

UNIVERSITY OF MISSOURI

COLLEGE OF AGRICULTURE

AGRICULTURAL EXPERIMENT STATION

RESEARCH BULLETIN 165

Cost of Marketing Livestock by Truck and Rail

(Publication authorized March 2, 1932.)



COLUMBIA, MISSOURI

MARCH, 1932

TABLE OF CONTENTS

INTRODUCTION	5
SOURCE OF DATA	5
METHOD OF ANALYSIS	6
TRUCK RATES IN 1930	9
DISTANCE AND RATE	9
DIFFERENCE BY MARKETS	10
DIFFERENCES BY SPECIES	11
VARIATIONS FROM AVERAGE	13
DIFFERENCES WITHIN COMMUNITIES	13
DIFFERENCES BETWEEN LOCALITIES	14
RAIL RATES IN 1930	17
RAIL AND TRUCK RATES COMPARED	19
RATE PER MILE	23
TOTAL COSTS OF MARKETING, 1930	23
FACTORS INCLUDED	23
TRUCK AND RAIL COMPARED	24
CHANGES IN RATES AND TOTAL COSTS	27
CONSIDERATIONS INVOLVED	27
THE TREND OF RATES	28
RATES AND COSTS FOR 1931	29

ABSTRACT

This report on the cost of marketing livestock by truck and rail is part of a more complete study of changes taking place in livestock marketing methods in Missouri, to be reported in a later bulletin for general distribution. Data on actual trucking charges, covering 3,223 shipments in 1930 and 1,837 shipments in 1931, were obtained from cooperative commission companies at St. Louis, Kansas City, and St. Joseph. Various tests indicate the sufficiency of the samples used. Data on local costs for rail shipments were obtained from 169 local association managers and railroad agents. Data on feed charges and other central market costs were obtained from the records of the commission or stockyards companies. The method of analysis used throughout is the regression line and associated measures, which are well adapted for keeping the material up to date at small cost, and for comparison with other studies which might be made in other states.

While distance from market is a principal factor determining truck rates, there are marked variations from the general tendencies of the data, due to local influences. Truck rates in 1930 were highest for sheep. Rates on hogs were slightly lower than for cattle from points within about 100 miles from market, but slightly higher beyond. In 1930 trucking rates were lowest in the St. Joseph territory. Rates from points nearer the market were lower in the Kansas City territory than the St. Louis territory, but from distant points St. Louis had lower rates.

The relation between distance from market and rate charged was more marked for rail than for truck shipments, and the individual cases varied less from the general tendencies of the data. Rail rates in 1930 for the three species ranked from high to low: sheep, hogs, cattle. There was more uniformity as between species and markets for rail than for truck rates. Truck rates on the average were higher than rail rates at all distances in 1930, on this relative basis being highest for sheep, cattle, and hogs in the order named, although at points beyond the average distance from market there was no difference between species in this respect.

The total costs of marketing between farm and packer include various charges, some of which are constant. The individual interested in the situation at a particular shipping point can, by filling in the variable items for his locality, determine accurately the relative total costs of marketing by truck and rail. The general tendencies of the data in the territories of the three markets indicate that in 1930 the total cost of marketing by truck was less than by rail from localities close to market, and higher from the outlying territory, the "point of equilibrium" varying by species and markets. For the State as a whole in 1930 it cost more to ship sheep by truck at all distances. For hogs truck shipment was the cheapest up to about 70 miles, and for cattle up to about 50 miles.

Data on trucking charges for years prior to 1930 were not readily available. In the Kansas City territory the trend of rates for 25 identical towns, from 1928 to 1931, was sharply downward, the greatest drop taking place in 1931. Somewhat similar declines are indicated for St. Louis. Much more complete data were obtained covering the change in rates from 1930 to 1931, for all markets and species. The largest decline was in the St. Joseph territory, and almost as much in the Kansas City area, particularly at the longer distances for the latter market. There was considerably less change in the St. Louis territory. The greatest change was for hogs and cattle. There was less relation between distance and rates in 1931 than in 1930, because of the introduction of other competitive factors.

Using the 1931 truck rates, and making allowances for a reduction in the local hauling charge on rail shipments, it was found that the total cost of marketing livestock by truck was considerably more favorable as compared with rail than in 1930. For all species to St. Joseph, and hogs to Kansas City, the cost was less by truck than by rail. For hogs to St. Louis and cattle to Kansas City the costs on the average were about the same by truck and rail. For sheep to Kansas City, and both cattle and sheep to St. Louis, rail shipment was cheaper than truck.

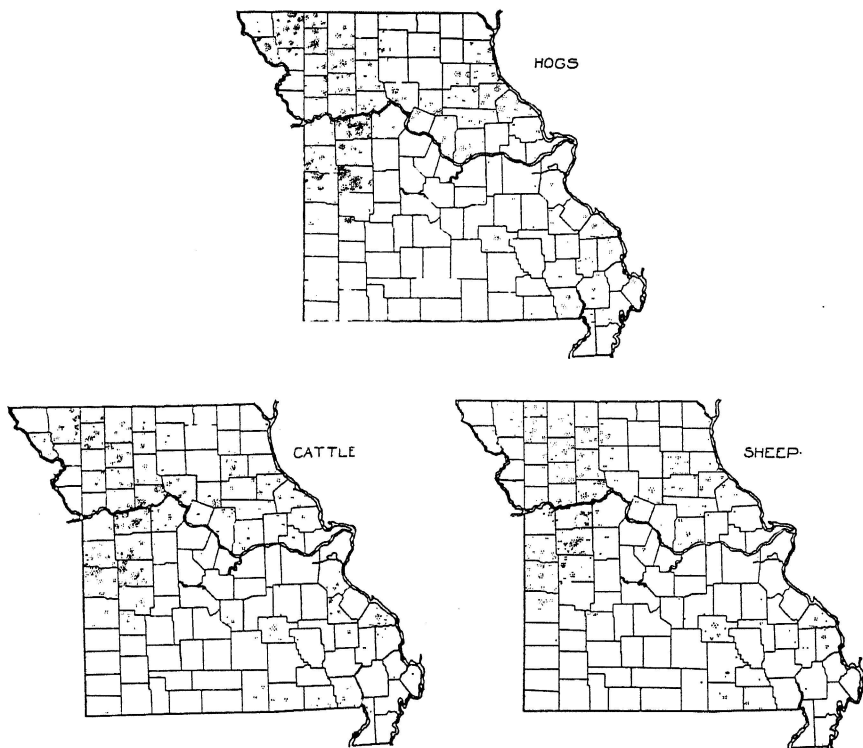


Fig. 1. Points of Origin of Truck Shipments Included in Analysis of Truck Rates for 1930. Shipments included in the analysis for 1931 were from approximately the same territory, and slightly fewer in number.

ACKNOWLEDGMENT

This study was made possible by the courtesy of the following firms in permitting use of their records: Producers Commission Association, National Stockyards, Illinois; Producers Commission Association and Farmers Union Livestock Commission, Kansas City; Farmers Union Livestock Commission, St. Joseph.

The cooperation of the many managers of local shipping associations and local railroad agents who furnished information on local charges is gratefully acknowledged.

Mr. David P. Janes, Secretary of the State Public Service Commission, furnished the data on rail rates.

Mr. B. H. Frame, Dr. C. H. Hammar, and Mr. H. M. Garlock of the Missouri College of Agriculture gave particularly valuable criticisms and suggestions.

Cost of Marketing Livestock by Truck and Rail

F. L. THOMSEN AND W. R. FANKHANEL

The recent and rapid development of trucking already has resulted in radical changes in the livestock marketing situation in Missouri. The number of cooperative shipping associations has been reduced by more than half. Market destinations of livestock from different sections of the State have shifted. The truck has made possible, although not necessarily desirable, the use of types of marketing facilities entirely new to this State.

These shifts in livestock marketing methods, both actual and prospective, will be treated in a forthcoming publication of this Station. Their interpretation will depend to a considerable extent upon the relative costs of marketing by truck and rail. These relative costs constitute the subject of the present publication.

Source of Data.—Data on truck rates for hogs, cattle and sheep to St. Louis, Kansas City, and St. Joseph were obtained from the records of cooperative commission firms on those markets. The number of shipments and pounds included are shown in Table 1. The points of

TABLE 1.—NUMBER OF SHIPMENTS AND HUNDREDWEIGHT OF HOGS, CATTLE, AND SHEEP INCLUDED IN TRUCK RATE DATA

	Shipments		Cwt.	
	1930	1931	1930	1931
St. Louis				
Hogs-----	393	225	8,339	7,486
Cattle-----	273	237	5,369	7,370
Sheep-----	146	189	1,328	2,150
Kansas City				
Hogs-----	604	218	13,596	7,937
Cattle-----	470	117	10,880	4,862
Sheep-----	343	157	3,529	1,672
St. Joseph				
Hogs-----	367	245	7,735	8,997
Cattle-----	303	227	6,320	6,053
Sheep-----	324	222	3,151	3,199

origin of the shipments are shown in Figure 1. In St. Louis only one of the cooperative commission associations (The Producers) was willing to furnish access to its records, thus limiting somewhat the geographic distribution of the sample, since the receipts of the two cooperatives on that market do not originate proportionately in the same territory.

The individual shipments were allocated to towns according to the postoffice of the shipper. The transcription of records was continued at each market until it was evident that additional shipments to these commission firms would not include an appreciable number of additional towns. Since the rates on individual shipments from the same localities usually were the same or very similar, it was evident that the inclusion of additional account sales would not add materially to the representativeness of the sample.

Corroboration of the representativeness of the truck rates is to be found in many of the charts and tables, in such things as the absence of numerous unexplainable or conflicting tendencies in the data, the way in which the regression lines for different markets tend to parallel each other with each separate species, and many other factors apparent to readers familiar with the interpretation of statistically treated data.

