AN ECONOMIC ANALYSIS OF THE NUMBER AND SIZE OF COOPERATIVE GRAIN ELEVATORS IN KANSAS, 1950 TO 1980

by

CLEMENT E. WARD

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Approved by:

Milton L. Manuel
Major Professor

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CHAPTER I

INTRODUCTION

Expanding population numbers and rising per capita incomes have contributed to increased domestic and foreign demand for food and feed grains during the past two decades. In addition there has been a growing concern for the quality and quantity of food being consumed. The trend established by these factors probably will continue during the present decade thus creating a favorable situation for further growth in demand for feed and food grains.

Also as in the past it appears the United States will be a substantial provider of the world's grain supply. During the 1950's and 1960's total annual grain production in Kansas rose and according to a recent study Kansas will provide an even larger percentage of the total United States grain supply.[1] Thus the demand situation for Kansas grain producers is also favorable.

Just as the total production of grain in Kansas has increased the percentage of grain which is marketed has also increased; from 68.1 percent in 1950, to 75.9 percent in 1960, to 82.2 percent in 1969.[2] Due

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[1]Orlan H. Buller, et al., Kansas Agriculture and Agribusiness in 1980, Research Paper No. 3 (Manhattan, Kansas: Kansas Agricultural Experiment Station, May, 1971.)

[2]Percentage of grain marketed is used in this paper synonymously with off-farm grain sales and refers to that portion of the total annual grain production which leaves the farm on which it was produced. Included in off-farm grain sales is grain sold to elevators, processors and other livestock feeders; not included in off-farm grain sales is grain fed by the producer or stored at the production site. Percentage of off-farm grain sales for

to the recent rapid expansion in cattle feedlot operations, many of which depend on other producers for a substantial portion of their grain supply, the percentage of off-farm grain sales may continue to increase in the 1970's. More will be mentioned concerning this in a later section.

Country grain elevators perform such major marketing functions as assembling, storing and merchandising Kansas produced grain. The country grain elevator industry will provide the same key role in the marketing process as it has in the past if the assumptions concerning grain production and percentage of off-farm grain sales are correct.

Both producers and consumers are concerned with prices of food and feed grains and related products. Since these prices are directly affected by the costs of doing business it is worthwhile to consider how well, in terms of least costs, the industry is performing its marketing functions.

Objectives

This study examined the industry in terms of least costs and projected for 1980 how the cooperative subsector would be performing its grain handling role.

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each year was calculated as follows:

$$Z = \frac{\sum_{i=1}^{7} a_i X_i}{\sum_{i=1}^{7} X_i}$$

$i = 1, \ldots, 7$

X = Grains; (1) wheat, (2) grain sorghum, (3) corn, (4) soybeans, (5) oats, (6) barley and (7) rye.

a = Percentage of off-farm grain sales; each grain. Source: Kansas State Crop and Livestock Reporting Service, Topeka, Kansas.

Z = Percentage of off-farm grain sales; all grains.

Specifically the objectives are:

a. Determine and analyze changes in number and size of country grain elevators in Kansas for the years 1950, 1960 and 1969.

b. Determine how well the industry is performing its grain handling function by comparing data on the number and size of country grain elevators and their volume handled with relevant cost-volume studies.

c. Estimate an economical number and size of cooperatively owned country grain elevators for Kansas in 1980.

d. Assist cooperative elevator managers and decision makers in planning more efficient grain handling operations.

Data Sources

The data for this study came primarily from the Kansas Grain and Feed Dealers Association's Official Directory for 1950, 1960 and 1969. This is a biennially printed trade association publication listing country elevators, terminal elevators, flour and feed mills, alfalfa, grain and seed processors, commission agents and grain brokerage firms in Kansas. Additional information is included about each grain elevator and processing plant, such as the storage capacity, number of plants, processing capacity and lines of products handled.

Another source of data was a ten percent sample interview survey taken in 1955, 1961 and 1968 in Kansas. The random sample was stratified by crop reporting districts and was found to be representative of the state population as well as within each district.[3] Other sources of data included the Kansas

[3]For a more complete discussion see; Don D. Pretzer, "The Organization of Country Elevators in Kansas." (Unpublished M.S. thesis, Kansas State University, 1970), pp. 23-36.

State Statistician's Office, USDA Crop and Livestock Reporting Service, USDA Farmer Cooperative Service and other data published by the Kansas State University Experiment Station.

