University of Tennessee, Knoxville
TRACE: Tennessee Research and Creative Exchange

Masters Theses | Graduate School

11-1963

A transportation acquisition model for corn

Joe Kenneth Robertson

Follow this and additional works at: https://trace.tennessee.edu/utk_gradthes

Recommended Citation

Robertson, Joe Kenneth, "A transportation acquisition model for corn. " Master's Thesis, University of Tennessee, 1963.
https://trace.tennessee.edu/utk_gradthes/8568

This Thesis is brought to you for free and open access by the Graduate School at TRACE: Tennessee Research and Creative Exchange. It has been accepted for inclusion in Masters Theses by an authorized administrator of TRACE: Tennessee Research and Creative Exchange. For more information, please contact trace@utk.edu.

To the Graduate Council:

I am submitting herewith a thesis written by Joe Kenneth Robertson entitled "A transportation acquisition model for corn." I have examined the final electronic 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.

Cecil E. Fuller, Major Professor

We have read this thesis and recommend its acceptance:

Stanton P. Parry, A. J. Garbarino, Lewis Copeland

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

November 22, 1963

To the Graduate Council:

I am submitting herewith a thesis written by Joe Kenneth Robertson entitled "A Transportation Acquisition Model for Corn." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

Cecil E. Fuller
Major Professor

We have read this thesis and recommend its acceptance:

Stanton P. Parry

Ralph J. Galvarino

Lewis Copeland

Accepted for the Council:

Hilton A. Smith
Dean of the Graduate School

A TRANSPORTATION ACQUISITION MODEL FOR CORN

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

---

by

Joe Kenneth Robertson

November, 1963

24
33

ACKNOWLEDGEMENTS

The writer wishes to express his sincere appreciation and indebtness to those who have given willingly of their time to assist in the completion of this study. Failure to recognize some who deserve acknowledgement does not indicate lack of gratitude.

To Dr. Cecil E. Fuller, who has been teacher, counselor, and friend, the writer is most deeply indebted, and any acknowledgement made would be all too inadequate to express my gratitude. Sincere appreciation is extended for his patience, criticism, direction, and encouragement during the course of this study.

Appreciation is expressed to Dr. Stanton P. Parry and Mr. A. J. Garbarino for their advice and counselling throughout the study, and to Mr. David S. Chambers whose instruction has been most helpful.

Special acknowledgement to Mr. Bruce McGhee, Navigation Economics Branch, Tennessee Valley Authority, for his aid in securing the transportation cost data.

The writer is indebted to the secretaries and statistical clerks in the Department of Agricultural Economics for their aid in preparing the manuscript. Appreciation is also expressed to Mrs. Patricia Dyer for typing the final manuscript.

A very special indebtness is acknowledged to my wife for the encouragement, complete support, and patience rendered to me, for her sacrifices made this study possible.

J.K.R.

584742

TABLE OF CONTENTS

LIST OF TABLES

TABLE PAGE

TABLE PAGE

LIST OF FIGURES

CHAPTER I

INTRODUCTION

In 1959, Tennessee farmers received $35.7 million income from the sale of cash grains (Table I). This amounted to 39 per cent of the total value of grains produced in Tennessee and was an estimated increase of 102 per cent over the 1950 value of cash grains. The fact that cash grains were an important source of farm income was attested to by their relative position as a source of total farm income in Tennessee. Total farm income from cash grains was exceeded only by livestock and poultry and the individual field crops, cotton and tobacco, returning $229.9 million, $112.9 million, and $65.0 million, respectively, in 1959.[1] The sale of livestock, livestock products, poultry, and poultry products could be considered another method of marketing grain. Grains marketed in these forms are often unfit or unpalatable for food purposes, and this is a method of converting such commodities to food products demanded by consumers.

Total production of grains in Tennessee in 1959 increased 1.6 per cent over that of 1950, while the total amount of grains offered by farmers for sale as cash grains increased 110 per cent (Table II). This increase in total cash grain volume was influenced by the increased amounts of corn, wheat, and soybeans sold as cash crops.

At the same time, total animal units on Tennessee farms increased by 2.8 per cent. The numbers of poultry, heavy consumers of feed grains, decreased in this period, but this decrease was offset by an increase in the numbers of cattle and calves and hogs and pigs on Tennessee farms, also heavy consumers of feedstuffs (Table III).

---

[1] United States Bureau of the Census, United States Census of Agriculture: 1959, Tennessee, Vol. I, Part 31 (Washington: Government Printing Office, 1961), pp. 10, 15.

TABLE I

TOTAL AND CASH VALUE OF GRAIN CROPS, TENNESSEE, 1950 AND 1959

Grain	1950		1959	
	Total Value	Cash Value[a]	Total Value	Cash Value[a]
	(1000 Dollars)			
Corn	$79,318	$ 7,630	$61,480	$14,760
Wheat	6,876	3,544[b]	6,140	4,743
Oats	3,409	636[b]	3,331	753
Barley	1,028	197[b]	1,011	190
Sorghum	1,359	29	3,826	251
Soybeans	5,928	5,681[b]	15,667	15,014
Total	$97,919	$17,716	$91,454	$35,711

Source: United States Bureau of the Census, United States Census of Agriculture: 1959, Tennessee, Vol. I, Part 31 (Washington: Government Printing Office, 1961), pp. 11-12.

Note: The data presented in this and other tables may or may not be additive due to rounding error.

[a]Cash value refers to that sold as cash grains.

[b]Estimates.

TABLE II

TOTAL AND CASH PRODUCTION OF GRAIN CROPS IN TENNESSEE AND PER CENT OF TOTAL AS CASH, 1950 AND 1959

Grain	Production					
	1950			1959		
	Total	Cash[a]	Per Cent	Total	Cash[a]	Per Cent
	(1000 Bushels)			(1000 Bushels)		
Corn	56,100	6,398	11.4	50,905	13,418	26.4
Wheat	3,488	1,836	52.6	3,469	2,680	77.2
Oats	4,281	805	18.8	4,164	941	22.6
Barley	1,020	197	19.3	1,064	120	11.3
Sorghums	95	19	20.0	1,190	239	20.1
Soybeans	2,850	2,731	95.8	8,160	7,820	95.8
Total	67,833	11,985	17.7	68,952	25,218	36.6

Source: United States Bureau of the Census, United States Census of Agriculture: 1959, Tennessee, Vol. I, Part 31 (Washington: Government Printing Office, 1961), pp. 11-12.

[a]Cash production refers to that volume sold as cash grain.

TABLE III

TOTAL LIVESTOCK ON TENNESSEE FARMS, AND PER CENT CHANGE, 1950 AND 1959

Type of Livestock	1950	1959	Per Cent Change
Cattle and Calves	1,561,136	1,742,552	+11.6
Horses and Mules	370,840	139,380	-62.4
Hogs and Pigs	1,365,757	1,609,569	+17.8
Sheep and Lambs	368,127	260,506	-29.2
Poultry:			
Chickens	8,041,237	6,836,245	-15.0
Turkeys	18,249	17,915	- 1.8
Total[a]	5,101,048	5,244,852	+ 2.8

Source: United States Bureau of the Census, United States Census of Agriculture: 1959, Tennessee, Vol. I, Part 31 (Washington: Government Printing Office, 1961), p. 9.

[a]Total is given in grain-consuming animal units, weighted as follows: cattle on feed, 2.0; horses, 1.34; hogs, 0.712; sheep, 0.12; chickens, 0.0577; and turkeys, 0.07.

In 1959, the estimated grain deficit in Tennessee was 1,563,000 short tons. Shipments from other areas of the nation to meet this deficit amounted to an estimated 379,000 short tons by rail, 960,000 by water, and 224,000 by motor truck.[2] In comparison, the deficit in 1950 was only 441,000 tons, clearly showing a substantial increase in the deficit grain position of Tennessee during the past decade.[3]

I. REVIEW OF LITERATURE

The study of regional grain marketing under SM-11, as reported in the Southern Cooperative Series Bulletin No. 60, June, 1958, disclosed serious deficiencies in information relative to the transportation of grain into and within the southern region, especially data on transfer costs.

The Southeastern Regional Grain Marketing Research Project SM-11, Revised, is presently engaged in assembling information concerning transportation costs and volumes and their influence on the spatial pattern of origin and destination points of grains and grain products. This report is a portion of Tennessee's contribution to that project.

Some earlier work was reported in the University of Tennessee Rural Research Series (monographs).[4] These reports were of studies dealing with regional variations in grain prices and local (Knoxville) milling and distribution patterns, but no factual data relevant to transfer costs were included.

---

[2] Interstate Commerce Commission Hearing, I. & S. Docket No. 7656, Exhibit No. 4 (JJC-1), witness: John J. Corson, "Statistical Tabulations of Grain Shipments by Rail, Water, and Motor Transportation Into, Within, and Out of the Southeast" (Washington: Interstate Commerce Commission, January 8, 1962.

[3] R. D. Jennings, Feed Consumed by Livestock - Supply and Disposition of Feeds, 1949-1950, Agriculture Research Service, United States Department of Agriculture, Statistical Bulletin No. 145 (Washington: Government Printing Office, June, 1954), p. 8.

[4] Charles E. Allred and others, "Regional Differences in Farm Price of Corn, Tennessee and United States," Rural Research Series, Monograph No. 31 (Knoxville: University of Tennessee, March 20, 1937); Charles E. Allred, "Regional Variation in Farm Price of Small Grains,

The motor truck study of the cooperative states of the North Central Region (NCM-19), Truck Shipments of Grain in the North Central Region, 1956, presented data on the volume and kinds of grain moving into Tennessee and other southern states by truck.

One study in Ohio, dealing with trucked volumes of grain, gave data dealing with rates for various volumes of grains for varying distances.[5] A companion study conducted in Indiana included similar data for that state.[6] Other studies have been conducted in the North Central Region on grain movements, but data concerning transportation costs were not included.[7]

II. PROBLEM

As Tennessee is a deficit feed grain producing area, the feedstuffs required to maintain the livestock population must be imported from other areas of the nation to supplement local production of these

---

Tennessee and United States," Rural Research Series, Monograph No. 55 (Knoxville: University of Tennessee, September 20, 1937); Charles E. Allred and B. H. Luebke, "Marketing Field Seed in the Knoxville Area, Part I, Supply, Distribution, and Regulations," Rural Research Series, Monograph No. 124 (Knoxville: University of Tennessee, March 25, 1941); Charles E. Allred and others, "The Grain Milling Industry in Knoxville Trade Area," Rural Research Series, Monograph No. 142 (Knoxville: University of Tennessee, October 23, 1942); Magnus B. Johnson and B. H. Luebke, "Disposition and Outlets for Grain in Knoxville Trade Area," Rural Research Series, Monograph No. 152 (Knoxville: University of Tennessee, April 25, 1943).

[5] John W. Sharp and John Amos, "Truck Shipments of Ohio Grain," Research Circular 92 (Wooster: Ohio Agricultural Experiment Station, November, 1960), pp. 22-23.

[6] Paul L. Farris and David A. Storey, "Truck Shipments of Grain from Indiana Elevators" (Lafayette: Indiana Agricultural Experiment Station, Purdue University, August, 1959), pp. 7, 36-37. (Mimeograph EC-134).

[7] Agricultural Marketing Service, United States Department of Agriculture, Grain Transportation in the North Central Region, Marketing Research Report No. 490 (Washington: Government Printing Office, July, 1961); Kenneth R. Farrell, Grain Marketing Statistics for the North Central States (Columbia: Missouri Agricultural Experiment Station, June, 1958).

grains. The grain marketing problems have been intensified due both to the increased proportion of grain entering the marketing channels of the state as cash grain and the increasing feed grain deficit position of the state. Corn was selected for analysis due to its importance as a feed grain and basic ingredient of manufactured animal feeds.

The imported corn was transported into Tennessee by various transport methods: truck, rail, and barge. Previous studies have not provided factual data pertaining to the costs of transporting corn into Tennessee. More specifically, the problem was the determination of the relative cost efficiency with which Tennessee grain firms obtained corn from external sources.

III. OBJECTIVES

The objectives of this thesis were:

1. To describe the movements of feed grains in Tennessee, 1959 and 1960.[8]
2. To determine the cost of transporting corn into Tennessee from external supply centers, by method of carriage.
3. To relate these costs to the spatial arrangements of points of external origin and internal destination.
4. Construction of a least-cost transportation model for corn, using price and transportation cost differentials.

IV. BENEFITS

The data and analysis presented should be of value to processors and grain handlers in particular and indirectly to the livestock and poultry industry of the state. A spatial equilibrium model was constructed involving costs of transporting corn by various transportation methods between representative points of external origin and internal destination, volumes moving from and/or to these points, and price of corn at the points of origin.

---

[8] Includes soybeans.

Economic efficiency may be increased through the use of information derived from the least-cost transportation model. If the model can provide information to effect a savings in corn transportation costs, the savings may be passed on to the grain handlers and/or processors, assuming this savings is not lost through "leakage" in the marketing system. This savings would allow the grain handlers and/or processors to expand their individual operations or maintain present scale of plant and incur greater profits. The savings would probably be passed on to the consumers in the form of lower prices in the long run, but this would depend upon the market structure of the individual firms in the market system.

V. PROCEDURE OF THE STUDY

Data

The data relevant to this study included:

1. Storage capacity volumes.
2. Points of origin and volumes of corn and other feed grain receipts;
   a. Representative external points.
   b. Representative internal points.
3. Destination points and volumes of corn and other feed grain shipments;
   a. Representative external points.
   b. Representative internal points.
4. Price series data for # 2 yellow corn at representative points of origin and destination.
5. Transportation costs for corn by mode of carriage between representative external origin and internal destination points.

Method of securing and sources of data

The data concerning storage capacities and representative points of external origin and destination were obtained from a sample of Tennessee grain dealers. The internal points of origin and destination

were selected by dividing the state into four major market areas with Memphis, Nashville, Chattanooga, and Knoxville as the major distribution centers for each area, respectively. A more detailed account of the statistical methodology is found in Chapter II.

The price series data were obtained from the Grain Marketing Division, Agricultural Marketing Service, United States Department of Agriculture.

Rail and barge transportation cost data were obtained from the Navigation Economics Branch, Tennessee Valley Authority, for the selected representative origin and destination points. The motor truck transportation data were obtained for the selected points of origin and destination by the utilization of a regression formula based upon motor charges as reported by the grain firms interviewed in Tennessee and the other states participating in the Southeastern Regional Grain Marketing Research Project SM-11, Revised.[9]

---

[9]These states were Alabama, Arkansas, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Tennessee.

CHAPTER II

STATISTICAL METHODOLOGY

A problem basic to this study was the determination of sources and volumes of corn which moved between points outside and within Tennessee via the appropriate transportation system, and the associated transfer costs. It was important to secure information as reliable and accurate as possible. Since it was too laborious to conduct a census of Tennessee grain firms, a sample consisting of 197 firms was employed. The procedure and the sample techniques outlined were designed and formulated, and the sample drawn, by statisticians of the United States Department of Agriculture for all states cooperating in the SM-11 project.

The statistical data collected were for the years 1959 and 1960 and included: (1) storage volumes, (2) volumes of feed grains via the appropriate method of carriage, (3) price series for corn for selected points of origin and destination, and (4) corn transportation costs by each method of carriage between the selected points.

The data were obtained from a stratified sample of Tennessee grain dealers. The grain merchandising firms were classified into four strata on the basis of storage capacity. These strata were (1) large elevators, (2) oilseed-crushing plants, (3) small elevators, and (4) feed mills. Storage capacity was used as a sampling basis because a linear regression analysis indicated that, of all known factors, volume and storage capacity had the closest relationship.[1]

---

[1]Letter from Travis Phillips, Associated Economist, Mississippi Agricultural Experiment Station, State College, Mississippi, to author dated October 6, 1962.

Since Stratum I accounted for approximately 47 per cent of the listed grain storage capacity in Tennessee, it was completely enumerated (Table IV). Stratum II contained firms with 31 per cent of the total storage capacity of the states and was also completely enumerated. Approximately 13 per cent of total storage was accounted for by firms in Stratum III, and in this case the firms were listed in descending order of capacity and every third firm was drawn systematically from a random start. The remaining total storage capacity for grain was controlled by firms listed in Stratum IV. Here, as in the case of Stratum III, every third firm was chosen, but the firms were listed alphabetically as the storage capacities, if any, were not known.

The 197 firms in the sample were contacted but information schedules were taken from only 108 firms (Table V). In Stratum I, eight firms were excluded from the sample, three because they handled seed grain only, three were out of business, and two were operated as a single firm in connection with a third in this stratum. Two of the remaining thirty-two firms were non-cooperators.

Of the eleven firms sampled in Stratum II, three were dropped because they were cottonseed processors only and three were non-cooperators. The sample size of Stratum III was reduced by the removal of seventeen firms that were found to be out of business and seven which were seed and bagged-feed dealers. Five firms in this stratum were non-cooperators. Stratum IV contained only thirty firms that were applicable to the study. The remaining forty-four were either out of business or handled bagged-feeds only.

