, 230,000, 331,200, 450,800, 588,800, 745,200, 920,000, and 1,113,200 bushels successively.

Using Table VII as a source of data, the variable costs made up such a small portion of the total cost that, for practical purposes, they were negligible. As a result, the short-run total cost function is constant over the relative range. The short-run average cost curves generated by constant total-cost functions are rectangular hyperbolas.

The general equation for these average-cost functions are:

$$SAC = \frac{A}{Q} \tag{3.4}$$

where A is the constant total cost for the range of quantities and Q is the various quantities within the range. When total cost is a constant, marginal cost is zero. At the point where the short-run average cost is equal to the long-run average cost, the short-run and long-run marginal costs are also identical. Thus, short-run marginal cost is zero to the quantity where short-run average cost equals long-run average cost. Here, it is discontinuous upward to the long-run marginal cost curve. Beyond this quantity, the short-run and long-run marginal cost curves are identical.

The long-run total cost equation (3.1) was evaluated for the discontinuous points of demand. The results are shown in Table IX.

TABLE IX

EVALUATION OF THE TOTAL COST FUNCTION[a/] FOR THE QUANTITIES AT WHICH THE DEMAND IS DISCONTINUOUS

Quantity Bushels (x)	Evaluation 12,000	.03722x	$-$ .0000000108x^2	Total Cost Dollars
82,800	12,000	3,081.82	- 74.04	15,007.78
147,200	12,000	5,478.78	- 234.01	17,244.77
230,000	12,000	8,560.60	- 571.32	19,989.28
331,200	12,000	12,327.26	- 1.184.69	23,142.57
450,800	12,000	16,778.78	- 2,194.78	26,584.00
588,800	12,000	21,915.14	- 3,744.20	30,170.94
745,200	12,000	27,736.34	- 5,997.49	33,738.85
920,000	12,000	34,242.40	- 9,141.12	37,101.28
1,113,200	12,000	41,433.30	- 13,383.51	40,049.79

a/ $TC = 12{,}000 + .03722x - .0000000108x^2$

The total cost column represents the short-run total cost figures for the various scales of plant represented in the quantity column. (Table IX). Short-run average cost is determined by dividing the short-run total cost by quantity.

The short-run average cost functions evaluated for the relative range of quantities are shown in schedule form in Appendix G. A graph of the short-run cost functions is shown in Figure 8. The short-run average cost functions are labeled SAC_1, SAC_2, ----- SAC_9. The short-run marginal curves are labeled SMC_1, SMC_2, ----- SMC_9.

Summary

With the use of five model elevators and their relative cost budgets, a long-run total cost function was determined. From the long-run total cost function long-run average and marginal costs were determined.

The points of discontinuous demand were used as the plant capacities for the terminal points of short-run average cost curves. Based on the relatively small percent which variable cost is of total cost for a given plant, short-run total cost was assumed to be constant. The short-run average cost functions were rectangular hyperbolas and the corresponding marginal costs were zero.

The long-run and short-run average and marginal cost functions shown in Figure 8 constitute the cost side of the analysis required for both cooperative and private firm decisions.

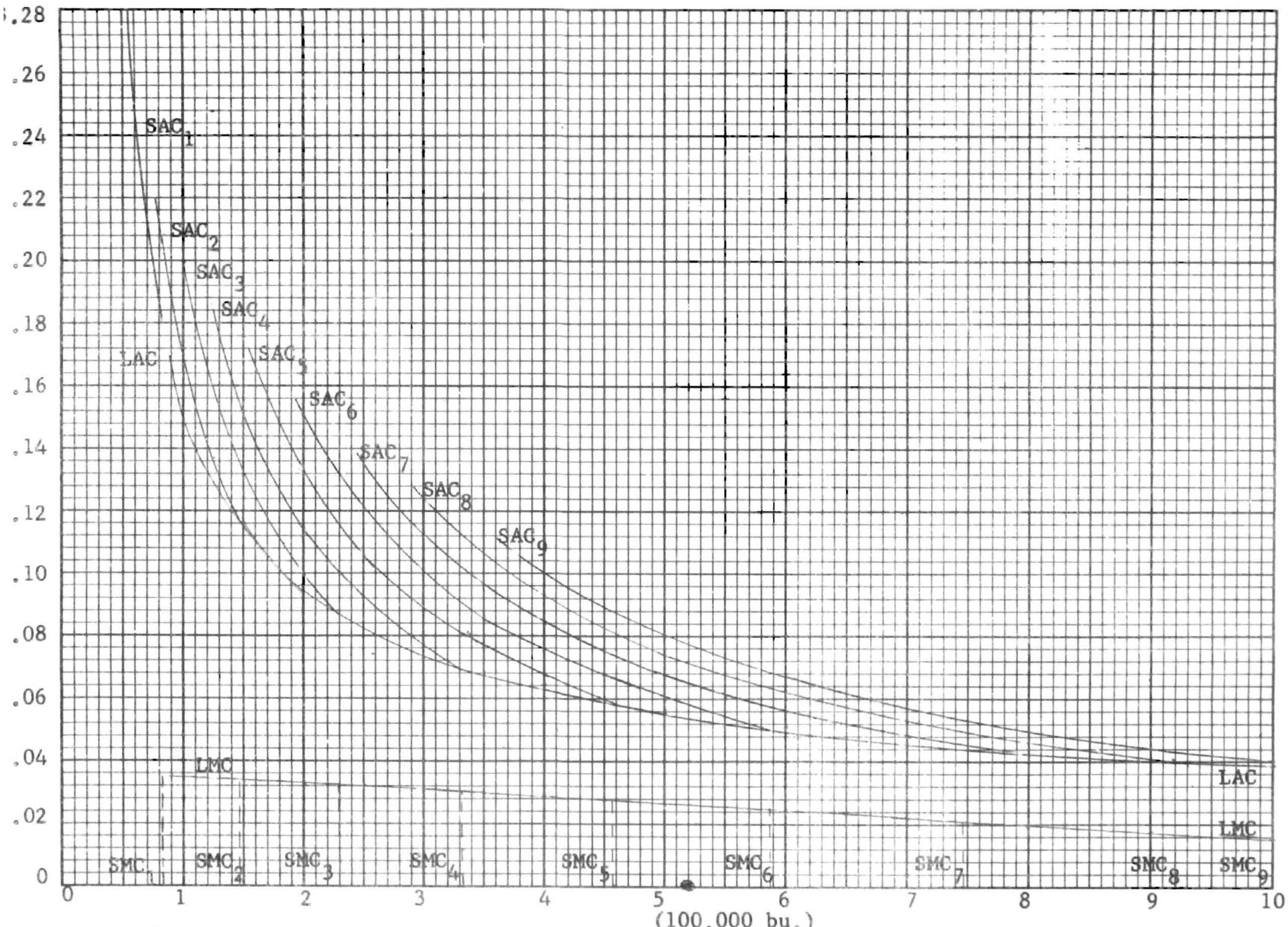

Figure 8. The Long-run Average and Marginal Cost Curves for Elevator Services and Short-run Average and Marginal Cost Curves for Points of Discontinuous Demand

CHAPTER IV

SCALE-OF-PLANT AND PRICING DECISIONS

The demand and cost analysis developed in Chapters II and III provides the tools necessary for making scale-of-plant and price decisions.

The economic significance of cooperation is best shown in terms of a comparison between the actions of a cooperative and a private firm. A cooperative builds a scale of plant with a merchandising capacity to handle the production in the market area and charges a price for services equal to the average cost of production. The scale of plant built by a private firm is a plant represented by the short-run average cost curve which becomes asymptotic to the long-run average cost curve at the quantity where marginal revenue equals long-run marginal cost.

The functioning of cooperatives in the industry may be viewed in terms of a norm. For this purpose, a spatial equilibrium model for cooperative grain elevators may be utilized.

The Spatial Equilibrium Model for Cooperatives

The spatial criterion for industry equilibrium is satisfied when cooperative firms are dispersed throughout the industry so that the change in cost of transportation to attract the marginal unit between firms is equal to the change in average merchandising cost to the firm receiving the marginal unit. A cooperative firm's theoretical demand and cost situation which satisfies the spatial criteria are depicted in Figure 9. The demand curve D D' is the theoretical demand function. The long-run average cost curve is LAC. The scale of plant is represented by the short-run average cost curve, SAC. The quantity OX of services is performed at a price of OP. Production takes place at a point where the short-run average cost curve becomes asymptotic to the long-run average cost curve.

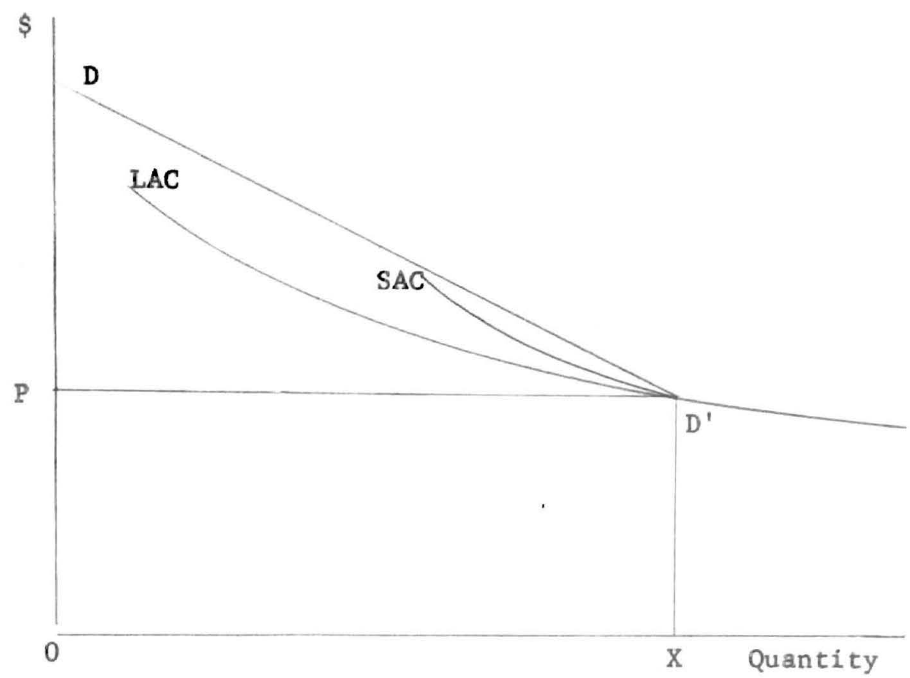

Figure 9. A Theoretical Spatial Equilibrium Model

At the quantity OX, the demand curve becomes perfectly inelastic. The area of perfectly inelastic demand is the range of prices through which competing firms practice retaliatory pricing.

The Influence of Limiting Institutions

Institutional limitations exist in the wheat elevator industry which prevents the attainment of pure spatial equilibrium. Because of lower transportation rates and in-transit rail privileges, wheat is usually shipped by rail. Thus, elevators are almost always located where rail sidings are available. In Oklahoma there are few examples of elevators without access to rail facilities.

Another institution which hinders the attainment of spatial equilibrium and presents difficulties in economic analysis is the truck rates for hauling wheat from the farm to elevator.

The demand functions derived in Chapter II are discontinuous because of the institutional pricing of truck transportation. A discontinuous total revenue function which corresponds to the derived demand function in Figure 4 is shown in Figure 10. The lines extending downward from each point of discontinuity represent the decrease in total revenue caused by improper pricing.

