AN ANALYSIS OF FLOW PATTERNS AND TRANSPORTATION FOR BEEF FROM KANSAS FEDERALLY INSPECTED PLANTS IN 1972

by 1050 710

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B. A., Fort Hays Kansas State College, 1969

A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Agricultural Economics
Department of Economics

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1974

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ACKNOWLEDGMENTS

I would like to express my sincerest gratitude to my major professor, Dr. Orlo Sorenson, to members of my graduate committee, and to all those who assisted me in this thesis. Without their help and encouragement this paper would never have been completed.

I especially want to thank my wife, Janet, and my young son, John, for their patience during the writing of this paper. I would also like to thank my wife for the long hours she spent typing and proofreading this thesis.

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CHAPTER 1

INTRODUCTION

In recent years there has been an increasing interest shown in distribution patterns and transportation networks for feedgrains and livestock. During this same period there has been little work done in the area of transportation of meat and meat products, therefore leaving a gap in the overall view of the livestock industry.

Kansas was fifth in a ranking of states in dressed beef production in 1972. Table I shows the growth of the beef slaughtering industry in Kansas in the past two decades. The data have been broken down into months to show the seasonal variations. Cattle slaughter in Kansas has more than doubled since 1950. Table II compares dressed beef production in Kansas in the last two decades with production in the United States for the same years. Kansas' rank among states in number of cattle slaughtered moved from eighth in 1960 to fifth in more recent years with slightly more than 7 percent of the U. S. total.

The cost relationship between assembling raw materials and transportation of finished products has long been recognized as a key factor in plant location. Since the cost of feed is a relatively high percentage of total production cost for beef and pork, the relationship between feed cost and the cost of transporting these products is one of the major factors in determining the location of livestock feeding operations. Due to the present transportation rate structure, it is generally more

TABLE 1

TOTAL LIVEWEIGHT OF SLAUGHTERED CATTLE IN KANSAS, 1950-1972

Month	1950	1955	1960	1965	1970	1971	1972
	thousands of pounds						
January	90,948	95,423	101,332	130,816	179,692	207,192	216,512
February	72,763	82,216	93,600	120,006	172,515	175,517	205,390
March	78,710	84,757	92,324	137,768	174,736	208,098	220,041
April	67,941	80,157	78,705	115,575	153,840	198,072	209,608
May	66,257	84,262	87,261	109,109	153,008	199,977	233,927
June	69,610	88,703	96,135	114,195	161,553	208,437	226,548
July	77,306	88,015	93,605	115,758	152,862	215,688	204,232
August	91,308	110,584	103,244	127,530	165,584	209,902	224,675
September	99,077	110,173	103,668	124,236	186,697	210,080	226,628
October	89,130	103,682	99,687	125,118	201,285	216,240	238,872
November	79,633	105,535	92,814	127,635	200,136	214,920	226,556
December	87,082	110,280	93,184	131,838	217,600	200,744	224,016
Total	969,765	1,143,787	1,135,559	1,479,584	2,139,508	2,464,867	2,657,005
Monthly Average	80,814	95,316	94,630	123,299	178,292	205,406	221,417

Source: Kansas Crop and Livestock Reporting Service, "Livestock Slaughter," (Topeka, Kansas: Kansas Department of Agriculture, 1951-1973).

TABLE II

DRESSED BEEF PRODUCTION IN KANSAS AND THE U.S., KANSAS PERCENTAGE OF U.S. PRODUCTION AND KANSAS RANK AMONG ALL STATES FOR SELECTED YEARS, 1950-1972

Year	Kansas Production*	U.S. Production*	Kansas Percent of U.S.	Kansas Rank Among States*
	- - (Millions of Pounds) - -			
1950	510	9,239	5.52	6
1955	629	13,225	4.75	7
1960	667	14,337	4.65	8
1965	867	18,325	4.73	7
1966	962	19,694	4.88	6
1967	988	20,185	4.89	6
1968	913	20,842	4.38	8
1969	1,007	20,953	4.80	7
1970	1,267	21,472	5.90	5
1971	1,459	21,692	6.72	5
1972	1,573	22,218	7.08	5

*Source: Kansas Crop and Livestock Reporting Service, "Livestock Slaughter," (Topeka, Kansas: Kansas Department of Agriculture, 1951-1973).

economical for the meat processor to ship the finished product to market than to locate near the market and import livestock.[1]

Table III shows the top ten states in beef slaughter in the United States since 1964. The data show that the top ten states slaughtered 65 percent of all commercially slaughtered beef in the U. S. in 1964. Geographic concentration has increased and by 1971 the top ten states slaughtered 70 percent of all commercially slaughtered beef in the U. S. During this same period the concentration of the slaughtering industries has moved westward where livestock and feedgrains are readily available. This is indicated by the decline of slaughtering in Illinois, Ohio and Wisconsin and the increase in slaughtering in Kansas, Nebraska and Colorado.

Historically, cattle were first slaughtered around 1650 in North America. Local butcher shops killed and dressed the meat for farmers, but didn't retail the meat to the community. It was not until the late 1600's that packing houses were established to supply the surrounding communities.

As the population moved westward other innovations arose to meet the changing demands of the consumers. Great cattle drives soon became popular and since this form of movement was extremely hard on the livestock, (i.e., excessive weight losses and high mortality rate), packing houses found it more economical to locate closer to the range lands where the cattle were raised. Approximately the same period of time the advent of canal and river transportation also helped stimulate the movement of slaughtering houses to the West.

About 1857, the use of natural ice in packing fresh meat helped stimulate the growth of the industry. The packers now could buy cattle

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[1]W. F. McPherson and H. G. Witt, "Feed and Livestock Transport Cost Relationship," Transportation Journal, VIII, No. 8 (Fall, 1968), pp. 25-36.

TABLE III

CATTLE SLAUGHTERED BY THE TOP TEN PRODUCING STATES AND THE PERCENTAGE OF THE TOTAL U.S. PRODUCTION BY THESE STATES FROM 1964-1971 (States Listed in Ranking Order)*

1964		1965		1966		1967	
State	No. of Head Commercially Slaughtered (In 1,000's)	State	No. of Head Commercially Slaughtered (In 1,000's)	State	No. of Head Commercially Slaughtered (In 1,000's)	State	No. of Head Commercially Slaughtered (In 1,000's)
Iowa	3,630	Iowa	3,987	Iowa	4,046	Iowa	4,229
California	2,957	California	3,004	Nebraska	3,442	Nebraska	3,552
Nebraska	2,802	Nebraska	2,879	California	3,121	California	3,050
Texas	2,180	Texas	2,383	Texas	2,427	Texas	2,573
Minnesota	1,696	Minnesota	1,607	Minnesota	1,717	Minnesota	1,900
Illinois	1,459	Illinois	1,544	Kansas	1,609	Kansas	1,617
Kansas	1,419	Kansas	1,477	Illinois	1,557	Colorado	1,558
Colorado	1,322	Colorado	1,430	Colorado	1,540	Missouri	1,502
Ohio	1,251	Ohio	1,269	Missouri	1,423	Illinois	1,491
Missouri	1,215	Wisconsin	1,221	Ohio	1,311	Ohio	1,259
Top Ten Total	19,931	Top Ten Total	20,801	Top Ten Total	22,193	Top Ten Total	22,731
Top Ten %**	64.7	Top Ten %**	64.2	Top Ten %**	65.7	Top Ten %**	67.0

*Source: U.S. Department of Agriculture, Agricultural Statistics, 1965-1972, (Washington, D.C.: Government Printing Office).

**Percentage of U.S. Commercial Slaughter Processed by the Top Ten States.

TABLE III. (Continued)*

1968		1969		1970		1971	
State	No. of Head Commercially Slaughtered (In 1,000's)	State	No. of Head Commercially Slaughtered (In 1,000's)	State	No. of Head Commercially Slaughtered (In 1,000's)	State	No. of Head Commercially Slaughtered (In 1,000's)
Iowa	4,588	Nebraska	4,159	Nebraska	4,338	Nebraska	4,428
Nebraska	3,847	Iowa	4,130	Iowa	4,322	Iowa	4,281
California	2,919	Texas	3,011	Texas	3,184	Texas	3,529
Texas	2,779	California	2,936	California	2,849	California	2,854
Minnesota	1,985	Minnesota	1,868	Kansas	2,014	Kansas	2,341
Colorado	1,574	Colorado	1,714	Colorado	1,975	Colorado	2,311
Missouri	1,565	Kansas	1,664	Minnesota	1,654	Minnesota	1,585
Kansas	1,504	Missouri	1,590	Illinois	1,349	Illinois	1,398
Illinois	1,407	Illinois	1,417	Missouri	1,271	Ohio	1,126
Wisconsin	1,220	Wisconsin	1,245	Wisconsin	1,155	Wisconsin	1,078
Top Ten Total	23,388	Top Ten Total	23,734	Top Ten Total	24,111	Top Ten Total	24,931
Top Ten %**	66.6	Top Ten %**	67.2	Top Ten %**	68.7	Top Ten %**	69.9

*Source: U.S. Department of Agriculture, Agricultural Statistics, 1965-1972, (Washington, D.C.: Government Printing Office).

**Percentage of U.S. Commercial Slaughter Processed by the Top Ten States.

in the summer months when they were usually cheaper and easier to ship. With the meat packed in ice the packers could ship their product without fear of heavy spoilage. With the advent of steampower in the late 1800's, packers were able to achieve greater output through the use of assembly lines and also produce meat by-products.

By the end of the nineteenth century, the system consisted of country livestock dealers and farmers who delivered cattle to rail heads for transportation to terminal markets for slaughter. The carcasses were shipped to branch houses for distribution to the final market areas. There were no further major transportation innovations until the 1920's when motor trucks began to compete with the railroads for the transportation of livestock and carcasses. With motor carriers in use, packers were no longer restricted to terminal markets and this brought about further interior movement of packing house operations and a decline in the importance of terminal markets.

Since World War II there has been a trend of lessening of concentration in the packing industry. According to McCoy, census data show the largest four companies accounted for 35 percent of commercial beef and veal slaughter in 1947. The top four companies in 1963 accounted for 24 percent. Presently the figure can be expected to be about the same with the largest decline in concentration of cattle slaughtering.[2]

There have been several developments which have enabled new firms to enter the cattle slaughtering industry. Improved trucks and roads have made it unnecessary for live animals to be shipped to market by rail. The new firms began constructing plants with modern technology at interior points where slaughter animals were closer at hand. Since about a third of the liveweight of meat animals is lost in slaughtering, transportation

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[2]John H. McCoy, Livestock and Meat Marketing (Westport, Connecticut: The AVI Publishing Company, Inc., 1972), p. 165.

costs were reduced by locating plants in livestock production areas. Also, wage rates were frequently lower at interior points. Since the cattle industry itself was expanding more rapidly than other industries, new firms could enter the industry without reducing the number of animals available to established firms. The wide use of federal grades for beef also made it easier for new firms to compete for customers on equal terms with older packers.

A recent development in transport of meat is expanded use of Trailer-On-Flat-Car (TOFC) service. Through this method packers are able to load truck trailers and place them on rail flat cars for delivery. Once the rail cars reach the designated locations, trucks pick up the trailers and deliver them to customers.

At the present time packers have four alternative methods for shipping red meat: (1) refrigerated rail cars, (2) TOFC rail service, (3) commercial motor carriers, and (4) packer-owned truck fleets.

Objectives of the Study

Transportation performs a vital function in the continued growth of Kansas slaughtering operations. As an increasingly surplus beef production area, distribution channels for Kansas packers became longer and the packers' ability to compete for markets subject to greater challenge. So that a better understanding of transportation can be gained, data will be developed on the present transportation networks for Kansas meat processors. These data will be formalized so that flow and counter-flow patterns will shed light upon the development of Kansas packing plants. This study will attempt to provide added insight into transportation costs faced by Kansas plants and its influence on the competitive position of these firms.

The specific objectives of this paper are as follows:

1. Define the geographic locations of the market areas where Kansas beef is shipped and also determine the volume of meat shipped to various destinations.

2. Determine the mode of transportation used, the factors involved in the selection of the method of transportation, and the costs incurred by the packers.

3. Analyze the structure of transport costs as related to the ability of Kansas packers to compete in various consuming regions.

CHAPTER 2

APPLICABLE THEORETICAL CONCEPTS RELATING TO PLANT LOCATION AND MARKET AREAS

Transportation costs and location theory are inseparable. Traditional analysis assumes either fixed markets and undetermined production areas or fixed production areas and undetermined markets. Also location theory assumes given transportation facilities. Analysis involving the determination of transport routes and facilities under varying production and marketing assumptions and their relationships is not as well developed. Both the fixed transport and variable transport analysis lead directly into the analysis of the types and levels of regional or spatial economic activity.

On the basis of relative transport requirements for raw materials and finished products, industries have been classified as material-oriented, market-oriented or attracted to intermediate points. Industries in which major materials are available at market points or whose raw materials are easily transported are market-oriented. Soft drink industries and bakery industries are examples. Meat packing industries are clearly material-oriented, since significant weight loss occurs at the point of slaughter. Soybean processing is an example of an intermediate location industry. In-transit railroad rates are an important consideration in intermediate location.

Best known early theories relating transportation characteristics to location were put forth by J. H. Von Thunen on agricultural location and by Alfred Weber on industrial location.

Von Thunen reasoned that the cost of producing agricultural products varied inversely with transport costs and the latter varied proportionately with the distance from a given market center. Assuming price of labor and capital are equal at all locations, land rents and transportation costs were co-determinants of location.

Weber's theory of industrial location also emphasized transportation factors but recognized trade-off in location among transportation costs and agglomeration factors. Other things equal, Weber postulated that industrial sites would be selected that would minimize unnecessary movement, and hence represent minimum energy positions. Movement cost is made up of three factors: the distance units are moved, weight of the unit to be moved, and effort or cost of moving materials over unit distances.

Weber formed several conclusions based on his theory of "one market, one material" case. First, if the raw material is ubiquitous (equally available everywhere) production will occur at the market since it would not be practical to pay transport costs for raw materials that are available at the market. Second, a pure raw material (no weight lost in manufacturing the finished product) may be located away from the market. In this instance, manufacture can occur at the market or at the location of the raw material. Finally, the raw material may be gross (weight is lost in the manufacturing of the finished product) and located away from the market. Production occurs at the location of the gross material in this situation since it is less expensive to ship smaller amounts of the finished product than greater amounts of the raw material.[3]

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[3]Roy J. Sampson and Martin T. Farris, Domestic Transportation Practice, Theory and Policy (Boston: Houghton Mifflin Co., 1966), p. 222.

The final conclusion presented by Weber is the best illustration of the livestock slaughtering industry (i.e., use of localized gross materials). Since approximately one-third of the animal liveweight is lost during slaughter and livestock transportation rates are between 80 and 90 percent of fresh meat transport rates,[4] it is generally more economical for slaughtering firms to locate near to their source of raw material and transport the finished product to the market.

Effects of Labor and Transportation

As mentioned in the previous chapter, labor was also an important factor that influenced the decentralization of the packing industry. In most cases labor costs are lower in rural areas than in urban areas, and this has been a complementary factor in the packing industry. This may not always be true for all industries; cheap labor locations may be offset by higher transportation costs in some situations. If this is true then there is a definite trade-off between transport costs and labor costs. This theory probably can best be demonstrated by the use of Walter Isard's graphic approach.

Figure 1 illustrates the central idea of Isard's theory of substitution. Points A, B, C, and D are cheap labor sites where the labor outlay per ton of product is measured on the vertical axis. For each point the transport outlay involved in the raw material and the finished product is estimated from the relevant transformation curve displaying the substitution possibilities between each pair of transport inputs. The estimated transport outlay for each point is measured on the horizontal axis. Line A, B, C, D, is called the outlay-substitution line. This line shows the substitution feasibilities between transport outlays

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[4] Meats and Packing House Products From Midwest to Coast, 309 I.C.C. 551 (1960).

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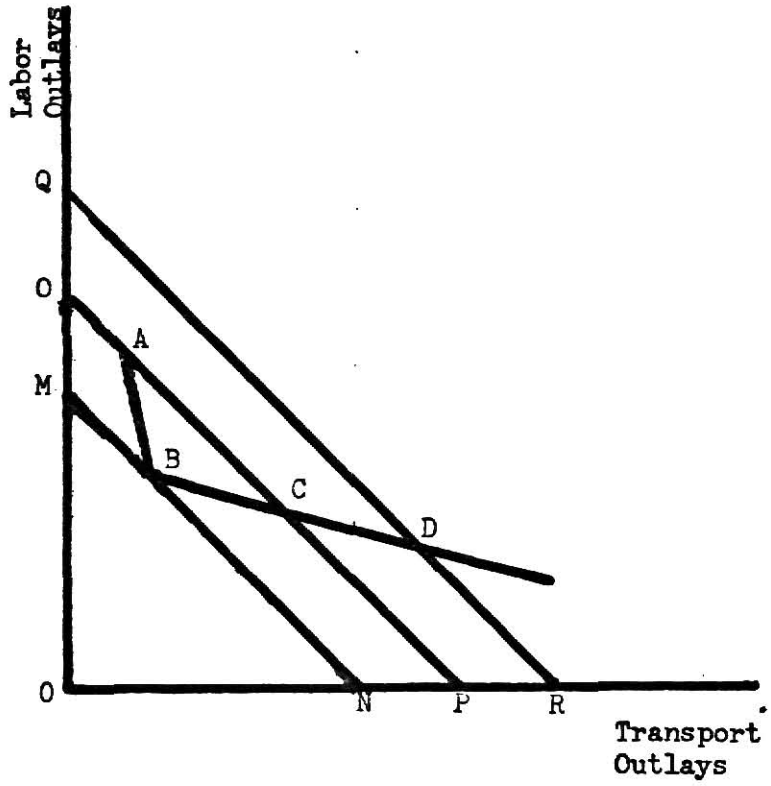
FIGURE 1

ISARD'S ANALYSIS OF SUBSTITUTION BETWEEN TRANSPORT AND LABOR OUTLAYS



and labor outlays. Marginal substitution may not always be possible since the relationship of cheap labor points and distance would be plotted as discreet points rather than a curve. Iso-outlay lines represent transport plus labor outlays. These lines are straight and have a slope of minus one. Lines MN, OP, and QR represent the iso-outlay lines. Point A depicts the cheapest transport outlay point while point D shows the cheapest labor point. Point B represents the equilibrium location because it lies on the lowest iso-outlay line, MN. Even though C and D are cheaper labor sites, the heavy transport outlays outweigh the cheap labor.[5]

Market Areas as Defined by Transportation Rate Structuring

A theoretical approach will be used in this section to demonstrate how markets are divided by transportation costs. Even though the following cases cited are oversimplified, they depict basic market division theory.

The following theoretical analysis is based on the writings of August Losch and presented by Stuart Daggett in Principles of Inland Transportation.