In order to establish an estimate of the total grain movement, expansion factors were calculated for each stratum. This was achieved by dividing the sample storage capacity of each stratum into its respective universe storage capacity. In order to make the estimate as nearly correct as possible, the universe and sample storage for each stratum was adjusted for those firms dropped from the sample before calculating the factors. The firms listed as non-cooperators were included in the adjusted universe and sample because enough was discovered about their activities to assume that their business operations were not

TABLE IV

UNIVERSE AND SAMPLE SIZE, BY NUMBER OF FIRMS AND STORAGE CAPACITY, BY STRATA, TENNESSEE, 1960

Strata	Number of Firms		Storage Capacity in Bushels	
	Universe	Sample	Universe	Sample
Stratum I				
Large Elevators	40	40	16,843,500	16,843,500
Stratum II				
Oilseed Crushers	11	11	11,000,000	11,000,000
Stratum III				
Small Elevators[a]	234	72	4,673,000	1,409,750
Stratum IV				
Feed Mills	237	74	3,293,800[b]	1,028,450[b]
Total	522	197	35,810,300	30,281,700

[a]Breaking point between large elevators and small elevators was 98,000 bushels of storage.

[b]Estimated.

TABLE V

ADJUSTED UNIVERSE AND SAMPLE STORAGE CAPACITIES, SAMPLE SIZE AND EXPANSION FACTORS BY STRATA, TENNESSEE, 1960

Strata	Sample Size	Adjusted Storage Capacity in Bushels		Expansion Factors
		Universe	Sample	
Stratum I	30	12,175,250	11,855,250	1.0270
Stratum II	5	14,000,000	8,100,000	1.7284
Stratum III	43	3,155,200	903,295	3.4930
Stratum IV	30	1,366,300	416,940	3.2770
Total	108	30,696,750	21,275,485	1.4428

too different from those firms interviewed in the study. These expansion factors were then applied to the volume of grain reported in the sample to give an estimate of the total movement in Tennessee for 1959 and 1960. The expansion factor applied to the total reported movements obtained in the sample was 1.4428, while the Stratum I factor was 1.0270; Stratum II was 1.7284; Stratum III was 3.4930; and Stratum IV was 3.2770.

CHAPTER III

GRAIN MOVEMENTS IN TENNESSEE, 1959 AND 1960

I. INTRODUCTION

In order to construct a least-cost acquisition, or "best-source," model for corn based on price and transportation differentials, knowledge of corn movements was essential. These data, and similar data for other feed grains, were important in ascertaining the deficit position of Tennessee relative to the selected grain types which were considered in this chapter. To assess the deficit required three sets of summary data: volumes of grain received, volumes shipped, and volumes of production in Tennessee. These summary data are presented in this section along with a brief analysis of the types of transportation involved in these movements.

Grain firms in Tennessee received approximately 144 million bushels of grain in 1959 (Table VI). Of this amount, ninety-nine million bushels were held in storage and/or converted, for the most part, to feeds for the animal population of Tennessee and neighboring states with the remaining forty-five million re-shipped as raw grain. In 1960, these same firms received a total of approximately 126 million bushels of grain from all sources. Only forty-four million bushels of these grain receipts were re-shipped as raw grain with the majority, again, being held in storage for future resale and/or immediate or future processing into grain products, notably feeds.

Gross receipts of grain for the years 1959 and 1960 were handled primarily by the truck and rail transport methods, with rail being the more important in 1959 and truck in 1960. Truckers accounted for 38 per cent of gross receipts in 1959 and 42 per cent in 1960. Forty-six per cent of the 1959 receipts were handled by rail compared to 38 per cent for 1960. Barge receipts were fairly stable, percentage-wise, for both years, transporting 16 per cent of the gross in 1959 and 20 per cent in 1960.

TABLE VI

TOTAL VOLUME OF GRAIN RECEIVED AND SHIPPED,[a] BY MODE OF TRANSPORTATION, TENNESSEE, 1959 AND 1960

Grain Type and Year	Receipts				Shipments			
	Truck	Rail	Barge	Total	Truck	Rail	Barge	Total
				(1000 Bushels)				
1959								
Corn	34,153	7,985	14,784	56,922	12,955	7,487	6,332	26,774
Soybeans	9,536	22,558	920	33,014	1,850	3,419	2,234	7,503
Wheat	4,275	7,096	5,916	17,287	1,630	2,544	764	4,938
Oats	3,996	6,054	1,773	11,823	2,089	1,262	--	3,351
Barley	819	3,245	12	4,076	254	393	--	647
Grain Sorghums	2,131	19,219	153	21,503	502	1,607	--	2,109
Total	54,911	66,157	23,557	144,624	19,280	16,711	9,330	45,321
1960								
Corn	32,635	7,107	18,677	58,419	12,594	8,368	4,601	25,563
Soybeans	9,340	21,842	914	32,096	1,937	3,427	1,601	6,965
Wheat	4,531	9,667	4,350	18,547	2,220	3,524	561	6,305
Oats	3,549	2,590	1,314	7,453	2,163	936	--	3,099
Barley	832	1,040	16	1,888	249	300	--	549
Grain Sorghums	2,072	5,202	195	7,469	506	1,191	257	1,953
Total	52,959	47,448	25,465	125,872	19,668	17,746	7,020	44,434

Source: Appendix Tables XIX, XX, XXI, XXII, XXIII, XXIV, XXV, and XXVI.

[a]Includes grain received from and shipped to all points within Tennessee as well as out-of-state points.

More grain was shipped by truck than by either rail or barge in both 1959 and 1960. The percentage of gross shipments by truck, rail, and barge for 1959 were 42, 37, and 21, and for 1960, 44, 40, and 16, respectively.

Estimates presented in Chapter I indicate that Tennessee is in a deficit position as a grain-producing state. By utilizing the primary data collected for this study and the production volumes of Tennessee grains, it was possible to arrive at an estimate of the total net deficit position of the state for the six grain types selected (Table VII).

The net deficit for each grain type was arrived at by subtracting the volume of grain produced in Tennessee from the net volume in the state for each of the two years under consideration. The net volume of grain in Tennessee was calculated by summing the volume of grain produced locally within the state and the volume shipped into the state from external supply sources, and then subtracting the volume of grain shipped by Tennessee grain firms to out-of-state destinations.

The deficit in 1959 was slightly less than sixty-three million bushels of grain and forty-six million in 1960. Corn accounted for one-third of the deficit in 1959 and one-half in 1960, this increase in the latter year being attributable to a fairly stable net deficit volume for corn in the light of a decline in the total net deficit. A contributor to the larger deficit in 1959 was grain sorghums. Wheat contributed 14 per cent of the total net deficit in 1959 and 18 per cent in 1960, even though there was a decrease in the net deficit of wheat in 1960 of 5 per cent from the 1959 position. The soybean deficit was 11 and 17 per cent of the total net deficit in 1959 and 1960, respectively. Oats and barley accounted for 16 per cent of the 1959 total net deficit and 9 per cent of the forty-six million bushel deficit of 1960.

II. GRAIN RECEIPTS OF TENNESSEE GRAIN FIRMS, 1959 AND 1960

Data presented in the previous section indicates a deficit of substantial amounts existed in Tennessee in 1959 and 1960 in all types

TABLE VII

NET GRAIN DEFICIT IN TENNESSEE, BY GRAIN TYPE, 1959 AND 1960

Grain Type and Year	Volume Produced[a]	Volume Shipped into Tenn.[b]	Gross Volume in Tennessee	Volume Shipped out of Tenn.[c]	Net Volume in Tenn.	Net Deficit in Tenn.
			(1000 Bushels)			
1959						
Corn	65,560	40,201	105,761	19,138	86,623	21,063
Soybeans	7,560	11,473	19,033	4,234	14,799	7,239
Wheat	3,720	12,409	16,129	3,299	12,830	9,110
Oats	5,166	9,230	14,396	2,309	12,087	6,921
Barley	1,480	3,645	5,125	269	4,856	3,376
Grain Sorghums	1,248	15,577	16,825	439	16,386	15,138
Total	84,734	92,535	177,269	29,688	147,581	62,847
1960						
Corn	52,806	42,464	95,270	18,049	77,221	24,415
Soybeans	8,865	11,214	20,079	3,422	16,657	7,792
Wheat	3,288	13,254	16,542	4,602	11,940	8,652
Oats	3,500	5,488	8,988	2,333	6,655	3,155
Barley	962	1,475	2,437	271	2,166	1,204
Grain Sorghums	1,088	1,723	2,811	396	2,415	1,327
Total	70,509	75,619	146,128	29,074	117,054	46,545

[a]Source: S. T. Marsh, "1960 Crop Summary, Tennessee," Crop Reporting Service, Tennessee Department of Agriculture, Release 2118 (Nashville: Tennessee Department of Agriculture, December 21, 1960), p. 3-4, (Mimeographed) and S. T. Marsh, "1961 Crop Summary, Tennessee," Crop Reporting Service, Tennessee Department of Agriculture (Nashville: Tennessee Department of Agriculture, December 29, 1961), p. 3-4, (Mimeographed).

[b]Appendix Table XIX.

[c]Appendix Table XXIII.

of grain. Forty per cent or less of total receipts originated from within the state in both years. Of the 144 million bushels of grain received in 1959 by Tennessee grain dealers, only 52.0 million bushels entered the marketing channel from sources within the state (Appendix Table XIX). A smaller gross volume entered the market in 1960 from in-state sources, in this case 50.2 million bushels. Only 32 per cent of the total corn receipts in both years originated from in-state sources.

The importance of each of the three transportation methods involved in total movements is indicated in the previous section, but when one reviews the position of these methods relative to movements from out-of-state sources, one finds the relationships somewhat altered. The rail system was the dominant method of transportation involving receipts from exterior points for both 1959 and 1960. Rail accounted for about one-half of this volume received in 1959, with the other one-half almost equally shared by truck and barge (Table VIII). Forty-seven per cent of the volume of corn received from external sources in 1959 was transported by truck, while 37 per cent came by barge and 16 per cent by rail.

The portion of externally produced volumes entering Tennessee in 1960 by rail transportation declined to 35 per cent, while truck increased to 31 per cent and barge handled 34 per cent. Forty-four per cent of the corn imported from external sources in 1960 was transported via barge, 42 per cent via truck, and 14 per cent via rail.

It was a major concern to establish the supply areas of the nation from which corn and other grains were shipped into Tennessee not only because of the large volumes imported in 1959 and 1960, but also because of the necessity to identify these sources in order to conduct a comparative analysis of optimum and actual acquisition costs for corn. For this reason it was also important to ascertain the degree of employment of each of the transportation methods by these supply firms. Knowledge of transportation used was also important because many firms in Tennessee did not have the necessary plant facilities for rail transportation and relatively few had barge facilities. Thus, for many of the small grain firms motor truck was the only form of transportation they could employ

TABLE VIII

VOLUME OF GRAIN RECEIVED FROM EXTERNAL SOURCES, BY MODE OF TRANSPORTATION, TENNESSEE, 1959 AND 1960

Grain Type and Year	External Volume Received			
	Truck	Rail	Barge	Total
	(1000 Bushels)			
1959				
Corn	19,059	6,358	14,784	40,201
Soybeans	1,511	9,042	920	11,473
Wheat	767	5,727	5,916	12,409
Oats	2,170	5,287	1,773	9,230
Barley	491	3,142	12	3,645
Grain Sorghums	53	15,370	153	15,577
Total	24,053	44,935	23,557	92,535
1960				
Corn	17,907	5,880	18,677	42,464
Soybeans	1,461	8,841	914	11,214
Wheat	1,007	7,898	4,350	13,254
Oats	2,202	1,972	1,314	5,488
Barley	565	895	16	1,475
Grain Sorghums	97	1,430	195	1,723
Total	23,238	26,916	25,465	75,619

Source: Appendix Tables XIX, XX, XXI, and XXII.

in direct transfer between themselves and the supply area. In contrast, the larger firms utilized rail and barge but motor truck was also utilized to a high degree relative to the gross volumes of grain they received annually.

The North Central Region of the United States was a major supplier of grain to Tennessee in both 1959 and 1960.[1] This grain-producing area contributed 56 and 66 per cent of grain shipped into Tennessee in 1959 and 1960, respectively (Table IX). Other individual state sources were Kentucky and Texas. Corn was supplied principally by Illinois, Indiana, and Kentucky.

Of the twenty-four million bushels of grain imported by truck in 1959, 38 per cent originated in Illinois, with an equivalent per cent coming from Indiana and Kentucky collectively (Appendix Table XX). The major portion of this volume from these states consisted of corn; in fact, corn accounted for almost 80 per cent of all grain imported by truck in 1959. This situation was slightly changed in 1960, but Illinois was still the prime supplier of grain by motor truck, providing one-third of the volume. Indiana and Kentucky increased their truck shipments to 23 and 20 per cent, respectively. Again, as in 1959, corn was the more important grain in this movement, accounting for 77 per cent of the total motor volume.

The largest exterior supply area utilizing rail transportation in 1959 was Texas, supplying approximately one-third of the total grain received from out-of-state points, and this entire volume was composed of grain sorghums (Appendix Table XXI). Arkansas was the major shipper of grain into Tennessee via rail in 1960, and of the 22 per cent of grain shipped by rail from that state, three-quarters were soybeans.

The barge system of transportation was used exclusively in the time period under study for grain shipments originating outside of Tennessee. As only two of the four major cities serviced by barge in Tennessee are located on the same tributary, transhipment of grain within the state by barge is rather awkward. Illinois supplied in excess of one-

---

[1]The North Central Region refers to the states of Illinois, Indiana, Iowa, Minnesota, Missouri, Ohio, and Wisconsin.

TABLE IX

DISTRIBUTION OF GRAIN RECEIVED FROM EXTERNAL SOURCES, TENNESSEE, 1959 AND 1960

Source	Year	
	1959	1960
	(Per Cent)	
Alabama	*	*
Arkansas	8	9
Georgia	*	*
Illinois	28	34
Indiana	10	11
Iowa	*	*
Kansas	3	4
Kentucky	8	10
Minnesota	4	6
Mississippi	6	7
Missouri	9	8
Nebraska	1	1
North Carolina	*	*
Ohio	5	7
Oklahoma	1	1
Texas	15	--
Wisconsin	*	*
Total	100	100

Source: Appendix Table XIX.

*Less than one per cent.

half of the grain barged into Tennessee in 1959 and 81 per cent of this was corn (Appendix Table XXII). Minnesota shipments accounted for 14 per cent of total barge movements, with two-thirds being corn. Sixty-three per cent of all 1959 barge movements from external sources was comprised of corn.

Seventy-three per cent of the 1960 barge receipts from external sources was corn. Illinois supplied some 72 per cent of all corn barged into Tennessee in 1960. Minnesota shipped 14 per cent of the total barge movement from external sources into Tennessee in 1960, this volume being about two-thirds corn.

III. GRAIN SHIPMENTS OF TENNESSEE GRAIN FIRMS, 1959 AND 1960

Of the 144 million bushels of grain received in Tennessee during 1959, only 29.7 million were re-shipped by the state's grain firms to all points as raw grain, compared to 29.1 million in 1960 (Table VI). This points up the fact that the majority of grains entering Tennessee were used in the state as feed and/or food inputs.

Nevertheless, some grains were transhipped and it was necessary to investigate the pattern of this flow by transportation method and volume. Only one-third of the raw grains transhipped in 1959 were intrastate movements, with one-half being corn (Appendix Table XXIII). Corn also was the major grain involved in the shipments to out-of-state destinations, 64 per cent. The pattern for 1960 was unchanged, with one-third of the grain outshipments being intrastate movements. Corn again was the most important grain, accounting for one-half of the intrastate movement.

As in the case of out-of-state receipts, rail transportation was used for most shipments of grain to out-of-state destinations from Tennessee grain firms. Rail accounted for 11.3 million and 12.5 million bushels in 1959 and 1960, respectively (Table X). Once again, as in the case of the intrastate shipments, corn was the prime grain involved in the out-of-state shipments, amounting to approximately 6.5 million

TABLE X

VOLUME OF GRAIN SHIPPED TO EXTERNAL DESTINATIONS, BY MODE OF TRANSPORTATION, TENNESSEE, 1959 AND 1960

Grain Type and Year	External Volume Shipped			
	Truck	Rail	Barge	Total
		(1000 Bushels)		
1959				
Corn	6,593	6,212	6,332	19,138
Soybeans	--	1,999	2,234	4,234
Wheat	578	1,957	764	3,299
Oats	1,561	748	--	2,309
Barley	214	55	--	269
Grain Sorghums	93	347	--	439
Total	9,039	11,318	9,330	29,688
1960				
Corn	6,386	7,062	4,601	18,049
Soybeans	--	1,821	1,601	3,422
Wheat	1,165	2,876	561	4,602
Oats	1,654	679	--	2,333
Barley	206	64	--	271
Grain Sorghums	102	38	257	396
Total	9,513	12,541	7,020	29,074

Source: Appendix Tables XXIII, XXIV, XXV, and XXVI.

bushels in 1959 and 1960. Corn constituted the major volume shipped by all three transportation methods in both time periods.