The possible loss of revenue becomes greater as quantity increases. At smaller quantities, the loss resulting from incorrect pricing may not be of great consequence. In the increasing section of the total revenue function, incorrect pricing can result in a reduced total revenue even with an increase in quantity handled. For example, the total revenue for handling 450,800 bushels may be as little as $41,000, while the total revenue possible for handling 331,200 bushels is $43,056.

The total revenue function depicted in Figure 10 has no derivative per se. However, an average marginal revenue may be determined if an assumption is made that the total revenue function is linear between the points of discontinuity. The use of average marginal revenue determined from a total revenue function of the type shown in Figure 9 is generally acceptable for scale-of-plant decisions by private firms. The error in plant size which may result from using average marginal revenue as one of the elements in the marginal criteria scheme will never be greater than the quantity difference between two adjoining points of discontinuity.

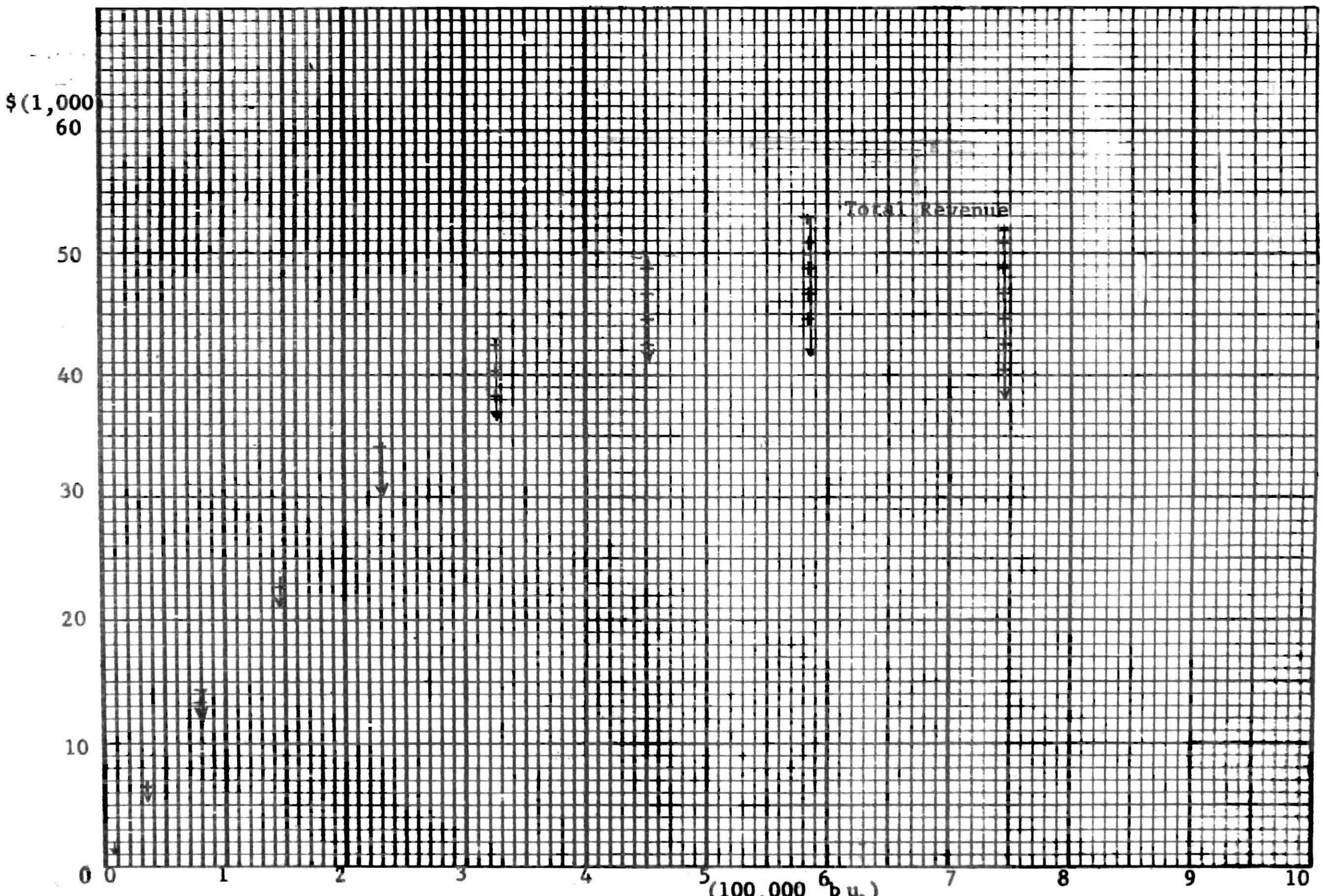

Figure 10. The Type of Discontinuous Total Revenue Function Corresponding to the Average Revenue Function in Figure 4.

Scale-of-Plant Decisions

For comparing scale-of-plant decisions by cooperatives as opposed to private firms, use will be made of the derived demand function presented in Figure 4 and the cost curves presented in Figure 8. To facilitate the comparison the demand and cost curves are presented together in Figure 11.

Private Firm

A private firm facing the demand and cost situation shown in Figure 11 uses marginal criteria for determining scale of plant. The long-run marginal cost curve intersects the average marginal revenue at a quantity of 588,800 bushels. The appropriate scale of plant corresponds to the short-run average cost curve labeled SAC_6. The maximum merchandising capacity of the plant is 588,800 bushels. At that quantity average marginal revenue equals long-run and short-run marginal cost, and short-run and long-run average cost are asymptotic. This choice provides a scale of plant from which the maximum profits may be attained. An identical solution is attained by the evaluation of total revenue and total cost, Appendix H.

Cooperative Firm

A cooperative facing the demand and cost situation shown in Figure 11 uses average cost and average revenue criteria for determining scale of plant. The long-run average cost curve intersects the average revenue curve at a quantity of 920,000 bushels. The appropriate scale of plant corresponds to the short-run average cost curve labeled SAC_8. The plant has a maximum merchandising capacity of 920,000 bushels. At that quantity average revenue equals long-run average cost equals short-run average cost. This choice provides cooperating farmers with elevator

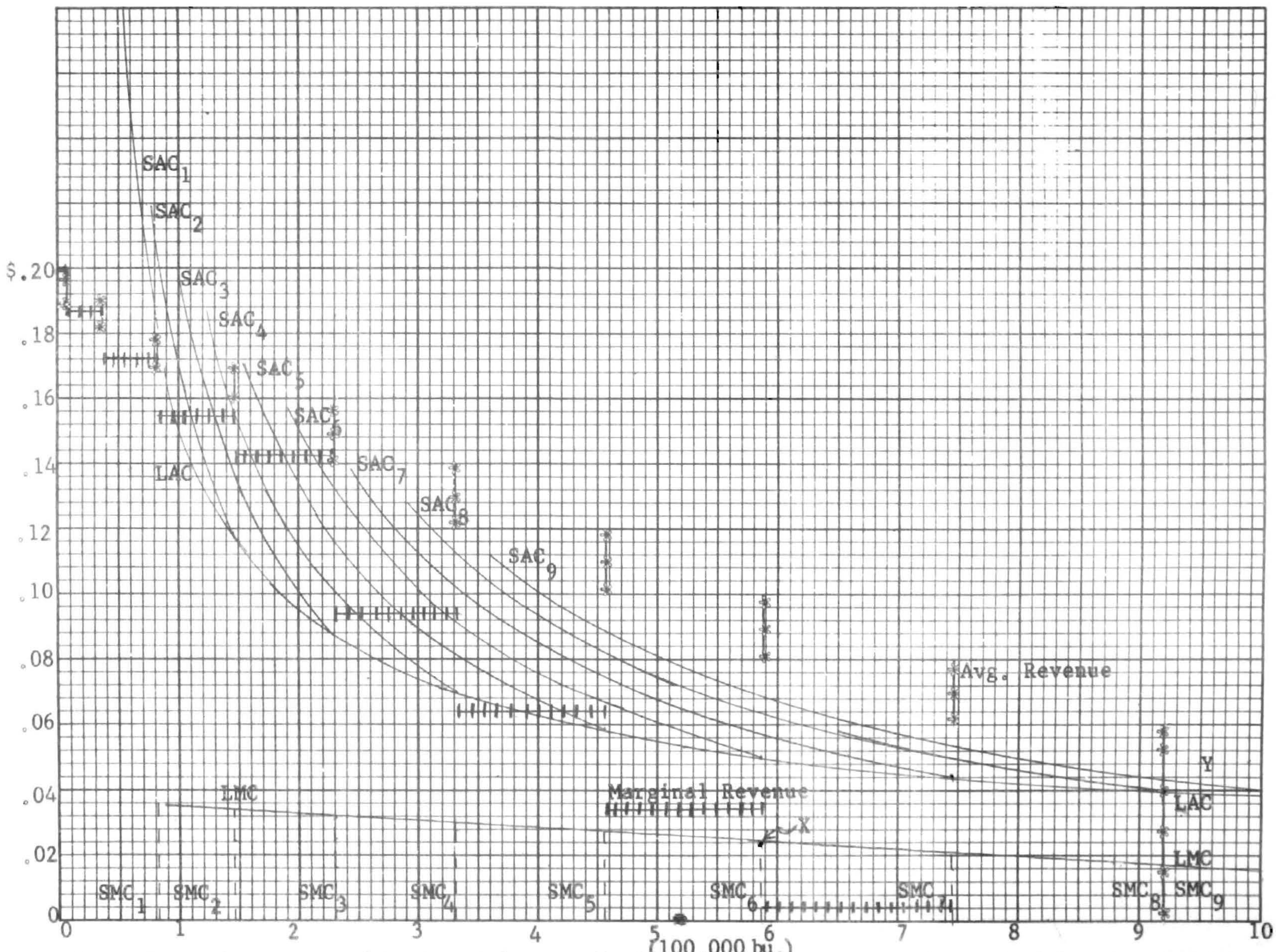

Figure 11. Short-run and Long-run Average Cost Curves and Average and Marginal Revenue Curves

services at a minimum average cost.

Comparison of Cooperative and Private Firm Scale-of-Plant Decisions

Monopolistic pricing is different for cooperatives and private firms. The difference arises because of different goals. The cooperative desires to minimize average cost and the private firm to maximize profits.

As has previously been pointed out, neither firm would attain the minimum point on the long-run average cost curve. However, a cooperative facing the same demand and cost situation would construct a larger plant than the private firm. The cooperative scale of plant would have a maximum merchandising capacity of 920,000 bushels; the private firm scale of plant would have a maximum merchandising capacity of 588,800 bushels.

Price Policy Decisions

Once scale-of-plant decisions have been made, price policy must be determined. The private firm charges a price equal to average revenue at the quantity where marginal revenue is equal to marginal cost. The cooperative charges a price equal to average cost at the point where short-run average cost equals average revenue.

Private Firm

A private firm facing the demand and cost situation shown in Figure 11 will construct a scale of plant represented by SAC_6. The price indicated by the average revenue curve is 10 cents per bushel at a quantity of 588,800 bushels.

The average cost of merchandising SAC_6 at 588,800 bushels is 5.1 cents per bushel. The total cost of operating the plant SAC_6 is \$30,170 per year (Appendix H). At a price of 10 cents per bushel, total revenue for the year is \$58,880. Annual profits from the operation are \$28,710.

Cooperative Firm

A cooperative facing the demand and cost situation shown in Figure 11 will construct a scale of plant represented by SAC_8. The price charged will be equal to short-run average cost. At a quantity of 920,000 bushels, the short-run average cost is 4 cents. Annual profits from the operation are -0-.

