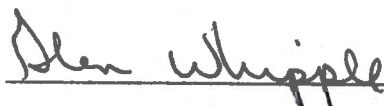


To the Graduate Council:

I am submitting herewith a thesis written by Kimberly A. Spielman entitled "An Analysis of Costs of Operation of Tennessee Livestock Auction Markets." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.


Dr. Dan L. McLeMore, Major Professor

We have read this thesis
and recommend its acceptance:




Accepted for the Council:


Vice Chancellor
Graduate Studies and Research

AN ANALYSIS OF COSTS OF OPERATION
OF TENNESSEE LIVESTOCK
AUCTION MARKETS

A Thesis
Presented for the
Master of Science
Degree
The University of Tennessee, Knoxville

Kimberly A. Spielman

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ABSTRACT

This study incorporated 101 accounting cost records from 1978 and 1980 to explore economies of size in Tennessee Livestock Auction Markets. Specific objectives of the thesis were: (1) To describe existing LAM operations in Tennessee; (2) To determine the typical cost structure of various size categories of auctions to identify major factors of firm efficiency; (3) To determine the current rates of return to market operators; (4) To identify the relationship between specific costs of operation and market size as indicated by animal marketing units handled; and (5) To estimate a long run average cost function for the industry to determine whether economies of size exist in Tennessee auctions.

Results of the cost analysis indicated that average total cost (ATC) generally declined up to the intermediate sizes of auctions, where they rose again. Following these increases, costs again declined through the largest volume levels. The two-year average total cost for all markets was \$5.12. The largest component of average total cost was salaries, comprising 50 percent of ATC. The group of auctions with the lowest salaries expense during both years also incurred the lowest ATC. Insurance comprised 7 percent of ATC, the second-largest component, while utilities represented the third-largest expense, 6 percent of ATC.

Land value and total fixed assets were the only asset values which were related to market volume. The smallest markets reported the lowest values for both categories during 1978 and 1980, but the largest values were not consistent with market size. No relationship existed between size of market and any category of liabilities or net worth.

Selling commissions, which are collected on each head of livestock sold, were the main source of revenue for auctions in both years. A distinct cost-size relationship existed for both total gross returns and total net returns. In both years, total gross returns and total net returns were lowest for the smallest markets and highest for the largest firms.

A long run average total cost (LRATC) function for the Tennessee livestock auction market industry was estimated by the Ordinary Least Squares (OLS) approach and the Minimum Absolute Deviations (MAD) method. The OLS method estimated the LRATC function by a regression of ATC against volume, indicating expected short run average cost conditions. The MAD approach fitted a frontier function, or envelope curve, to the bottom of the point scatter of ATC plotted against volume. This method thus provided a more appealing theoretical estimate of the LRATC function.

The OLS function indicated that 80 percent of the economies of size were exhausted at a volume of 30,000 A.M.U.'s, while the frontier function exhibited 80 percent of cost economies achieved at 15,000 A.M.U.'s. Thus, the theoretically correct frontier function indicated that smaller auction markets may capture a significant portion of the available economies of size. The OLS estimate indicates that markets must expand output to a larger size, 30,000 A.M.U.'s, to achieve most of the available cost economies. During 1980, 50 percent of the LAM's operating in Tennessee handled volumes less than 18,000 A.M.U.'s. The frontier function estimate thus appears to more accurately describe the Tennessee LAM industry, and may be the more appropriate LRATC estimate for Tennessee auction markets.

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CHAPTER I

THE PROBLEM AND OBJECTIVES OF THE STUDY

I. INTRODUCTION

The livestock marketing system has experienced immense growth and technological change during its development. Within the past two hundred years, new marketing techniques have led to an increasingly efficient system, as market entities strived to improve their economic position in the expanding livestock industry. As the number of livestock marketed commercially has increased through the years, new and more convenient marketing channels have developed to meet these demands.

One of the earliest methods of marketing livestock was that of droving herds to market. Producers would not attempt to find a buyer for their livestock until the drive was completed. Drives to market declined, however, as rail transportation developed in the Midwest during the late 1800's. Buyers were also sent into the countryside to purchase livestock, but no permanent markets were established. The first livestock commission firm, which represented producers for a fee, was established in 1857 (34, p. 15).

Following the Civil War, central terminal markets became popular in Midwestern packing centers. The first terminal market was established in 1865 in Chicago. Terminal markets became popular under conditions in which production was located far from slaughter and where long-distance hauls were required (34, p. 14).

Also following the Civil War, stockyards were established by private industries, packers, and railroads in major packing centers. Holding pens were provided at the yards, offering producers a location to end their drives and sell their livestock. Often, especially at yards operated by railroad companies, cattle could be carried directly into the packing center on the company's rail cars and then taken to the stockyard facilities (34, p. 19).

Terminal markets, cattle drives, and country buyers all declined in importance in the early 1900's, however, while cooperative selling agencies were being formed at terminal markets. Producers were dissatisfied with their current marketing alternatives. Factors which led to this dissatisfaction included: (1) less-than-carload freight rates that individual farmers found prohibitive; (2) complaints of low market prices; and (3) the suspicion that dealer operating margins were unjustifiably wide. Farmers cooperated at terminal markets to gather large lots of livestock to achieve carload freight rates. Cooperative agencies, however, did not solve as many marketing problems as had been hoped (34, p. 22).

Auction markets were beginning to become popular at this time, and they have played an increasingly important role in the agricultural marketing process since the early 1900's. The first auction began operation in 1836, when several Ohio stockmen organized a market to import purebred English cattle to sell at auction (34, p. 14).

II. AUCTION MARKETS IN THE U.S.

Improvements in communications, roads, and truck transportation were several factors which contributed to the early growth of livestock auction markets. During the 1930's, the number of auction markets increased rapidly, due to the Depression, drought, and subsequent sales of large numbers of livestock. These new auctions were popular with farmers because transportation and selling costs were reduced as markets developed closer to farms (34, p. 235).

The total number of auction markets in the U.S. has declined recently. After reaching a peak of 2500 markets in 1952, (9, p. 256) market numbers had fallen to 1,862 in 1979 (31, p. 5). The southeastern states, however, continued to increase market numbers following 1952, and auctions have become the major location for ownership transfer of livestock in the South (12, p. 5). Tennessee markets have followed this pattern of growth also, rising from 62 markets in 1955 to 74 markets in 1970 (17, p. 6).

III. AUCTION MARKETS IN TENNESSEE

Perhaps due to the adverse effects of rising inflation and interest rates, and a reduction in livestock herd numbers, only 63 auctions in Tennessee were registered with the U.S.D.A. Packers and Stockyards Administration in 1980 (33). In addition, 154 independent dealers and order buyers, 23 bonded packers, and one terminal market were listed for Tennessee (25). Therefore, a total of 241 recognized livestock marketing channels were operating in the state during 1980.

Thirty-two fewer Tennessee marketing agencies were registered in 1980 than in 1970, with eleven fewer auctions in operation. The decline in agents parallels the decrease in the total number of livestock sold through auctions in the State, which fell from 1.8 million head in 1970 (17, p. 6) to 1.4 million head in 1980. During 1980, approximately 722,000 cattle, 233,000 calves, 414,000 hogs, and 3400 sheep were sold through Tennessee auctions (28).

Auction markets are particularly vital to the Tennessee livestock industry, and they provide a central sales location for much of the livestock sold in the State. In 1980, 38.9% of the cattle purchased by packers in Tennessee were sold through auctions, while 41.6% were purchased through direct dealers, and 19.5% were purchased at terminal markets. Auctions are the third most important source of hogs purchased by packers in Tennessee. In 1980, 14.3% of the hogs bought by packers in the State were purchased at auctions. The number of sheep and goats marketed commercially in Tennessee is very small (32).

IV. AUCTION MARKET ACTIVITY

Although auction markets have increased in number and importance since their introduction in the early part of the century, their characteristics and methods of operation have changed very little through the years. Auctions continue to provide a central location for producers to assemble livestock being offered for sale to prospective buyers. Livestock is sold to the highest bidder through a competitive bidding process conducted by an auctioneer, whose responsibility is to obtain the greatest price possible for the animals being sold (34, p. 241).

Markets charge a fee to producers for the services which are provided. Fees may be charged on a percentage basis of total sale value, on a per head basis, or on a combination of these two methods. These fees, or commissions, represent the main source of auction market income, and may be adjusted according to the species of livestock, sex, weight, type of animal, or selling price. Additional fees may be collected for special services or those not normally required, such as animal storage, hay and feed, or weighing when not being sold. Commissions paid by consignors provide for the services of selling, weighing, feeding, yardage, and inspection (34, p. 241). Some markets may conduct dealer operations for additional income or participate in market support activity. Market support activity consists of the auction operator purchasing livestock on the auction market to assure a market and to support prices which may otherwise be too low to continue attracting desired volume.

To perform these services, auctions must have stockyard facilities, animal receiving facilities, and investment capital (34, p. 241). Considerable costs of operation can be incurred in providing these facilities.

Auction market costs of operation can generally be classified into two categories: fixed costs and variable costs. Fixed costs include those expenses which do not vary with the level of output (19), or in this case volume of livestock handled. Insurance, depreciation, taxes (other than income taxes), and license or bond premiums are typical fixed costs incurred by auctions.

Variable costs change as output changes (19). An increase in output causes variable costs to rise also, since greater output requires larger amounts of variable resources. Examples of variable costs are: labor costs, utilities, supplies, repairs and maintenance, and rental costs.

Many auction markets operate only one sale day per week, with facilities remaining idle for the remainder of the week. Because the number of sale consignments varies widely, both seasonally and annually, auction capacity may be underutilized for much of the year. Plants are often built to handle the largest expected per sale volume, yet this capacity may only be utilized during the peak fall season. Thus, not only may auction facilities be used inefficiently, but labor and other resources may remain underutilized for much of the year as well (34, p. 256).

Such inefficient resource utilization has led to excessive operating expenses for many auctions. These high costs must be absorbed by some segment of the marketing system. High costs incurred by auction operators may lead to increased tariff rates. These higher tariffs then increase the production costs of farmers who produce and sell livestock at auctions. If production costs become too high, farmers may limit the quantity of livestock produced. A decrease in production would reduce the supply of meat available, and this may lead to higher meat prices for consumers. The actual effects upon consumers of inefficient market operations depend upon the elasticity of demand and supply of meat.

Auction operation is further complicated by the competition markets encounter in obtaining livestock and buyers. Markets must compete with other auctions in attracting a sufficient volume of livestock to offer to buyers. Consignors to small-volume auctions are often penalized by buyers who are unable to purchase enough similar animals to make a truckload. Buyers may stop attending sales when sufficient livestock are not offered for sale. This leads to insufficient buyer competition present at sales to give consignors competitive prices for their livestock. When prices fall, farmers change markets, and per unit costs rise as auction volume falls. Many small markets discover that "volume attracts buyers and buyers attract consignments" (34, p. 256).

V. STATEMENT OF THE PROBLEM

Recent research indicates that many auctions continue to exist despite incurring high costs and utilizing inefficient operating methods. In many areas, an excessive number of markets are so concentrated geographically that it is impossible for any one of them to be efficient. According to Williams and Stout, as long as the present number of auctions remains so large, efficiency will continue to be low since no auction can attract a satisfactory volume (34, p. 254).

A study of Tennessee auction markets in 1970 by Hicks and Badenhop concluded that "Tennessee has too many markets to develop an efficient, low-cost livestock auction system" (17, p. 24). By estimating the costs of transportation and market operation, they determined the optimum size, number, and location of markets in the state. To create

a more efficient market system, Hicks and Badenhop recommended that the then current number of 74 auctions be reduced to a maximum of 35, with 18 the preferred number (17).

By 1980, however, auction market numbers had not been reduced significantly, with 63 livestock markets still in operation. Of these, 34 markets sold less than 20,000 head of livestock, 18 markets sold 20,000-50,000 head, and only 6 auctions handled more than 50,000 head of livestock. Thus, small markets comprised 59 percent of all auctions, yet they handled only 24 percent of the livestock sold through auctions. Intermediate-sized markets, 31 percent of the total number of auctions, sold 40 percent of all livestock, and large markets accounted for only 10 percent of the market population, yet sold 36 percent of all livestock sold through auctions (28).

Based upon these data in Tennessee, auctions would appear to be an area where the efficiency of the total marketing system could be improved. Little research has been conducted concerning the relationship between operating costs and volume of livestock handled by varying-sized markets in Tennessee. No research has been conducted within the past decade to compare the efficiency of small markets with large markets. Economies of size may not be realized by many small auctions. The existence of these many small auctions may prevent larger markets from receiving the full benefit of the economies available if fewer markets existed. Per unit costs may remain excessively high because of low volume and inefficient resource use.

VI. REVIEW OF LITERATURE

Researchers during the past 30 years have studied the relationship between operating costs of livestock auction markets and the size of the market to determine the efficiency of the marketing system. Several predominant characteristics of auction markets have emerged from these studies.

Numerous studies indicate the problem of an excess number of auctions. Wootan and McNeely discovered that market costs in Texas auctions could be lowered if fewer firms existed (36). Ohio researchers found that eight times as many markets operate in Ohio as are needed if all firms operated at optimum output (16). Hicks and Badenhop reported that Tennessee has too many auctions for an efficient market system to exist (17).

Because too many markets are in operation to support the volume of livestock handled, numerous small markets have evolved. A certain minimum amount of volume is required for a market to operate at a profitable level. Newberg reported that markets in the North Central region should handle a minimum of 15,000 marketing units per year to operate efficiently, but the majority of auctions studied in that region of the U.S. handled a low volume of livestock. Markets with a volume of less than 15,000 animal marketing units per year represented 53 percent of all observations, yet only 23.6 percent of the total volume of the auctions sampled was handled through these small markets. Auctions with annual volume greater than 30,000 marketing units represented only one-sixth of all observations, but they handled nearly 40 percent of

the total volume of livestock sold (25). Miller recommended that Ohio auction markets should handle more than 25,000 marketing units per year to achieve operating efficiency (23). A study of Kansas markets indicated that the twelve largest auctions commanded only 37 percent of the total market share (2). Grinnell and Shuffett reported that those Kentucky auctions having an annual gross income of less than \$60,000 could reduce unit costs by increasing the volume of livestock handled (14).

Researchers have discovered that certain costs incurred by auction markets consistently represent a larger proportion of total costs than do other costs. Grinnell and Shuffett reported that the largest variable cost to Kentucky market operators was labor costs, accounting for 48 percent of all firms' costs over an average five-year period (14). Grimes and Cramer indicated that labor costs comprised more than 50 percent of total costs for smaller auctions, and more than 45 percent of all costs for larger markets in Missouri. Advertising was the second largest cost item for all but the smallest markets in Missouri (13). North Dakota markets also incurred high labor costs, with labor representing 42 percent of all costs and being the largest cash expenditure. Publicity and public relations was also the second largest expense for these markets (22). According to Stoddard, small auction markets are characterized by their inefficient use of labor, resulting in high labor costs (27).

The conclusion reached by previous researchers is that larger auctions incur lower per unit costs than do smaller markets, at least up to a certain size of market. This condition is known as economies

of size, which exist when smaller plants (which are operating at their most efficient volume) incur higher unit costs than large plants which also are handling their most efficient volume (4). As a general rule, a firm's costs of production will decline when capacity and volume of the plant are increased (34). Theoretically, costs will begin to increase at some level of output, but this reversal is usually not encountered in empirical studies.

Auction market research results confirm the existence of economies of size. Newberg reported a decrease in costs per animal as auction volume increased to 20,000 animal marketing units per year, but costs began to stabilize after that size of plant was reached for markets in the North Central region (25). Grimes and Cramer indicated that explicit and implicit costs in Missouri auctions declined as sales volume rose (13). Large auctions in North Dakota also reported lower costs than smaller markets up to annual sales of 30,000 marketing units per year, but there was little cost savings beyond that volume (22). Wilson and Kuehn reported a decrease in West Virginia market costs as firm size increased (35). Similar results were indicated in Kentucky and Kansas auction markets as well (14, 2).

VII. OBJECTIVES

The purpose of this study is to conduct a cost analysis of Tennessee livestock auction markets to determine the degree of operational efficiency. The objectives are:

- (1) To describe existing livestock auction market operations in Tennessee.

- (2) To determine the typical cost structure of various size categories of auctions to identify major factors of firm efficiency.
- (3) To determine the current rates of return to market operators.
- (4) To identify the relationship between specific costs of operation and market size as indicated by animal marketing units handled.
- (5) To estimate a long run average cost function for the industry to determine whether economies of size exist in Tennessee auctions.

CHAPTER II

METHODOLOGY

I. METHODS OF COST ANALYSIS

Two methods of cost analysis were available in examining the cost structure of Tennessee livestock auction markets, the economic-engineering approach and the statistical accounting method. The economic-engineering method is based upon the premise that marketing efficiency depends upon operations being performed by economic units of the most efficient design and size. Through synthetic construction, physical input-output relationships must be converted to cost estimates. Emphasis is placed upon the separate determination of the physical relationships for each operation. Once input-output relationships have been formulated for individual operations using the economic-engineering method, costs of hypothetical plants may be determined as easily as those of existing plants. This information may be used to determine the optimal size and number of firms for an industry (3, 14).