Case I. Equal Manufacturing Costs -- Using Figure 2 it can be assumed that points A and B are the locations of manufacturing and that the costs of production are the same at both points. The transportation rate exactly covers the carrier's costs and the rate is the same per ton per mile from each point and in either direction. Each arc shown is a given distance from each respective point. The intersection of any two arcs (i.e., the arc encircling point A and the arc encircling point B) fixes the location of a point equally distant from A or B and it is

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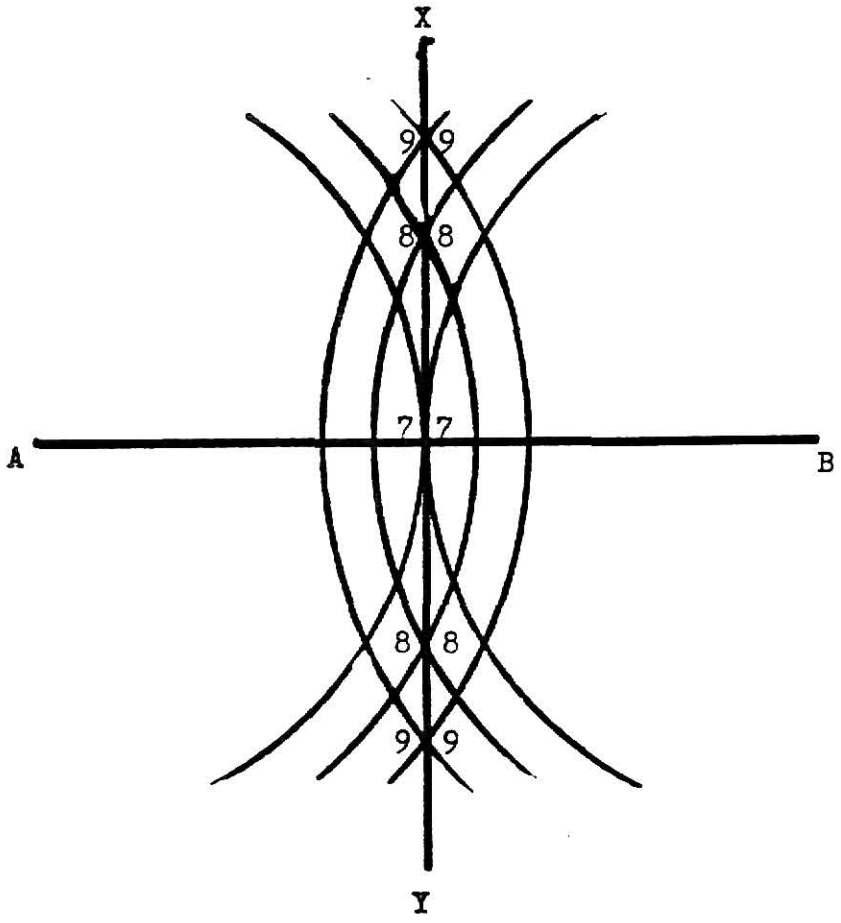
[5]Walter Isard, Location and Space-Economy (New York: The Technology Press of MIT, and John Wiley and Son, Inc., 1956), p. 127-131.

FIGURE 2

CASE I. EQUAL MANUFACTURING COSTS



Source: Stuart Daggett, Principles of Inland Transportation, 4th ed. (New York: Harper Brothers Publishers, 1955), p. 444.

equally expensive to reach in terms of production and transport costs. Based on the previous assumptions, all intersections will occur on line X, Y. This shows that each manufacturing point's market area is on its respective side of line X, Y.

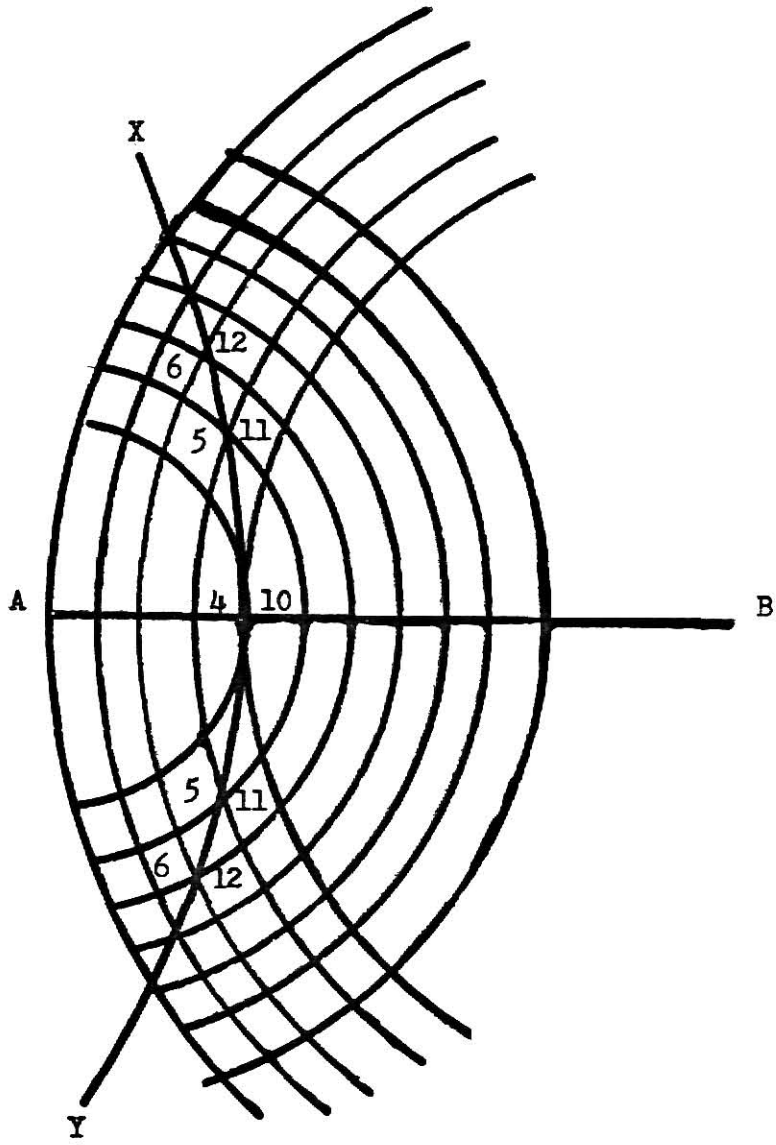
Case II. Unequal Manufacturing Costs -- It can be assumed in Figure 3 that production costs are higher at point A, where the cost at point B is X and the cost at point A is X plus 6. A line representing equal total costs will pass through points that are nearer to point A by 6 units, because the savings of transportation costs from A will be offset by the production disadvantage. It can be observed that where base prices at point A are higher than at point B, the boundary line will be a hyperbola around point A, line X, Y.

Case III. Variation in the Level of Transportation with Respect to Production Costs -- In this case it can be assumed that the cost of transportation per ton mile is cut in half and it applies to all shipments regardless of the point. The question is how will it affect market division. If Case I is used as a model, where production costs are equal, there will be no change in the division of markets. Now if the transportation cost is decreased by a half in Case II a change in the market division occurs as shown in Figure 4.

Since the production costs are higher at point A, a decrease in the transportation rate will decrease A's market from line X, Y to line X', Y'. The new boundary line shows that A's disadvantage increases from 6 units to 12 units and B's market area has increased by that amount. Under normal conditions a decline in the general level of transportation cost will increase the market area dominated by the manufacturer with the cost-of-production advantage.

FIGURE 3

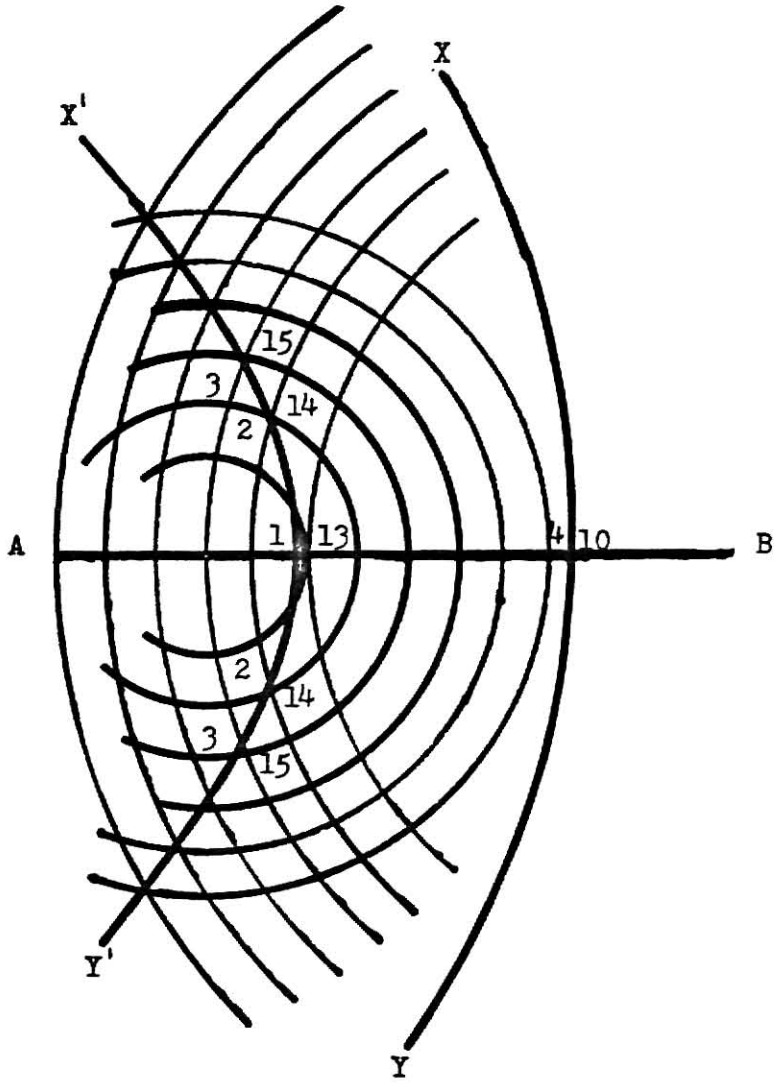
CASE II. UNEQUAL MANUFACTURING COSTS



Source: Stuart Daggett, Principles of Inland Transportation, 4th ed. (New York: Harper Brothers Publishers, 1955), p. 445.

FIGURE 4

CASE III. VARIATION IN THE LEVEL OF TRANSPORTATION WITH RESPECT TO PRODUCTION COSTS



Source: Stuart Daggett, Principles of Inland Transportation, 4th ed. (New York: Harper Brothers Publishers, 1955), p. 446.

Case IV. Transportation Rates That Are Not Proportional to Distance -- The shape of the market areas will change if the transportation rates are not proportional to distance. In this situation it can be assumed that the motor carriers arbitrarily establish rates which progress regularly up to a certain distance--12 units--but these rates do not increase after that point. So it can be assumed that the rate at 12 units is the maximum at any distance.

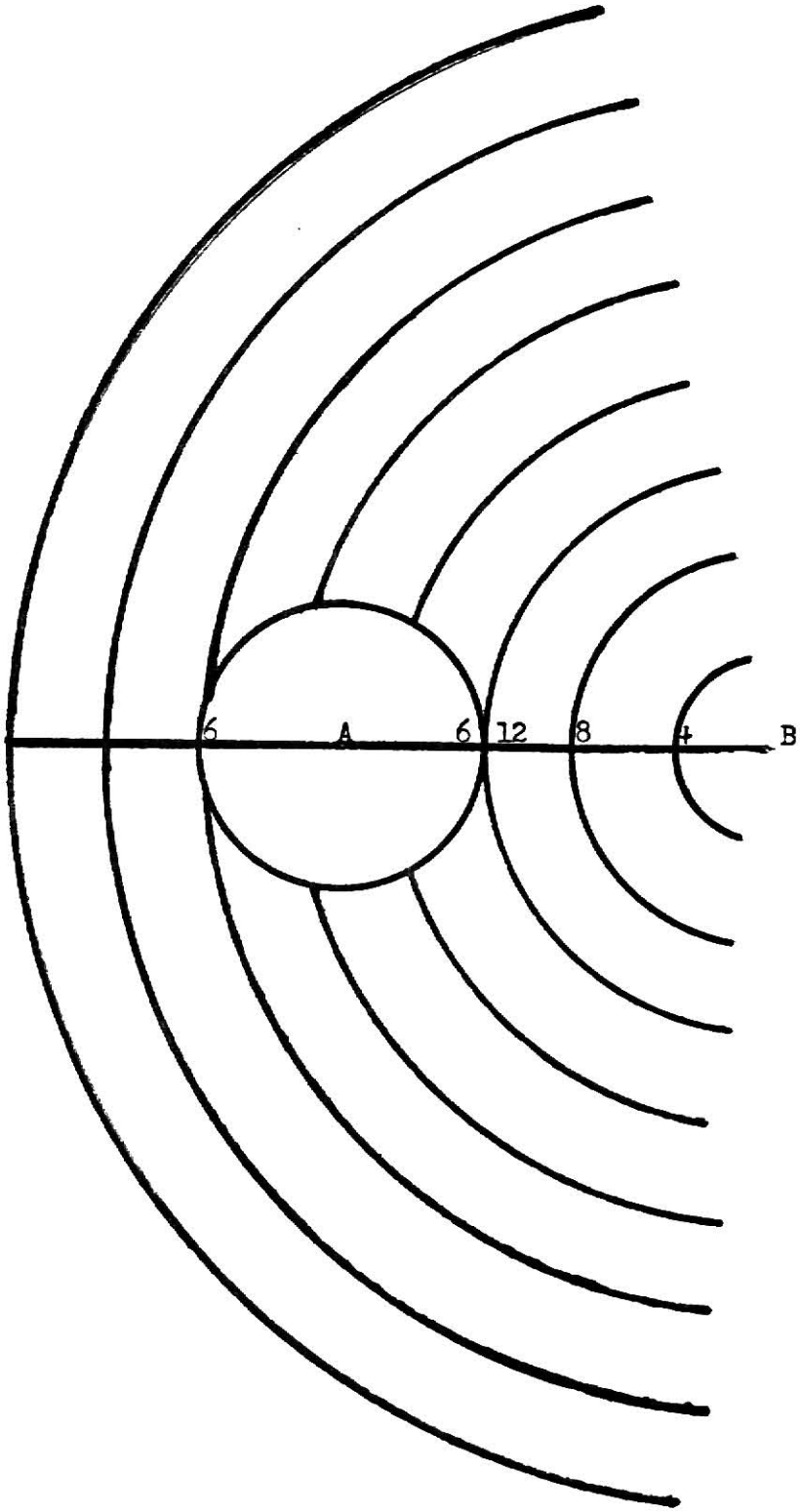
Using Figure 5 one can illustrate the effect that nonproportional rate structure has on two producers. Assume that point A has a production cost of plus six units of point B's production cost. The critical line is the locus of all points at which the transportation rate is equal to six units. Point A will dominate only the area that is bounded by this line, while point B will dominate the area beyond point A and a portion of the area between points A and B.

Concluding Comments

The previous discussion of market configuration lends itself well to problems faced by packing plants since these firms are selling products with homogenous transportation characteristics that are highly price-competitive in several markets. It should be noted that alternative modes of transportation can also affect market areas. Generally transport costs increase less rapidly than in proportion to distance since terminal costs are independent of length of haul. The tapering off of costs is characteristic of all modes of transportation, but it is more apparent with modes that have high terminal costs and relatively low line-haul costs. Railroads fall into this category since they have a high ratio of terminal costs to line-haul costs. On the other hand trucking firms have lower terminal costs and higher line-haul costs. By contrasting

FIGURE 5

CASE IV. TRANSPORTATION RATES THAT ARE NOT PROPORTIONAL TO DISTANCE



Source: Stuart Daggett, Principles of Inland Transportation, 4th ed. (New York: Harper Brothers Publishers, 1955), p. 448.

these two carriers it can be seen that if rail is the predominant mode of transport, then an industry would face a rate structure that would offer higher relative rates for short-hauls and relatively lower rates at greater distance, since terminal costs decrease when spread out over long-hauls. On the other hand if motor common carriers are used, the rate structure would offer lower rates initially, but since the trucking firm is faced with greater line-haul expenses, the rate progression is greater than for rail rates on longer hauls.

Market configuration can also be affected by geography and individual state regulations. These two factors affect the location of transportation routes, and the kinds of commodity movement, thus affecting transfer costs. These factors directly affect rates, thereby influencing patterns of producer location, marketing areas, and routing practices. It should be noted while the above mentioned locational factors, (especially state regulations), have more of an effect on trucking firms, geography can significantly alter market areas by its influence on both rail and motor common carriers.

CHAPTER 3

PROCEDURES AND METHODS OF ANALYSIS

Data Sources

The principal source of data concerning shipping patterns was from interviews with packing house personnel throughout the State. The study was limited to federally inspected slaughtering plants. Only federally inspected plants can ship products through interstate channels. In 1972 over 2.5 million head of cattle were commercially slaughtered in Kansas. Federally inspected slaughtering plants slaughtered approximately 2.4 million head which represents 95 percent of all Kansas commercial slaughter.

Non-federally inspected plants are inspected by state employees, but usually the same guidelines are used as for federal inspection. All shipments from state inspected plants must stay within the boundaries of the state. As a general rule non-federally inspected plants are smaller than federally inspected plants. Non-federally inspected slaughtering plants are subclassified by total liveweight slaughtered annually. The subclassifications fall into three intervals depending on annual slaughter, and they are as follows: greater than 2,000,000 pounds, the plants are large; 300,000 to 2,000,000 pounds, medium; and under 300,000, small.

The interviews held at the designated federally inspected packing plants consisted of acquiring information on destinations of meat shipments, the amount shipped, the mode of transport used, and specific shipping problems incurred by the packer.

So that transportation rates could be established to the various market areas, motor carrier tariffs had to be identified. The motor common carrier tariffs used in this study represented rates for common carriers. Although portions of the meat were shipped by contract carrier, the majority was shipped by common carrier. Little rate difference was found between contract carrier and common carrier rates when the two rates were compared. This information was supplied by George Hutchins of the Kansas Motor Carriers Association. The following tariffs were obtained from their respective issuing agencies:

1. Middlewest Motor Freight Bureau. Local, Joint, Proportional, Export and Import, Also Distance Commodity Rates on Meats and Packing House Products, (Tariff No. 100-C, MF-I.C.C. No. 625), Kansas City, Missouri: 1971.

2. Motor Carriers Traffic Association. Joint and Local Commodity Rates Applying on Fresh Meats and Packing House Products, (Tariff No. 155-L, MF-I.C.C. No. 887), Greensboro, North Carolina: 1972.

3. Rocky Mountain Motor Tariff Bureau, Inc. Rules, Points of Service, Individual Carriers' Exceptions to General Provisions of Tariffs, Governed by This Tariff, (Tariff No. 101, MF-I.C.C. No. 211), Denver, Colorado: 1972.

4. Rocky Mountain Motor Tariff Bureau, Inc. Local and Joint Commodity Rates, Also Distance Commodity Rates on Interstate and Foreign Commerce, (Tariff No. 261, MF-I.C.C. No. 212), Denver, Colorado: 1972.