Barge was the second most important transporter of grain moving out of Tennessee in 1958, 9.3 million bushels of the total movement, but was the least important in 1960, accounting for 7.0 million bushels. Motor truck transported 9.0 million and 9.5 million bushels in 1959 and 1960, respectively.

As Tennessee has been placed in the position of being a receiver of grains produced in other parts of the nation and also a supplier, it was expected that these grains would flow into the states to the South of Tennessee. The Southeastern states were the recipients of almost all grain shipped from Tennessee in both 1959 and 1960 (Appendix Table XXIII).[2]

Almost one-half of all grain shipped from Tennessee in both 1959 and 1960 was destined for export through Louisiana ports (Table XI). Large portions of grains were shipped to Georgia and Alabama in both years, supposedly to meet the demand for grain by the poultry industries in these two states. Amounts in excess of 10 per cent were shipped in undesignated amounts to undesignated states in the Southeastern Region.

Georgia was the recipient of the more than nine million bushels of grain transhipped by Tennessee grain firms by truck transportation in both 1959 and 1960. This heavy poultry producing state received approximately 60 per cent in both 1959 and 1960 (Appendix Table XXIV). The other major receiver of truck-transported grain was Alabama, receiving 30 per cent in both time periods. Corn accounted for more than 69 per cent of the total motor-movement received by each of these two states in both 1959 and 1960. Louisiana received most of the grain transported by rail, about 40 per cent in both 1959 and 1960, most of which was wheat and soybeans (Appendix Table XXV). Over one-fourth of the rail movement in both years was shipped to undesignated states in undesignated amounts to the Southeastern Region. Alabama received approximately 18 per cent in 1959 and 1960. As in the case of motor truck, corn was the

---

[2]The Southeastern states refers to Alabama, Georgia, Louisiana, Mississippi, North Carolina, and South Carolina.

TABLE XI

DISTRIBUTION OF GRAIN SHIPPED TO EXTERNAL DESTINATIONS, TENNESSEE, 1959 AND 1960

	Destination									
Year	Ala.	Ark.	Ga.	La.	Miss.	N.C.	S.C.	South-east[a]	Va.	Total
					(Per Cent)					
1959	16	*	23	47	*	*	*	12	*	100
1960	18	*	24	43	*	*	*	13	*	100

Source: Appendix Table XXIII.

*Less than one per cent.

[a]Southeast refers to Alabama, Georgia, Louisiana, Mississippi, North Carolina, and South Carolina. Shipments were made in undesignated volumes to these states.

major grain moving to these areas because of the poultry flocks situated in Alabama, Georgia, and the Carolinas.

The entire volume of grain the state's firms shipped by barge was consigned to Louisiana (Appendix Table XXVI). Here again, these grains were mostly for export from Louisiana's gulf ports, with corn and soybeans being 92 per cent of the 1959 volume and 88 per cent of the 1960 volume.

CHAPTER IV

THE CORN PRICING SYSTEM AND TRANSFER COST

I. INTRODUCTION

Corn was bought and sold at a multitude of points within Tennessee, as the grain firms were not concentrated in specific geographic locations but were distributed throughout the state. The firms which handled the major volume of corn were located in or near the four major metropolitan areas of the state, partly due to the availability of transportation facilities at these points. With this in mind, to facilitate this study the state was divided into four representative marketing areas. The selected marketing centers used were Memphis, Nashville, Chattanooga, and Knoxville (Figure I). For the purpose of constructing a minimum acquisition cost model, the price at each marketing center was assumed to be the prevailing price in the marketing area which this center served. The basis for this assumption was the observation that as the dealers in these marketing centers accounted for the vast majority of corn handled in the representative marketing area, they tended to act as price leaders for those firms situated at points removed from the center itself but within the marketing area.

The question then arose as to how does one account for the differences in price within the marketing area due to transfer cost. The transportation costs involved in moving corn from various supply areas to each of the marketing centers was assumed to be the prevailing rate for the outlying points as well. The implied assumption here was that transportation costs incurred in moving corn from the market center to all points within the area it served were equal and, therefore, for all practical purposes, zero. It then followed that the price of corn at the outlying points relative to the market center was the same as that quoted in the market center, as there was no additional charge for transportation under this assumption. This assumption does not hold in the case where corn was transhipped from one market center to another.

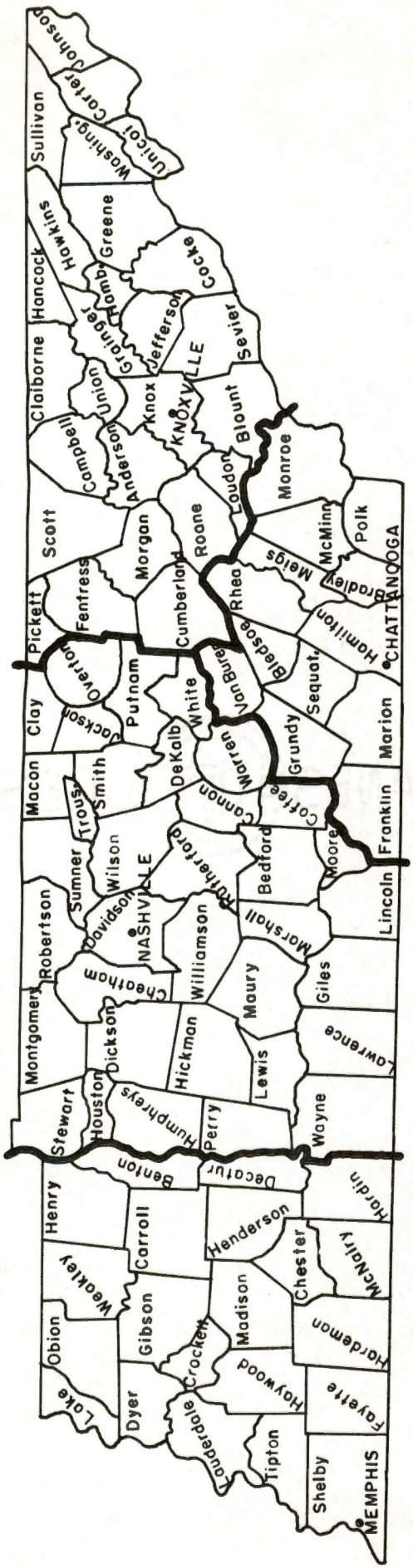

Figure 1. Market Areas and Centers for Grain Transportation Analysis, Tennessee, 1959 and 1960.

In this case, transportation costs were incurred and were reflected in the different prices quoted in the center to which the shipment was made.

It is well to point out the nature of the markets that each of the four centers serve with respect to their deficit character. The Nashville and Knoxville markets are primarily terminal markets, in that most of the volume received at these points is distributed within the deficit marketing areas they serve. Memphis and Chattanooga play a slightly different role, principally because of their access to barge facilities. As well as serving as terminal distributors for their respective deficit marketing areas, both Memphis and Chattanooga serve as important supply points for some of the deficit areas of Mississippi, Alabama, and Georgia, as well as other more distant points. Knoxville also acts as a supply point, to a small extent, for the western portions of the Carolinas and Virginia, but this role of supplier is only seasonal and is not of the same magnitude as the supplier role assumed by the Memphis and Chattanooga market centers.

As was the case of Tennessee marketing points, it was not feasible to construct a universal minimum acquisition cost model which would cover all possible external supply centers. Based upon the data reported in Chapter III, marketing centers within the major supplier states were selected as representative supply points (Figure II). The criteria for selection of these markets as representative supply centers on which to base price and transportation differentials were threefold. Firstly, availability of rail, barge, and truck transportation facilities emphasize the importance of the selected sources as natural assembly points for grain produced in each respective state. Secondly, these points are geographically located near the heart of the grain producing centers of each respective state or area. The third point was the vast volume of grain readily available at each of these markets, as emphasized by the fact that daily transactions are nationally reported for most of them. One other consideration which aided in the selection of these markets as representative supply centers was the geographic dispersion which made for more meaningful differentials in price and transportation cost data.

Figure 2. Selected Representative External Supply and Internal Receiving Centers for Corn, Tennessee, 1959 and 1960.

The assumptions of prevailing price and equal transportation cost which were applied to the four representative marketing, or receiving, points in Tennessee were also applied to each of the representative external supply centers. That is, it was assumed that the cost of transportation from all points, in a radial fashion, served by each selected external supply center would be equal and, therefore, zero for the purposes of this analysis. Thus, price at all points within the area would be the prevailing price at the market center as transportation would be a constant charge.

There are some transactions which take place along the periphery of Tennessee by firms of neighboring states. Such transactions, even-though taking place out-of-state, are, for all practical purposes, regarded as local transactions, as the direction of movement is toward the nearest major market, which would be one of the four Tennessee markets.

II. THE CORN PRICING SYSTEM

A comprehensive detailed investigation of the corn pricing system was not an objective of this study. Rather, a presentation of the pricing system as it reflected and depended upon transportation costs was all that was undertaken.

Monthly price series data for each representative external market was supplied, for most markets, by the Grain Division, Agricultural Marketing Service, United States Department of Agriculture (Appendix Tables XXVII and XXVIII). This price was an on-car, on-truck, on-barge quotation and included the marketing margin. To this price one needs only to add the cost of transporting the grain from the selected representative supply point to the representative Tennessee deficit market center to arrive at the total cost of obtaining corn at any of the four Tennessee centers. This price of corn fluctuated monthly because of changes in the price basis, transportation charge, and the handling margin. This margin was by no means constant and varied according to the nature of supply of corn available on the general market

within each marketing area of the state.

The presentation of these price data was merely for purposes of comparison with transfer costs which are developed in the following section of this chapter. The price data are for #2 yellow corn only and each price is assumed to be the prevailing price in all parts of each respective marketing area based on the assumption that the price differed in various parts of the area by the transportation charge for moving corn from the market center, and as these costs were assumed equal and therefore zero for analytical purposes, the price was the same in all parts of the marketing area. Thus, each of the marketing centers were taken to be representative of the respective area.

III. TRANSFER COST

In order to develop the scheme of the cost of transporting corn into Tennessee from selected external supply sources, certain assumptions were made. First, the general assumption of four representative Tennessee marketing centers with zero transfer costs within the marketing area was made. That is, these four points were used as representative receiving centers in Tennessee. Secondly, the supply centers within each of the states supplying corn to Tennessee were delineated under the same assumption as outlined in the previous section of this chapter. Points within each of the supplying states were chosen as being representative points and assumed to be such. This was necessary in order to determine the transfer rate between the selected representative supply points and the selected representative receiving points in Tennessee.

As the procedure for developing a transportation model was the same for all grain types, only one grain was used for purposes of demonstrating the analytical procedure of this study. The grain to be used in the analytical demonstration will be #2 yellow corn as this grain is the most important of the grain types considered in this study, as was demonstrated in the preceding chapter.

The initial problem in developing a matrix of motor rates was developing a regression equation for the purpose of determining rates between points involved in the matrix. Only a very small amount of corn

imported into Tennessee in 1959 and 1960 by motor truck was transported by truckers regulated by the Interstate Commerce Commission. Most of this movement involving truck was by self-owned or agricultural exempt truckers. In this case, there were no published rates available for use. From the initial survey of the grain firms of the state, one hundred and ten observations of motor rates for corn were obtained. Using the procedure outlined above to determine representative points within the supply states, the road mileage between the supply and receiving points was determined (Appendix Table XXIX). A regression of cents per bushel on mileage was attempted using a first degree parabola of the form $Y = a + bX$. The coefficient of determination (R^2) was only 42 per cent. A second degree parabola of the form $Y = a + bX + cX^2$ was then employed, but the resulting coefficient of determination did not yield an improvement over the previously calculated coefficient. The coefficient of determination was low in both cases because the truckers are not subject to a regulated uniform rate structure and rates therefore tend to be extremely divergent for any given mileage. For both the first and second degree parabolas, the $\bar{S}_{y.x}$ was 5.9 cents per bushel.

In order to secure a regression model with an acceptable coefficient of determination, the observations of motor rates for corn and corresponding mileage between supply and receipt points from all of the Southeastern states participating in the regional study, SM-11, Revised, were used.[1] A second degree parabola of the form $Y = a + bX + cX^2$ was employed, resulting in a coefficient of determination of 72.6 per cent and a standard error of estimate ($\bar{S}_{y.x}$) of 2.3 cents per bushel. The coefficient of determination and the standard error of estimate were both improved by the addition to the Tennessee data of more stable observations from the participating states. This model was then applied to the external supply sources from which Tennessee received corn by truck (Appendix Table XXX). The resultant charges between points were rounded to the nearest tenth of a cent, as truckers tend to set rates rather

---

[1] Furnished by Joe Chappell, North Carolina State College, Raleigh, North Carolina, Chairman, Rate Analysis Subcommittee, SM-11, Revised.

arbitrarily and this would be consistent with their rate setting.

Since rail movements were made under regulated rates, there was no need to construct a regression model to determine unit cost by rail between the selected supply centers, as this information was easily obtained from rate files (Appendix Table XXXI). Similarly, as barge movements are also regulated, rate files were also used to obtain unit cost data between the selected locations (Appendix Table XXXII). The barge and rail rates which were in force January 1, 1960, were taken as the effective rates, as this calendar date was the midpoint of the time period of this study.

These tables show the unit cost of transporting corn from the selected external supply centers to each appropriate market center in Tennessee. Rates are shown for each of the four market centers relative to all external supply centers even though the movement patterns developed by this study did not necessarily show movement from any particular supply location to all market centers in Tennessee. However, it was necessary to establish rates between all marketing centers in order to conduct a comparison of optimum and actual total acquisition cost.

These data were used to determine the minimum cost transport method and the minimum cost combination of transport methods and volumes of grain.

CHAPTER V

OPTIMUM TRANSPORTATION ACQUISITION MODEL

In general, the transportation problem centers around a homogeneous product which is to be shipped in various amounts as supplied by a given number of shipping origins. The cost of shipping a unit amount of product from any given origin to any given destination is given and is known for all combinations of origins and destinations. The problem is one of determining the amounts of the product to be shipped over all transportation routes so as to minimize the total cost function of transportation. The amount of a product shipped from any given origin to any given destination is known and subject to the restrictions that the total amount shipped from the origin is equal to or greater than zero and the total amount received by the destination is equal to or greater than zero. A temporary restriction is also enforced such that the total amount shipped is equal to the total amount received. The cost of shipping the given total amount is the product of the given transportation cost multiplied by the given total amount, where the given total amount shipped and received is bound by the restriction that this amount is equal to or greater than zero.

Hence, the transportation problem is to find values for the variable amounts of product shipped from given origins to given destinations such that the total cost of transportation is minimized, subject to the constraints that the amount shipped from any given origin to any given destination is equal and is known for all shipping origins and destinations. The problem is also subject to the constraint that the amount in transit between origins and destinations is equal to or greater than zero.[1]

In formulating an optimum, or least-cost, transportation model

---

[1]For the mathematical formulation of the transportation problem, see Saul I. Gass, Linear Programming (New York: McGraw-Hill Book Company, Inc., 1958), pp. 137-139.

for corn, utilizing selected representative external supply and internal receiving points, it was necessary to have knowledge of two basic variable components. First, it was required to know the monthly demand for corn at each of the selected representative internal markets as existed in 1959 and 1960. The second given variable was the total cost per bushel per month of acquiring corn at any given representative internal market from any given selected representative external source, where this total cost included the price of corn per bushel at any given representative external source and the transportation cost per bushel per each form of transportation (truck, rail, and barge) between any given representative external source and any given representative internal receiving market.

This is a slight modification of the general transportation model, as the function of the general model is to minimize total cost by determining the variable amounts of a product moving between the various combinations of source, or origin, and receiving points. In this problem of minimizing total acquisition cost for corn, the variable amounts (amount of corn demanded by each representative internal market) were given variables and the function of optimization was achieved by the selection of the minimum price-of-corn-transportation-cost combination between any given representative external supply source and internal receiving market.

From these two basic variable components of the corn transportation model, monthly volume of corn demanded and total monthly acquisition cost per bushel, it was possible to estimate three total cost values which defined the validity of the optimizing model. First, with acquisition cost per bushel per month, volume of corn demanded per month, and representative external supply sources given, the total actual acquisition cost for corn as incurred by Tennessee grain firms in 1959 and 1960 was estimated.