CHAPTER II

REVIEW OF RELEVANT COST-VOLUME STUDIES

Three studies which have been conducted in the Midwest relate costs of handling grain to volume handled. The portion of these studies relevant to this paper will be reviewed below.

Cost-Volume Study in Wheat Belt, 1955

Hall's study showed the relationship between costs and volume of handling small grain in the hard winter wheat belt.[4] His study was conducted to assist elevator operators meet the increased demand for elevator modernization in the most efficient manner. General guides were developed by using simulated elevators of a modern design.

Several firms of a specific size and type were selected for field observation during the four seasons in 1950-51 and audited records were used from nearly 250 Kansas elevators. From this information costs were developed as accurately as possible for several country elevator models and were analyzed. Costs were allocated by functions with grain handling considered to be the primary function. Each of the five models considered was of a standard design and for each model a maximum practical volume limitation and annual average turnover were determined. (See Table 1)

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[4] U.S., Department of Agriculture, Farmer Cooperative Service, New Local Elevators, Costs-Volume Relations in the Hard Winter Wheat Belt, by Thomas E. Hall et al., Service Report No. 12, (Washington, D. C.; Government Printing Office, May, 1955).

Table 1. Model size, maximum practical volume limitation and annual average turnover for each model used in Halls's study.[a]

Model Plant Size (bushels)	20,000	100,000	200,000	300,000	600,000
Maximum Practical Volume Limitation (bushels)	250,000	400,000	600,000	900,000	1,500,000
Annual Average Turnover	12.5	4.0	3.0	3.0	2.5

[a]See Footnote Number 4.

Hall considered two points to be of major importance concerning grain volume. One was the practical maximum limitations on volume that can be handled through a given size elevator. The second point was that different volume levels used in the models were presumed to be those that local management would consider as average at their building location. The maximum practical volume level was defined by Hall as: "...the practical maximum annual volume is what can be received during the wheat harvest, plus whatever is available for market later in the year from farm storage and from other grains with a different harvest season."[5] Limitations in volume may be caused by one or several factors: size and number of elevator legs, number of truck scales and receiving dumps, number of cars which can be spotted for loading daily, siding for empty and loaded boxcars, total capacity of the elevator and total on-farm storage capacity.

Turnover shows the number of times a plant of a given size handles a quantity of grain equal to its rated storage capacity. Turnover includes both peak harvest periods when a relatively large volume of grain is handled in a short time span and non-harvest periods when a relatively

[5]*Ibid.*, p. 13.

small volume of grain is handled over a much longer time span. Thus, turnover is an annual average and may be thought of as a uniform movement of grain through an elevator over a 12 month period though this is a simplification. Turnover, of course, decreases as one or more factors limit total annual volume handled.

Table 1 shows turnover at the maximum practical volume limitation for each model plant. For the 20,000 bushel model plant, a turnover of 12.5 may seem unreasonably high. Two possible explanations are given: (1) During the late 1940's and early 1950's there was much less grain stored on farms than in the 1960's so grain was marketed largely during peak harvest times. (2) Many more line elevators which were owned and operated by large grain marketing or milling firms were in operation. Small line elevators acted as buying stations or assemblers for larger terminal storage or processing plants and were not operated to store grain for extended periods of time. A 12.5 turnover, then, in 1950, may not have been unreasonable though it was not a typical level. A turnover of 12.5 in 1960 or later years probably would be unrealistically high.

Hall found the cost of handling grain was nearly two and one-half cents per bushel less for the 600,000 bushel plant compared to the 20,000 bushel plant when both operated at the maximum volume limitations. For a given volume, the smallest plant capable of handling that volume will have the lowest per unit cost. Thus cost per unit decreases as turnover increases.

Given a fixed cost per bushel larger plants will need to handle a larger volume but at a smaller turnover than smaller plants. Therefore a larger elevator can compete with a smaller elevator over a greater range of volumes. Each elevator of a given size operates at lowest per unit cost when volume equals its maximum practical scale.

Hall also investigated using a new elevator in conjunction with the older facility versus using the new elevator by itself. As might be expected by using the new and old elevator together a larger volume must be handled to achieve the same level of per unit cost as the new facility would have to handle if operated alone.

Cost-Volume Study in Corn Belt, 1957

Thurston, as Hall, analyzed the cost and volume relations in handling feed grains.[6] His approach was similar to Hall's procedure but was conducted in the corn belt. Case studies from cooperatively owned elevators in Illinois were used to develop operating costs for synthetic elevator models. Cost figures for 1956 were used and were budgeted to three functions with grain handling again being considered the primary function.