Comparison of Cooperative and Private Firm Price Decisions

The private firm handles 558,800 bushels as compared to 920,000 bushels handled by the cooperative. Farmers selling wheat through the private firm pay 10 cents, per bushel, for elevator services. Farmers selling wheat through the cooperative pay 4 cents, per bushel, for elevator services. Profits are \$28,710 for the private firm as opposed to no profits for the cooperative.

Dynamic Considerations

Thus far, the comparison of the cooperative and private firm actions has been limited to a static model. As yield, topography, competition, institutions, and other factors differ in different market areas, each firm faces a unique set of circumstances.

Yield Variability

The optimum scale of plant for a market area depends on the yield in the area. A unique scale of plant is optimum for each quantity of production. The effects of yield variability on optimum scale of plant may be stated in terms of a hypothesis.

Hypothesis: If a cooperative elevator facility has a merchandising capacity equal to the maximum crop in the area, then member patrons receive elevator services at a minimum average cost. The alternative hypothesis is: If a cooperative elevator facility has a merchandising capacity less than the maximum crop in the area, then member patrons receive elevator services at a minimum average cost.

These hypotheses must be tested in terms of the expected loss of wheat caused by insufficient handling capacity in large crop years compared to the additional cost of providing the larger facility. A hypothetical test was designed using a 200 square mile market area and average yield figures for Garfield County, Oklahoma from 1940 to 1955 inclusive. The years of excess of production over capacity for three different elevator facilities are shown in Table X. Yields above handling capacity of each elevator are listed. The quantities which could not be handled by the facilities are -0-, 399,700 and 1,462,300 bushels respectively for elevators with handling capacities of 1,325,000, 1,113,000, and 920,000 bushels.

If the price of wheat was $2.00 per bushel and the excess of yield over elevator capacity was a complete loss, the elevator with a merchandising capacity of 1,113,000 bushels would suffer a loss of $799,400 during the 16-year period. The elevator with a capacity of 920,000 bushels would suffer a loss of $2,924,600 during the same period.

The reduction in cost of merchandising between the 1,325,000 bushel elevator and the 1,113,000 bushel elevator is $2,400 per year

(Appendix H). The additional cost of this facility would be $38,400 over the 16-year period. With the 920,000 bushel facility, $5,300 per year or $84,800 of additional cost over the 16-year period would be incurred.

TABLE X

THE EXCESS OF PRODUCTION[a/] OVER MERCHANDISING CAPACITY FOR THREE DIFFERENT ELEVATOR FACILITIES

Year	Average Yield For County[b/] Bushels	Quantity Produced In Area[c/] Bushels	Wheat Which Cannot be Handled Through the Elevator: 1,325,000 bu. Capacity	1,113,000 bu. Capacity	920,000 bu. Capacity
1940	13.0	798,200	-	-	-
1941	11.4	700,000	-	-	-
1942	17.5	1,074,500	-	-	154,500
1943	8.0	491,200	-	-	-
1944	17.4	1,068,400	-	-	148,400
1945	14.7	902,600	-	-	-
1946	18.5	1,135,900	-	22,700	215,900
1947	16.5	1,013,100	-	-	93,100
1948	16.4	1,007,000	-	-	87,000
1949	14.4	884,200	-	-	-
1950	8.8	540,300	-	-	-
1951	13.2	810,500	-	-	-
1952	21.4	1,314,000	-	200,800	394,000
1953	14.1	865,200	-	-	-
1954	21.0	1,289,000	-	176,200	369,400
1955	6.0	368,400	-	-	-
		Total	-	399,700	1,462,300

a/ Based on average yield data for Garfield County, Oklahoma, 1940-1955 and an assumed 200 square mile market area in which 307 acres of each square mile are planted to wheat
b/ Source Oklahoma Agricultural Statistics
c/ Rounded to nearest 100 bushels

A total loss is not expected to be associated with inadequate elevator capacity. The loss would be the reduction in quality, shrinkage, and the additional cost of handling caused by inadequate facilities. If the loss amounted to 4.8 percent of the value of the wheat which the facility could not handle, it would be economically profitable to build the 1,325,000 bushel facility instead of the 1,113,000 bushel facility. If the loss amounted to 2.9 percent of the wheat which could not be handled, it would be economically profitable to build the large facility instead of the 920,000 bushel facility.

Differences in Technologies

The implications of technology differences between firms may be investigated with a simplified model of the type used for investigating demand in Chapter II. For the purpose of analysis, two cooperative elevators, A and B, located 20 miles apart will be used. The division of the farmers along a line between the two elevators will be investigated when both firms employ equally efficient technologies. Then the case where one firm has a technological advantage will be investigated.

A market division diagram may be used to show the market division on the basis of alternative cost to farmers. A farmer will market his wheat where the cost of marketing, transportation and elevator services, is a minimum.

Cost of elevator services and the sum of the cost of elevator services and transportation are shown in Figure 12. The cost of 4 cents for elevator services corresponds to the price indicated in Figure 11. The transportation rates are the commercial truck rates shown in Figure 2. The vertical summation of the cost of elevator services plus the cost of transportation makes up the marketing cost curves faced by farmers at various distances from each elevator. Hereafter, the marketing cost curves for patronizing A and B will be referred to as MCC_A and MCC_B respectively.

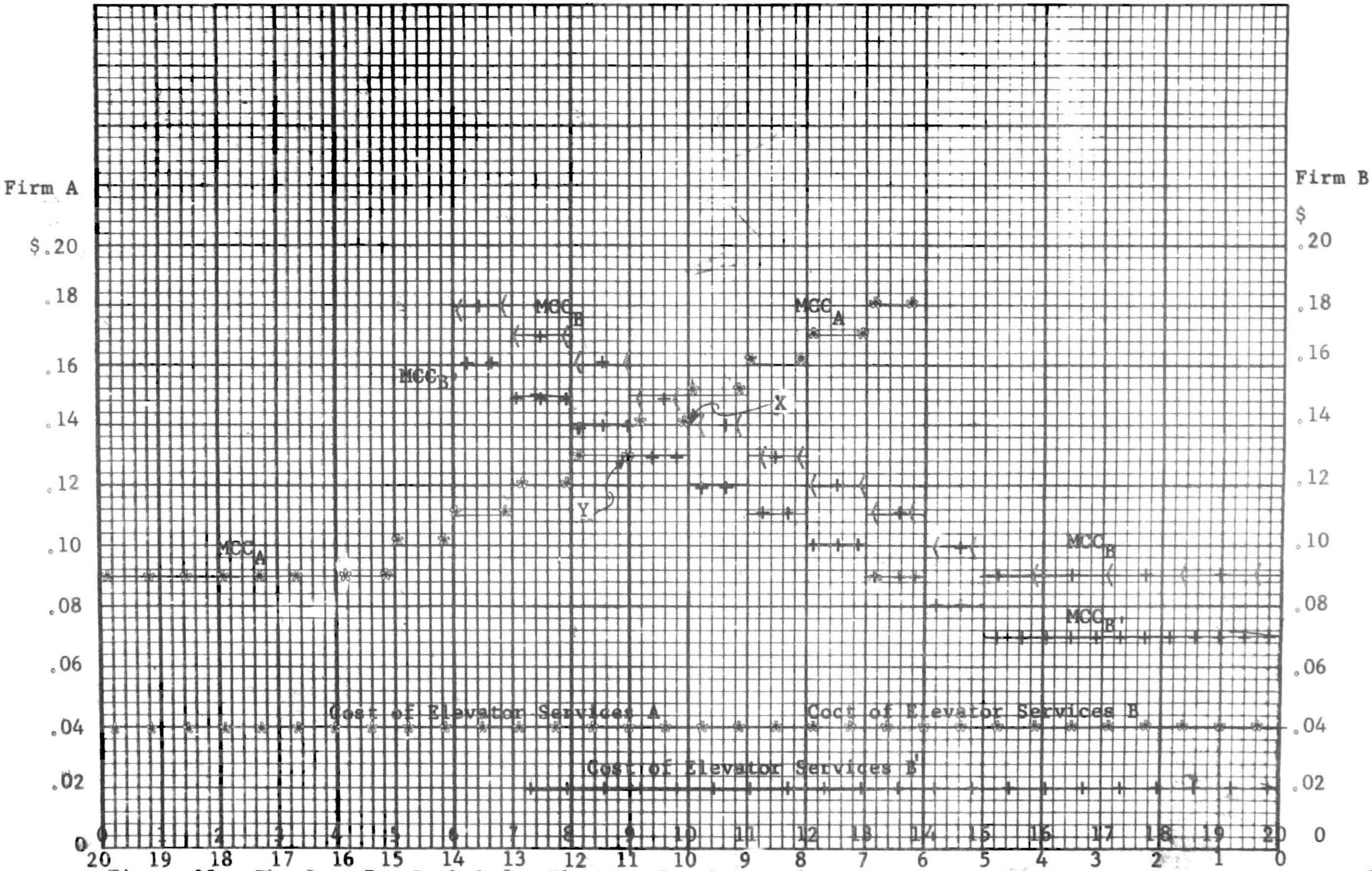

Figure 12. The Cost Per Bushel for Elevator Services and Transportation for Farmers Various Distances from Two Competing Elevators

The division of the market area occurs where $MCC_A = MCC_B$. With equal technologies the intersection of the two curves occurs at point X, indicating an even division of the market; ten miles going to either elevator.

An improved technology making it possible for B to perform elevator services at a cost of 2 cents per bushel results in a new division of the market. The reduced cost of elevator services is indicated by CES_B'. The new marketing cost curve for patronizing B is represented by MCC_B'. The two marketing cost curves now intersect at point Y. The area is now divided with A receiving 9 miles and B receiving 11 miles.

The results of the improved technology are that one mile leaves A and goes to B, and farmers who originally patronized B get a 2-cent price advantage. The farmers in the 11th mile to B now get a 1-cent price advantage.

Estimates Required for Cooperative Scale-of-Plant Decisions

The solution to scale-of-plant decisions for a specific association is greatly simplified as compared to the theory thus far developed. The estimates are listed in chronological order.

1. Size of Market Area.

   The size of the market area is approximately half the road distance between the firm and its competitors. The area bounded by this division can be adjusted for factors such as: type of road, terrain features, and traditions which may have been established.

2. Acres of Wheat Grown Inside the Area.

   In a free market this is a reasonably stable figure. With government acreage controls the county records show the allotment acreages.

3. Maximum Yield Per Acre.

Previous high yields are the best estimate available. Records of previous yields by counties are available in the agricultural statistics.

4. Wheat Production in the Area.

Once the potential market area has been established, an estimate of total yield in the area can be made. If the entire market area is fairly homogeneous, maximum yield per acre times the number of acres of wheat gives the total production for a peak year. If yield per acre varies over the trade area, total the production in each yield area over all areas.

5. Percent of Crop Harvested During the Peak Day.

If the length of harvest is 12 days and equal quantities of wheat are harvested each day, the elevator should have a maximum daily leg capacity of 1/12 of the total production in a peak year. If the harvest normally has a peak day in which 1/5 of the total volume is harvested, the elevator should have a maximum daily leg capacity of 1/5 of the production of a peak year.