Rail carload rates were acquired from a commercial rate and traffic consultant and the TOFC rail rates used were obtained from the Rock Island Railroad rate division in Wichita.

Other secondary data were obtained from various published sources. Agricultural Statistics, 1971 was a source of commercial slaughter statistics

by states and the 1971 U. S. census provided for state population figures. The average per capita beef consumption figures were obtained from American Meat Institute publications. So that the data acquired from interviews could be tested for reliability, aggregated data on federally inspected slaughter were obtained from the Kansas Crop and Livestock Reporting Service.

Procedure

The interviews were usually conducted at the designated plants.[6] Two different types of information were sought during these interviews--review of the 1972 shipping records and the transportation problems that arise in routine scheduling of shipments.

So that an accurate estimate of locations and amounts could be made in this study, a statistical sample was employed for use at the packing plants. Records of the 1972 calendar year were used in the sample survey and were obtained from eleven plants that shipped approximately 150 truck loads of beef per day. These records consisted of invoices, bills of lading, or weekly summary sheets.

The data sample consisted of 20 percent of all shipments for every seventh shipping day, based on a six-day shipping week. Sundays and holidays were excluded from the sample. Using this method 45 of 307 shipping days (six days per week less five holidays) in 1972 were sampled in the study. This method gave a good representation of shipping throughout the year, since some days are characteristically heavier shipping days than others. Sample days were 14.66 percent of annual shipping days.

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[6]Two plants preferred to prepare the shipping data themselves and for these plants a questionnaire was prepared. Along with this questionnaire a detailed list of instructions on how to conduct the survey was included. (See sample questionnaire in Appendix 1.)

Plants participating in the study represented 77.5 percent of all federally inspected beef slaughter in the State. The sample of shipments was 2.93 percent of shipments from participating plants and 2.27 percent of the total shipments from all Kansas federally inspected plants.

The significance of the sample was tested by estimating the amount of dressed beef from actual numbers of federally inspected slaughter cattle and comparing this to the amount of dressed beef estimated from sample shipment data. This procedure used in estimating the amount of dressed beef based on total slaughter consisted of multiplying the number of cattle slaughtered by federally inspected plants by the average liveweight of Kansas slaughter cattle (1065 pounds) and multiplying this amount by 61.5 percent (average carcass yield based on National Beef Council Statistics) so that the dressed weight could be found. The resulting total dressed weight estimate (1.566 billion pounds) compared closely to the dressed weight (1.546 billion pounds) estimated from sample data. The results showed that the sample was a good representative of Kansas shipped beef with less than a 5 percent error in the sample.

It should be noted that in some situations the estimated amounts of beef shipped to various states may show a larger error than 5 percent. This can be attributed to the fact that some packing firms that were not sampled may have shipping patterns substantially different from the average pattern for participating plants, and also to the possibility that destinations receiving small quantities may not appear in the sample.

Tariff Publication

Tariffs may be printed by individual railroads or trucking firms, but most are prepared by agents or associations working for carrier groups. Printed tariffs fall into two major categories:

1. Class Tariff -- This tariff states the rates per hundredweight that will be charged for the transportation of groups of articles of a given classification. Rates are normally indicated by mileage blocks but may also have point-to-point designations. Although these articles may be diverse in nature, they share common transport characteristics.

2. Commodity Tariff -- Each commodity tariff quotes rates on individual items or on a restricted list of like items. A representative example of a commodity tariff would be a tariff on meat and meat products. Commodity tariff rates are generally lower than class rates and take precedence over class rates. For this study commodity tariffs are used to obtain published rates.

Commodity tariffs employ either point-to-point or a mileage basis in establishing rates. Point-to-point tariffs provide rates on a hundredweight basis from specific origins to specific destinations. Mileage tariffs quote rates based on mileage only, regardless of the destination. The rate schedule from a mileage tariff usually increases systematically based on the distance hauled. As a general rule, mileage blocks (a group of miles placed into one category, and increased as a group) are used in the progression of rates.

Included in the rates are fixed charges such as terminal costs, administrative costs and return on value of physical facilities. These costs can be considered as fixed costs. With this in mind one can readily see that a greater percentage of terminal costs are involved in short-haul rates. On the longer hauls the terminal costs make up a smaller portion of the rate since it is spread out over more miles. For this reason rates on a longer haul have a tendency to increase at a decreasing rate.

Freight Rate Analysis

For the purpose of analyzing existing rate structures for motor carriers, three locations were used as origins and points within three regions were used as destinations. Wichita was chosen to be the representative shipping point for Kansas. Omaha, Nebraska and Waterloo, Iowa were chosen as origins for rate comparisons because each has a high density of packing plants in the surrounding area and plants at each point may be expected to compete for markets with Kansas plants. Destination points chosen represented population centers in (1) Northeastern states, (2) South and Southeastern states, and (3) Southwestern and Western states. All truck shipments are assumed to move on 40-foot mechanically refrigerated trailers at truck-load rates. So that the rates would remain uniform all beef movements were assumed to be carcass shipments. The rates were all hundredweight rates and were obtained from Motor Tariffs No. 155-L, I.C.C. No. 887, No. 100-C, I.C.C. No. 625, and No. 261, I.C.C. No. 212.

The following variables were used in the analysis:

Y = per hundredweight freight rate

X_1 = distance (miles)

X_1^2 = distance squared (miles)

For the purpose of rate analysis, a regression model was used to show the functional relationship between rate per hundredweight and distance hauled. A linear function was as follows:

$$Y_i = a + bX_1 + E_i$$

To further specify the relationship analyzed, a curvilinear function was employed. The following equation was used to express this curvilinear relationship:

$$Y_i = a + b_1X_1 + b_2X_1^2 + E_i$$

CHAPTER 4

DISTRIBUTION PATTERNS FOR BEEF FROM KANSAS FEDERALLY INSPECTED SLAUGHTERING PLANTS

Analysis of shipments reported from Kansas federally inspected slaughter plants in 1972 reveal a very broad geographic distribution. Shipments were reported to forty-two states and the District of Columbia. Exceptions were North Dakota, South Dakota, Idaho, Nevada, Wyoming, Washington, Alaska and Hawaii.

Table IV shows the results of the survey with the amounts rounded to the nearest thousand pounds. States east of the Mississippi River received three-fourths of the Kansas-slaughtered beef; of this quantity one-half was shipped to New England, Middle Atlantic, and South Atlantic Regions combined. Shipments to states west of Kansas accounted for less than one-tenth of the exported beef. It should be noted that 165.8 million pounds of beef (10.2 percent of the annual federally inspected production) was shipped to locations within the state. Although the majority of this fresh beef was consumed in Kansas, portions of this meat were redistributed by other packing plants in the state and the remainder was procured for use in fully processed foods. Table IV indicates carcass beef shipments totaling 785.6 million pounds which was 50.8 percent of all shipments and shipments of processed beef totaling 760.6 million pounds which was 49.2 percent of the total. Processed beef includes primal and sub-primal cuts (82 percent) and edible by-products. Total shipments by weight were, therefore, 50.8 percent carcass shipments, 40.3 percent primal and sub-primal cuts and 8.9 percent edible by-products.

TABLE IV

DESTINATIONS OF FEDERALLY-INSPECTED KANSAS SLAUGHTERED BEEF IN 1972

Region and State	Carcass Beef (1000's lbs.)	Processed Beef* (1000's lbs.)	Total (1000's lbs.)
New England	58,454	93,655	152,109
Maine	4,552	10,902	15,454
New Hampshire	4,628	4,743	9,371
Vermont	-----	1,696	1,696
Massachusetts	35,856	56,608	92,464
Rhode Island	2,769	843	3,612
Connecticut	10,649	18,863	29,512
Middle Atlantic	189,146	175,702	364,848
New York	87,089	127,314	214,403
New Jersey	73,026	36,195	109,221
Pennsylvania	29,031	12,193	41,224
East North Central	61,453	126,228	187,681
Ohio	16,102	28,383	44,485
Indiana	2,793	14,324	17,117
Illinois	26,024	33,404	59,428
Michigan	11,358	37,745	49,113
Wisconsin	5,166	12,372	17,538
West North Central	148,042	108,121	256,163
Minnesota	1,564	2,990	4,554
Iowa	3,032	2,477	5,509
Missouri	45,129	31,174	76,303
North Dakota	-----	-----	-----
South Dakota	-----	-----	-----
Nebraska	38	3,965	4,003
Kansas	98,279	67,515	165,794
South Atlantic	144,609	98,290	242,899
Delaware	-----	667	667
Maryland	23,054	8,400	31,454
District of Columbia	9,073	-----	9,043
Virginia	11,920	8,949	20,869
West Virginia	76	70	146
North Carolina	57,942	17,063	75,005
South Carolina	11,162	5,070	16,232
Georgia	6,827	23,717	30,544
Florida	24,555	34,354	58,909

*Includes primal, subprimal cuts and edible by-products.

TABLE IV. (Continued)

Region and State	Carcass Beef (1000's lbs.)	Processed Beef* (1000's lbs.)	Total (1000's lbs.)
East South Central	55,489	31,188	86,677
Kentucky	8,539	2,974	11,513
Tennessee	20,291	19,453	39,744
Alabama	21,371	1,615	22,986
Mississippi	5,288	7,146	12,434
West South Central	89,098	81,613	170,711
Arkansas	4,895	3,504	8,399
Louisiana	17,708	12,829	30,537
Oklahoma	14,516	22,385	36,901
Texas	51,979	42,895	94,874
Mountain	7,262	13,402	20,664
Montana	----	44	44
Idaho	----	----	----
Wyoming	----	----	----
Colorado	1,544	10,075	11,619
New Mexico	2,767	----	2,767
Arizona	2,951	35	2,986
Utah	----	3,248	3,248
Nevada	----	----	----
Pacific	32,043	32,351	64,394
Washington	----	----	----
Oregon	----	105	105
California	32,043	32,246	64,289
Alaska	----	----	----
Hawaii	----	----	----
Total	785,596	760,550	1,546,146

*Includes primal, subprimal cuts and edible by-products.

Table V illustrates the percentage of total volume of Kansas exported beef received by various states and regions. Seven states received slightly over 53 percent of the total amount of beef shipped from Kansas. The states and percentage received by each are as follows: New York, 15.53 percent; New Jersey, 7.91 percent; Texas, 6.87 percent; Massachusetts, 6.70 percent; Missouri, 5.53 percent; North Carolina, 5.43 percent; and California, 4.66 percent. Figure 6 shows the states and their geographic locations.

Figure 7 shows the regions and the percentage of total volume received by each region. The Middle Atlantic Region accounts for over 25 percent of the Kansas beef while the Mountain Region received less than 3 percent.

Beef Consumption by Region and State

For the purpose of offering an explanation for the existing beef market areas, data on beef consumption were compiled. The data indicates the amount of beef consumed by region and state and the amount of beef slaughtered in the same location. The results of this study are depicted in Table VI. Population figures for various states were obtained from the 1970 census and the total liveweight slaughtered came from Agricultural Statistics, 1971. By using the per capita consumption figure of 113.3 pounds the total amount of beef consumption was found.[7] So that the amount of meat available for consumption could be determined (based on carcass weight), the total liveweight slaughtered was multiplied by 61.5 percent.[8] The amount of beef consumed in each state was deducted

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[7]Herrill DeGraff, "Lower Price Is No Service If Meat Is Not Available To Be Purchased," The National Provisioner, April 15, 1972, p. 20.

[8]Beef Industry Council, A Steer's Not All Steak, (Chicago, Illinois: National Livestock and Meat Board.

TABLE V

DESTINATIONS OF FEDERALLY-INSPECTED KANSAS SLAUGHTER BEEF IN 1972
(Percentage of Interstate Volume)

Region and State	Percentage	Region and State	Percentage
New England	11.02	South Atlantic	17.60
Maine	1.12	Delaware	.05
New Hampshire	.68	Maryland	2.28
Vermont	.12	District of Columbia	.66
Massachusetts	6.70	Virginia	1.51
Rhode Island	.26	West Virginia	.01
Connecticut	2.14	North Carolina	5.43
		South Carolina	1.18
Middle Atlantic	26.43	Georgia	2.21
		Florida	4.27
New York	15.53		
New Jersey	7.91	East South Central	6.28
Pennsylvania	2.99		
		Kentucky	.83
East North Central	13.60	Tennessee	2.88
		Alabama	1.67
Ohio	3.22	Mississippi	.90
Indiana	1.24		
Illinois	4.31	West South Central	12.37
Michigan	3.56		
Wisconsin	1.27	Arkansas	.61
		Louisiana	2.21
West North Central	6.55	Oklahoma	2.67
		Texas	6.87
Minnesota	.33		
Iowa	.40	Mountain	1.50
Missouri	5.53		
North Dakota	----	Montana	----
South Dakota	----	Idaho	----
Nebraska	.29	Wyoming	----
		Colorado	.84
Pacific	4.67	New Mexico	.20
		Arizona	.22
Washington	----	Utah	.24
Oregon	.01	Nevada	----
California	4.66		
Alaska	----		
Hawaii	----		