Secondly, an estimate of total optimum acquisition cost per transportation method was derived for each of the three transportation methods actually employed in 1959 and 1960, where the total volume of corn demanded was the same as the volume actually imported during these years and the monthly volume demanded by each representative internal market

was divided between truck, rail, and barge and was restricted to the monthly volume actually imported by each transport mode in 1959 and 1960. This total cost estimate per transportation method was arrived at by locating the monthly optimum sources from among the selected representative external sources for each of the three transportation methods, truck, rail, and barge. The monthly optimum acquisition cost per each mode of transport was multiplied by the monthly volume of corn actually imported in 1959 and 1960 by the respective transport mode to estimate optimum acquisition cost of corn per mode of transport. These three estimates were then aggregated to estimate the total optimum acquisition cost of corn for 1959 and 1960.

The third total cost estimate which was derived was the total optimum acquisition cost where predetermined amounts of the monthly corn demand was not restricted to each transportation method. In this case, the total optimum acquisition estimate was made by determining the minimum transportation-cost-monthly-corn-price combination from among all given representative external sources and multiplying the monthly optimum resultant source by the monthly demand of corn and summing over twelve months. The product of this optimization of source was the total optimum, or minimum acquisition cost for both 1959 and 1960.

I. ACTUAL COST

The stated function of an optimum transportation model is to minimize the total cost of acquiring a product demanded by any given consuming unit from a number of given supply centers, where total demand volume, price at each supply point, and transportation costs between the supply points and destinations are given. But the computation of an estimate of optimum total cost is preceded by the computation of an estimate of total cost actually incurred during the same period of time. Such computation was made for each of the four selected representative internal Tennessee markets.

Corn was received in the amount of 9.5 million bushels at the representative Memphis market in 1959 and 12.2 million bushels in 1960

(Appendix Table XXXIII). These volumes were received from the selected representative external markets of Peoria, St. Louis, Kansas City, and Louisville. The volume of corn indicated as originating from each of these selected representative external sources may not have all originated at each of these points, but did originate from within the geographic areas for which each representative external origin served as a market. Hence, under the assumptions presented in Chapter IV, the total volumes received from each selected exterior market and its surrounding market area were assigned to the selected representative external market source.

The representative internal Nashville market received corn from a greater number of selected representative external sources than did any of the other representative markets in Tennessee, and it also required a much larger volume of corn, 16.0 million bushels in 1959 and 14.8 million bushels in 1960 (Appendix Table XXXIV). The representative external sources from which these volumes of corn originated were Peoria; St. Louis; Cincinnati; Louisville; Evansville; Sheffield, Alabama; and Tupelo, Mississippi.

Chattanooga, serving in this analysis as a representative internal receiving market for corn shipped from representative external sources, received corn in the amounts of 12.2 million and 12.5 million bushels in 1959 and 1960, respectively (Appendix Table XXXV). The selected representative external sources for these volumes were Cincinnati, Minneapolis, Peoria, St. Louis, Sheffield, Louisville, and Evansville. Corn supplied by the representative Minneapolis source was all shipped by barge, and because the river is closed to traffic due to its freezing-over in the months of November through March, corn does not move out of this source except by truck or rail in the winter months.

The fourth representative internal receiving market, Knoxville, drew corn from the selected representative external sources of Evansville, Cincinnati, Louisville, Peoria, Sheffield, and Gainesville, Georgia, in the amounts of 2.5 million bushels in 1959 and 2.9 million bushels in 1960 (Appendix Table XXXVI).

The estimate of total actual acquisition cost for each representative internal receiving market was calculated by multiplying the

monthly price per bushel of corn at each selected representative external source (Appendix Tables XXVII and XXVIII) supplying corn to the representative internal markets by the monthly volume of corn moving between the representative external and internal markets, plus the appropriate transportation charge per bushel (Appendix Tables XXX, XXXI, and XXXII) for moving this monthly volume by each transportation method actually employed. These monthly estimates of total actual acquisition cost were aggregated to give an estimate of the annual total acquisition cost as incurred in 1959 and 1960.

In 1959, the total cost of acquiring 40.2 million bushels of corn from representative external sources by representative internal markets was $53.8 million (Table XII). Forty-eight per cent of this actual total acquisition cost was incurred by purchasing and importing corn by truck transportation. The purchase and importation by rail transportation incurred a total acquisition cost for corn of $8.9 million. Corn was purchased at external sources and barged into only two of the representative internal markets, but the total cost of this acquisition operation amounted to 36 per cent of the total annual acquisition cost actually incurred in 1959.

The total actual acquisition cost of purchasing and importing 42.4 million bushels of corn from representative external sources into the representative internal markets in 1960 was $54 million. The total cost of corn purchased and delivered by truck and barge transportation accounted for 43 per cent, each, of the total annual acquisition cost. As the volume of corn shipped by rail transportation into Tennessee declined in 1960 compared to 1959, the total acquisition cost of corn purchased and delivered by rail declined 11 per cent from that of 1959.

II. OPTIMUM COST BY EACH TRANSPORTATION METHOD

The computation of optimum costs estimated on a transportation method-restricted basis is a valid tool when one considers that the actual patterns of corn movements into Tennessee, as presented in Chapter III, involved shipments by truck, rail, and barge in 1959 and

TABLE XII

ESTIMATED TOTAL ACTUAL ACQUISITION COST OF CORN,[a] BY TRANSPORTATION METHOD, TENNESSEE, 1959 AND 1960

Representative Market and Year	Transportation Method			
	Truck	Rail	Barge	Total
	(1000 Dollars)			
1959				
Memphis	$ 1,427	$3,318	$ 7,825	$12,570
Nashville	17,501	3,847	--	21,347
Chattanooga	4,545	511	11,458	16,514
Knoxville	2,149	1,195	--	3,344
Total	$25,621	$8,871	$19,283	$53,774
1960				
Memphis	$ 871	$2,211	$11,821	$14,903
Nashville	15,274	3,660	--	18,934
Chattanooga	4,541	546	11,219	16,306
Knoxville	2,410	1,473	--	3,883
Total	$23,097	$7,889	$23,040	$54,026

Source: Appendix Tables XLI, XLII, XLIII, and XLIV.

[a]Cost figures include all costs of acquiring corn, delivered in Tennessee by each transportation method, as incurred in 1959 and 1960.

1960. This is true because there were some grain firms which were equipped to receive grain by truck only and a smaller number equipped for both truck and rail receipts. Those firms equipped to handle receipts by truck, rail, and barge were a small minority.

In computing an estimate of optimum cost for each transportation method, the model was restricted so that an optimum source, or sources, was selected for each transportation method. The model was further restricted so that the total monthly volume of corn which entered each of the representative internal markets in 1959 and 1960 by each transportation method was the monthly volume applied to the monthly optimum price-transportation-cost combination for each transportation method in each representative internal market.

The volume of corn actually transported each month by the appropriate transportation system (Table XIII) was multiplied by the monthly optimum price-of-corn-transportation-cost combination for each transportation method employed in 1959 and 1960 by each representative internal market (Table XIV). This monthly minimum acquisition cost was aggregated to derive an estimate of total optimum acquisition cost which Tennessee grain firms could have incurred if they had optimized acquisition cost using the same transportation methods and volumes of corn per method as was the actual case in 1959 and 1960.

The total cost of acquiring corn from optimum representative external sources, where source was optimized utilizing the same transportation methods and monthly demand of corn delivered per each method as was the actual case in 1959 and 1960, was considerably lower than the total cost actually incurred. Optimization per transportation method rendered a total acquisition cost of $49.6 million in 1959 and $50.6 million in 1960 (Table XV). This was a reduction of $4.2 million in the actual cost incurred in 1959 and $3.4 million in 1960. Optimization of truck transportation would have reduced total cost of acquisition by truck in 1959 and 1960 by about 6.5 per cent, a savings of approximately $1.5 million. Savings on rail-imported corn would have meant a reduction of the acquisition cost by rail in 1959 of three-quarters of a million dollars and one-half million dollars in 1960. A reduction of $1.7 million

TABLE XIII

VOLUME OF CORN DEMANDED AT EACH REPRESENTATIVE INTERNAL MARKET, BY TRANSPORTATION METHOD, TENNESSEE, 1959 AND 1960

Month and Year		Representative Internal Market									
		Memphis			Nashville		Chattanooga			Knoxville	
		Truck	Rail	Barge	Truck	Rail	Truck	Rail	Barge	Truck	Rail
		(1000 Bushels)									
1959	Jan.	61	96	1,058	1,120	204	301	--	419	148	73
	Feb.	59	88	391	1,032	194	300	--	416	126	73
	Mar.	57	86	247	1,044	195	302	--	422	125	73
	Apr.	102	125	265	1,055	194	343	--	799	154	73
	May	102	124	275	1,117	265	387	--	1,018	130	73
	June	100	126	157	1,077	254	268	80	846	131	73
	July	103	331	69	1,148	255	258	100	954	164	72
	Aug.	102	331	142	1,113	255	256	120	1,039	122	72
	Sept.	118	334	861	1,178	348	369	60	996	122	73
	Oct.	63	216	988	1,094	246	151	--	668	139	73
	Nov.	60	217	1,130	1,057	246	194	--	517	116	75
	Dec.	59	214	793	1,150	175	165	--	435	116	75
1960	Jan.	44	79	1,852	1,030	200	325	--	491	170	93
	Feb.	41	70	583	941	190	338	--	506	148	94
	Mar.	42	70	354	943	189	363	--	509	148	94
	Apr.	61	91	352	956	187	411	--	933	174	93
	May	61	90	393	1,027	259	380	--	1,045	151	93
	June	64	90	265	981	248	255	87	1,084	151	93
	July	66	216	87	1,052	249	212	109	1,089	184	93
	Aug.	67	217	69	1,017	249	168	131	1,038	143	93
	Sept.	77	219	1,476	1,086	343	362	65	999	141	93
	Oct.	38	154	1,666	1,000	242	201	--	423	160	92
	Nov.	35	155	1,566	967	242	194	--	250	139	92
	Dec.	36	152	1,317	1,010	171	209	--	330	138	93

Source: Appendix Tables XXXIII, XXXIV, XXXV, and XXXVI.

TABLE XIV

OPTIMUM ACQUISITION COST FOR THE TRANSPORTATION METHODS ACTUALLY EMPLOYED BY EACH SELECTED REPRESENTATIVE INTERNAL MARKET, TENNESSEE, 1959 AND 1960

Month and Year		Selected Representative Internal Market									
		Memphis			Nashville		Chattanooga			Knoxville	
		Truck	Rail	Barge	Truck	Rail	Truck	Rail	Barge	Truck	Rail
		(Cents Per Bushel)									
1959	Jan.	122.3	136.2	117.7	124.4	132.8	121.8	138.4	122.0	122.4	136.1
	Feb.	122.3	134.2	115.7	124.4	128.6	121.8	134.8	120.0	122.3	138.1
	Mar.	126.3	134.2	119.7	128.4	128.6	125.8	134.8	124.0	126.3	137.1
	Apr.	133.8	135.2	125.3	129.6	129.6	134.5	135.8	126.5	134.3	139.7
	May	136.3	139.2	128.7	133.6	133.6	135.8	139.8	130.5	135.3	142.1
	June	135.8	137.2	127.3	131.6	131.6	136.5	137.8	128.5	137.0	141.7
	July	135.8	137.2	127.3	131.6	131.6	135.4	137.8	128.5	134.3	141.7
	Aug.	134.3	137.2	126.7	131.6	131.6	133.8	137.5	128.5	133.3	134.7
	Sept.	119.8	121.2	111.3	115.6	115.6	120.5	121.8	112.5	121.0	123.7
	Oct.	110.8	112.2	102.3	106.6	106.6	111.5	112.8	103.5	112.0	116.7
	Nov.	121.7	124.2	118.8	115.4	115.8	118.9	121.4	113.7	118.1	119.1
	Dec.	120.3	123.2	113.3	117.6	117.8	119.8	123.8	114.5	120.4	122.1
1960	Jan.	123.3	127.2	117.3	121.6	121.6	122.8	127.8	118.5	123.4	130.1
	Feb.	120.3	127.2	116.7	121.6	121.6	119.8	127.8	118.5	120.4	131.7
	Mar.	122.3	129.2	118.7	123.6	123.6	121.8	129.8	120.5	122.4	133.7
	Apr.	130.3	135.2	123.3	129.6	129.6	129.8	135.8	126.5	130.3	138.1
	May	131.3	135.2	121.7	129.6	129.6	129.4	135.8	126.0	128.3	138.1
	June	130.3	135.2	121.3	129.6	129.6	129.8	135.8	126.5	130.4	138.7
	July	130.3	132.2	122.3	126.6	126.6	129.8	132.8	123.5	130.4	136.7
	Aug.	129.3	135.2	121.3	129.6	129.6	128.8	135.8	126.5	129.4	138.7
	Sept.	116.8	118.2	108.3	112.6	112.6	117.5	118.8	109.5	118.0	122.7
	Oct.	115.8	117.2	107.3	115.6	115.6	116.5	117.8	108.5	117.0	120.7
	Nov.	109.8	111.2	101.3	105.6	105.6	110.5	111.8	102.5	110.3	115.7
	Dec.	111.8	113.2	103.3	107.6	107.6	112.5	113.8	104.5	113.0	117.7

Source: Appendix Tables XXXVII, XXXVIII, XXXIX, and XL.

TABLE XV

ESTIMATED TOTAL OPTIMUM ACQUISITION COST OF CORN[a] FOR EACH TRANSPORTATION METHOD, TENNESSEE, 1959 AND 1960

Market and Year	Transportation Method			
	Truck	Rail	Barge	Total
		(1000 Dollars)		
1959				
Memphis	$ 1,265	$2,967	$ 7,142	$11,374
Nashville	16,370	3,538	--	19,908
Chattanooga	4,198	486	10,419	15,103
Knoxville	2,022	1,165	--	3,187
Total	$23,855	$8,156	$17,561	$49,572
1960				
Memphis	$ 783	$2,009	$11,030	$13,822
Nashville	14,540	3,351	--	17,891
Chattanooga	4,203	518	10,475	15,196
Knoxville	2,274	1,454	--	3,728
Total	$21,801	$7,331	$21,505	$50,637

[a]Assuming that each optimum source has sufficient supply to meet the total monthly demand per each transportation method as actually transported in 1959 and 1960. The costs were computed from data presented in Tables XIII and XIV.

in total barge acquisition cost could have been realized in 1959 through optimization of barge procurement and $1.5 million in 1960. Sources optimized on a transportation method basis were Evansville, Minneapolis, Omaha, Louisville, and Cincinnati.

Optimization on a transportation-restricted basis would have produced a total savings in total acquisition cost of $4.2 million in 1959 and $3.4 million in 1960.

III. OPTIMUM COST

The computation of optimum costs estimated on a transportation method-restricted basis is, as previously stated, a valid tool, but this type of restricted computation does not completely solve nor provide a final answer to the transportation model, as the solution is the minimization of the cost of acquiring corn from all combinations of selected representative external sources by all combinations of transportation methods and does not impose the restriction that a predetermined amount of corn must be transported by each form of transportation.

In determining the estimate of total optimum acquisition cost, the monthly optimum source was first determined. The location of the representative external source, or sources, was not determined under the restriction that a predetermined volume of corn is allocated to any given form of transportation. The achievement of this minimization was actually accomplished by optimizing both price of corn and transportation cost, i.e., determining the representative external source, or sources, which possessed the optimum monthly acquisition combination of price per bushel and transportation charge per bushel (Table XVI).

The optimum total acquisition cost was calculated by multiplying the optimum monthly price-per-bushel-transportation-charge-per-bushel combination, or optimum monthly acquisition cost per bushel, for each representative internal market by the monthly demand for corn at each representative internal market. The monthly corn demand (Table XVII) was that volume of corn actually received each month in 1959 and 1960.

TABLE XVI

OPTIMUM ACQUISITION COST FROM SELECTED REPRESENTATIVE EXTERNAL CORN SOURCES, BY REPRESENTATIVE INTERNAL MARKET, TENNESSEE, 1959 AND 1960

Month and Year		Representative Internal Market			
		Memphis	Nashville	Chattanooga	Knoxville
		(Cents Per Bushel)			
1959	Jan.	117.7	122.0	121.8	122.4
	Feb.	115.7	120.0	120.0	122.1
	Mar.	119.7	124.0	124.0	126.1
	Apr.	125.3	126.0	126.5	128.5
	May	128.7	130.1	130.5	132.5
	June	127.3	128.1	128.5	130.5
	July	127.3	128.1	128.5	130.5
	Aug.	126.7	128.1	128.5	130.5
	Sept.	111.3	112.1	112.5	114.5
	Oct.	102.3	103.1	103.5	105.5
	Nov.	111.8	115.1	113.7	115.8
	Dec.	113.3	114.1	114.5	116.5
1960	Jan.	117.3	118.1	118.5	120.5
	Feb.	116.7	118.1	118.5	120.4
	Mar.	118.7	120.1	120.5	122.4
	Apr.	123.2	126.1	126.5	128.5
	May	121.7	126.1	126.0	128.1
	June	121.3	126.1	126.5	128.5
	July	122.3	123.1	123.5	125.5
	Aug.	121.3	126.1	126.5	127.5
	Sept.	108.3	109.1	109.5	111.5
	Oct.	107.3	108.1	108.5	110.5
	Nov.	101.3	102.1	102.5	104.5
	Dec.	103.3	104.1	104.5	106.5

Source: Appendix Tables XXXVII, XXXVIII, XXXIX, and XL.