6. The Availability of Rail Cars.

If shipping is done by rail and cars are readily available, the quantity of bin space must meet the requirements for separating and blending wheat for moisture, weight, or other characteristics. If the rail service is such that orders are filled within one day of the time needed, the quantity of bin space required will be equal to the quantity of wheat received on the peak day. Bin space and daily leg capacity are substitutes up to a point where bin space equals daily leg capacity. For merchandising, bin space in excess of daily leg capacity is wasted.

If rail car availability is uncertain, bin space for the entire crop may be desirable.

7. Plant Specifications.

The above estimates are combined and expressed in terms of bin space and leg capacity.

Estimates Required for Cooperative Price Decisions

The estimates required for making price decisions indicated by the theory developed earlier in the chapter are:

1. Cost of Operation. A given scale of plant operates primarily on fixed cost. Therefore, cost of operation for previous years provides a reliable estimate.

2. Total production of wheat in the area. A practical way to estimate total production is to have each director of the association make an estimate of yields in his particular area. The estimates can then be reconciled at a director meeting.

Average cost or price is then determined by dividing cost of operation by the production estimate. The inaccuracies in yield estimates can be compensated by the use of safe margins. In this instance, the decision is based on the minimum quantity of grain which might be produced in the market area. In other words, the estimation of yield made by the manager and directors should be in the form of a minimum possible yield.

The practical reason for the use of minimum yields to determine cooperative price policy is obvious when patronage refunds are considered in their proper role. If too little is charged for elevator services and a loss results, the cooperative is unable to draw the difference from the membership. However, if a net saving is shown, it is easily distributed to members on the basis of patronage.

An Example of a Cooperative Scale-of-Plant Decision

A group of farmers, who ban together in the ownership and operation of an elevator, must decide what size elevator to construct. They need information about production, speed of harvest, rail service, and plant specifications.

For a case example, consider a market area which is bounded by a line connecting points one-half the distance between the case elevator and nearest competitors. Assume that this area extends 12 miles east, 10 miles south, 8 miles west and 10 miles north (a map of the area is shown in Chart 4.1. The production characteristics are those indicated in the various sections.

The estimate of total yield is made by evaluating maximum yield for each area and summing these estimates over all areas as shown in Table XI.

TABLE XI

ESTIMATE OF MAXIMUM YIELD IN THE AREA

Adjacent Area	Acres	Yield Per Acre	Total Yield
67 sq. miles x 640 acres x 18 bushels per acre =	42880		771,840
28.8 sq. miles x 640 acres x 20 bushels per acre =	18432		368,640
20.4 sq. miles x 640 acres x 15 bushels per acre =	13056		195,840
		Estimated Total	1,336,320

The next consideration would be speed of harvest. The one day when the greatest quantity of wheat is harvested is the crucial day for making

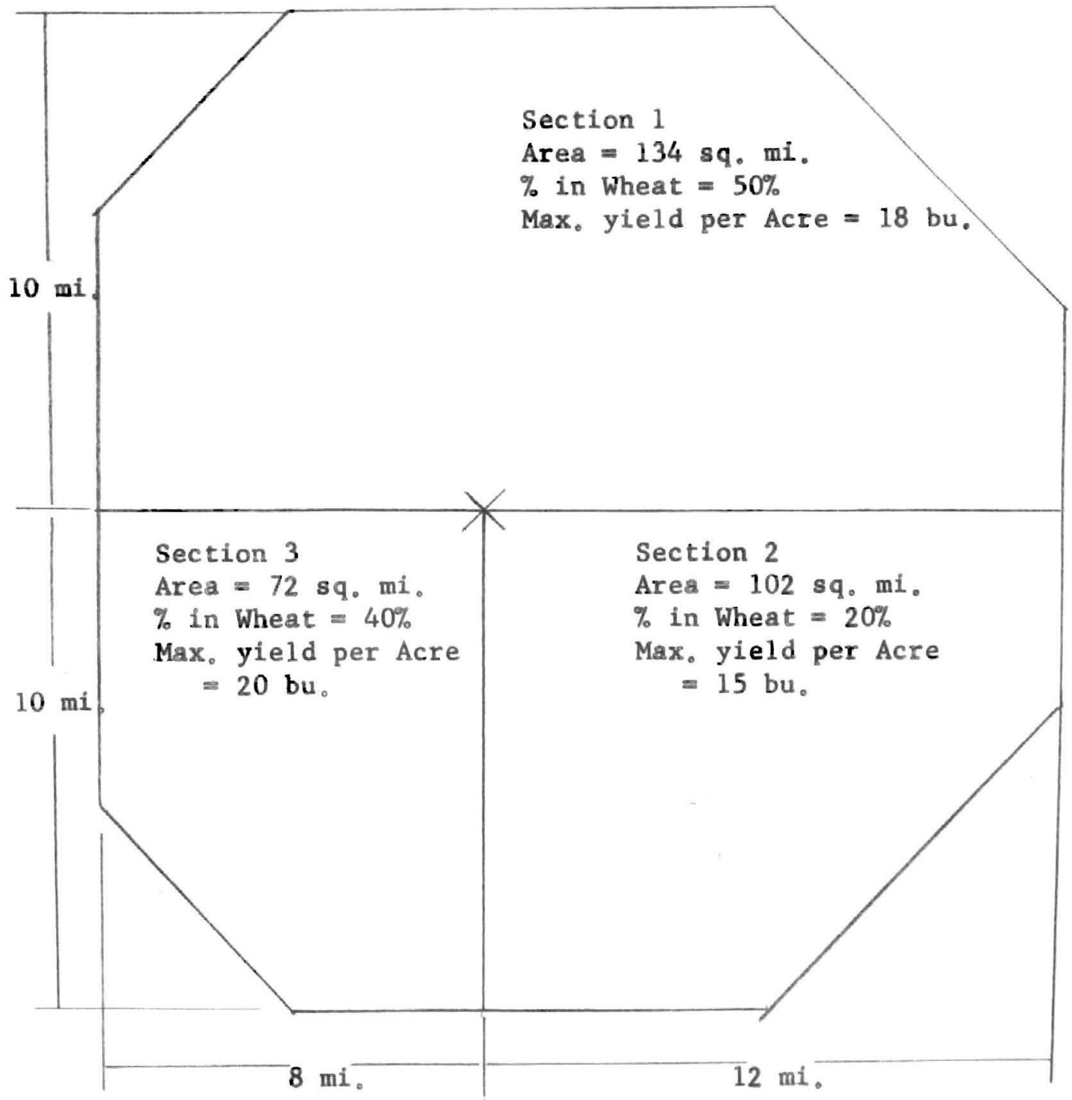

Chart 4.1. An Example Market Area

the scale-of-plant decision. Sections of the market area may be harvested at different times. The estimate as to peak-day deliveries must be made on the market area as a whole. Assume previous delivery records show that the maximum proportion of the crop delivered in any one day was 22 percent.

The maximum expected deliveries in one day would be 22 percent of 1,336,320 bushels or 293,990 bushels. Assume that need for rail cars for shipping wheat can be predicted with enough accuracy so that cars are available within one day of the time needed. It is necessary to construct elevator-bin capacity equal to the peak day deliveries or 293,990 bushels (approximately a 300,000 bushel elevator). The leg capacity required would be 29,400 bushels per hour if the harvest day were a 10-hour period.

Cars can be loaded during the night. Thus, leg capacity requirements are only those required for elevating. If rail cars are available exactly when needed, leg capacity per hour substitutes for bin space at a 10:1 ratio between 300,000 bushels and the minimum bin space for blending. The same quantity of wheat could be merchandised with 200,000 bushels bin space and 39,400 bushels per hour leg capacity, or 100,000 bushels bin space and 49,400 bushels per hour leg capacity.

The reverse would be true if rail cars were expected to be available within several days of the time needed. The required bin capacity would equal the maximum total deliveries expected during the days when rail cars are not available. In this case, leg capacity would not substitute for bin capacity.

Assume the situation was such that a 300,000 bushel elevator, with a 29,400 bushel per hour leg capacity, was the optimum elevator facility. The board of directors would receive bids for an elevator with these specifications and the minimum bid would be accepted.

Example of Pricing of Elevator Services

The next step is to compute the total cost of operating the facility for one year. (The procedure outlined in Chapter III and Table XI provides a method of estimation).

With a total cost figure of $42,451.72 (Equation 3.1), a pricing policy can be established for any given year if the total production of the area is known. Perfect knowledge as to yields prior to harvest time is impossible. The next best alternative is an estimate. The board of directors or managers, utilizing all the information available, make a conservative estimate of the crop. The reason for a conservative estimate is to insure that costs are covered. If the yield estimate is 1,000,000 bushels, the manager should pay the farmers the "on-track" bid minus 4.3 cents per bushel. Since pricing is done in whole cents, an "on-track" bid of $2.00 per bushel would find farmers being paid $1.95 for their wheat.

If the crop estimate was 800,000 bushels and the "on-track" bid was $2.00 per bushel, the price paid farmers would be ($2.00 - .054 = $1.946) $1.94 per bushel. The average cost per bushel for merchandising can be determined by dividing total cost ($42,451.72) by the crop estimate.

At the end of the year, the net savings resulting from even-cent pricing and the conservative estimate are refunded to member patrons on the basis of quantity of wheat merchandised.

Summary

Within the framework of the derived demand and cost functions from Chapters II and III, scale-of-plant and price decisions were investigated with the use of both cooperative and private firm criteria.

The use of cooperative criteria as opposed to private firm criteria for decisions results in a larger scale of plant, larger quantity handled, lower cost, and lower price charged for services.

The final two sections of the chapter were devoted to an example of the analysis required for scale-of-plant and price decisions.

CHAPTER V

GENERAL ASPECTS OF COOPERATIVE BUSINESS

While conducting the case studies, many aspects of business were encountered which are peculiar to cooperatives. The ensuing discussion is a summary of the more important impressions gained during the investigation. Some of the impressions are evaluated only in subjective terms; others are developed theoretically and the relevant criteria for decisions stated explicitly. These impressions of the varied aspects of cooperative management are outlined here, with a belief that an appreciation of the complexity of management may be gained, if the scope of the decisions necessary for an association to function is understood.

Risk

In the making of decisions with dynamic implications, risk plays an important role. Risk is discussed here in terms of patronage refunds and responsibility bearing by farmers.

Patronage Refunds

Patronage refunds may be defined as that portion of the net savings of a cooperative paid to patrons on the basis of quantity of business done with the cooperative.

Net savings arise from differences in the cost of providing goods or services and the price charged for goods or services.

Since price uncertainties and shrinkage and spoilage risks are inherent in the buying and selling of wheat and handling of merchandise, it is operationally necessary to charge a price for services and merchandise somewhat higher than the cost involved in providing the services or supplying the merchandise. This difference will be referred to as a "safe margin". The magnitude of this "safe margin" will depend on the amount of risk assumed by the cooperative. The amount which the "safe margin" exceeds the costs incurred, through the assumption of risk, will ultimately be paid to member patrons in the form of patronage refunds.

The information obtained from a farmer preference study completed in 1955, indicates that 16 of the 42 farmers interviewed mentioned the patronage dividend received as one of the reasons for starting to patronize a cooperative grain elevator.[11] The line of reasoning underlying this preference appears to be unwarranted, since the only method by which a net earning can be shown from normal merchandising operations is by charging more for services than the cost of producing the services. Because of the higher initial price, the farmer loses the use of this money from the time the transaction is made until the cooperative ends its accounting period and distributes the net savings. The basis on which net savings are distributed is determined by a vote of the membership. Some of the alternatives available for making this distribution are:

1. A percentage of the total dollar volume of patronage for the year. Example: A cooperative did $300,000 worth of business during the year and had net savings of $10,000. Farmer A did $3,000 in

[11] Jerry G. West,"A Pilot Study of Farmers Preferences for Marketing Services in Kingfisher County, Oklahoma"(Unpub. M.S. Thesis, Oklahoma State University, 1955), p. 31

business with the cooperative, thus his portion of the net savings was 3,000/300,000 or 1/100 of the net savings. The farmer should receive $100 in patronage refunds.