The economic-engineering method is useful because more details of plant organization are available after a least-cost type of plant has been identified. Data requirements, however, are great because detailed time and motion analyses of the production of each product or service (using each available production process, at alternate rates of output for each of several plants differing in size) must be developed. The expense of this research may become prohibitive. Also, statistical measurements of reliability are not available. The results obtained

using this method can only be checked for accuracy by comparing results with alternative sources of information (3, 14, 20).

The statistical accounting approach uses the cost accounting records of existing firms as data for developing cost relationships. Reliable cost records must be obtained from firms operating at various levels of output over a common period of time.

With the statistical method, cost functions may be derived from accounting data in either of two ways. The first is to obtain historical cost-output data of a single plant that, over time, has not altered plant size or technology, but has had a varied rate of output. Short run cost functions may be developed using this data, and long run cost functions may also be estimated if plant size has varied (11, 20). The second form is to obtain a stratified sample of firms of various sizes, each using the same accounting method and technology. The historical record of costs and output of each sample firm is treated as one observation. These data are used to determine average per unit costs, and a regression equation may be fitted to these data to estimate a long run average total cost function (20).

The statistical accounting method offers the advantages of lower cost of data collection and preparation, and may provide statistical measurements of reliability. A cost analysis based on accounting data may produce a useful estimate of the economies of size present in an industry, or the variation in relative efficiency among firms. For these reasons, the statistical accounting method was employed in this study of Tennessee markets.

Cross-section data used in the statistical accounting method will provide observations over a wide range of volume levels necessary for long-run analysis. Data may be obtained for a relatively large number of firms for a given time period, which is required for analysis of long-run costs. Cross-section or stratified sample data is more appropriate for an industry which is technologically stable, such as the livestock auction market industry.

Use of stratified sample data may be improved by including multi-period observations from each sample firm. The likelihood that firms within the sample are operating near capacity and with least-cost methods is greater when the firm's least-unit cost observation is selected from a time series of observations (14).

II. MEASUREMENT OF OUTPUT

In order to derive specific unit cost-volume relationships, the firms under consideration must be grouped into size categories according to some measure of output. Several output classification criteria may be used, including: (1) gross income; (2) value of livestock handled; (3) investment; and (4) animal marketing units.

Grouping auctions based on gross income gives a superficial indication of market size, but this figure may include income from sources other than the auction market itself. Feed account or market support income may be included in gross income, and therefore this would not be a consistent measure for all firms. Neither value of livestock handled nor investment accurately reflects output of firms on a basis suitable for comparison.

Animal marketing units (A.M.U.) classification requires that heterogeneous livestock species must be converted to the common unit of measure, A.M.U. The cost of handling and selling each species varies, and the proportion of different types of livestock sold varies among all markets. Therefore, a unit of each species of livestock must be expressed as equivalent to the other species. The standard A.M.U. is defined by U.S.D.A. as one cow, one calf, three hogs, four sheep, or one horse (27, p. 7). These values were determined by equating the amount of pen space and handling costs for each type of livestock (27, p. 5).

Grouping auctions by A.M.U. is a more appropriate measure of output of the firm than the other approaches mentioned. The A.M.U. provides an unbiased and accurate measure of actual firm output. Thus, in this study auction market output was in A.M.U.'s, and markets were grouped into size categories based upon this output measure.

III. ECONOMIC THEORY OF COST FUNCTIONS

A long run average total cost (LRATC) function is one of several cost estimates which may be used to illustrate the quantitative relationship between volume of livestock handled and operating costs incurred by auction markets. Estimation of such an LRATC function may indicate whether the Tennessee livestock auction market industry exhibits economies of size. Cost functions for livestock auction markets are expected to conform to accepted micro-economic theory.

Although auction market activity occurs in the short run, long run cost estimates must be made when a market considers entering the industry or altering its current scale of operation (14, p. 46). The short run is defined as the period of time during which the quantities of some, but not all, inputs can be varied. The fixed inputs such as plant size and major equipment determine a firm's scale of operation. Total fixed cost will remain constant regardless of the rate of output because the quantity of fixed inputs is constant.

Certain other inputs such as labor can vary in quantity in the short run and are known as variable inputs. A short run cost estimate for a firm represents unit costs for variations in the volume handled which do not require change in the scale of plant (7, p. 388). Short run costs are incorporated into long run cost estimates, because a short run total cost curve corresponds to any given set of fixed inputs (5, p. 145).

Average costs are determined by the ratio of cost to quantity of output, or in this case, volume of livestock handled. Short run average cost curves are drawn with a 'U'-shape, and the shapes are reflections of the efficiency with which resources are used by each size firm (34, p. 152). A discrete set of short run curves demonstrates that each firm size possesses a certain set of volumes which can be produced most economically by that size firm. If the additional plants which are possible to build are added to the set of cost curves, then it would be shown that one rate of output exists which each of the plants can produce at least cost (5, p. 145).

Short run average fixed cost (SRAFC), average variable cost (SRAVC), and average total cost (SRATC), may be calculated and illustrated graphically. Average fixed cost declines as output increases, since the total fixed cost remains unchanged while quantity of output increases (21, p. 170). Initially, SRAVC decreases as output rises, but higher average variable costs result beyond a certain output. Total costs represent the sum of fixed costs and variable costs. Average total cost will decrease for those rates of output where both SRAFC and SRAVC fall. Average total cost reaches a minimum at a higher output than does AVC, since rises in SRAVC are more than offset by decreases in SRAFC at lower outputs (21, p. 171).

The long run time horizon differs from the short run in that the firm's long run production function is the only technological constraint upon production decisions (5, p. 140). All inputs are variable so a firm can vary its plant and equipment in any manner. The firm must therefore determine the optimal stock of plant and output, as well as the optimal rate of combining expendable input factors used in production (5, p. 140).

In the long run, the firm selects its "rates of utilization of variable inputs and its stock of fixed inputs to enable it to maximize profits by producing its chosen rate of output at the minimum possible total cost" (5, p. 165). The minimum possible cost for a particular rate of output is indicated by the firm's long run total cost function.

The long run average total cost (LRATC) function may be determined for any level by dividing the long run total cost for a given output by the volume of output (27, p. 97). This LRATC function, or planning

curve, is the locus of points representing the least possible average cost of producing a particular amount of output using the optimum input combinations and plant size for that amount of output (27, p. 19). It illustrates changes in average costs associated with changes in auction market size.

The LRATC function is an 'envelope curve' to the short run average cost curves. It is a continuous curve drawn tangent to the group of SRATC functions, each representing a different scale of plant and equipment (5, p. 155). The minimum point of the LRATC curve indicates the least-cost, most efficient size of plant and plant output and represents long run industry equilibrium.

The LRATC function, in theory, would decrease at a decreasing rate over the small firm sizes and may or may not turn up for very large sizes. The shape of the LRATC estimate is determined by economies and diseconomies of size. Economies of size cause the LRATC function to decline as output rises while diseconomies are indicated by a rising LRATC. The relationship between LRATC and SRATC curves is illustrated in Figure 1. The efficient firms' average cost and output are illustrated by AC and Q respectively.

IV. METHODS USED TO ESTIMATE THE LONG RUN

AVERAGE TOTAL COST FUNCTION

Cost functions for livestock auction markets are expected to conform to accepted micro-economic theory. With this conceptual background, both the structure of economies of size and a least-cost firm size may be determined by estimating a long run average total cost function (27).

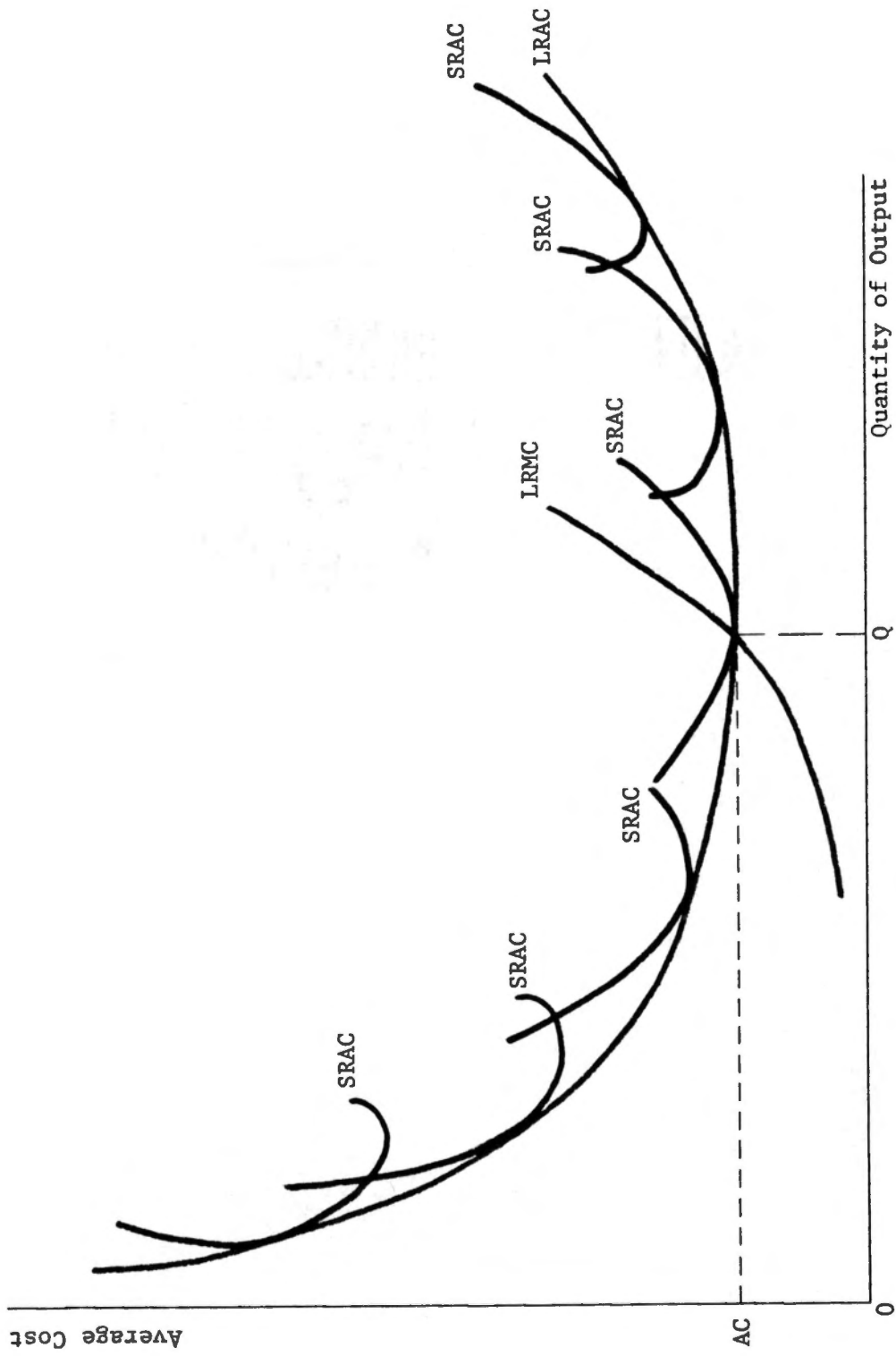


Figure 1. Graphic Illustration of Long-Run and Short-Run Average Total Cost Functions

The ordinary least squares (OLS) method of regression is commonly used in cost studies due to familiarity and low cost. This approach uses cross-section data in a regression of total unit cost on output to estimate the LRATC function.

The use of a frontier function to estimate an LRATC function has been suggested as an alternative approach to the OLS method. Bressler proposed that a frontier function may more accurately reflect the true LRATC curve than that provided by a regression line. Miller and Nauheim suggested that the solution to an economies of size study may be found utilizing a minimized linear programming model. Hazell incorporated the mean absolute deviation linear programming model as an alternative to quadratic programming in formulating efficient farm plans. Other work concerning the use of frontier functions has been conducted by Farrell and Fieldhouse, Seitz, and Aigner and Chou (1, 8, 15, 23, 26).

In order to obtain an envelope curve fitted to the bottom of the point scatter of unit cost plotted against volume, this study incorporated the minimum absolute deviations (MAD) method using linear programming techniques (26). Minimization of the mean absolute deviation between actual average total cost and estimated average total cost, subject to the constraint that estimated average total cost be less than or equal to actual average total cost, results in an envelope function fitted to the bottom of the scatter diagram of individual firm average total costs and volume.

Although the frontier function has not received widespread use by researchers in estimating industry cost functions, this approach may be a more appealing estimator of the LRATC function than the OLS

method. The OLS method produces a function which indicates the mean unit cost incurred on the average by markets of a certain size. However, since the observations on cost actually represent firms operating at various points along numerous short run average cost curves, the OLS method actually produces a function showing expected short run average cost at a series of volumes. This function must be above the envelope LRATC assuming small errors of measurement in the observations. A frontier function fitted to the lower extremes of the scatter of cost-volume observations would more closely approach the theoretical notion of an LRATC curve which is an envelope to the short run average cost curves.

Although the frontier function more accurately resembles the theoretical LRATC curve, measurement error may have a greater influence on the results of this method than the OLS method. The frontier function is constrained by the location of a few points at the lower extreme of the scatter of average costs for any given volume. Thus, errors in measurement in these few observations may have a disproportionately large impact on the estimated function.

Because both the OLS method and the frontier function method of estimating an LRATC function may be useful in describing a long run cost function, each of these approaches was utilized to estimate a long run average total cost function for the Tennessee livestock auction market industry.

V. MODELS USED TO ESTIMATE THE LONG RUN

AVERAGE TOTAL COST FUNCTION

Economic theory suggests a cost function which would decrease at a decreasing rate. Four functional forms were hypothesized as potential forms for the Tennessee auction market LRATC:

$$(1) Y = a + b_1 X + b_2 X^2$$

$$(2) Y = a + b_1 \frac{1}{X}$$

$$(3) \ln Y = a + b_1 \ln X$$

$$(4) Y = a + b_1 \frac{1}{X} + b_2 \frac{1}{X^2}$$

where: Y = Total cost per animal marketing unit (AMU)

X = Number of A.M.U.'s handled per year.

Equation (1) is a quadratic form. This describes a cost function which is consistent with economic theory of the behavior of an LRATC function. This estimate would decrease at a decreasing rate, reach a minimum, and then increase at an increasing rate, that is, turn up at the end.

Equations (2) and (3) exhibit asymptotic characteristics. As the curves approach zero, they flatten out, but they never reverse their slope. Equation (3), the log function, tends to modify the curve as if the abscissas were compressed near zero, and stretched out in the higher values. This function is either convex or concave from above when b is positive, but if b is negative, the curve will always be concave from above. Log curves nearly always become asymptotic, because a log cannot be obtained from a negative number.

Equation (4), a hyperbola, also becomes asymptotic as it approaches both the X and Y axes, even if one or both variables are negative values. This model utilizes the reciprocals of the independent variables of the quadratic equation as independent variables.

Using the MAD method, a long run average cost function of the form $Y_i = b_0 + b_1 X_i + E_i$

where: Y_i = Actual average total cost for market

X_i = Volume (output) handled by market

E_i = Random error term

may be estimated by constraining $b_0 + b_1 X_i \leq Y_i$, that is $E_i \geq 0$. Only efficient firms will satisfy the equality, since the remainder of firms produce at a cost above the frontier function.

Because an infinite set of b_i will satisfy the above condition, an optimizing criterion must be imposed. Minimizing the linear sum of the errors (E_i) forces the estimated cost function to lie as near the center of the scatter as possible, subject to $b_0 + b_1 X_i \leq Y_i$.

Expressing the term $\sum_{i=1}^n E_i$ as a linear function of $b_0 + b_1 X_i$, the programming problem is:

$$\text{Minimize: } \sum_{i=1}^n E_i = \sum_{i=1}^n (Y_i - b_0 + b_1 X_i)$$

$$\begin{array}{l} \text{Subject to: } b_0 + b_1 X_1 \leq Y_1 \\ \quad \quad \quad \vdots \quad \quad \quad \vdots \\ \quad \quad \quad b_0 + b_1 X_n \leq Y_n \end{array}$$

Because the Y_i term is constant for any specific observation, minimizing

$\sum_{i=1}^n E_i$ maximizes $b_0 + b_1 X_i$. Thus Y_i may be eliminated and the program-

ming problem becomes:

$$\text{Maximize: } b_0 \sum_{i=1}^n (1_i) + b_1 \sum_{i=1}^n (-1_i) + b_2 \sum_{i=1}^n (X_i) + b_3 \sum_{i=1}^n (-X_i)$$

$$\text{Subject to: } b_0 (1) + b_1 (-1) + b_2 (X_1) + b_3 (-X_1) \leq Y_1$$

$$\vdots \quad \quad \quad \vdots \quad \quad \quad \vdots \quad \quad \quad \vdots$$

$$b_0 (1) + b_1 (-1) + b_2 (X_n) + b_3 (-X_n) \leq Y_n$$

$$(b_0, b_1, b_2 \leq 0).$$

The negative volume variables are included because linear programming does not allow negative activity levels. To allow the b coefficients to be negative, the X_i terms were included once as positive and once as negative.

To estimate the frontier function as accurately as possible, the exact functional form specified will be the same as the OLS equation which provides the best explanation of the variability in Y . No statistical measures of significance are provided by the frontier function, so the proper form of the function is crucial to correctly identifying the LRATC estimate. Because the MAD approach incorporates the theoretical envelope concept of an LRATC estimate. Because the MAD approach incorporates the theoretical envelope concept of an LRATC, a properly-specified frontier function may be preferred to the OLS estimate as the true long run average cost estimate for Tennessee livestock auction markets.