Rail rates were obtained from the State Public Service Commission. Since the rail rate is the same for any one town, for which there may be several truck rates, there are fewer individual cases included in the analysis of rail rates, although the sample is fully as representative.

All rates from Missouri points used in the main portion of this study are for the year 1930. Since then some changes have taken place in both truck and rail rates. It is probable that stability in rates will not be reached for some time to come, and meanwhile it will be necessary to rely upon studies of the situation existing at a particular time, making allowances for changes occurring thereafter. For this reason, and because the data available for 1930 were more complete, the more recent data (1931) have been separately presented in the final section of this report.

Method of Analyzing Rates.—In analyzing and graphing truck and rail rates there are two principal objectives: first, to summarize the data in such manner as to show the general trend or what are generally referred to as “normal”, “average”, or “representative” conditions; and second, to show the extent to which individual cases fail to conform to this hypothetical norm, and hence the possibilities of error in basing conclusions concerning any particular point upon the general tendencies of the data.

These objectives are most nearly attained by the use of the regression diagram and associated statistical measures. However, these devices are open to the objection that they are not well adapted to interpretation by the general reader. For this reason, the report is published as a technical bulletin, but anyone not acquainted with statistical

methods can understand practically all of the analysis after a careful reading of the following explanation.

The individual charts in Figure 2 and other similar charts illustrate the principle of the regression diagram. The vertical scale (y) in this figure represents the rate per hundredweight for trucking hogs, cattle or sheep, respectively, to the market indicated. The horizontal or bottom scale (x) represents the distance from the market. It is found, for example, that a shipment of hogs from a town approximately 150 miles from St. Louis carries a rate of 45 cents. A dot is then placed on the diagram at a point representing the intersection of two imaginary lines drawn at right angles from the points on the horizontal and vertical scales representing the mileage (150) and rate (45 cents) for that town. If additional cases having the same mileage and rate are encountered, no additional dots are shown. In other words, *each dot may or may not represent more than one observation*; hence, the total number of cases included is considerably more than the number of dots shown.

Next, a trend line is calculated which best fits the individual cases. This is termed the regression line, and is designed to show the general tendencies of the data. In calculating the regression line, four different methods were available: (1) It could be based upon all of the individual cases or shipments included in the data. (2) Average rates for each mileage could first be computed, and the line based upon these averages. (3) The average rate for each town or shipping point could first be computed, and the line calculated to fit these averages. (4) The line could be based upon the dots shown in the diagram, i. e., upon all of the different mileage-rates encountered. The first of these methods was selected as best representing the existing conditions.

Three important statistical measures are used in connection with the regression diagram: (1) the coefficient of correlation r , which indicates the degree to which the differences in rates are explained by differences in distance from market, or mileage; (2) the regression equation $y = a + bx$, which shows the point a at which the line intercepts or crosses the vertical scale, and the amount b of change in the rate which "on the average" accompanies a given change in mileage; (3) the standard error of estimate S_y , which indicates the accuracy with which the regression line of probable rates for the respective mileages indicates the actual rate which may obtain for any given point, considering the scatter of the individual cases about the line.*

These three measures are used in connection with practically all of the diagrams. They are not, however, essential to the interpretation

*These three measures all refer to the characteristics of the given sample of rates. The standard error of the regression coefficient, given in Table 2, indicates the variation which would be found in the value of b , or the coefficient of regression, if successive samples of rates were drawn from the same territory.

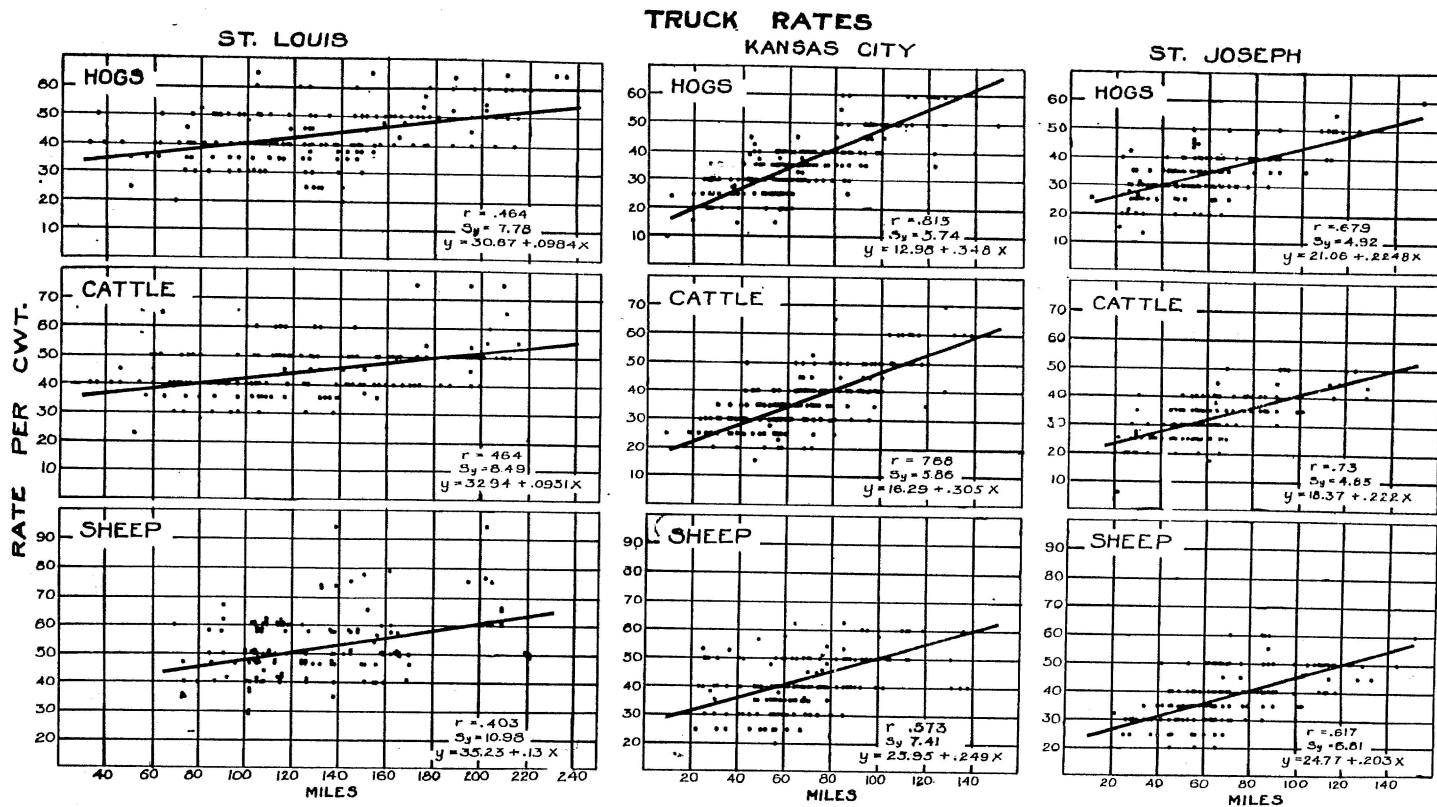


Fig. 2. Truck Rates for Hogs, Cattle and Sheep, to Three Missouri Markets, by Miles, 1930.

of the charts themselves. Those unacquainted with statistical measures can easily visualize the situation existing by closely examining the respective diagrams.

TRUCK RATES IN 1930

Truck rates for hogs, cattle and sheep to St. Louis, Kansas City, and St. Joseph, according to distance from market, are shown in Figure 2. The coefficient of correlation, values of the factors in the regression equation, standard error of the regression coefficient, and number of cases in the sample are given in Table 2. The coefficients of correlation have been checked for significance according to Fisher's method*, and all of them were found to be significant in that similar coefficients obtained from other samples almost certainly would be positive.

TABLE 2.—MEASURES OF ASSOCIATION BETWEEN TRUCK RATES AND DISTANCE FROM MARKET, 1930

	Hogs			Cattle			Sheep		
	St. Joe	St. Louis	K. C.	St. Joe	St. Louis	K. C.	St. Joe	St. Louis	K. C.
r -----	.678	.464	.815	.730	.464	.768	.617	.403	.573
S_y *-----	4.92	7.78	5.74	4.85	8.49	5.86	6.81	10.98	7.41
a *-----	21.06	30.65	12.98	18.37	32.92	16.29	24.77	35.23	25.95
b *-----	.224	.0985	.348	.222	.095	.305	.203	.13	.249
N -----	363	393	601	301	274	510	321	146	357
σ_{yx} *-----	.0128	.00947	.0100	.0124	.0109	.0112	.0144	.0246	.0783

* $y = a + bx$.

Relation between Distance and Rate.—For none of the three markets was there any very high degree of association between distance and rate. This is due to the many other factors, local in nature, which influence truck rates. The most distinct relation between rates and distance was in the St. Joseph territory, as shown by the relatively high correlation and low error of estimate. St. Louis had the most uniform relationship for hogs, cattle and sheep, the coefficients of correlation for which differed only slightly. In the Kansas City territory the relationship was very uneven, the degree of association between rates and distance being fairly high for cattle and hogs, but very small for sheep. Even the latter is significant, however, as shown by the test indicated in the preceding paragraph.

By squaring the correlation coefficients the percentages of the fluctuations in rates for each specie and market territory which are explained by differences in mileage are obtained. The lowest was 16 per cent for sheep to St. Louis, and the highest 66 per cent for hogs to Kansas City. The average for all species and markets was 40 per cent. This means that 60 per cent of the differences in rates for individual shipments were the result of conditions largely local in character.

*Wallace, H. A., and Snedecor, G. W., *Correlation and Machine Calculation*, pp. 62-63.

