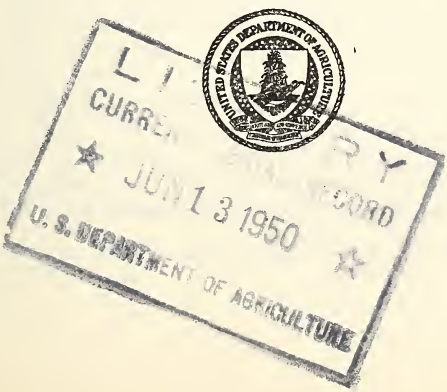
Circular No. 847

Effect of Increases in Freight Rates on Agricultural Products

by DONALD E. CHURCH, Transportation Economist
Bureau of Agricultural Economics

UNITED STATES DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C. APRIL 1950



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SUMMARY

In 1949 the transportation "bill" (exclusive of local haulage) for agricultural and related products amounted to about 3.6 billion dollars. For food products alone, it was nearly 2.5 billion. Both of these bills were more than double their prewar levels, mainly because of the combined effect of higher rates and greater volume, although longer hauls also were factors.

Railroad rates on commodities as a whole have increased about 57 percent since July 1, 1946, when the series of postwar rate increases began. However, rates on agricultural products apparently have increased somewhat less than have rates for all commodities combined. Rates charged by regulated motor carriers apparently have increased

[1] This circular was made possible through funds authorized by the Research and Marketing Act of 1946.

almost in proportion to railroad rates, although numerous instances are reported in which selected agricultural commodities are diverted from rail to motortruck because of lower-than-rail rates. A considerable part of this diversion may be caused by such service factors as smaller minimum weights, faster service, and less handling. In some instances, these service considerations favor motortruck hauls even at higher-than-rail rates.

The impact of increases in transportation rates differs from the impact of increases in almost all other types of costs. An increase in transportation costs by a uniform percentage, such as a 10-percent increase on all existing rates, tends to *decrease* prices at nearby markets (despite higher absolute transportation charges) and to increase prices at distant markets. As discussed more fully in a later section, this difference in price changes among markets is caused by a change in the difference between the transportation rates to the various markets. This, in turn, generates a change in the relative quantities shipped to each market. In contrast, few of the other types of costs differ for shipments to one market as compared with another.

The succession of rate increases since the middle of 1946 has not only raised the transportation cost between producer and consumer; it has changed the differentials among producers and markets. Thus the previous competitive balance has been altered. This should force substantial readjustments throughout the agricultural economy, readjustments which would affect farmers, packing and processing plants, distributors, consumers, and even the carriers themselves.

Initially, increases in transportation charges increase costs to shippers and widen the margins between shippers and wholesalers, as demonstrated by statistical studies of potato prices. Coincidental with the increased price spreads were shifts in the volume of products shipped to various markets. Diversion from rail to motor carriers has been reported in substantial amounts, especially for fresh fruits and vegetables. Processors and distributors also are showing increased interest in owning and operating private motortrucks as a means of lowering transportation costs.

Longer-range effects have begun to materialize. For example, railroads in Maine reduced rates for potatoes between Maine and other New England points, even at the time that a request for a further general rate increase was pending before the Interstate Commerce Commission. Other selective reductions in rates have been made and additional proposals for reduced rates are reported under consideration by some railroad rate bureaus. Further readjustments are to be anticipated, partly to lessen diversion to motortrucks and water carriers, but also to lessen competitive disadvantages that were unavoidably created by the previous fairly uniform percentage rate increases.

More permanent readjustments are being widely discussed and some action apparently has been taken. For example, some food processors are decentralizing their operations to avoid the cost of long hauls. This decentralization is accomplished through the acquisition of plants near leading markets and to some extent through

other arrangements. Some processors are reported to be changing their lines—virtually discontinuing the products that previously moved into distant markets, and further diversifying their production to obtain a larger volume of sales in nearby markets.

These changes necessarily affect the agricultural situation directly through prices and costs and indirectly through changes in the competitive balance between producing areas and markets. Although the initial effect on prices and costs appeared shortly after the increase in rates, changes in marketing channels, outlets, transport media, location of plants, and other operational phases require extended periods of time to materialize, even though given a strong impetus such as has occurred in rates and rate differentials.

FOOD TRANSPORTATION BILL

The total expenditure for intercity [2] transportation of farm food products during 1949 is estimated to have been about 2.5 billion dollars (table 1). This total bill is about 2½ times the prewar expenditures (1939), primarily because of the compounding effect of simultaneous increases in rates, volume, and length of haul. Roughly three-fifths of the rise between 1939 and 1949 was caused by rate increases, one-fifth by increases in volume, and another fifth by longer hauls. Between 1939 and 1949, rates for food products apparently increased about 55 percent, volume was up about 20 percent, and length of haul increased about 18 percent.[3]

Broadly speaking, the effect upon the transportation bill of simultaneous increases in all three factors is not unlike the compounding of interest. Small relative increases in each of the three create an increase that is considerably larger than the sum of the relative increases.

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[2] Includes all transportation except local haulage within cities or between farms. Local haulage is known to be a substantial part of *total* transportation cost, but an approximation of the actual cost of local movements has not been made because of lack of reasonably reliable information. The total includes only railroad and for-hire and private motortrucks. Although some farm food products are hauled by water (especially inland water and the Great Lakes), and by air, the estimated volume is too small to affect the total significantly.

[3] Precise measurements are not available, especially for rates and length of haul. Railroad rates shown by BAE indexes for fresh fruits and vegetables rose 39 percent and rates for wheat increased 50 percent between 1939 and 1949. Between June 1946 and September 1949 the I. C. C. estimated railroad rate increases as follows: Grain 52 percent, fruits and vegetables 43 percent, other agricultural crops 56 percent, animals and meat products 60 percent, manufactured products 64 percent. As many food products are manufactured, the rates on food generally rose more than for the raw products in the two available agricultural rate indexes. Therefore, a 55-percent increase is assumed to be a reasonable estimate for food products generally. The increase in average length of haul for all commodities by railroad was 16 percent between 1939 and 1948. No data are available for length of haul of food products, but it is assumed that the increase was at least as large and probably larger than for all commodities combined, probably 18 percent. Volume of food marketed increased about 20 percent between 1939 and 1948.

TABLE 1.—*Estimated intercity transportation cost for farm products, 1929-49*

Year	Transportation cost [1]		
	Railroad [2]	For-hire and private trucking [3]	Total [4]
	Billion dollars	*Billion dollars*	*Billion dollars*
1929	0. 78	0. 24	1. 02
1930	. 79	. 27	1. 06
1931	. 71	. 29	1. 00
1932	. 59	. 30	. 89
1933	. 54	. 24	. 78
1934	. 56	. 28	. 84
1935	. 50	. 28	. 78
1936	. 53	. 30	. 83
1937	. 53	. 34	. 87
1938	. 59	. 38	. 97
1939	. 58	. 40	. 98
1940	. 58	. 44	1. 02
1941	. 66	. 42	1. 08
1942	. 81	. 34	1. 15
1943	. 92	. 31	1. 23
1944	1. 00	. 34	1. 34
1945	1. 06	. 43	1. 49
1946	1. 04	. 61	1. 65
1947	1. 17	. 79	1. 96
1948	1. 27	. 93	2. 20
1949 [5]	1. 31	1. 21	2. 52

[1] Includes transportation for civilian consumption plus costs within United States for transportation of food products for commercial export, military, and lend-lease.

[2] Derived from Class I Steam Railroad reports to Interstate Commerce Commission of freight revenues for selected commodities.

[3] Estimated as follows: Total truck miles estimated by I. C. C. based on data Public Roads Administration; ton-miles converted to revenues on basis of revenue of Class I Motor Carriers reported for period since 1939 and estimated for earlier years on price indexes of carrier operating-cost components; revenue for food assumed to be same percentage of total for motor as for rail after allowance for products of mines.

[4] Revenue from milk included in entire series, protective service includes 1938 to date.

[5] Preliminary.