TABLE XVII

VOLUME OF CORN DEMANDED BY REPRESENTATIVE TENNESSEE MARKETS, 1959 AND 1960

Month and Year		Selected Representative Tennessee Markets				
		Memphis	Nashville	Chattanooga	Knoxville	Total
		(1000 Bushels)				
1959	Jan.	1,215	1,324	720	221	3,480
	Feb.	538	1,226	716	199	2,679
	Mar.	390	1,239	724	198	2,551
	Apr.	492	1,249	1,142	227	3,110
	May	502	1,382	1,405	203	3,492
	June	383	1,331	1,194	204	3,112
	July	503	1,403	1,312	236	3,454
	Aug.	575	1,368	1,415	194	3,552
	Sept.	1,313	1,526	1,425	195	4,459
	Oct.	1,267	1,340	819	212	3,638
	Nov.	1,287	1,303	711	191	3,492
	Dec.	1,066	1,325	600	191	3,182
1960	Jan.	1,975	1,230	816	263	4,284
	Feb.	694	1,131	844	242	2,911
	Mar.	466	1,132	872	242	2,712
	Apr.	504	1,143	1,344	267	3,258
	May	544	1,286	1,425	244	3,499
	June	419	1,229	1,426	244	3,318
	July	369	1,301	1,410	277	3,357
	Aug.	353	1,266	1,337	236	3,192
	Sept.	1,772	1,429	1,426	234	4,861
	Oct.	1,858	1,242	624	252	3,976
	Nov.	1,756	1,209	444	231	3,640
	Dec.	1,505	1,181	539	231	3,456

Source: Appendix Tables XXXIII, XXXIV, XXXV, and XXXVI.

It was assumed that each of the optimized selected representative external sources had sufficient supply each month to meet the total demand of corn for each representative internal market.

The total optimum acquisition cost for corn, optimizing that source, or sources, having the minimum acquisition cost or price-per-bushel-transportation-charge-per-bushel combination, was $48.3 million in 1959 and was $49.5 million in 1960 (Table XVIII). The optimum price-transportation-cost combination in both years was for barge transportation in almost every month for most of the representative internal markets. Total optimum acquisition cost employing barge transportation was 98 per cent of the total optimum acquisition cost in 1959 and 99 per cent in 1960. The optimum price-transportation-cost combination was for truck transportation in a few instances in both 1959 and 1960.

Optimization of acquisition would have reduced the total actual acquisition cost by 10 per cent in 1959, a savings of $5.4 million, and 8 per cent in 1960, a savings of $4.5 million. The actual transportation patterns, as presented in Chapter III, disclosed that corn was received at the representative internal markets of Tennessee from selected representative external sources by truck, rail, and barge, with truck transporting about one-half of all exterior shipments. But optimization shows that in order for the grain firms to have minimized total acquisition costs in 1959 and 1960, they should have secured corn by barge from Evansville, Omaha, and Cincinnati in most months and occasionally from Louisville and St. Louis, rather than by truck, rail, and barge from Peoria, St. Louis, Kansas City, Louisville, Cincinnati, Evansville, and Minneapolis.

TABLE XVIII

ESTIMATED TOTAL OPTIMUM ACQUISITION COST OF CORN[a], BY TRANSPORTATION METHOD, TENNESSEE, 1959 AND 1960

Market and Year	Transportation Method		Total
	Truck	Barge	
		(1000 Dollars)	
1959			
Memphis		$11,042	$11,042
Nashville		19,354	19,354
Chattanooga	$ 877	14,020	14,897
Knoxville	271	2,771	3,042
Total	$1,148	$47,188	$48,335
1960			
Memphis		$13,597	$13,597
Nashville		17,323	17,323
Chattanooga		15,007	15,007
Knoxville	$ 588	2,961	3,549
Total	$ 588	$48,888	$49,476

[a]Assuming that each optimum source has sufficient supply to meet total monthly demand. The costs were computed from data presented in Tables XVI and XVII.

CHAPTER VI

SUMMARY AND CONCLUSIONS

I. SUMMARY

Tennessee is a deficit feed-grain-producing state and the additional feed grains necessary to meet the feeding requirements of the state's livestock population must be imported into the state from exterior supply sources. The basic problem which was explored in this study was the cost efficiency with which Tennessee grain firms obtained corn from external sources. The objectives of this study were (1) to describe the movements of feed grains in Tennessee in 1959 and 1960, (2) to determine the cost of transporting corn into Tennessee from external supply centers, by method of carriage, (3) to relate these costs to the spatial arrangements of points of external origin and internal destination, and (4) construction of a least-cost transportation model for corn, using price and transportation cost differentials.

The grain volume data necessary for this study were obtained from a sample of Tennessee grain dealers; the price series data for corn from the Grain Marketing Division, Agricultural Marketing Service, United States Department of Agriculture; and the transportation cost data for rail and barge from the Navigation Economic Branch, Tennessee Valley Authority. The truck transportation cost data were obtained from a regression equation.

The net deficit of feed grains was estimated at 62.8 million bushels in 1959 and 46.5 million bushels in 1960. Corn had the largest deficit, 21.0 million and 24.4 million bushels in 1959 and 1960, respectively.

Approximately 144 million bushels of grain were received by Tennessee grain firms in 1959 and 126 million bushels in 1960. Of the 1959 gross receipts, 92.5 million bushels originated from external sources, of which 40.2 million bushels were corn. In 1960, 75.6 million bushels of grain were supplied by external sources, with 42.5 million of this being

corn. Grain was imported into Tennessee from external sources by truck, rail, and barge transportation both of these years. The largest portion of feed grains were imported by rail transportation in 1959 and 1960, 48 and 35 per cent, respectively. Barge and truck each transported approximately one-fourth of the 1959 and 1960 volumes received from external sources. The major external sources of grains for both 1959 and 1960 were Arkansas, Illinois, Indiana, Kentucky, Missouri, and Ohio.

Besides supplying deficit areas in Tennessee, the grain firms interviewed shipped 29.7 million bushels to deficit areas in neighboring states in 1959, and 29.1 million bushels in 1960. Approximately two-fifths of the shipments to out-of-state destinations were made by rail transportation, about one-fourth via barge, and one-third via truck in both 1959 and 1960. The states receiving these volumes of grain shipped via Tennessee grain firms were Louisiana, Georgia, and Alabama. Approximately two-thirds of the total shipments in both years to these external markets was corn.

In this study, Tennessee was divided into four marketing areas with Memphis, Nashville, Chattanooga, and Knoxville serving as representative internal markets. In a like manner, representative external sources were selected. These were Minneapolis, Omaha, Kansas City, St. Louis, Peoria, Chicago, Evansville, Cincinnati, and Louisville. Price data for corn and charges for transportation by truck, rail, and barge were then obtained for each of these selected representative external sources on a monthly basis for 1959 and 1960. The selected representative supply sources were delineated under the assumption that the price at each market center was the prevailing price in the marketing area which this center served. The transportation rate per any given transportation method from any selected representative external supply source to any representative internal (Tennessee) market was also assumed to be the prevailing rate for the market area served by that center, under the assumption that transfer rates would be equal when moving grain from all points within a given market area to that area's market center and, hence, zero for analytical purposes.

In general, the transportation model attempts to minimize the total cost of acquiring variable amounts of a homogeneous product from a given number of supply centers to a consuming unit where price of the product at the given supply centers, transportation charges between each given supply center and the consuming unit, and total demand at the consuming unit are known. In this study, the homogeneous product was #2 yellow corn, demanded in the amounts of 9.5 million bushels at the representative internal Memphis market in 1959 and 12.2 million bushels in 1960. The representative internal markets of Nashville, Chattanooga, and Knoxville demanded 16.0 million, 12.2 million, and 2.5 million bushels in 1959 and 14.8 million, 12.5 million, and 2.9 million bushels in 1960, respectively. The price of corn at each of the nine selected representative external markets was known, as was the transportation cost per bushel per each transportation method (truck, rail, and barge) from all selected external supply sources to each representative internal market.

The estimated total acquisition cost of corn for all four representative internal markets as actually incurred by Tennessee grain firms in 1959 was $53.8 million and in 1960, $54.0 million. The total acquisition function of purchasing and transporting corn into Tennessee utilizing truck was $25.6 million and $23.1 million in 1959 and 1960, respectively. Rail acquisition costs were $8.9 million and $7.9 million during this time period, while the purchase and subsequent barging acquisition function incurred total costs of $19.3 million and $23.0 million in 1959 and 1960, respectively.

As many firms in Tennessee did not have facilities to receive grain by rail and/or barge, the model was restricted so that optimization of each transportation mode was achieved where predetermined volumes of total demand were allocated to each transportation method. In this case, optimization per transportation method, the total acquisition costs were $49.6 million in 1959 and $50.6 million in 1960, representing a savings of $4.2 million in 1959 and $3.4 million in 1960 over the total acquisition cost actually incurred. Optimized truck acquisition of corn was $23.9 million and $21.8 million in 1959 and 1960. Rail acquisition

optimization was $8.2 million and $7.3 million in each time period. Total acquisition cost for barge optimization in 1959 was $17.6 million and $21.5 million in 1960. Optimum sources were Evansville, Minneapolis, Omaha, Louisville, and Cincinnati.

Optimization of monthly source-price-transportation-cost combination, where volumes of demand were not predetermined and allocated to any given transportation method, yielded a total acquisition cost of $48.3 million in 1959 and $49.5 in 1960. These figures represent a savings of $5.5 million in 1959 and $4.5 million in 1960 which Tennessee grain firms could have incurred if they had optimized their cost of acquisition of corn. The optimum acquisition of corn was by barge for all of the twenty-four months covered by this study for the representative internal markets of Memphis and Nashville, twenty-three months for Chattanooga, and twenty-one months for Knoxville. Optimum transportation method for the remaining months in the representative Chattanooga and Knoxville markets was truck. Rail transportation did not enter into the optimum model any month for any internal market. Optimum sources were Evansville, Omaha, and Cincinnati.

II. CONCLUSIONS

Grain firms in Tennessee could have saved from $4.2 to $5.5 million in 1959 by optimization of total corn acquisition cost. Their savings in 1960 could have been from $3.4 to $4.5 million. They did not optimize and, hence, lost the benefit of these savings.

The point immediately emerges that most firms can not optimize acquisition cost since the optimum transport mode was barge and they are not located near navigable waterways. Theoretically, the market can optimize in this fashion but it would probably mean that the vast majority of firms in a given market would be totally dependent upon a very few firms which control the facilities necessary for barge receipt of corn. The independent nature of most individual local firms in any given market would not allow this to come about. But these same firms could have optimized acquisition cost by optimizing the transportation method by which they received corn and incurred savings

of $4.2 million and $3.4 million in 1959 and 1960, respectively. Hence, optimization, where predetermined amounts of the total demand for corn at any given representative internal market was not allocated to any given transportation method, might have been difficult to reach because of lack of proper plant facilities.

This, then, leads to the question as to why Tennessee grain firms did not achieve optimization of each transportation method. It could have been because of ignorance of the markets, but this was probably not the case. Factors other than price and transportation cost differentials probably influenced their choice of external supply sources since total acquisition cost actually incurred was higher than total optimum acquisition cost. Some of these factors could have been tradition, loyalty, good-will, service, credit, special privileges, economic dependence upon a parent company, as in the case of a subsidiary, or any number of other reasons. There is, perhaps, some validity in the question as to the importance which market information plays in the decision-making process of which source or sources to use in securing corn. Does this information come from a private intelligence organization, federal government news releases, or other sources?

In any case, optimization would not come cheap to the corn procurer or the consumer. Optimization is not there merely for the taking for many firms. In order to achieve market optimization of acquisition cost, most firms would have to make vast cash outlays for the purpose of purchasing new facilities or remodeling old ones, so that they could take advantage of cheaper transportation methods. Hence, the total savings through market optimization, i.e., all firms optimizing within any given market area, could not be passed on to the consumer in the form of lower product prices until the cost of the additional equipment was recovered. Economically, the firm can afford to bear the additional expense of adding new plant facilities only as long as this expense is recovered by the savings accruing from the lower acquisition cost.

Since this study was undertaken, certain technological innovations in rail facilities, resulting in changes in rates, have occurred which are not reflected in the cost data of this study. Therefore, further

study seems to be called for in the following areas:

(1) The effect of recent rail rate reductions on the cost of importing corn into Tennessee.

(2) The capital outlays necessary for some grain firms to make plant conversions in order to obtain cheaper total acquisition cost and are these outlays economically justifiable.

(3) A study to determine what factors other than price and transportation cost differentials influence the decision-making process of Tennessee grain firms.

BIBLIOGRAPHY

BIBLIOGRAPHY

BOOKS

Ferguson, Robert O. and Lauren F. Sargent. Linear Programming: Fundamentals and Applications. New York: McGraw-Hill Book Company, Inc., 1958.

Friedrich, Carl J. (trans.). Alfred Weber's Theory of the Location of Industries. Chicago: The University of Chicago Press, 1929.

Gale, David. The Theory of Linear Economic Models. New York: McGraw-Hill Book Company, Inc., 1960.

Gass, Saul I. Linear Programming. New York: McGraw-Hill Book Company, Inc., 1958.

Greenhut, Melvin L. Plant Location in Theory and Practice. Chapel Hill: University of North Carolina Press, 1956.

Hoover, Edgar M. The Location of Economic Activity. New York: McGraw-Hill Book Company, Inc., 1948.

Isard, Walter. Location and Space-Economy. New York: John Wiley and Sons, Inc., 1956.

Loesch, August. The Economics of Location. Trans. William H. Woglom. New Haven: Yale University Press, 1954.

Rand McNally and Company. Rand McNally Road Atlas, United States, Canada, Mexico. New York: Rand McNally and Company, 1957.

Symonds, Gifford H. Linear Programming: The Solution of Refinery Problems. New York: Esso Standard Oil Company, 1955.

ESSAYS IN COLLECTION

Von Thuenen, Johann H. "The Isolated State," Source Readings in Economic Thought. Eds. Philip C. Newman and others. New York: W. W. Norton and Company, Inc., 1954.

GOVERNMENT PUBLICATIONS

Agricultural Marketing Service, United States Department of Agriculture. Grain Transportation in the North Central Region. Marketing Research Report No. 490. Washington: Government Printing Office, July, 1961.

Jennings, R. D. Feed Consumed by Livestock - Supply and Disposition of Feeds, 1949-1950. Agriculture Research Service, United States Department of Agriculture, Statistical Bulletin No. 145. Washington: Government Printing Office, June, 1954.

United States Bureau of the Census. United States Census of Agriculture: 1959, Tennessee. Vol. I, Part 31. Washington: Government Printing Office, 1961.

GOVERNMENT HEARINGS

Interstate Commerce Commission Hearing. I. & S. Docket No. 7656, Exhibit No. 4 (JJC-1). Witness: John L. Corson. "Statistical Tabulations of Grain Shipments by Rail, Water, and Motor Transportation Into, Within, and Out of the Southeast." Washington: Interstate Commerce Commission, January 8, 1962.

BULLETINS

Farrell, Kenneth R. Grain Marketing Statistics for the North Central States. Columbia: Missouri Agricultural Experiment Station, June, 1958.

Martin, Lee R. and others. Grain Marketing Problems in the South. Southern Cooperative Series Bulletin No. 60. Fayetteville: University of Arkansas Experiment Station, June, 1958.

Schumaier, C. P. and C. L. Ahrens. Truck Shipments of Grain in the North Central Region, 1956. North Central Grain Marketing Research Committee, NCM-19. Urbana: University of Illinois, March, 1960.

CIRCULARS

Sharp, John W. and John Amos. "Truck Shipments of Ohio Grain." Research Circular 92. Wooster: Ohio Agricultural Experiment Station, November, 1960.

MONOGRAPHS

Allred, Charles E. "Regional Variations in Farm Price of Small Grains, Tennessee and United States." Rural Research Series, Monograph No. 55. Knoxville: University of Tennessee, September 20, 1937.

_____, and B. H. Luebke. "Marketing Field Seed in the Knoxville Area, Part I, Supply, Distribution, and Regulations." Rural Research Series, Monograph No. 124. Knoxville: University of Tennessee, March 25, 1941.

_____, and others. "The Grain Milling Industry in Knoxville Trade Area." Rural Research Series, Monograph No. 142. Knoxville: University of Tennessee, October 23, 1942.

_____, and others. "Regional Differences in Farm Price of Corn, Tennessee and United States." Rural Research Series, Monograph No. 31. Knoxville: University of Tennessee, March 20, 1937.

Johnson, Magus B. and B. H. Luebke. "Disposition and Outlets for Grain in Knoxville Trade Area." Rural Research Series, Monograph No. 152. Knoxville: University of Tennessee, April 25, 1943.