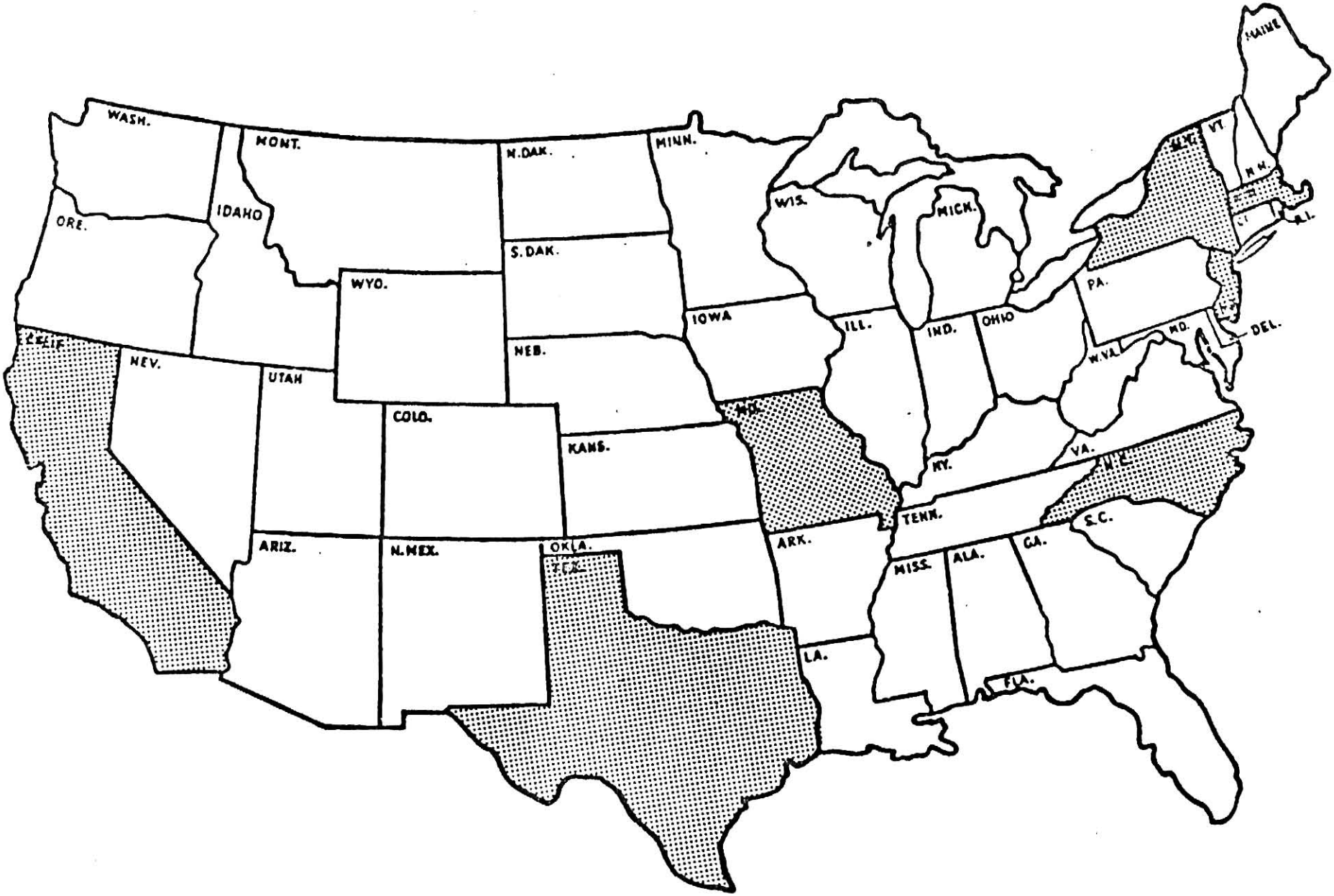

FIGURE 6. GEOGRAPHIC LOCATION OF SEVEN STATES RECEIVING 53 PERCENT OF KANSAS SLAUGHTERED BEEF IN 1972

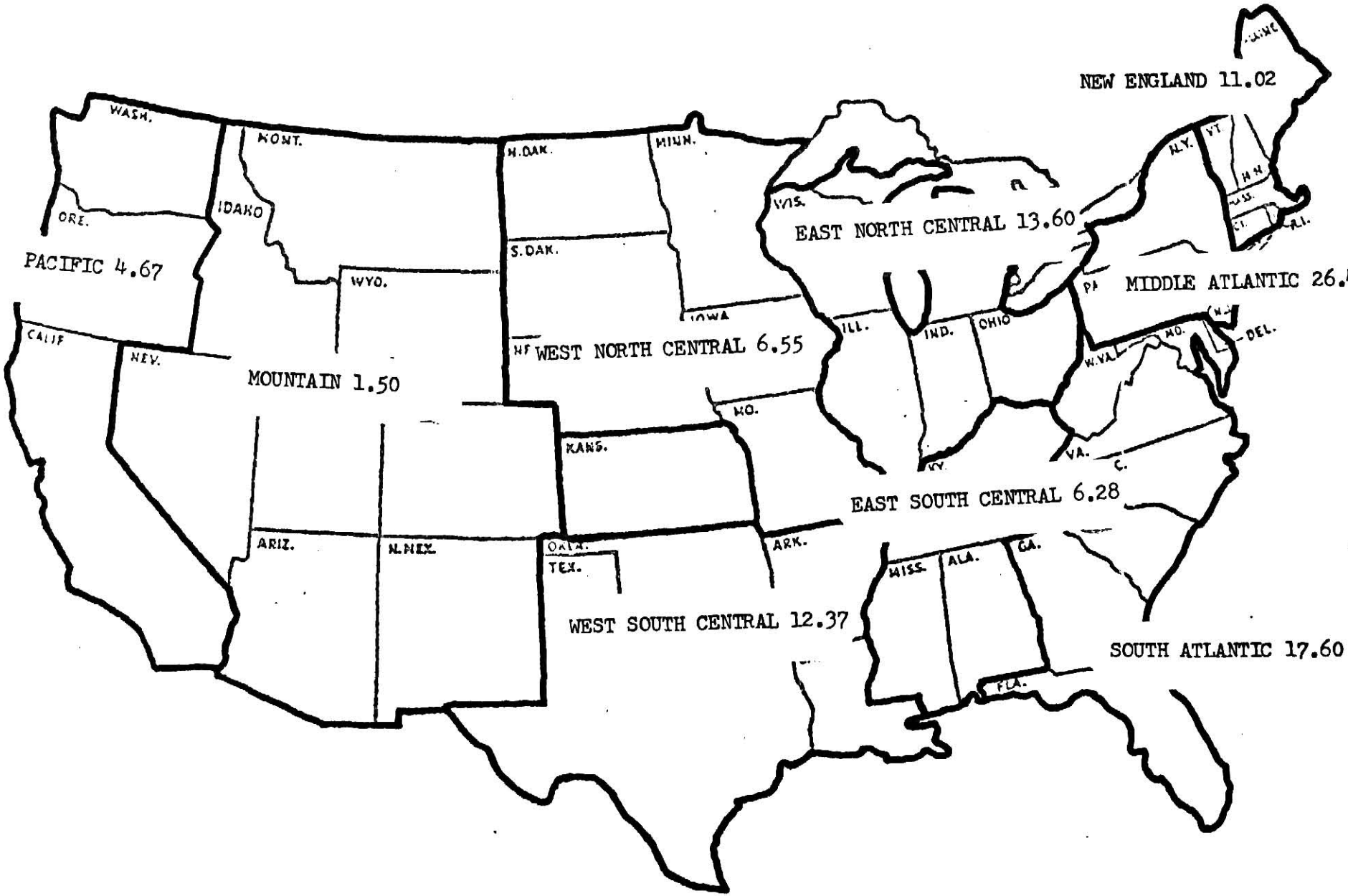

TABLE 7. GEOGRAPHIC DISTRIBUTION AND PERCENTAGE AMOUNT OF BEEF SHIPPED FROM KANSAS IN 1972 BY REGION

TABLE VI

BEEF CONSUMPTION AND PRODUCTION BY REGION AND STATE IN 1970

Region and State	Population 1970*	Total Slaughtered Liveweight#	Beef Consumption (113.3/capita)+	Carcass Weight**	Surplus or Deficit
			thousands of pounds		
New England	11,841,663	180,241	1,341,660	110,848	(1,230,812)
Maine	992,048		112,399		
New Hampshire	737,681		83,579		
Vermont	444,330		50,343		
Massachusetts	5,689,170		644,583		
Rhode Island	946,725		107,264		
Connecticut	3,031,709		343,493		
Middle Atlantic	37,199,040	1,641,777	4,214,651	1,009,693	(3,204,958)
New York	18,236,967	413,042	2,066,248	254,021	(1,812,227)
New Jersey	7,168,164	414,090	812,153	254,665	(557,488)
Pennsylvania	11,793,909	814,645	1,336,250	501,007	(835,243)
East North Central	40,252,476	5,049,409	4,560,606	3,117,687	(1,442,919)
Ohio	10,652,017	1,090,133	1,206,874	670,432	(536,442)
Indiana	5,193,669	594,119	588,443	365,383	(223,060)
Illinois	11,113,976	1,379,913	1,259,213	848,646	(410,567)
Michigan	8,875,083	709,474	1,005,547	436,327	(569,220)
Wisconsin	4,417,731	1,295,770	500,529	796,899	296,370
West North Central	16,319,187	15,423,995	1,848,964	9,485,756	7,636,792
Minnesota	3,804,971	1,801,466	431,103	1,107,902	676,799
Iowa	2,824,376	4,615,511	320,002	2,838,539	2,518,537
Missouri	4,676,501	1,302,169	529,848	800,834	270,986
North Dakota	617,761	212,532	69,992	130,707	60,715
South Dakota	665,507	702,420	75,402	431,988	356,586
Nebraska	1,483,493	4,650,389	168,080	2,859,989	2,691,909
Kansas	2,246,578	2,139,508	254,537	1,315,797	1,061,260

TABLE VI. (Continued)

Region and State	Population 1970*	Total Slaughtered Liveweight#	Beef Consumption (113.3/capita)+	Carcass Weight**	Surplus or Deficit
			thousands of pounds		
South Atlantic	30,671,337	1,173,340	3,475,062	721,605	(2,753,457)
Delaware	548,104	95,232	62,100	58,568	(447,940)
Maryland	3,922,399		444,408		
District of Columbia	756,510	------	85,713	------	(85,713)
Virginia	4,648,494	161,193	526,674	99,134	(427,540)
West Virginia	1,744,237	61,253	197,622	37,671	(159,951)
North Carolina	5,082,059	154,945	575,797	95,291	(480,506)
South Carolina	2,590,516	64,460	293,505	39,643	(253,862)
Georgia	4,589,575	259,309	519,999	159,475	(360,524)
Florida	6,789,443	376,948	769,244	231,823	(537,421)
East South Central	12,803,470	1,192,906	1,450,633	733,637	(716,996)
Kentucky	3,218,706	236,999	364,679	145,754	(218,925)
Tennessee	3,923,687	562,411	444,554	345,883	(98,671)
Alabama	3,444,165	131,993	390,224	81,176	(309,048)
Mississippi	2,216,912	261,503	251,176	160,824	(90,352)
West South Central	19,320,630	3,778,747	2,189,028	2,323,929	134,901
Arkansas	1,923,295	162,445	217,909	99,904	(118,005)
Louisiana	3,641,306	120,769	412,560	74,273	(338,287)
Oklahoma	2,559,299	620,160	289,969	381,398	91,429
Texas	11,196,730	2,875,373	1,268,590	1,768,354	499,764
Mountain	8,371,562	3,906,301	948,499	2,402,375	1,453,876
Montana	694,409	214,297	78,677	131,793	53,116
Idaho	712,567	407,706	80,734	250,739	170,005
Wyoming	332,416	31,012	37,663	19,072	(18,591)
Colorado	2,207,259	2,108,476	250,082	1,296,713	1,046,631
New Mexico	1,106,000	340,410	125,310	209,352	84,042
Arizona	1,770,900	511,710	200,643	314,702	114,059
Utah	1,059,273	268,914	120,016	165,382	45,366
Nevada	488,738	23,776	55,374	14,622	(40,752)

TABLE VI. (Continued)

Region and State	Population 1970*	Total Slaughtered Liveweight#	Beef Consumption (113.3/capita)+	Carcass Weight**	Surplus or Deficit
		thousands of pounds			
Pacific	26,522,631	3,925,226	3,005,014	2,414,014	(591,000)
Washington	3,409,169	578,338	386,259	355,678	(30,581)
Oregon	2,091,385	348,925	236,954	214,589	(22,365)
California	19,953,134	2,938,680	2,260,690	1,807,288	(453,402)
Alaska	300,382	-------	34,033	-------	(34,033)
Hawaii	768,561	59,283	87,078	36,458	(50,619)
U. S. Total	203,301,996	36,291,942	23,034,117	22,319,544	(714,573)

*Source: U. S. Bureau of Census, U. S. Census of Population: 1970, Number of Inhabitants, Final Report P C (1)-A1, United States Summary, (Washington, D. C.: Government Printing Office, December, 1971).

#Source: U. S. Department of Agriculture, Agricultural Statistics, 1971, (Washington, D. C.: Government Printing Office, 1971).

+Source: DeGraff, Herrill, "Lower Price Is No Service if Meat is Not Available to Be Purchased," The National Provisioner, April 15, 1972, pp. 16-32.

**Source: Calculated at 61.5% of animal liveweight. Beef Industry Council, A Steer's Not All Steak, (Chicago, Illinois: National Livestock and Meat Board).

from the amount produced in each state so that surplus or deficit consumption for each state and region could be found. These data only show consumption by permanent residents and do not include transitory population such as tourists and migrant workers. Table VI shows that all states east of the Mississippi River, except Wisconsin, did not produce enough beef to meet the consumer demand in 1970. The Middle Atlantic and South Atlantic Regions have imported most of the beef consumed. The Pacific Region was the only region west of the Mississippi River that showed a deficit beef consumption balance, and California constituted the majority of this deficit. The West North Central Region is by far the largest beef surplus balance region in the United States and is able to ship large quantities of beef to regions with deficit beef consumption balances. The Mountain Region and the West South Central Region also have surplus beef consumption balances, but are of a smaller magnitude than the West North Central Region. Even though the total beef consumption balance for the United States shows a deficit, it should be noted that the net imports for beef in 1970 was 1,753.5 million pounds.[9]

Table VII shows Kansas slaughtered beef as a percentage of total United States consumption. Over 5 percent of the beef consumed in all regions except the Pacific, Mountain, and East North Central Regions consist of Kansas federally inspected beef. This table also shows that Kansas supplies approximately 7 percent of the beef consumed in the United States.

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[9]U. S. Department of Agriculture, Livestock and Meat Situation, (Washington, D. C.: U. S. Government Printing Office, May, 1973), pp. 21-22.

TABLE VII

KANSAS FEDERALLY INSPECTED BEEF AS A PERCENTAGE
OF TOTAL UNITED STATES CONSUMPTION BY REGION
(in thousands of pounds)

Region	Total Consumption	Estimated Shipments From Kansas	Kansas Shipments as a Percent of Total Consumption
New England	1,341,660	152,109	11.34
Middle Atlantic	4,214,651	364,848	8.66
East North Central	4,560,606	187,681	4.12
West North Central	1,848,964	256,163	13.85
Pacific	3,005,014	64,394	2.14
South Atlantic	3,475,062	242,899	6.97
East South Central	1,450,633	86,677	5.96
West South Central	2,189,028	170,711	7.80
Mountain	948,499	20,664	2.18
Total	23,034,117	1,546,146	6.71

CHAPTER 5

COMPARATIVE ANALYSIS OF CURRENT RATE STRUCTURES

Mode of Transport

The mode of transportation used was obtained through interviews at packing plants. Information was obtained on a sample basis as explained in Chapter 3 from bills-of-lading or from invoices. Motor common carrier was the most frequent method of transport used and it accounted for over 75 percent of interstate shipments. Trucks, including packer-owned fleets, transported all intrastate shipments. TOFC rail service was used for approximately 20 percent of the interstate shipments. Refrigerated car movement was seldom used.

When TOFC service was used two different billing plans were employed:

Plan I -- The railroads transport the loaded trailer or semitrailers of motor carriers. Shipments move on a motor carrier bill of lading and are charged motor carrier rates. The railroad receives either a part of the rate or charges a flat rate per trailer.

Plan II -- The freight moves on railroad billing at railroad rates in trailers furnished by the railroad. The service includes picking up the loaded trailer at the point of shipment and delivering it to the consignee's place of business at the destination. A variation of Plan II is also used where the shipper and the consignee move the trailers to and from the railroad.

The role of backhaul on interstate shipments is hard to define since not all backhaul shipments return directly to truck origins. Since refrigerated trailers are not built to haul bulky items the backhaul is usually limited to fruits and vegetables from Southern Regions of the United States and California as reported by Kansas-based truckers in this study.

Cost Structure

For many classes of freight, railroads and motor carriers produce services that are competitive and very similar. The services are, however, produced under individual firm cost conditions that are quite different. Cost differences result in differences in rates and services provided. The ability to adjust rates in response to competitive pressure (or lack of) is also very different for one mode than for another. A brief review of basic cost differences will aid in understanding the patterns of rates developed by each type of carrier.

Railroad Cost Structure. The railroad companies can be very competitive in short-run pricing policies and the pricing of a particular service. The rail industry is characterized by having a large investment in long-lived facilities. These facilities include such items as track right-of-ways, terminals and rolling stock. For this reason railroads have a large amount of fixed costs, that is, during the life of the facilities the expenses of interest, depreciation, property tax and some types of maintenance do not vary with the amount of freight hauled. The railroad's usable life of equipment is considerably longer than its competitors. In addition railroads have large overhead expenses in the form of executive, administrative and clerical personnel that are not directly related to the amount of traffic. As much as two-thirds of the total cost may be

in the form of fixed costs; therefore, railroads have a cost structure that would normally give them a pricing advantage in the short run.[10]

Changes in the degree of competition and backhaul potentials have a definite effect on rates. Backhaul lowers line-haul expenses through added revenue on return trips, thus allowing for lower rates to points with high backhaul potentials. The effect on rates of reduced demand and for transport services occasioned by increased carrier competition can best be discussed by using a modified monopolistic competition pricing model for a given location and point in time. This is illustrated in Figures 8 and 9. By using the two-dimensional graph in Figure 8 and using basic economic theory (i.e., equilibrium is at a point on the demand curve directly above the intersection of the Marginal Revenue and Marginal Cost Curves, point B), one can determine the rate charged, P. Now assume a change in the demand has occurred through competition from another mode of transportation. The firm in Figure 8 is now faced with a price that is higher than his competitors, but he has the same level of costs as before. The firm can lower rates to the level of average variable costs and stay within a rational pricing framework. The change in demand and the lower rate are illustrated in Figure 9, where D' is the new demand curve and P' is the new rate. This rate covers variable costs (point B'), for the level of operation.

The Interstate Commerce Commission encourages rail carriers to maintain rail rates that are at or above Out-of-Pocket Costs, which is a cost concept different from short-run variable costs but does not include a fully distributed share of costs not variable with changes in traffic.

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[10]Roy J. Sampson and Martin T. Farris, Domestic Transportation Practice, Theory and Policy, (Boston: Houghton Mifflin Co., 1966), p. 46.

FIGURE 8

MARKET CONDITIONS PERMITTING RATES
ABOVE AVERAGE TOTAL COSTS

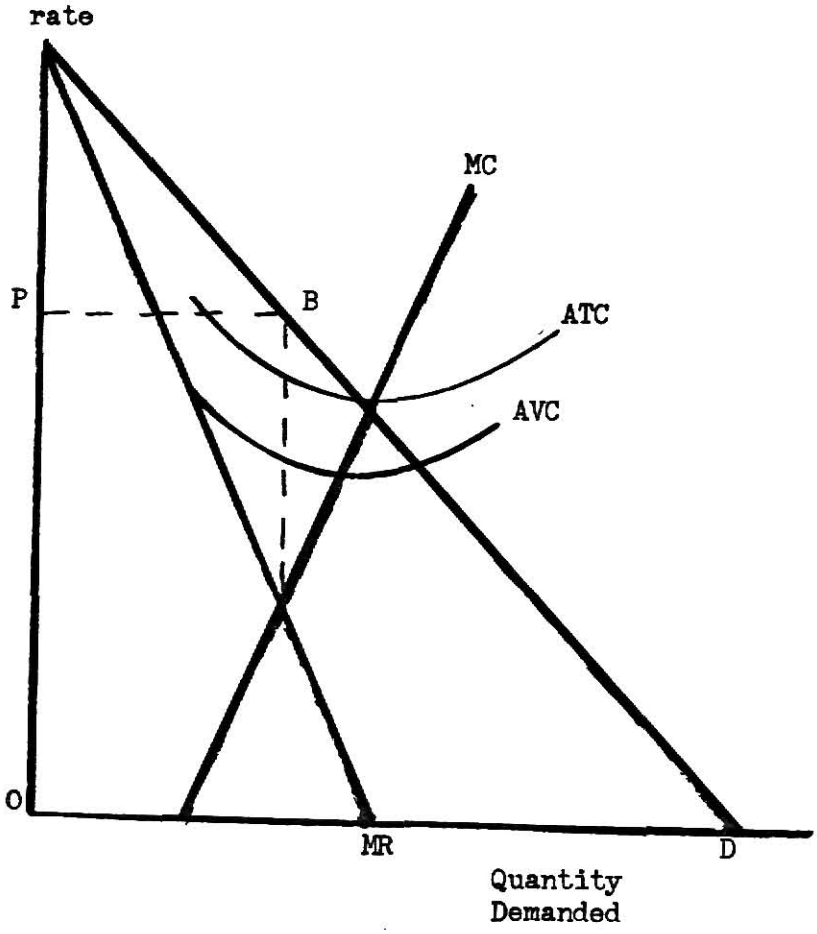
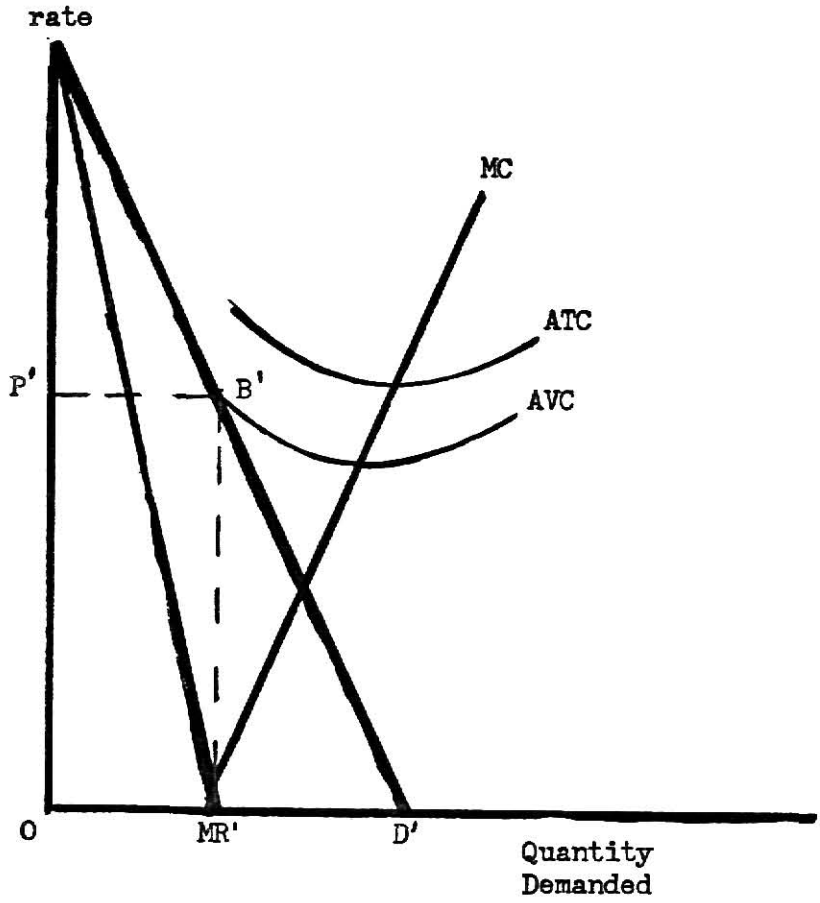


FIGURE 9

MARKET CONDITIONS PERMITTING RATES THAT COVER AVERAGE VARIABLE COSTS ONLY



The amount of revenue obtained by railroads in relationship to Out-of-Pocket Costs varies by commodities and by regions. The Revenue to Out-of-Pocket Cost ratio is used to show the amount of revenue that is collected over Out-of-Pocket Costs. The ratios for territorial movements for refrigerated rail cars hauling meat in 1966 are as follows: Western Territory to points in the Official Territory, 107; Western Territory to points in the Western Territory, 117; and Official Territory to points in the Official Territory, 109. The Average Revenue to Out-of-Pocket Cost Ratio for the United States was 112.