Trends in the total farm food transportation bill and shipper expenditures for railroad and motor-carrier service are shown for the last 20 years by table 1 and figure 1. The estimated total bill reached a low point in 1933 and again in 1935 but since 1935 it has continuously increased. As judged by railroad-rate indexes for fruits, vegetables, and cotton,[4] the general level of rates for food products apparently remained almost unchanged between 1935 and mid-1946 except for the emergency increase that was granted in March 1942 and with-

[4] See UNITED STATES BUREAU OF AGRICULTURAL ECONOMICS. MARKETING AND TRANSPORTATION SITUATION, December 1948 and March 1949.

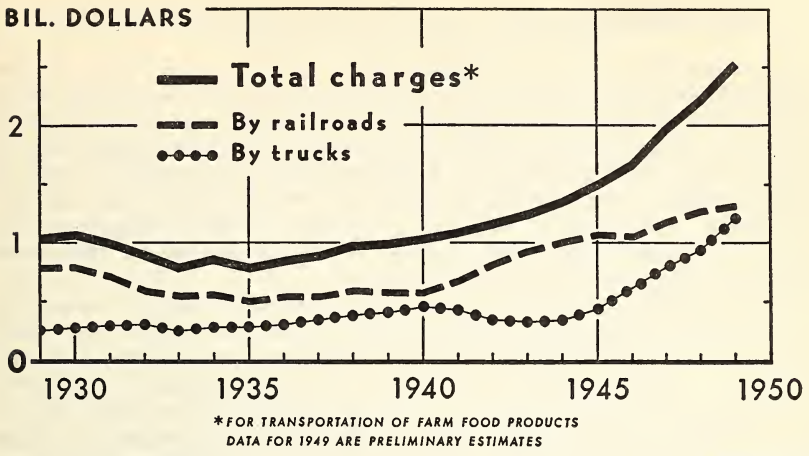

FIGURE 1.—Total bill for hauling food between cities.

drawn in May 1943. Consequently, almost the entire increase in the food transportation bill between 1935 and 1946 was caused by an increase in volume, coupled with a rise in average length of haul. Following June 1946, a series of railroad-rate increases has been granted, and motor-carrier rates in general appear to have increased in about the same proportion. Virtually all of the increase in the total transportation bill during the last 2 years may be attributed to changes in railroad and motor-carrier freight rates.

Figure 1 also reveals the trends in use of railroad and motor carriers in intercity transportation of farm food products. In brief, trucks are taking more and more of the business. Part of the increase in truck volume may be new traffic arising from the fact that truck service is available, but probably the great bulk has been diverted from the railroads. The war temporarily halted the basic growth in truck haulage, but more than made up that delayed growth.

Because of the lack of detailed statistical data, particularly for motortruck movements of food products, these are rough estimates.[5] The railroad component is reasonably accurate, as relatively minor adjustments in actual railroad revenue reports were needed to measure movements of food products. Refinements of the motortruck transportation bill would be desirable if better information could be obtained. However, the motortruck bill appears to be reasonably sound because the sum of the railroad bill plus the motortruck bill yields a reasonable total, despite wide variations in the trends of the two components. Further confirmation of these estimated trends in the transportation bill is given by the fact that independent tests based on volume, length of haul, and changes in rate levels roughly agree with the trend in the food bill.

[5] For a more complete description of the estimates, see UNITED STATES BUREAU of AGRICULTURAL ECONOMICS. MARKETING AND TRANSPORTATION SITUATION, May 1949.

TRANSPORTATION AND MARKETING BILLS

The estimated cost of transportation of food discussed in the preceding section includes the transportation bill for farm food products for civilian consumption, plus the total cost in the United States for transportation of food products for commercial export, military use, and lend-lease. Although these noncivilian costs of transportation cannot be segregated as between railroad and motor-truck costs, they can be estimated in total. Table 2 compares the intercity transportation bill with the total marketing bill for farm food products bought by civilian consumers.

The transportation bill has absorbed around 10 to 12 percent of the total marketing bill in almost every year since 1929. In 1949, transportation was estimated to have amounted to 13 percent of the total bill. This may reflect the recent increases in rates. However, small changes in the ratio may not be significant in view of the unavoidable approximations used in the basic computations. The marketing bill includes transportation costs and such merchandising costs as storing and selling, cost of processing (as milling wheat into flour, or canning tomatoes), and all other costs incurred between farmer and consumer.[6]

TABLE 2.—*Estimated intercity total transportation and marketing costs for farm food products purchased by civilian consumers*, 1929–49

Year	Transportation [1]	Marketing [2]	Transportation as a percentage of marketing
	Billion dollars	*Billion dollars*	*Percent*
1929	0. 97	10. 31	9
1930	1. 01	10. 18	10
1931	. 96	8. 78	11
1932	. 86	7. 57	11
1933	. 76	7. 55	10
1934	. 81	8. 09	10
1935	. 77	7. 83	10
1936	. 82	8. 61	10
1937	. 85	8. 39	10
1938	. 94	8. 39	11
1939	. 95	8. 48	11
1940	1. 00	8. 50	12
1941	1. 01	8. 85	11
1942	1. 00	9. 92	10
1943	1. 00	10. 37	10
1944	1. 07	10. 78	10
1945	1. 23	11. 04	11
1946	1. 48	13. 67	11
1947	1. 76	15. 88	11
1948	2. 01	17. 55	12
1949 [3]	2. 29	18. 20	13

[1] Differs from total transportation bill for farm products because estimated transportation cost of products for commercial exports, military use, and lend-lease, have been excluded.

[2] U. S. Department of Agriculture, Agriculture Information Bulletin 4, p. 14.

[3] Preliminary estimate.

[6] For further description of the marketing bill, see UNITED STATES BUREAU OF AGRICULTURAL ECONOMICS, PRICE SPREADS BETWEEN FARMERS AND CONSUMERS, 1913–48. U. S. Dept. Agr., Agriculture Info. Bul. 4, page 13.

TRANSPORTATION BILL FOR AGRICULTURAL AND RELATED PRODUCTS

Some agricultural products, such as fresh fruits and vegetables, are used almost exclusively as food products. Others, as tobacco, are almost exclusively nonfoods. Still others, wheat for instance, used both for flour and for chicken feed, serve both food and nonfood uses.

The food transportation bill previously discussed included charges for transporting foods plus the food "share" of the transportation charge for products that are used for both food and nonfood uses. The agricultural transportation bill discussed below includes the bill for transporting all agricultural products irrespective of the nature of their use. Consequently, the agricultural transportation bill is larger than the food transportation bill by the amount involved in the "nonfood" component.

The total intercity transportation charges for agricultural and related products are estimated to have been about 3.6 billion dollars in 1949 as compared with 2.5 billion for food products alone and about 13.9 billion for all commodities, including products of mines, manufactures, and all others, as shown by table 3. Thus, the transportation bill for agricultural and related products represents almost a fourth of the total national intercity transportation bill.

As in the case of food products alone, large increases in volume, freight rates, and longer hauls have more than doubled the agricultural transportation bill since prewar. Increases in rates have been significant only since the middle of 1946.

TABLE 3.—*Estimated costs of transportation for agricultural and nonagricultural products by type of carrier, 1939 and 1949* [1]

Type of carrier	Agricultural and related products		Nonagricultural products		Total	
	1939	1949	1939	1949	1939	1949
	Billion dollars	*Billion dollars*	*Billion dollars*	*Billion dollars*	*Billion dollars*	*Billion dollars*
Railroads	0. 8	1. 9	2. 6	5. 7	3. 4	7. 6
Motortruck	. 5	1. 7	1. 2	3. 8	1. 7	5. 5
Other [2]	([3])	([4])	. 9	. 8	. 9	. 8
Total	1. 3	3. 6	4. 7	10. 3	6. 0	13. 9

[1] Preliminary estimate for 1949.
[2] Water carriers of freight, air carriers of freight and express.
[3] Approximately 0.05 billion dollars.
[4] Less than 0.05 billion dollars.