For each model a base volume was established which was representative of the volume handled by that size and type of elevator in Central Illinois. Turnover was figured from the model size and base handling volume. (See Table 2).

Thurston's study also found per unit handling cost decreased as volume increased. For a given volume handled a smaller plant had a lower per unit cost thus again indicating a decrease in per unit cost as turnover increases. As had Hall, Thurston determined that in order

[6] U.S., Department of Agriculture, Farmer Cooperative Service, Cost-Volume Relationships for New Country Elevators in the Corn Belt, by Stanley K. Thurston and R. J. Mutti, Service Report No. 32, (Washington, D. C., Government Printing Office, September, 1957).

to attain a given cost per unit the larger plants must handle a greater total volume of grain but may have a lower turnover.

Table 2. Model descriptions, sizes, base volumes and turnover for Thurston's study.[a]

Model Description	Rated Capacity (bushels)	Base Handling Volume (bushels)	Turnover
Old 30,000 bu elevator	30,000	200,000	6.7
New 30,000 bu elevator	30,000	200,000	6.7
Old 30,000 bu + two 20,000 bu concrete tanks	70,000	300,000	4.3
Old 30,000 bu + four 25,000 bu concrete tanks	130,000	400,000	3.1
Old 30,000 bu + 60,000 bu concrete	90,000	500,000	5.6
Old 30,000 bu + 100,000 bu concrete	130,000	600,000	4.6
Old 30,000 bu + two 55,000 bu flat	140,000	300,000	2.1
Old 30,000 bu + 200,000 bu concrete	230,000	800,000	3.5
Old 30,000 bu + 400,000 bu concrete	430,000	1,000,000	2.3

[a]See Footnote Number 5.

At the base volume levels assumed larger facilities had lower per unit costs even though turnover figures were lower at that volume. When operating at one-half the base volume levels larger plants had an even greater absolute cost advantage.

Optimum Number and Size of Elevators in Kansas, 1969.

Using the economic engineering approach Fuller developed LAC functions for five model elevators each handling three volume levels of grain.[7]

[7]Stephen W. Fuller, "The Optimum Number and Size of Country Grain Elevators in Spatial Equilibrium." (Unpublished Ph.D. dissertation, Kansas State University, 1970)

Model plant sizes used by Fuller were: 100,000 bu, 200,000 bu, 300,000 bu, 600,000 bu, and 1,000,000 bu. When developing his three LAC curves he assumed these plants handled one of three volumes of grain; equal to, twice and three times the rated storage capacity.

Fuller's LAC functions indicated economies of size were present over the entire range of plant sizes used in his study. As might be expected these economies are more pronounced among smaller plant sizes rather than larger sized plants. As was found in previously discussed studies cost per unit decreased as turnover increased. Fuller's results showed that a smaller plant operating at a relatively high turnover may have lower per unit costs than a large plant operating with less than optimum volume.

Besides developing plant cost functions Fuller derived an assembly cost function for each of what was found to be the four most common truck sizes used to deliver grain to country elevators. Each assembly cost function was then weighted by the volume of grain each truck size delivered to obtain the weighted assembly cost function.

The primary factors influencing assembly costs are density of production and distance grain must be transported from farm to elevator. As total production per a given area increases a smaller supply region is needed to assemble a given quantity of grain and assembly costs decrease. The converse is true also. As can then be seen the distance grain must be hauled causes the cost of assembly to vary.

Fuller's objective was to minimize combined plant costs and assembly costs and arrive at an optimum number and size of country grain elevators in Kansas. He arrived at a least-cost volume of grain necessary per county and then estimated the required plant size. An optimum number and size of country grain elevators was determined and will be discussed in a later section.

CHAPTER III

NUMBER AND SIZE OF ELEVATORS IN 1950

In this section number and size of elevators operating in 1950 will be presented. Information was divided into cooperative and non-cooperative forms of ownership, compiled by crop reporting districts and then summarized for the entire state. When feasible findings were related to previously discussed cost studies.

Data on number and size of elevators vary greatly. Problems arise in using such terms as elevator, plant, firm, country and terminal.

In this paper an elevator is synonymous with a plant and refers to one physical facility at one site. An elevator normally consists of an elevator leg and a headhouse. Because two or more plants may be licensed to store grain as a single unit the number of licensed elevators understates the actual number of physical facilities. A firm may be one plant or several plants under the same ownership. Number of elevator firms is even smaller than number of licensed elevators in the state. Problems arise when firm and elevator or firm and plant are used synonymously.