MIMEOGRAPHS

Farris, Paul L. and David A. Storey. "Truck Shipments of Grain from Indiana Elevators." Lafayette: Indiana Agricultural Experiment Station, Purdue University, August, 1959. (Mimeograph EC-134.)

Marsh, S. T. "1960 Crop Summary, Tennessee." Crop Reporting Service, Tennessee Department of Agriculture, Release 2118. Nashville: Tennessee Department of Agriculture, December 21, 1960. (Mimeographed.)

_____. "1961 Crop Summary, Tennessee." Crop Reporting Service, Tennessee Department of Agriculture. Nashville: Tennessee Department of Agriculture, December 29, 1961. (Mimeographed.)

APPENDIX

TABLE XIX

VOLUME OF GRAIN RECEIVED, BY SOURCE, TENNESSEE, 1959 AND 1960

Grain Type and Year	Source								
	Tenn.	Ala.	Ark.	Ga.	Ill.	Ind.	Iowa	Kan.	Ky.
	(1000 Bushels)								
1959									
Corn	16,721	272	--	78	20,752	5,990	--	--	4,991
Soybeans	21,540	--	5,184	--	760	--	159	--	774
Wheat	4,877	318	9	224	1,169	1,604	--	2,755	662
Oats	2,594	6	375	145	3,044	1,538	--	--	7
Barley	430	--	91	--	11	8	--	--	1,366
Grain sorghums	5,927	--	1,434	--	--	--	--	9	84
Total	52,089	595	7,093	448	25,736	9,140	159	2,764	7,883
1960									
Corn	15,955	278	--	49	21,985	6,383	--	--	5,341
Soybeans	20,882	--	5,184	--	760	--	154	--	700
Wheat	5,294	318	9	248	1,857	1,632	--	2,643	713
Oats	1,965	6	372	145	991	568	--	--	7
Barley	413	--	74	--	11	8	--	--	666
Grain sorghums	5,746	--	1,322	--	--	--	--	51	121
Total	50,253	602	6,962	442	25,604	8,590	154	2,694	7,548

TABLE XIX (continued)

Grain Type and Year	Source									
	Minn.	Miss.	Mo.	Neb.	N.C.	Ohio	Okla.	Texas	Wis.	Total
					(1000 Bushels)					
1959										
Corn	2,168	67	2,452	--	--	3,431	--	--	--	56,922
Soybeans	--	4,227	369	--	--	--	--	--	--	33,014
Wheat	192	37	1,879	1,155	138	1,344	924	--	--	17,287
Oats	1,583	694	1,215	--	--	531	--	--	92	11,823
Barley	--	175	1,995	--	--	--	--	--	--	4,076
Grain sorghums	--	--	175	--	--	--	--	13,874	--	21,503
Total	3,943	5,199	8,085	1,155	138	5,307	924	13,874	92	144,624
1960										
Corn	2,486	91	2,459	--	--	3,392	--	--	--	58,419
Soybeans	--	4,176	240	--	--	--	--	--	--	32,096
Wheat	206	33	2,027	1,085	138	1,421	924	--	--	18,547
Oats	1,661	685	586	--	--	357	--	--	111	7,453
Barley	--	42	662	--	12	--	--	--	--	1,888
Grain sorghums	--	--	228	--	--	--	--	--	--	7,469
Total	4,354	5,027	6,202	1,085	150	5,170	924	--	111	125,872

TABLE XX

VOLUME OF GRAIN RECEIVED VIA TRUCK, BY SOURCE, TENNESSEE, 1959 AND 1960

Grain Type and Year	Source							
	Tenn.	Ala.	Ark.	Ga.	Ill.	Ind.	Kan.	Ky.
	(1000 Bushels)							
1959								
Corn	15,094	272	--	78	8,512	4,730	--	3,633
Soybeans	8,025	--	881	--	--	--	--	31
Wheat	3,508	282	--	172	7	32	--	126
Oats	1,826	6	211	145	545	322	--	7
Barley	328	--	45	--	11	8	--	229
Grain sorghums	2,078	--	--	--	--	---	--	53
Total	30,858	559	1,138	395	9,075	5,091	--	4,080
1960								
Corn	14,728	278	--	49	7,011	4,957	--	3,921
Soybeans	7,880	--	881	--	--	--	--	31
Wheat	3,524	283	--	177	7	35	180	178
Oats	1,347	6	211	145	597	306	--	7
Barley	268	--	59	--	11	8	--	389
Grain sorghums	1,975	--	--	--	--	--	--	91
Total	29,721	566	1,152	371	7,626	5,306	180	4,616

TABLE XX (continued)

Grain Type and Year	Source						
	Minn.	Miss.	Mo.	N.C.	Ohio	Wis.	Total
			(1000 Bushels)				
1959							
Corn	--	67	413	--	1,355	--	34,153
Soybeans	--	599	--	--	--	--	9,536
Wheat	--	--	--	138	10	--	4,275
Oats	524	289	--	--	122	--	3,996
Barley	--	128	70	--	--	--	819
Grain sorghums	--	--	--	--	--	--	2,131
Total	524	1,083	483	138	1,486	--	54,911
1960							
Corn	--	91	318	--	1,219	--	32,635
Soybeans	--	548	--	--	--	--	9,340
Wheat	--	--	--	138	10	--	4,531
Oats	524	293	--	--	94	18	3,549
Barley	--	27	59	12	--	--	832
Grain sorghums	--	--	6	--	--	--	2,072
Total	524	958	446	150	1,323	18	52,959

TABLE XXI

VOLUME OF GRAIN RECEIVED VIA RAIL, BY SOURCE, TENNESSEE, 1959 AND 1960

Grain Type and Year	Source							
	Tenn.	Ala.	Ark.	Ga.	Ill.	Ind.	Kan.	Ky.
	(1000 Bushels)							
1959								
Corn	1,627	--	--	--	1,878	1,260	--	1,358
Soybeans	13,515	--	4,303	--	--	--	--	743
Wheat	1,369	36	9	52	83	1,572	320	536
Oats	768	--	163	--	1,966	1,217	--	--
Barley	103	--	46	--	--	--	--	1,137
Grain sorghums	3,849	--	1,434	--	--	--	--	31
Total	21,231	36	5,955	52	3,927	4,049	320	3,803
1960								
Corn	1,227	--	--	--	1,494	1,426	--	1,420
Soybeans	13,002	--	4,303	--	--	--	--	668
Wheat	1,770	36	9	71	83	1,597	2,463	536
Oats	618	--	161	--	394	261	--	--
Barley	145	--	15	--	--	--	--	277
Grain sorghums	3,771	--	1,322	--	--	--	--	31
Total	20,532	36	5,810	71	1,971	3,285	2,463	2,932

TABLE XXI (continued)

Grain Type and Year	Source							
	Minn.	Miss.	Mo.	Neb.	Ohio	Texas	Wis.	Total
				(1000 Bushels)				
1959								
Corn	--	--	1,131	--	730	--	--	7,985
Soybeans	--	3,629	369	--	--	--	--	22,558
Wheat	192	37	1,469	87	1,334	--	--	7,096
Oats	--	405	1,112	--	331	--	92	6,054
Barley	--	46	1,913	--	--	--	--	3,245
Grain sorghums	--	31	--	--	--	13,874	--	19,219
Total	192	4,147	5,994	87	2,396	13,874	92	66,166
1960								
Corn	--	--	803	--	737	--	--	7,107
Soybeans	--	3,629	240	--	--	--	--	21,842
Wheat	206	33	1,436	17	1,411	--	--	9,667
Oats	--	392	484	--	189	--	92	2,590
Barley	--	15	587	--	--	--	--	1,040
Grain sorghums	--	--	77	--	--	--	--	5,202
Total	206	4,069	3,628	17	2,337	--	92	47,448

TABLE XXII

VOLUME OF GRAIN RECEIVED VIA BARGE, BY SOURCE, TENNESSEE, 1959 AND 1960

Grain Type and Year	Source								
	Ill.	Iowa	Kan.	Minn.	Mo.	Neb.	Ohio	Okla.	Total
					(1000 Bushels)				
1959									
Corn	10,362	--	--	2,168	908	--	1,347	--	14,784
Soybeans	760	159	--	--	--	--	--	--	920
Wheat	1,078	--	2,435	--	411	1,068	--	924	5,916
Oats	534	--	--	1,058	103	--	78	--	1,773
Barley	--	--	--	--	12	--	--	--	12
Grain sorghums	--	--	9	--	144	--	--	--	153
Total	12,734	159	2,444	3,226	1,577	1,068	1,425	924	23,557
1960									
Corn	13,480	--	--	2,486	1,275	--	1,436	--	18,677
Soybeans	760	154	--	--	--	--	--	--	914
Wheat	1,767	--	--	--	591	1,068	--	924	4,350
Oats	--	--	--	1,137	103	--	74	--	1,314
Barley	--	--	--	--	16	--	--	--	16
Grain sorghums	--	--	51	--	144	--	--	--	195
Total	16,006	154	51	3,623	2,128	1,068	1,510	924	25,465

TABLE XXIII

VOLUME OF GRAIN SHIPPED, BY DESTINATION, TENNESSEE, 1959 AND 1960

Grain Type and Year	Destination										
	Tenn.	Ala.	Ark.	Ga.	La.	Miss.	N.C.	S.C.	Southeast[a]	Va.	Total
	(1000 Bushels)										
1959											
Corn	7,636	3,624	--	5,481	6,954	232	51	49	2,695	52	26,774
Soybeans	3,269	--	--	--	3,989	--	--	--	245	--	7,503
Wheat	1,639	117	16	406	2,721	16	7	7	--	7	4,938
Oats	1,042	897	--	923	--	--	10	7	460	11	3,351
Barley	378	52	--	--	4	--	--	--	214	--	647
Grain sorghums	1,669	31	--	--	315	--	--	--	93	--	2,109
Total	15,630	4,721	16	6,811	13,982	249	68	64	3,707	70	45,321
1960											
Corn	7,514	4,143	--	5,207	5,333	275	51	49	2,940	52	25,563
Soybeans	3,543	--	--	--	3,423	--	--	--	--	--	6,965
Wheat	1,703	216	16	936	3,396	16	7	7	--	7	6,305
Oats	766	831	--	1,003	--	--	10	7	460	23	3,099
Barley	278	53	--	--	12	--	--	--	206	--	549
Grain sorghums	1,557	31	--	--	264	--	--	--	101	--	1,953
Total	15,360	5,271	16	7,146	12,428	291	68	64	3,707	82	44,434

[a]Southeast refers to Alabama, Georgia, Louisiana, Mississippi, North Carolina, and South Carolina. Shipments were made in undesignated volumes to these states.

TABLE XXIV

VOLUME OF GRAIN SHIPPED VIA TRUCK, BY DESTINATION, TENNESSEE, 1959 AND 1960

Grain Type and Year	Destination									
	Tenn.	Ala.	Ark.	Ga.	Miss.	N.C.	S.C.	Southeast[a]	Va.	Total
	(1000 Bushels)									
1959										
Corn	6,362	2,112	--	4,124	207	51	49	--	52	12,955
Soybeans	1,850	--	--	--	--	--	--	--	--	1,850
Wheat	1,052	117	16	406	16	7	7	--	7	1,630
Oats	528	541	--	793	--	10	7	198	11	2,089
Barley	40	--	--	--	--	--	--	214	--	254
Grain sorghums	409	--	--	--	--	--	--	93	--	502
Total	10,237	2,770	16	5,323	223	68	64	506	70	19,280
1960										
Corn	6,208	2,096	--	3,921	217	51	49	--	52	12,594
Soybeans	1,937	--	--	--	--	--	--	--	--	1,937
Wheat	1,055	175	16	936	16	7	7	--	7	2,220
Oats	509	558	--	859	--	10	7	198	23	2,163
Barley	43	--	--	--	--	--	--	206	--	249
Grain sorghums	404	--	--	--	--	--	--	101	--	506
Total	10,155	2,828	16	5,715	234	68	64	505	82	19,668

[a]Southeast refers to Alabama, Georgia, Louisiana, Mississippi, North Carolina, and South Carolina. Shipments were made in undesignated volumes to these states.

TABLE XXV

VOLUME OF GRAIN SHIPPED VIA RAIL, BY DESTINATION, TENNESSEE, 1959 AND 1960

Grain Type and Year	Destination						
	Tenn.	Ala.	Ga.	La.	Miss.	Southeast[a]	Total
	(1000 Bushels)						
1959							
Corn	1,275	1,512	1,358	622	26	2,695	7,487
Soybeans	1,420	--	--	1,755	--	245	3,419
Wheat	587	--	--	1,957	--	--	2,544
Oats	514	357	130	--	--	262	1,262
Barley	338	52	--	4	--	--	393
Grain sorghums	1,260	31	--	315	--	--	1,607
Total	5,393	1,951	1,488	4,652	26	3,201	16,711
1960							
Corn	1,306	2,047	1,286	732	58	2,940	8,368
Soybeans	1,606	--	--	1,822	--	--	3,427
Wheat	648	41	--	2,835	--	--	3,524
Oats	257	273	145	--	--	262	936
Barley	236	53	--	12	--	--	300
Grain sorghums	1,153	31	--	7	--	--	1,191
Total	5,202	2,444	1,431	5,408	58	3,201	17,746

[a]Southeast refers to Alabama, Georgia, Louisiana, Mississippi, North Carolina, and South Carolina. Shipments were made in undesignated volumes to these states.

TABLE XXVI

VOLUME OF GRAIN SHIPPED VIA BARGE, BY DESTINATION, TENNESSEE, 1959 AND 1960

Grain Type and Year	Destination: Louisiana	Total
	(1000 Bushels)	
1959		
Corn	6,332	6,332
Soybeans	2,234	2,234
Wheat	764	764
Oats	--	--
Barley	--	--
Grain sorghums	--	--
Total	9,330	9,330
1960		
Corn	4,601	4,601
Soybeans	1,601	1,601
Wheat	561	561
Oats	--	--
Barley	--	--
Grain sorghums	257	257
Total	7,020	7,020

TABLE XXVII

MONTHLY #2 YELLOW CORN PRICES FOR SELECTED EXTERNAL MARKETS, 1959 AND 1960

Month and Year	Selected Representative External Market								
	Evansville[a]	Louisville[a]	Minneapolis[b]	St. Louis[b]	Chicago[b]	Omaha[b]	Kansas City[b]	Cincinnati[a]	Peoria[b]
	(Cents Per Bushel)								
1959									
January	1.23	1.21	1.04	1.20	1.20	1.06	1.13	1.21	1.19
February	1.18	1.23	1.04	1.20	1.20	1.04	1.12	1.23	1.19
March	1.18	1.22	1.08	1.22	1.24	1.08	1.12	1.25	1.23
April	1.19	1.26	1.18	1.31	1.31	1.16	1.22	1.33	1.30
May	1.23	1.27	1.18	1.32	1.30	1.17	1.24	1.33	1.30
June	1.21	1.31	1.20	1.34	1.34	1.21	1.28	1.34	1.31
July	1.21	1.29	1.18	1.32	1.32	1.16	1.26	1.30	1.28
August	1.21	1.28	1.16	1.29	1.30	1.15	1.22	1.19	1.28
September	1.05	1.21	1.10	1.19	1.19	1.09	1.14	1.08	1.22
October	.96	1.02	1.04	1.22	1.14	1.10	1.16	1.08	1.15
November	1.08	1.04	1.05	1.14	1.14	1.07	1.09	1.14	1.13
December	1.07	1.07	1.02	1.12	1.12	1.05	1.10	1.14	1.12

TABLE XXVII (continued)

Month and Year	Selected Representative External Market								
	Evansville[a]	Louisville[a]	Minneapolis[b]	St. Louis[b]	Chicago[b]	Omaha[b]	Kansas City[b]	Cincinnati[a]	Peoria[b]
	(Cents Per Bushel)								
1960									
January	1.11	1.15	1.05	1.20	1.18	1.10	1.17	1.20	1.17
February	1.11	1.20	1.02	1.20	1.16	1.05	1.13	1.18	1.15
March	1.13	1.23	1.04	1.21	1.18	1.07	1.16	1.19	1.17
April	1.19	1.23	1.12	1.25	1.24	1.12	1.17	1.25	1.22
May	1.19	1.23	1.13	1.24	1.22	1.10	1.18	1.25	1.23
June	1.19	1.25	1.12	1.22	1.22	1.13	1.18	1.23	1.22
July	1.16	1.26	1.12	1.26	1.23	1.17	1.23	1.24	1.21
August	1.19	1.26	1.11	1.20	1.20	1.12	1.20	1.23	1.20
September	1.02	1.23	1.04	1.14	1.18	1.12	1.13	1.08	1.17
October	1.01	1.09	1.01	1.11	1.13	1.06	1.06	1.05	1.10
November	.95	1.11	.93	.99	.96	.92	.98	1.00	.99
December	.97	1.07	1.00	1.10	1.04	1.02	1.04	1.11	1.05

[a]Mid-month prices (nearest 15th), furnished by area grain firms.