VI. SOURCE OF DATA

Data for the cost analysis of Tennessee livestock auction markets were gathered from the Packers and Stockyards Administration Form 130 for 1978 and 1980. All auctions in operation in Tennessee are required to file this report annually with the P&SA, U.S.D.A., Memphis area.

The Form 130 is an annual report including a balance sheet of assets and liabilities, reconciliation of net worth, summary of income statements, a separate income statement for the auction activity, detail of market support activity and dealer operations, and volume of livestock handled during the year. Results of this study were based upon figures derived from pages two through six of the nine-page report. The 1980 Form was shortened to four pages, and all four pages were used. The name and address of each auction operator was deleted from the report to insure confidentiality of the accounting records.

A total of 118 Annual Reports of Tennessee auction markets were collected from the Memphis office. Of these reports, 61 observations were from 1978 and 57 were from 1980. After examining the data, however, only 55 observations from 1978 and 46 from 1980 were used. Several reports were deleted because they contained insufficient cost data to be of use. Others were dropped from the study because of incomplete information concerning the volume of livestock handled. Other reports deleted represented markets which only conducted horse sales. These data were not included because they did not reflect a typical auction market operation. Some firms terminated business operations during the year, thus reporting incomplete data. Several

reports were deleted because inconsistent accounting practices were reflected.

Data from both 1978 and 1980 were combined to estimate the long run average total cost function. The 1980 costs were deflated to 1978 dollars by the Index of Prices Paid by Farmers. This accounted for inflationary rises in prices which could distort true cost comparisons between 1978 and 1980 data (29, 30).

Markets were divided into seven size categories. Parameters of these categories and the number of auctions in each category are shown in Table 1.

VII. DETERMINATION OF SPECIFIC UNIT

COST-VOLUME RELATIONSHIPS

To identify key factors of firm efficiency in Tennessee livestock auction markets, specific unit cost-volume relationships were derived for the various size categories of auctions. By examining the composition of the cost structure, inefficient areas of market operation may be identified. These figures may also be compared to determine whether larger markets incur lower costs than do smaller markets. Each of these costs was expressed in per-unit figures by dividing the total expense by the volume of livestock handled to yield the cost incurred for each A.M.U. handled. For each size category, the mean, standard deviation, and minimum and maximum values were determined. This information will aid in determining the existence of economies of size in Tennessee auction market operations.

Table 1. Number and Average Volume for Livestock Auction Markets by Size Group, Tennessee, 1978 and 1980

Volume Handled Per Year (A.M.U.)	1978		1980	
	Number of Markets	Average Volume Handled (A.M.U.)	Number of Markets	Average Volume Handled (A.M.U.)
Less than 9,000	7	5,814	14	5,840
9,000 - 17,999	15	13,810	14	13,115
18,000 - 26,999	13	21,648	5	20,892
27,000 - 35,999	4	31,244	6	32,276
36,000 - 44,999	5	39,455	2	40,711
45,000 - 53,999	7	51,453	3	46,046
More than 54,000	4	75,412	2	69,702

Expenses were classified as either fixed costs or variable costs. Fixed costs were composed of: total depreciation, taxes (excluding income taxes), other insurance, legal fees, interest, and licenses and premiums. Variable costs included: unemployment insurance, salaries, rent, utilities, travel and auto, advertising, supplies, bad debts, trucking, maintenance, miscellaneous labor, and miscellaneous expenses. Average fixed costs, average variable costs, and average total costs were calculated for each year of operation, and also for the two years combined. Average total costs were then used in estimating the LRATC function based upon each individual operation.

Other characteristics of auctions and auction market ownership were also determined. Group averages for each asset held, liability incurred, net worth, or income source were found. These values may describe any differences in investment, liabilities, net worth, or profitability which may occur between small and large sizes of auction markets.

Through examination of these specific unit cost-volume relationships, and through the estimation of a long run average total cost function, the existence and magnitude of economies of size in the industry may be identified.

CHAPTER III

DESCRIPTIVE ANALYSIS OF AUCTION MARKET OPERATIONS

I. COST ANALYSIS

The relationships between specific unit costs and volume were examined to determine whether certain market sizes employ particular types of resources more efficiently than others. By determining the composition of operating costs for all markets, auction owners may become aware of inefficiencies or areas for improvement in their own operations. Results of these investigations are reported below:

Fixed Costs

Depreciation. Per unit depreciation costs include building, equipment and machinery, and automobile depreciation charges. Generally depreciation costs declined as market size increased, although there were several exceptions during both years (Table 2). In 1978, average costs fell from Group I through Group III, but Group IV firms reported higher costs.¹ Expenses for Groups V and VII continued the pattern decline, although Group VI costs increased slightly. The

¹Size groups defined as:

<u>Size Group</u>	<u>Animal Marketing Units Handled</u>
I	Less than 9,000
II	9,000-17,999
III	18,000-26,999
IV	27,000-35,999
V	36,000-44,999
VI	45,000-53,999
VII	More than 54,000

Table 2. Per Unit Cost of Depreciation, Other Insurance, and Interest for Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980 (Actual Dollars per A.M.U.)

Year	Size Group	Depreciation			Other Insurance			Interest		
		Mean	Std. Dev.	Range	Mean	Std. Dev.	Range	Mean	Std. Dev.	Range
1978	I	.370	.324	0.00--0.70	.361	.211	0.11--0.69	.110	.115	0.00--0.31
	II	.097	.099	0.00--0.34	.341	.153	0.13--0.75	.119	.167	0.00--0.59
	III	.078	.060	0.00--0.24	.178	.097	0.04--0.40	.077	.120	0.00--0.34
	IV	.243	.152	0.09--0.45	.200	.053	0.15--0.27	.309	.276	0.00--0.60
	V	.080	.073	0.00--0.20	.273	.138	0.12--0.45	.060	.109	0.00--0.25
	VI	.101	.057	0.01--0.16	.220	.087	0.09--0.36	.056	.075	0.00--0.18
	VII	.057	.064	0.00--0.13	.120	.100	0.04--0.27	.043	.054	0.01--0.12
All		.134	.165	0.00--0.70	.257	.151	0.04--0.75	.103	.148	0.00--0.60
1980	I	.176	.269	0.00--1.01	.116	.277	0.08--0.88	.195	.295	0.00--0.95
	II	.092	.093	0.00--0.27	.332	.218	0.03--0.75	.060	.111	0.00--0.37
	III	.181	.166	0.03--0.45	.270	.135	0.09--0.43	.401	.344	0.00--0.85
	IV	.104	.099	0.00--0.25	.257	.108	0.15--0.46	.056	.083	0.00--0.21
	V	.010	.130	0.01--0.19	.384	.073	0.33--0.44	.344	.119	0.26--0.43
	VI	.129	.114	0.00--0.22	.362	.059	0.30--0.42	.012	.017	0.00--0.03
	VII	.010	.014	0.00--0.02	.115	.016	0.10--0.13	.003	.003	0.00--0.01
All		.128	.173	0.00--1.01	.345	.216	0.03--0.88	.144	.236	0.00--0.95
1978 & 1980		.131	.168	0.00--0.01	--	--	--	.122	.193	0.00--0.95

largest average depreciation charge was reported by Group I in 1978, while Group VII firms incurred the lowest per unit cost.

During 1980, unit charges generally declined, although Groups III and VI incurred somewhat higher costs than the other firms. Groups I and VII again averaged the greatest and least costs per unit, respectively. The average depreciation cost for all firms during 1978 and during 1980 were \$.134 and \$.128, respectively, while the two-year average charge was \$.131. During 1978, unit depreciation charges represented the third largest fixed cost, while in 1980 this was the fourth highest fixed expense. A complete summary of depreciation charges is given in Table 2.

Insurance (Other than unemployment). Markets pay insurance premiums for protection against theft, fire, liability for personal injury, and injury to or death of livestock on market premises, or enroute to and from the auction. Insurance costs during both years declined from Group I through IV, then increased for firms in Group V (Table 2). The per unit insurance expense then fell through the remaining groups, with Group VII paying the least amount for each year. The largest cost was incurred by the smallest markets during 1978 and 1980, indicating that cost economies exist for the larger markets in this study. The mean insurance expense per unit in 1978 was \$.257, rising to \$.345 during 1980. Insurance ranked as the largest component of fixed costs for firms during both years, comprising 35 percent of fixed expenses in 1980.

Interest. Per unit interest expenses were smallest for the largest volume market groups, with intermediate-sized groups incurring

the highest costs during both 1978 and 1980 (Table 2). In 1978, firms in Group IV reported the greatest interest charge with Group VII markets handling less than 27,000 A.M.U.'s annually achieved lower average costs than did those firms with volume between 27,000 A.M.U.'s. The average interest charge for all auctions in 1978 was \$.10, the fourth-largest fixed expense. During 1980, markets incurred an average per unit cost of \$14, with interest ranking as the third greatest portion of fixed expenses.

Taxes (excluding income taxes). The per unit group tax costs did not indicate a relationship between size of market and tax expenses per A.M.U. handled. During 1978, Group V firms incurred the lowest tax expense, while markets in Group VI reported the largest costs. In 1980, however, the largest per unit tax cost was incurred by Group V, and the smallest tax expense was reported by the largest volume group, Group VII. The 1978 average tax expense for all markets was \$.137, but this figure more than doubled to \$.283 for the 1980 average tax cost. During both years of operation, taxes were the second largest component of fixed costs. Table 3 shows the per unit tax charges for each volume category.

Licenses and Premiums. Licenses are purchased by auction markets in order to operate, and certain employees such as weighmasters are required to be bonded. Bonding requirements, which are based upon the size of livestock receipts, guarantee sellers that they will receive payment for any livestock which are consigned to the market. Per unit costs for licenses and premiums declined as market size increased,

Table 3. Per Unit Cost of Taxes, Licenses and Premiums, and Legal Fees, for Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980 (Actual Dollars per A.M.U.)

Year	Size Group	Taxes			Licenses and Premiums			Legal Fees		
		Mean	Std. Dev.	Range	Mean	Std. Dev.	Range	Mean	Std. Dev.	Range
1978	I	.125	.104	0.00--0.25	0.045	0.034	0.000---.090	.109	.205	0.000--0.56
	II	.141	.138	0.00--0.50	0.031	0.064	0.000---.260	.078	.118	0.000--0.47
	III	.157	.092	0.00--0.29	0.013	0.012	0.000---.030	.026	.028	0.000--0.11
	IV	.141	.065	0.06--0.21	0.014	0.012	0.000---.030	.043	.037	0.0.0--0.10
	V	.134	.020	0.00--0.05	0.017	0.020	0.000---.050	.024	.032	0.003--0.08
	VI	.188	.144	0.01--0.45	0.005	0.016	0.000---.040	.008	.012	0.000--0.03
	VII	.114	.064	0.04--0.20	0.004	0.002	0.002---.010	.009	.006	0.003--0.02
1980	All	.137	.111	0.00--0.50	0.021	0.038	0.000---.260	.048	.009	0.000--0.56
	I	.348	.308	0.00--1.09	0.049	0.124	0.000---.470	.083	.192	0.000--0.70
	II	.208	.109	0.00--0.36	0.034	0.056	0.000---.130	.082	.203	0.000--0.77
	III	.271	.064	0.21--0.34	0.011	0.017	0.000---.040	.006	.013	0.000--0.03
	IV	.317	.219	0.04--0.68	0.000	0.000	0.000---.000	.042	.043	0.000--0.12
	V	.478	.391	0.20--0.76	0.000	0.000	0.000---.000	.013	.018	0.000--0.03
	VI	.273	.061	0.21--0.33	0.001	0.001	0.000---.002	.036	.063	0.000--0.11
1978 & 1980	VII	.117	.030	0.10--0.14	0.045	0.033	0.000---.090	.009	.009	0.003--0.02
	All	.283	.215	0.00--1.09	0.024	0.072	0.000---.470	.060	.154	0.000--0.77
		.204	.181	0.00--1.09	0.023	0.056	0.000---.470	.054	.127	0.000--0.77

although the costs were the smallest component of fixed costs during both 1978 and 1980 (Table 3). The average unit cost in 1978 and 1980 was \$.023.

Legal and Accounting Fees. These per unit fixed expenses were lowest for the largest markets and highest for the smallest firms, showing a definite cost-volume relationship (Table 3). During 1978, legal fees fell from \$.109 for Group I to \$.009 for Group VII firms, while in 1980, costs ranged from \$.083 for Group I to \$.009 for Group VII. The average legal fee expenses in 1978 was \$.048, and the 1980 group average was \$.060. This was the fifth-largest fixed cost in both years.

Total Fixed Costs. During 1978, the largest average total fixed costs were reported by markets handling less than 9,000 A.M.U.'s per year. The lowest costs were incurred by the largest size group, handling more than 54,000 A.M.U.'s (Table 4). There was a significant cost decrease realized by the large markets as costs fell from \$1.120 for Group I to \$.348 for Group VII. Firms in Group IV incurred the second-largest fixed costs, suggesting that intermediate size markets may be less efficient than either the very small or very large auctions. These firms handling 45,000 to 54,000 A.M.U.'s have the large capacity and thus incur higher fixed costs of operation to support a large volume of livestock. By not handling as much volume as larger markets, however, firms in these intermediate groups (IV and V) are at a cost disadvantage compared to either larger or smaller markets.

Table 4. Per Unit Fixed Costs, for Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980 (Actual Dollars Per A.M.U.)

Year	Size Group	Mean	Std. Dev.	Range
1978	I	\$1.120	.431	0.64--1.92
	II	0.808	.370	0.18--1.35
	III	0.529	.178	0.12--0.72
	IV	0.949	.410	0.47--1.44
	V	0.489	.232	0.25--0.79
	VI	0.582	.250	0.18--0.80
	VII	0.348	.216	0.15--0.63
	All	0.701	.373	0.12--1.92
1980	I	\$1.261	.811	0.18--2.93
	II	0.823	.339	0.22--1.59
	III	1.162	.526	0.60--1.90
	IV	0.787	.330	0.48--1.26
	V	1.318	.435	1.01--1.63
	VI	0.812	.053	0.76--0.87
	VII	0.254	.018	0.24--0.27
	All	0.984	.579	0.18--2.94
1978 & 1980		\$0.830	.496	0.12--2.94

The highest per unit cost during 1980 was reported by Group V, \$1.318, followed by Group I firms with a cost of \$1.261. This pattern is similar to that found in 1978, with intermediate size markets incurring costs as high or higher than the smallest firms. The lowest cost reported by firms in 1980 was by Group VII, \$.254. These facts indicated that economies of size are realized by large markets in the payment of fixed costs.

The composition of total fixed costs may be examined to identify the large components of this expense. For all auctions in 1978 and 1980 combined, other insurance was the largest single fixed cost, representing 36 percent of total fixed cost. Taxes were the second-highest fixed cost, making up one-fourth of this cost category. These two costs represent over two-thirds of the average fixed cost figure. Because of the nature of fixed costs, these expenses do not vary with the level of output, but remain constant in the short run view of operation. Insurance is a required expense for any business, and taxes also do not offer an alternative for decreasing costs. In this aspect, auction markets have little opportunity to significantly decrease unit fixed costs other than by increasing the level of output over which these costs may be spread. Table 5 illustrates the percentage of fixed costs each component of cost contributes.

Variable Costs

Salaries. The salaries expense included both salaries of owners and of employees. Salaries reported by markets during 1978 did not

Table 5. Specific Unit Fixed Costs, Means, and Rank in Relation to Total Fixed Costs, for Tennessee Livestock Auction Markets, by Year, 1978 and 1980 (Actual Dollars per A.M.U.)

Year	Cost	Rank	% of UTC	Mean	Standard Deviation
1978	Other Insurance	1	37	\$.257	.151
	Taxes	2	20	.137	.111
	Depreciation	3	19	.134	.165
	Interest	4	15	.103	.148
	Legal Fees	5	7	.048	.099
	Licenses/Premiums	6	2	.021	.038
	Unit Fixed Costs			\$.701	.370
1980	Other Insurance	1	35	\$.345	.216
	Taxes	2	29	.283	.215
	Interest	3	15	.144	.236
	Depreciation	4	13	.128	.173
	Legal Fees	5	6	.060	.072
	Licenses/Premiums	6	2	.024	.072
	Unit Fixed Costs			\$.908	.580

exhibit economies of size (Table 6). The average unit salary cost among small markets was lower than that incurred by large markets. Some small unincorporated market owners may not receive a salary until other expenses have been met, receiving any excess returns as a salary. Thus, a salary expense may not be included in a small market's wage expense. This omission will be reflected by a lower total salaries cost. Larger markets, often incorporated, pay the operator a salary, and thus the total wage compensation would be reflected in total salaries.

The smallest average per unit total salary cost during 1978 was paid by Group III, while the largest salary expense was incurred by firms in Group II (Table 6). Group I and Group VII had the second and third lowest salaries expense, respectively.

During 1980, markets did exhibit economies of size with respect to salaries expense. Group I auctions reported the largest unit salaries cost, while markets in Group VII paid the lowest cost for the year. Salaries declined from Group I through III, but Groups IV and V showed increased costs. Expenses for Groups VI and VII then continued to decline. Costs fell from a high of \$3.712 to the low of \$2.220 per unit handled. During 1978 and 1980, the salaries expense was the single largest variable cost incurred, comprising 60 percent of unit total variable costs.

