



Cost-volume relationships in locally owned Montana cooperative elevators
by Edward L Hanson

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree
of Master of Science in Agricultural Economics
Montana State University
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Abstract:

The purpose of this study is to analyze the economic efficiency of resource used in Montana cooperative grain elevators. This study shows the cost-Volume relations in country elevators in this state. The study supplies information to elevator managers regarding costs of operation and suggestions for increasing efficiency and net gains.

Part I introduces the problem and objectives of the research. It also indicates the area and limitations of the study and the hypothesis formulated from the objectives.

Part II contains the analysis of the data and the relationship of volume upon costs of operation and margins. The influence of sideline operations upon elevator operation is analyzed and discussed. It was found that as volume of grain handled was increased the average cost per bushel decreased. Also significant is the fact that as receipts of an elevator increase gross margins may be lower since costs of operation are lower with higher volumes.

Part III discusses the implications of the data presented in Part II relative to other elevators, new elevators, and in relationship with other areas. Recommendations for increased savings are made in this section along with some theoretical modifications.

COST-VOLUME RELATIONSHIPS
IN
LOCALLY OWNED MONTANA COOPERATIVE ELEVATORS

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EDWARD L. HANSON

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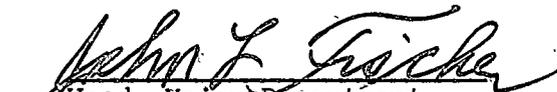
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Any errors or omissions in this study are the responsibility of the author.

ABSTRACT

The purpose of this study is to analyze the economic efficiency of resource use in Montana cooperative grain elevators. This study shows the cost-volume relations in country elevators in this state. The study supplies information to elevator managers regarding costs of operation and suggestions for increasing efficiency and net gains.

Part I introduces the problem and objectives of the research. It also indicates the area and limitations of the study and the hypothesis formulated from the objectives.

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PART I

INTRODUCTION

Problem Situation

Many changes have occurred in the techniques of producing and marketing grain during recent years. These changes have been particularly pronounced for wheat which is the principal agricultural commodity in Montana.

Technological changes developed during recent years have had a tremendous effect on our grain marketing structure. A change of major importance is the reduction in the length of time required to harvest and to deliver the grain to country elevators. The introduction of self-propelled combines and the increased use of trucks which take the grain directly from the combines to the elevators has speeded the flow of grain into marketing channels. The increased use of migratory harvesting crews who furnish all of the necessary machinery and equipment has further decreased the amount of time necessary for harvesting with the result that grain elevators are now required to handle more grain in a much shorter period of time.

Harvest time congestion at country grain elevators is a common problem in Montana. As a result, grain elevators have had to expand in size and increase handling efficiency.

Studies were made by the Farmer Cooperative Service in which costs for farm and elevator storage were examined in Oklahoma, North Dakota, and Indiana. Elevator storage was found to be less expensive than farm storage and more convenient from the marketing standpoint since grain could

be sold and delivered any day the farmer should choose, regardless of weather conditions and with less labor effort.^{1/}

Government grain programs have increased the farmer's need for additional storage capacity. Larger storage facilities are also needed to enable farmers to store large crops until a short crop year when they can take advantage of the income tax structure.^{2/} By storing grain from one year to the next, the farmer is able to spread his tax liability over a period of two years. Montana elevator managers are also interested in additional storage capacity enabling them to take advantage of the government storage programs. In recent years, commercial firms have been induced to build new and larger storage facilities. Easy money policy, guaranteed occupancy, and rapid depreciation write-off have been particularly influential.^{3/}

The trend toward larger storage capacity has been pronounced. In Montana, 95 percent of the licensed commercial elevators had a capacity of less than 50,000 bushels in 1930, and only five percent had a capacity of more than 50,000 bushels (see Figure 1). In 1954, 42 percent of Montana's licensed elevators had a capacity of less than 50,000 bushels, and 58 percent had a 50,000 bushel capacity or more. The average size of

^{1/} Thomas E. Hall, Changing Grain Storage Costs, Farm vs. Elevator, Farm Credit Administration Circular C-151, United States Department of Agriculture, Washington, D. C., 1953.

^{2/} Layton Thompson, Chairman, Subcommittee on Grain Storage, Great Plains Council, Economic Aspects of Grain Storage in the Northern Great Plains, Montana Agricultural Experiment Station, Bulletin 523, Bozeman, Montana, August 1956; p. 12.