2. A flat rate per bushel of wheat delivered to the elevator. (Patronage refunds paid only on wheat under consideration). Example: A cooperative handled 400,000 bushels of wheat and had net savings of $10,000. Farmer A delivered 4,000 bushels of wheat to the cooperative. Thus, he was entitled to 4,000/400,000 or 1/100 of the net savings. Farmer A should receive $100 in patronage refunds.

3. A flat rate per bushel of wheat placed in government loan plus a flat rate for cash wheat delivered. Example: A cooperative received 200,000 bushels of wheat for government loan and 100,000 bushels of cash wheat. Net savings of $20,000 resulted from the storage enterprise, and net savings of $1,000 resulted from sales of cash wheat. Farmer A delivered 2,000 bushels of wheat for government loan and 500 bushels as cash wheat. Thus, he is entitled to 2,000/200,000 or 1/100 of the net savings from storage and 500/100,000 or .5/100 of the net savings from sales of cash wheat. Farmer A should receive $200 in patronage refunds from storage and $5 in patronage refunds from the sale of cash wheat.

4. Payment on the basis of volume of patronage limited by the ownership of stock.

Cooperative law prevents payment of unlimited dividends on common stock. However, there is a possibility that a system of dividends on patronage up to some percent of the common stock held by each member might provide a useful method of distribution.

With different conditions of price each of these methods of distributing net earnings have relative advantages. If all enterprises are operated on the same percentage margins and no grain is stored, method number one of distribution is appropriate.

If the percentage margins for all merchandise are equal but a different percentage margin is taken on wheat, method number two is appropriate for distributing net earnings from the wheat operation. The remainder of the net earnings can still be distributed according to method number one.

If both storage and merchandising of wheat are done, method number three is appropriate for distributing earnings from the wheat operation. Again, the remainder of the net earnings may be distributed by method number one.

If the only source of net earnings is the storage operation, method number four offers some advantages. Physical plant and grain are necessary before storage income is possible. The ownership of the physical plant is represented primarily by outstanding common stock. The grain for storage comes from the members of the cooperative. Method number four provides for the distribution of earnings on a patronage basis, limiting the absolute amount receivable by a member to a percentage of the common stock he owns. Thus, the ownership of the physical plant is recognized as a limiting factor for storage income.

The criteria for determining the method by which net earnings are to be distributed is: Is the method consistent with individual profit maximization by member patrons?

Responsibility Bearing for Decisions

When the membership votes to make major additions to permanent assets, economic risk seldom plays a major role in the decision-making process. The financing of construction, such as elevators, is usually done through the Bank for Cooperatives in Wichita, Kansas. The farmers may be asked to provide 20 percent of the total cost of construction.

If an elevator with 100,000 bushels of bin space costs $103,000, (Appendix A) farmers would probably be required to furnish $20,000 and the bank would provide the other $83,000. If 400 farmers are member patrons of the cooperative and each shares the expense evenly, a total loss would cost each farmer only $400.00. The bank stands to loose far more of the initial cost price than any single farmer or the entire group of farmers.

There is a greater risk associated with a wrong decision which is seldom considered by farmers in their decision-making process. This risk is the increased average cost per unit incurred because of an inappropriate scale of plant.

If the production is 450,000 bushels in an area, a 100,000 bushel elevator can handle the crop at 6 cents, per bushel (Figure 8). If the cooperative builds a 200,000 bushel elevator, the cost of handling the 450,000 bushels of wheat is more than 8 cents, per bushel. A difference of 2 cents, per bushel, in the price received by farmers for their wheat is a reduction in farmer profits of $9,000 per year. If this additional cost is considered for the life of the elevator (33 years), the loss to the farmers in terms of inefficient scale of plant would be $297,000. This is the hidden risk which is often overlooked when a major decision is made.

During the period when the government-occupancy contracts and 5-year amortization plans were available, the risk associated with initial construction costs approached zero. The risk of increased average cost caused by an improper scale of plant was not reduced by the government incentive programs.

The cost associated with a wrong decision on leg capacity of an elevator may be far greater than the cost of a wrong scale-of-plant decision. Observations made during the case studies indicated a tendency to overbuild bin space and underbuild leg capacity. The following conclusions from Farmer Cooperative Service, Circular 10, June, 1955 are in substantial agreement with this statement.

> "2. In making your appraisal, it is less costly to be on the conservative side in determining elevator storage capacity. Provision should be made, however, at time of building for adding storage capacity at a later date when your need may be greater or more evident in terms of specific volume.
>
> "3. It is better to be on the liberal side in appraising volume to be merchandised or handled, when deciding on receiving and loading out equipment capacity. Once the elevator is built, alterations to increase equipment handling capacity or shipping capacity may be impossible or quite expensive."[12]

When leg capacity per hour is inadequate to handle deliveries, the cost in terms of lost time of trucks, harvesting machinery, and labor may far exceed any consideration of risk in the minds of the individual farmers when they vote on construction.

Delineation of Areas of Responsibility

Within a business organization where management functions are performed at three levels, the borders of the areas of responsibility should be clearly defined.

All the managers of the case-study cooperatives indicated they had a mental impression of the division of responsibilities. However,

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[12] Thomas E. Hall, New Country Elevators, FSC Circular 10, June, 1955, p. 9.

no specific delineation of areas of responsibility was found in the records of any of the case-study cooperatives. The criteria which appear to be consistent with the divisions of responsibility found are:

1. Timeliness of decisions.

2. Relative costs if the decision is made by the manager, directors, or the members.

3. Relative adequacy of information available to the manager, the directors, and the members.

4. Possible results in terms of farmer profits, cooperative strength, and satisfaction of members.

Manager Responsibility

The decisions usually left entirely to the managers are: The lines of merchandise which constitute the sidelines operation, the inventories maintained, the percent margins to take on merchandise, and the prices to charge for services.

Managers share with directors and members the responsibility for additions to permanent assets. The range of maximum expenditures made by managers without consulting the board of directors was \$50 to \$1000. The range of maximum expenditures which managers reported they would make without consulting the board of directors was \$50 to \$10,000.

Director Responsibility

The directors have the responsibility of establishing cooperative firm policy within which the manager is to operate. This policy must serve the interests of the member patrons in their endeavors to maximize profits.

The board of directors also has a responsibility of providing information to the members for augmenting their decisions. The type of information which the board provides is usually of a technical type not readily available to the individual members. This type of information includes such things as bids on construction, capacity of various plant facilities, estimated annual cost of operating various facilities, labor required, expected life of a facility and other related technical information.

Member Responsibility

Each member has a responsibility to himself and his fellow cooperators of seeing that economically efficient means of doing business are employed by the cooperative. The maintenance of efficiency is not dependent on the price mechanism in the classical sense. Efficiency is maintained by member action in voting for new construction, electing directors who will function in the best interest of farmers, and patronizing the cooperative.

Adequacy of Information for Decisions

Most managers of the case-study cooperatives felt that the information available had been inadequate when most major decisions were made.

An example of this weakness is a failure to examine possible alternative farm programs before making a decision on size of elevator facility to construct. The main concern should be the effects on production and price of the possible alternative farm programs.

The directors should investigate the technical facts underlying all the alternative choices which the membership might make. With the available facts, the farmer can analyze his own business structure and make his decision based on the relative advantages.

For decisions on major additions to permanent assets, it is not enough that the directors investigate the situation and make a single recommendation. They are seldom in a position to evaluate the impact of alternative decisions on individual members. The selection of the final action should always be based on the evaluation of the individua members. Chapters II, III, and IV furnish the method and criteria for these decisions and are generally applicable to all major decisions such as scale of plant.

The criteria against which the adequacy of information can be evaluated are:

1. The cost of obtaining additional information.

2. The value of additional information for making decisions.

3. The relative degree of uncertainty with and without additional information.

4. The magnitude of the consequences resulting from a wrong decision.

Use of Business Records and Audits

One of the reasons for keeping business records is to provide management with business controls. Business records should furnish the information needed for most day-to-day operating decisions and much of the data for making major decisions.

There are many kinds of business records which a firm may use. The criteria for establishing records to keep are:

1. Are the records understandable?

2. Do the records furnish all the desired information?

3. Is the cost of the records prohibitive?

The auditor's report is a consolidation of the cooperative's business for one accounting period. It includes as a minimum a balance sheet, operating and trading statements, statement of commodities, detail of expenses, and a statement of wheat account.

The auditor's report is the primary internal check into the business activities of the cooperative. The audit provides directors and members a concise report of the cooperative's business and financial position, and a check into the soundness of the manager's business policies.

By the use of inventory and gross sales figures from the audit, average inventory turnover can be determined. The inventory turnover and the percent margins, from the trading statement, provides an indicator of returns to operating capital and return on an enterprise basis. These indicators provide information useful in making enterprise adjustments and in deciding how net earnings are to be distributed. An enterprise should be discontinued if returns are insufficient to cover costs. If inventory turnover is very slow, the possibility of correcting size of inventory and price should be investigated. The distribution of net earnings should be weighted to enterprises according to the percentage contribution to net earnings by each enterprise.

Minutes of Director Meetings

Fourteen of the seventeen cases studied held scheduled board meetings monthly. The order of business was usually to read and approve the minutes of previous meetings, hear the manager's report, conduct unfinished business, new business, and adjourn.

The value of well-kept minutes of director and membership meetings is seldom recognized. Too often, only the decision is written down. The method of making the decision, the data considered, and the criteria used are seldom recorded. This information is not usually of immediate value. However, its value comes from its use as a reference when other decisions with similar characteristics are to be made.

Good minutes to director meetings can furnish an excellent training-aid for new directors. A review of minutes over previous years gives a new director insight into the thinking of previous directors as they made decisions.

Attendance at Membership Meetings

A farmer interested in maximizing profits should have information about the cost of goods and services provided by the cooperative so he can incorporate them in his business decisions. A chief source of member information is attendance of membership meetings.

The records of the case elevators studied showed an average attendance at annual meetings of 18 percent; the range being 9.8 percent to 42.7 percent. The percentage of the membership attending meetings tends to be relatively stable for any given association.

Getting farmers interested enough in their cooperative to attend membership meetings has always been a problem. This problem may be considered in relation to two questions:

1. Who is responsible for creating farmer interest in the cooperative?

2. What can be done to motivate farmers to attend meetings?

The responsibility for creating interest and the motive to attend meetings are interrelated factors which may be expressed finally in terms of profitability of farming. The farmer is concerned with the cost of marketing his wheat. Directors are interested as farmers and as paid representatives of farmers. The manager is interested in fulfilling the requirements of his duties as manager.

The interests of members, directors, and manager may all be served by increasing membership attendance at meetings. The chain of events which might be expected to result from increased membership attendance of meetings are: larger volume of business, reduced average costs, and increased returns to farmers.

Policy on Accounts Receivable

Most cooperatives in Oklahoma have, at some time, operated a good portion of their sideline sales on credit. There is no harm to be derived from credit itself; rather, it is the abuse of a sound credit policy which most often causes trouble. In a few cases studied, it was a complete lack of a credit policy which caused trouble.