Railroad freight rates are usually designed to show the rate between a given origin and destination and are published in tariffs quoted in cents per hundredweight. These rates are further broken down into car load (CL) and less than car load (LCL) quantities, with the LCL rates being slightly higher for a given distance. Generally rail freight rates are lower than truck rates on large shipments on long hauls because the terminal and handling costs are lower; however, this may not always be true for short hauls.

Truck Cost Structure. The cost structure for trucking firms differs drastically from railroads. Whereas the railroads have a high fixed cost, truckers have a high variable cost. This can be explained by the fact that trucks use publicly-owned rights-of-way and have a smaller investment in terminal facilities and vehicles. The operating expenses for carriers hauling general commodities in the Middle West can be broken down in the following fashion: line-haul expenses are 43.7 cents per mile or .17 cents per hundredweight and terminal costs are 18.9 cents per hundredweight. The terminal costs consist of 15 cents per hundredweight for pick up and delivery, 3.5 cents per hundredweight for platform handling and .4 cent

per hundredweight for billing and collecting.[11] Carriers hauling meat have additional expenses in mechanical refrigeration and meat racks for suspended carcasses, both in the initial cost and in maintenance, thus adding to fixed and variable costs. A well-managed trucking firm can operate profitably with an operating ratio of 93.[12] On the other hand, railroads have financial difficulties if the operating ratio exceeds the low or middle 70's.[13]

Keeping the cost structure in mind one can see that trucking costs vary much more directly in relation to the volume of traffic than railroads. Also in the short run, rates cannot fall much below the total cost. Since the railroads have a larger cushion of fixed costs, they usually have a pricing advantage in many short-run competitive situations.

Trucking regulations for carriers hauling regulated commodities are generally comparable to railroad regulations. The trucking firms compete primarily with railroads for relatively high-rated traffic (i.e., high value in relation to weight and bulk), particularly for short hauls. The published rates are usually quoted in cents per hundredweight for truckloads (TL) and less-than-truckloads (LTL) quantities and in a similar manner as rail rates. Due to differing terminal and line-haul handling expenses, truck rates are generally lower for small shipments at short distances.

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[11]Interstate Commerce Commission, Cost of Transporting Freight by Class I and Class II Motor Common Carriers of General Commodities by Regions or Territories for the Year 1970, (Washington, D. C.: Government Printing Office, 1972).

[12]Percentage of operating income going for operating expenses.

[13]Roy J. Sampson and Martin T. Farris, Domestic Transportation Practice, Theory and Policy, (Boston: Houghton Mifflin Co., 1966), p. 46.

Rate Analysis

Rate structures were analyzed so that the competitive nature of Kansas packers in comparison to other major beef surplus states could be learned. Wichita was chosen for the point representing Kansas since it had the highest concentration of meat packers in its area. Nebraska and Iowa were chosen as alternative origins since they were the top two states in beef slaughter and are in the same general geographic location as Kansas. Omaha, Nebraska and Waterloo, Iowa were picked as the representative points of origin since both cities have a high density of packing house operation in their respective areas. The destinations chosen represent major population centers in the United States; Kansas beef is shipped to most of these destinations.

Northeastern Region. Destinations used to represent the Northeast Region are indicated along with rates per hundredweight and mileages in Tables VIII, IX and X. The Region is described as Northeast with reference to Wichita and, therefore, contains two points (Kansas City and St. Louis) that are not northeast from Omaha or Waterloo. Other destination points are generally northeast with reference to all three origins.

Table XI illustrates published minimum hundredweight rates from each origin to the selected destinations along with rate differences among origins to each destination. To only one destination in this list (Kansas City) does Wichita have a transportation rate advantage over Omaha and Waterloo origins. For some population centers, (Chicago and Springfield, Illinois, for example) rates from Wichita to destinations are more than two times the Waterloo-to-destination rates.

Transport rates increase with distance but often at a decreasing rate. Rate per ton-mile tends to decline with distance but also at a

TABLE VIII

MOTOR FREIGHT RATES FROM WICHITA, KANSAS TO THE NORTHEASTERN REGIONS AS OF DECEMBER 31, 1972*

Destinations	Miles	minimum weight 30,000	35,000
		cents per - - hundredweight - -	
Kansas City, MO	197	57	
St. Louis, MO	452		115
Springfield, IL	510		159
Indianapolis, IN	678	238	
Chicago, IL	698		146
Cincinnati, OH	784		172
Dayton, OH	785		181
Columbus, OH	849		196
Detroit, MI	946	227	
Cleveland, OH	974		228
Pittsburgh, PA	1035		245
Buffalo, NY	1159		245
Baltimore, MD	1242		262
Washington, D.C.	1244		262
Syracuse, NY	1306		269
Philadelphia, PA	1313		263
Trenton, NJ	1336		264
New York, NY	1397		264
Albany, NY	1437		277
Hartford, CT	1500		271
Springfield, MA	1518		271
Providence, RI	1561		277
Boston, MA	1595		271

*Source: Middlewest Motor Freight Bureau. Tariff No. 100-C, MF-I.C.C. No. 625.

Motor Carriers Tariff Association. Tariff No. 155-L, MF-I.C.C. No. 887.

TABLE IX

MOTOR FREIGHT RATES FROM WATERLOO, IOWA TO THE NORTHEASTERN REGIONS AS OF DECEMBER 31, 1972*

Destinations	Miles	minimum weight 30,000	34,000	35,000	38,000
		- - - - cents per hundredweight - - - -			
Chicago, IL	268			71	
Springfield, IL	295			69	
Kansas City, MO	307			73	
St. Louis, MO	354				91
Indianapolis, IN	450			109	
Detroit, MI	532			135	
Dayton, OH	536			121	
Cincinnati, OH	556			123	
Columbus, OH	572			125	
Cleveland, OH	601			131	
Pittsburgh, PA	718	156			
Buffalo, NY	786	172			
Syracuse, NY	933	203			
Baltimore, MD	934		194		
Washington, D.C.	936		194		
Philadelphia, PA	1005		223		
Trenton, NJ	1028		226		
Albany, NY	1064		223		
New York, NY	1077		223		
Springfield, MA	1145		228		
Hartford, CT	1161		226		
Providence, RI	1222		239		
Boston, MA	1226		236		

*Source: Middlewest Motor Freight Bureau. Tariff No. 100-C, MF-I.C.C. No. 625.

Motor Carriers Tariff Association. Tariff No. 155-L, MF-I.C.C. No. 887.

TABLE X

MOTOR FREIGHT RATES FROM OMAHA, NEBRASKA TO THE NORTHEASTERN REGIONS AS OF DECEMBER 31, 1972*

Destinations	Miles	minimum weight 30,000	35,000	38,000
		- - cents per hundredweight - - -		
Kansas City, MO	203	87		
Springfield, IL	410		118	
St. Louis, MO	454			100
Chicago, IL	462		98	
Indianapolis, IN	587	148		
Dayton, OH	690	172		
Cincinnati, OH	693	169		
Detroit, MI	722		174	
Columbus, OH	750	180		
Cleveland, OH	791		187	
Pittsburgh, PA	903		203	
Buffalo, NY	976		208	
Baltimore, MD	1121		223	
Washington, D.C.	1123		223	
Syracuse, NY	1123	206		
Philadelphia, PA	1192		223	
Trenton, NJ	1215		244	
New York, NY	1267	233		
Albany, NY	1254		223	
Hartford, CT	1351		233	
Springfield, MA	1335		239	
Providence, RI	1412		239	
Boston, MA	1416		239	

*Source: Middlewest Motor Freight Bureau. Tariff No. 100-C, MF-I.C.C. No. 625.

Motor Carriers Tariff Association. Tariff No. 155-L, MF-I.C.C. No. 887.

TABLE XI

MINIMUM TRUCKLOAD RATES* FROM WICHITA, OMAHA AND WATERLOO ORIGINS TO SELECTED NORTHEASTERN DESTINATIONS

TO	FROM** Wichita (1)	Omaha (2)	Waterloo (3)	Col. 1 Minus Col. 2 (4)	Col. 1 Minus Col. 3 (5)
	- - - - - - - cents per hundredweight - - - - - - -				
Kansas City	57	87	73	-30	-16
St. Louis	115	100	91	15	24
Springfield (Ill.)	159	118	69	41	90
Indianapolis	238	148	109	90	129
Chicago	146	98	71	48	75
Cincinnati	172	169	123	3	49
Dayton	181	172	121	9	60
Columbus	196	180	125	16	71
Detroit	227	174	135	53	92
Cleveland	228	187	131	41	97
Pittsburgh	245	203	156	42	89
Buffalo	245	208	172	37	73
Baltimore	262	223	194	39	68
Washington	262	223	194	39	68
Syracuse	269	206	203	63	66
Philadelphia	263	223	223	40	40
Trenton	264	244	226	20	38
New York	264	233	223	31	41
Albany	277	223	223	54	54
Hartford	271	233	226	38	50
Springfield (Mass.)	271	239	228	32	43
Providence	271	239	239	38	38
Boston	271	239	236	32	35

* Hundredweight rate for largest minimum weight load listed in the tariff. Minimum weight is not the same for all rates.

** Source of Rates: Middlewest Motor Freight Bureau, Tariff No. 100-C, MF-I.C.C. No. 625.

decreasing rate. Published truck rates for meat in Tables VIII, IX and X illustrate these tendencies, although the rate of decline in average ton-mile rate is not uniform among the three origins.

To analyze rate/distance relationships in truck rates and to illustrate differences among origins, regression analysis was applied to rates from each of three origins to Northeastern destinations. Both linear and quadratic regression equations were used with data from each origin.[14]

The quadratic equation in each case resulted in closer approximation of the rate/distance relationship than the linear relationship. From Wichita the correlation coefficient squared increased from 85.1 with linear form to 91.4 with quadratic; from Omaha, 92.5 to 95.6; and, from Waterloo, 98.3 to 98.9. All results were statistically significant at the 0.5 percent level.

Comparative coefficients for the quadratic regressions are as follow with standard error of each coefficient indicated in parenthesis:

For Wichita, $Y = -3.03 + \underset{(.0513)}{.332X_1} - \underset{(.0000259)}{.0000987X_1^2}$,

For Omaha, $Y = 16.5 + \underset{(.0359)}{.27X_1} - \underset{(.0000202)}{.000079X_1^2}$, and

For Waterloo, $Y = -3.207 + \underset{(.0273)}{.271X_1} - \underset{(.000018)}{.0000591X_1^2}$.

Rate/distance relationships plotted from the quadratic functions above are shown in Figure 10. Curvilinear relationships varying in shape among the three functions are clearly evident. The relative flatening of the curve for Wichita origins at distances greater than 1,000 miles reduces the rate differences between Wichita and other origins to more

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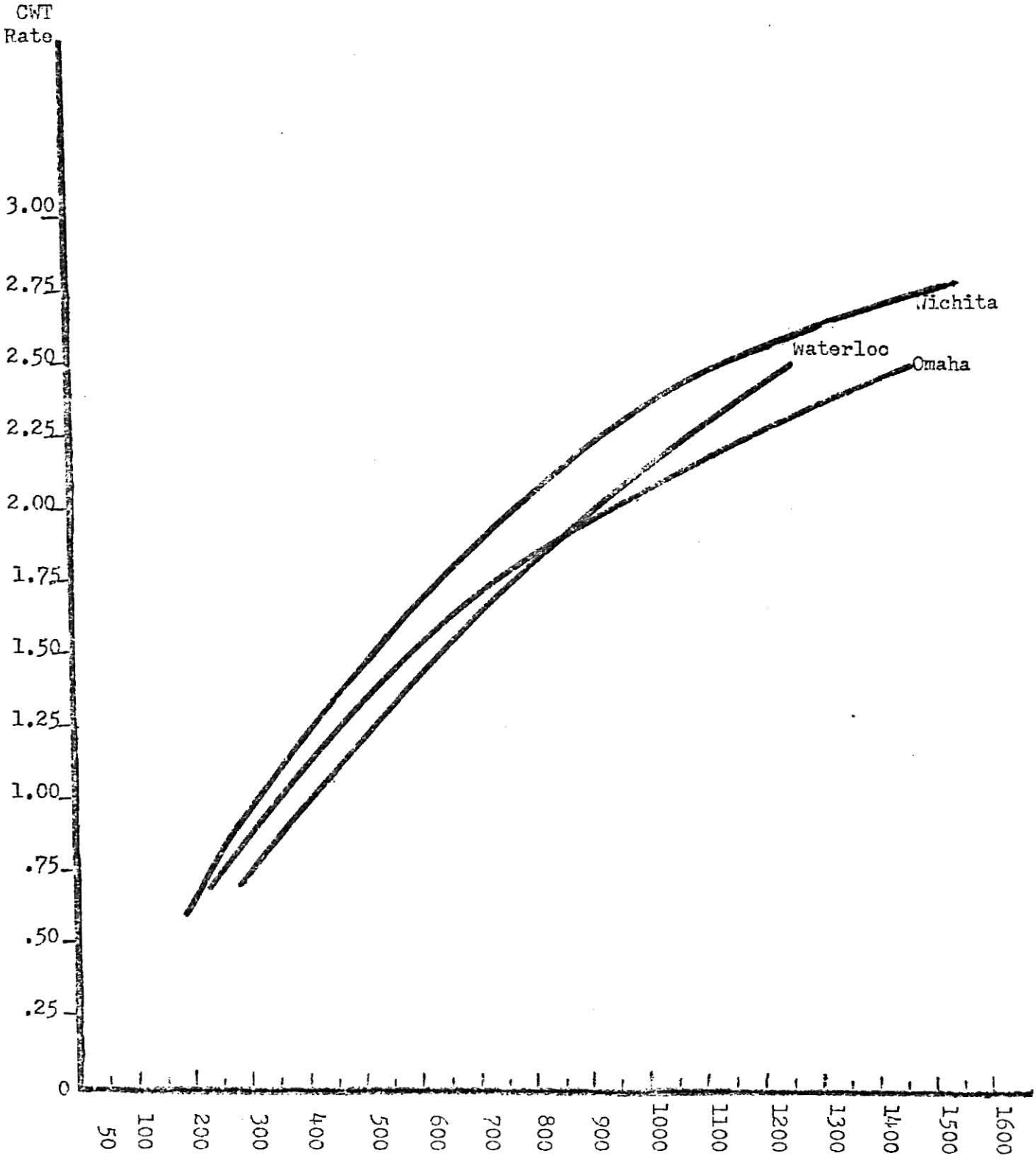
[14]Linear equations were of the form $Y = a + b_1x_1 + E$ and the quadratic: $Y = a + b_1x_1 + b_2x_1^2 + E$ where Y is rate in cents per hundredweight; x_1 is the distance in miles; and x_1^2 is the distance squared.

FIGURE 10

PLOTTED REGRESSION EQUATIONS FOR POINTS IN THE NORTHEASTERN REGIONS FROM WICHITA, KANSAS, OMAHA, NEBRASKA, AND WATERLOO, IOWA



distant Northeast points such as Trenton, New York City, Springfield (Mass.), Providence and Boston relative to middle-distance points such as Indianapolis, Chicago, Cleveland and Detroit.

Figure 10 also demonstrates the level at equal distances of rates from Wichita compared with rates from Omaha and Waterloo to the same destinations. The statistical function from data for Wichita origins lies above similar functions from Omaha and Waterloo indicating higher rates at equal distances throughout the range of distances illustrated.

South and Southeast Region. The destinations used to represent the South and Southeastern Regions are indicated in Tables XII, XIII and XIV, along with their respective mileage from the predetermined origins and per hundredweight freight rates. This region is depicted as lying to the South and Southeast of the three origins used in the analysis.

Table XV illustrates published minimum hundredweight freight rates from each origin to the selected destinations along with rate differences among these origins to each destination. The Table demonstrates that Wichita has a definite transportation advantage to destinations in Oklahoma, Arkansas and Texas. Also, Wichita has a freight advantage over Omaha and Waterloo to destinations in Florida, except Tampa where Waterloo has a 2 cent per hundredweight advantage. Waterloo tends to have a freight advantage to destinations in Tennessee, Georgia, Alabama, North Carolina and South Carolina over Wichita and Omaha.

When comparing the rate advantages of the three origins on a per ton-mile basis, Wichita consistently has a higher per ton-mile rate to the South and Southeastern Regions. The higher per ton-mile rate can be partially explained by the fact that this rate usually decreases with

TABLE XII

MOTOR FREIGHT RATES FROM WICHITA, KANSAS TO THE SOUTH AND SOUTHEASTERN REGIONS AS OF DECEMBER 31, 1972*

Destinations	Miles	minimum weight 28,000	30,000	35,000
		- - cents per hundredweight - -		
Oklahoma City, OK	158		65	
Dallas, TX	370			117
Little Rock, AR	452			113
Memphis, TN	534			129
Houston, TX	609		186	
Nashville, TN	699			160
Birmingham, AL	780			173
New Orleans, LA	825			173
Chattanooga, TN	834			171
Montgomery, AL	865			178
Knoxville, TN	874			182
Mobile, AL	893			187
Atlanta, GA	902			187
Tallahassee, FL	1069			207
Charlotte, NC	1100			223
Charleston, SC	1205			235
Jacksonville, FL	1207			222
Tampa, FL	1311			241
West Palm Beach, FL	1467			252
Miami, FL	1532			257

*Source: Middle West Motor Freight Bureau. Tariff No. 100-C, MF-I.C.C. No. 625.

Motor Carriers Tariff Association. Tariff No. 155-L, MF-I.C.C. No. 887.

TABLE XIII

MOTOR FREIGHT RATES FROM WATERLOO, IOWA TO THE SOUTH AND SOUTHEASTERN REGIONS AS OF DECEMBER 31, 1972*

Destinations	Miles	minimum weight 28,000	30,000	35,000
		- - cents per hundredweight - -		
Memphis, TN	639			147
Little Rock, AR	646			164
Nashville, TN	647			141
Oklahoma City, OK	655			173
Chattanooga, TN	782			160
Dallas, TX	797	251		
Knoxville, TN	805			162
Birmingham, AL	823			166
Atlanta, GA	900			173
Montgomery, AL	917			174
Mobile, AL	987			184
Charlotte, NC	1006			213
New Orleans, LA	1030			190
Houston, TX	1036	283		
Tallahassee, FL	1121			211
Charleston, SC	1160			224
Jacksonville, FL	1213			226
Tampa, FL	1355			239
West Palm Beach, FL	1494			255
Miami, FL	1562			264

*Source: Middle West Motor Freight Bureau. Tariff No. 100-C MF-I.C.C. No. 625.

Motor Carriers Tariff Association. Tariff No. 155-L, MF-I.C.C. No. 887.