^{3/} Ibid., p. 12.

commercial storage facilities in Montana increased from 34,000 bushels in 1930 to 80,000 bushels in 1954.^{1/} Many Montana elevator managers and their boards of directors are considering additional storage capacity, ranging from 50,000 to 100,000 bushels.

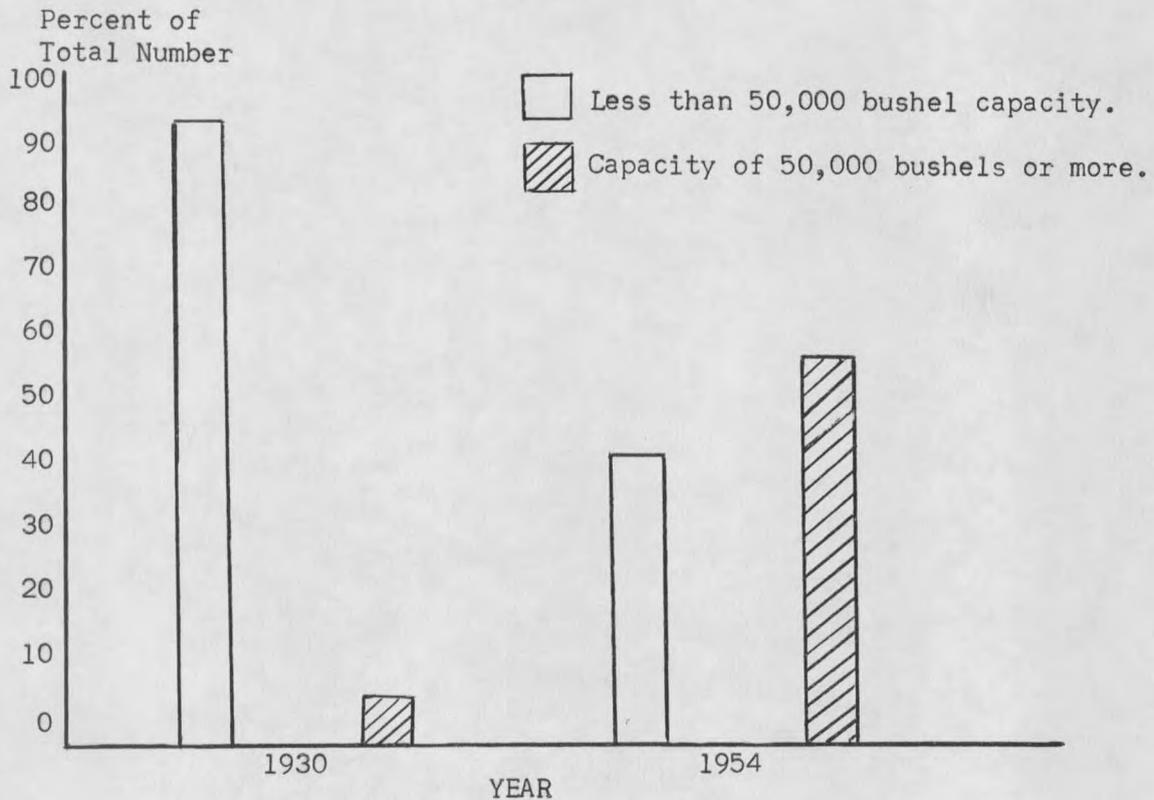


Figure 1. Growth in Capacity of Montana Grain Elevators, 1930-1954.

The trend for larger storage capacity has been important because the larger the capacity of the grain elevator the larger the volume of grain it can handle. By increasing the volume of grain, an elevator can take advantage of certain efficiencies of operation which will reduce costs.

^{1/} Ibid., p. 26.

Some important items which increase efficiency are larger legs, bigger grain dump pits, and automatic equipment which is practical with large volumes.

Cooperative as well as independent elevator managers must select the combination of grain merchandizing activities, sideline operations and storage services that will be most profitable. Efficient use of labor is also an important factor which must be considered in the expansion of any business.

Operational efficiency may be increased by diversification within the grain elevator operation. Size of elevator will be important in regard to sideline operations, costs, and savings.

Most Montana elevators transact sideline operations in addition to their grain merchandizing and grain storage function. These sidelines usually consist of sales of feed, petroleum products and miscellaneous farm supplies. The introduction of sideline sales may reduce the variability in total income to elevators. Large cooperative sales organizations and farm supply dealers are interested in expanding sideline sales in grain elevators since sales to elevators provide additional outlets for them.