There are various credit policies which are worthy of mention and should be considered. If the manager and the directors are poor bill collectors and recognize this characteristic in themselves, a cash policy will prove most satisfactory. If the manager is willing to do the work required to keep accounts receivable in good shape, the cooperative may find it advantageous to extend credit up to 30 days or possibly more in the period just prior to harvest season.

In the case of a cooperative which has a very small merchandising section, there may be a danger of extending credit, and, without realizing it, cause the merchandising section to be an economic liability. The amount of money may be relatively small compared to the total operation. However, compared to the small merchandising section, it may be large.

When any line of business has 5 percent or more of a year's volume in accounts receivable over 30 days or has bad debt write-offs above 3 percent, the credit policy should be reviewed by the directors with the idea of possible revisions.

A credit policy which works well for one cooperative may not work well for others. A cash basis is the only universally effective policy. In cases studied where cooperatives had changed from a 30-day credit policy to a cash policy, most managers reported a temporary loss of business, sometimes as much as a 20 percent reduction in sales. The effects were invariably short-lived and volume of business returned to about the same level as before the cash policy came into effect.

When a credit policy is being used, the cost of accounting and of money for financing the policy should be taken into consideration. The interest rate of money is its supply cost, and the member patron taking advantage of a credit policy is using money, the cost of which is equal to the market rate of interest. In this situation, the farmer should expect to pay a price for the use of credit equal to the cost of providing this credit. Therefore, accounts receivable will be paying their supply cost plus accounting cost.

Theoretically, the risk of loss from bad debts calculated from the association's bad debt statistics of previous years should also be included in the rate of interest charged on accounts receivable. If the credit policy is properly managed, this will amount to such a small amount that it can be neglected in practice.

Newsletters

The use of a cooperative newsletter or bulletin is one of the most inexpensive ways available for getting information to the cooperative members. Information on price policy, accounts receivable, lines of merchandise, financial condition, and items of general interest may be included in newsletters.

A farmer is better satisfied with the price he gets if he knows how that particular price is determined. For instance, an estimate must be made of the average cost of producing elevator services for the expected yield several days before harvest. If a draft of the price decision is mailed to each member, no question as to fairness of price need arise during the marketing season.

Product Differentiation

When a farmer becomes accustomed to services of a particular firm, he may continue to patronize that firm even at a small price disadvantage. The attachment of customers to a particular firm, even at an economic disadvantage, is characterized by product differentiation. The extent elevator services may be differentiated in the minds of farmers depends on the size of the production area, the number of firms operating in the area, and the density of production. The farmers evaluation of products received is a subjective one, not necessarily based on economic consideration. Such things as ownership of stock, treatment received from personnel, and patronage refunds are some of the most common differentiations in the minds of farmers.

Ownership of Stock.

Many farmers feel they should patronize a cooperative because they are stockholders. Being a stockholder is not a sufficient reason for patronizing a cooperative if higher returns can be realized by patronizing a private firm. The optimum decision must hinge on long-run considerations. A farmer should patronize the firm which, in the long run, nets him the highest returns for wheat after the cost of transportation.

In recent years the majority of capitol stock was issued as a result of patronage. When the net savings were allocated each year, those patrons who were not stockholders were given stock credits for their share of the patronage refunds. When the amount of stock credits equaled the value of a share of stock, the share was issued to the farmer patron. Thus, he became a stockholder. If the farmer's original decision to patronize the cooperative is consistent with the desire to maximize profits, ownership of stock is a good criteria for patronizing the cooperative.

Treatment Received from Elevator Personnel.

The treatment received by patrons and prospective patrons is very important as a means of product differentiation. The economic stimulus of price may have little effect in drawing customers away from a firm where they receive extremely good treatment. Many farmers will forego a cent or two, per bushel, of wheat if they are very friendly with the manager and employees of a particular firm.

Also, any slight evidence that a firm is unethical in business, giving poor weights, failing to grade wheat correctly, or pricing unfairly, may result in a great loss of business because of differentiated services. In this case, the farmers feel that the services are substandard. However, following a set price policy puts a cooperative at a disadvantage in fighting an active price war with a private firm. If the cooperative manager is to manipulate price to counter a competing private firm, he cannot at the same time justify a movement of 5-10 cents, per bushel, in price paid for wheat when the market price at all major markets has not changed appreciably.

Patronage Dividends.

Patronage dividends were discussed earlier relative to risk in operations. However, they must be mentioned here because farmers tend to consider patronage dividends more as a differentiated product than as actual price. The differentiation of services by farmers on the basis of patronage refunds is probably caused by a lack of understanding of monopoly profits.

If farmers patronize the cooperative which pays the largest cash dividend and disregard the cost of transportation, the case is one of differentiation only in the mind of the farmer. If the logic of the risk and patronage refund section of this chapter is followed, one can better understand the shortcomings of patronage dividends as a criteria for patronizing a certain cooperative.

Other Means of Product Differentiation.

Additional factors which may differentiate a particular firm in the minds of farmers are: better scales, landlord influence, other business at the same firm, desire to be regarded as a regular customer, and a feeling that the firm is the price setter.

The extent to which a firm has differentiated its goods and services in the minds of farmers determines the advantage which that firm has beyond its location advantage.

Pricing Non-Standard Commodities

When a farmer brings a load of below-standard wheat to the cooperative elevator, he expects to be able to sell it at some price. For example, a load of wheat that is 14.5 percent moisture is delivered to the cooperative. The manager refuses to bid on the load because he wishes to teach the farmer a lesson. The farmer may have two alternatives available. He may take the wheat home and dry it or take it to the nearest competing elevator and sell it at whatever price is offered.

The cooperative manager has the responsibility of providing a given quality and quantity of services at a minimum average cost. The cooperative manager should consider it his obligation to determine the cost of handling the wet wheat, the risks involved, and the market price for the wheat. The manager should then determine what price can be paid for the wheat and explain the method of price determination to the farmer. The farmer may still sell his wheat elsewhere, but he will feel better knowing that he has a market for his wheat in the cooperative.

It is desirable to notify farmers a week or so before harvest season what the schedule of dockage for weight and moisture will be. In addition, farmers should be informed as to the policy on price premiums for protein content and improved variety. This information can be distributed as part of the newsletter discussed earlier in this chapter.

Cooperative Terminals Selling Grain Oligopolistically

Each individual member of a cooperative is interested in the maximization of profits from his farming operation. Patronizing a cooperative which performs needed services at average cost is consistent with this profit maximization motive. Also, when wheat is transferred from ownership by the cooperative to ownership by private firms, it is consistent to obtain a total revenue as high as possible.

In this respect, the quantity of grain shipped to the terminal by its member cooperatives may be thought of as being fixed for any one period in time (1 year). This quantity of grain is to be sold for a maximum total revenue.

A unique problem exists in that the total cost figure for merchandising services would be adjusted by the payment of patronage refunds to local cooperative elevators. The local cooperatives, in turn, pay patronage refunds to the farmers who originally delivered the grain. The problem is to obtain the greatest total revenue possible from a given quantity of wheat.

In order to determine the maximum total revenue figure for the sale of a given quantity of wheat, the demand for wheat faced by the terminal elevator must be examined.

If, at the intersection of the demand and supply curves, the price elasticity of demand faced by the terminal were relatively elastic ($Ep > 1.0$), the maximum total revenue would be obtained by selling the entire quantity of wheat at a price corresponding to the intersection of the demand and supply curves, Figure 13.

The percent of the total supply of a particular type, quantity, and grade of wheat held by the cooperative terminal facility may be large. This situation would indicate that possibly the price elasticity of demand faced by the terminal might be less than unity. In that case, total revenue would be increased by raising the price and selling a smaller quantity of grain.

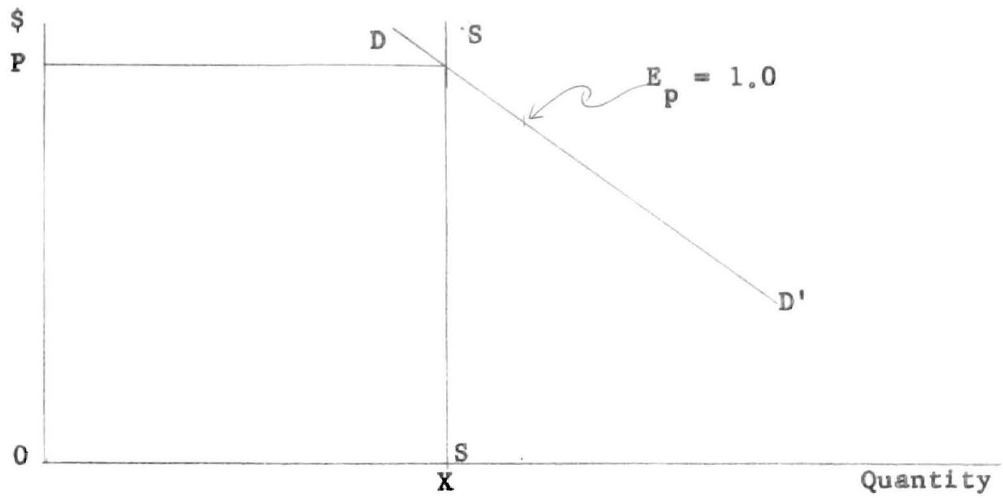

Figure 13. The Hypothetical Supply-Demand Situation Facing A Cooperative Terminal

Several factors exist which dictate the sale of the entire quantity of wheat held by the terminal. First, different types and grades of wheat are substitutes through certain ranges; thus, having the entire supply of one type and grade may have little influence on the price elasticity of demand faced by the holder of this wheat. Second, buyers of wheat from the terminal are not pure competitors. Consequently, they can effect price and quantity if they recognize their position in the industry, and if they have knowledge as to the supply situation of wheat. Third, the terminal would have a marginal cost of storage associated with the entire volume of wheat if a part of the total supply was withheld from the market. The wheat which was not sold must be stored. The cost of storage would have to be paid from the proceeds of the sales made.

A combination of the three above situations causes a terminal to face an elastic demand curve, ($E_p > 1.0$) if its volume is small relative to the total volume of wheat produced in the industry. It may be concluded that the optimum price and quantity for a cooperative terminal would be the entire quantity at the highest possible price.

Market Area Analysis for Multiple Cooperative Projects

When a cooperative enters a line of business in which transportation costs outweigh efficiencies of large-scale operations within the primary market area, scale of plant and price are determined by the management of a single cooperative.

In a line of business in which transportation costs outweigh economies of scale only in an area much larger than the primary market area, scale of plant and price decisions could not be made completely internal to one cooperative. In this case, a cooperative would find it advantageous to join with other similar cooperatives in the particular line of business. Thus, the decisions on size of market area must be made by the joint management of several existing associations.

An example of this situation might be the construction of a feed mill and the distribution of the feeds produced.

If the cooperatives involved in the joint endeavor recognize their relative bargaining positions, the market area would be organized in such a way that the proper scale of plant would be located where the cost of transportation plus the unit cost of production is a minimum. Also, all possible actions would be taken to block entry by competing firms, either cooperative or private.

Blocking entry is important because it is the only action which can prevent excess plant capacity. The reason for excess capacity may be developed in terms of location. If originally, the correct scale of plant is built and properly located, the market area is bordered by a line approximately one-half the distance between the plant and the nearest competing plants.