Unemployment Insurance. These insurance expenses tended to decline as level of output increased. The largest cost in 1978, however, was incurred by Group V firms \$.114, while Group I followed with the second-largest cost of \$.008 (Table 6). The smallest unit cost was reported by Group VI, \$.017, and Group VII ranked next with a cost of \$.032.

Table 6. Per Unit Cost of Salaries, Unemployment Insurance, and Utilities, for Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980 (Actual Dollars per A.M.U.)

Year	Size Group	Salaries			Unemployment Insurance			Utilities		
		Mean	Std. Dev.	Range	Mean	Std. Dev.	Range	Mean	Std. Dev.	Range
1978	I	1.935	1.064	0.78--3.73	0.088	0.179	0.00--0.49	.355	.190	.164--0.63
	II	2.220	0.699	1.10--3.53	0.078	0.111	0.00--0.39	.260	.107	.090--0.46
	III	1.850	0.616	0.84--2.87	0.039	0.044	0.00--0.17	.183	.086	.070--0.41
	IV	2.148	0.483	1.61--2.69	0.060	0.047	0.00--0.11	.287	.087	.180--0.31
	V	2.097	0.604	1.25--2.84	0.114	0.065	0.01--0.19	.212	.116	.130--0.39
	VI	2.175	0.387	1.60--2.69	0.017	0.033	0.00--0.09	.146	.055	.090--0.22
	VII	2.077	0.757	1.45--3.18	0.032	0.029	0.00--0.07	.114	.060	.020--0.15
1980	All	2.064	0.669	0.78--3.73	0.061	0.093	0.00--0.49	.226	.125	.020--0.63
	I	3.712	1.526	0.97--6.08	0.013	0.032	0.00--0.10	.513	.250	.250--1.03
	II	2.828	1.112	1.41--4.87	0.036	0.082	0.00--0.23	.335	.178	.090--0.76
	III	2.690	1.044	1.37--3.81	0.000	0.000	0.00--	.324	.187	.170--0.61
	IV	3.281	0.468	2.65--3.82	0.008	0.019	0.00--0.05	.225	.052	.150--0.29
	V	3.167	0.290	2.96--3.37	0.000	0.000	0.00--	.102	.051	.070--0.14
	VI	2.705	0.372	2.31--3.05	0.000	0.000	0.00--	.197	.026	.170--0.21
1978 & 1980	VII	2.220	0.986	1.52--2.92	0.015	0.021	0.00--0.03	.168	.007	.160--0.17
	All	3.121	1.178	0.97--6.08	0.016	0.050	0.00--0.23	.347	.216	.070--1.03
		2.546	1.071	0.78--6.08	--	--	--	.281	.182	.020--1.03

Costs during 1980 were less related to firm size, with Group II markets reporting the highest cost. Groups III, V, and VI did not report any unemployment insurance cost. Group IV reported a cost of only \$.008, the lowest cost for 1980. This expense ranked as the tenth-largest variable cost in 1978, and the eleventh-largest in 1980.

Utilities. Per unit utility costs decreased as firm size increased during 1978 and 1980 (Table 6). In 1978, Group I incurred the largest utility expense, while Group VII firms reported the lowest cost. Costs declined through Group III, and again for Groups V through VII, But Group IV reported higher, rather than lower, costs. During 1980, Group I again incurred the largest per unit costs, and Group V markets reported the smallest utility expense. This was the second largest component of variable costs for both years of operation.

Travel and Auto. Expenses for travel and auto were not related to volume of output, as they varied greatly during both years (Table 7). In 1978, the highest unit costs were reported by both the smallest and largest size groups, with the intermediate size firms incurring lower costs. The high cost incurred by Group VII may be related to the amount of dealer operation activity which the firms were engaged in. The smallest cost incurred in 1978 was by Group VI, \$.034. During 1980, Group III costs were the largest, while Group VII firms reported the lowest travel and auto expenses. This cost represented the ninth-largest component of variable costs in 1978, and the tenth-largest in 1980.

Table 7. Per Unit Cost of Travel and Auto, Advertising, and Supplies, for Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980 (Actual Dollars per A.M.U.)

Year	Size Group	Travel and Auto			Advertising			Supplies		
		Mean	Std. Dev.	Range	Mean	Std. Dev.	Range	Mean	Std. Dev.	Range
1978	I	.134	.296	0.000--0.80	.052	.053	0.020--.17	.121	.050	0.07--0.20
	II	.059	.082	0.000--0.26	.078	.069	0.003--.21	.158	.130	0.06--0.57
	III	.041	.056	0.000--0.17	.057	.059	0.000--.22	.118	.065	0.01--0.25
	IV	.066	.066	0.000--0.16	.040	.025	0.010--.07	.208	.067	0.15--0.31
	V	.094	.070	0.020--0.20	.103	.108	0.010--.29	.160	.136	0.06--0.39
	VI	.034	.044	0.005--0.11	.057	.061	0.000--.16	.203	.210	0.04--0.66
	VII	.134	.154	0.000--0.35	.029	.011	0.020--.04	.159	.126	0.08--0.35
1980	All	.070	.125	0.000--0.80	.063	.063	0.000--.29	.153	.118	0.01--0.66
	I	.146	.215	0.000--0.59	.137	.146	0.000--.48	.282	.381	0.00--1.18
	II	.027	.045	0.000--0.13	.086	.085	0.000--.29	.115	.066	0.00--0.27
	III	.055	.443	0.000--1.02	.103	.095	0.000--.25	.229	.223	0.00--0.50
	IV	.033	.038	0.000--0.10	.148	.171	0.010--.44	.190	.085	0.06--0.33
	V	.187	.039	0.160--0.22	.016	.023	0.000--.03	.185	.114	0.10--0.27
	VI	.104	.172	0.004--0.30	.018	.019	0.000--.04	.051	.045	0.00--0.08
1978 & 1980	VII	.009	.013	0.000--0.02	.033	.001	0.030--.03	.044	.003	0.00--0.01
	All	.100	.198	0.000--1.02	.101	.119	0.000--.48	.184	.236	0.00--1.18
		.084	.162	0.000--1.02	.080	.094	0.080--.48	.167	.181	0.00--1.18

Advertising. Markets incur advertising costs through newspapers, radio, television, handbills, and signs. Per unit advertising expenses were lower for the larger size markets than they were for intermediate or smaller firms during both years (Table 7). In 1978, Group V reported the greatest advertising expense, with Group VII paying the smallest amount. Group IV firms in 1980 incurred the largest per unit cost, while Groups V and VI reported the lowest cost. Advertising expenses were the tenth-largest variable expense during both 1978 and 1980.

Supplies. The supplies expense included routine office supplies (postage and stationary), yard supplies (weight tickets, receipt forms), and veterinary supplies. Unit costs for supplies declined from a high of \$.282 by Group I firms to a low of \$.044 for Group VII in 1980 (Table 7). No such economies were reported in 1978, however, as costs rose from \$.121 for Group I to \$.159 for Group VII, with intermediate size markets incurring even higher costs. In 1978, Group I incurred the lowest supplies expense, with Group IV paying the largest per unit cost. This was the sixth-largest available cost in 1978 and the seventh-largest in 1980. The two-year average unit expenses was \$.167.

Rent. There appeared to be no relationship between unit rental costs and firm size during either year. The largest expense in 1978 was incurred by Group I, while Group IV firms paid the lowest rental expense. The highest rental cost in 1980 was reported by Group IV, however, and the lowest charge was by Group VI. The 1978 average

rental expense of \$.16 ranked as the fifth-largest variable cost, and the 1980 average of \$.32 was the fourth-largest such expense, seen in Table 8.

Bad Debt. This expense was abnormally high for several size groups in both 1978 and 1980, but this cost was not related to firm size (Table 8). Bad debts are reflective of a market's effectiveness in choosing good credit risks. During 1978, the highest bad debt expense was reported by Group V, and Group VII reported the lowest cost. In 1980, Group I firms had a bad debt expense of \$.73, the year's high. Groups VI and VII incurred the lowest cost, \$.03, although Groups III and V did not report a bad debt cost. In 1978, bad debt expenses were the third-largest cost, and the fifth-largest component in 1980.

Trucking. Trucking is provided for transporting livestock purchased for market support. This expense was not found to be related to market volume during either year (Table 9). The lowest cost in 1978 was paid by Groups I and III, while Group IV reported the highest expense. During 1980, Group III and Group VI incurred the lowest and highest costs, respectively. The two-year average trucking expense was \$.122, and this was the eighth-largest component of variable cost during both years.

Miscellaneous Labor. Expenses for miscellaneous labor included wages paid other than salaries of employees and owners. Also included in this category were fees paid to auctioneers, veterinarians, contract

Table 8. Per Unit Cost of Repairs and Maintenance, Rent, and Bad Debt, for Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980 (Actual Dollars per A.M.U.)

Year	Size Group	Repairs and Maintenance			Rent			Bad Debt		
		Mean	Std. Dev.	Range	Mean	Std. Dev.	Range	Mean	Std. Dev.	Range
1978	I	.177	.149	0.030--0.43	.2610	.557	0.00--1.4900	0.097	0.229	0.00--0.62
	II	.132	.104	0.010--0.33	.2050	.318	0.00--1.1300	0.273	0.502	0.00--1.69
	III	.115	.115	0.003--0.46	.1090	.344	0.00--1.2500	0.129	0.431	0.00--1.56
	IV	.112	.052	0.040--0.14	.0030	.007	0.00--0.0100	0.579	1.100	0.00--2.23
	V	.149	.106	0.040--9.31	.2350	.526	0.00--1.1800	0.376	0.619	0.00--1.43
	VI	.104	.076	0.000--0.24	.0830	.174	0.00--0.4800	0.158	0.356	0.00--0.96
	VII	.112	.126	0.010--0.29	.1950	.215	0.01--0.4500	0.061	0.043	0.00--0.09
1980	All	.129	.106	0.000--0.46	.1610	.345	0.00--1.4900	0.218	0.491	0.00--3.40
	I	.435	.456	0.050--1.53	.4420	.792	0.00--2.8100	1.734	1.100	0.00--3.40
	II	.101	.074	0.000--0.20	.3850	.716	0.00--2.1300	0.061	0.169	0.00--0.60
	III	.075	.052	0.000--0.14	.0003	.001	0.00--0.0014	0.0000	0.0000	0.00
	IV	.131	.105	0.040--0.31	.4750	.575	0.00--1.4300	0.136	0.326	0.00--0.80
	V	.143	.106	0.070--0.22	.0050	.007	0.00--0.0100	0.000	0.000	0.00
	VI	.319	.142	0.190--0.47	.0440	.040	0.00--0.0800	0.027	0.046	0.00--0.08
1978 & 1980	VII	.068	.087	0.010--0.13	.1500	.213	0.00--0.3000	0.027	0.037	0.00--0.05
	All	.219	.298	0.000--1.53	.3230	.631	0.00--2.8200	0.263	0.684	0.00--3.40
		.170	.219	0.000--1.53	.2350	.500	0.00--2.8100	0.238	0.584	0.00--3.40

Table 9. Per Unit Cost of Trucking, Miscellaneous Labor, and Miscellaneous Expenses, for Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980 (Actual Dollars per A.M.U.)

Year	Size Group	Trucking			Miscellaneous Labor			Miscellaneous Expenses		
		Mean	Std. Dev.	Range	Mean	Std. Dev.	Range	Mean	Std. Dev.	Range
1978	I	.028	0.056	0.00--0.62	.029	.046	0.00--.11	.155	.137	-0.0300--0.39
	II	.092	0.218	0.00--0.80	.064	.101	0.00--.30	.166	.242	-0.0100--0.90
	III	.034	0.050	0.00--0.15	.022	.068	0.00--.25	.187	.213	0.0100--0.67
	IV	.040	0.074	0.00--0.15	.234	.278	0.00--.56	.210	.099	0.1000--0.32
	V	.390	0.710	0.00--1.65	.065	.146	0.00--.33	.079	.092	0.0000--0.20
	VI	.040	0.084	0.00--0.23	.041	.065	0.00--.17	.235	.192	0.0000--0.45
	VII	.054	0.038	0.01--0.10	.090	.086	0.00--.21	.110	.059	0.0300--0.17
All		.084	0.249	0.00--1.65	.061	.116	0.00--.56	.170	.186	-0.0100--0.90
1980	I	.290	1.100	0.00--3.40	.219	.312	0.00--.97	.428	.420	-0.0002--1.35
	II	.072	0.172	0.00--0.64	.049	.087	0.00--.27	.183	.208	0.0001--0.75
	III	.019	0.043	0.00--0.10	.133	.278	0.00--.63	.348	.300	-0.0300--0.72
	IV	.070	0.067	0.00--0.15	.067	.097	0.00--.22	.333	.149	0.1500--0.55
	V	.089	0.115	0.01--0.17	.222	.028	0.20--.24	.074	.010	0.0700--0.08
	VI	.591	1.020	0.00--1.77	.070	.122	0.00--.21	.741	.302	0.3900--0.94
	VII	.066	0.040	0.04--0.09	.109	.154	0.00--.22	.202	.201	0.0600--0.34
All		.167	0.400	0.00--1.77	.124	.212	0.00--.97	-.328	.322	-0.0300--1.35
1978 & 1980		.122	0.327	0.00--1.77	.090	.169	0.00--.97	.242	.267	-0.0300--1.35

labor, and services such as janitorial cleaning. This cost was not related to the volume of livestock handled. Group VII firms incurred the highest per unit cost in 1978, while Group III reported the smallest expense (Table 9). During 1980, Groups I and V had the largest cost, and Group II paid the lowest unit expense. There was no pattern of consistent increases or decreases in costs for either year. This cost represented the tenth-highest variable cost in 1978, and the ninth-highest variable cost in 1980.

Miscellaneous Expenses. The miscellaneous expenses category included any other costs which were not previously accounted for. Such costs as losses on dead livestock and grading and canning were included. There was no relationship between miscellaneous costs and market size. During 1978, Group VI firms incurred the lowest costs, while the largest expenses were paid by Group IV markets (Table 9). The largest size of markets, Group VII, reported the third lowest costs. Firms in Group VI incurred the highest expenses in 1980, however, and Group V markets reported the smallest expenses. During 1978, these costs were the fourth-largest component of variable costs, and in 1980, the third-highest variable expense. The two-year average cost was \$.242.

Total Variable Costs. Average total variable costs per A.M.U. for markets during 1978 varied from a low of \$2.883 for Group III, to the high of \$4.073 for Group V (Table 10). Group VII, the largest market size, reported the second-lowest variable cost, \$3.166, followed by Group VI with a cost of \$3.292. Thus, the two largest volume groups incurred the second and third lowest variable costs. This indicates

Table 10. Per Unit Variable Costs for Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980 (Actual Dollars Per A.M.U.)

Year	Size Group	Mean	Std. Dev.	Range
1978	I	\$3.434	1.070	1.58-- 5.00
	II	3.784	0.771	2.96-- 5.48
	III	2.883	0.754	2.05-- 4.61
	IV	3.984	1.061	2.84-- 5.39
	V	4.073	0.873	3.03-- 5.03
	VI	3.292	0.783	2.24-- 4.60
	VII	3.166	0.891	2.58-- 4.47
	All	3.460	0.902	1.58-- 5.49
1980	I	\$7.350	3.433	3.17--16.25
	II	4.277	0.903	2.97-- 6.10
	III	4.176	1.144	2.15-- 4.90
	IV	5.098	0.924	3.95-- 6.44
	V	4.189	0.481	3.85-- 4.53
	VI	4.868	0.921	3.98-- 5.82
	VII	3.122	0.821	2.53-- 3.69
	All	5.293	2.443	2.15--16.25
1978 & 1980		\$4.294	1.992	1.58--16.25

that some size advantage is possible at the largest volume levels, but not at the intermediate size levels. The largest component of variable cost in 1978 was salaries, comprising 60 percent followed by utilities at 7 percent (Table 11). The average unit variable cost in that year was \$3.460.

During 1980, a similar cost-volume relationship was identified. The largest variable cost was reported by Group I, \$7.350, followed by Group IV at \$5.098. Group VII incurred the lowest unit variable cost of \$3.122, with Group III next at \$4.176 and Group V at \$4.189. Thus, the largest size of markets realized reduced costs, but costs of small and intermediate size firms varied, as the intermediate level markets (Groups IV and V) reported higher costs than markets either slightly smaller or larger. The largest component of variable costs in 1980 was, again, salaries representing 59 percent of these expenses. The second-largest variable cost was utilities, at 7 percent. The average per unit variable cost in 1980 was \$5.293.

Average Total Cost. Composed of total fixed cost and total variable cost, average total cost exhibited the same pattern as average variable cost (Table 12). Per unit total costs declined up until the intermediate size markets, where they rose again. Costs declined through the largest volumes of market size afterwards. The largest unit total cost in 1978 was incurred by Group IV firms, \$4.933. The lowest unit charge was reported by Group III at \$3.412, followed by Group VII, \$3.514 and Group VI, \$3.874.

The 1980 results behaved in a similar manner. Group I incurred the largest cost of \$8.611. Costs fell, and then alternately rose

Table 11. Specific Unit Variable Costs, Means, and Rank in Relation to Total Variable Costs, for Tennessee Livestock Auction Markets, by Year, 1978 and 1980 (Actual Dollars Per A.M.U.)