Research Problem

Elevator managers in Montana need information that will enable them to appraise the influence of plant size and the volume of sideline activities on the cost of operating country elevators. The economic problem

of Montana cooperative grain elevators can thus be stated in terms of economic efficiency criteria.

The efficiency of country elevators in performing the services of assembly, storage, conditioning, shipping, reflecting supply-demand relationships and to a limited extent price discovery has a direct impact on the returns to producers.

The problem this study is concerned with is the economic efficiency of resource use in Montana cooperative grain elevators. Local cooperatives include 12 percent of the elevators in Montana. There are a total of 400 country elevators in the state. Inferences drawn from a study of cooperatives may relate to all country elevators in the state.

Cooperative grain elevators are owned by the farmers. The farmer owners elect a board of directors who in turn hire a manager to operate their business. The farmer member who delivers his grain to the cooperative shares in the profits or net margins in accordance with the amount of grain he delivers to the elevator. This share is returned to the farmer in the form of patronage refunds. It is important that the members elect qualified men with good business backgrounds to their boards of directors and demand that the boards hire qualified individuals to manage their elevators. Therefore the distinguishing feature of cooperatives is that the farmers own the cooperative elevator and share the net gain.

Objectives of the Study

1. To study facilities, operational techniques, services and costs of independent cooperatives in Montana.

2. To make an economic analysis of relationships between costs and facilities, operational techniques and services.
3. To determine possible ways of increasing operational efficiency of grain elevators.

Hypothesis

Country elevator operating costs are directly related to plant size, volume of sideline operations, and volume of grain moving through the elevator into marketing channels.

Area and Limitations of the Study

The area under consideration is the entire State of Montana. Data were obtained from elevators located primarily in the northern and eastern portions of the state. These areas are the major wheat producing regions in Montana and are primarily dryland farming areas.

It becomes necessary to point out several limitations when working with a broad study of this nature: (1) the time available for the research; (2) the inaccuracies of personal estimates; (3) practically no previous research on cost-volume studies of grain elevators in Montana; and (4) allocation of costs to the various activities may be difficult since existing facilities and available labor may be used to operate sideline activities.^{1/}

^{1/} The term "existing facilities" in this study means the space and equipment which is in existence and was not specifically installed to handle sidelines.

Procedure

This study is concerned with cooperative grain elevators. Data were available from schedules taken from the Farmer Cooperative Service, United States Department of Agriculture.

Managers of all independent (local board of directors) cooperative grain elevators in Montana were contacted by personal interview during the summer of 1957. Data were obtained for their 1956-1957 fiscal year regarding costs of operation, volume of grain handled, type of facility, services performed and volume of sideline operations.

Fifteen of the 48 elevators contacted were selected and data used in making the cost analysis in Part II. The 15 were selected because the schedules for them contained complete financial statements. The financial statements were analyzed to determine the relationships between cost for handling grain receipts and cost for sideline operations and their effect upon type of facility, operational techniques and data other than specific costs were obtained from the schedules for the total of 48 elevators.

Margins gained on both the grain operation and sideline operations were computed and related to size of elevator, volume of grain receipts, and sideline operations.

Implications are made regarding the usefulness of the observations to new elevators, to elevators other than cooperatives, and to elevators in other areas of the United States. Some implications of the significance of sidelines along with the grain merchandizing and storage functions of grain elevators is presented.

Average costs of handling grain receipts were calculated and divided into three categories: (1) labor, (2) depreciation expense, and (3) operating expenses. The combination of these costs is the total cost of handling grain receipts. Cost curves are drawn approximating the average cost for labor, depreciation, operation expenses and total average costs.

Costs are related to the gross and net margins of the firms. These firms are classified into the following capacity sizes: under 100,000 bushels; 100,000 to 200,000 bushels; 200,000 to 300,000 bushels and those over 300,000 bushels.

Theoretical Considerations

Assumptions necessary to the theoretical considerations are a single firm takes such a small proportion of the total amount of any resource that it cannot influence resource price; firms can get all they want of any one resource at a constant price.