Railroad data based on Interstate Commerce Commission commodity revenues for Class I railroads; motortruck data based on Interstate Commerce Commission estimates of ton-mile by all types of motortrucks (for-hire plus private trucks) in intercity service translated into dollars on basis of revenue per ton-mile of Class I motor carriers reporting to the Interstate Commmerce Commission; division between agricultural and nonagricultural for motortrucks assumed to be the same as railroad, after allowance for products of mines; data for "other" estimated from Civil Aeronautics Board reports, Army Engineer, and Interstate Commerce Commission water-carrier reports.

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RECENT TRENDS IN RAILROAD AND MOTOR-CARRIER RATES

Railroad rates remained essentially at prewar levels until the middle of 1946. The first major increase became effective on July 1, 1946, when rates were raised 6.5 percent on most commodities, although a 3-percent increase was imposed on grain, livestock, and some other specified commodities. That increase was followed by 7 other general rate-increase actions, resulting in an average increase above the 1946 level of about 57 percent by September 1, 1949, as shown by the accompanying summary.

Regulated motor-carrier rates apparently have risen somewhat less than railroad rates. The upward trend in motor-carrier rates appears to have started somewhat earlier than did the increases in rail rates, as judged by a compilation of representative freight-rate increases for motor common carriers issued by the Department of Commerce,[7] as shown by the accompanying summary.

Increases in railroad freight rates and charges authorized by Interstate Commerce Commission

Effective date and average percentage increase over rates in effect, June 30, 1946	Explanation of increase
July 1, 1946 — 6.5 percent	3 percent on grain, livestock, and other specified commodities; 6-percent general increase in other rates and most accessorial charges; specified increases in line-haul rates on coal and coke; *additional* 5-percent increase in Official Territory.
Jan. 1, 1947 — 17.6 percent	20-percent increase above June 30 rates and charges except: 25 percent in Official Territory, 22.5 percent between Official Territory and other territories; 20 percent within and between other territories; 15 percent increase on specified commodities (including grain, livestock, and certain other agricultural commodities) certain commodities (cotton in bales, citrus and other fruits and vegetables, and wool) subject to maximum specified increases in cents.
Oct. 13, 1947 — 28.1 percent	10-percent emergency surcharge except: No increase for demurrage or protective services; increase of 10 cents per ton on iron ore and sinter; specific increases in dollars per carload on coal and coke.

[7] UNITED STATES DEPARTMENT OF COMMERCE. AN EVALUATION OF MOTOR TRANSPORTATION. Industry Reports, Domestic Transportation, May–August 1948, pages 92–101.

Increases in railroad freight rates and charges authorized by Interstate Commerce Commission—Continued

Effective date and average percentage increase over rates in effect, June 30, 1946	Explanation of increase
Jan. 5, 1948 37.8 percent	20-percent interim surcharge (superseding action of October 13, 1947) subject to numerous maxima and exceptions; specified increases in rates per ton on certain products of mines; no increase in charges for protective services.
May 6, 1948 42.8 percent	Before adjustments for exceptions and specific maxima, increases above January 1947 rates estimated to aggregate 30 percent within Eastern Territory, 25 percent within Southern Territory, 25 percent from, to, and within Zone I of Western Trunkline Territory, 20 percent within the remainder of Western Territory; 10-percent increase for protective services; specific increases on certain handling charges.
Aug. 21, 1948 44.2 percent	Previous temporary increases made permanent except: Maxima on citrus fruits reduced; some nonagricultural products reduced, some increases; protective services increased additional 5 percent.
Jan. 11, 1949 51.7 percent	Pending further hearings, interim increase allowed averaging 5.2 percent for country, as a whole—6 percent within and between Eastern and Southern Territories; 5 percent within Zone I of Western Trunkline Territory; 4 percent within Western Territory (other than Zone I of Western Trunkline Territory) and 5 percent on interterritorial movements except between Eastern and Southern. Increases to be superimposed on existing rates. Held to maximums of 6 cents per cwt. on fruits, vegetables, and melons, and 4 cents on sugar and lumber. No increase in protective services.
Sept. 1, 1949 57.3 percent	Permanent increases granted (superseding interim increases granted Jan. 11) averaging 9.1 percent above the rates at end of 1948 for country as a whole—10 percent within and between Eastern and Southern Territories, 9 percent within Zone I of Western Trunkline Territory, 8 percent within Western Territory (other than Zone I) and 9 percent on interritorial movements except those between the Eastern and Southern Territories. Held to maximums of 9 cents per cwt. on fresh fruits, vegetables, and melons and to 6 cents on sugar and lumber. No increase on protective services.

Average percentage increases summarized from analyses by Bureau of Transport Economics and Statistics, Interstate Commerce Commission; explanation of increases summarized from I. C. C. decisions.

Representative interstate regulated motor common carrier freight-rate increase authorized by the Interstate Commerce Commission, 1942–49 [1]

Date of increase	Explanation of increase [2]
March 1942	6 percent on most commodities, 3 percent on others in all territories.
October 1943	4 percent except Middle West, Southwestern, and Rocky Mountain regions.
April 1945	Emergency increases of 2½ cents per 100 pounds on less than truckload, and 1 cent per 100 pounds on truckload traffic in Central, Middle Atlantic, and New England area (amounted to 4 percent in New England), surcharge of 5 cents on less than 5,000 pounds in Rocky Mountain Territory and Pacific States.
First half of 1946	Various, such as: Substitution of a 15-percent increase on shipments of 6,000 pounds or over in Middle Atlantic States; increase of 20 percent with maximum of 20 cents per 100 pounds on shipments under 2,000 pounds, and 10 percent with maximum of 10 cents per 100 pounds on shipments of 2,000 to 5,000 pounds in Southern Territory; increase of about 4 percent in the Middle West; increase of about 10 percent in New England; surcharges varying from 1 cent to 20 cents per 100 pounds in Rocky Mountain and Pacific States.
Second half of 1946	10 percent in Rocky Mountain and Middle Western areas, other increases in other territories.
First half of 1947	13–25 percent generally with other increases in other territories. No increases noted in Southwestern area.
Second half of 1947	10 percent generally except Middle Atlantic and Southwestern with 20 cents per 100 pounds on shipments under 5,000 pounds in the Central States; no increase noted in Middle Atlantic and Southwestern States.
First half of 1948	10 percent in most areas; some Rocky Mountain and Pacific States 20 percent; no increases noted in Middle Western Territory.
Second half of 1948	10-percent general increase in Central States.
Year 1949	4–5 percent general increase in New England, Middle Atlantic, Rocky Mountain, and Pacific Northwest Territories and between some territories.

[1] Generally, motor common carrier rates have been increased in line with increases granted the railroads following action in Ex Parte 148, 162, and 166.

[2] Areas constituting various territories or States are not entirely accurate as some overlapping occurs between territories of some rate bureaus; as rate increases are not necessarily confined to State boundaries; and as many rates published are applicable between territories as distinguished from those applicable within a territory.

Information prior to second half of 1948 summarized from AN EVALUATION OF MOTOR TRANSPORTATION, United States Department of Commerce, Industry Reports, Domestic Transportation, May–August 1948, pages 92–101.

General rate increases for railroads usually are granted on a Nation-wide basis, with exceptions that can be estimated within a reasonable degree of accuracy. No such uniformity of action exists among the numerous motor-carrier tariff bureaus. Furthermore, a large proportion of the recent rate actions by motor carriers has involved readjustments of their rate structures. Many specific rates decreased at the same time that other rates increased. Consequently, an over-all estimate of the change in the motor-carrier rate level cannot be made readily.

However, variations in the carrier revenue per ton-mile of freight hauled roughly indicate changes in rate levels. By using ton-mile data, allowance is made for most of the influence of changes in length of haul and volume. Fluctuations in the revenue per ton-mile therefore represent primarily changes in rates, although variations in the proportion of the high-rated to the low-rated commodities probably have a significant influence and the influence of other factors may not be completely removed.

As shown by table 4, the major increase in revenue per ton-mile for motor carriers occurred between 1946–49. The trend of railroad revenue per ton-mile roughly approximates that of motor carriers. Railroads obtained slightly less than 1 cent per ton-mile in 1940. Ton-mile revenue declined somewhat between 1940 and 1943, and in 1949 it is estimated to have increased to 1.35 cents. The average railroad ton-mile revenue increase between 1945 and 1949 is estimated to have been approximately 40 percent as compared with 30 percent for motor carriers.