From these measures and the observed scatter about the line of the individual cases it is evident that the rate at any particular point is likely to differ materially from that estimated from the line of regression. The same would be true of average rates for different mileage groups. For this reason any individual farmer located a certain distance from market cannot accurately gauge his rate by this or any other group of data. Nevertheless, the data display certain definite tendencies which are brought out by the regression lines, and from which valid general conclusions may be drawn.

Rate Differences by Markets.—The differences in the trend of rates for hogs, cattle and sheep, by markets, is indicated by the values of the regression factors in Table 2, and more clearly in Figure 3. In this comparison there are two factors to be considered: the initial rate a and the amount of increase in rate with increases in distance. The differences in both of these two factors as between the three markets are fairly uniform for the three species of livestock.

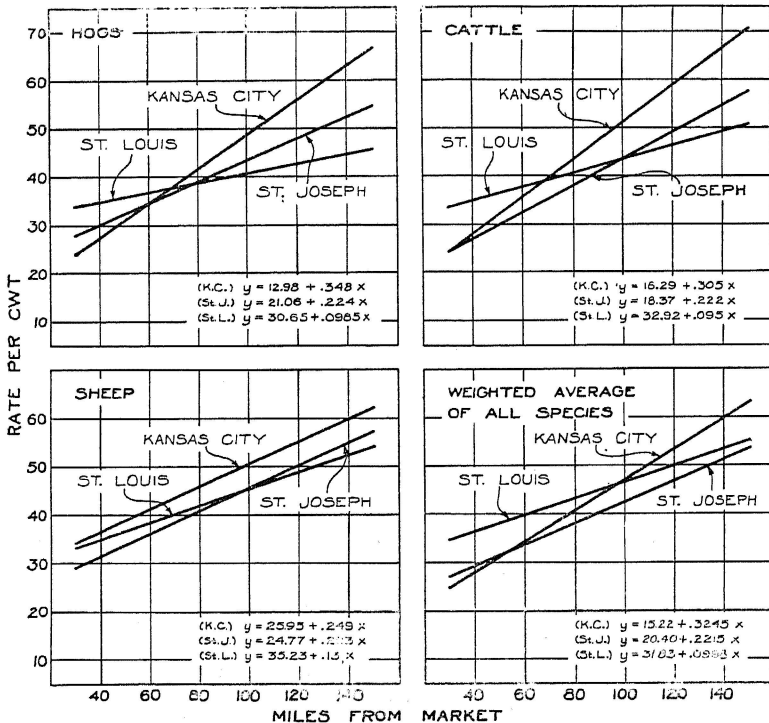


Fig. 3. Comparison of Truck Rates on Hogs, Cattle, Sheep, and All Livestock, by Markets, 1930.

The initial rates from points close to the market for cattle and hogs were noticeably higher for St. Louis than the other two markets, which were rather similar in this respect. This is shown by the points at which the regression lines meet the vertical scale in Figure 3, and the values of a in Table 2. This may be due to the longer drive through heavy traffic and across the River at St. Louis. For sheep St. Louis was no higher in this respect than Kansas City.

On the other hand, as shown by the slope of the lines in Figure 3 and the values of b in Table 2, truck rates tended to rise with increases in distance much faster at Kansas City and St. Joseph than at St. Louis. The increase with distance was greatest for Kansas City.

The rates for all markets and species of livestock tended to approach each other most closely at a distance of approximately 75 miles. Taking into account both initial rate and increases with distance, and combining all three species,* it is apparent that livestock truck rates were lower for St. Joseph than for either Kansas City or St. Louis. The latter were on the whole about equal, Kansas City having the lower rates to distances of about 100 miles, and St. Louis lower rates for points more distant from the market. Considering the fact that more trucking is done within than without a radius of 100 miles, it may be concluded that weighted average rates for St. Louis were higher than for Kansas City. These comparisons are made in the fourth section of Figure 3.*

Rate Differences by Species.—The rates to all three markets for any one species might be combined by calculating regression lines for hogs, cattle, or sheep, based upon all of the individual shipments from the State, but such a combination would be misleading. Applied to these data it indicates a tendency to curvilinearity which actually does not exist, as shown by other tests. The apparent curvature is due to differences in the general levels of rates and mileage ranges for the several markets included. Rates to St. Louis on hogs from points 80 miles or more distant were materially lower than for the other two markets, and in the combined scatter diagram a large proportion of the cases found at this mileage extreme were from the St. Louis territory. This condition is cited in detail to demonstrate the impracticability of combining in this manner the rates for different markets.

The same objective may be obtained without introducing this error, by combining the respective linear regression lines for each species, as has been done in Figure 4. This procedure has the same objectives and statistical justification as the calculation of regression lines showing the general tendency of individual cases within the area of a single

*In the combination of regression lines shown in Section 4 of Figure 3, the values of a and b for hogs, cattle and sheep were weighted according to the relative importance of each as to volume of trucking to the three markets combined. Obviously, separate weights for each market could not be used, as in that case the respective lines would reflect differences in the volume of the separate species in addition to differences in rates.

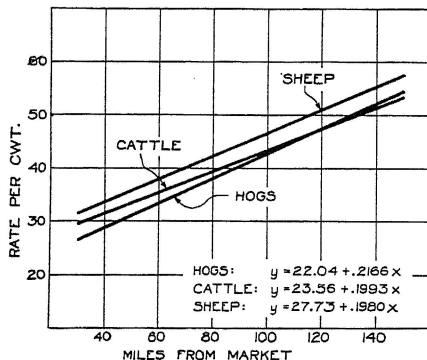


Fig. 4. Hog, Cattle and Sheep Truck Rates for Three Missouri Markets Combined, 1930. Based on the Separate Market Regression Lines, Weighted According to the Truck Receipts of the Respective Species at Each Market.

market. While the State is not homogeneous as to trucking rates, neither is a market territory. The values of a and b for the respective markets were weighted according to the number of head of livestock trucked from Missouri points to each market. Thus, the result (Figure 4) is comparable to a state average of wheat prices consisting of a weighted average of district average prices, as commonly reported by the Bureau of Agricultural Economics, and has similar limitations.

This composite picture of state rates reveals that rates for sheep were around 4 cents per hundredweight higher than for hogs, in the three market territories combined. The rates for hogs were also lower than for cattle within a radius of 100 miles, after which they were about the same or very slightly higher.

These combined rates perhaps are most significant in disproving the rather common notion that there is a considerable difference in the rates for the three species. The impression may be based largely on differences existing in some communities from which few cattle and sheep are trucked, resulting in higher rates for them as compared with hogs. Sheep rates are more frequently quoted per head than per hundredweight, and there is less uniformity in rates for sheep than for the other species. These conditions would tend to create the impression of relatively higher rates for sheep than actually exist.

While combination rates for all species or markets are interesting, the rates for cattle, hogs and sheep for each of the three markets are much more representative and significant, and while separate treatment is more cumbersome it is necessarily followed in connection with the major points raised in the following sections.

Variations from the General Tendency.—The marked variation in truck rates as between local points, after eliminating the influence of distance from markets, is shown in Figure 2 and Table 2.

The least amount of variation was encountered in the St. Joseph territory, and the greatest (except for sheep) in the St. Louis territory. The local variations in sheep rates to Kansas City were so great as to almost completely obscure the influence of distance from market, as shown in Table 2.

Sheep also had the greatest amount of variation as between localities in the territories of the other two markets. Cattle and hogs showed much less variation in rates, and this variation was very similar for each species in all of the three markets, as indicated by the remarkably close correspondence of their respective standard errors of estimate.

Variations in truck rates not due to distance from market are of two kinds:

Differences in Rates within the Same Communities.—Livestock trucking rates within a community usually vary somewhat, but within a comparatively narrow range. Of localities from which two or more rates were obtained, the following proportion showed at least some variation in rates: hogs 68 per cent; cattle 74 per cent; sheep 82 per cent. The coefficients of variation in rates for towns having ten or more rates included in the data are shown in Table 3. The average was around ten per cent. As applied to a locality with an average rate of 25 cents, this would mean that rates on individual shipments varied between 22.5 and 27.5 cents. Part of the variation shown undoubtedly is due to the fact that not all of the shipments included in the data were made in the same month of 1930. With the rapid changes taking place

TABLE 3.—COEFFICIENTS OF VARIATION IN TRUCK RATES WITHIN COMMUNITIES FROM WHICH RECORDS OF TEN OR MORE SHIPMENTS WERE OBTAINED, BY SPECIES AND MARKETS

City	Hogs	Cattle	Sheep
St. Louis.....	9.7	7.9	----
Kansas City.....	10.5	8.7	13.2
St. Joseph.....	8.1	9.3	15.6
Wt. Average.....	9.7	8.8	14.7

in truck rates in some areas, one shipment might be as much as a nickel under another without any variation in rates within the community at any particular time.

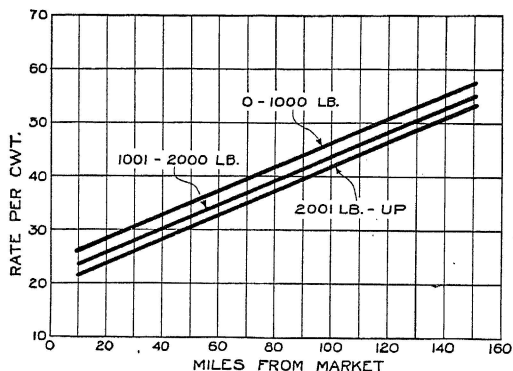


Fig. 5. Truck Rates for Hogs to Three Markets Combined, According to Size of Load. Rates on individual shipments to each market were first segregated according to size of load, regression lines calculated, and the latter combined for all markets by averaging the values of (a) and (b).