[b]Simple average of daily closing prices, f.o.b. track, supplied by Grain Division, Agricultural Marketing Service, United States Department of Agriculture.

TABLE XXVIII

MONTHLY #2 YELLOW CORN PRICES FOR SELECTED MINOR EXTERNAL MARKETS, 1959 AND 1960

Month and Year	Selected Representative External Market		
	Tupelo, Miss.[a]	Sheffield, Ala.[b]	Gainesville, Ga.
	(Cents Per Bushel)		
1959			
January	127.0	122.5	139.0
February	129.0	123.5	140.0
March	132.0	126.5	139.0
April	140.0	134.5	140.0
May	140.0	135.5	142.0
June	140.0	134.5	140.0
July	138.0	133.5	139.0
August	134.0	128.5	135.0
September	122.0	130.5	125.0
October	115.0	114.5	118.0
November	123.0	122.5	121.0
December	121.0	118.5	122.0
1960			
January	125.0	125.5	125.0
February	126.0	123.5	126.0
March	128.0	124.5	125.0
April	131.0	131.5	126.0
May	134.0	128.5	132.0
June	132.0	126.5	128.0
July	132.0	127.5	130.0
August	129.0	126.5	130.0
September	116.0	120.5	121.0
October	116.0	116.5	118.0
November	109.0	108.5	121.0
December	112.0	110.5	121.0

[a]Memphis price plus eight cents truck charge to Tupelo.

[b]Chattanooga price less $1.25/ton barge charge to Sheffield.

TABLE XXIX

HIGHWAY MILEAGE, SELECTED REPRESENTATIVE EXTERNAL SOURCE TO INTERNAL MARKET, TENNESSEE, 1960

External Source	Internal Market			
	Memphis	Nashville	Chattanooga	Knoxville
	(Miles)			
Evansville, Ind.	277	160	298	317
Louisville, Ky.	379	182	280	256
Minneapolis, Minn.	979	862	1000	975
St. Louis, Mo.	294	300	438	562
Chicago, Ill.	706	452	590	565
Omaha, Neb.	752	788	926	978
Kansas City, Mo.	548	584	722	774
Cincinnati, Ohio	481	286	339	271
Peoria, Ill.	588	428	566	583
Tupelo, Miss.	---	220	---	---
Sheffield, Ala.	---	119	166	279
Gainesville, Ga.	---	---	---	187

Source: Rand McNally and Company, Rand McNally Road Atlas, United States, Canada, Mexico (New York: Rand McNally and Company, 1957).

TABLE XXX

UNIT COST FOR TRUCK CARRIAGE OF CORN IN BULK, SELECTED EXTERNAL SOURCE TO INTERNAL MARKET, TENNESSEE, 1959 AND 1960

External Source	Internal Market			
	Memphis	Nashville	Chattanooga	Knoxville
	(Cents Per Bushel)[a]			
Evansville, Ind.	14.8	10.6	15.5	16.0
Louisville, Ky.	17.7	11.4	14.9	14.1
Minneapolis, Minn.	18.3	20.4	17.8	18.4
St. Louis, Mo.	15.4	15.5	19.0	20.8
Chicago, Ill.	21.4	19.2	21.0	20.8
Omaha, Neb.	21.3	21.1	19.4	18.3
Kansas City, Mo.	20.6	21.0	21.4	21.2
Cincinnati, Ohio	19.7	15.1	16.7	14.6
Peoria, Ill.	21.0	18.8	20.8	21.0
Tupelo, Miss.	----	12.9	----	----
Sheffield, Ala.	----	8.8	10.8	14.9
Gainesville, Ga.	----	----	----	11.6

Note: The regression equation employed was $Y = 3.03797 + 0.05319X - 0.00003841X^2$, where $S_{y.x} = 2.29$ cents per bushel and $R^2 = 0.72604$.

[a]Rounded to nearest tenth of a cent.

TABLE XXXI

UNIT COST FOR RAIL CARRIAGE OF CORN IN BULK, SELECTED EXTERNAL SOURCE TO INTERNAL MARKET, TENNESSEE, JANUARY 1, 1960[a]

External Source	Internal Market			
	Memphis	Nashville	Chattanooga	Knoxville
	(Cents Per Bushel)			
Evansville, Ind.	16.2	10.6	16.8	20.7
Louisville, Ky.	20.2	11.8	17.4	15.1
Minneapolis, Minn.	47.9	48.4	54.6	58.4
St. Louis, Mo.	16.2	17.4	23.5	25.8
Chicago, Ill.	31.6	28.0	34.2	38.1
Omaha, Neb.	40.3	45.1	51.2	53.5
Kansas City, Mo.	33.9	43.1	49.3	51.5
Cincinnati, Ohio	24.1	16.2	18.5	15.7
Peoria, Ill.	28.0	28.8	35.0	34.4

Source: Navigation Economics Branch, Tennessee Valley Authority, Knoxville, Tennessee.

[a]Minimum weight 100,000 lbs., except actual weight will apply in the following cases:

(1) When grain is loaded at point of origin within 24 inches of roof, at side walls of cars, for the purpose of Federal, State, or Official Grain Exchange Inspection.
(2) When grain is loaded to grain line of cars so marked.
(3) When the car is loaded to full visible capacity.

TABLE XXXII

UNIT COST FOR BARGE CARRIAGE OF CORN IN BULK, SELECTED EXTERNAL SOURCE TO INTERNAL MARKET, TENNESSEE, JANUARY 1, 1960[a]

External Source	Internal Market			
	Memphis	Nashville	Chattanooga	Knoxville
	(Cents Per Bushel)			
Evansville, Ind.	6.3[b]	7.1	7.5	9.5
Louisville, Ky.	7.8[b]	12.0[b]	9.7	11.8
Minneapolis, Minn.	13.4[b]	17.8[b]	17.4	19.5
St. Louis, Mo.	2.6[b]	8.9[d]	6.4[b]	7.5
Chicago, Ill.	8.7[b]	13.1[d]	13.8	15.9
Omaha, Neb.	11.7[c]	16.0[d]	16.0	18.1
Kansas City, Mo.	9.8[c]	14.2[d]	14.2	16.3
Cincinnati, Ohio	8.3	12.0	10.6	13.3
Peoria, Ill.	6.8[b]	13.2[b]	12.1	14.2

Source: Navigation Economics Branch, Tennessee Valley Authority, Knoxville, Tennessee.

[a]Minimum weight 750 net tons.

[b]Minimum weight 600 net tons.

[c]Minimum weight 900 net tons.

[d]Cairo, Ill. combination.

TABLE XXXIII

VOLUME OF CORN RECEIVED FROM SELECTED REPRESENTATIVE EXTERNAL SOURCES, BY TRANSPORTATION METHOD, MEMPHIS, 1959 AND 1960

Month and Year	Selected Representative External Source									
	Peoria, Ill.			St. Louis, Mo.			Kansas City, Mo.	Louisville, Ky.		
	Truck	Rail	Barge	Truck	Rail	Barge	Barge	Truck	Rail	Total
1959	(1000 Bushels)									
January	57	37	1,010	1	47	28	20	3	12	1,215
February	55	36	340	1	46	31	20	3	6	538
March	53	36	215	1	46	12	20	3	4	390
April	98	52	130	1	69	52	83	3	4	492
May	98	52	130	1	69	63	83	3	3	502
June	97	53	55	1	70	17	85	2	3	383
July	87	129	55	15	198	13	--	2	4	503
August	86	129	130	15	198	11	--	2	4	575
September	100	129	857	15	200	4	--	3	5	1,313
October	51	138	860	9	77	128	--	3	1	1,267
November	48	154	848	9	56	162	--	3	7	1,287
December	47	154	717	9	55	76	--	3	5	1,066
Total	877	1,099	5,347	78	1,131	597	311	33	58	9,531

TABLE XXXIII (continued)

Month and Year	Selected Representative External Source									
	Peoria, Ill.			St. Louis, Mo.			Kansas City, Mo.	Louisville, Ky.		
	Truck	Rail	Barge	Truck	Rail	Barge	Barge	Truck	Rail	Total
	(1000 Bushels)									
1960										
January	41	31	1,770	2	33	61	21	1	15	1,975
February	39	31	520	1	33	42	21	1	6	694
March	40	31	310	1	33	22	22	1	6	466
April	59	42	225	1	45	42	85	1	4	504
May	59	42	230	1	45	78	85	1	3	544
June	62	42	80	1	45	100	85	1	3	419
July	59	87	55	6	125	32	--	1	4	369
August	60	87	55	6	125	14	--	1	5	353
September	70	87	1,470	6	125	6	--	1	7	1,772
October	35	81	1,500	2	64	166	--	1	9	1,858
November	32	77	1,320	2	65	246	--	1	13	1,756
December	33	77	1,170	2	65	147	--	1	10	1,505
Total	585	715	8,705	31	803	956	319	12	85	12,215

TABLE XXXIV

VOLUME OF CORN RECEIVED FROM SELECTED REPRESENTATIVE EXTERNAL SOURCES, BY TRANSPORTATION METHOD, NASHVILLE, 1959 AND 1960

Month and Year	Selected Representative External Source											
	Peoria, Ill.		St. Louis, Mo.	Cincinnati, Ohio		Sheffield, Ala.	Tupelo, Miss.	Louisville, Ky.		Evansville, Ind.		
	Truck	Rail	Truck	Truck	Rail	Truck	Truck	Truck	Rail	Truck	Rail	Total
	(1000 Bushels)											
1959												
January	573	81	14	1	10	--	16	272	55	244	58	1,324
February	559	70	14	1	10	--	--	221	56	237	58	1,226
March	562	70	13	1	10	--	--	228	56	240	59	1,239
April	567	70	13	1	10	--	--	231	54	243	60	1,249
May	551	81	13	-	10	51	17	250	114	235	60	1,382
June	553	70	13	-	10	51	--	222	114	238	60	1,331
July	587	70	14	-	10	51	--	247	115	249	60	1,403
August	574	70	14	1	10	51	--	231	115	242	60	1,368
September	576	81	14	1	10	51	17	275	197	244	60	1,526
October	561	35	14	1	10	--	--	282	116	236	85	1,340
November	549	35	14	1	80	--	--	265	116	228	85	1,303
December	563	46	14	1	10	--	17	320	34	235	85	1,325
Total	6,775	779	164	9	120	255	67	3,044	1,142	2,871	790	16,016

TABLE XXXIV (continued)

Month and Year	Selected Representative External Source											
	Peoria, Ill.		St. Louis, Mo.	Cincinnati, Ohio		Sheffield, Ala.	Tupelo, Miss.	Louisville, Ky.		Evansville, Ind.		
	Truck	Rail	Truck	Truck	Rail	Truck	Truck	Truck	Rail	Truck	Rail	Total
1960	(1000 Bushels)											
January	469	81	6	1	2	--	23	266	55	265	62	1,230
February	462	70	6	1	2	--	--	216	56	256	62	1,131
March	460	70	6	1	1	--	--	216	56	260	62	1,132
April	463	70	6	1	1	--	--	229	54	257	62	1,143
May	452	81	6	1	1	51	23	246	114	248	63	1,286
June	452	70	6	1	1	51	--	221	114	250	63	1,229
July	482	70	6	1	1	51	--	251	115	261	63	1,301
August	471	70	6	1	1	51	--	235	115	253	63	1,266
September	473	81	6	1	2	51	23	276	197	256	63	1,429
October	461	35	6	1	2	--	--	284	116	248	89	1,242
November	452	35	6	1	2	--	--	267	116	241	89	1,209
December	463	46	6	1	2	--	22	269	34	249	89	1,181
Total	5,560	779	72	12	18	255	91	2,976	1,142	3,044	830	14,779

TABLE XXXV

VOLUME OF CORN RECEIVED FROM SELECTED REPRESENTATIVE EXTERNAL SOURCES, TRANSPORTATION METHOD, CHATTANOOGA, 1959 AND 1960

Month and Year	Selected Representative External Source										
	Cincinnati, Ohio			Minneapolis, Minn.	Peoria, Ill.		St.Louis, Mo.	Sheffield, Ala.	Louisville, Ky.	Evansville, Ind.	
	Truck	Rail	Barge	Barge	Truck	Barge	Truck	Truck	Truck	Truck	Total
1959	(1000 Bushels)										
January	81	--	79	--	79	340	--	1	28	112	720
February	80	--	79	--	79	337	--	1	28	112	716
March	82	--	79	--	79	343	--	1	28	112	724
April	122	--	79	218	80	502	--	1	28	112	1,142
May	137	--	60	394	45	564	--	1	14	190	1,405
June	107	80	60	342	45	444	--	1	14	101	1,194
July	127	100	50	379	33	525	--	1	12	85	1,312
August	151	120	40	380	26	619	--	1	9	69	1,415
September	149	60	70	331	40	595	43	1	13	123	1,425
October	22	--	250	124	54	294	43	1	21	10	819
November	66	--	250	--	54	267	43	1	21	9	711
December	45	--	250	--	33	185	42	1	24	20	600
Total	1,169	360	1,346	2,168	647	5,015	171	12	240	1,055	12,183

TABLE XXXV (continued)

Month and Year	Selected Representative External Source										
	Cincinnati, Ohio			Minneapolis, Minn.	Peoria, Ill.		St.Louis, Mo.	Sheffield, Ala.	Louisville Ky.	Evansville Ind.	
	Truck	Rail	Barge	Barge	Truck	Barge	Truck	Truck	Truck	Truck	Total
	(1000 Bushels)										
1960											
January	64	--	167	--	92	324	--	1	56	112	816
February	66	--	175	--	106	331	--	1	53	112	844
March	63	--	192	--	135	317	--	1	53	111	872
April	97	--	200	254	149	479	--	1	53	111	1,344
May	87	--	209	405	64	431	--	1	27	201	1,425
June	106	87	100	458	21	526	--	1	27	100	1,426
July	113	109	67	466	18	556	--	1	13	67	1,410
August	128	131	26	385	9	627	--	1	8	22	1,337
September	98	65	134	390	32	475	69	3	26	134	1,426
October	48	--	58	128	18	237	69	3	41	22	624
November	41	--	50	--	18	200	70	2	41	22	444
December	56	--	58	--	18	272	70	2	41	22	539
Total	967	392	1,436	2,486	680	4,775	278	18	439	1,036	12,507

TABLE XXXVI

VOLUME OF CORN RECEIVED FROM SELECTED REPRESENTATIVE EXTERNAL SOURCES, BY TRANSPORTATION METHOD, KNOXVILLE, 1959 AND 1960

Month and Year	Selected Representative External Source									
	Evansville, Ind.		Cincinnati, Ohio		Louisville, Ky.		Peoria, Ill.	Gainesville, Ga.	Sheffield, Ala.	
	Truck	Rail	Truck	Rail	Truck	Rail	Truck	Truck	Truck	Total
	(1000 Bushels)									
1959										
January	79	39	16	21	27	13	20	6	--	221
February	57	39	17	21	27	13	19	6	--	199
March	57	39	16	21	27	13	19	6	--	198
April	90	39	14	21	26	13	18	6	--	227
May	67	39	14	21	26	13	17	6	--	203
June	67	39	14	21	26	13	18	6	--	204
July	100	39	14	20	26	13	17	7	--	236
August	57	39	14	20	26	13	17	7	1	194
September	57	39	14	21	26	13	17	7	1	195
October	73	39	14	21	27	13	17	7	1	212
November	50	40	15	21	26	14	17	7	1	191
December	50	40	15	21	26	14	17	7	1	191
Total	804	470	177	250	316	158	213	78	5	2,471

TABLE XXXVI (continued)

Month and Year	Selected Representative External Source									
	Evansville, Ind.		Cincinnati, Ohio		Louisville, Ky.		Peoria, Ill.	Gainesville, Ga.	Sheffield, Ala.	
	Truck	Rail	Truck	Rail	Truck	Rail	Truck	Truck	Truck	Total
	(1000 Bushels)									
1960										
January	86	49	22	28	41	16	17	4	--	263
February	64	50	22	28	41	16	17	4	--	242
March	64	50	22	28	41	16	17	4	--	242
April	95	50	19	27	41	16	15	4	--	267
May	72	50	19	27	41	16	15	4	--	244
June	72	50	19	27	41	16	15	4	--	244
July	105	50	19	27	41	16	15	4	--	277
August	63	50	19	27	41	16	15	4	1	236
September	62	50	19	27	41	16	14	4	1	234
October	80	49	20	27	41	16	14	4	1	252
November	57	49	20	27	42	16	14	5	1	231
December	57	49	20	27	42	17	14	4	1	231
Total	877	596	240	327	494	193	182	49	5	2,963

TABLE XXXVII

OPTIMUM REPRESENTATIVE EXTERNAL SOURCE FOR CORN, BY TRANSPORTATION METHOD, REPRESENTATIVE INTERNAL MEMPHIS MARKET, 1959 AND 1960