TABLE 4.—*Revenue per ton-mile by Class I motor carriers of property and by railroads, 1940–49*

Year	Revenue per ton-mile by class I	
	Motor carriers	Railroads
	Cents	*Cents*
1940	3. 9	0. 95
1941	3. 7	. 94
1942	3. 8	. 93
1943	3. 8	. 93
1944	4. 0	. 95
1945	4. 0	. 96
1946	4. 3	. 98
1947	[1] 4. 8	1. 08
1948	[1] 5. 2	1. 25
1949 [2]	5. 2	1. 35

[1] Revised.

[2] Estimate based on 9 months computed from Interstate Commerce Commission reports.

The fact that the revenue per ton-mile of regulated motor carriers is nearly four times the ton-mile revenue of railroads is accounted for primarily by differences in the nature of the traffic. *Regulated* motor carriers are engaged principally in hauling high-rated commodities rather than the low-rated commodities, such as wheat and coal. Hauls by motor carriers are usually shorter, and these normally yield higher ton-mile revenues than do the longer hauls. Shipments of small quantities make up a larger share of the total motortruck tonnage than is the case for railroads. All of those factors tend to increase the ton-mile revenue for motor carriers above that for railroads.

GENERAL RAILROAD RATE LEVEL FOR SELECTED AGRICULTURAL COMMODITIES

Generally speaking, two major sets of factors are considered in setting railroad rates. One set involves costs of rendering transportation service—such as length of haul, weight of products that can be shipped in a single freight car, and risk of loss and damage. The other set involves elements that are concerned with the "value of service." This set of factors involves such questions as carrier competition, market competition, and effect of rates on traffic volume.

TABLE 5.—*Average length of haul, short line, revenue and load, of selected agricultural commodities, 1948* [1]

Commodity	Revenue		Length of haul, short-line	Load per car
	Per short-line ton-mile	Per hundred-weight		
	Cents	*Cents*	*Miles*	*Tons*
Flour, wheat	0. 81	27	662	37
Soybean oil cake	. 98	24	485	38
Cereal food preparations	1. 16	37	635	24
Sugar beets	1. 22	5	84	39
Barley and rye	1. 30	28	435	49
Apples	1. 41	137	1, 950	20
Oats	1. 42	27	384	40
Sorghum grain	1. 43	32	454	52
Wheat	1. 46	27	365	53
Corn	1. 50	25	329	51
Oranges and grapefruit	1. 55	123	1, 591	23
Lettuce	1. 64	184	2, 247	12
Potatoes	1. 65	68	823	21
Hay	1. 99	45	448	15
Cotton in bales	2. 01	56	556	21
Soybeans	2. 48	19	152	50
Tobacco, unmanufactured	3. 03	61	400	15

[1] Based on 1-percent sample of carload waybills covering traffic terminated on Class I railroads in 1948. Interstate Commerce Commission, carload waybill analyses, 1948.

Most significant from a cost-of-service standpoint is the length of haul, which varies widely among agricultural products. For example, in 1948 the average length of haul for sugar beets was only 84 miles[8] compared with an average for lettuce of 2,247 miles (table 5). The effect of this factor is seen in the wide variation in average revenue per 100 pounds, which ranges from as little as 5 cents for sugar beets to $1.84 for lettuce.

However, distance does not account for all variations, as shown by the fact that average railroad freight revenue per ton-mile also varies widely among the agricultural commodities. Ton-mile revenue is less than 1 cent (0.81) for wheat flour compared with 3.03 cents per ton-mile for unmanufactured tobacco. As shown in table 5, wheat flour has a relatively high weight per carload and it is normally hauled a long distance, in contrast to the light loading and shorter hauls of unmanufactured tobacco.

SHIPPER COSTS AND RAIL RATES

The interrelationships between rail rates and shipper costs in getting products to market are demonstrated by figure 2 for fruits and vegetables, wheat, and cotton. The solid lines on the charts measure freight rates only and are not affected by other factors.[9] The dotted lines on the chart measure the revenue received by railroads per ton

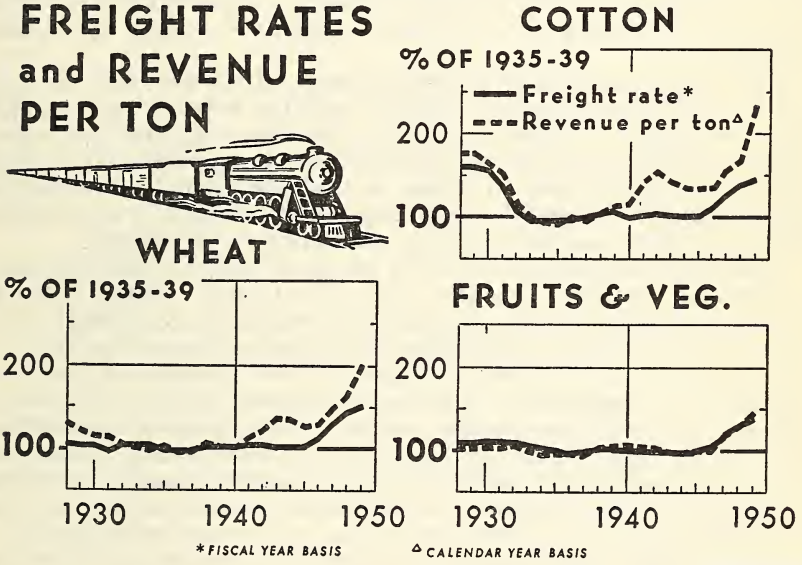

FIGURE 2.—Freight rates and revenue per ton; fruits and vegetables, wheat, and cotton, 1928–48

[8] Based on "short-line" mile which is the shortest practicable railroad distance between point of origin and destination. The actual haul may have been performed by a railroad which operated over a longer route. Consequently, the actual length of haul is somewhat longer than this "short-line" average.

[9] For description of points of origin and destination, commodities, and method of computing the rate indexes, see United States Bureau of Agricultural Economics *Marketing and Transportation Situation,* December 1948 and March 1949.

of commodities originated. From a shipper's point of view, this average revenue per ton is his cost for rail transportation per ton of products shipped.[10] As the primary interest of this report is from the standpoint of shippers, it is well to think of the revenue per ton as the shipper's cost for movements by railroad. However, it should be recognized that the fluctuations in the shipper's cost per ton result not only from changes in freight rates, but also from length of haul and geographic distribution. In the case of averages for fruits and vegetables, some fluctuations also are caused by changes in the relation between tonnage of high-rated and of low-rated commodities.

Each of the three commodities shown on the chart demonstrates peculiarities that are not common to the others. The closest relationship between fluctuations in freight rates and shipper costs is found in fruits and vegetables where the major difference is a tendency for shipper cost per ton to increase gradually (in relation to rates). This was found to be almost continuous during the last 20 years. Major departures from that trend occurred during the latter stages of the depression of the 1930's and during the mobilization and war years. In the case of wheat, the revenue per ton originated between 1928–36 dropped, whereas rail rates tended to remain relatively constant. However, between 1940–45, average cost per ton rose sharply in contrast to the stable rates. This reflected mainly the sharp increase in export shipments of wheat which involve longer hauls than do normal domestic movements. Since 1945, the increase in average revenue per ton has been somewhat less than the increase in rates.

The case of cotton is strikingly different. Between 1928 and 1933, rail rates on cotton dropped sharply and the revenue per ton came down even more. Following 1939, the mobilization and war periods created a bulge in revenue per ton which was not paralleled by changes in railroad freight rates. The rise and subsequent fall in revenue per ton probably was caused by corresponding changes in export shipments of cotton and diversion to rails from water carriers.