Year	Cost	Rank	% of UTC	Mean	Standard Deviation
1978	Salaries	1	60	\$2.064	0.669
	Utilities	2	7	0.226	0.125
	Bad Debt	3	6	0.218	0.491
	Miscellaneous	4	5	0.170	0.186
	Rent	5	5	0.161	0.345
	Supplies	6	4	0.153	0.118
	Maintenance	7	4	0.129	0.106
	Trucking	8	2	0.084	0.249
	Travel and Auto	9	2	0.070	0.125
	Advertising	10	2	0.063	0.063
	Unemployment Insurance	11	2	0.061	0.093
	Miscellaneous Labor	11	2	0.061	0.116
	Unit Variable Costs			\$3.460	0.900
1980	Salaries	1	59	\$3.121	1.178
	Utilities	2	7	0.347	0.216
	Miscellaneous	3	6	0.328	0.322
	Rent	4	6	0.323	0.631
	Bad Debt	5	5	0.263	0.684
	Maintenance	6	4	0.219	0.298
	Supplies	7	3	0.184	0.236
	Trucking	8	3	0.167	0.400
	Miscellaneous Labor	9	2	0.124	0.212
	Advertising	10	2	0.101	0.119
	Travel and Auto	11	2	0.100	0.198
	Unemployment Insurance	12	.30	0.016	0.050
	Unit Variable Costs			\$5.290	2.440

Table 12. Per Unit Total Costs, for Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980 (Actual Dollars Per A.M.U.)

Year	Size Group	Mean	Std. Dev.	Range
1978	I	\$4.553	1.218	2.32-- 6.35
	II	4.592	0.876	3.46-- 6.26
	III	3.412	0.840	2.35-- 5.25
	IV	4.933	1.349	3.31-- 6.47
	V	4.562	0.946	3.56-- 5.82
	VI	3.874	0.885	2.52-- 5.40
	VII	3.514	1.067	2.79-- 5.10
	All	4.160	1.070	2.32-- 6.47
1980	I	8.611	3.692	3.50--16.97
	II	5.099	1.024	3.48-- 6.95
	III	5.339	1.559	2.75-- 6.80
	IV	5.885	0.880	4.59-- 6.95
	V	5.507	0.916	4.86-- 6.16
	VI	5.679	0.895	4.79-- 6.58
	VII	3.366	0.839	2.77-- 3.96
	All	6.277	2.699	2.75--16.97
1978 & 1980		5.124	2.240	2.32--16.97

and declined between Groups III and VII. Group VII reported the lowest charges, \$3.366, while Group II firms incurred the second lowest unit total cost. A significant cost advantage was thus realized by the largest group of markets. Groups V and VI, although incurring costs lower than those reported by the smallest market volumes, did not achieve costs as low as those markets handling volumes between 9,000 A.M.U.'s and 27,000 A.M.U.'s.

These higher costs for markets in Groups V and VI may have led to the decline in the number of auctions in these categories between 1978 and 1980. Reference to Table 1, page 27 indicates that the number of markets in Group V fell from five in 1978 to two in 1980. The number of auctions in Group VI declined also, from seven in 1978 to three in 1980. The number of firms in Group I, however, doubled between 1978 and 1980.

The structure of unit total cost, shown in Table 13, for all auction markets in this study, indicates that salaries was the largest component of costs. Representing 50 percent of unit total costs, this variable input comprises a much larger proportion of total costs than any other expense. Insurance ranked as the second-largest component of average total cost, but it comprised only 7 percent of ATC.

Reference to Table 6 and Table 12 indicates that during 1978 and 1980, the size group which reported the lowest salaries expense per unit also incurred the lowest average total cost. This confirms the belief that utilizing labor more efficiently could significantly decrease ATC for a market. As labor costs continue to rise, more efficient organization and utilization of labor will become crucial to livestock auction market profitability and survival.

Table 13. Specific Unit Costs, Means, and Rank in Relation to Total Costs, for All Tennessee Livestock Auction Markets, 1978 and 1980 (Actual Dollars Per A.M.U.)

Cost Category	Rank	Mean Unit Cost	Standard Deviation	% of Total Costs
Salaries	1	\$2.546	1.071	49.7
Insurance	2	0.338	0.199	6.6
Utilities	3	0.281	0.182	5.5
Miscellaneous	4	0.242	0.267	4.7
Bad Debt	5	0.238	0.584	4.6
Rent	6	0.235	0.500	4.6
Taxes	7	0.204	0.181	4.0
Maintenance	8	0.170	0.219	3.3
Supplies	9	0.167	0.181	3.3
Depreciation	10	0.131	0.168	2.6
Interest	11	0.122	0.193	2.4
Trucking	12	0.122	0.327	2.4
Miscellaneous Labor	13	0.090	0.169	1.8
Travel and Auto	14	0.084	0.162	1.6
Advertising	15	0.080	0.094	1.6
Legal Fees	16	0.054	0.127	1.1
Licenses and Premiums	17	<u>0.023</u>	0.056	0.4
Total Costs		\$5.124		

Although insurance expenses are the second-largest component of average total cost, these costs seem to offer less opportunity for significant cost reductions in ATC. Because both unemployment insurance and other insurance are included in this category, fixed and variable expenses are to be considered. Little opportunity may exist to increase the efficiency with which insurance inputs are used.

Utilities and miscellaneous expenses also were ranked highly in the composition of average total cost, although these represented only 6 and 5 percent, respectively, of ATC. These variable costs offer additional opportunity to reduce operating expenses by more efficient use of utilities and a more conscientious awareness of charges made to the miscellaneous account.

II. ASSET ANALYSIS

Several important categories of assets held by livestock auction markets were also examined. In attempting to establish a relationship between the actual dollar value of the asset and market output, useful descriptive information concerning the various sizes of markets was obtained.

Current Assets

Accounts Receivable. Group averages for total accounts receivable indicated that no relationship existed between auction market volume and the value of this current asset. During 1978, the largest auctions reported the smallest accounts receivable, and the smallest auctions held the second-smallest account. Firms in Group III, handling 18,000 to 26,999 A.M.U.'s, reported the largest receivable asset.

For markets operating in 1980, Group V firms held the lowest value of this account, while markets in Group II reported the largest value. The average accounts receivable asset value in 1978 was \$57,439, but this figure increased to \$66,417 for firms in 1980 (Table 23, Appendix).

Total Current Assets. This value included cash, inventories, marketable securities, accounts receivable, notes receivable, and other current assets. Market volume was not related to this asset except for the smallest size group. Auctions in Group I reported the lowest value of total current assets, while Group III firms held the largest. During 1980, markets in Group I also had the smallest value, with Group V reporting the greatest amount of current assets. The value of total current assets rose from an average of \$80,376 in 1978 to \$89,186 during 1980 (Table 23, Appendix).

Fixed Assets

Land Value. The fixed asset of land value reflects the worth of the property upon which the auction is located. Because the P&SA Form 130 did not specify, the value reported may have been either the current value or the purchase price of the land when it was obtained.

The land value of markets was consistent with the volume of livestock handled for auctions in 1978, but not in 1980. The firms with the least level of output reported the lowest land value in 1978 and 1980. Group VII, the largest size of markets, had the greatest value of this fixed asset in 1978, but Group II firms reported the largest value in 1980. The two-year average land value of markets was \$16,171 (Table 23, Appendix).

Depreciated Building Value. The method of depreciation used by markets may vary, but the value reported by auctions was treated as though these were comparable. Group I firms had the lowest value for both years, which was consistent with the land value results. During 1978, markets in Group III reported the largest depreciated building value, while Group VI firms had the largest value in 1980. The 1978 average for this fixed asset was \$50,556, and this value had risen to \$53,285 by 1980 (Table 24, Appendix).

Total Fixed Assets. For markets operating in 1978, a direct relationship existed between total fixed assets and the volume of livestock handled. The lowest and highest values for total fixed assets were reported by the smallest and largest sizes of markets. During 1980, the smallest asset value was again held by Group I, but the largest account was reported by firms in Group II. This was due to Group II's largest land value and second-largest depreciated building value. The average total fixed asset value for all markets in both years was \$59,792 (Table 24, Appendix).

Total Assets. Although the value of all assets rose as market volume increased, the largest amount of total assets owned was not reported by the Group VII markets. During 1978 and 1980, Group I firms held the lowest value of assets. Group III reported the largest total assets in 1978, but a large portion of this value was in the form of accounts receivable. In 1980, Group II markets had the greatest asset value. Thus, the highest total assets figures were reported by the two groups which also reported the largest accounts

receivable value. This may indicate that these smaller auctions were slower in collecting those accounts due them, or they may have been more willing to extend credit to buyers than the markets of larger size. The value of total assets increased from \$137,042 in 1978 to \$141,270 in 1980 (Table 24, Appendix). Results for 1980, however, did not include values for the Group VII markets, because these firms did not include this information on the Form 130.

III. LIABILITIES ANALYSIS

Total Current Liabilities

The actual dollar value of liabilities represents total accounts which are due and payable within one year. No relationship was found between market volume and current liabilities. During 1978, firms in Group II reported the lowest value, while Group III owed the largest amount. Group IV reported the second-highest current debt, although this situation changed in 1980, as Group IV incurred the lowest total value for that year. Firms in Group II had the largest current liability value in 1980. This liability rose from a 1978 average of \$43,159 to \$53,370 in 1980 (Table 25, Appendix).

Long Term Liabilities

The total value of this liability indicates mortgage payments or other payments not due within the current year. The lowest of these accounts was owed by Group I in 1978 and Group III reported the largest value. Group III also incurred the largest current liabilities in that year. The same results were found in 1980, with Groups I and III

reporting the least and greatest values. The overall average long term liabilities due for 1978 and 1980 was \$30,803 (Table 25, Appendix), with the largest group of firms not reporting a value for the account.

IV. NET WORTH ANALYSIS

Total Net Worth

The actual dollar value of total net worth represents the difference between total assets and total liabilities. Market volume and total net worth were not related for either year of operation. During 1978, Group V firms reported the greatest net worth value, with Group I reporting the least worth. Group VII markets had the second-lowest value. Group I reported the lowest net worth in 1980, while Group III markets had the largest (Table 25, Appendix). The average total net worth in 1978, \$87,075, declined to \$71,154 in 1980. Group VII did not indicate a 1980 value for net worth.

Net worth was also examined by the components of preferred capital stock, common capital stock, paid-in capital, and retained earnings for incorporated firms, and owners' capital and undivided profits for unincorporated markets. Results of this analysis are given in Table 26, Appendix.

Common capital stock and retained earnings were the two forms of net worth more commonly reported for corporations. Owners' capital and undivided profits were both indicated by unincorporated markets. Group VII did not include any values for the 1980 specific forms of worth.

V. SOURCES OF REVENUE

Selling Commissions

The main source of revenue per A.M.U. for Tennessee auction markets was from selling commissions collected when livestock is sold through the sale. The amount of the commission varies with the species of livestock, the selling price, weight or sex of the animal, and maybe a percentage of the sale price, a fixed rate per head, or a combination of these two methods.

Revenue per A.M.U. received from this source was the greatest for Group I markets and the least for firms in Group V during 1978, with a range of \$3.82 to \$5.42 per A.M.U. (Table 14). Group VII reported the second-lowest per head commissions, indicating that the smaller markets received a larger amount per A.M.U. sold. In 1980, Group I again reported the largest selling commissions revenue, while Group VII firms received the smallest per A.M.U. revenue.

Yardage

This was the second-largest component of auction market revenues. Yardage receipts per A.M.U. were highest for Group V in 1978 and lowest for Group IV (Table 14). In 1980, however, Group IV firms received the largest returns from this source, while Group V reported the lowest yardage receipts. There was no relationship between volume and returns from yardage, but Group VII firms did not report income from this source during either year. The average return for all firms in both years as \$0.37 per A.M.U.

Table 14. Gross Returns from Selling Commissions and Yardage for Tennessee Livestock Auction Markets, by Group, 1978 and 1980 (Actual Dollars Per A.M.U.)

Year	Size Group	Selling Commissions		Yardage	
		Mean	Std. Dev.	Mean	Std. Dev.
1978	I	5.42	0.920	0.130	0.237
	II	4.49	1.408	0.170	0.320
	III	4.04	1.644	0.330	0.960
	IV	4.97	0.634	0.010	0.020
	V	3.82	0.868	0.860	1.045
	VI	4.05	1.043	0.350	0.453
	VII	3.89	1.090	0.000	0.000
	All	4.38	1.315	0.264	0.626
1980	I	7.10	2.030	0.310	0.496
	II	4.91	1.560	0.630	1.428
	III	5.95	2.240	0.200	0.438
	IV	4.56	1.500	1.260	1.454
	V	6.51	1.300	0.030	0.037
	VI	5.03	1.040	0.320	0.550
	VII	3.53	0.650	0.000	0.000
	All	5.66	1.986	0.494	1.027
1978 & 1980		4.96	1.767	0.370	0.836

Other Sources

Various other sources of revenue contributed to total auction market receipts, including: buying commissions, other commissions, feed account, rent, interest, and other sources. Of these, the largest component was other sources. These sources of revenue are summarized in Table 27, Appendix, but they did not contribute significantly to the total returns of most auction markets.

VI. RETURNS TO LIVESTOCK AUCTION MARKET OPERATORS

Gross Returns

Gross returns represent total receipts collected by auctions from the sources of revenue previously discussed, before operating costs are paid. Total gross returns earned by markets during 1978 were highest for Group VII firms, \$299,302, and lowest for Group I, \$32,219 (Table 15). Auction size and gross receipts were thus directly related in that year. The average gross return for all markets in 1978 was \$122,858.

During 1980, the smallest auctions again reported the smallest gross returns. Larger sizes of markets continued to receive higher returns through Group VI, with Group VI grossing the largest amount. \$304,346. Group VII firms reported the next-largest receipts. The average gross returns for 1980 firms was \$118,002, declining 38 percent from 1978. The largest markets received the largest gross returns.

Net Returns

These returns are received by markets following payment of operating costs. Auctions received total net returns between \$1280 for

Table 15. Average Gross Returns and Average Net Returns to Tennessee Livestock Auction Market Operations, by Size Group, 1978 and 1980 (Actual Dollars)

Year	Size Group	Gross Returns		Net Returns	
		Mean	Std. Dev.	Mean	Std. Dev.
1978	I	32,219	14,691	6,796	6,101
	II	65,185	23,271	1,280	9,950
	III	93,513	25,115	19,675	20,316
	IV	155,529	14,714	17,227	27,141
	V	189,348	33,418	9,372	16,176
	VI	224,598	46,449	24,489	39,493
	VII	299,302	127,973	26,603	13,463
	All	122,858	88,777	13,017	21,271
1980	I	44,906	18,758	1,106	11,486
	II	76,153	19,168	9,988	16,793
	III	124,113	44,920	12,749	27,616
	IV	205,745	47,241	14,819	21,394
	V	237,747	12,835	10,057	36,514
	VI	304,346	56,670	42,649	41,201
	VII	244,840	74,221	7,312	7,409
	All	118,002	88,368	10,232	121,081
1978 & 1980		120,646	88,181	11,749	21,125

Group II and \$26,603 for Group VII in 1978 (Table 15). These results are similar to the gross returns values for that year. Groups I and VI reported the second-lowest and highest returns, respectively, indicating a relationship between market size and operating costs. The average net return for firms in 1978 was \$13,017.

Markets in Group I received the lowest returns during 1980, \$1106, while Group VI reported the largest net returns of \$42,649. The two extreme values of gross and net returns correspond directly. Groups I through IV also showed a direct relationship between size and net returns, but results beyond these groups varied. Group I reported the largest average total costs in 1980, and this combined with the smallest gross returns, led to the low net returns for this level of volume. Group VII markets incurred the lowest average total costs in 1980, however, and these firms received the second-smallest net returns. For markets operating in 1980, gross and net returns were related, although average total cost and net returns were not. The 1980 firms averaged a net return of \$10,232, a decrease from the 1978 figure.

Measures of Return

Six ratios or measures of returns to various categories were determined for the markets. These allow for comparison of the returns or profitability of alternate sizes of auction market operation.

Gross Returns per Dollar of Net Worth. This figure indicates the return to capital stock, retained earnings, or undivided profits. There was no relationship between market volume and the value of this ratio (Table 16). Returns varied widely among groups. During 1978,

Table 16. Gross Returns to Various Accounts, for Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980 (Actual Dollars Per A.M.U.)

Year	Size Group	Gross Returns Per Dollar of Net Worth			Gross Returns Per Dollar of Total Assets			Gross Returns Per A.M.U. Sold		
		Mean	Std. Dev.		Mean	Std. Dev.		Mean	Std. Dev.	
1978	I	1.497	1.216		1.237	1.106		5.688	0.518	
	II	7.479	25.422		1.725	2.405		4.694	1.306	
	III	3.337	6.152		1.382	1.214		4.361	1.296	
	IV	2.138	1.131		1.412	0.725		5.010	0.598	
	V	7.550	8.257		6.870	8.671		4.820	0.903	
	VI	2.280	1.281		1.760	1.365		4.370	0.908	
	VII	3.950	0.460		2.130	0.710		3.880	1.100	
1980	All	4.319	13.073		2.086	3.313		4.676	1.146	
	I	2.088	4.218		2.398	2.895		8.195	3.290	
	II	14.182	43.538		1.190	1.022		5.819	1.157	
	III	0.518	7.924		2.631	2.821		6.000	2.287	
	IV	7.280	9.165		7.150	9.255		6.370	1.270	
	V	4.760	4.773		1.880	1.559		5.840	0.039	
	VI	2.190	0.922		1.400	0.448		6.610	1.254	
1978 & 1980	VII	--	--		--	--		3.480	0.720	
	All	7.037	26.500		2.495	3.936		6.584	2.394	
		5.520			2.270			5.550		

Groups V and II had the greatest gross returns per dollar of net worth. Group I firms reported the lowest return. During 1980, Group II returned the largest amount, while the lowest value was reported by Group III. The average return in 1978 and 1980 was \$5.52.