Information is collected via samply survey on commercial grain storage by the Kansas State Crop and Livestock Reporting Service.[8] Storage capacity includes facilities licensed to store grain under the Uniform Grain Storage Agreement. Each year the Kansas State Crop and Livestock Reporting Service compares elevator numbers and

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[8]J.E. Pallesen, telephone interview, Statistical Reporting Service, USDA, Topeka, Kansas. June, 1971.

capacity with the Commodity Credit Corporation.

Two or more physically separated elevators located at the same site and under common ownership may be licensed as a single unit. One or more elevators of this type may not be licensed to store grain if it is used only during peak volume times each year.

Data for this study include both licensed and non-licensed country grain elevators. Therefore, elevator numbers may appear to be larger than as stated elsewhere but are believed to be an accurate count of physical facilities. Total capacity in this study also may be licensed or non-licensed but may be less than stated elsewhere because only upright storage was included.

Pallesen indicated it was difficult to distinguish between country and terminal elevators.[9] Though the Kansas State Crop and Livestock Reporting Service does not distinguish between the two types, approximately 60 of the larger elevators are surveyed individually rather than with the sample survey.

Information is received annually by the Kansas Grain and Feed Dealers Association from each elevator in Kansas.[10] Their official directory lists terminal elevators and Cranor defines them as elevators capable of placing official weights and grades on grain. Elevator numbers in this study include only country elevators.

Therefore, plant numbers in this study may be larger and storage capacity may be smaller than found elsewhere. As a result average plant size may be understated and turnover overstated when compared

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[9] Ibid.

[10] John Cranor, telephone interview, President, Kansas Grain and Feed Dealers Association, Hutchinson, Kansas. June, 1971.

with other published figures. Conclusions drawn from this study are not believed to be affected significantly by the variation in data used in this study compared with similar data used in other studies.

Data on number and capacity of country grain elevators were compiled from the Kansas Official Directory for 1950, 1960, and 1969. (See Selected Bibliography). After compiling number and capacity data, average plant size was calculated by dividing total capacity by the number of elevators. Average plant size was figured for each crop reporting district and the state as a whole and by type of business organization, cooperative and non-cooperative. Average plant size was multiplied by average annual turnover, to arrive at the average annual volume of grain handled per plant.

Turnover was determined by dividing total off-farm grain sales by total grain elevator capacity for a given geographic region. As was stated earlier, turnover is an average annual figure thus assumes a uniform movement of grain to and from an elevator throughout the year. This is an over-simplification because plants handle relatively more grain during harvest periods than during the remainder of the year. Turnover was figured for a geographic region but could not be figured by type of business organization. Therefore, turnover was assumed to be uniform over a given geographic area and for both subsectors.

Two subsectors, cooperative and non-cooperative, were assumed in this paper. The term subsector was used to group all cooperatively owned elevators together and distinguish them from all elevators under a different type of ownership.

In 1950 (See Table 3) there were 1,642 country grain elevators in Kansas with a total capacity of 71.653 million bushels. Kansas farmers marketed 68.1 percent of the 344.9 million bushels of grain produced.[11] Total annual production included production of seven grains; wheat, grain sorghum, corn, soybeans, oats, barley and rye. Not all 234.8 million bushels was handled by country elevators; however, the amount of grain by-passing country elevators was believed to be small and has been disregarded for 1950. From above figures average plant size for the state in 1950 was determined, 43,638 bushels. Turnover was 3.3 so an average size plant handled 142,993 bushels of grain.

Maximum practical volume limitation for the 20,000 bushel model plant was 250,000 bushels so its turnover was 12.5. Comparable figures for the 100,000 bushel model plant were 400,000 bushels and a turnover of four. Grain elevators in 1950, could have reduced per unit handling costs had each plant handled a larger volume of grain or in other words had there been a larger turnover.

Using average plant size statistics, it appears elevators throughout the state could have had lower per unit handling costs. Elevators in certain crop reporting districts; northeast, east-central and southeast, were operating relatively efficiently. In these districts elevators had average plant sizes of less than 25,000 bushels with turnovers of approximately eight to twelve times, thus were operating close to their maximum volume limitations. Elevators in the remaining districts had larger average plants but

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[11]Kansas State Board of Agriculture, Report at the Board, Farm Facts, 1950. (Topeka, Kansas: Ferd Voiland Jr. State Printer, 1951).

Table 3. Number and size of country elevators, average plant size, turnover, and volume handled per elevator, by crop reporting district and by type of business organization, Kansas, 1950.