TABLE XIV

MOTOR FREIGHT RATES FROM OMAHA, NEBRASKA TO THE SOUTH AND SOUTHEASTERN REGIONS AS OF DECEMBER 31, 1972*

Destinations	Miles	minimum weight 28,000	30,000	35,000
		- - cents per hundredweight - -		
Oklahoma City, OK	453		140	
Little Rock, AR	595	195		
Dallas, TX	648	222		
Memphis, TN	658			145
Nashville, TN	752			154
Houston, TX	887	257		
Chattanooga, TN	887			173
Birmingham, AL	904			172
Knoxville, TN	926			178
Montgomery, AL	989			178
Atlanta, GA	1005			184
New Orleans, LA	1013			182
Mobile, AL	1022			187
Charlotte, NC	1135			227
Tallahassee, FL	1193			218
Charleston, SC	1281			239
Jacksonville, FL	1318			233
Tampa, FL	1435			247
West Palm Beach, FL	1591			264
Miami, FL	1656			270

*Source: Middle West Motor Freight Bureau. Tariff No. 100-C, MF-I.C.C. No. 625.

Motor Carriers Tariff Association. Tariff No. 155-L, MF-I.C.C. No. 887.

TABLE XV

MINIMUM TRUCKLOAD RATES* FROM WICHITA, OMAHA AND WATERLOO ORIGINS TO SELECTED SOUTH AND SOUTHEASTERN DESTINATIONS

TO	FROM** Wichita (1)	Omaha (2)	Waterloo (3)	Col. 1 Minus Col. 2 (4)	Col. 1 Minus Col. 3 (5)
	cents per hundredweight				
Oklahoma City	65	140	173	-75	-108
Dallas	117	222	251	-103	-134
Little Rock	113	195	164	-82	-51
Memphis	129	145	147	-16	-18
Houston	186	257	283	-71	-97
Nashville	160	154	141	6	19
Birmingham	173	172	166	1	7
New Orleans	173	182	190	-9	-17
Chattanooga	171	173	160	-2	11
Montgomery	178	178	174	0	4
Knoxville	182	178	162	4	20
Mobile	187	187	184	0	3
Atlanta	187	184	173	3	14
Tallahassee	207	218	211	-11	-4
Charlotte	223	227	213	-4	10
Charleston	235	239	224	-4	11
Jacksonville	222	233	226	-11	-4
Tampa	241	247	239	-6	2
West Palm Beach	252	264	255	-12	-3
Miami	257	270	264	-13	-7

* Hundredweight rate for largest minimum weight load listed in the tariff. Minimum weight is not the same for all rates.

** Source of Rates: Middlewest Motor Freight Bureau, Tariff No. 100-C, MF-I.C.C. No. 625.

distance traveled and Wichita is relatively closer to the destinations used in the analysis.

So that the rate/distance relationships could be further analyzed regression analysis was applied to destinations in the South and Southeastern Regions. Both linear and quadratic regression equations were used.[15]

The quadratic equation in two of the cases demonstrated a closer approximation of the rate/distance relationship than the linear equation. In the third case (Omaha) the linear regression approach depicted the best rate/distance approximation. From Wichita the correlation coefficient squared increased from 94.1 with the linear equation approach to 95.5 with the quadratic equation but the level of significance dropped from .5 percent to 2.5 percent; and from Waterloo the correlation coefficient squared increased from 58.7 to 59.3, the level of significance also decreased from .5 percent to 15 percent. When the quadratic equation approach was applied to Omaha an infeasible solution was reached so only the linear equation was used and its correlation coefficient squared was .59 with a significance level of .5 percent.

Comparative coefficients for the regression equations are as follow, with standard error of each coefficient indicated in parenthesis:

$$\text{For Wichita, } Y = 39.66 + \underset{(.0299)}{.20099X_1} - \underset{(.0000166)}{.0000381X_1^2},$$

$$\text{For Waterloo, } Y = 31.81 + \underset{(.2071)}{.2282X_1} - \underset{(.000101)}{.000054 1X_1^2}, \text{ and}$$

$$\text{For Omaha, } Y = 107.08 + \underset{(.0186)}{.0945X_1}.$$

Figures 11, 12 and 13 show the same information as in Tables XII, XIII and XIV. The per hundredweight freight rates were plotted from each

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[15]The same equations used in the analysis of the destination in the Northeastern Regions of the United States were used in this analysis.

FIGURE 11

PLOTTED RATES FROM WICHITA, KANSAS TO THE SOUTH AND SOUTHEASTERN REGIONS AS OF DECEMBER 31, 1972

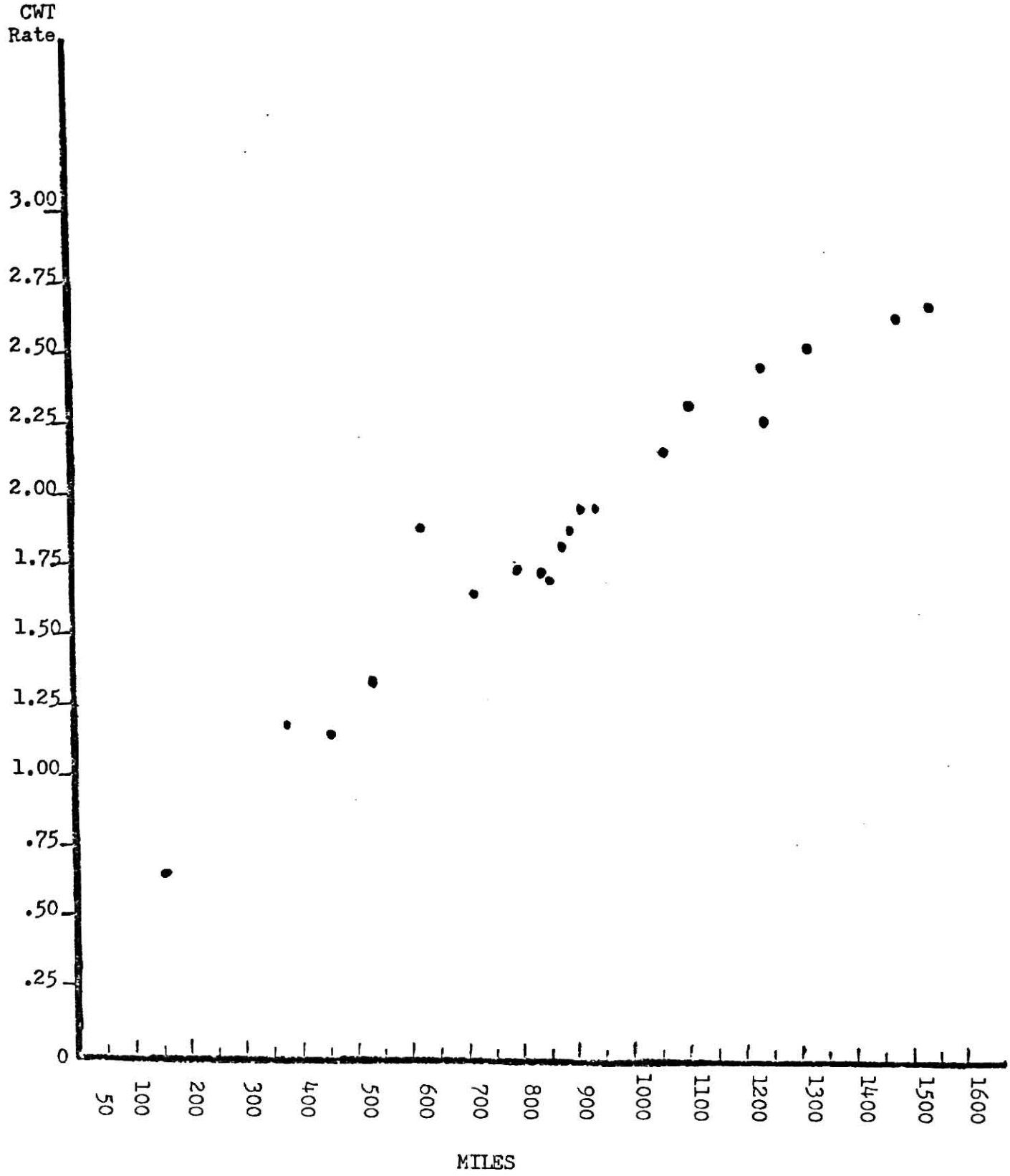


FIGURE 12

PLOTTED RATES FROM WATERLOO, IOWA TO THE SOUTH AND SOUTHEASTERN REGIONS AS OF DECEMBER 31, 1972

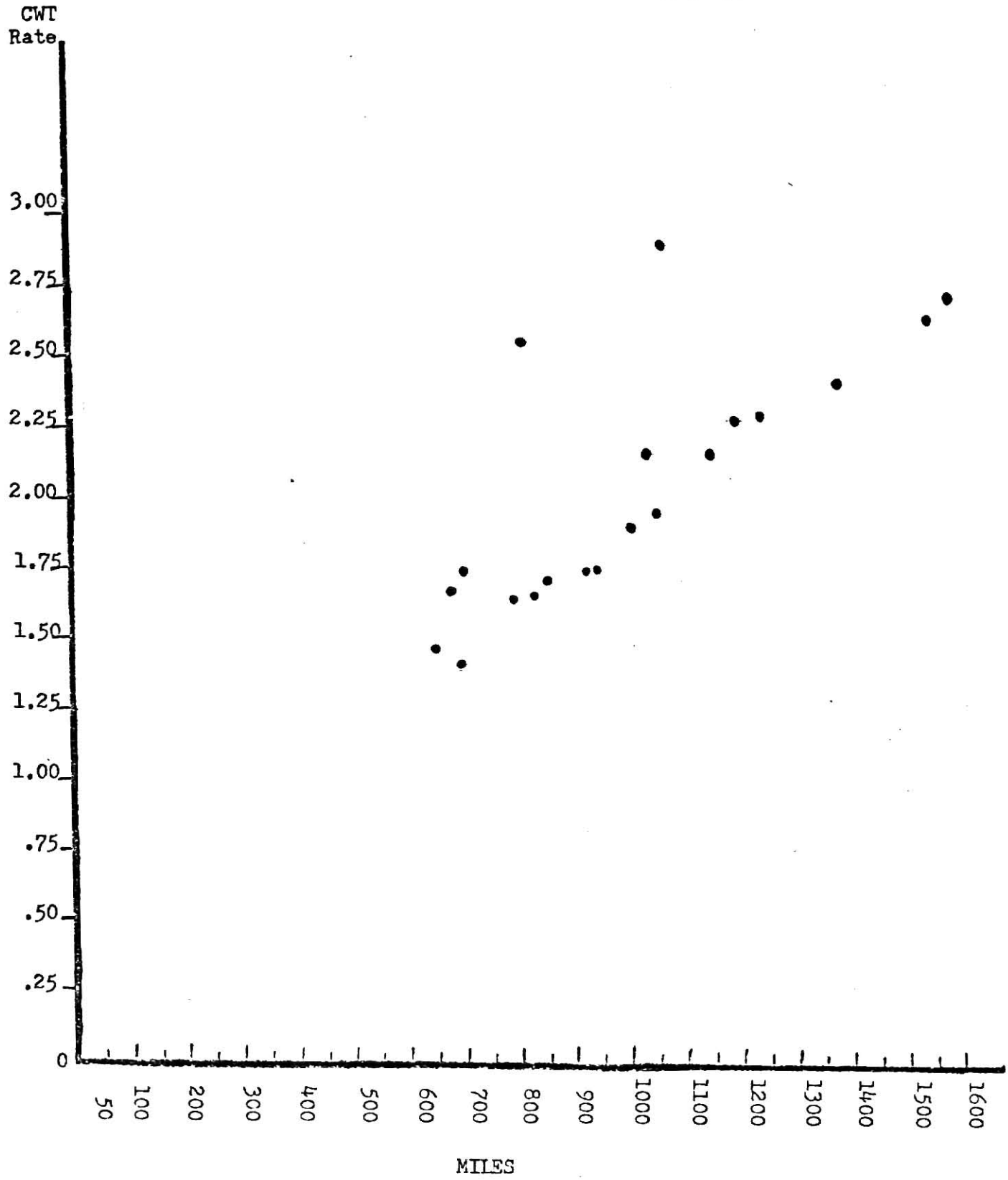
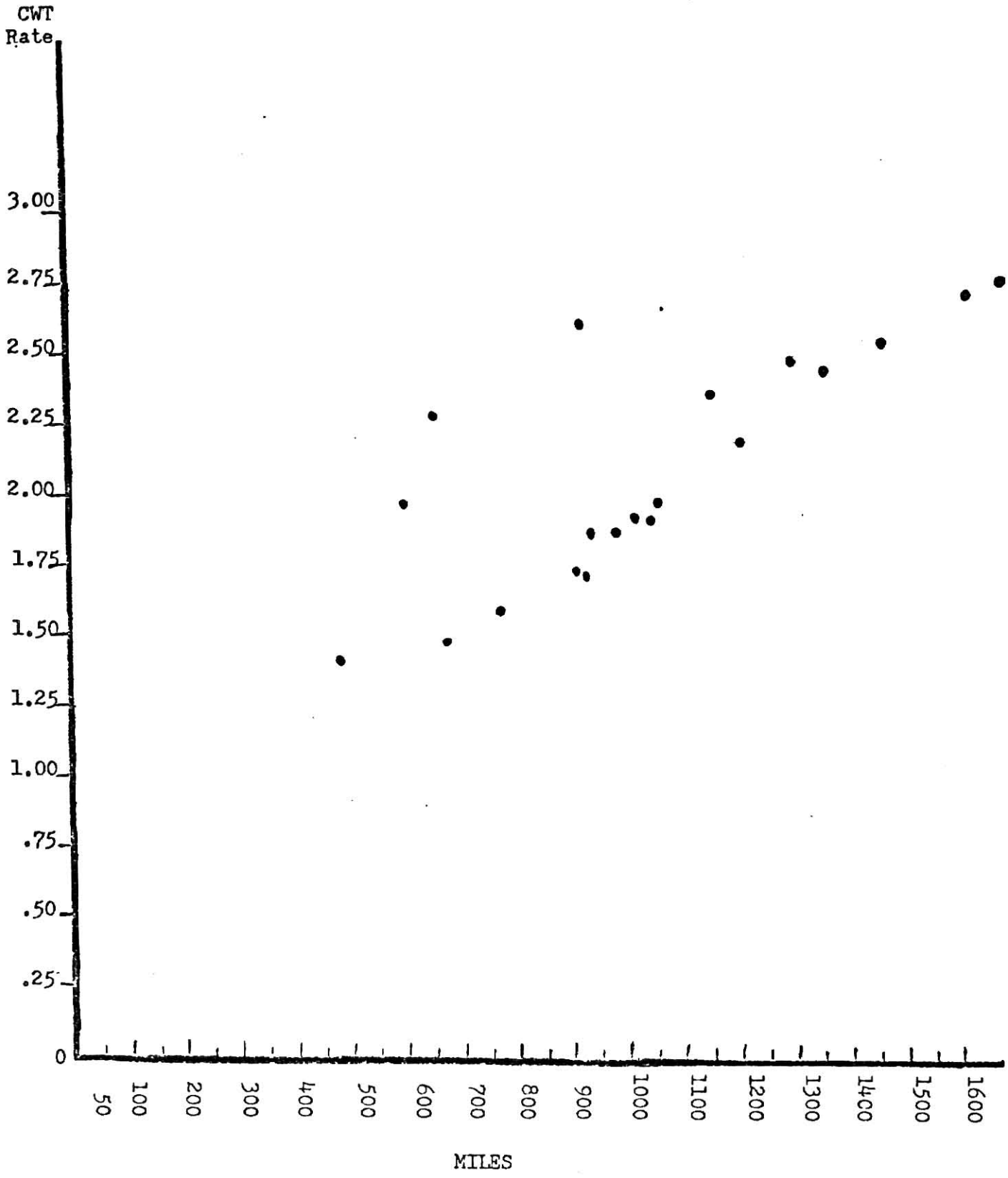


FIGURE 13

PLOTTED RATES FROM OMAHA, NEBRASKA TO THE SOUTH AND SOUTHEASTERN REGIONS AS OF DECEMBER 31, 1972



origin so that one can readily see why regression analyses were not as accurate at approximating rate/distance relationships. These figures clearly show that freight rates from Waterloo and Omaha do not follow a definite trend in Oklahoma, Arkansas, and Texas as in the remaining states used in the analysis. On the other hand Wichita follows a definite trend (i.e., increasing at a decreasing rate).

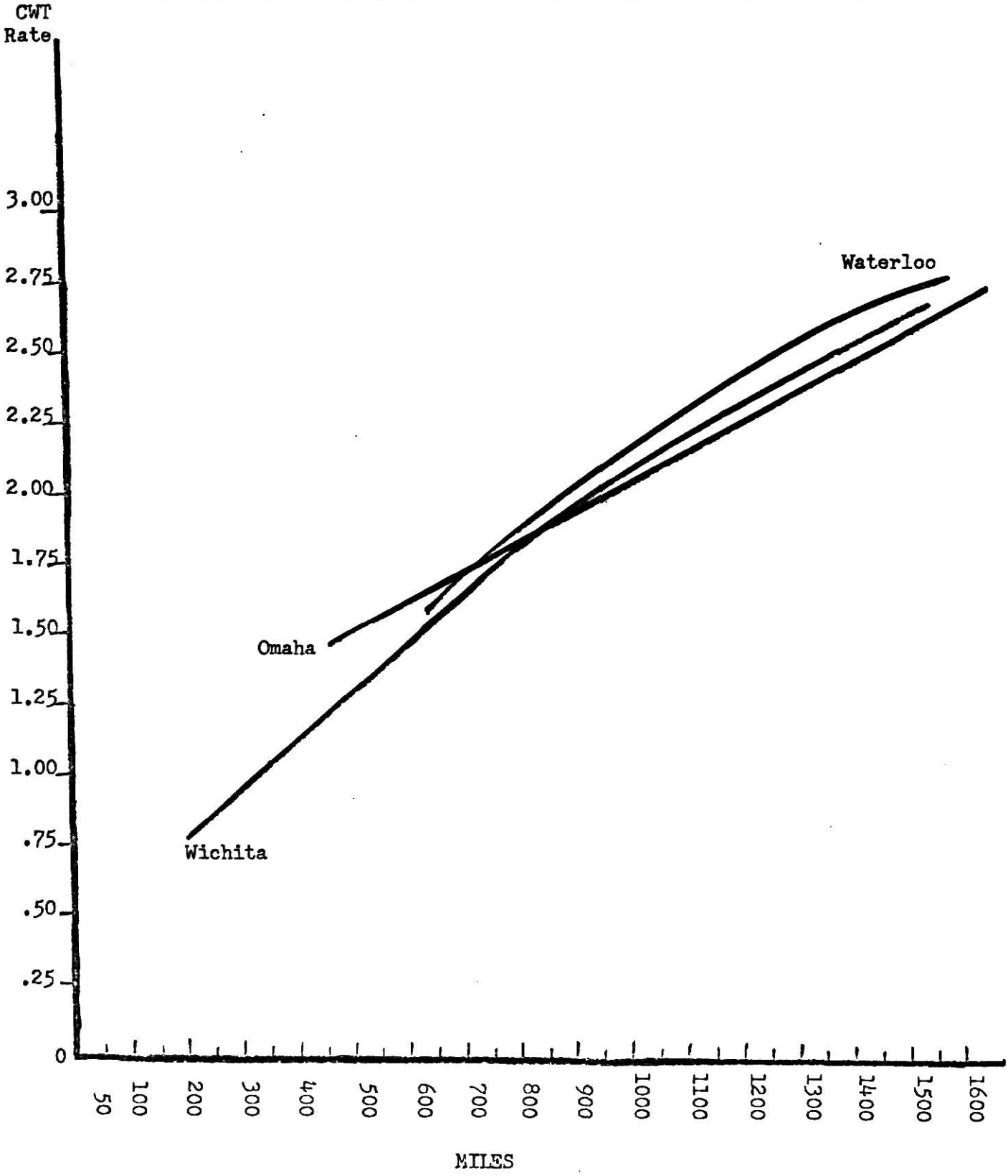
Rate/distance relationships plotted from the above regression equations are shown in Figure 14. The curvilinear relationships depict Wichita and Waterloo, while the linear expression illustrates Omaha's rate/distance relationship.