Excess capacity problems may develop because of entry by a greater than optimum number of firms or from the expansion and modernization of a previously optimum size and number of plants. In the developmental stages of an industry, the entry of an unnecessarily large number of firms is likely to create excess capacity. In a fairly mature industry with increasing technology, excess capacity is likely to develop because of the expansion and modernization of existing facilities.

In either case, a firm with a correct scale of plant for a given area would lose customers when another plant, causes the cost of product plus transportation to be lower for some customers in the market area. These customers would have an alternative source of supply and would attach themselves to the source which offers the lower cost product, if the two products are homogeneous. When the firm with the proper scale of plant faces a reduced demand situation, the plant cannot be operated at the proper level. An increase in average cost of production would cause further loss of customers who then have alternative sources of supply.

The loss of demand would be the loss of marginal customers or the loss of marginal cooperative outlets because of better alternative sources of supply.

The loss of the individuals may be of little importance compared to the loss of a cooperative outlet. Unless the marginal cooperatives had extensive vested interest in the plant supplying them, they would be prone to purchase from the firm offering the product at the lowest price. This action would be consistent with maximization of profits by individual farmers.

An investigation of the relative bargaining position of the firms which cooperate in the building of the plant facility may disclose how entry into the market may be blocked or restricted.

A customer located near the center of a monopolized market would be more susceptible to monopolistic pricing than a customer on the fringe of the market. Small price increases would result in the loss of fringe customers because other firms offer alternative sources of supply. The centrally-located customers have no alternative source of supply. They are attached firmly to the monopolist.

If all firms and individuals recognize their relative bargaining positions, a solution of restricted entry necessarily results. The outlet firms and customers on the fringe of the market area have an advantageous bargaining position. They cannot purchase the product at a price below the cost of production. However, they are in a position to bargain for transportation rates below the actual cost of transportation. The central firms and customers are willing to pay the additional cost, since the loss of fringe firms and customers cause the plant facility to be operated at a less than optimum capacity and thus increase the average cost of production. This would be true, especially, if the plant facilities were relatively inflexible with regard to quantity of output. Also, alternative sources of supply to the centrally-located customers would be restricted by transportation costs. They would be willing to pay an average cost of transportation for the market.

The result of equalization of the cost of transportation would be a market with restricted entry. A new firm would locate where it would have a market compatable with its plant facility. The outlet firms and customers would be approximately the same distance from its plant facility as the customers of other plants. Thus, new plants would be constructed at locations which would provide sufficient demand. No excess plant capacity would result.

This solution would be adequate for a developing industry in the construction of original plant facilities. It does not represent a solution to excess capacity resulting from innovations.

To make the necessary adjustments for innovations, the size of market area must be increased, the number of firms decreased, and the number of outlet firms served by each plant facility increased. With recognized interdependence on the part of all factors in the industry, these adjustments would be made when the average cost of product could be reduced by making the adjustments. Included in the average cost of innovations would be such items as: unamortized plant facility and other fixed cost items associated with the old plant which would not be productive after the change was made. The analysis as to bargaining position of border firms, the charging of average transportation costs to all outlets, and the restriction of entry will be applicable.

Without recognized interdependence full advantage cannot be taken of production expansion innovations. Output would be restricted for plant facilities applying a new innovation.

Other plants in the industry would face insufficient market demand to properly utilize existing plants. The result would be excess capacity and higher average cost of product.

Multi-Location Problems

General Manager Control

The "multi-location cooperatives" present difficulties in general manager control. The simple fact that facilities are maintained at more than one geographic location presents a problem in communication and control.

The general records of the association should be maintained at the general manager's office. These records furnish a major source of information upon which to base decisions. Without easy access to them, the general manager is at a disadvantage when making decisions concerning general policy.

At some of the "multi-location cooperatives" no consideration was given to the differences in cost of merchandising at different locations. Price was determined by the general manager and the other stations were forced to price similarly. A more appropriate method would be separate cost estimates for each station and prices determined according to these estimates.

"Multi-Location Cooperatives" With No General Manager

Some advantages may be gained by not having a general manager. The loss from not having a general manager usually outweighs the advantages gained.

The troubles usually caused by having a general manager result from his attempt to aggregate the separate stations, loosing sight of their individual identity. Ordering of merchandise is done on an aggregate basis and in turn consigned to each station as the general manager decides. Differences in patrons at the various stations may result in over-stocking of items which will not sell. A good station manager may loose his incentive to produce if he cannot manage his inventories as he sees fit. Patrons at a location may blame the station manager for improper management of his stock of merchandise.

Other problems which may present difficulties are: Where is the dividing line between the general manager's jurisdiction and the station manager's jurisdiction? How restrictive can the general manager's policy limitations be on the station manager and still please the members of the cooperative?

There are numerous small items for which no one is responsible when there is no general manager. For example: advertising; visiting with farmers about insecticides, fertilizer, etc.; distributing farmer information; receiving records from all stations with the idea of consolidating purchases where possible; advising board of directors on matters pertaining to overall business; honoring farmers' complaints, especially those against specific station managers or employees; and attending numerous other business and social functions. These are functions requiring the attention of a general manager.

Business organization decisions are probably best made by the board of directors. The directors are in a position to weigh the advantages and disadvantages of having a general manager.

The importance of having complete understanding between the station managers, directors, and the general manager as to areas of responsibility cannot be overemphasized. When the general manager is also responsible for the management of one of the stations, this station should be the general offices of the association. If possible, it should be centrally located. Probably it is advantageous to have all the station managers as well as the general managers attend director meetings. If it is impossible for the station managers to attend director meetings, they should be furnished a copy of the minutes of the meetings as a reference.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The job of cooperative management is to facilitate the action of the cooperative association in providing member patrons the quantity and quality of goods and services desired at a price equal to the average cost of production.

A method of economic analysis for decision making by cooperative elevator associations was outlined. The two major components of the analysis used were derived demand and cost of production for elevator services. The derived demand was developed in terms of farmer response to cost of marketing differences between alternative elevators. The cost analysis included the determination of both long-run and short-run total, average, and marginal cost functions. The cost functions were derived from a system of synthetic cost budgets developed for elevator facilities with given physical specifications.

To examine the performance of the cooperative its actions were compared to those of a private firm facing an identical condition of derived demand and cost functions. The cooperative will build a larger scale of plant, handle more grain, have lower cost, and charge less for elevator services than the private firm.

A cooperative elevator facility is the optimum scale of plant for an area if its capacity is just large enough to handle a maximum crop. A hypothesis to this effect was tested. With the data used a maximum capacity facility was optimum if the loss and additional cost incurred was 4.8 percent of the value of the wheat in excess of the merchandising capacity for the smaller facility.

The price which a cooperative charges for elevator services is equal to the average cost of providing these services. Initially, the cooperative will charge each member patron a price which will exceed the actual production costs by a margin of safety. This margin is a form of premium to insure against the risks assumed in performing elevator services. At the end of the cooperative's accounting period, the amount by which the price charged exceeds the costs incurred is refunded to the member patrons on the basis of patronage.

The price to be charged for elevator services is a decision faced by the cooperative each harvest. An estimate of production in the market area is a necessary part of the price decision. This production estimate can be made by combining the estimates of the directors and others. As an elevator with a given scale of plant operates almost entirely on fixed cost, an estimate of cost per bushel can be determined by dividing the total fixed cost by the production estimate. This cost estimate plus a margin of safety is the price which farmers initially pay for elevator services. Viewed alternatively, this is the amount which is subtracted from the on-track bid, received by the cooperative, to determine the amount farmers will be paid for wheat.

For the cooperative elevator industry, spatial equilibrium criteria are satisfied when a number of cooperative firms is dispersed throughout the industry at locations where the change in transportation cost necessary to attract marginal units is equal to the reduction in the firm's average cost resulting from receiving the marginal unit. The existing institutions prevent the fulfillment of the equilibrium criteria. However, within the limits set by institutions, the industry does approach equilibrium.

Risk is an important consideration in cooperative business, both as an influence which makes necessary the payment of patronage refunds and in terms of responsibility bearing. The "safe margins" which must be charged because of risk bearing result in net savings at the end of an accounting period. The distribution of net savings is based on patronage so that each member patron receives his purchases of goods and services at cost.

Responsibility bearing, as related to risk in cooperatives, is more important in terms of increased production costs than of chance of losing initial investment from an incorrect scale-of-plant decision. An inefficiency in handling which causes the cost per bushel of performing elevator services to increase only slightly may cause farmers to incur expenses which exceed the original cost of the elevator several times during the life of the facility.

The delineation of areas of responsibility should be determined on the basis of timeliness of decision, cost of making the decision, adequacy of the information available, and the magnitude of the results attained if the manager makes the decision, if the board makes the decision, and if the membership makes the decision.

Product differentiation plays an important role in attracting farmers to a cooperative. The demand faced by two identical firms in identical market areas may differ if farmers distinguish between the goods and services of the two firms. Product differentiation may influence demand positively or negatively depending on whether the farmers feel that the goods and services are superior or substandard.

Terminal elevators operated by cooperatives do not control a portion of the total wheat production large enough to increase total revenue by withholding wheat from the market. Consequently, the proper terminal policy is to sell the entire supply of wheat at the most favorable price.

For lines of business in which transportation costs outweigh economies of scale only in an area larger than the primary market area, several cooperatives may jointly participate in the operation. In this case, decisions are made jointly by the participating cooperatives. Entry of other firms into this particular line of business is restricted by pricing transportation at average cost for the entire area.

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APPENDIXES

APPENDIX A

CONTRACTOR ESTIMATES OF COST OF CONSTRUCTION

Bin Space	Specifications	Cost
20,000 bu. elevator	3,000 bu. per hr. leg (10 h.p. mtr.) 9 in. distributor steel spouting 10 bu. automatic scale 3 h.p. overhead trucklift	$ 46,000
50,000 bu. elevator	6,000 bu. per hr. leg (40 h.p. mtr.) 9 in. distributor steel spouting 25 bu. automatic scale 5 h.p. overhead trucklift	65,000
100,000 bu. elevator	10,000 bu. per hr. leg (90 h.p. mtr.) 12 in. distributor steel spouting 25 bu. automatic scale 7-1/2 h.p. overhead trucklift	103,000
200,000 bu. elevator	20,000 bu. per hr. leg (90 h.p. mtr.) (2 dumps - 2 legs each) 12 in. distributor steel spouting 25 bu. automatic scale 10 h.p. overhead trucklift	158,000
300,000 bu. elevator	30,000 bu. per hr. leg (90 h.p. mtrs.) (3 dumps - 2 legs each) 12 in. distributor steel spouting 25 bu. automatic scale 10 h.p. overhead trucklift	212,000

APPENDIX B

LEAST SQUARES COMPUTATION FOR TOTAL COST FUNCTION, $Y = a + bX$

Basic Data

X (Merchandising Capacity)		Y (Total Cost)	
	90,000		14,927
	225,000		19,371
	450,000		28,262
	900,000		35,414
	1,350,000		42,928
ΣX	3,015,000	ΣY	140,902
$\overline{X}$	603,000	$\overline{Y}$	28,180
ΣX^2	2,893,725,000,000	ΣY^2	4,493,582,400
$\frac{(\Sigma X)^2}{N}$	1,818,045,000,000	$\frac{(\Sigma Y)^2}{N}$	3,970,562,000
Σx^2	1,075,680,000,000	(Cor.) Σy^2	523,020,400
ΣXY	108,243,450,000		
$\frac{(\Sigma X \Sigma Y)}{N}$	84,962,700,000		
Σxy	23,280,750,000		