Additional information showing trends of shipper cost for major groups of agricultural products is given in table 6. Shipper cost for marketing livestock shows the more spectacular increase, rising from $6.54 a ton in 1928 to more than $13 a ton estimated for 1949. A large part of that increase was caused by the diversion of short-haul movements to motortrucks, which automatically increases the average cost per ton for shipments that remain on the railroads even without a change in rates. Although the increase in cost per ton of fruits and vegetables was slightly larger in terms of dollars per ton, it represented a smaller percentage increase because the average cost for fruits and vegetables was a great deal higher than was that for livestock.

Table 6 shows that the transportation cost for fruits and vegetables

[10] Technically, average revenue per ton is obtained by dividing the total railroad revenue by the number of "tons originated." Each time a new waybill is issued, the shipment becomes an "origination." For example, if a carload of potatoes moves through two hands from farm to final consumption, and if each handler takes delivery and then makes further shipment by railroad, that one carload of potatoes becomes two carloads originated and the average revenue per carload is half the total railroad transportation cost from the farm to final consumption. However, the average still represents the shipper cost, as in this instance each handler would be a shipper.

was $17.45 a ton in 1928 and that it rose to $25 in 1949. For all agricultural products combined, the increase was not so large as in the two classes mentioned, chiefly because of the heavy volume of bulk products, such as grains and cotton. The average railroad cost per ton of all agricultural products was slightly more than $7 in 1928 as compared with almost $9 in 1949.

TABLE 6.—*Average rail freight transportation cost per ton, of agricultural products, by groups, 1928–49*

Year	Fruits and vegetables	Cotton and cottonseed	Grain	Livestock	All agricultural products
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1928	17. 45	7. 63	4. 12	6. 54	7. 04
1929	17. 75	7. 83	4. 00	6. 45	7. 09
1930	17. 91	6. 90	3. 77	6. 55	6. 99
1931	17. 92	6. 71	3. 73	7. 00	7. 18
1932	18. 15	5. 50	3. 33	7. 08	7. 00
1933	17. 21	5. 26	3. 27	7. 11	6. 50
1934	16. 89	4. 76	3. 20	7. 29	6. 77
1935	16. 91	4. 99	3. 17	7. 46	6. 74
1936	17. 27	5. 29	3. 03	7. 46	6. 45
1937	16. 77	5. 20	3. 15	7. 60	6. 32
1938	17. 83	5. 66	3. 39	8. 01	6. 40
1939	18. 46	6. 32	3. 35	8. 26	6. 70
1940	18. 75	6. 82	3. 42	8. 21	6. 81
1941	18. 27	8. 37	3. 73	8. 14	6. 91
1942	18. 04	8. 89	4. 00	8. 40	7. 19
1943	17. 12	8. 48	4. 42	8. 28	7. 12
1944	16. 92	7. 99	4. 41	8. 19	7. 44
1945	17. 49	8. 08	4. 34	8. 69	7. 31
1946	17. 43	8. 25	4. 27	9. 66	7. 49
1947	20. 78	9. 39	4. 86	10. 11	7. 80
1948	22. 73	10. 08	5. 43	12. 51	8. 97
1949 [1]	25. 39	9. 85	6. 22	13. 48	8. 78

[1] Preliminary.

EFFECT OF RECENT RATE INCREASES ON RATE DIFFERENTIALS

As previously indicated, rates between various points of origin and destination vary with many factors, such as length of haul, density of loading, liability to loss and damage, and competition. These variations create differences, that is, differentials, in rates between one point of origin and destination as compared with other points of origin and destination.

Uniform percentage changes in rates normally result in varying changes in the rate differentials, in terms of cents per hundred pounds because the basic rate between one set of points usually differs from the rate between another set of points. For example, on January 15, 1950, the rate for Virginia potatoes to New York City (table 7) was 51 cents per hundred pounds, as compared with $1.70 from California. A 10-percent increase in both rates would result in a 5-cent increase on Virginia potatoes and a 17-cent increase on California potatoes. The differential would increase from $1.19 to $1.31 and would place

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California suppliers at a 12-cent greater rate disadvantage than before the rate increase.

A difference of opinion exists regarding the significance of such an increase in the rate differentials. Some believe that the competitive situation would remain essentially unchanged because the *percentage* increase in the differential is the same as the *percentage* increase in rates—all rose 10 percent. The author believes that the competitive situation would be altered, because the absolute difference in comparative costs would be changed.

A definite conclusion cannot be reached at present because not enough facts are known about the differences in the effects of percentage changes as compared with absolute changes in rate differentials. Probably the major uncertainties involve consumer preferences and competitive pricing practices. If consumers tend to think in terms of *relative* differences in prices of closely competitive products, it would be reasonable to assume that equal percentage changes in rates and hence rate differentials would not alter the competitive situation. If consumers tend to think of the differences in prices of competitive items in terms of so many cents per pound, dozen, or box, then a change in the actual rate differential would tend to divert demand to the product that had the smallest absolute increase in rates. In that event, a change in the absolute differential would alter the competitive situation. These broad statements oversimplify the issues and fail to recognize a number of other considerations which might modify the conclusion somewhat.

Most rate increases since the war have been uniform percentage increases, varying among regions and commodities. Two outstanding general types of exceptions were made. Rate differentials in coal were frozen, and each rate was increased by a fixed number of cents per ton. The other was a compromise in rates for fruits and vegetables where the full impact of uniform percentage increases was dampened by limiting the maximum increase to a specified amount in cents per 100 pounds. This device is known technically as a "hold-down." Specific examples of hold-downs are shown in table 7. For example, in shipments of Idaho and California potatoes to New York City, the increases from both origins amounted to 42 cents per 100 pounds by January 15, 1950. The hold-downs were imposed also on tomatoes from Texas and Florida, on lettuce from California and Arizona, as well as on a number of other specific movements shown in the table. Because of high rates per 100 pounds, these hold-downs applied only on the long hauls. They held the differential constant and at the same time permitted an increase in the rates. If hold-downs had not been used, current differentials and increases in differentials would have been larger.

Comparisons of the differentials in rail rates that existed immediately before and after the recent series of increases in rail rates are given in tables 7 to 9. For example, the rail rate for Long Island potatoes to New York City was 10 cents per 100 pounds in June 1946, as compared with $1.28 per 100 pounds on potatoes from California. This placed California producers at a competitive transportation disadvantage of $1.18 compared with those Long Island producers who used railroad transportation. By January 15, 1950, the rail charges from Long Island to New York City had increased to 18 cents per 100

pounds, as compared with $1.70 for California producers. Consequently, the series of increases in rail rates places the California producer at a 34-cent greater disadvantage than previously existed.

A second example is the case of oranges from Florida and California to New York City. Prior to the recent increases, rail cost was 72 cents greater from California than from Florida to New York City. By January 15, 1950, the differential had increased to 81 cents per 100 pounds. Other illustrations of similar situations may be found in the various commodities listed in tables 7 to 9.

TABLE 7.—*Comparative freight rates and differentials for selected fruits and vegetables from various shipping points to New York City, June 30, 1946 and January 15, 1950*

Commodity and origin	Freight rates per 100 pounds to New York City					
	Actual			Differential above lowest rate shown		
	June 30, 1946	January 15, 1950	Increase	June 30, 1946	January 15, 1950	Increase
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Potatoes:						
New York, Long Island	0. 10	0. 18	0. 08			
Virginia	. 30	. 51	. 21	0. 20	0. 33	0. 13
North Carolina	. 47	. 75	. 28	. 37	. 57	. 20
Maine	. 47	. 62	. 15	. 37	. 44	. 07
South Carolina	. 48	. 88	. 40	. 38	. 70	. 32
Florida	. 70	1. 11	. 41	. 60	. 93	. 33
Idaho	1. 07	1. 49	. 42	. 97	1. 31	. 34
California	1. 28	1. 70	. 42	1. 18	1. 52	. 34
Cabbage:						
New York	. 30	. 51	. 21			
South Carolina	. 55	1. 06	. 51	. 25	. 55	. 30
Florida	. 82	1. 23	. 41	. 52	. 72	. 20
Texas	1. 19	1. 64	. 45	. 89	1. 13	. 24
Tomatoes:						
Florida, Sanford	1. 03	1. 45	. 42			
Texas, San Benito	1. 55	1. 97	. 42	. 52	. 52	
Lettuce:						
Arizona	1. 74	2. 16	. 42			
California	1. 84	2. 26	. 42	. 10	. 10	
Oranges:						
Florida	. 63	. 96	. 33			
California	1. 35	1. 77	. 42	. 72	. 81	. 09
Peaches:						
North Carolina	. 67	1. 09	. 42			
South Carolina	. 75	1. 17	. 42	. 08	. 08	
Georgia	. 86	1. 28	. 42	. 19	. 19	
California	1. 50	1. 92	. 42	. 83	. 83	
Pears:						
California	1. 42	1. 84	. 42			
Washington	1. 42	1. 84	. 42			
Apples:						
New York	. 30	. 52	. 22			
Virginia	. 32	. 54	. 22	. 02	. 02	
California	1. 35	1. 92	. 57	1. 05	1. 40	. 35
Washington	1. 35	1. 92	. 57	1. 05	1. 40	. 35

Rate data obtained from railroad tariffs by Transportation and Warehousing Branch, P. M. A.