Variation in rates within the rural free delivery area of a post office, the basis of the above comparison, may be due to one or more of the following factors: large coverage by mail routes, making some parts of the territory more distant from market or hard roads; differences in road conditions within the locality; reliability and condition of equipment of the hauler; differences in methods of quoting rates (per head, per cwt., per load); rates including and not including insurance; bargaining ability and importance of the individual farmer's volume to the trucker; rate cutting to encourage movement when business is slack; presence or absence of return pay load, such as feed, to shipper; and the size of the load.

The influence of the latter factor, for hogs, is shown in Figure 5. The absolute differences in rates shown by this chart are not so important as the regularity of the difference at varying distances from market. This serves to increase confidence in the representativeness of the sample and the validity of other comparisons made, and also points to the delicacy with which truck rates reflect differences in some of the conditions affecting hauling costs.

Differences in Rates as between Localities.—In addition to distance from market, some of the principal factors which result in variations in truck rates in different communities are:

(1) Local competition among truckers. In some communities there are more trucks than are necessary to handle the normal business, and rate slashing occurs. In others the irresponsible haulers have been weeded out and rates relatively stabilized. Competition between independent trucks and transfer companies sometimes brings at least temporarily lower rates.

(2) Competition from the local shipping association. In some localities wide awake shipping association managers have developed membership loyalty and the organizations' services to a point where truckers must offer very low rates in order to get the business. For example, Columbia, which is about 130 miles from market, has a truck rate (1931) of only 25 cents, but the association is still doing a good business.

(3) Rail competition. Many towns are on branch lines of the railroad but on direct highways to market. Such towns are likely to have higher truck rates for a given distance than are those in which truck and rail distances are similar, or in which the town is situated on the main line of a railroad but not on a main highway. The kind of service rendered by the railroad is another factor. At some points stock loaded in the afternoon does not arrive at destination in time for the early market, while truck shipments loaded at night make it without trouble. Slow rail schedules increase shrink and otherwise add to the advantages of truck shipment, and if counteracting influences are not present may cause truck rates to be higher than from other points giving better service or lower rates on rail shipments.

(4) Road conditions formerly were responsible for differences in rates between localities, but are no longer much of a factor in this regard, as most communities now have access to good roads. Bad roads off of the main highway are more likely to result in variations in rates within rather than between communities.

(5) Prevalence of back hauls. In some sections the livestock trucks are able to obtain rather regular return loads, enabling them to operate at lower rates on the going trip. This will depend upon local needs for feed, etc., custom, and the character of l. c. l. freight service.

(6) Volume of livestock shipped out of the locality. It is logical to assume that communities which produce enough livestock to furnish a steady and heavy volume for truckers will have lower rates than areas of sparse production, although so many other factors affect rates that the influence of volume may be obscured. Partial evidence on this point is furnished by a tabulation of rates to East St. Louis for hogs

TABLE 4.—COMPARISON OF AVERAGE TRUCK RATES FOR HOGS AND CATTLE TO EAST ST. LOUIS FROM COUNTIES ABOVE AND BELOW AVERAGE PRODUCTION FOR THE TERRITORY FOR THE RESPECTIVE SPECIES

	N	Low Production Territory		High Production Territory		Dif- ference	σD
		Ave. Miles	Ave. Rate	Ave. Miles	Ave. Rate		
Hogs----	100	139	.45	144	.42	.029	.016
Cattle---	100	128	.50	133	.41	.083	.016

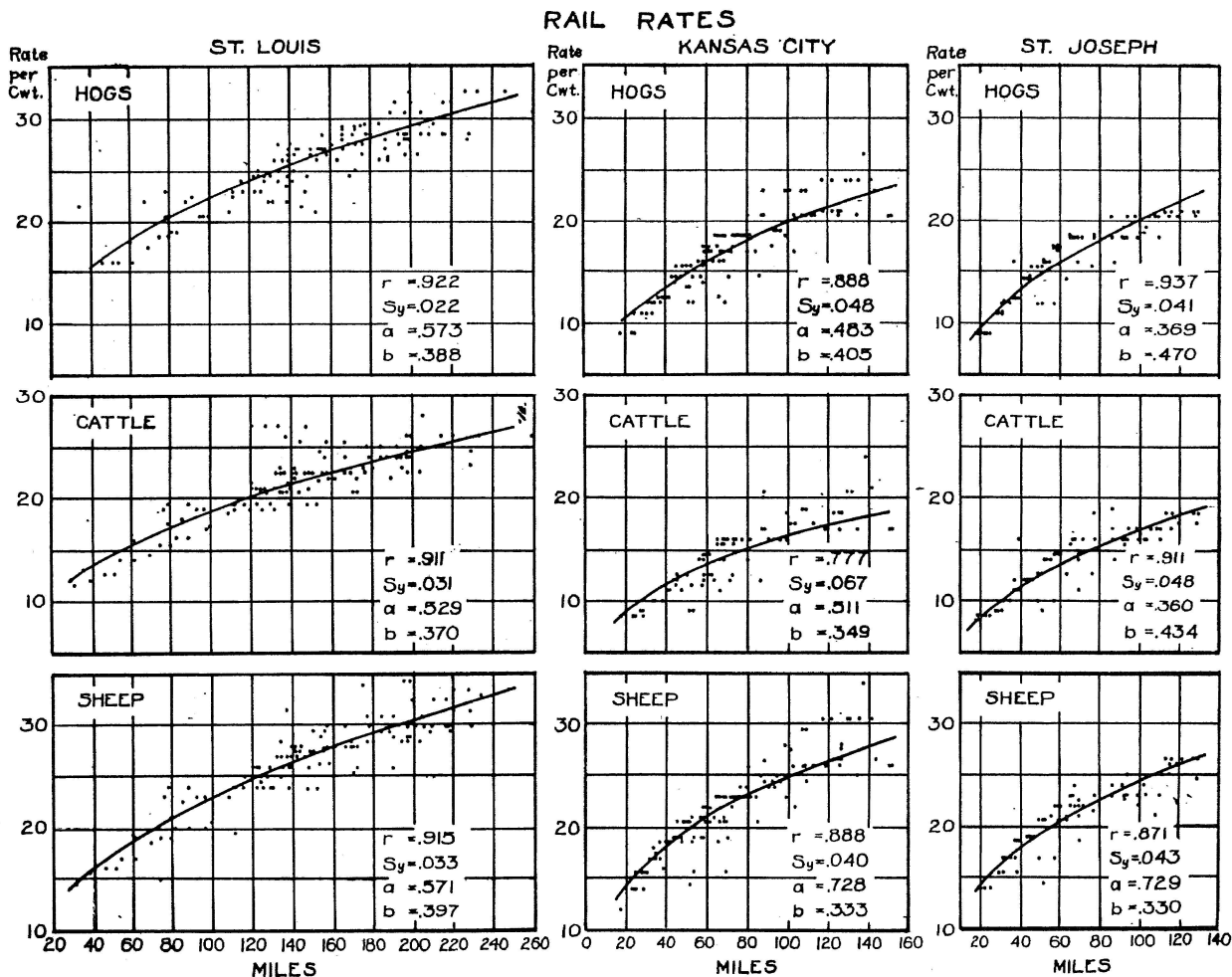


Fig. 6. Rail Rates (Single Deck) for Hogs, Cattle and Sheep to Three Missouri Markets, by Miles, 1930. (Regression curve: $\log y = a + b \log x$).

and cattle from counties which were above and below the respective averages of production for the St. Louis territory. The averages and measures of error are presented in Table 4. There was a significant difference in favor of the high production territory for cattle, but the difference for hogs, while in the expected direction, apparently is not sufficient to be conclusive. Insufficient data were available for a similar comparison for sheep.

RAIL RATES IN 1930

Rail rates for cattle, hogs and sheep to the three markets, and statistical measures of association, are presented in Figure 6 and Table 5, similar to Figure 2 and Table 2 for truck rates. The distances used are rail rather than highway mileages.

TABLE 5.—MEASURES OF ASSOCIATION BETWEEN RAIL RATES AND DISTANCE FROM MARKET

	Hogs			Cattle			Sheep		
	St. Joe	St. Louis	K. C.	St. Joe	St. Louis	K. C.	St. Joe	St. Louis	K. C.
r -----	.9371	.9221	.8882	.9109	.9112	.7769	.8716	.9154	.8879
S_y^* -----	.0409	.0226	.0481	.0478	.0312	.0675	.0429	.0335	.0398
a^* -----	.3690	.5730	.4832	.3598	.5296	.5109	.7291	.5708	.7282
b^* -----	.4706	.3883	.4051	.4344	.3749	.3495	.3301	.3977	.3355
N -----	79	132	127	87	126	127	81	130	127

*Log $y = a + b \log x$.

It will be noticed that the relation between distance and rates for rail shipments is plainly curvilinear, as contrasted with the linear relation for truck rates within the distance ranges encountered. This difference is due to the manner in which the rate structure for each type of transportation is built up.

TABLE 6.—AVERAGE DISTANCE TO MARKET BY RAIL AND TRUCK*

Market	Hogs		Cattle		Sheep	
	Truck	Rail	Truck	Rail	Truck	Rail
St. Louis---	139	152	134	146	124	138
Kansas City	62	76	64	80	69	84
St. Joseph--	62	68	63	67	70	78
Average----	88	99	87	98	88	100

*Includes only towns for which both rail and truck distances and rates were available.