Costs can be divided into short-run and long-run costs. The short-run is a time period so short that the firm is unable to vary the quantities of some resources used. The short-run is then any time period between that in which no resources can be varied in quantity and that in which all resources but one are variable.^{1/}

In the short-run costs can be divided into fixed costs and variable costs. Fixed costs are those costs or expenses which must be met regardless of volume turnover or whether any business is conducted. Some fixed costs to grain elevators are the costs of depreciation, interest, director's

^{1/} Richard H. Leftwich, The Price System and Resource Allocation, Rinehart and Company Inc., New York, 1955, p. 135.

fees, lease and rent expense, scale inspection and managers salaries. Salaries for other employees can be considered partially variable because an employee can be discharged if necessary to cut expenses when business declines. However, most elevators require at least one additional man besides the manager throughout the year.

Variable costs are those costs incurred for variable resources which fluctuate in relationship to the volume of business. Some of the variable costs incurred by grain elevators are part-time labor expense, heat, power, repair costs, telephone and telegraph expense above the monthly minimum rate, truck expenses, donations, operating supplies and travel expenses. Variable costs increase as the firm's volume increases because larger volumes require larger quantities of the variable resources.

Each elevator has a physical maximum capacity, and it would be difficult to handle additional grain above this maximum. At this point the variable cost curve would rise sharply. Factors which govern maximum capacity are actual elevator capacity, size of legs, size and number of dump pits, capacity of load-out scale, availability of railroad cars and trucks to transport grain to market and terminal storage, availability of terminal storage and amount of elevator space occupied by stored grain.

The long-run would be a period of time long enough for the firm to be able to vary the quantities of all resources used. There are no fixed costs -- all costs are variable. The long-run for grain elevators would probably be a year or more as it takes time to increase the capacity by

building a new main house or an annex. Management is another factor which is not readily variable.

Figure 2 shows a long run average cost curve formed by a series of short-run average cost curves along which the firm can move over a length of time. The long-run average cost curve shows the least possible cost per unit of producing various outputs when the firm has time to build any desired scale of plant. The short-run average costs curves represent various scales of plants to which the firm can move over the long-run. The long-run average cost curve is called an envelope curve.^{1/}

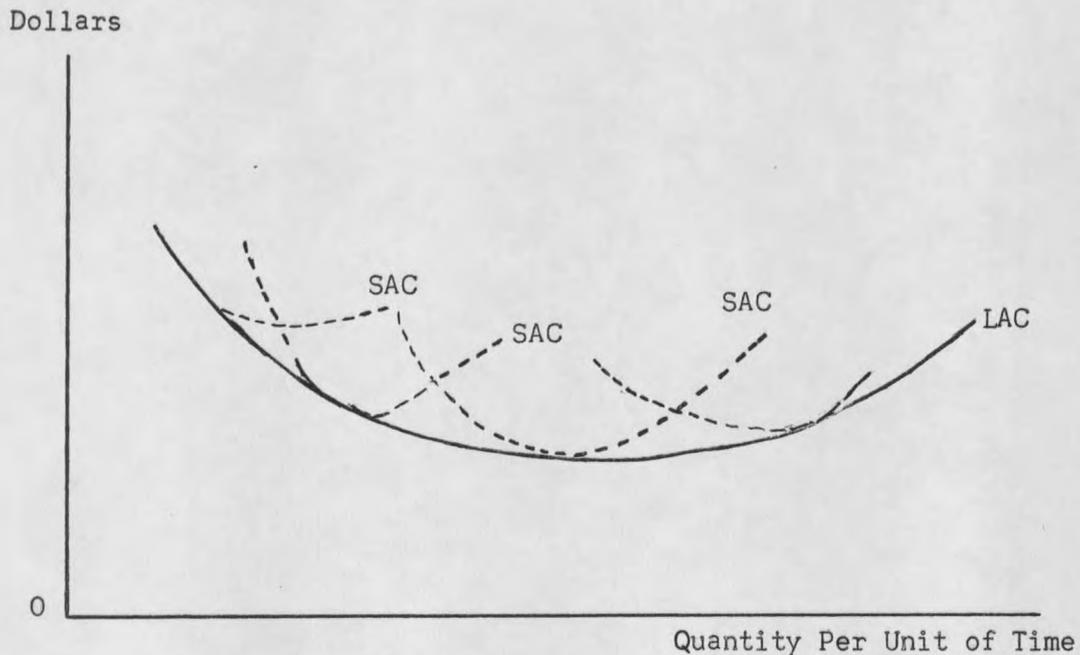


Figure 2. The Formation of a Long-run Average Cost Curve From a Series of Short-run Average Cost Curves.