Gross Returns per Dollar of Total Assets. This ratio shows the total returns earned by the market for each dollar of asset, and a higher ratio indicates higher returns to assets. Firms in Group V returned the largest amount per dollar of assets during 1978, \$6.87, and the lowest return was reported by Group I, \$1.24 (Table 16). The average return in 1978 was \$2.09.

During 1980, Group IV returned the year's highest value of \$7.15, with Group II yielding the lowest value of \$1.19. The 1980 average ratio was \$2.27. These results were too varied to conclude that output and returns per dollar of asset are related.

Gross Returns per A.M.U. Sold. This average reflects the total return received per A.M.U. handled. A definite relationship existed between volume and per head returns, as the smallest markets earned the largest returns and large markets earned the smallest returns in both years (Table 16). During 1978, Group I firms received the high of \$5.70 while Group VII reported the low return of \$3.88. These same results were obtained in 1980, with the range of returns between \$3.48 and \$8.19. All markets averaged \$5.55 gross return per A.M.U. in 1978 and 1980.

Net Returns per Dollar of Net Worth. The net ratios were calculated after operating expenses were deducted. These may be more revealing indicators of firm efficiency. Group VII firms yielded the largest return in 1978, \$.51, with Group II reporting the lowest value, -\$.21 (Table 17). During 1980, however, Group II markets returned the year's high of \$1.00. Group III firms had a return to net worth of \$.81. These results indicate that net returns per dollar of net worth vary considerably from year to year, with volume playing little role in the size of the net return. The two-year average net return to net worth was \$.23.

Net Returns per Dollar of Total Assets. The actual yield on each dollar invested in the market is given by this ratio. Firms in Group I returned the largest amount in 1978, \$.38, and Group II markets had a negative yield of \$.05 for the year's low value (Table 17). During 1980, Group VI markets returned \$.16 for the highest amount, and the lowest return was -\$.07 by Group I. These figures show an inconsistency, as Group I returned the largest value in 1978 but the lowest value in 1980. The average return per dollar of assets was \$.11.

Net Returns per A.M.U. Sold. There was no relationship between volume and net returns per A.M.U. handled (Table 17). During 1978, Group I had the highest return, \$1.12, while Group II reported the low value of \$.09. In 1980, Group VI firms returned the largest value, \$.93, and the lowest return was from Group I, \$.04. The overall net return for 1978 and 1980 was \$.49.

Table 17. Net Returns to Various Accounts, for Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980 (Actual Dollars Per A.M.U.)

Year	Size Group	Net Returns Per Dollar of Net Worth		Net Returns Per Dollar of Total Assets		Net Returns Per A.M.U. Sold	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1978	I	0.436	0.695	0.383	0.630	1.124	0.813
	II	-0.207	0.511	-0.047	0.327	0.088	0.720
	III	0.306	0.393	0.187	0.231	0.923	0.995
	IV	0.223	0.324	0.192	0.251	0.517	0.832
	V	0.210	0.425	0.210	0.410	0.250	0.412
	VI	0.270	0.451	0.230	0.414	0.480	0.767
	VII	0.510	0.360	0.240	0.080	0.370	0.220
1980	I	0.042	0.894	-0.073	0.600	0.041	2.173
	II	1.000	3.040	0.110	0.106	0.698	1.142
	III	-0.813	1.896	0.115	0.324	0.621	1.355
	IV	0.090	0.225	0.080	0.218	0.470	0.658
	V	-0.150	0.522	-0.030	0.221	0.270	0.910
	VI	0.150	0.292	0.160	0.196	0.930	0.896
	VII	--	--	--	--	0.110	0.117
1978 & 1980		0.230		2.270		0.490	

VII. SUMMARY OF RESULTS

Results of the cost analysis for 1978 indicate that significant decreases in average fixed cost occurred as firm size increased from Group I to Group VII. In 1980, the largest AFC was reported by Group V, while the largest markets again incurred the lowest average fixed cost. Other insurance was the largest component of AFC, comprising 36 percent, followed by taxes at 25 percent.

Some cost-size advantage existed with average variable cost at the largest volume levels, but not at intermediate sizes. Salaries was the single largest variable expense representing 60 percent. The two-year average variable cost was \$4.33 per A.M.U. (1978 dollars).

Average total cost generally declined up to the intermediate sizes of auctions, where they rose again. Following these increases, costs again declined through the largest volume levels. The two-year ATC was \$5.12. Markets in the intermediate size groups incurred higher costs on the average than either smaller or larger markets. This may have led to the decline in number of auctions in size groups V and VI between 1978 and 1980, while the number of smallest markets doubled between the two years.

The largest component of ATC was salaries, comprising 50 percent of ATC. The group with the lowest salaries expense in both years also incurred the lowest ATC.

Land value and total fixed assets were the only asset values which were related to market volume. The smallest markets reported the lowest values for both categories during 1978 and 1980, but the largest values were not consistent with market size. Total assets were related

to the accounts receivable value. The smallest markets also reported the lowest total assets.

There was no relationship between size of market and any category of liabilities or net worth. This lack of relationship existed for both 1978 and 1980.

Selling commissions, which are collected on each head of livestock sold, were the main source of revenue for auctions in both years. The lowest per A.M.U. revenues from this source were received by the larger markets, with the smallest Group I firms reporting the largest per A.M.U. commissions from sales in each year. Yardage was the second-largest source of revenue, although there was no relationship between size and yardage per A.M.U.

A distinct cost-size relationship existed for both total gross returns and total net returns. In both years, total gross returns and total net returns were lowest for the smallest markets and highest for the largest firms. Gross returns per A.M.U. sold and market size were definitely related, however. The smallest markets received the largest amount of return per A.M.U. sold and the largest firms received the least gross returns per A.M.U. No relationship existed between net returns per A.M.U. sold and market size, or between market size and gross returns per dollar of net worth or per dollar of total assets.

CHAPTER IV

ESTIMATION OF COST FUNCTIONS

The four functional forms previously described were used in regressions of average fixed cost against volume, average variable cost against volume, and average total cost against volume. Observations from 1978 and 1980 (deflated) were combined into one data set.

I. AVERAGE FIXED COST FUNCTION

Regression results from the four models are shown in Table 18. The overall regression for Model (1) was significant at the 0.99 probability level. The b_1 estimate was significant at the 0.95 level, but the b_2 estimate was not significantly different from zero. The signs on the estimates of b_1 and b_2 conformed to those expected from economic theory. This model produced the lowest coefficient of determination (R^2).

Model (2) produced overall regression results and a b_1 estimate which were significant at the 0.99 level. The coefficient of determination was larger than that received from the previous model, indicating improved explanation of the variance in Y. Model (3) gave results similar to those produced by Model (2) for the entire model and the b_1 estimate.

Model (4) yielded highly significant overall regression results and a b_1 estimate (0.99 level), but the second explanatory variable, $\frac{1}{X^2}$, was not significant at the 0.95 level. This model was chosen as

Table 18. Unit Fixed Cost Functions for Tennessee Livestock Auction Markets, 1978 and 1980

Model	Parameter Estimates			R^2
	a	b_1	b_2	
(1) $Y = a + b_1 X + b_2 X^2$	1.203	-2.118E-5 (0.763E-5)	1.486E-10 (9.9715E-11)	.174
(2) $Y = a + b_1 \frac{1}{X}$	.624	2459.523 (458.458)	--	.225
(3) $\ln Y = a + b_1 \ln X$	2.825	-.32613 (.067)	--	.198
(4) $Y = a + b_1 \frac{1}{X} + b_2 \frac{1}{X^2}$	.527	4415.637 (1261.615)	-4182411.352 (2516419.92)	.246

the appropriate average fixed cost (AFC) function representing the Tennessee livestock auction market industry because it yielded the largest coefficient of determination of any model used.

Average fixed cost and volume were inversely related (Table 4, page 35). Average fixed cost per A.M.U. declined most rapidly as auction volume rose to 30,000 A.M.U.'s, with 79 percent of the cost economies realized at this volume (Table 19). The AFC function is shown in Figure 2.

II. AVERAGE VARIABLE COST FUNCTION

Model (1) produced an overall regression which was significant at the 0.99 level and an estimate of b_1 significant at the 0.95 level for average variable cost (AVC), as shown in Table 20. The lowest coefficient of determination (R^2) was received from this model.

The Model (2) b_1 estimate and total regression were significant at the 0.99 level, with a larger R^2 . Model (3) also yielded a b_1 estimate significant at the 0.99 level, although the coefficient of determination was lower than the previous model.

Model (4) again provided the largest coefficient of determination. This model was selected as the AVC estimate for auction markets in Tennessee.

Along the AVC function estimated by Model (4), substantial decreases in average variable cost per A.M.U. occurred in auction operations up to an output level of 30,000 A.M.U.'s. At this volume level, 80 percent of the economies of size were captured. This is consistent with the AFC results, and indicates that markets operating below 30,000 A.M.U.'s

Table 19. Cost Economies Realized Along Average Fixed Cost and Average Variable Cost Functions for Tennessee Livestock Auction Markets, 1978 and 1980, Estimated by Ordinary Least Squares

Volume (A.M.U.)	Percent of Cost Economies Realized	
	Average Fixed Cost ^a (%)	Average Variable Cost ^b (%)
3,000	34	41
5,000	43	47
10,000	57	60
20,000	71	73
30,000	79	80
40,000	82	84
50,000	85	87
60,000	88	89

^aPercent cost economies realized was defined as the difference between estimated average fixed cost (AFC) at the minimum observed volume and estimated AFC at the volume under consideration, divided by the difference between estimated AFC at the minimum observed volume and estimated AFC as the asymptotic minimum of the function

$$\frac{AFC_{\text{min.vol.}} - AFC_{\text{vol.i}}}{AFC_{\text{min.vol.}} - AFC_{\text{asympt.min.}}} .$$

^bPercent cost economies realized was defined as the difference between estimated average variable cost (AVC) at the minimum observed volume and estimated AVC at the volume under consideration, divided by the difference between estimated AVC at the minimum observed volume and estimated AVC at the asymptotic minimum of the function

$$\frac{AVC_{\text{min.vol.}} - AVC_{\text{vol.i}}}{AVC_{\text{min.vol.}} - AVC_{\text{asympt.min.}}} .$$

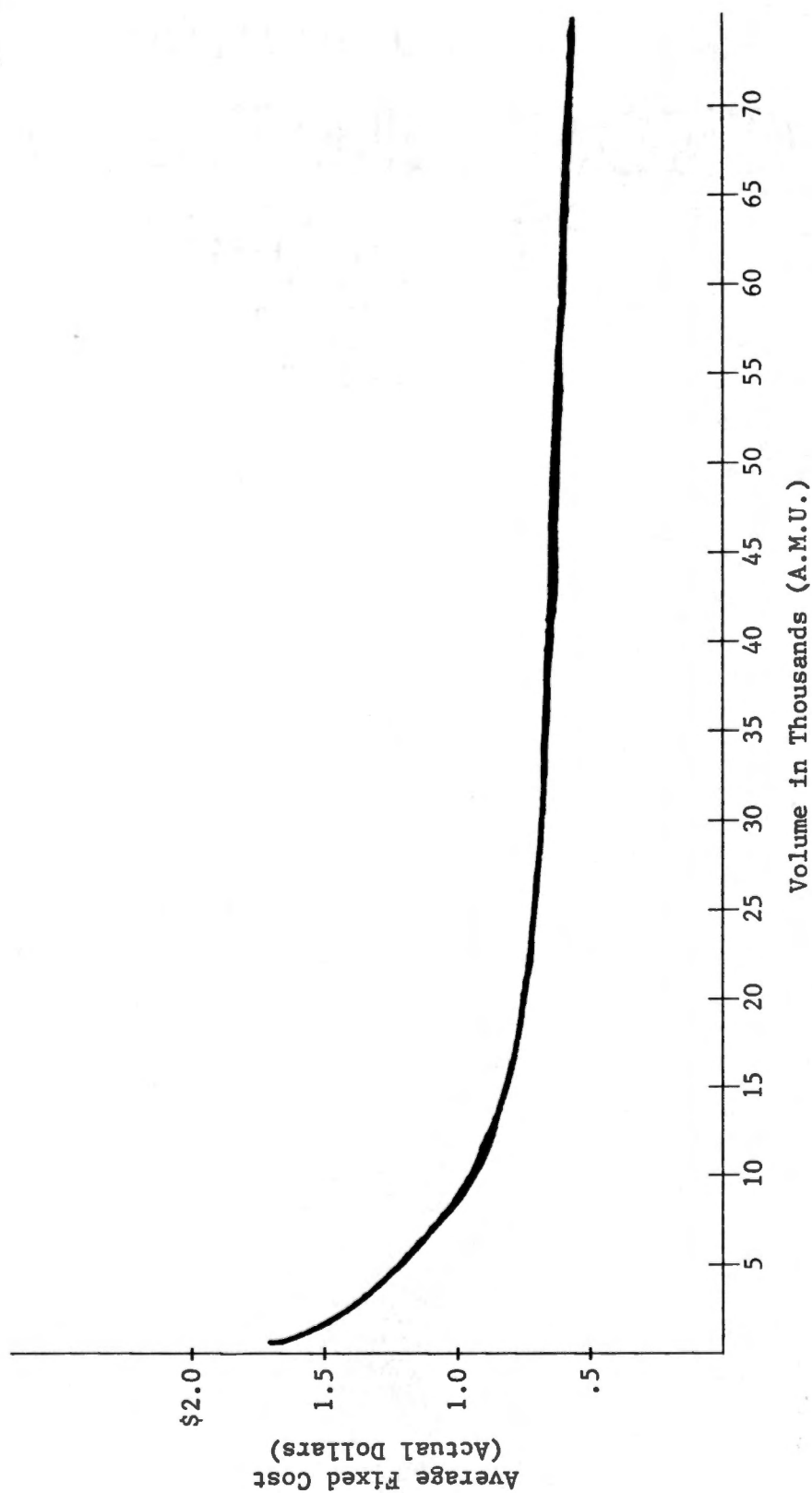


Figure 2. Average Fixed Cost Function for the Tennessee Livestock Auction Market Industry Using Ordinary Least Squares Method (1978 and 1980 Data Combined)

Table 20. Unit Variable Cost Functions for Tennessee Livestock Auction Markets, 1978 and 1980

Model	Parameter Estimates			R^2
	a	b_1	b_2	
(1) $Y = a + b_1X + b_2X^2$	5.796	-9.912E-5 (0.315E-5)	-9.912E-10 (0.315E-5)	.127
(2) $Y = a + b_1 \frac{1}{X}$	3.591	8400.233 (1913.233)	--	.163
(3) $\ln Y = a + b_1 \ln X$	2.958	-.161 (.041)	--	.133
(4) $Y = a + b_1 \frac{1}{X} + b_2 \frac{1}{X^2}$	2.892	22548.860 (5115.226)	-30251490.67 (10202841.927)	.232

are most capable of reducing operating costs by expanding volume. This is a realistic objective, as 68 of the observations sold less than 27,000 A.M.U.'s during 1978 and 1980. Table 19 shows the cost economies captured at various output levels, and Table 10, page 47, indicates that AVC varied inversely with output. The AVC function for Tennessee livestock auction markets is illustrated in Figure 3.

III. LONG RUN AVERAGE TOTAL COST FUNCTION

Ordinary Least Squares Estimation

Model (1) gave total regression results significant at the 0.99 confidence level, but the b_1 and b_2 estimates were significant only at the 0.95 level (Table 21). The signs of the coefficients were consistent with expected signs from economic theory. This model provided the least explanation of variability in average total cost (ATC).

Model (2) produced a b_1 estimate and overall regression results which were significant at the 0.99 level. The amount of variability explained by this model increased above Model (1). Model (3) yielded a lower coefficient of determination, but b_1 and the entire regression model were also significant at the 0.99 level.

The Model (4) overall regression was significant at the 0.99 level, but the b_1 and b_2 estimates were significant at the 0.95 level. The largest coefficient of determination was provided by this model. The estimate given by Model (4) was selected as the ordinary least squares method LRATC function for the Tennessee livestock auction market industry because it provided the largest coefficient of determination.