TABLE 7.—COMPARISON OF COST OF MARKETING HOGS BY TRUCK AND RAIL FROM SPECIFIC SHIPPING POINTS, 1930*

Town No.	Miles	Rail								Truck					
		Assn. Chg.	Local Haul	Frts. Rate	Feed	Ydge.	Com.	Ins.	Total	Total	Rate	Feed	Ydge.	Com.	Ins.
1	104	10	12	24	7	6	10	3.5	72.5	85.5	54	4.5	7	12.5	7.5
2	117	5	10	24.5	7	6	10	3.5	66.0	79.5	48	4.5	7	12.5	7.5
3	127	9	10	23	7	6	10	3.5	68.5	62.5	30	4.5	7	12.5	8.5
4	125	12	15	20.5	7	6	10	4.0	74.5	61.5	30	4.5	7	12.5	7.5
5	124	8	15	28.5	7	6	10	3.5	78.0	72.5	40	4.5	7	12.5	7.5
6	126	10	10	23	7	6	10	3.5	69.5	75.5	43	4.5	7	12.5	8.5
7	231	9	10	31.5	7	6	10	4.5	78.0	98.5	65	4.5	7	12.5	9.5
8	231	10	10	31.5	7	6	10	4.5	79.0	98.5	65	4.5	7	12.5	9.5
9	170	7	10	30.5	7	6	10	4.5	75.0	72.5	40	4.5	7	12.5	8.5
10	162	5	10	29.5	7	6	10	4.5	72.0	76.5	44	4.5	7	12.5	8.5
11	175	15	14	26.5	7	6	10		78.5	77.5	45	4.5	7	12.5	8.5

*The points selected for this comparison were chosen because of the unusual completeness of data on local charges, and not to illustrate any particular conditions. For all cases the truck and rail shipments were to the same market.

While the limitations of averages of averages must be recognized in considering Figure 7, this chart probably is sufficiently representative to indicate the general differences in rail rates for the different species and markets. Cattle rates appear to be somewhat lower than hogs, and hogs lower than sheep. St. Louis was very slightly higher than the other two markets for all of the species combined, although it had lower rates for sheep from points relatively close to the market. However, the differences by markets are hardly great enough to be significant.

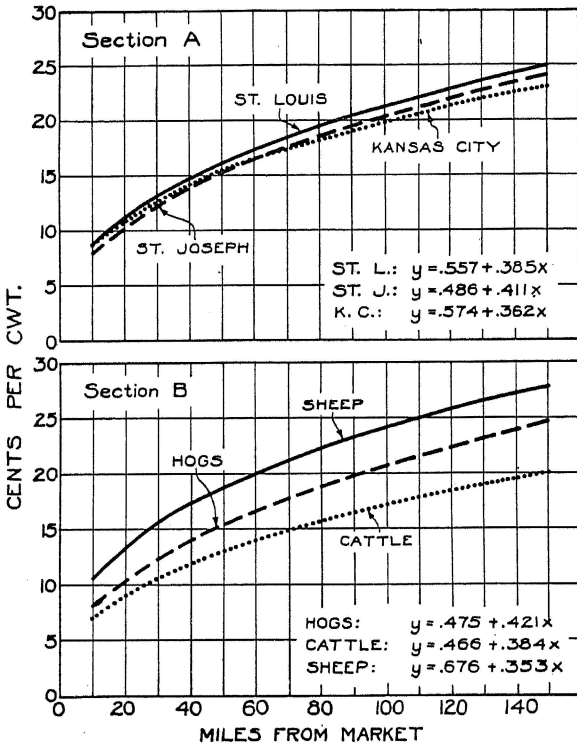


Fig. 7. Averages of Rail Rates by Species and Markets, 1930. Unweighted averages of the separate regression lines (Log $y = a + b \log x$) for the three species, by markets (Sec. A), and for the three markets, by species (Sec. B).

Rail and Truck Rates Compared.—There is more uniformity in rates as between species and markets for rail shipments than for truck rates, as shown by a comparison of the various charts. The coefficients of correlation are materially higher, and the scatter about the lines is less, for rail as compared with truck rates. This, of course, is due to the way in which the respective rates are determined, one as the result of the free play of competition, the other fixed under more or less definite rules and procedure.

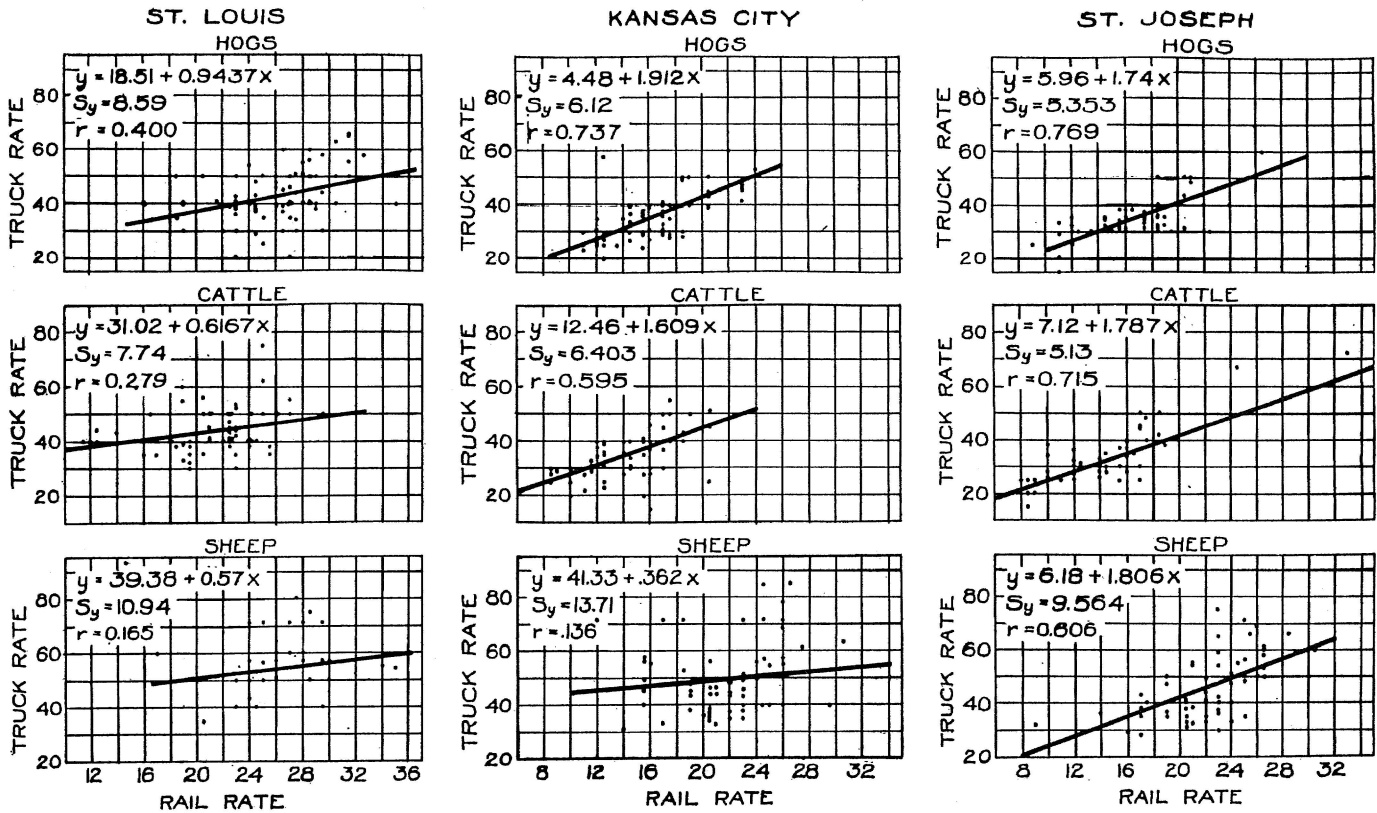


Fig. 8. Relation between Truck and Rail Rates, by Markets and Species, 1930.

The relation between truck and freight rates for the several species and markets is shown directly in Figure 8. The most distinct relation was for St. Joseph, and the least for St. Louis, as shown by the respective correlation coefficients. By reading from the horizontal scale to the regression line, and thence to the vertical scale, the truck rate which in 1930 was most likely to accompany any given rail rate may be determined. Because of the wide variations of individual cases from the lines of regression, as shown by the standard errors, the latter represent the situation only in a very general way. There was almost no relationship for sheep at St. Louis and Kansas City.

TABLE 8.—MEASURES OF ASSOCIATION BETWEEN TRUCK RATES AND DISTANCE FROM MARKET, 1931

	Hogs			Cattle			Sheep		
	St. Joe	St. Louis	K. C.	St. Joe	St. Louis	K. C.	St. Joe	St. Louis	K. C.
r -----	.660	.301	.608	.595	.380	.662	.595	.178	.500
S_y^* -----	3.84	7.43	4.67	4.35	6.38	5.12	7.28	10.89	11.45
a^* -----	13.85	30.02	15.71	14.93	30.25	16.14	17.53	45.78	21.21
b^* -----	.13	.054	.159	.1368	.057	.178	.193	.049	.275
N -----	245	225	218	227	237	117	222	189	157
% Change from 1930-----	-37.4	-11.7	-26.2	-28.1	-16.5	-20.1	-18.6	3.5	-5.8

* $y = a + bx$.

From this chart it is seen that in 1930 a town having a freight rate on hogs to St. Joseph of 20 cents per hundred would have a truck rate of 40 cents per hundred, if it represented average conditions. The chances of the truck rate being greater than 55 cents or less than 25 cents were almost negligible, as shown by the range on each side of the regression line of three times the standard error. The same test may be applied to other distances, markets and species. For example, in 1930 a rail rate of 20 cents to Kansas City on hogs would likely be accompanied by a truck rate of around 43 cents, but might fall within a range of from 25 to 61 cents.

Based upon the general tendencies of the data in all of the markets, truck rates relative to rail rates were higher for sheep than for other species at points close to the market, cattle and hogs following in the order named. At more distant points carrying higher rail and truck rates there was no material difference between species with respect to the relation between truck and rail rates. Similarly, at distant points carrying the higher rates there was little difference in the relation between truck and rail rates between the three markets, although from points close to market truck rates relative to rail were higher in the St. Louis than in the other two market territories. These relationships are all indicated by comparisons of the regression lines or of the respective values of a and b .