Month and Year	Transportation Method and Representative External Source							
	Truck			Rail		Barge		
	Evansville	Louisville	Minneapolis	Evansville	St. Louis	Evansville	Louisville	Omaha
	(Cents Per Bushel)							
1959								
January	137.8	138.7	122.3	139.2	136.2	129.3	128.8	117.7[a]
February	132.8	140.7	122.3	134.2	136.2	124.3	130.8	115.7[a]
March	132.8	139.7	126.3	134.2	138.2	124.3	129.8	119.7[a]
April	133.8	143.7	136.3	135.2	147.2	125.3[a]	133.8	127.7
May	137.8	144.7	136.3	139.2	148.2	129.3	134.8	128.7[a]
June	135.8	148.7	138.3	137.2	150.2	127.3[a]	138.8	132.7
July	135.8	146.7	136.3	137.2	148.2	127.3[a]	136.8	127.7
August	135.8	145.7	134.3	137.2	145.2	127.3	135.8	126.7[a]
September	119.8	138.7	128.3	121.2	135.2	111.3[a]	128.8	120.7
October	110.8	119.7	122.3	112.2	138.2	102.3[a]	109.8	121.7
November	122.8	121.7	123.3	124.2	130.2	114.3	111.8[a]	118.7
December	121.8	124.7	120.3	123.2	128.2	113.3[a]	114.8	116.7

TABLE XXXVII (continued)

Month and Year	Transportation Method and Representative External Source					
	Truck		Rail	Barge		
	Evansville	Minneapolis	Evansville	Evansville	Omaha	Cincinnati
	(Cents Per Bushel)					
1960						
January	125.8	123.3	127.2	117.3[a]	121.7	128.3
February	125.8	120.3	127.2	117.3	116.7[a]	126.3
March	127.8	122.3	129.2	119.3	118.7[a]	127.3
April	133.8	130.3	135.2	125.3	123.7	123.3[a]
May	133.8	131.3	135.2	125.3	121.7[a]	123.3
June	133.8	130.3	135.2	125.3	124.7	121.3[a]
July	130.8	130.3	132.2	122.3[a]	128.7	122.3[a]
August	133.8	129.3	135.2	125.3	123.7	121.3[a]
September	116.8	122.3	118.2	108.3[a]	123.7	116.3
October	115.8	119.3	117.2	107.3[a]	117.7	113.3
November	109.8	111.3	111.2	101.3[a]	103.7	108.3
December	111.8	118.3	113.2	103.3[a]	113.7	119.3

Note: The acquisition price underlined is the optimum price and external representative source for each transportation method. Those representative external sources not included were priced above the optimum price.

[a]Optimum acquisition cost and representative external source. These costs were calculated from Tables XXVII, XXX, XXXI, and XXXII.

TABLE XXXVIII

OPTIMUM REPRESENTATIVE EXTERNAL SOURCE FOR CORN, BY TRANSPORTATION METHOD, REPRESENTATIVE INTERNAL NASHVILLE MARKET, 1959 AND 1960

Month and Year	Transportation Method and Representative External Source						
	Truck			Rail		Barge	
	Evans-ville	Louis-ville	Minne-apolis	Evans-ville	Louis-ville	Evans-ville	Omaha
	(Cents Per Bushel)						
1959							
Jan.	133.6	132.4	124.4	133.6	132.8	130.1	122.0[a]
Feb.	128.6	134.4	124.4	128.6	134.8	125.1	120.0[a]
March	128.6	133.4	128.4	128.6	133.8	125.1	124.0[a]
April	129.6	137.4	138.4	129.6	137.8	126.1[a]	132.0
May	133.6	138.4	138.4	133.6	138.8	130.1[a]	133.0
June	131.6	142.4	140.4	131.6	142.8	128.1[a]	132.0
July	131.6	140.4	138.4	131.6	140.8	128.1[a]	132.0
Aug.	131.6	139.4	136.4	131.6	139.8	128.1[a]	131.0
Sept.	115.6	132.4	130.4	115.6	132.8	112.1[a]	125.0
Oct.	106.6	113.4	124.4	106.6	113.8	103.1[a]	126.0
Nov.	118.6	115.4	125.4	118.6	115.8	115.1[a]	123.0
Dec.	117.6	118.4	122.4	117.6	118.8	114.1[a]	121.0
1960							
Jan.	121.6			121.6		118.1[a]	126.0
Feb.	121.6			121.6		118.1[a]	121.0
March	123.6			123.6		120.1[a]	123.0
April	129.6			129.6		126.1[a]	128.0
May	129.6			129.6		126.1	126.0[a]
June	129.6			129.6		126.1[a]	129.0
July	126.6			126.6		123.1[a]	133.0
Aug.	129.6			129.6		126.1[a]	128.0
Sept.	112.6			112.6		109.1[a]	128.0
Oct.	115.6			115.6		108.1[a]	122.0
Nov.	105.6			105.6		102.1[a]	108.0
Dec.	107.6			107.6		104.1[a]	118.0

Note: The acquisition price underlined is the optimum price and external representative source for each transportation method. Those representative external sources not included were priced above the optimum price.

[a]Optimum acquisition cost and representative external source. These costs were calculated from Tables XXVII, XXX, XXXI, and XXXII.

TABLE XXXIX

OPTIMUM REPRESENTATIVE EXTERNAL SOURCE FOR CORN, BY TRANSPORTATION METHOD, REPRESENTATIVE INTERNAL CHATTANOOGA MARKET, 1959 AND 1960

Month and Year	Transportation Method and Representative External Source									
	Truck				Rail			Barge		
	Evansville	Louisville	Minneapolis	Omaha	Evansville	Louisville	Cincinnati	Evansville	Louisville	Omaha
	(Cents Per Bushel)									
1959										
January	138.5	135.9	121.8[a]	125.4	139.8	138.4	139.5	130.5	130.7	122.0
February	133.5	137.9	121.8	123.4	134.8	140.4	141.5	125.5	132.7	120.0[a]
March	133.5	136.9	125.8	127.4	134.8	139.4	143.5	125.5	131.7	124.0[a]
April	134.5	140.9	135.8	135.4	135.8	143.4	151.5	126.5[a]	135.7	132.0
May	138.5	141.9	135.8	136.4	139.8	144.4	151.5	130.5[a]	136.7	133.0
June	136.5	145.9	137.8	140.4	137.8	148.4	152.5	128.5[a]	140.7	137.0
July	136.5	143.9	135.8	135.4	137.8	146.4	148.5	128.5[a]	138.7	132.0
August	136.5	142.9	133.8	134.4	137.8	145.4	137.5	128.5[a]	137.7	131.0
September	120.5	135.9	127.8	128.4	121.8	138.4	126.5	112.5[a]	130.7	125.0
October	111.5	116.9	121.8	129.4	112.8	119.4	126.5	103.5[a]	111.7	126.0
November	123.5	118.9	122.8	126.4	124.8	121.4	115.5	115.5	113.7[a]	123.0
December	122.5	121.9	119.8	124.4	123.8	124.4	132.5	114.5[a]	116.7	121.0

TABLE XXXIX (continued)

Month and Year	Transportation Method and Representative External Source					
	Truck			Rail	Barge	
	Evansville	Minneapolis	Omaha	Evansville	Evansville	Omaha
	(Cents Per Bushel)					
1960						
January	126.5	122.8	129.4	127.8	118.5[a]	126.0
February	126.5	119.8	124.4	127.8	118.5[a]	121.0
March	128.5	121.8	126.4	129.8	120.5[a]	123.0
April	134.5	129.8	131.4	135.8	126.5[a]	128.0
May	134.5	130.8	129.4	135.8	126.5	126.0[a]
June	134.5	129.8	132.4	135.8	126.5[a]	129.0
July	131.5	129.8	136.4	132.8	123.5[a]	133.0
August	134.5	128.8	131.4	135.8	126.5[a]	128.0
September	117.5	121.8	131.4	118.8	109.5[a]	128.0
October	116.5	118.8	125.4	117.8	108.5[a]	122.0
November	110.5	110.8	111.4	111.8	102.5[a]	108.0
December	112.5	117.8	121.4	113.8	104.5[a]	118.0

Note: The acquisition price underlined is the optimum price and external representative source for each transportation method. Those representative external sources not included were priced above the optimum price.

[a]Optimum acquisition cost and representative external source. These costs were calculated from Tables XXVII, XXX, XXXI, and XXXII.

TABLE XL

OPTIMUM REPRESENTATIVE EXTERNAL SOURCE FOR CORN, BY TRANSPORTATION METHOD, REPRESENTATIVE INTERNAL KNOXVILLE MARKET, 1959 AND 1960

Month and Year	Transportation Method and Representative External Source									
	Truck				Rail			Barge		
	Evansville	Louisville	Minneapolis	Omaha	Evansville	Louisville	Cincinnati	Evansville	Louisville	Omaha
	(Cents Per Bushel)									
1959										
January	139.0	135.1	122.4[a]	124.3	143.7	136.1	136.7	132.5	132.8	124.1
February	134.0	137.1	122.4	122.3	138.7	138.1	138.7	127.5	134.8	122.1[a]
March	134.0	136.1	126.4	126.3	138.7	137.1	140.7	127.5	133.8	126.1[a]
April	135.0	140.1	136.4	134.3	139.7	141.1	148.7	128.5[a]	137.8	134.1
May	139.0	141.1	136.4	135.3	143.7	142.1	148.7	132.5[a]	138.8	135.1
June	137.0	145.1	138.4	139.3	141.7	146.1	149.7	130.5[a]	142.8	139.1
July	137.0	143.1	136.4	134.3	141.7	144.1	145.7	130.5[a]	140.8	134.1
August	137.0	142.1	134.4	133.3	141.7	143.1	134.7	130.5[a]	139.8	133.1
September	121.0	135.1	128.4	127.3	125.7	136.1	123.7	114.5[a]	132.8	127.1
October	112.0	116.1	122.4	128.3	116.7	117.1	123.7	105.5[a]	113.8	128.1
November	124.0	118.1	123.4	125.3	128.7	119.1	129.7	117.5	115.8[a]	125.1
December	123.0	121.1	120.4	123.3	127.7	122.1	129.7	116.5[a]	118.8	123.1

TABLE XL (continued)

Month and Year	Transportation Method and Representative External Source								
	Truck			Rail			Barge		
	Evans-ville	Minne-apolis	Omaha	Evans-ville	Louis-ville	Cincin-nati	Evans-ville	St. Louis	Omaha
	(Cents Per Bushel)								
1960									
January	127.0	123.4	128.3	131.7	130.1	135.7	120.5[a]	127.5	128.1
February	127.0	120.4[a]	123.3	131.7	135.1	133.7	120.5	127.5	123.1
March	129.0	122.4[a]	125.3	133.7	138.1	134.7	122.5	128.5	125.1
April	135.0	130.4	130.3	139.7	138.1	140.7	128.5[a]	132.5	130.1
May	135.0	131.4	128.3	139.7	138.1	140.7	128.5	131.5	128.1[a]
June	135.0	130.4	131.3	139.7	140.1	138.7	128.5[a]	129.5	131.1
July	132.0	130.4	135.3	136.7	141.1	139.7	125.5[a]	133.5	135.1
August	135.0	129.4	130.3	139.7	141.1	138.7	128.5	127.5[a]	130.1
September	118.0	122.4	130.3	122.7	138.1	123.7	111.5[a]	121.5	130.1
October	117.0	119.4	124.3	121.7	124.1	120.7	110.5[a]	118.5	124.1
November	111.0	111.4	110.3	115.7	126.1	115.7	104.5[a]	106.5	110.1
December	113.0	118.4	120.3	117.7	122.1	126.7	106.5[a]	117.5	120.1

Note: The acquisition price underlined is the optimum price and external representative source for each transportation method. Those representative external sources not included were priced above the optimum price.

[a]Optimum acquisition cost and representative external source. These costs were calculated from Tables XXVII, XXX, XXXI, and XXXII.

TABLE XLI

ESTIMATED TOTAL ACTUAL ACQUISITION COST OF CORN,[a] BY TRANSPORTATION METHOD, MEMPHIS, 1959 AND 1960

Source and Year	Transportation Method			Total
	Truck	Rail	Barge	
	(1000 Dollars)			
1959				
Peoria, Ill.	$1,273	$1,636	$6,677	$9,587
St. Louis, Mo.	108	1,600	737	2,445
Kansas City, Mo.	--	--	411	411
Louisville, Ky.	45	81	--	126
Total	$1,427	$3,318	$7,825	$12,570
1960				
Peoria, Ill.	$ 814	$1,020	$10,316	$12,150
St. Louis, Mo.	41	1,074	1,100	2,215
Kansas City, Mo.	--	--	405	405
Louisville, Ky.	16	116	--	133
Total	$ 871	$2,221	$11,821	$14,903

[a]Cost figures include all costs of acquiring corn, delivered at the representative internal Memphis market by each transportation method. The costs were calculated from Tables XXVII, XXX, XXXI, XXXII, and XXXIII.

TABLE XLII

ESTIMATED TOTAL ACTUAL ACQUISITION COST OF CORN,[a] BY TRANSPORTATION METHOD, NASHVILLE, 1959 AND 1960

Source and Year	Transportation Method			Total
	Truck	Rail	Barge	
		(1000 Dollars)		
1959				
Peoria, Ill.	$ 9,575	$1,187	--	$10,762
St. Louis, Mo.	227	--	--	227
Cincinnati, Ohio	12	166	--	178
Sheffield, Ala.	7	--	--	7
Tupelo, Miss.	94	--	--	94
Louisville, Ky.	3,978	1,510	--	5,488
Evansville, Ind.	3,608	983	--	4,592
Total	$17,501	$3,847	--	$21,347
1960				
Peoria, Ill.	$ 7,478	$1,137	--	$ 8,615
St. Louis, Mo.	96	--	--	96
Cincinnati, Ohio	16	24	--	39
Sheffield, Ala.	6	--	--	6
Tupelo, Miss.	123	--	--	123
Louisville, Ky.	3,876	1,507	--	5,383
Evansville, Ind.	3,679	992	--	4,672
Total	$15,274	$3,660	--	$18,934

[a]Cost figures include all costs of acquiring corn, delivered at the representative internal Nashville market by each transportation method. These costs were calculated from Tables XXVII, XXVIII, XXX, XXXI, XXXII, and XXXIV.

TABLE XLIII

ESTIMATED TOTAL ACTUAL ACQUISITION COST OF CORN,[a] BY TRANSPORTATION METHOD, CHATTANOOGA, 1959 AND 1960

Source and Year	Transportation Method			Total
	Truck	Rail	Barge	
	(1000 Dollars)			
1959				
Cincinnati, Ohio	$1,638	$511	$1,728	$ 3,877
Minneapolis, Minn.	--	--	2,891	2,891
Peoria, Ill.	926	--	6,839	7,765
St. Louis, Mo.	232	--	--	232
Sheffield, Ala.	17	--	--	17
Louisville, Ky.	321	--	--	321
Evansville, Ind.	1,411	--	--	1,411
Total	$4,545	$511	$11,458	$16,514
1960				
Cincinnati, Ohio	$1,308	$546	$ 1,857	$ 3,711
Minneapolis, Minn.	--	--	3,172	3,172
Peoria, Ill.	942	--	6,190	7,131
St. Louis, Mo.	354	--	--	354
Sheffield, Ala.	24	--	--	24
Louisville, Ky.	583	--	--	583
Evansville, Ind.	$1,330	--	--	$ 1,330
Total	$4,541	$546	$11,219	$16,306

[a]Cost figures include all costs of acquiring corn, delivered at the representative internal Chattanooga market by each transportation method. These costs were calculated from Tables XXVII, XXVIII, XXX, XXXI, XXXII, and XXXV.

TABLE XLIV

ESTIMATED TOTAL ACTUAL ACQUISITION COST OF CORN,[a] BY TRANSPORTATION METHOD, KNOXVILLE, 1959 and 1960

Source and Year	Transportation Method			Total
	Truck	Rail	Barge	
		(1000 Dollars)		
1959				
Evansville, Ind.	$1,058	$ 638	--	$1,696
Cincinnati, Ohio	241	344	--	585
Louisville, Ky.	424	213	--	637
Peoria, Ill.	306	--	--	306
Gainesville, Ga.	113	--	--	113
Sheffield, Ala.	7	--	--	7
Total	$2,149	$1,195	--	$3,344
1960				
Evansville, Ind.	$1,114	$ 780	--	$1,894
Cincinnati, Ohio	315	433	--	748
Louisville, Ky.	659	259	--	918
Peoria, Ill.	249	--	--	249
Gainesville, Ga.	67	--	--	67
Sheffield, Ala.	7	--	--	7
Total	$2,410	$1,473	--	$3,883

[a]Cost figures include all costs of acquiring corn, delivered at the representative internal Knoxville market by each transportation method. These costs were calculated from Tables XXVII, XXVIII, XXX, XXXI, XXXII, and XXXVI.