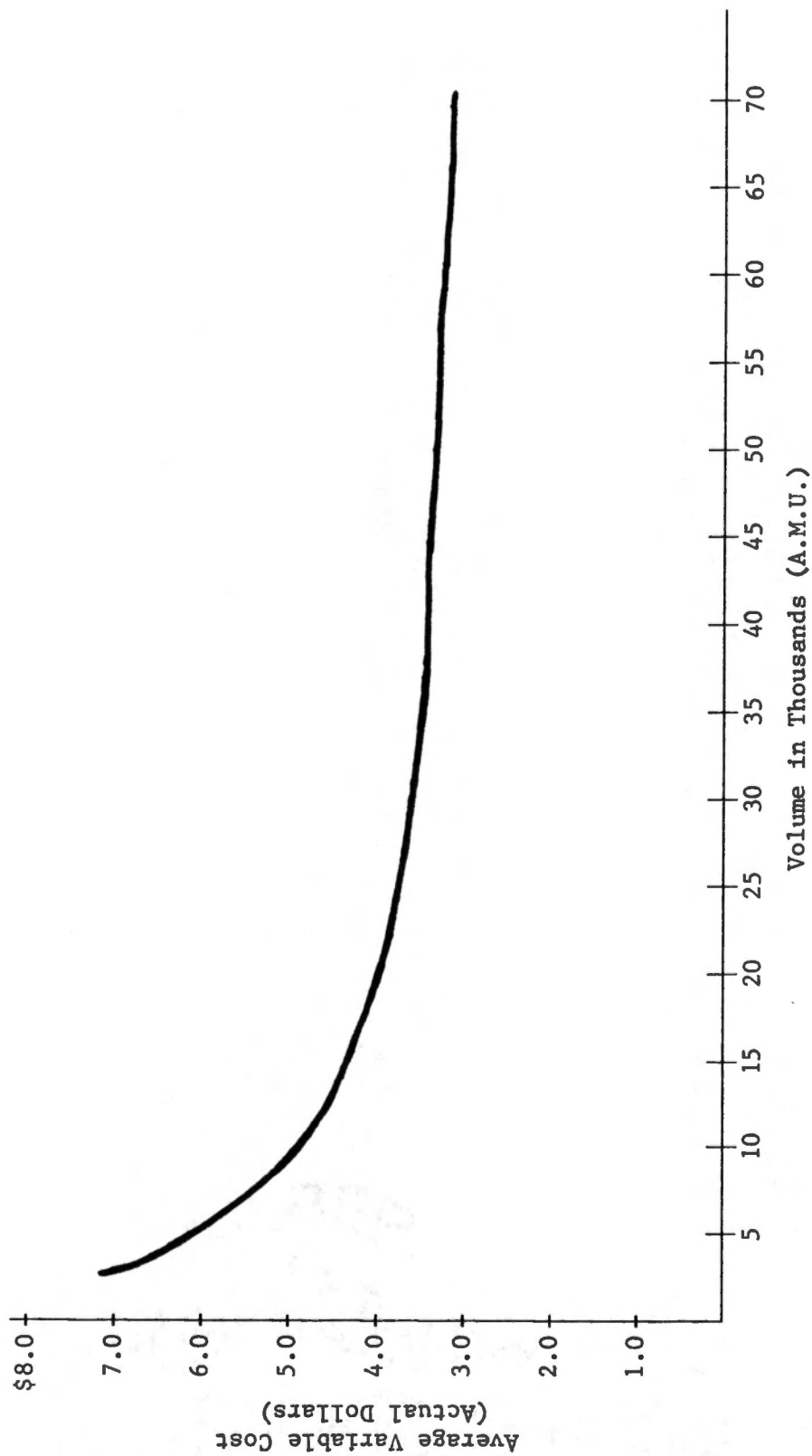


Figure 3. Average Variable Cost Function for the Tennessee Livestock Auction Market Industry Using Ordinary Least Squares Method (1978 and 1980 Data Combined)

Table 21. Long Run Average Total Cost Functions for Tennessee Livestock Auction Markets, 1978 and 1980

Model	Parameter Estimates			R ²
	a	b ₁	b ₂	
<u>Ordinary Least Squares Estimates</u>				
(1) Y = a + b ₁ X + b ₂ X ²	6.998	-.0001203 (.0000347)	1.105E-9 (0.453E-9)	.164
(2) Y = a + b ₁ $\frac{1}{X}$	4.215	10859.756 (2084.052)	--	.215
(3) ln Y = a + b ₁ ln X	3.426	-.19062 (.03919)	--	.193
(4) Y = a + b ₁ $\frac{1}{X}$ + b ₂ $\frac{1}{X^2}$	3.420	26964.497 (5547.660)	-34433902.026 (11065375.041)	.286
<u>MAD Estimate of Frontier Function</u>				
(4) Y = a + b ₁ $\frac{1}{X}$ + b ₂ $\frac{1}{X^2}$	2.050	7929.66	-5749146.97	

Minimum Absolute Deviation Estimation

The objective function used in estimating the frontier function estimate of LRATC was of the Model (4) form. The linear programming problem was:

$$\begin{aligned}
 \text{Maximize:} \quad & b_0^n (1) + b_1^n (-1) + b_2 \sum_{i=1}^n \frac{1}{X_i} + b_3 \sum_{i=1}^n \frac{-1}{X_i} + b_4 \sum_{i=1}^n \frac{1}{X_i^2} + \\
 & b_5 \sum_{i=1}^n \frac{-1}{X_i^2} \\
 \text{Subject to:} \quad & b_0 (1) + b_1 (-1) + b_2 \frac{1}{X_1} + b_3 \frac{-1}{X_1} + b_4 \frac{1}{X_1^2} + b_5 \frac{-1}{X_1^2} \leq Y_1 \\
 & \vdots \quad \quad \quad \vdots \quad \quad \quad \vdots \quad \quad \quad \vdots \quad \quad \quad \vdots \\
 & b_0 (1) + b_1 (-1) + b_2 \frac{1}{X_n} + b_3 \frac{-1}{X_n} + b_4 \frac{1}{X_n^2} + b_5 \frac{-1}{X_n^2} \leq Y_n
 \end{aligned}$$

Results of the linear programming solution are shown in Table 21 and Figure 4. If measurement error did not lead to misestimation of the frontier function, this LRATC estimate represents the minimal operating expenses obtainable at various given levels of output.

Comparison of OLS and MAD Estimates

The OLS approach describes the mean current cost conditions of Tennessee markets at one point in time. It yields a cost estimate of expected SRATC conditions over a range of volumes and this approach indicates where opportunities exist for cost reductions in existing average market operations. The OLS function may overestimate the range over which economies of size occur in the long run, since firms may be operating at some level along their individual SRATC curves other than the tangency point with the envelope curve. The OLS LRATC function only represents the average costs obtainable by various levels of

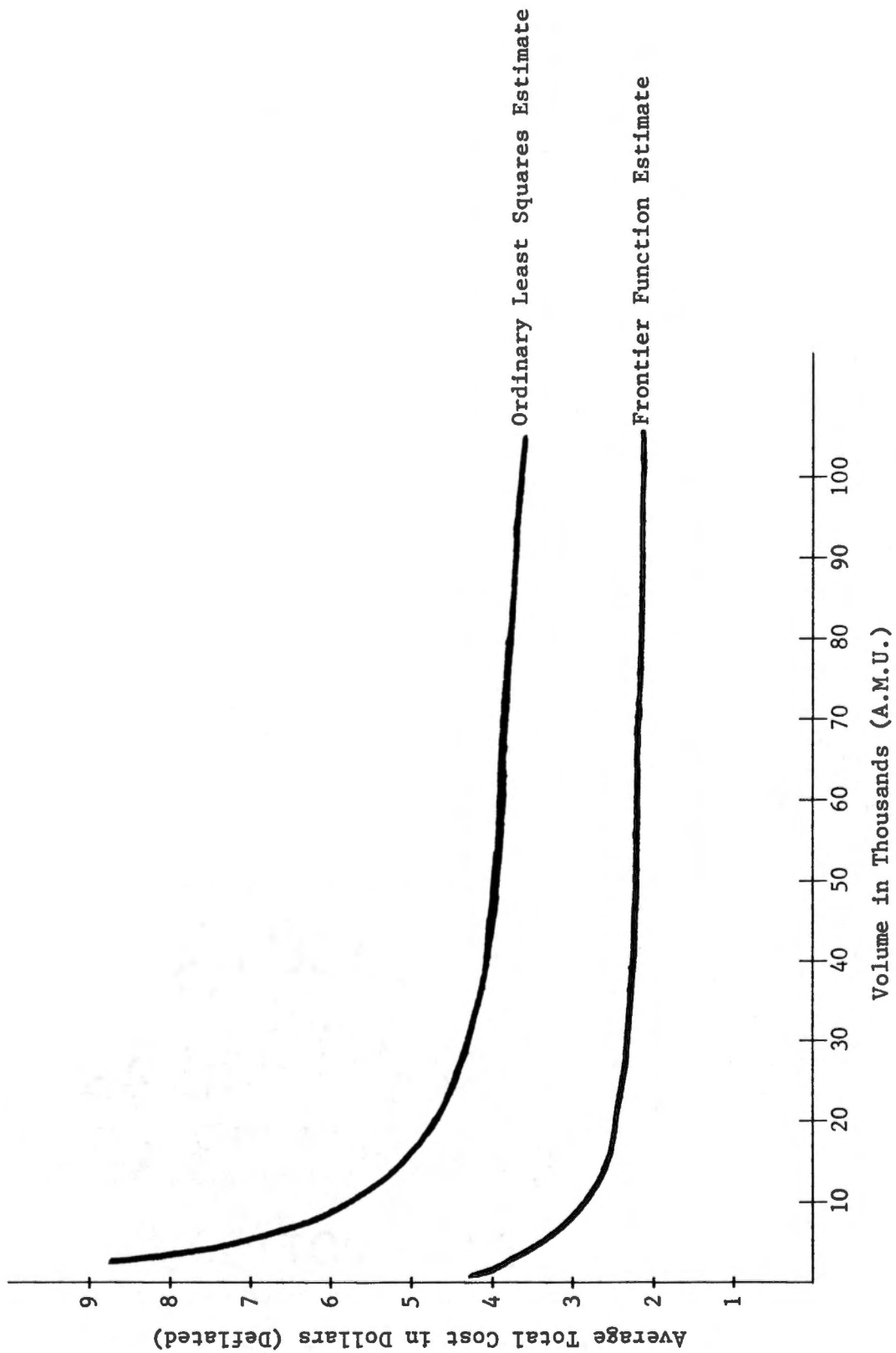


Figure 4. Long-Run Average Total Cost Functions for the Tennessee Livestock Auction Market Industry Using Ordinary Least Squares and Frontier Function Methods (1978 and 1980 Data Combined)

output, not the minimal operating costs which may be possible in long run operations. Thus, the OLS approach should not be considered an accurate long run estimator of available cost economies.

The frontier function provides a more theoretically appealing LRATC estimate for the industry because it embodies the envelope concept to the various SRATC curves. In the long run, markets are free to enter and leave the industry, and existing firms can make long run adjustments in market operation such as capital improvements to alter capacity. The frontier function thus illustrates the minimal obtainable cost level for various volume levels in the long run, rather than simply reflecting changes along SRATC functions as the OLS method does.

The results of the OLS estimate indicate that economies of size exist in Tennessee livestock auction markets, with the LRATC function declining substantially at volume levels up to 30,000 A.M.U.'s. Beyond that level of output, the function begins to flatten, with the average market handling a volume less than 30,000 A.M.U.'s in a position to attain the greatest decline in average total cost by increasing volume. At this level of output, auctions achieve 80 percent of the economies of size which may be realized along the OLS function (Table 22). The elasticity of cost with respect to volume declines from -0.37 at a volume of 7500 A.M.U.'s to -0.19 at 30,000 A.M.U.'s.

Results from the frontier function also show that economies of size exist in the industry, although most cost economies are realized at one half the volume level compared to the OLS function. Along the frontier function, increased market volume leads to the greatest economies realized by those markets handling volume less than 15,000

Table 22. Comparison of Long Run Average Total Cost Functions Derived from Minimum Absolute Deviation of a Frontier Function and from Ordinary Least Squares

Volume (A.M.U.)	OLS			Frontier Function		
	Average Total Cost (\$)	Cost Function ^a Elasticity	% Cost Economies Realized ^b (%)	Average Total Cost (\$)	Cost Function ^a Elasticity	% Cost Economies Realized ^b (%)
5,000	7.44	-.36	46	3.41	-.33	60
7,500	6.40	-.37	53	3.01	-.28	68
10,000	5.77	-.35	59	2.78	-.24	74
15,000	5.06	-.30	68	2.55	-.19	80
25,000	4.44	-.22	77	2.36	-.13	87
30,000	4.28	-.19	80	2.30	-.11	89
40,000	4.07	-.16	84	2.25	-.09	91
50,000	3.95	-.13	87	2.19	-.07	93
70,000	3.80	-.10	90	2.16	-.05	95

^aElasticity of average total cost with respect to volume was determined according to:

$$\text{Elasticity} = \frac{d\text{ATC}}{d\text{Vol}} \cdot \frac{\text{Vol}}{\text{ATC}}$$

^bPercent cost economies realized was defined as the difference between estimated average cost (ATC) at the minimum observed volume and estimated ATC at the volume under consideration, divided by the difference between estimated ATC at the minimum observed volume and estimated ATC at the asymptotic minimum of the function.

$$\frac{\text{ATC}_{\text{min.vol.}} - \text{ATC}_{\text{vol.1}}}{\text{ATC}_{\text{min.vol.}} - \text{ATC}_{\text{asympt.min.}}}$$

A.M.U.'s is -0.19 , compared to -0.30 along the OLS estimate at the same volume.

Of the auctions included in this study, 67 percent handled less than 27,000 A.M.U.'s. Assuming the OLS function to be the appropriate estimate of the LRATC, over two-thirds of the existing industry captures less than 80 percent of the available economies of size. Auctions could increase efficiency and substantially reduce operating costs by expanding output to 30,000 A.M.U.'s.

The frontier function estimate, however, appears to more accurately reflect observed industry behavior. Those auction markets operating at volumes less than 18,000 A.M.U.'s comprised 50 percent of the observations. The fact that one half of the industry operates at smaller volume levels suggests that operators are unaware of the cost decreases available by expanding volume to 30,000 A.M.U.'s, or they have discovered that they are unable to attain significant cost economies by operating markets of expanded volume. If auction operators felt that costs would be reduced by increasing output, as indicated by the OLS function, then the number of smaller markets would be expected to decline over time. The larger and more efficient markets would force the smallest, least efficient firms out of business by attracting volume away from the smaller competitors.

The number of markets handling less than 9,000 A.M.U.'s, however, doubled from 7 to 14 between 1978 and 1980 (Table 1) rather than declined. Auctions with volume between 18,000 and 26,999 A.M.U.'s declined in number from 13 to 5 from 1978 to 1980. If the OLS estimate of the LRATC function accurately describes long run market behavior, then the number

of markets handling volume between 18,000 and 26,999 A.M.U.'s should increase rather than decrease. This decline in intermediate-sized markets, however, may have been influenced by the cattle cycle and the decline in A.M.U.'s handled by auction markets in Tennessee between 1978 and 1980.

Although the frontier function provides a more appropriate theoretical estimation of the LRATC than the OLS estimate, the survival of so many small markets may be influenced by factors other than those considered by this study. Related factors such as transportation costs should be a topic for future research when evaluating the efficiency of Tennessee livestock auction markets.

For practical evaluation of Tennessee livestock auction market performance and efficiency at the present time, the OLS estimate would provide the needed descriptive information. Under the current operating conditions, auctions handling under 30,000 A.M.U.'s may expand volume to this capacity and realize a significant portion of the available economies of size. This function may overestimate the long run economies available, however, because average SRATC conditions are reflected by the OLS method.

Since 50 percent of the auctions operated at volumes less than 18,000 A.M.U.'s, the frontier function appeared to describe actual industry behavior more appropriately than did the OLS estimate. If volume must be expanded to 30,000 A.M.U.'s for markets to operate efficiently, as shown by the OLS LRATC estimate, then the Tennessee livestock auction market industry is operating inefficiently. Over 60 percent of the firms in 1978 and 1980 operated at volume levels below

30,000 A.M.U.'s. If the OLS function were correct, it would indicate that these markets would have to expand output significantly to remain in business. Fewer small markets would continue to operate in the future because of the high costs estimated by the OLS function, as operators attempt to increase volume and capture the economies available along this estimated curve.

The increase in number of markets handling less than 9,000 A.M.U.'s per year between 1978 and 1980, however, does not reflect this anticipated increase in volume. Obviously, operators do not feel that the reductions in cost achieved by expanding output to 30,000 A.M.U.'s are not applicable to their markets, or that the economies are overestimated. The frontier function estimate, where 80 percent of the economies are achieved at 15,000 A.M.U.'s, reflects the Tennessee livestock auction market industry behavior more accurately than the OLS function does. Despite previous research, the results of this study indicate that most (80 percent) of the available economies of size may be realized by auction markets with volume levels at 15,000 A.M.U.'s.

CHAPTER V

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

I. SUMMARY

Previous research has indicated that livestock auction market operations typically incur lower per unit costs as the level of output is increased, and significant economies of size may be achieved by expanding volume. However, too many markets often exist in a given geographic area for a firm to handle a level of volume large enough to capture a great portion of these available economies. A 1970 study by Hicks and Badenhop reported that the Tennessee livestock auction market industry was characterized by too many markets for efficient operation to be realized (17).

Although more than one-half of the auction markets operating in Tennessee during 1980 handled fewer than 18,000 animal marketing units (A.M.U.), only 24 percent of the livestock sold passed through these small markets. Little research has been performed recently to determine whether these markets are too small to achieve economies of size, or at what level of volume markets in Tennessee may achieve the bulk of available cost economies.