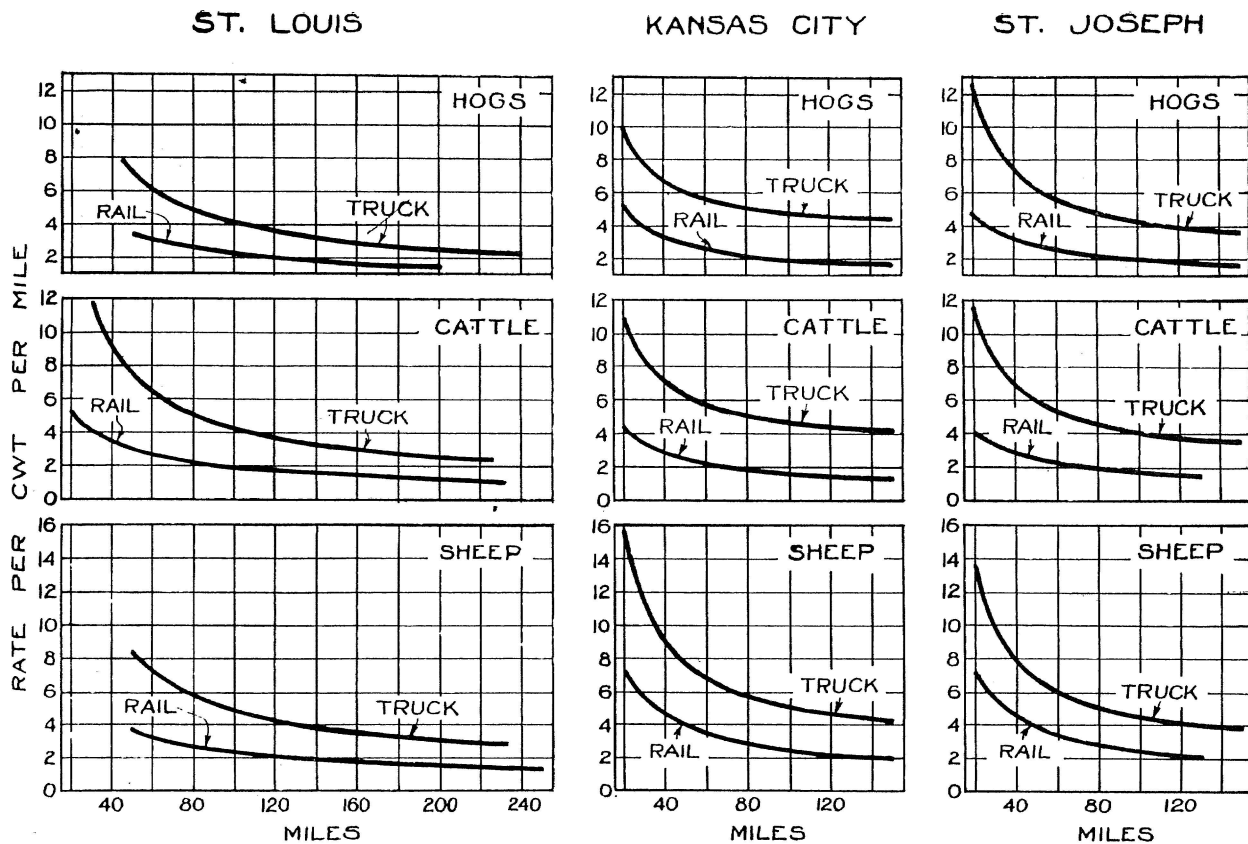


Fig. 9. Truck and Rail Rates per Mile, by Markets and Species, 1930 (in tenths of a cent per cwt. per mile).

Rates Per Mile.—One rather commonly used basis of rate comparisons is the rate per mile. This is shown for both rail and truck shipments in Figure 9.

For both methods of transportation and all markets and species the rate per mile declined as distance from market increased, rapidly at first, but very gradually beyond distances of about 100 miles. The "point of stabilization" varied more by markets than by species, being farthest out for St. Louis.

The rate per mile changed with increases in distance more for truck than for rail shipments. In other words, *from the standpoint of rates alone*, the advantage of rail over truck decreased as distance from market increased. This was true, notwithstanding the fact that each additional mile adds more to the truck rate than to the rail rate (except for St. Louis, see values of b in Figure 8). The reason, of course, is that the truck shipments have a higher initial rate to be prorated over the additional mileage. If shipments were made for longer distances than covered by the data or actual shipments the lines for truck and rail rates (Figure 9) would again begin to diverge, at the point where the decline in the pro-rata value of a in Figure 8 was offset by the greater value of b .

TOTAL COST OF MARKETING, 1930

The foregoing facts and analysis are important to the marketing or transportation specialist as a basis for dealing with the various problems arising from truck and rail transportation of livestock. The farmer, on the other hand, is only incidentally interested in rates. His real concern is with the total costs of marketing by the two available methods.

Factors Included in Marketing Costs.—The costs of marketing by truck include the following items: (1) hauling charge, (2) insurance, (3) yardage, (4) feed, (5) commission, (6) shrinkage, and (7) any price discount which may be applied by buyers to trucked hogs.

The costs of marketing by rail include the following items: (1) local hauling charge to shipping point, (2) local shipping association charge (or its equivalent in handling costs incurred by the individual shipper), (3) insurance (unless included with association charge), (4) freight charge, (5) yardage, (6) feed, (7) commission, (8) shrinkage.

It is possible to obtain definite figures representing some of these cost items, such as insurance, commission and yardage charges, in addition to transportation rates. For others it is necessary to rely on somewhat unsatisfactory estimates, although in most cases any possible inaccuracies are sufficiently small to affect in only a small way the total cost.

The local hauling cost and shipping association charges used are based upon figures submitted by the managers of local associations, or local railroad agents who furnished the information when it could not be obtained direct from the managers, covering 169 associations. The local association charge used was 9 cents per hundred, which is approximately the average of the replies received. In calculating the local hauling charge an average haul of 7.5 miles was assumed, with a rate (1930) of 1.6 cents per hundredweight per mile, making the total charge 12 cents per hundred. This figure undoubtedly is somewhat high for many communities, but for average loads and conditions the available data would seem to justify it.

In calculating total costs no account was taken of shrinkage. No data on this item for Missouri were available, and their collection would involve such a heavy cost as to make it inadvisable. Studies made by others, notably Ashby of Illinois*, indicate that there is no material difference in shrinkage by truck and rail. None of the studies made and reported thus far appear to be conclusive, because of differences in mileage of the truck and rail shipments, but they must suffice until additional facts are available.

Likewise, no price discrimination against trucked hogs, which was reported by some interests, was taken into consideration. Salesmen and others on the market maintained there was no truth in these rumors.

Since no data from other sources on feed costs were available, some effort was made to obtain a representative figure for this item. Feed charges per hundredweight vary widely, being influenced by numerous factors such as number of animals to the pen, length and roughness of haul, how fed before shipping, condition on arrival, and the impracticability of adjusting the quantity of feed to the animals' exact requirements. In the case of some shipments, as of sheep from nearby points, no feed is used or charged, while with others it is.

The marked lack of uniformity in feed charges is shown in Figure 10, which is based upon records of actual charges made on individual shipments of hogs to St. Louis. It will be observed that any relation between distance travelled and feed charges is obscured by the other factors mentioned. In calculating the total marketing costs an average charge for feed for each species was used.

The rail rates used are for single-deck cars, since it was believed they would be more representative.

Total Costs.—The total costs of marketing hogs, cattle and sheep, by truck and rail, to each of the three markets, for 1930, is shown in Figure 11. These charts are based upon the separate cost items calculated as explained in the foregoing section, and upon the regression lines of

*Latest study reported in mimeographed statement and as yet unpublished.

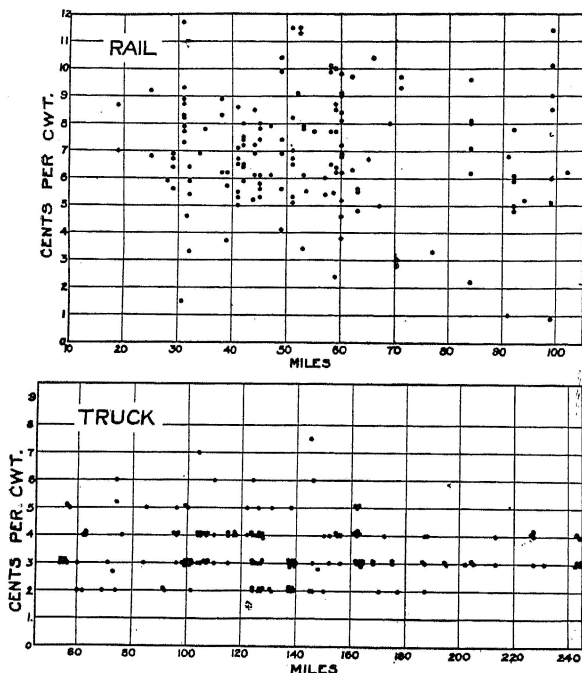


Fig. 10. Feed Charges on Truck and Rail Shipments of Hogs to St. Louis, According to Distance Covered by Shipments, 1930.

truck and rail rates shown in figures 2 and 6. It is apparent that these lines represent only the general tendencies of the data, and that for any one point the comparative total costs may have been quite different.

There are two factors affecting total marketing costs by the two methods; first, the cost per hundredweight for a given number of miles, or cost per mile; and second, the number of miles which must be covered by each method. Only the first of these factors is considered in Figure 11. It might be assumed that with a large number of cases the average mileage would be as great by one method of transportation as the other. However, it appears that many towns located on branch railroad lines are on main highways, and that the average distance by rail is greater than by truck. The actual differences are shown in Table 6. For all species and markets the distance by rail was greatest. However, the standard errors of the differences, where calculated, indicated that the latter were far from reliable indications of the actual differences, although the uniformity of the relation is significant. For this and other reasons, no attempt was made to lag the lines showing rail costs, although this factor should be taken into consideration in making comparisons for individual cases.