Crop Reporting District	Number	Total Capacity (1,000 bushels)	Average Plant Size (bushels)	Turnover	Average Volume Handled Per Plant (bushels)
Northwest					
Cooperative	30	1,760	58,667	4.3	253,981
Non-Cooperative	99	4,125	41,667	4.3	180,385
Total	129	5,885	45,620	4.3	197,498
West-Central					
Cooperative	25	1,375	55,000	2.9	159,880
Non-Cooperative	101	4,534	44,891	2.9	130,494
Total	126	5,909	46,897	2.9	136,325
Southwest					
Cooperative	60	9,539	158,983	1.0	166,010
Non-Cooperative	149	11,297	75,819	1.0	79,170
Total	209	20,836	99,694	1.0	104,100
North-Central					
Cooperative	58	2,737	47,190	1.5	71,804
Non-Cooperative	165	5,004	30,327	1.5	46,146
Total	223	7,741	34,713	1.5	52,819
Central					
Cooperative	70	3,870	55,286	2.6	146,364
Non-Cooperative	202	8,208	40,634	2.6	107,574
Total	272	12,078	44,404	2.6	117,555
South-Central					
Cooperative	77	5,661	73,519	3.6	264,205
Non-Cooperative	272	6,774	24,904	3.6	89,498
Total	349	12,435	35,630	3.6	128,044
Northeast					
Cooperative	30	765	25,500	7.9	200,616
Non-Cooperative	86	1,761	20,477	7.9	161,099
Total	116	2,526	21,776	7.9	171,318
East-Central					
Cooperative	17	396	23,294	9.4	218,607
Non-Cooperative	83	2,001	24,108	9.4	226,246
Total	100	2,397	23,970	9.4	224,951

Southeast					
Cooperative	25	297	11,880	12.4	147,472
Non-Cooperative	93	1,549	16,656	12.4	206,899
Total	118	1,846	15,644	12.4	194,328
State Totals					
Cooperative	392	26,400	67,347	3.3	220,682
Non-Cooperative	1,250	45,253	36,202	3.3	118,627
Total	1,642	71,653	43,638	3.3	142,993

had lower turnovers and, consequently, had higher per unit handling costs.

All nine districts had fewer cooperative elevators than non-cooperative plants and less cooperative capacity than non-cooperative capacity. Of the total number of plants, 392 or 23.9 percent were cooperatively owned. The percentage of total capacity accounted for by cooperatives was larger, 36.8 percent or 26.4 million bushels. Thus for the entire state average size cooperative plants were larger. Examining each district it was found average size cooperative plants were larger in seven of the nine districts. The exceptions were in the east-central and southeast districts.

Turnover, as was stated earlier, was assumed to be uniform for a given geographic area and for both cooperative and non-cooperative subsectors. Therefore the subsector in a given geographic area which had the largest average plant size also handled the largest volume of grain per plant. For the entire state and seven of the nine districts the cooperative subsector was handling the largest volume of grain per plant. In these districts cooperative plants were handling grain at a lower cost per unit than non cooperative plants, assuming turnover was the same for each subsector.

CHAPTER IV

NUMBER AND SIZE OF ELEVATORS IN 1960

Between 1950 and 1960 many changes occurred which affected the Kansas country grain elevator industry. Certain government actions encouraged storage construction such as the Occupancy Guarantee Contracts in 1953-54 which provided a minimum income from government storage contracts. A policy change causing an increase in storage construction was in the Internal Revenue Code. The change provided for a more rapid depreciation of new facilities during the period 1952 to 1956. In addition storage rates rose and attracted new construction. As transportation and harvesting techniques improved and production increased elevators were forced to handle a larger volume of grain in a shorter period of time, also influencing new construction. Much of the construction of storage facilities came in the form of new plants which increased total number as well as total capacity of elevators in Kansas.

From 1950 to 1960 total annual grain production in Kansas increased by 72.9 percent, from 344.9 to 596.4 million bushels.[12] While production increased, percentage of grain being marketed also rose from 68.1 percent to 75.9 percent. As a result nearly twice as much grain was marketed in 1960 as in 1950, 452.6 and 234.8 million bushels respectively. Though the western one-third of Kansas accounted for a larger increase in grain marketed the eastern one-third had a larger percentage increase in total capacity.

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[12]Kansas State Board of Agriculture, Report of the Board, Farm Facts, 1960-1961. (Topeka, Kansas: State Printing Plant, 1961).