The objectives of this study of Tennessee livestock auction markets were: (1) To describe existing livestock auction markets in Tennessee; (2) To determine the typical cost structure of various size categories of auctions to identify major factors of firm efficiency; (3) To determine current rates of return to market operators; (4) To identify the

relationship between specific costs of operation and market size; (5) To estimate a long run average cost curve for the industry to determine whether economies of size exist in Tennessee auctions.

To achieve these objectives, auctions were grouped according to the volume of livestock handled measured in animal marketing units. The A.M.U. system developed by U.S.D.A. relates pen space required by various species to handling costs. Cost and volume data were obtained from the 1978 and 1980 Packers and Stockyards Administration Form 130. Costs for firms in 1980 were deflated by the Index of Prices Paid by Farmers, and 101 observations were included in the study.

In order to satisfy the first and third objectives, relevant group means were calculated. Information taken from Form 130 was used to determine asset values per A.M.U., liability values per A.M.U., and net worth values per A.M.U. Data from the income statement portion of the form was included in calculating returns to these accounts.

The second and fourth objectives were achieved by calculating group means for twelve specific operating costs. These costs were also categorized as fixed costs, variable costs, average fixed costs, average variable costs, and average total costs.

Estimation of a long run average total cost curve (LRATC) for the Tennessee livestock auction market industry was achieved through two methods. A multiple regression model was estimated by regressing average total cost against volume. The model selected as the ordinary least squares estimate of the LRATC was:

$$ATC = 3.419 + 26,964.497 \frac{1}{X} - 34,433,902 \frac{1}{X^2}$$

A frontier function was also fitted to the bottom of the scatter diagram as an estimate of the LRATC. The equation for this estimate was:

$$ATC = 2.05 + 7,929.66 \frac{1}{X} - 5,749,146.80 \frac{1}{X^2}$$

II. CONCLUSIONS

Average total costs for each size group of markets for the 1978 and 1980 data combined ranged from \$3.46 for Group VII firms to \$7.26 for markets in Group I. Thus, economies of size were observed in the extreme volume groups. Individual yearly data indicated that the intermediate size firms (Groups IV and V) incurred ATC as high or higher than costs of smaller markets.

The largest single component of the average total cost, \$5.12 for all markets in 1978 and 1980 combined, was salaries expense. This cost comprised 50 percent of ATC. During 1978, smaller markets employed labor more efficiently, while the larger firms incurred the lowest salaries expense in 1980. Thus, no consistent pattern was found relating salaries costs to market volume, but labor was identified as the primary source of high operating costs. Inefficient labor utilization was found to be a cause of inefficient market operation in previous research, and significant cost advantages may be obtained by small and intermediate markets in Tennessee also by employing labor more efficiently.

The other large components of average total cost were insurance, 6.6 percent, and utilities, 5.5 percent. Fixed costs of insurance may be more difficult to reduce than salaries costs. Certain utility costs will continue to rise in the future, and efficient use will be necessary.

The OLS estimate of the LRATC function provided the mean description of cost conditions for existing livestock auction markets in Tennessee. Because the "average" method of estimating an LRATC by OLS only reflects movements along various SRATC curves of firms, this cost function does not necessarily reflect those auction capacities which may be most efficient in the long run. Firms may make adjustments in capacity or other changes in operations to reduce costs in the long run. This function does not represent such least-cost adjustments which could be made by each volume level. The OLS function will lie above the frontier function because of the average estimation used. Thus, the range of volumes over which economies of size are important may be exaggerated in the long run.

The frontier function estimate of an LRATC function provided a more appealing theoretical cost estimate. Because this approach incorporates an envelope curve fitted to the bottom of the cost observations, the frontier function estimate will represent the minimal cost levels attainable at given levels of volume. Changes in capacity are therefore considered when estimating the frontier function, as markets may be expected to alter volume towards the least-cost output, or where significant economies of size may be attained. This function is thus a better estimator of possible long run economies of size.

The frontier function LRATC estimate declines more rapidly and flattens out at lower volumes compared to the OLS estimate. The OLS function indicated that 80 percent of the cost economies were realized at an output level of 30,000 A.M.U.'s. The frontier function, however, indicated that 80 percent of the available economies were captured at 15,000 A.M.U.'s.

When making recommendations for the future concerning efficient market size, the frontier function would be the more accurate estimator of available cost economies. This theoretically correct approach more closely defines a true LRATC than does the OLS estimate. The envelope concept employed by the frontier function creates a more appealing long run ATC estimate of the Tennessee livestock auction market industry, describing the observed behavior of the industry in 1978 and 1980.

III. IMPLICATIONS

Because many researchers in the past have estimated a long run cost function for auction markets using the OLS approach, possible economies of size may have been exaggerated. The results of this study indicate that the level of volume required to achieve significant cost decreases may not be as large as once believed. The continued existence of small markets in Tennessee tends to support this conclusion.

The number of markets in the study declined from 55 in 1978 to 46 in 1980. If the number of livestock marketed in the state declines, additional markets may be forced to discontinue operations.

An alternative for operators could be to combine several small markets. This would expand volume so that markets may capture economies of size necessary to remain efficient. This may only transfer costs, however, as transportation costs for those selling livestock would increase. These sellers may then be forced to improve their marketing efforts and discover better market alternatives.

Efficient labor utilization must become a top priority for market operators, although this may be a difficult task. To attract and

maintain good employees through the entire year, excess labor may be required during periods of low volume even while this practice may not seem to be the most efficient.

The improvement and use of electronic marketing systems may become a factor in Tennessee auction markets in the future. Farmers selling livestock through private video sales could lead to a further decline in volume of livestock handled at auctions. As these alternative methods of marketing become more refined and desirable to farmers, auction markets will be forced to become as efficient as possible to remain competitive.

The results of this study indicate that the smaller volume markets play a substantial role in the Tennessee livestock auction market industry. The efficiency with which particular resources are utilized may determine cost economies achieved as strongly as a certain level of volume itself may. Future research should concentrate upon the existence or disappearance of these many small firms. Also, markets' reactions to continued inflation and lower levels of output may be monitored to predict future industry behavior. In order for auctions to maintain their primary role in the Tennessee livestock industry, market operators must strive to reduce costs while serving the needs of their customers.

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APPENDIX

Table 23. Specific Asset Values, for Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980 (Actual Dollars)

Year	Size Group	Accounts Receivable			Total Current Assets			Land Value		
		Mean	Std. Dev.		Mean	Std. Dev.		Mean	Std. Dev.	
1978	I	8,794	10,920		15,024	13,938		4,691	3,429	
	II	28,987	18,420		47,319	37,492		25,253	27,295	
	III	119,537	200,316		144,979	230,992		13,088	13,868	
	IV	21,896	34,777		76,305	71,846		12,495	15,652	
	V	31,880	27,771		76,843	130,357		21,611	22,901	
	VI	52,260	38,476		92,639	67,849		10,601	9,293	
	VII	4,214	--		96,072	106,671		58,573	--	
1980	All	35,508	93,704		80,376	133,644		16,501	18,812	
	I	38,469	45,903		42,961	49,745		2,312	2,148	
	II	101,596	223,933		132,105	250,505		24,407	25,928	
	III	85,541	48,319		80,487	68,119		23,154	15,676	
	IV	23,995	40,519		46,511	58,050		16,959	16,322	
	V	2,984	0		147,156	142,241		4,302	2,548	
	VI	71,798	76,389		104,268	74,464		9,250	3,889	
1978 & 1980	VII									
	All	36,096	110,992		89,186	156,038		15,726	19,386	
		61,243	127,068		84,180	142,946		16,171	18,880	

Table 24. Other Asset Values for Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980
(Actual Dollars)

Year	Size Group	Depreciated Building Value		Total Fixed Assets		Total Assets	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1978	I	23,836	19,266	26,182	21,296	37,475	23,419
	II	27,988	26,113	42,266	43,811	105,429	189,557
	III	67,833	149,844	71,676	155,977	219,075	376,871
	IV	60,290	29,248	75,473	48,724	113,833	122,423
	V	55,646	48,350	66,451	59,771	165,203	237,147
	VI	64,008	47,206	73,094	55,368	177,151	86,642
	VII	56,736	34,715	86,022	76,133	81,047	95,231
1980	All	50,556	83,344	59,722	91,249	137,042	225,860
	I	12,096	14,786	11,848	14,326	41,525	45,336
	II	84,816	170,864	99,378	178,736	256,440	442,670
	III	45,661	41,114	59,353	53,400	141,420	115,834
	IV	58,196	61,069	66,675	70,604	83,221	115,334
	V	37,529	5,350	41,831	7,898	188,987	150,139
	VI	91,627	16,758	97,794	22,029	247,504	141,030
1978 & 1980	VII	--	--	--	--	--	--
	All	53,285	100,827	59,874	108,132	141,270	265,840
		51,780	90,995	59,792	98,710	138,968	243,625

Table 25. Liability Values and Net Worth Values for Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980 (Actual Dollars)

Year	Size Group	Total Current Liabilities			Total Fixed Assets			Total Net Worth		
		Mean	Std. Dev.		Mean	Std. Dev.		Mean	Std. Dev.	
1978	I	8,115	14,601		2,200	4,919		29,955	18,973	
	II	5,140	6,883		26,129	36,923		76,291	164,379	
	III	105,466	186,748		37,101	64,397		109,408	166,582	
	IV	55,311	84,268		6,666	11,547		67,351	58,835	
	V	19,178	25,241		24,038	41,634		139,273	241,952	
	VI	32,158	29,768		22,182	38,036		122,811	57,389	
	VII	50,000	--		--	--		46,835	63,184	
1980	All	29,819	88,067		22,752	40,673		87,075	139,536	
	I	28,213	40,630		8,499	16,856		20,547	36,205	
	II	107,975	282,327		28,802	62,510		139,203	207,750	
	III	69,729	73,961		116,135	69,722		29,902	40,529	
	IV	5,167	4,049		23,337	40,412		68,969	87,251	
	V	31,185	19,538		60,375	74,777		97,427	94,900	
	VI	52,005	50,246		102,693	177,869		92,805	93,749	
1978 & 1980	VII	--	--		--	--		--	--	
	All	42,706	148,463		27,410	63,902		71,154	130,935	
		52,240	141,170		30,803	59,264		79,824	135,249	

Table 26. Average Value of Six Forms of Net Worth Held, for Tennessee Livestock Auction Markets,
by Size Group, 1978 and 1980 (Actual Dollars)

Year	Size Group	Preferred Capital Stock			Common Capital Stock			Paid-In Stock		
		Mean	Std. Dev.		Mean	Std. Dev.		Mean	Std. Dev.	
1978	I	0	0	0	10,000	0	0	0	0	0
	II	0	0	0	36,750	33,925	2,007	2,007	0	0
	III	234,160	0	0	71,452	104,703	12,051	12,051	6,382	6,382
	IV	0	0	0	120,000	0	0	0	0	0
	V	0	0	0	38,488	0	0	0	0	0
	VI	0	0	0	54,825	86,220	144,520	144,520	0	0
	VII	0	0	0	10,000	0	0	0	0	0
	All	4,257	31,574	55,820	77,638	3,760	19,721			
1980	I	0	0	6,000	7,000	1,504	712	1,504	712	712
	II	117,850	159,594	70,822	128,522	16,069	7,501	16,069	7,501	7,501
	III	0	0	5,000	0	0	0	0	0	0
	IV	0	0	76,756	93,250	18,467	0	18,467	0	0
	V	0	0	13,000	16,971	0	0	0	0	0
	VI	-90,752	0	10,000	0	144,520	0	144,520	0	0
	VII	0	0	0	0	0	0	0	0	0
	All	3,151	0	42,892	24,337	4,656	21,665	4,656	21,665	21,665
1978 & 1980		94,777	36,826	50,279	79,620	30,070	49,021	30,070	49,021	49,021

Table 26 (Continued)

Year	Size Group	Retained Earnings		Owners' Capital		Undivided Profits	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1978	I	14,848	0	36,252	19,367	6,988	0
	II	19,371	26,892	145,509	250,455	6,048	15,678
	III	32,579	37,839	59,044	30,110	16,271	9,802
	IV	14,002	0	32,877	9,339	34,823	28,159
	V	0	0	297,475	331,376	21,996	23,765
	VI	24,253	59,055	114,699	81,618	27,376	1,242
	VII	123,687	0	12,264	0	41,386	0
1980	All	10,683	28,686	4,296	114,819	5,454	12,416
	I	5,446	25,783	20,504	17,052	-2,356	0
	II	-13,923	63,817	187,198	263,540	18,829	20,488
	III	-2,846	23,002	71,963	13,721	-11,767	0
	IV	64,155	27,953	21,470	0	7,885	3,749
	V	84,427	77,930	0	0	0	0
	VI	27,178	0	234,525	66,545	0	0
1978 & 1980	VII	0	0	0	0	0	0
	All	5,585	34,264	44,062	124,858	854	5,533
1978 & 1980		23,969	49,329	113,109	173,234	16,157	17,162

Table 27. Average Gross Returns from Various Sources per A.M.U., for Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980 (Actual Dollars)

Year	Size Group	Buying Commissions		Other Commissions		Feed Account		Rent		Interest		Other	
		Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
1978	I	.000		.050		-.040		.000		.140		.090	
	II	.004		.010		.010		.010		.010		.060	
	III	.000		.010		.002		.010		.010		.060	
	IV	.000		.000		.002		.010		.001		.030	
	V	.000		.000		.000		.040		.020		.210	
	VI	.000		.300		-.010		.020		.000		.030	
	VII	.000		.000		.000		.000		.010		.020	
1980	All	.00.		.049		-.003		.012		.024		.069	
	I	.010		.003		.030		.010		.040		.190	
	II	.010		.000		.000		.150		.040		.180	
	III	.000		.000		.000		.000		.000		.050	
	IV	.000		.450		.000		.000		.010		.060	
	V	.000		.000		.000		.020		.070		.080	
	VI	.000		.000		.000		.040		.000		.350	
1978 & 1980	VII	.000		.000		.000		.000		.000		.030	
	All	.005		.060		.008		.052		.026		.152	
1978 & 1980		.003		.050		.002		.030		.020		.110	

Table 28. Average Number of Livestock Handled Per Species by Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980

Year	Size Group	Cows	Calves	Hogs	Sheep	Horses
1978	I	3,499	2,141	406	121	9
	II	9,230	3,335	2,777	252	276
	III	11,554	6,300	10,581	204	216
	IV	19,961	9,010	6,698	104	15
	V	33,268	5,284	2,333	489	3
	VI	40,117	8,442	5,398	1,132	812
	VII	26,694	2,957	186,950	414	9
1980	All	17,217	5,090	14,656	358	233
	I	3,174	1,620	2,037	194	319
	II	8,383	3,189	4,421	259	5
	III	10,159	5,805	14,519	342	3
	IV	19,429	8,218	8,966	410	1,538
	V	36,188	1,940	4,532	2,143	537
	VI	28,106	16,149	14,775	482	79
1978 & 1980	VII	13,331	1,289	165,036	284	0
	All	11,142	4,360	12,397	366	328
		14,758	4,758	13,627	362	276

Table 29. Number of A.M.U.'s Handled Through Market Support Activity, by Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980

Size Group	1978		1980	
	Mean	Std. Dev.	Mean	Std. Dev.
I	207	392	157	219
II	281	625	133	164
III	250	310	1,137	2,157
IV	87	173	164	199
V	3,226	3,925	813	1,150
VI	283	589	878	1,520
VII	1,198	1,877	1,131	1,599
All	585	1,514	375	885
1978 & 1980	489	1,265		

Table 30. Number of A.M.U.'s Handled Through Dealer Operations, by Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980

Size Group	1978		1980	
	Mean	Std. Dev.	Mean	Std. Dev.
I	290	675	735	2,171
II	852	2,838	10,945	35,077
III	10,014	32,211	2,131	4,681
IV	1,645	1,911	136	208
V	3,346	6,817	--	--
VI	598	912	5,562	8,634
VII	1,418	2,835	--	--
All	3,239	15,874	4,167	19,625
1978 & 1980	3,662	17,596		

Table 31. Average Number of Sale Days Per Year, for Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980

Size Group	1978	1980
I	50	52
II	51	53
III	52	52
IV	52	72
V	62	91
VI	67	52
VII	102	128
All	58	60
1978 & 1980	59	

Table 32. Average Gross Value of Livestock Sold, by Tennessee Livestock Auction Markets, by Size Group, 1978 and 1980 (Actual Dollars)

Size Group	1978	1980
I	\$ 1,245,508	\$ 1,704,177
II	2,714,734	3,693,920
III	4,464,044	5,535,312
IV	7,237,633	9,868,664
V	8,748,713	12,184,315
VI	12,298,040	14,823,011
VII	13,407,570	10,398,238
All	5,816,051	5,480,349
1978 & 1980	\$5,663,157	

VITA

Kimberly Annette Spielman was born in Tacoma, Washington on September 21, 1959, the daughter of Kenneth E. and Julia R. Spielman. Following Kim's birth, the family moved to western Maryland. Kim and her younger brother, Trent, spent their childhood in LaVale, and she graduated from Allegany High School, Cumberland in June 1977.

Tired of Appalachian snowstorms and the equally frigid Yankee hospitality, Kim migrated South the following autumn. She entered Berry College, Mt. Berry, Georgia in September 1977, with a major in Animal Science/Business. While attending Berry, Kim was employed by the college's beef cattle farm. Ms. Spielman received the Bachelor of Science degree in November 1980.

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