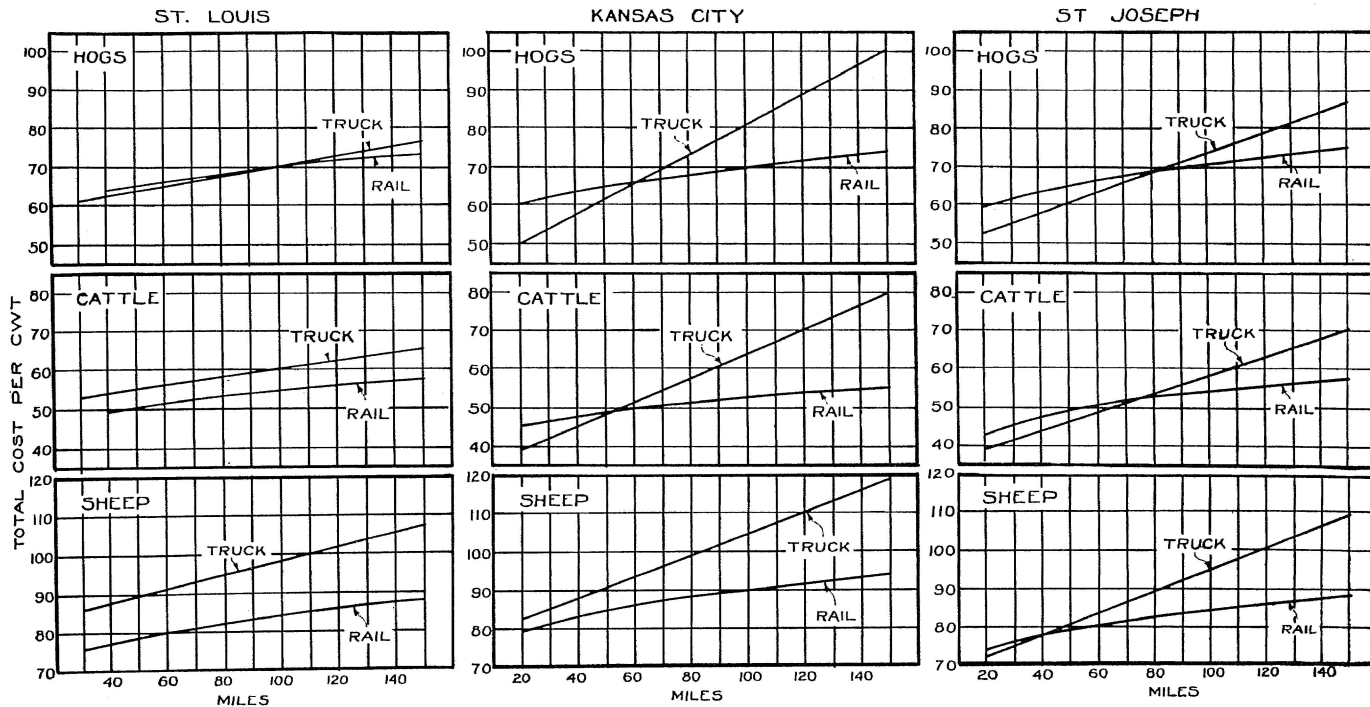


Fig. 11. Total Cost of Marketing Hogs, Cattle and Sheep by Truck and Rail, by Miles and Markets, 1930. This chart includes all money costs from farm to packer, except shrinkage. Some of the local cost items are estimated, as explained in text. Comparative costs for any particular locality may vary considerably from those shown in the chart, due to variations in rates and other charges.

It is apparent that for most species the cost of marketing by truck was less than by rail within a certain radius of the market. This was not true of cattle and sheep for St. Louis, or sheep for Kansas City. The "point of equilibrium" between truck and rail costs was somewhat irregular for the different species and markets, being most distant for St. Louis, St. Joseph, and Kansas City in the order named. Beyond these points truck costs were greater than rail costs.

The lines for all three markets may be combined, by species, although the error involved in any use of averages is thereby increased. This chart, which is omitted because of space limitations, indicates that in 1930, for the State as a whole, it cost more to market sheep by truck than it did by rail, at all distances. For hogs truck shipment was cheapest up to around seventy miles, while the two methods were approximately the same for cattle up to about 50 miles, after which truck shipment became more expensive.

In order to show the great variations in relative costs of marketing by truck and by rail which are due to local conditions, Table 7 has been prepared. The shipping points included were selected because they were the only ones for which complete local costs were available, most reports from associations having omitted one or another of the items. Hence, these cases should not be looked upon as typical or average. They merely illustrate variations in the separate items entering into the costs of marketing, and the material differences which may exist in the relative total costs by the two methods. Those who wish to make the comparison for any particular shipping point may do so by substituting the current local charges for hauling to the local yards, the association charge, insurance, and truck and freight rates.

CHANGES IN TRUCK RATES AND TOTAL COSTS

Rates and costs disclosed in any transportation study are likely to become unrepresentative within a short time, particularly during a period of rapid adjustments like the present and immediate future. It is during such a period of change, however, that the facts are most needed, since the railroads, shipping associations or other marketing agencies involved must meet the problems as they arise.

While actual rates and costs may change from year to year, many of the principles involved do not. When basic factors once are known, the extent and significance of rate changes can be much more easily and accurately judged. This is particularly true of analyses based on regression lines, representing rate tendencies, and their combination with other cost items to form lines of estimate for total costs at different distances. The use of these devices has the very distinct advantage of

making relatively easy future corrections for rate changes. The present study, which has required a considerable amount of time and expense for experimentation, could be kept up to date with a very small annual or biennial expenditure.

Another advantage of this method is that similar studies which might be made by other agencies for other markets and periods of time would be directly comparable, as it is a simple matter to compare regression lines either graphically or by means of the values of the equation and associated measures. Thus, the essential elements in a similar study of rates for Chicago, Sioux City, and other markets could be combined in a single table with those for the three Missouri markets.

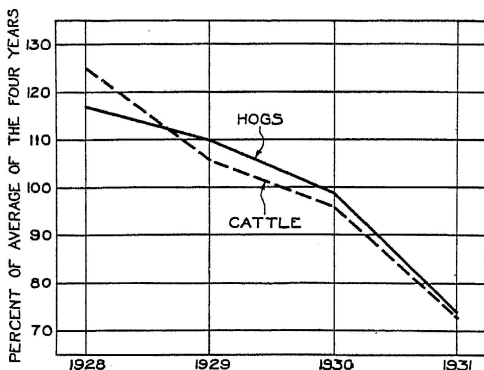


Fig. 12. Combined Trucking Rates to Kansas City from 25 Identical Towns, 1928-1930.

The Trend of Rates.—Reliable data showing the trend in rates for more than a few years were not available. At Kansas City records were obtained covering the years 1928-1931. It was found possible to trace trucking rates from twenty-five towns through these years. The results are shown in Figure 12. Rates on cattle and hogs have declined about the same, although cattle rates were relatively lower in 1931 than in 1928. It is significant that the greatest decline was from 1930 to 1931. The change for these 25 towns checked very closely with the average for a much larger number of shipments obtained for 1931, as compared with 1930.

The change in rates to St. Louis from 1927 to 1930 is indicated in Figure 13. The regression lines for Illinois, covering the year 1927, were calculated from average rates by mileage groups reported in an Illinois study.* The lines for Missouri to the same market, covering the year 1930, were prepared by first grouping the rates in the same manner and then constructing lines through the averages, making the two sets of data comparable in this respect.

This chart indicates very clearly the marked decline in rates which has occurred since 1927. Further comparison may be made with Figure 14, showing rates to St. Louis for 1931. While some of the change

*Ashby, R. C., Livestock Truckage Rates in Illinois, Ill. Agr. Exp. Sta. Bul. 342.

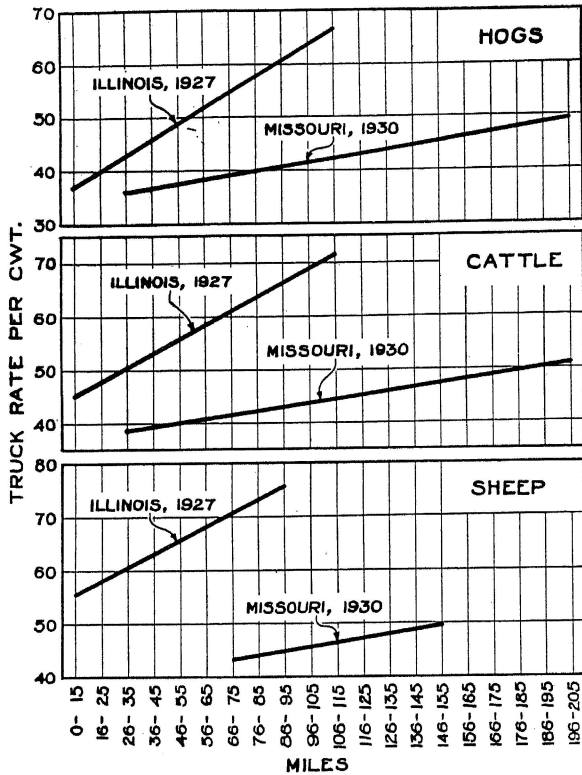


Fig. 13. Livestock Trucking Rates to East St. Louis from Points in Illinois (1927) and Missouri (1930).

in rates between 1927 and 1930 may be due to territorial differences, it is likely that the lines approximately represent the situation existing on either side of the River. It will be noted that both the absolute and percentage declines were greater as distance from market increased.

Rates and Costs for 1931.—Because of the big change in rates from 1930 to 1931 disclosed for the 25 towns previously mentioned, it was found desirable to make practically a new analysis for 1931. The number of shipments included, by species and markets, is shown in Table 1. The geographical distribution of these shipments was very similar to that for the 1930 shipments.