It should be noted that the plotted regression functions in Figure 14 are not as accurate as the plotted regression functions in Figure 10 due to lower significance levels of the variables and the poor fit of the variables to their respective regression lines. Although Waterloo tends to have an absolute freight rate advantage to intermediate points in the Southeast due to closer geographic location to these areas, the plotted regression function shows that the rate structure from Waterloo is relatively higher than the other origins at points of equal distance. As pointed out earlier, Wichita had higher per ton-mile costs to the selected destinations, but when measured upon distance, Wichita shows a more favorable rate structure.

Western Region. The current freight rates for meat and packing house products were structured in such a manner that regression analysis was not required. All rates were set up in a zone system (i.e., destinations of similar locations as well as origins of similar locations are placed into groups and rates in the zone apply to all points within the group). Chronological development of these rates provides some insight

FIGURE 14

PLOTTED REGRESSION EQUATIONS FOR POINTS IN THE SOUTH AND SOUTHEAST REGIONS FROM WICHITA, KANSAS, OMAHA, NEBRASKA, AND WATERLOO, IOWA



into the reason for a structure that is different from east-bound or south-bound rates.

In the years preceding 1958 the rate structure was reported to be highly disorganized and favored plants in the older and more established terminal areas in the Midwest. In an attempt to standardize and organize rate structures for Midwest shippers, the Cudahy Packing Company at Omaha, Nebraska set up a mileage scale that applied to Midwestern firms shipping to the West. This scale known as the "Cudahy Scale" also established lower rates to the West. The reason behind this was that private carriers were taking away the business of common carriers and this scale would allow the common carriers to be more competitive. The Rocky Mountain Motor Tariff Bureau then used this scale in their tariffs. After these rates were published several concerns on the West Coast protested these rates on the basis that they would be harmful to West Coast packers and showed preference to the Midwest Packers. When the case was put before the Interstate Commerce Commission in 1960 the rates were found lawful after a 3 percent increase on all proposed rates were approved.[16]

In 1962 the Midwest shippers applied for further rate reduction based on the "Cudahy Scale" so that the motor common carriers could compete against TOFC rail rates and private carriers. Again the West Coast packers protested the rate reduction. When the case was presented before the Interstate Commerce Commission in 1963, the Midwest shippers were allowed the rate decrease.[17]

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[16] Meats and Packing House Products From Midwest to Coast, 309 I.C.C. 551 (1960).

[17] Meats and Packing House Products From Central and Western States to Far Western States, 319 I.C.C. 667 (1963).

The current motor common carrier rate structure is set up in such a manner that it follows the rail rate patterns (i.e., one rate applies to large zones, as opposed to point-to-point freight rates used in the Eastern Regions of the United States). Tables XVI, XVII and XVIII depict the rates from Wichita, Waterloo and Omaha to destinations in the Western Regions of the United States. These Tables readily illustrate the zone rate characteristics for the West. Wichita has a 9-cent absolute advantage over Omaha and Waterloo to destinations in the Southwestern Region of the United States but when these rates are considered on a per ton-mile basis Wichita has a higher per ton-mile rate.

Per hundredweight rates to destinations in Oregon and Washington from Wichita show a 9-cent absolute advantage over Waterloo and are equal to the rates of Omaha, but the per ton-mile rates from Wichita are lower than the two comparison origins.

The characteristics of the transportation rates to the Western Regions show that zone rates are less likely to be influenced by carrier costs as is the case for rates to destinations east of Kansas. With this in mind one can see that Wichita is placed at a rate disadvantage to destinations in the Southwest since carrier costs should be lower than the comparison origins because of its closer geographic location to the Southwest.

Figures 15 and 16 depict the different rate structures faced by Kansas shippers. These Figures best illustrate the zone rates to the West and how they differ from point-to-point rates to the East. Figure 15 shows the plotted regression equation and actual rates to the Northeastern Regions while Figure 16 shows the same for the Southeastern Regions. These figures clearly demonstrate the effect of zone rates to destinations relatively close to the shipping origins. The initial destination to the Southwest (731 miles) has a freight rate that is slightly over a dollar

TABLE XVI

MOTOR FREIGHT RATES FROM WICHITA, KANSAS, TO POINTS IN THE WESTERN REGION OF THE UNITED STATES AS OF DECEMBER 31, 1972*

(Rates in Cents Per Hundredweight)

From Wichita To:	Miles	30M#	33M	35M
Gallup NM	731		287	264
Flagstaff AZ	919		287	264
Tucson AZ	998		287	264
Phoenix AZ	1028		287	264
Las Vegas NV	1184		299	264
Yuma AZ	1203		287	264
San Diego CA	1377		299	264
Los Angeles CA	1397		299	264
Reno NV	1512		299	264
Fresno CA	1536		299	264
Sacramento CA	1644		299	264
San Francisco CA	1716		299	264
Denver CO	509	131		118
Salt Lake City	1005	339		282
Pocatello ID	1111	---	---	---
Twin Falls ID	1215	---	---	---
Helena MT	1239	---	---	---
Boise ID	1344	---	---	---
Spokane WA	1562	---	---	---
Pendleton OR	1569	333		277
Portland OR	1776	333		277
Salem OR	1794	333		277
Seattle WA	1845	333		277

* Source: Rocky Mountain Motor Tariff Bureau, Inc., Tariff No. 261, MF-I.C.C. No. 212.

Minimum rate in thousands of pounds.

TABLE XVII

MOTOR FREIGHT RATES FROM WATERLOO, IOWA, TO POINTS IN THE WESTERN REGION OF THE UNITED STATES AS OF DECEMBER 31, 1972*

(Rates in Cents Per Hundredweight)

From Waterloo To:	Miles	30M#	33M	35M
Gallup NM	1227		314	273
Flagstaff AZ	1413		314	273
Tucson AZ	1494		314	273
Phoenix AZ	1524		314	273
Las Vegas NV	1608		326	273
Yuma AZ	1699		314	273
Reno NV	1724		326	273
Sacramento CA	1860		326	273
San Diego CA	1873		326	273
Los Angeles CA	1890		326	273
San Francisco CA	1950		326	273
Fresno CA	2001		326	273
Denver CO	783	195		
Helena MT	1181	329		287
Salt Lake City	1195	---	---	---
Pocatello ID	1231	345		287
Twin Falls ID	1053	345		287
Boise ID	1454	345		287
Spokane WA	1504	329		287
Pendleton OR	1657	345		287
Seattle WA	1787	345		287
Portland OR	1850	345		287
Salem OR	1896	345		287

* Source: Rocky Mountain Motor Tariff Bureau, Inc., Tariff No. 261, MF-I.C.C. No. 212.

Minimum rate in thousands of pounds.

TABLE XVIII

MOTOR FREIGHT RATES FROM OMAHA, NEBRASKA, TO POINTS IN THE WESTERN REGION OF THE UNITED STATES AS OF DECEMBER 31, 1972*

(Rates in Cents Per Hundredweight)

From Omaha To:	Miles	30M#	33M	35M	38M
Gallup NM	999		297		273
Flagstaff AZ	1170		297		273
Tucson AZ	1266		297		273
Phoenix AZ	1296		297		273
Las Vegas NV	1365		308		273
Yuma AZ	1471		297		273
Reno NV	1481		308		273
Sacramento CA	1617		308		273
San Diego CA	1645		308		273
Los Angeles CA	1647		308		273
San Francisco CA	1707		308		273
Fresno CA	1758		308		273
Denver CO	540	97		87	
Salt Lake City	942		308		
Pocatello ID	1025	303			277
Helena MT	1055	317			277
Twin Falls ID	1129	303			277
Boise ID	1258	303			277
Spokane WA	1378	333			277
Pendleton OR	1483	333			277
Seattle WA	1661	333			277
Portland OR	1690	333			277
Salem OR	1708	333			277

* Source: Rocky Mountain Motor Tariff Bureau, Inc., Tariff No. 261, MF-I.C.C. No. 212.

Minimum rate in thousands of pounds.

FIGURE 15

ACTUAL RATES, PLOTTED REGRESSION EQUATION FOR POINTS IN THE NORTHEASTERN REGIONS, AND ZONE RATES FOR POINTS IN THE SOUTHWESTERN AND NORTHWESTERN REGIONS FROM WICHITA, KANSAS

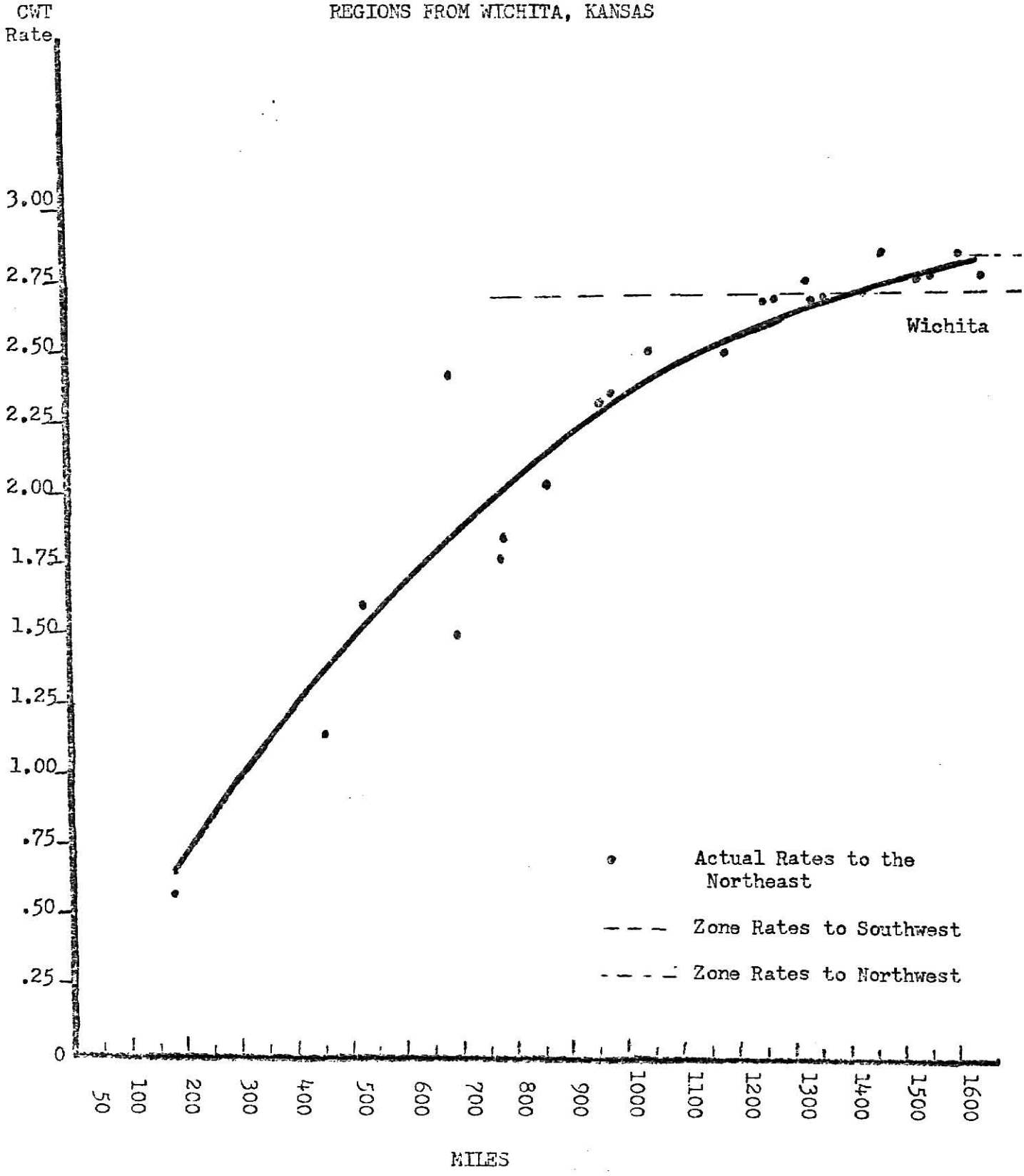
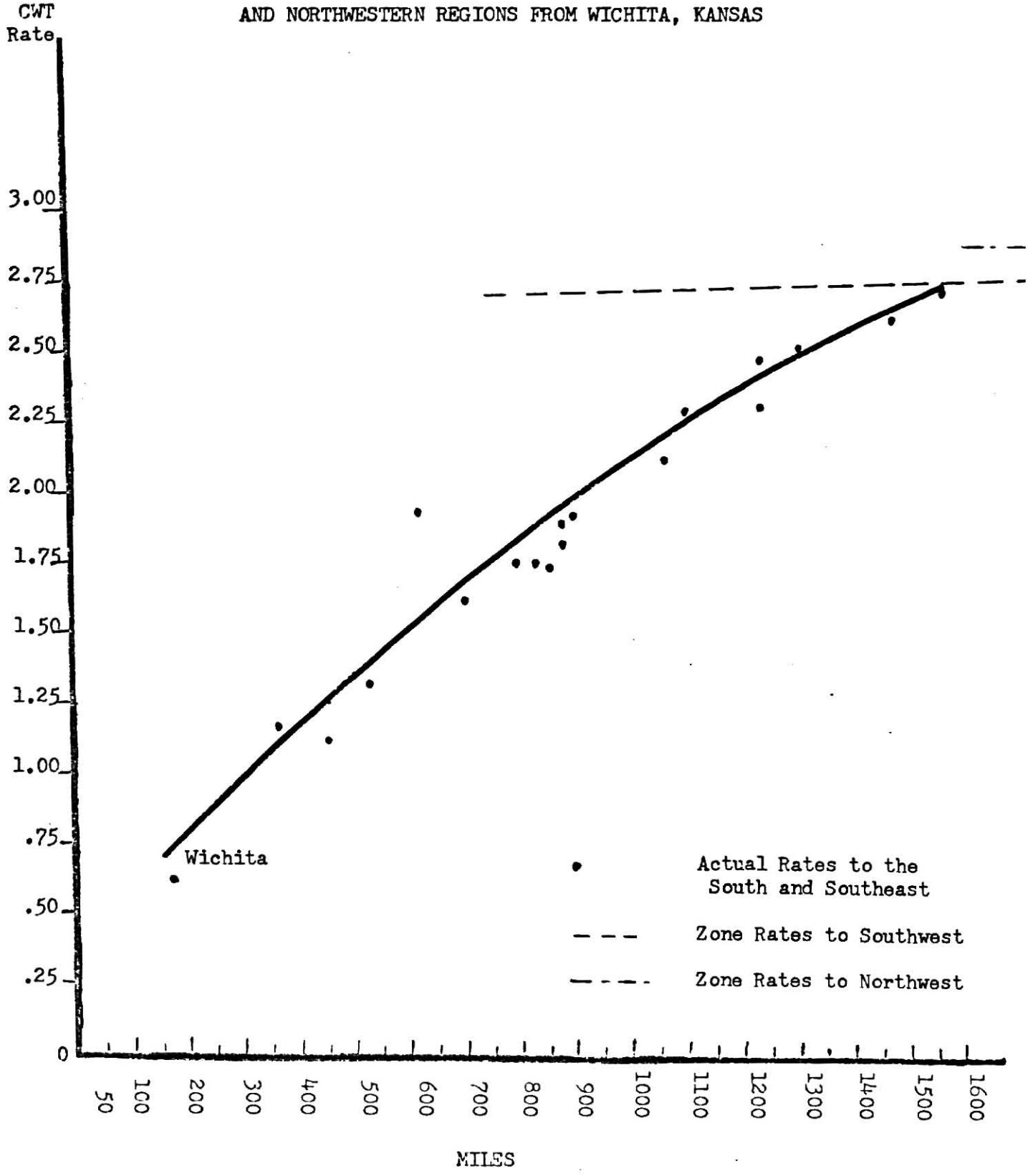


FIGURE 16

ACTUAL RATES, PLOTTED REGRESSION EQUATION FOR POINTS IN THE SOUTH AND SOUTHEASTERN REGIONS AND ZONE RATES FOR POINTS IN THE SOUTHWESTERN AND NORTHWESTERN REGIONS FROM WICHITA, KANSAS



higher than destinations at the same approximate distance in the East. At approximately 1,500 miles the zone rate structure tends to equal the rates for the same distances to the Southeastern Regions as illustrated in Figure 16, while Figure 15 shows the two opposing rate schedules tend to equalize at approximately 1,200 miles. The zone rate structure for the Northwest cannot easily be compared to point-to-point rate schedules since the distance to Northwest destinations is greater than the distance traveled in the East.

Rates of Alternative Modes of Transportation

Table XIX shows rates to various shipping points representing market areas in the United States from Wichita. The purpose of the Table is to depict the differences in rates of the alternative modes of transportation. Rail car rates over eight hundred miles to points East of Kansas have a tendency to be more competitive with truck rates. Rail rates to the West Coast are substantially above TOFC and truck rates.

TOFC rail service has the competitive advantage to both the East and West Coasts. Rates are between 35 cents per hundredweight to 59 cents per hundredweight lower than existing truck rates to the East Coast and 32 cents lower on the West Coast, but packers using TOFC rail service indicated that handling and transfer charges from the dock to final destination were not included in this rate. These charges were usually a minimum of 10 cents per hundredweight over the rate charged.

Even though TOFC rail service has the competitive advantage to the coastal regions, motor common carriers haul more meat to these regions because TOFC rail service is less flexible and usually takes twenty-four hours longer to arrive at the final destination. When TOFC rail service is used by the packers the predominant destination is the New York metropolitan area.