^{1/} Ibid., p. 150.

The long-run average cost curve is usually thought to be U-shaped. In the long-run, increases in output are achieved by construction of larger scales of plants. If the long-run average cost curve decreases as output increases, it means that successively larger scales of plants are more efficient than the smaller ones. This is true until at a given scale of plant, costs are at a minimum. Beyond this minimum long-run average costs increase, meaning that successively larger scales of plants becomes less efficient.^{1/} This is referred to as the area of diseconomies of scale and results from difficulties of coordination and control which reduces the efficiency per dollar outlay on management as the scale of plants is increased, per unit costs of production will increase.^{2/}

When the scale of plants has become sufficiently large for diseconomies of scale to become apparent, the long-run average cost curve turns upward to the right. However, as the minimum cost point of a plant is reached a larger scale plant may be constructed through advanced technology and the area of diseconomies of scale may never be reached.

Part II describes various scales of size for Montana grain elevators. Long-run average cost curves (economies of scale curves) are used to represent the relationship between costs and size of operations.

^{1/} Ibid., p. 152.

^{2/} Ibid., p. 154.

PART II

THE ANALYSIS

Operational Techniques

Montana's grain market outlets divide the state into two areas. One area is the western part of the state where the majority of the grain is shipped to the West Coast; the other is eastern Montana with Minneapolis as its primary market.

Grain elevator managers in western Montana associated with the Grain Terminal Association sell in 500 bushel lots to the Association on the day of purchase. Those in eastern Montana attempt to sell primarily on a to-arrive basis through grain brokerage firms; although some may also sell in 500 bushel lots on the day of purchase to the Grain Terminal Association in Great Falls for movement to the West Coast markets. Those in eastern Montana also sell futures in order to hedge their purchases where those in western Montana sell only cash grain. Some of Montana's independent cooperatives market through grain brokerage firms which hold seats on the grain exchange. Others market through regional cooperatives which are also members of the grain exchange.

All Montana cooperatives provide storage services for their patron members. Through arrangements with grain brokerage firms and regional cooperatives, terminal storage facilities are available to the country elevators thus increasing their storage capacity.

In Montana, elevators must charge "four cents per bushel for all grains except flax for receiving, grading, weighing, elevating, and insuring 15 days or part thereof free storage and delivering to the owner. For flax, the charge is five cents per bushel."^{1/} Two cents per bushel is charged for cleaning grain at the request of the owner, in which case screenings are delivered to him. The legal charges for storage are 1/30 of one cent per day per bushel for storage after the period of free storage has elapsed.^{2/}

Most elevators do some processing, namely cleaning and treating grain for seed. Other processing, such as feed manufacturing, grinding, and mixing, is conducted by only a few organizations.

Insect infestation and quality deterioration from excessive moisture content is a minor problem in this state, since Montana has a dry climate. Most elevators are not equipped with dryers and therefore the managers refuse to accept grain with a high moisture content for storage. Elevator managers fumigate about once a year at a time when their bins are empty.

The size of the trade area for Montana grain elevators is dependent upon geographical features; such as rivers, mountains and towns. The size of the trade area varies from a radius of two to three miles to 100 miles. The average radius of the trade area is 19 miles.

^{1/} Department of Agriculture, Labor, and Industry, Grain Standards and Marketing Laws of the State of Montana, Revised 1950, Helena, Montana, p. 8.

^{2/} Layton Thompson, op.cit., p. 29.

Three of the 48 elevators visited had branch houses. Two of the cooperatives utilized their branches to a large extent but the third filled the branch house at harvest with long term storage grain. Since the branch house in the latter case is only four miles away, an addition to the main elevator would be more efficient.

During the fiscal year 1956-1957 most of the elevators reported increased volume which was attributed to the redemption of Commodity Credit Corporation loans on wheat. Some elevators experienced decreased volume because of extremely dry weather.

Most of the elevators studied had automatic load-out scales. The majority of these were of 10 bushel capacity. However, some still have hopper scales which are not as efficient as the automatic scale.

The average receiving capacity for the elevators surveyed was 2,955 bushels per hour. The average loading out capacity was 2,563 bushels per hour. The receiving capacity of an elevator is governed by the size of the dump pit and capacity of the legs which carry the grain from the dump pit to the bins. The loading out capacity is governed again by the leg capacity but more important by the loading out scale. The larger the loading out scale the faster the grain can be loaded for shipment. An automatic load out scale allows for speedier loading.