The detailed analysis of the 1931 truck rates is shown in Table 8 which may be compared with Table 2 for differences between the two years, 1930 and 1931. For every species and market the correlation between rates and distance was lower for 1931. This indicates that distance was of less importance as a factor determining the rate to market

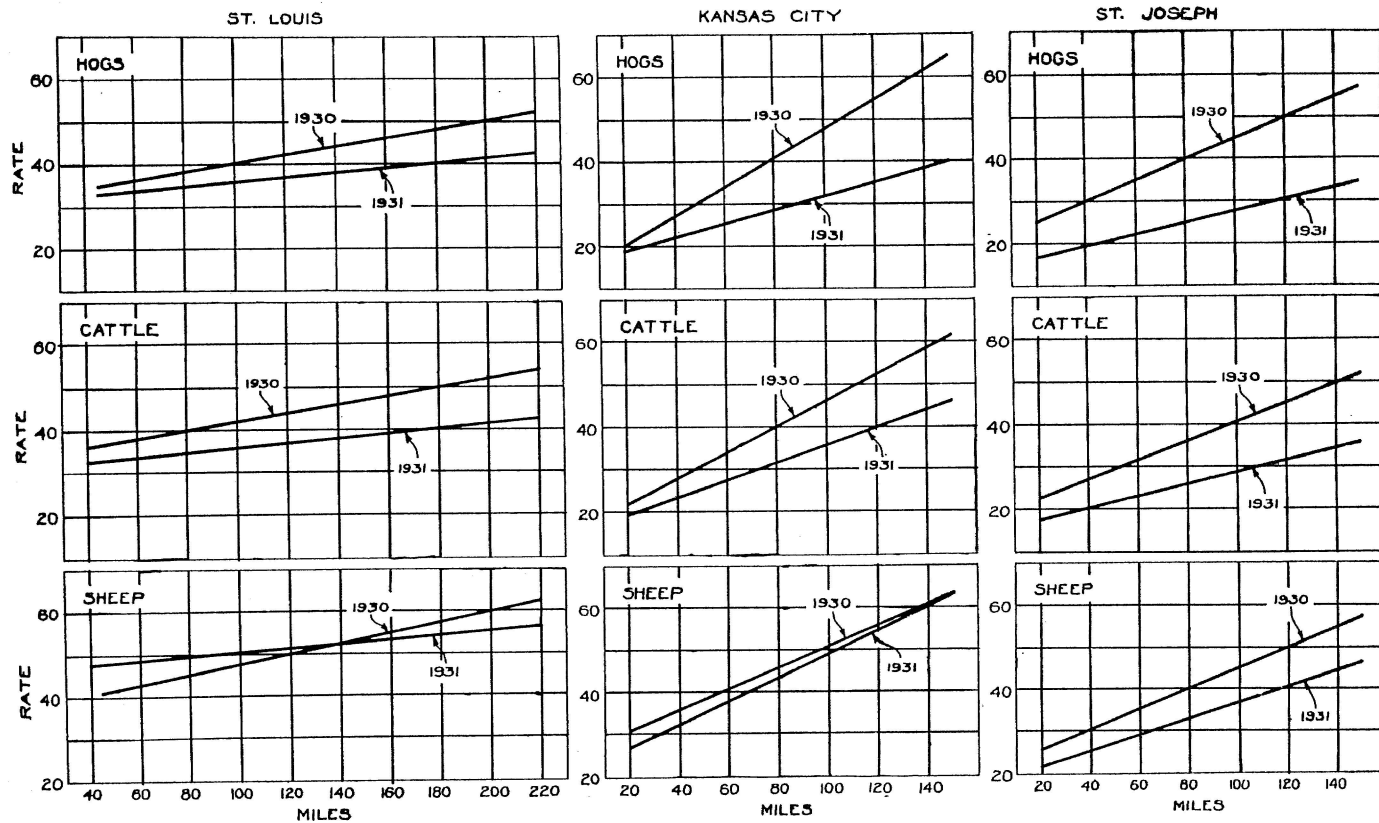


Fig. 14. Truck Rates for 1931 Compared with Rates for 1930, by Miles, Markets and Species.

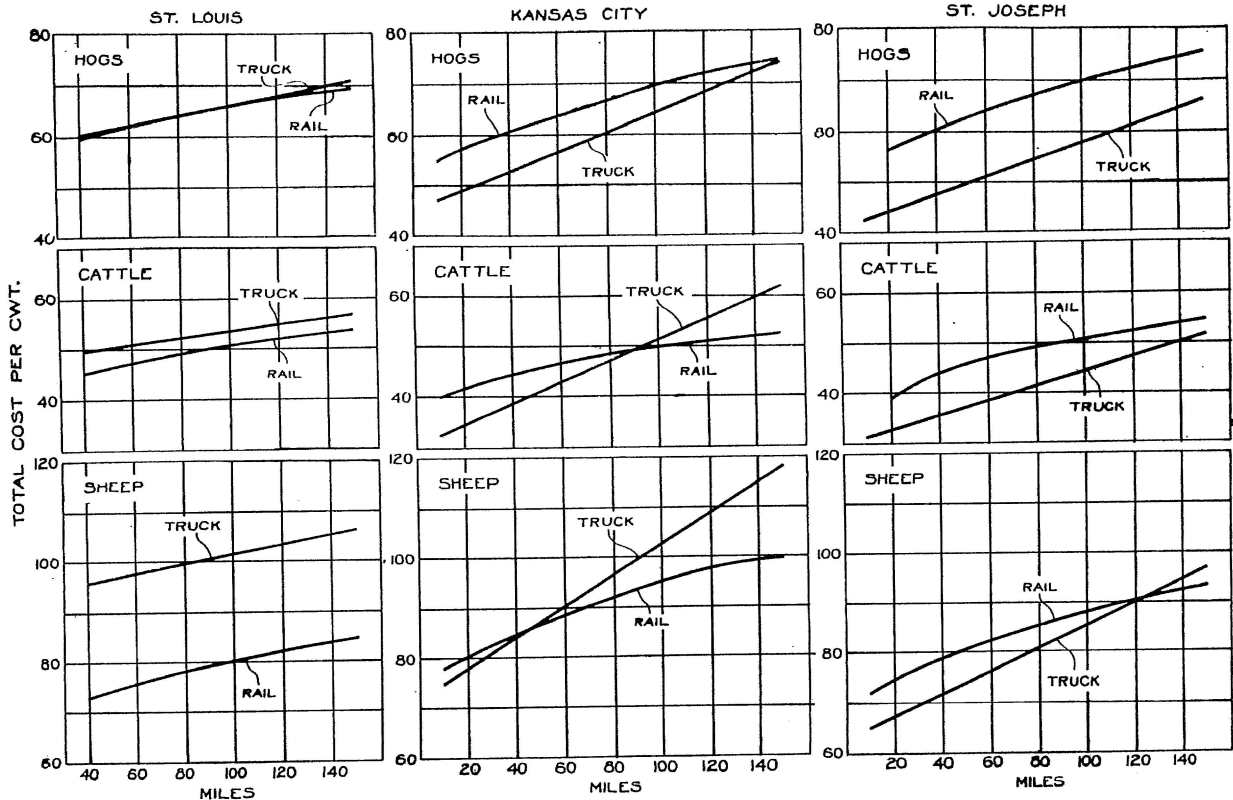


Fig. 15. Total Costs of Marketing by Truck and Rail, by Miles, Markets and Species, 1931. (See Explanation under Figure 11).

from the individual shipping points. A number of reasons for this are suggested, including lower cost of gasoline and tires, relatively greater improvement in roads most distant from the markets, and relatively greater increase in competition in the outlying territory.

The change in the general rate tendencies from 1930 to 1931, for the several species and markets, is shown in Figure 14, and the values of a and b in Table 8. The distribution of individual shipments has been omitted from Figure 14 to conserve space, but some idea of the scatter for 1931 may be obtained from the values of S_y in Table 8. While the number of cases used for 1931 was smaller, the scatter about the line was less, absolutely, as compared with 1930. This means that the regression lines of estimate for 1931 were more representative of the individual cases than those for 1930, in terms of cents per hundredweight. Of course, this is largely due to the reduction in the level of rates, and the 1931 lines are not as representative as those for 1930 in terms of percentages.

The greatest change in rates was in the St. Joseph and Kansas City territories. In all cases except sheep at Kansas City the declines were greatest as distance from the market increased. Rates on sheep to St. Louis from points close to the market apparently increased slightly, although the change was so slight as to be attributable possibly to chance fluctuations in the data. The declines were greatest for hogs and smallest for sheep in all markets. The average percentage drop for each species and market is shown in the bottom line of Table 8.

In calculating total marketing costs for 1931, based on these revised truck rates, all other items remained the same except the local hauling charge on rail shipments. While no new data on local hauling rates were available, it was assumed that they had declined about 25 per cent, an estimate based upon verbal reports from local points. This is the only change made in the cost of marketing by rail. During the first part of 1932 some increases in rail rates went into effect, but since recently promulgated regulations applying to truckers may result in somewhat higher truck rates, it was believed best to leave the final comparison of total costs as of 1931. This is shown in Figure 15.

It is apparent that in 1931 the cost of marketing by truck was considerably lower compared with rail than in 1930. For all species to St. Joseph, and hogs to Kansas City, the cost was less by truck than by rail. For hogs to St. Louis and cattle to Kansas City the costs were about the same, taking into account the complete mileage range. For sheep to Kansas City and both cattle and sheep to St. Louis, rail shipment was cheaper than truck. These developments are very significant. They indicate that no longer is convenience the main or only incentive to truck shipments. Cost, the big argument previously used in support of rail movement, now is generally in favor of the truck.