TABLE 8.—*Comparative freight rates and differentials for selected fruits and vegetables from various shipping points to Chicago, June 30, 1946, and January 15, 1950*

Commodity and origin	Freight rates per 100 pounds to Chicago					
	Actual			Differential above lowest rate shown		
	June 30, 1946	Jan. 15, 1950	Increase	June 30, 1946	Jan. 15, 1950	Increase
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Potatoes:						
Minnesota	0. 41	0. 64	0. 23			
Nebraska	. 53	. 83	. 30	0. 12	0. 19	0. 07
Colorado	. 61	. 96	. 35	. 20	. 32	. 12
Florida	. 73	1. 13	. 40	. 32	. 49	. 17
Idaho	. 74	1. 14	. 40	. 33	. 50	. 17
California	. 92	1. 34	. 42	. 51	. 70	. 19
Cabbage:						
New York	. 44	. 73	. 29			
Texas	. 91	1. 33	. 42	. 47	. 60	. 13
Tomatoes:						
Texas, Jacksonville	. 87	1. 29	. 42			
Texas, San Benito	. 91	1. 33	. 42	. 04	. 04	
Florida, Sanford	1. 08	1. 50	. 42	. 21	. 21	
Lettuce:						
Arizona	1. 33	1. 75	. 42			
California	1. 43	1. 85	. 42	. 10	. 10	
Oranges:						
Florida	. 88	1. 10	. 22			
California	1. 31	1. 73	. 42	. 43	. 63	
Peaches:						
Illinois	. 41	. 70	. 29			
Georgia	. 82	1. 24	. 42	. 41	. 54	. 13
South Carolina	. 84	1. 26	. 42	. 43	. 56	. 13
California	1. 50	1. 92	. 42	1. 09	1. 22	. 13
Pears:						
California	1. 42	1. 84	. 42			
Washington	1. 42	1. 84	. 42			
Apples:						
Illinois	. 23	. 40	. 17			
New York	. 43	. 75	. 32	. 20	. 35	. 15
Idaho	. 99	1. 41	. 42	. 76	1. 01	. 25
Washington	1. 15	1. 57	. 42	. 92	1. 17	. 25
California	1. 15	1. 57	. 42	. 92	1. 17	. 25

Rate data obtained from railroad tariffs by Transportation and Warehousing Branch, P. M. A.

TABLE 9.—*Comparative railroad freight rates on wheat, cotton, livestock and products for selected origins and destinations, June 30, 1946, and January 15, 1950*

Commodity	Origin	Destination	Actual rates per 100 pounds		
			June 30, 1946	Jan. 15, 1950	Increase
			Dollars	*Dollars*	*Dollars*
Wheat	Hutchinson, Kans	Kansas City, Mo	0. 18	0. 26	0. 08
	Larimore, N. Dak	Minneapolis, Minn	. 20	. 30	. 10
	Enid, Okla	New Orleans, La	. 36	. 54	. 18
Cotton	Clarksdale, Miss	New Orleans, La	. 36	. 53	. 17
	Huntsville, Ala	Greenville, S. C	. 44	. 68	. 24
	Ardmore, Okla	Greenville, S. C	. 82	1. 12	. 30
	Clarksdale, Miss	Boston, Mass. (via rail and water).	1. 22	2. 05	. 83
Cattle	Carrollton, Mo	Kansas City, Mo	. 15	. 23	. 08
	Lanark, Ill	Chicago, Ill	. 17	. 29	. 12
	Hereford, Tex	Kansas City, Mo	. 48	. 71	. 23
	Miles City, Mont	Chicago, Ill	. 68	1. 07	. 39
Sheep	Bedford, Iowa	Chicago, Ill	. 40	. 63	. 23
	Klamath Falls, Oreg	San Francisco, Calif	. 44	. 66	. 22
	Idaho Falls, Idaho	Chicago, Ill	. 95	1. 48	. 53
Hogs	Shelbyville, Mo	East St. Louis, Ill	. 18	. 28	. 10
	Parsons, Kans	East St. Louis, Ill	. 33	. 51	. 18
	Marshalltown, Iowa	Chicago, Ill	. 34	. 53	. 19
Wool (in grease)	Ogden, Utah	San Francisco, Calif	. 79	1. 23	. 44
	Chicago, Ill	Boston, Mass	. 88	1. 44	. 56
	Cheyenne, Wyo	Boston, Mass	1. 92	2. 64	. 72
	Ogden, Utah	Boston, Mass	2. 28	3. 03	. 75
	Portland, Oreg	Boston, Mass	2. 33	3. 08	. 75
Eggs	Marshalltown, Iowa	Chicago, Ill	. 38	. 63	. 25
	Marshalltown, Iowa	New York, N. Y	1. 02	1. 67	. 65

Rate data obtained from railroad tariffs by Transportation and Warehousing Branch, P. M. A.

EFFECTS OF TRANSPORTATION COSTS DIFFER FROM EFFECTS OF MOST OTHER COSTS

The effects of an increase in transportation costs on agricultural prices, farm returns, and distribution of products among markets are complex. Broadly speaking, in the short run, an increase in actual rates is largely absorbed by producers. On the other hand, wholesale prices and distribution of products among markets apparently are largely affected by changes in the transportation rate differentials. An increase in freight rates may cause an actual decrease in the wholesale price in one market and may simultaneously increase the price in another market. Most other costs or changes in those costs do not directly influence the geographic distribution of commodities, nor do they influence prices differently in one market from those in another for products of identical grade and quality.

To indicate more clearly the reason for this difference in the impact of costs, it may be useful to classify costs into three general groups based upon the relative time at which they are incurred during the production and marketing process. Group 1 includes all costs incurred before shipment from the shipping point. Group 2 includes the transportation costs taken broadly to embrace the actual transportation rate, together with supplementary services (such as refrigeration) and any other special costs which are involved in transportation between the shipping point and the various wholesale markets. Group 3 includes all costs incurred after the completion of transportation, and primarily involves storage and merchandising. This classification oversimplifies the actual situation but it emphasizes the fundamental considerations.

Group 1 of these costs (essentially production costs) at one shipping point probably do not vary for units of identical size and grade shipped to one market as compared with another.[11] Consequently, these costs would not affect the shipper's decision as to which market would be the more profitable. Similarly, group 3 (largely storage and merchandising costs) normally should not vary significantly on a per unit basis in any one market between a commodity obtained from one source and an identical commodity obtained from another source. For that reason, these costs would not influence the choice as to source of supply. However, as is later discussed, differences in the costs in one market as compared with those in another may have an effect that is similar to differentials in transportation costs.

In sharp contrast to those two groups of costs, transportation charges from one source of supply to a given market normally differ from the charges to an alternative market. Furthermore, transportation costs from two alternative sources of supply to a single competitive market normally differ. These differences in transportation costs exert a powerful influence upon the selection of sources of supply and they affect the determination of relative prices and the distribution of products among markets.