There was a small amount of flat grain storage in use. Where flat storage was used, it contained long term storage grain such as the stored under government programs. One elevator had a considerable amount of flat storage and as a result had high handling costs per bushel.

Cost-volume Relationships

The percent of income received from the grain operation for each elevator, was determined by dividing gross income for the grain operation (margins from grain sales, storage income and other income related to the grain operation as distinguished from sideline operations) by the total gross income of the elevator. The grain operation and the sideline operation were charged with those expenses which could be directly assigned. The expenses which could not be specifically assigned to the grain operation were allocated according to the proportion of total income received from grain; the balance being allocated to sideline operations. The total expenses allocated to grain were then divided by bushel receipts yielding the average cost per bushel for handling total grain receipts for each elevator in the sample. The average costs for labor, depreciation and operating expenses were computed and allocated in an identical manner.

The allocation of costs between various functions presents many problems to the analyst. First is the problem of determining which costs can be charged directly to the various operations. Another is to determine how to allocate those costs which cannot be charged directly to the various operations.

In analyzing costs in this study, we should remember that the output of a given scale of plant is most efficient when the average cost is lowest.

Here the cost of the inputs of resources per unit of output of product is least.^{1/}

Figure 3 shows possible short-run cost situations (dotted lines) faced by elevators as they expand in the long-run (solid line). The exact shape of the short-run cost curves is unknown. Only that these curves are tangent to the long-run economies of scale curve at points A, B, C and D.

You will notice that the short-run curves are not tangent to the economies of scale curve at their low points. This is to indicate that a firm anticipating expansion does not theoretically operate at the point of minimum cost. They normally operate in the area of decreasing costs.

Point D on the long-run curve is the last point for which data were available to calculate and the shape of the curve beyond this point is unknown but is believed to be decreasing at a decreasing rate.

Figure 4 illustrates the relationship of bushel receipts or annual grain volume to grain expenses for the fiscal year 1956-1957. As grain volume increased average costs per bushel for handling grain tended to decrease. Contrary to the traditional approach of the gradual sloping, envelope shaped, long-run average cost curves described in Part I, costs drop sharply when volume is increased at the lower levels. When the higher volumes are reached costs decrease at a decreasing rate. Data were not available regarding costs beyond a volume of 2.25 million bushels but it is believed that costs continue to decrease at a decreasing rate

^{1/} Richard H. Leftwich, op.cit., p. 148.