Regression Equation

$b = \Sigma xy \ / \ \Sigma x^2$ .02164282

$a = \overline{Y} - b\overline{X}$ 15129.37954

$\hat{Y} = a + bX$ 15129.37954 + .02164282X

Correlation Coefficient

$SSR = b(\Sigma xy)$ 50386108.1715

$R^2 = SSR \ / \ \Sigma y^2$ .09633679

Unexplained Variation

$SSE = Sy^2 - SSR$ 472634291.8285

$S^2 = SSE \ / \ N - 2$ 157544763.9428

Standard Errors of b & t Value

$S_b = S^2 \ / \ \Sigma x^2$ .012102092

$t = b \ / \ S_b$ 1.78835362

APPENDIX C

LEAST SQUARES COMPUTATION FOR TOTAL COST FUNCTION, $Y = a + b_1 X + b_2X^2$

Basic Data

X_1(Merchandising Capacity)		$X^2 (X_2)$		Y(Total Cost)	
	(1,000)		(1,000,000)		
	90		8,100		14,927
	225		50,625		19,371
	450		202,500		28,262
	900		810,000		35,414
	1,350		1,822,500		42,928
Total	3,015		2,893,725		140,902
Mean	603		578,745		28,180
ΣX^2	2,893,725	ΣX_2^2	4,021,241,000,625	ΣY^2	4,493,582,400
$\frac{(\Sigma X)^2}{N}$	1,818,045	$\frac{(\Sigma X_2)^2}{N}$	1,674,728,875,125	$\frac{(\Sigma Y)^2}{N}$	3,970,562,000
Σx^2	1,075,680	Σx_2^2	2,346,512,125,500	Σy^2	523,020,400

Regression Equation

$\hat{Y} = a + b_1X_1 + b_2X_2^2$ $\quad$ $12{,}001.5959 + .0372223X - .0000000108X^2$

Correlation Coefficient

$R^2 = SSR / \Sigma y^2$ $\quad$ .990191

Unexplained Variation

$SSE = \Sigma y^2 - SSR$ $\quad$ 5,130,225.51

$S^2 = SSE / N - 2$ $\quad$ 2,565,112.76

Standard Errors of b & t Value

S^2b_2 = .0000214376	Sb_2 = .0046300780	$t\ b_2$ = -2.338628
S^2b_1 = 46.7645013800	Sb_1 = 6.8384575300	$t\ b_1$ = 5.443090

APPENDIX D

LEAST SQUARES COMPUTATION FOR TOTAL COST FUNCTION, $Y = aX^b$

Basic Data

Log X		Log Y	
	4.95424		4.17406
	5.35218		4.28713
	5.65321		4.45117
	5.95424		4.54913
	6.13033		4.63276
ΣX	28.04420	ΣY	22.09425
$\overline{X}$	5.60884	$\overline{Y}$	4.41885
ΣX^2	158.1830279206	ΣY^2	97.7722238639
$(\Sigma X)^2/N$	157.2954307280	$(\Sigma Y)^2/N$	97.6311766125
Σx^2	.8875971926	Σy^2	.1410472514
ΣXY	124.2751446355		
$(\Sigma X \Sigma Y)/N$	123.9231131100		
Σxy	.3520314655		

Regression Equation

$b = \Sigma xy / \Sigma x^2$	.39661174
$a = \overline{Y} - b\,\overline{X}$	2.19431821
$\hat{Y} = aX^b$	$2.19431821X^{.39661174}$

Correlation Coefficient

$SSR = b(\Sigma xy)$	.13960199
$R^2 = SSR / \Sigma y^2$	.98975335

Unexplained Variation

$SSE = \Sigma y^2 - SSR$	.0014452614
$S^2 = SSE / N - 2$	.003481754

Standard Errors of b & t Value

$S_b = S^2 / \Sigma x^2$	.023297252
$t = b / S_b$	17.023970900

APPENDIX E

THE EVALUATION OF THE LONG-RUN AVERAGE COST FUNCTION FOR VARIOUS QUANTITIES OF WHEAT

Quantity	$\frac{12,000}{x}$	+.03722	-.0000000108x	Average Cost
90,000 (bu.)	$ .13333	$ .03722	$ -.00097	$ .16958
100,000	.12000	.03722	-.00108	.15614
125,000	.09600	.03722	-.00135	.13187
150,000	.08000	.03722	-.00162	.11560
175,000	.06857	.03722	-.00189	.10390
200,000	.06000	.03722	-.00216	.09506
250,000	.04800	.03722	-.00270	.08252
300,000	.04000	.03722	-.00324	.07398
350,000	.03429	.03722	-.00378	.06773
400,000	.03000	.03722	-.00432	.06290
450,000	.02666	.03722	-.00486	.05902
500,000	.02400	.03722	-.00540	.05582
600,000	.02000	.03722	-.00648	.05074
700,000	.01714	.03722	-.00756	.04680
800,000	.01500	.03722	-.00864	.04358
900,000	.01333	.03722	-.00972	.04083
1,000,000	.01200	.03722	-.01080	.03842
1,200,000	.01000	.03722	-.01296	.03426
1,400,000	.00857	.03722	-.01512	.03067

APPENDIX F

THE EVALUATION OF THE LONG-RUN MARGINAL COST FUNCTION FOR VARIOUS QUANTITIES OF WHEAT

Quantity	.03722	-.0000000216x	Marginal Cost
90,000	.03722	.00194	.03528
100,000	.03722	.00216	.03506
125,000	.03722	.00270	.03452
150,000	.03722	.00324	.03398
175,000	.03722	.00378	.03344
200,000	.03722	.00432	.03290
250,000	.03722	.00540	.03182
300,000	.03722	.00648	.03074
350,000	.03722	.00756	.02966
400,000	.03722	.00864	.02858
450,000	.03722	.00972	.02750
500,000	.03722	.01080	.02642
600,000	.03722	.01296	.02426
700,000	.03722	.01512	.02210
800,000	.03722	.01728	.01994
900,000	.03722	.01944	.01778
1,000,000	.03722	.02160	.01558
1,200,000	.03722	.02592	.01130
1,400,000	.03722	.03024	.00698

APPENDIX G

THE EVALUATION OF SHORT-RUN AVERAGE COST FOR VARIOUS SCALES OF PLANT FROM 0 TO 1,113,000 BUSHELS

Quantity Bushels	Short-Run Average Cost Dollars	Short-Run Marginal Cost Dollars
SAC_1 = $15,000/Q, limit 82,800 bushels		
20,000	.75	0
40,000	.375	0
60,000	.25	0
80,000	.188	0
82,800	.181	.036
SAC_2 = $17,200/Q, limit 147,200 bushels		
75,000	.229	0
80,000	.215	0
100,000	.172	0
120,000	.143	0
140,000	.123	0
147,200	.117	.034
SAC_3 = $20,000/Q, limit 230,000 bushels		
100,000	.200	0
120,000	.167	0
140,000	.143	0
160,000	.125	0
180,000	.111	0
200,000	.100	0
220,000	.091	0
230,000	.087	.033
SAC_4 = $23,100/Q, limit 331,200 bushels		
125,000	.185	0
140,000	.165	0
160,000	.144	0
180,000	.128	0
200,000	.115	0
220,000	.105	0
240,000	.096	0
260,000	.089	0
280,000	.083	0
300,000	.077	0
320,000	.072	0
331,200	.070	.030

Appendix G (Continued)

Quantity Bushels	Short-Run Average Cost Dollars	Short-Run Marginal Cost Dollars
SAC_5 = \$26,600/Q, limit 450,800 bushels		
160,000	.166	0
180,000	.148	0
200,000	.133	0
220,000	.121	0
240,000	.111	0
260,000	.102	0
280,000	.095	0
300,000	.089	0
320,000	.083	0
340,000	.078	0
360,000	.074	0
380,000	.070	0
400,000	.067	0
420,000	.063	0
440,000	.060	0
450,800	.059	.028
SAC_6 = \$30,200/Q, limit 588,800 bushels		
200,000	.151	0
220,000	.137	0
240,000	.126	0
260,000	.116	0
280,000	.108	0
300,000	.101	0
320,000	.094	0
340,000	.089	0
360,000	.084	0
380,000	.079	0
400,000	.075	0
420,000	.072	0
440,000	.069	0
460,000	.066	0
480,000	.063	0
500,000	.060	0
520,000	.058	0
540,000	.056	0
560,000	.054	0
580,000	.052	0
588,800	.051	.025

Appendix G (Continued)

Quantity Bushels	Short-Run Average Cost Dollars	Short-Run Marginal Cost Dollars
SAC_7 = \$33,700/Q, limit 745,200 bushels		
240,000	.140	0
260,000	.130	0
280,000	.120	0
300,000	.112	0
320,000	.105	0
340,000	.099	0
360,000	.094	0
380,000	.089	0
400,000	.084	0
420,000	.080	0
440,000	.076	0
460,000	.073	0
480,000	.070	0
500,000	.067	0
520,000	.065	0
540,000	.062	0
560,000	.060	0
580,000	.058	0
600,000	.056	0
620,000	.054	0
640,000	.053	0
660,000	.051	0
680,000	.050	0
700,000	.048	0
720,000	.047	0
740,000	.046	0
745,200	.045	.021
SAC_8 = \$37,100/Q, limit 920,000 bushels		
300,000	.124	0
340,000	.116	0
380,000	.098	0
420,000	.089	0
460,000	.081	0
500,000	.074	0
540,000	.069	0
580,000	.064	0
620,000	.060	0
660,000	.056	0
700,000	.053	0
740,000	.050	0
780,000	.048	0
820,000	.045	0
860,000	.043	0

Appendix G (Continued)

Quantity Bushels	Short-Run Average Cost Dollars	Short-Run Marginal Cost Dollars
SAC_8 = \$37,100/Q, limit 920,000 bushels		
900,000	.041	0
920,000	.040	.018
SAC_9 = \$40,000/Q, limit 1,113,000 bushels		
400,000	.10	0
440,000	.091	0
480,000	.083	0
520,000	.077	0
560,000	.071	0
600,000	.067	0
640,000	.063	0
680,000	.059	0
720,000	.056	0
760,000	.053	0
800,000	.050	0
840,000	.048	0
880,000	.045	0
920,000	.043	0
960,000	.042	0
1,000,000	.040	0
1,040,000	.038	0
1,080,000	.037	0
1,113,000	.036	.014

APPENDIX H

TOTAL COST - TOTAL REVENUE COMPARISONS FOR PRIVATE FIRM PROFIT MAXIMIZATION SCALE OF PLANT

Quantity Bushels	Total Cost Dollars	Total Revenue Dollars	Profit Dollars
82,800	15,000	14,900	- 100
147,200	17,200	25,000	7,800
230,000	20,000	36,800	16,800
331,200	23,100	46,400	21,300
450,800	26,600	54,100	27,500
588,800	30,200	58,900	28,700
745,200	33,700	59,600	25,900
920,000	37,100	55,200	18,100
1,113,200	40,000	33,400	- 6,600
1,325,000	42,400	13,300	- 29,100

VITA

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Candidate for the Degree of

Doctor of Philosophy

Thesis: A METHOD OF ECONOMIC ANALYSIS FOR DECISION MAKING BY COOPERATIVE ELEVATOR ASSOCIATIONS

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THESIS TITLE: A METHOD OF ECONOMIC ANALYSIS FOR DECISION MAKING BY COOPERATIVE ELEVATOR ASSOCIATIONS

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