An illustration of the effect of transportation costs and an increase in those costs is given in tables 10 and 11 under hypothetical conditions, based upon a few fundamental assumptions and mathematical calculations derived from those assumptions.[12] The hypothetical case involves a single commodity from one shipping point to two wholesale markets. For the sake of simplicity, no allowance is made for products from other sources of supply or for possible sales to other markets. Furthermore, to avoid introducing changes that could be attributed to causes other than rates, it is assumed that the total quantity shipped from the source of supply does not change because of a change in freight rates. It is also assumed that the demand for this commodity

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[11] There are exceptions to that generalization, especially with regard to wrapping, packaging, crating, and loading of products for nearby markets. Other costs may also be reduced if the producer is not attempting to get the maximum amount of superior-grade products. The sizes and grades shipped to local markets frequently are inferior to those shipped to distant markets. For analytical purposes, such different sizes and grades are treated as separate products rather than variations applicable to a single product.

[12] See Appendix for a more complete statement of assumptions and mathematical derivations.

TABLE 10.—*Transportation charges, prices, distribution of shipments, and farm returns under assumed conditions*

Item	Distant market one-third the size of near markets		Markets of equal size		Distant market three times the size of near market	
	Before increase (1)	After increase (2)	Before increase (3)	After increase (4)	Before increase (5)	After increase (6)
Transportation charge per unit:	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Distant market	2. 00	3. 00	2. 00	3. 00	2. 00	3. 00
Near market	1. 00	1. 50	1. 00	1. 50	1. 00	1. 50
Difference	1. 00	1. 50	1. 00	1. 50	1. 00	1. 50
Transportation charge:						
Total	49, 287. 00	73, 436. 00	59, 002, 00	87, 762. 00	69, 212. 00	103, 185. 00
Average per unit shipped	1. 23	1. 84	1. 48	2. 19	1. 73	2. 58
Shipments:	*Units*	*Units*	*Units*	*Units*	*Units*	*Units*
Distant market	9, 287	8, 957	19, 002	18, 508	29, 212	28, 790
Near market	30, 713	31, 043	20, 998	21, 492	10, 788	11, 210
Total	40, 000	40, 000	40, 000	40, 000	40, 000	40, 000
Wholesale price per unit:	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Distant market	10. 77	11. 16	10. 52	10. 81	10. 27	10. 42
Near market	9. 77	9. 66	9. 52	9. 31	9. 27	8. 92
Difference	1. 00	1. 50	1. 00	1. 50	1. 00	1. 50
Weighted average	10. 00	10. 00	10. 00	10. 00	10. 00	10. 00
Average farm return per unit [1]	5. 77	5. 16	5. 52	4. 81	5. 27	4. 42

[1] Average wholesale price minus average transportation charge, minus $3 other marketing charge, per unit.

Explanatory note: See text for discussion of assumptions used in developing the above figures; major assumptions are perfect price competition among buyers and sellers, "unit elasticity" of demand, identical total quantity sold under each of the various situations, per unit marketing costs (other than transportation) identical for each market (namely $3 per unit), farm return equal to wholesale price minus transportation and other marketing costs.

has "unit elasticity," meaning that a doubling of quantity shipped to one market would cut wholesale prices in that market in half. As a direct consequence of that assumption, the total market value of all units sold in each market does not change. It is also assumed that the third group of costs (storage and merchandising) is the same for the two markets and that all costs other than transportation do not change as a direct result of the change in transportation costs.

TABLE 11.—*Percentage change in transportation charge, distribution of shipments, and farm return after rate increase*

Item	Distant small market	Markets same size	Distant large market
(A) Change in transportation charge per unit:	*Percent*	*Percent*	*Percent*
Distant market	+50. 0	+50. 0	+50. 0
Near market	+50. 0	+50. 0	+50. 0
Average for both markets	+49. 0	+48. 7	+49. 1
(B) Change in volume of shipments:			
Distant market	−3. 6	−2. 6	−1. 4
Near market	+1. 1	+2. 4	+3. 9
Total shipments	0	0	0
(C) Change in wholesale prices per unit:			
Distant market	+3. 7	+2. 7	+1. 5
Near market	−1. 1	−2. 3	−3. 8
Average for both markets	0	0	0
(D) Change in average farm return per unit	−10. 6	−12. 9	−16. 1
(E) Transportation charge as a percentage of market value:			
Before rate increase	12. 3	14. 8	17. 3
After rate increase	18. 4	21. 9	25. 8
Difference	+6. 1	+7. 1	+8. 5
(F) Transportation charge as a percentage of farm return:			
Before rate increase	21. 4	26. 7	32. 8
After rate increase	35. 6	45. 7	58. 4
Difference	+14. 2	+19. 0	+25. 6

EXPLANATORY NOTE: Above figures are derived directly from data in table 10; see text for statement of assumptions.

For the sake of concreteness, column 1 of table 10 shows the theoretical distribution of 40,000 units to two markets when the transportation charges are $2 to the distant market and $1 to the near market and when the demand in the distant market is a third as large as that of the near market. The relative size of the markets is measured by the relative quantities that the two markets would absorb at the same price. Because of the difference in price between the two markets the relative quantities that actually would move to the two, as shown in the tables, differ somewhat from that 1:3 relationship. Column 2 in table 10 shows the situation that would exist if the transportation charges to each market were increased by 50 percent.

Columns 3 and 4 demonstrate the corresponding situations that would exist if both markets were of equal size, and columns 5 and 6 show the situations when the distant market is three times as large as the nearby market. The relative changes that occur because of the

50-percent increase in transportation charges are shown in table 11 for the three sets of market sizes.

Among the outstanding features of this hypothetical case is the actual decline in wholesale prices at the near market despite higher transportation costs. This is caused by the diversion of some shipments from the higher rate market, thereby increasing the quantity (hence lowering the price) at the nearer market. The extent of this diversion of shipments is controlled by the amount needed to readjust the prices in the two markets to the new differential in transportation costs.[13]

Another major feature is the showing that the transportation cost *differentials* are the prime transportation factors in determining relative quantities shipped to each market and in determining the difference in wholesale prices at the two markets. In contrast, the rate *level* (dollars per 100 pounds) is the prime transportation factor in determining the farm return. These conclusions may readily be seen in the formulas presented in the Appendix.

In the simplest terms, differences in wholesale prices for identical products tend to equal differentials in transportation costs, as producers at one shipping point normally attempt to obtain the same f. o. b. shipping-point return from units sent to one market as for those sent to other markets. The question as to whether actual transportation charges are $2 and $1 to the two markets, respectively, or whether they are $2.50 and $1.50 has no bearing on the wholesale price level or on differences in wholesale prices at the two, unless the level of transportation charges should affect the total quantity shipped. In the short run, quantity shipped probably would not be affected, especially if the change in rates were not large. Shipments, of course, would be stopped almost abruptly if transportation and other marketing costs exceeded wholesale prices. In longer periods, the quantity shipped probably would be affected by the relative profitability of the product in question as compared with alternative products, and quantities may be shifted. However, studies indicate that output of agricultural products as a whole is fairly nonresponsive to changes in average prices and costs, and for some individual products, production adjustments occur very slowly.

On the other hand, transportation charges are part of the cost of marketing agricultural products. Consequently, the *level* (rather than the differentials) of transportation costs is of prime importance for estimating the effect of transportation charges on farm return.

More specifically, table 11 shows that a 50-percent increase in transportation charges (under conditions assumed in the illustration) raises the average transportation cost by 49 percent, a somewhat smaller amount, and diverts some shipments from the distant market to the nearer market (1 to 4 percent). It thereby raises the wholesale price at the distant market but reduces prices at the nearer market, and it reduces farm returns by 10 to 16 percent. Although the change in

[13] If the elasticity of demand differed in two different markets and if shipments to each market were controlled by a single distributing organization, the difference in wholesale prices might not tend to equal the transportation differential, as demonstrated by F. V. Waugh, E. L. Burtis, and A. F. Wolf in CONTROLLED DISTRIBUTION OF A CROP. Quart. Jour. Econ., November 1936, pp. 1–41. However, this illustration represents the more frequent situation in agricultural marketing where competition exists among sellers.

transportation differential and the level of transportation costs have jointly resulted in this situation it is nevertheless possible to indicate which factors were more important in each instance.