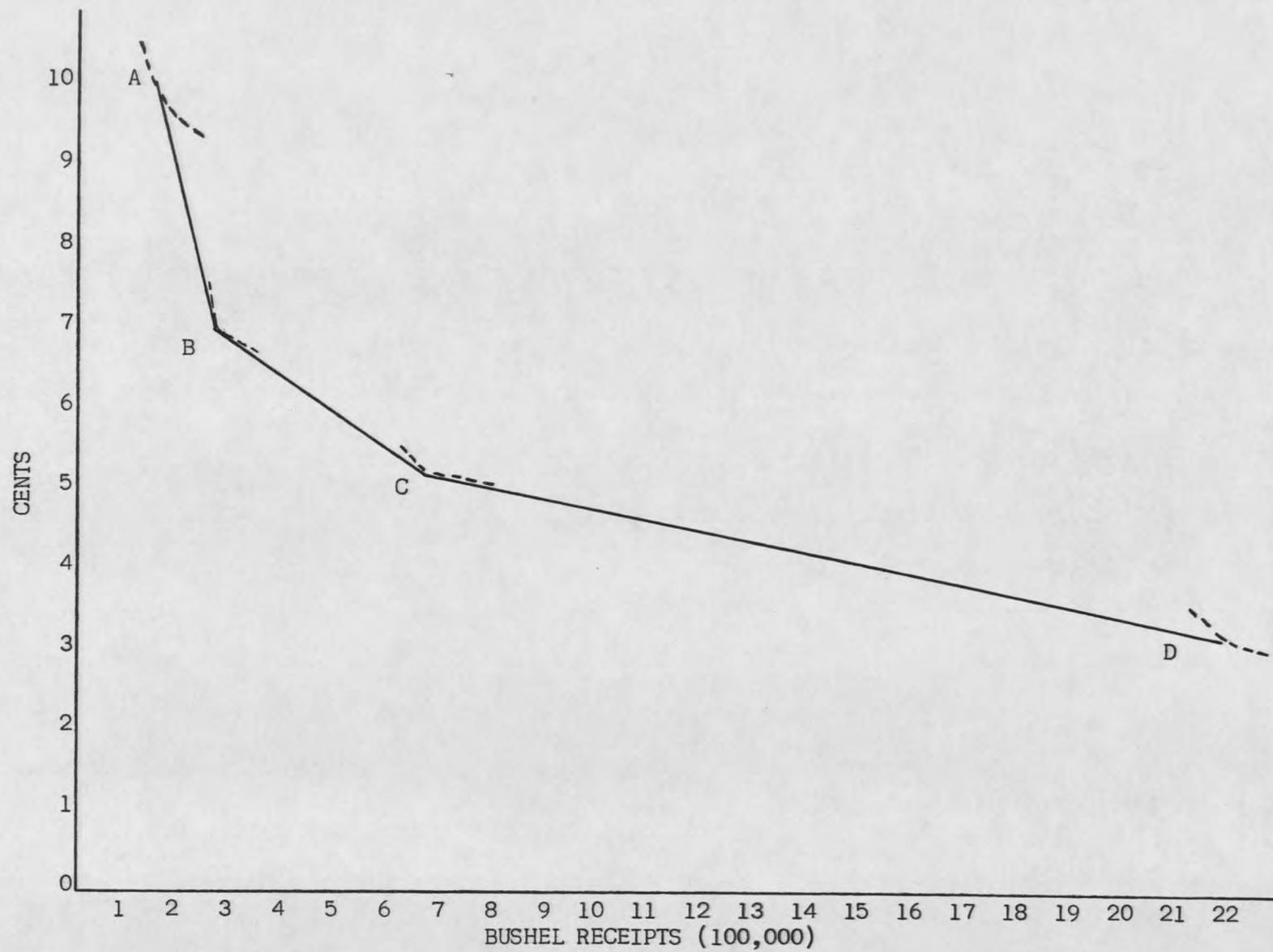


Figure 3. Derivation of Long-run Economies of Scale Curve From Short-run Cost Curves.