TABLE XIX

FREIGHT RATES IN CENTS PER HUNDREDWEIGHT FROM WICHITA, KANSAS TO DESTINATIONS BY ALTERNATIVE MODES OF TRANSPORTATION
(Truck Rates as of December 31, 1972 and Rail Car and TOFC Rates as of June 30, 1973)

Destination	Truck Rates* Minimum Size Load				Trailer on Flat Car#		Rail Rate+ Minimum Size Load						
	30,000	35,000	38,000	40,000	Rate	Minimum	21,000	23,000	30,000	35,000	45,000	55,000	excess
St. Louis MO		115							132				
Chicago IL		146					189						
Detroit MI	227							262	208	192	179		over 45M 104
Cleveland OH		228						268	213	198	184	168	over 75M 110
Buffalo NY		245						297	237	219	203		over 45M 121
Baltimore MD		262			203	$780.50		331	264	243	226		over 45M 136
New York NY		264			223	$826.00		354	283	262	243	236	over 75M 137
Boston MA		271			236	$710.50		371	295	271	254		over 45M 152
Little Rock AR		113							$528/Car				over 35M 48
Nashville TN		160					170		148		126		
Montgomery AL		178					207		176		150		
Charlotte NC		223					279		202		173		
Tampa FL		241					262		246		208		
Miami FL		257					280		247		210		
Amarillo TX		103							$445/Car				over 38M 38
Albuquerque NM				130					$685/Car				over 38M 66
Phoenix AZ			264				369						
San Diego CA			264		232	76M	428						
Los Angeles CA			264		232	76M	428						
San Francisco CA			264		232	76M	418						

*Source: Rocky Mountain Motor Tariff Bureau, Inc. Tariff No. 261, MF-I.C.C. No. 212.

#Rock Island Railroad, Rate Division, Wichita, Kansas.

+Acme Traffic Service, Inc., Kansas City, Missouri.

Problems Inherent to Slaughtering Operations in the Procurement of Transportation

The present system of distribution has many inadequacies in the transport of packing house products. One of the major problems faced by packers is being unable to obtain vehicles when needed; this problem is especially acute during peak periods of production. Also common carriers are hard to obtain for short-hauls. Poor rail service further amplifies the problem.

Even though the railroads have been trying to meet competition with motor carriers by use of TOFC service, the equipment used is old and deteriorated and slower than common carrier truckers. Most Kansas packers indicated that shipping time was usually 24 to 30 hours longer for coastal hauls when they used TOFC service. Also the use of TOFC is only practical at major rail heads and does not meet the needed flexibility of modern slaughter house operations.[18]

Some slaughter house operations have been forced to fill in the transportation gap with a private fleet of refrigerated trucks. Most packers felt they could compete with common carriers on short-haul movements, but were at a definite disadvantage on longer hauls. When the packers used their own truck fleets, the backhaul was practically nonexistent since most deliveries are to small cities and towns that have little production and need for freight hauling.

Other problems associated with red meat transport, but less serious are: (1) some carriers operate under temporary authority and cannot be relied upon for continued use; and (2) the failure of the producer to utilize an existing carrier since the packer may not always have the

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[18]There are two advantages to piggy-back service due to the slow transit time: (1) it allows paper to get to the bank so that the ability to order, notify, and ship is increased; (2) the trailers are used for temporary warehouses.

quantity of a particular grade and yield needed to fill an order. If this is the case then the packer may have to ship less than a full load and reschedule the remainder of the order, thus increasing transport costs.

CHAPTER 6

SUMMARY AND CONCLUSIONS

Kansas ranks fifth in the nation in the production of beef. Research in the area of transportation is needed to help maintain growth in this vital industry. At present little work has been completed in total traffic patterns of meat packing industry. Also the recent growth of commercial feeding operations has placed added pressure on the beef packers to provide greater channels of distribution for the meat produced.

Presently the livestock industry has located in feedgrain surplus areas so that cost of transport of animal feed is minimized. Present transportation rate structures make it more economical for meat processors to ship finished products to the market areas than shipping livestock greater distances, thus the meat processors have a tendency to locate in areas where livestock is fed for slaughter.

Objectives of this study were to define existing market areas for Kansas beef and determine the volume of beef shipped to these locations. Once the market areas were found, the mode of transport was determined and the freight cost of packers was also determined. Existing freight rates were analyzed to determine the competitive position of Kansas packers with other West North Central Region packers as affected by transport rates.

The principal source of information was from personal interviews with packing plant personnel throughout the State. The data collected primarily represented interstate shipments of dressed beef. Only federally

inspected plants were interviewed since only these plants can ship meat outside of the State. In 1972 federally inspected slaughtering plants produced 95 percent of the Kansas commercially-slaughtered beef.

To estimate market locations and amounts of beef shipped by Kansas packers, a statistical sample of shipments from each plant was obtained. Shipping records for the 1972 calendar year were sampled. Data were obtained from eleven firms that slaughtered 77.5 percent of all Kansas federally inspected beef. The sampling technique used consisted of 20 percent of all shipments for every seventh shipping day, based on a six-day shipping week. Using this method 45 of 307 shipping days in 1972 were sampled in this study. The sample days were 14.7 percent of the annual shipping days. On an annual basis the sample was 2.3 percent of all truck, TOFC rail, and rail carload shipments. When the total amount of beef estimated in the survey was compared with the amount derived from secondary sources, less than a 5 percent error was found in the estimated amount, thus showing that the sample was a good indication of actual beef movements.

The results of the survey indicated that 1.46 billion pounds of beef were processed by Kansas federally inspected firms. Of this quantity, 1.38 billion pounds of beef were shipped through interstate channels. Seventy-five percent of all interstate shipments of beef went to points east of the Mississippi River and 55 percent of this quantity went to Eastern Seaboard States. A further breakdown of the geographic regions and the percentage amount of Kansas exported beef are as follows: Middle Atlantic, 26.43 percent; South Atlantic, 17.60 percent; East North Central, 13.60 percent; West South Central, 12.37 percent; New England, 11.02 percent; West North Central, 6.55 percent; East South Atlantic, 6.28 percent; Pacific, 4.67 percent; and Mountain, 1.50 percent.

Using secondary data, statistics were compiled showing the amount of surplus or deficit beef consumption by state and region. This Table was based on population and the amount of beef slaughtered in each state. A surplus area indicated that the area slaughtered more beef than was locally consumed, whereas a deficit area had to import beef for consumers. The West North Central, West South Central and Mountain Regions are the only surplus regions. All other regions were deficit by varying amounts. The Middle Atlantic Region has the largest deficit whereas the West North Central Region produces approximately 7.5 billion pounds of surplus beef.

Motor common carrier was the most frequent method of transport used and it accounted for over 75 percent of interstate shipments and all intrastate shipments. TOFC rail service was used for approximately 20 percent of the interstate shipments and refrigerated rail car movement accounted for the remaining 5 percent.

Since refrigerated trailers are not built to haul bulky items, backhaul is usually restricted to carrying produce and commodities. This type of backhaul for Kansas shipment origins is usually limited to Southern and Southeastern destinations.

Existing rate structures were analyzed so that the transportation influence on competitive positions of Kansas packers might be indicated. Wichita was chosen as a representative origin for Kansas and was compared with Omaha, Nebraska and Waterloo, Iowa. Nebraska and Iowa were used because these states are two major beef slaughtering states in the United States and they are in the same geographic region as Kansas. The destination used in the analysis represented major population centers in all regions of the United States.

Regression analysis was used to determine how much of the freight rate was based on mileage. The following variables were used in the analysis: Y, cost per hundredweight; X_1, distance; X_1^2, distance squared. In all cases, except one, a quadratic function expressed the best fit.

When regression analysis was used on points in the Northeastern Regions, the equation explained over 90 percent of the variation from all three origins. Multiple correlation coefficients squared ranged from .914 to .989. In all curvilinear functions the independent variables were significant at .5 percent level and the F-statistic was significant at the 1 percent level. The regression equation showed that approximately 27 cents per hundredweight per hundred miles to 33 cents per hundredweight per hundred miles is built into the rate structure. The functions show that both Omaha, Nebraska and Waterloo, Iowa have lower line-haul costs to Northeastern destinations than Wichita, Kansas, but rates from these origins increase slightly more rapidly with distance, hence, rate disadvantage for Kansas origins decreases at longer distances. The regression function from Wichita shows that rate increases taper off more rapidly with distance especially after 1,000 miles.

When points in the South and Southeastern Regions were used in the regression function less of the rate variations were explained by distance. The multiple correlation coefficient squared for the equation depicting points from Wichita was .955 with the significance level at 2.5 percent. The multiple correlation coefficient squared for the function expressing Waterloo's rates was .593 and had a significance level of 15 percent. A curvilinear function did not show a feasible rate/distance relationship for rates from Omaha so a linear regression model was used. It showed that the multiple correlation coefficient squared was .59 and

the independent variable was significant at the .5 percent level. When the equations for the South and Southeastern Regions were compared to the equations for the Northeastern Regions, levels of rates were lower for the South and Southeastern Regions. The line-haul costs were between 20 cents per hundredweight per hundred miles and 23 cents per hundredweight per hundred miles which is lower than the line-haul costs for the Northeastern Regions.

The zone rate structure to the Western Regions of the United States did not lend itself well to regression analysis. Chronological development of these rates provide some insight into the reason for their structuring. In the years preceding 1958, the rate structure was highly disorganized and favored established terminal areas in the Midwest. The Cudahy Packing Company set up a mileage scale in an attempt to standardize and organize rate structures for Midwest shippers. This scale also established lower rates to the West Coast so that the motor common carriers would be more competitive with private carriers. In 1962 Midwest shippers received further rate reductions so that they could compete with TOFC rail services. The current motor common carrier rate structure is set up in such a manner that it follows rail rate patterns (i.e., one rate applies to large zones as opposed to point-to-point freight rates used in the Eastern Regions of the United States).

When comparing freight rates for alternative modes of transportation to points depicting market areas in the United States, refrigerated rail car rates over 800 miles to points east of Kansas are lower than truck rates. Rail car rates to the West are substantially higher than truck rates. TOFC rail service rates are the lowest at both coastal regions, but these rates do not reflect unloading and transfer charges which are

usually a minimum of 10 cents per hundredweight. When TOFC rail service is used by the packers the predominant destination is the New York metropolitan area.

This study found that due to the existing rate structure of motor common carriers, Kansas shippers had a tendency to be more competitive at East Coast markets, especially the Northeast, than intermediate market areas when compared with Iowa and Nebraska. All three states face the same rate structure for points in the Western Regions, thus Kansas shippers are placed at a rate disadvantage since carrier costs should be lower due to a closer geographic location to most destinations in the West.

SELECTED BIBLIOGRAPHY

Beef Industry Council. A Steer's Not All Steak. Chicago, Illinois: National Livestock and Meat Board.

Been, Richard Olof. "A Reconstruction of the Classical Theory of Location." Unpublished Ph.D. dissertation, University of California, Berkeley, 1965.

Daggett, Stuart. Principles of Inland Transportation. 4th ed. New York: Harper Brothers Publishers, 1955.

DeGraff, Herrill. "Lower Price is No Service if Meat is Not Available to be Purchased," The National Provisioner, April 15, 1972.

Household Goods Carriers' Bureau. Household Goods Carriers' Bureau, Mileage Guide, No. 9. Washington, D.C.: 1967.

Interstate Commerce Commission. Cost of Transporting Freight by Class I and Class II Motor Common Carriers of General Commodities by Regions or Territories for the Year 1970. Washington, D.C.: Government Printing Office, 1972.

Interstate Commerce Commission. Interstate Commerce Commission Reports. Vol. 309, Washington, D.C.: Government Printing Office, 1961.

Interstate Commerce Commission. Interstate Commerce Commission Reports. Vol. 319, Washington, D.C.: Government Printing Office, 1966.

Isard, Walter. Location and Space-Economy. New York: The Technology Press of MIT, and John Wiley and Son Inc., 1956.

Kansas Crop and Livestock Reporting Service. "Livestock Slaughter," Topeka, Kansas: Kansas Department of Agriculture, 1951-1973.

Kearney, A. T. Company. Study of the Feasibility of a Physical Distribution System for Use in Evaluating Improvements in the Cattle and Fresh Beef Industry. Transportation and Facilities Research Division, Agricultural Research Service, United States Department of Agriculture, Washington, D.C.: Government Printing Office, 1971.

Locklin, Philip D. Economics of Transportation. 7th ed. Homewood, Illinois: Richard D. Irwin, Inc., 1972.

McCoy, John H. Livestock and Meat Marketing. Westport, Connecticut: The AVI Publishing Company, Inc., 1972.

McPherson, W. F., and Witt, H. G. "Feed and Livestock Transport Cost Relationship." Transportation Journal. Vol. 8, No. 4 (Fall, 1968).

Midwest Motor Freight Bureau. Local, Joint, Proportional, Export and Import, Also Distance Commodity Rates on Meats and Packing House Products. Tariff No. 100-C, MF-I.C.C. No. 625. Kansas City, Missouri: 1971.

Motor Carriers Tariff Association. Joint and Local Commodity Rates Applying on Fresh Meats and Packing House Products. Tariff No. 155-L, MF-I.C.C. No. 887. Greensboro, North Carolina: 1972.

National Commission on Food Marketing. Organization and Competition in the Livestock and Meat Industry. Technical Study No. 1, Washington, D. C.: Government Printing Office, 1966.

Richardson, Harry W. Regional Economics. New York: Praeger Publishers, 1969.

Rocky Mountain Motor Tariff Bureau, Inc. Local and Joint Commodity Rates, Also Distance Commodity Rates on Interstate and Foreign Commerce. Tariff No. 261, MF-I.C.C. No. 212. Denver, Colorado: 1972.

Rocky Mountain Motor Tariff Bureau, Inc. Rules, Points of Service, Individual Carriers' Exceptions to General Provisions of Tariffs, Governed by This Tariff. Tariff No. 101, MF-I.C.C. No. 211. Denver, Colorado: 1972.

Sampson, Roy J., and Farris, Martin T. Domestic Transportation Practice, Theory and Policy. Boston: Houghton Mifflin Co., 1966.

Sorenson, Orlo, and Gillaspie, Richard L. Cattle Trucking Rates by Kansas Carriers. Agricultural Experiment Station, Kansas State University, Research Paper 9, 1972.

Thompson, W. H. Transportation of Livestock and Meats From Iowa. Iowa State University Department of Industrial Administration Special Report No. 60, April, 1969.

U. S. Bureau of Census. U. S. Census of Population: 1970, Number of Inhabitants, Final Report P C (1)-A1, United States Summary. Washington, D. C.: Government Printing Office, December, 1971.

U. S. Department of Agriculture. Agricultural Statistics, 1971. Washington, D. C.: Government Printing Office, 1971.

U. S. Department of Agriculture. Livestock and Meat Situation, May, 1973. Washington, D. C.: Government Printing Office, 1973.

APPENDIX

KANSAS STATE UNIVERSITY
Department of Economics

Meat Transportation Survey 1972

1. Name of Firm
   Location
   Type of Operation

2. Sample amount in pounds of meat shipped in 1972 (origin to destination).

Month	Destinations	Amount	Cost of Transport	Rate per Shipment	Mode of Transport	Type of meat Shipped*
January 3						
11						
19						
27						
February 4						
12						
21						
29						
March 8						
16						
24						
April 1						
10						
18						
26						
May 4						
12						
20						
29						

* i.e., boxed, carcass, primal cuts or edible by-products.

Month	Destinations	Amount	Cost of Transport	Rate per Shipment	Mode of Transport	Type of meat Shipped*
June 6						
14						
22						
30						
July 8						
17						
25						
August 2						
10						
18						
26						
September 4						
12						
20						
28						
October 6						
14						
23						
31						
November 8						
16						
24						

Month	Destinations	Amount	Cost of Transport	Rate per Shipment	Mode of Transport	Type of meat Shipped*
December 2						
11						
19						
27						

AN ANALYSIS OF FLOW PATTERNS AND TRANSPORTATION FOR BEEF FROM KANSAS FEDERALLY INSPECTED PLANTS IN 1972

by

STEVEN GEORGE BITTEL

B. A., Fort Hays Kansas State College, 1969

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Agricultural Economics
Department of Economics

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1974

In 1972 Kansas ranked fifth in the Nation in the slaughter of beef. Little is known about the transportation networks faced by Kansas packers in national distribution of meat. The objectives of this study were to define the existing market areas for Kansas beef and determine the volume of beef shipped to these markets. The modes of transport and the shipping costs of packers were also determined. The existing freight rates were analyzed to determine the competitive position of Kansas packers with other West North Central Region packers.

The principal source of information on distribution patterns was personal interviews with management and traffic personnel from eleven federally inspected packing plants. These plants slaughtered 77.5 percent of the federally inspected beef slaughtered in Kansas in 1972. A 20 percent sample was taken of all shipments on every seventh shipping day based on a six-day shipping week. On an annual basis the sample was 2.3 percent of all shipments from Kansas federally inspected slaughtering plants and 3.0 percent from plants participating in the study.

The results of the survey indicated that 1.46 billion pounds of beef were processed by Kansas federally inspected firms and of this quantity 1.38 billion pounds of beef were exported from the State. Seventy-five percent of all interstate shipments were East of the Mississippi River and less than 5 percent of the beef went to the West Coast.

Motor common carrier was the most frequent method of transport used and it accounted for 75 percent of all interstate traffic. TOFC rail service was used in approximately 20 percent of the interstate shipments while refrigerated rail car made up the remaining 5 percent.

Regression analyses were used to analyze the existing rate structures so that the competitive position of Kansas packers would be determined.

Wichita was chosen as a representative origin for Kansas and was compared to Omaha, Nebraska and Waterloo, Iowa. The destinations used in the analysis represented major population centers in all regions of the United States. A quadratic equation was used to express this rate/distance relationship.

Distance explained over 90 percent of the truck rate variation for selected Northeastern destinations from each of the three origins. Analysis showed line-haul costs of 27 to 33 cents per hundredweight per 100 pounds with variation occurring among different lengths of haul and among origins. Line-haul charges from Wichita were high relative to other origins but rate of increase tapered off more rapidly at greater distances than for other origins. Wichita has less of a transportation rate disadvantage at greater distances for shipments to the Northeast than for intermediate distances.

When points to the South and Southeastern Region were used in regression analysis, distance explained 95 percent of rate variation from Wichita but only 59 percent of variation from Omaha and Waterloo. Rates from Omaha and Waterloo to points South of Kansas were higher relative to distance (and because of greater distances) than from Wichita. Wichita has a slight absolute advantage in transport rate to Southeastern destinations but a much smaller advantage than Waterloo and Omaha in Northeastern markets.

Regulated truck rate structure on movements to the West reflect a zone system with equal rates from origin to several destinations at unequal distances. Wichita rates to grouped Southwestern destinations were below rates for shipments to the same destinations from Omaha and Waterloo. To Northwestern destinations, Wichita rates are the same as Omaha and below Waterloo.

Refrigerated rail car rates were lower than truck rates at distances greater than 800 miles to points east of Kansas but substantially higher to points West of Kansas. TOFC rail service rates were the lowest for both coastal regions.