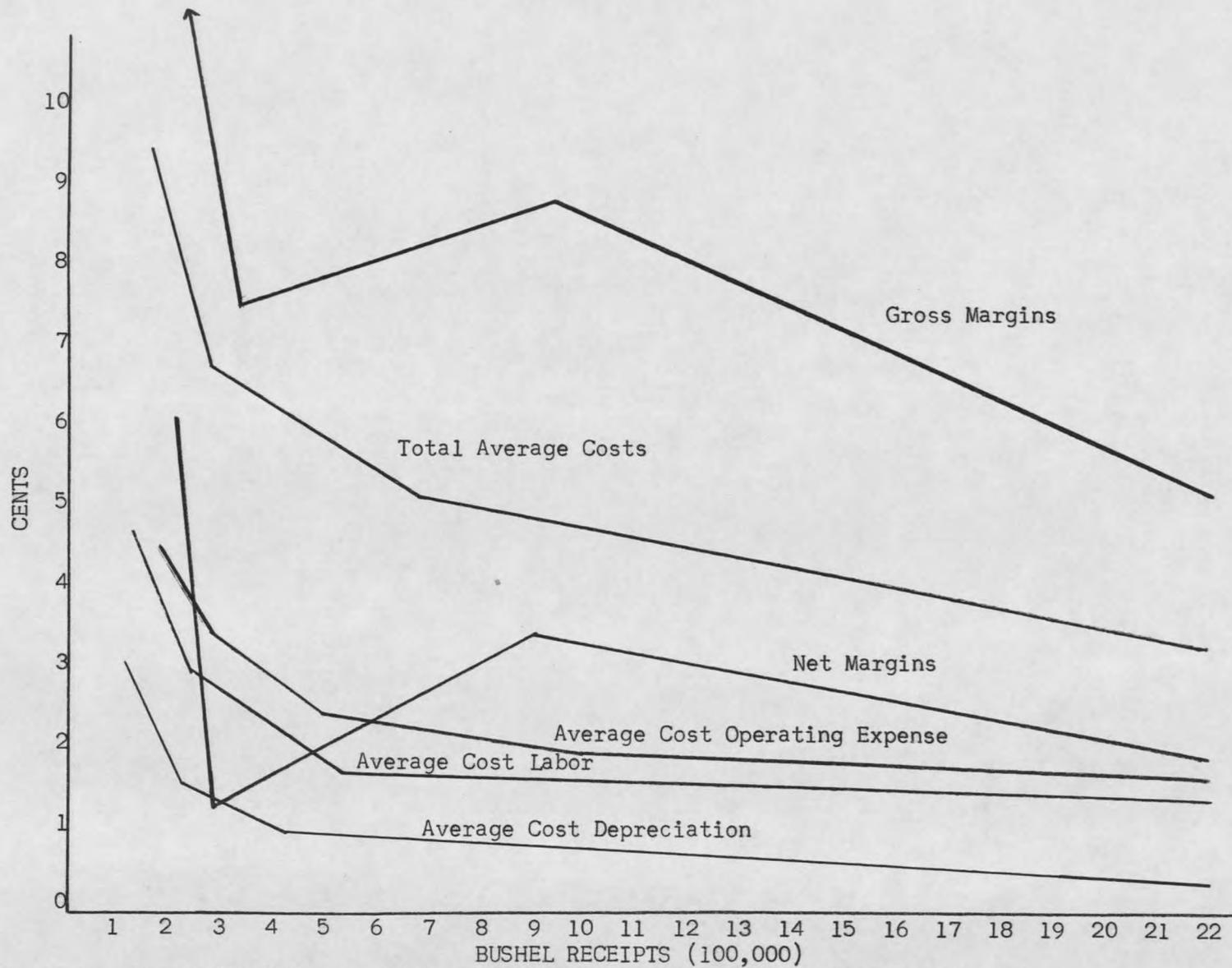


Figure 4. Operational Costs and Margins Per Bushel Received at Country Elevators.

until an unknown point of maximum efficiency is reached. Beyond this point is the area of decreasing returns to scale (increasing costs) according to the traditional approach. However, this area of decreasing returns to scale may never be reached, as increased technology may open new areas of economies of scale which are unknown at the present time. Total average costs decreased from 9.7 cents per bushel for elevators with an average volume of 190,000 bushels to 3.1 cents when volume exceeded two million bushels.

Figure 4, also depicts the relationship of gross and net margins to bushel receipts. Gross margins for the small volume elevators are high, for elevators with average receipts of 241,748 bushels the gross margin is 14.1 cents per bushel decreasing to 7.5 cents when the receipts reach 339,305 bushels. There is a slight increase to 8.9 cents when receipts are 926,765 bushels and a drop to 5.9 cents when receipts are 2,209,416 bushels.

Net margins follow a similar pattern as the gross margins with the low volume elevators having fairly high net margins. This is perhaps from taking too high a gross margin in the beginning. Net margins for an elevator having average receipts of 231,855 was 6.1 cents per bushel, decreasing to 3.7 cents when receipts increased to 298,188 bushels, and to 1.3 cents when receipts increased to 299,856 bushels. There was an increase in net margins to 3.6 cents when receipts increased to 926,165 bushels and to 2.0 cents when receipts were increased to 2,209,416 bushels.

Gross margins of necessity have to be high when an operator expects to have high operational costs. However, from the spread indicated above

it appears some managers are taking a higher gross margin than may be necessary. Net margins are the difference between gross margins less the operational costs. These are distributed to the patrons in the form of patronage dividends.

Figure 5 shows the average cost relationships by bushel capacities. For those elevators under 100,000 bushel capacity, total average costs were 7.60 cents per bushel received; for those with capacities from 100,000 to 200,000 bushels, total average costs were 7.02 cents; for the 200,000 to 300,000 bushel houses, total average costs were 5.80 cents; and for those elevators over 300,000 bushels in capacity, total average costs were 3.85 cents.

Volume is a determinant of elevator cost; as volume increases, average cost per bushel should decrease. Yet the volume an elevator can handle is dependent on many things, i.e., the capacity of the elevator, efficiency of equipment and labor utilization, availability of terminal storage which in turn is dependent on the transportation facilities needed to reach the terminal storage. There is usually a railroad car shortage during the harvest season creating a big problem for the elevator managers. Weather is perhaps the biggest determining factor of volume as in time of a drouth in the area, volume will be very low, therefore, increasing the average cost of handling each bushel of grain receipts.

An excellent example of what can happen to an elevator when a drouth hits the area causing receipts to drop to 89 percent of elevator capacity, is what happened in one case under study during the 1956-1957 fiscal year.