For example, the failure of the average transportation charge per unit to increase as much as the increase in rates is caused by the fact that the change in transportation differential caused a diversion of part of the long-haul traffic to the nearer destination. Both changes in volumes at each market and changes in wholesale prices were caused solely by the change in transportation differentials. Such changes would not have arisen had the differential not been changed. For instance, if the increase in transportation charges had been 50 cents per 100 pounds for both hauls rather than 50 percent, neither volume nor wholesale prices would have changed under the general assumptions used in this illustration. This increase in "cents per hundred" is typical of the hold-down device mentioned earlier.

The reduction in the farm return, on the other hand, is almost solely caused by the increase in the rate level, although the change in differentials was responsible for a moderate diversion to the lower-rated market and thereby held the decrease in farm return somewhat less severe than it would have been without the diversion.

Stress has been placed on transportation charges and differentials, as the primary intent was to estimate the probable influence of transportation costs and of the changes in those costs. However, an added comment should be made concerning marketing costs other than transportation. As indicated in the Appendix, differences in these costs in one market as compared with another should have the same effect as differentials in transportation costs. The levels of marketing costs other than transportation should have the same effect as the levels of transportation costs.

The fundamental difference between the effect of transportation and other types of costs rests upon geographic differences. Transportation charges normally differ between markets. In contrast, production costs normally do not differ for units sold to one market as compared with another. Marketing costs, exclusive of transportation charges, in any *one* market probably do not differ materially for substantially identical products from different sources of supply, but these marketing costs probably differ somewhat between markets.

The theoretical effect of a difference in marketing charges between markets should have the same effect as an equally large transportation differential, but the actual impact of the transportation charge probably is considerably larger. This magnified influence may be attributed to several related circumstances. Rate and service hearings by regulatory agencies focus attention upon precise transportation charges, and foster critical analyses of rate structures, comparative rates, movements, and other pertinent factors. Publicity given to these hearings not only draws attention to statements made by opposing parties; it tends also to increase the attention of other persons to transportation charges that affect their own business even though these are unrelated to the particular hearing.

In addition, shippers and buyers are particularly aware of transportation charges and differentials, as transportation is singled out as a separate item in each transaction through the specific definition of point of delivery. With f. o. b. shipping point, for example, the

buyer pays the transportation charges and necessarily makes an allowance in his bid as compared with a contract that involves a delivered price.

Few other costs are known with such definiteness. A large proportion of the individual middlemen do not know their own costs precisely, except on an average basis which may hide differentials through the averaging process. Differences between markets are much less clearly determinable. They are rarely the subject of publicity that would bring sufficient conviction and definiteness to cause action such as normally would follow a change in transportation rates.

INTERSTATE COMMERCE COMMISSION SEES IMPORTANCE OF RATE IMPACT

Shippers have been particularly emphatic in their statements that the recent increases in rates and in rate differentials have been and will continue to be an upsetting factor. According to their testimony, potential traffic will be lost because of the higher rate level, and competitive positions will continue to be shifted by the changes in rate differentials.

As shippers are participants at hearings in opposition to increases in railroad and motor-carrier rates, it is not unreasonable to assume that their statements may exaggerate at least the degree of disturbance. Carriers do not contend that the rate increase will not tend to cause those results, but they state that the extent of reductions in potential traffic or changes in competitive position will be negligible, and that these results are unavoidable in view of the carriers' needs for additional revenue.

However, the Interstate Commerce Commission has emphasized in its decisions the seriousness of the effects of rate changes; therefore weight is given to the belief that the consequences must be substantial.

The gravity of the issues, as expressed by the Commission in formal documents, is shown by the following quotations. After concluding that a fairly uniform percentage increase in rates was the only immediate practicable solution to the financial situation of the railroads, the Commission stated in April 1948 that it granted rate increases, "although we have not completed the readjustments of the freight rate structure of the country necessitated by the successive large increases in basic rates involved in this proceeding. This is both a revenue case and a rate case. *How great and how difficult is the rate readjustment feature of this proceeding—and how important to the commerce of the country—is, we fear, not generally understood.* We must, however, presently deal with the revenue features of the case so as to carry out the intent of Congress to maintain an adequate national transportation system * * *" [14] [Italics supplied.]

In its final decision in this revenue case, the Commission again stressed its belief that the recent increases have created numerous undesirable rate relationships and differentials, as follows: "To deal with the thousands of those commodities moving in commerce so that we may exercise the legislative power of *prescribing rates or rate*

[14] Increased freight rates, 1947. Ex Parte No. 166, decided April 13, 1948, mimeographed statement, sheet 4.

relations which will conform in all respects to the Interstate Commerce Act would require much more information with respect to many of the important commodities involved than is now before us. To obtain it would necessarily consume such an amount of time as to render futile the accomplishment of the basic purposes of the present investigation."[15] [Italics supplied.]

The Commission not only recognized the existence of undesirable relationships; it invited complaints from shippers and encouraged carrier discussions with shippers, which might lead to voluntary rate adjustments, and offered the services of its staff to foster these readjustments. All of these were clearly or forcefully set forth in the Commission's formal decisions which stated in part: "There are many commercial relations which the adjustments already allowed by us or proposed by the carriers would necessarily disturb temporarily, but which would be capable of correction within a reasonable time. *There are also other situations where the allowance of any increases of substantial size must disturb pre-existing relations beyond the possibility of remedial correction so as to maintain the former competitive status. We have the assurance of the petitioners of their intention to proceed by voluntary discussion and cooperation with the shippers and representatives of markets, to devise and endeavor to put into eflect such measures* as will restore former competitive relations as completely as possible. We expect full and prompt compliance with these representations, in the spirit of the proceeding. Restoration of rate relations should not be made the excuse for further increasing revenues or of bettering the competitive situation of the carriers. As in previous cases of this character, we tender the good offices of our staff in negotiations or advice as to technical features. Further, the remedies provided by the act, in the way of petitions or complaints for readjustments or for further relief will be available."[16] [Italics supplied.]

STATISTICAL EVIDENCE CONCERNING EFFECT OF FREIGHT RATES

Despite the fact that one of the key issues in many rate cases is the effect of the proposed rate changes upon volume of shipments and impact on shippers and the national interest, convincing statistical evidence has been singularly lacking. Volumes of shipments vary from period to period and from market to market for a multiplicity of reasons. Prices also are the final effect of a combination of changes in underlying factors which involve both transportation and non-transportation situations. Analytical methods and sufficiently detailed and accurate market reports were inadequate to isolate the effect of rates and rate changes from other factors. Consequently, judgment supplemented by statistical background material necessarily has been the basis for judging the effect of rates.

An illustration of the diversity of opinion is given by the general railroad rate level case recently decided by the Interstate Commerce Commission (Ex Parte 168). At one extreme is the carriers' statement

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[15] Ex Parte No. 166, decided July 27, 1948, mimeographed sheets 85–86.
[16] See footnote 15.

that the increase in rates will reduce traffic only on western railroads, and that even for this group of carriers the reduction would be less than 1 percent. At the other extreme are shippers who believe the increase will sharply reduce the volume they can ship to some major markets, especially on long-haul movements, such as California potatoes to New York. Some shippers see almost wholesale diversion to motortrucks; others believe they must move their processing plants in order to offset the retarding effects of an adverse rate differential. Some believe the railroads are "pricing themselves out of the market," whereas the railroads hold that increased rates are essential to their financial health and will increase their profits. Obviously, both viewpoints cannot be correct with respect to the extent of the impact. Additional objective information is needed.

A new attempt is being made under the auspices of the Research and Marketing Act to estimate statistically the impact of transportation rates on the agricultural economy. The recent sharp increases in transportation charges and differentials, coupled with improved market reports of prices and shipments, may have created a situation in which it may be possible to isolate transportation factors from others. Furthermore, improvements in analytical techniques during recent years should prove valuable.

The quantitative-theoretical approach presented in an earlier section[17] is being expanded to more realistic conditions in order to determine approximately the nature and extent of changes that may be expected from given changes in transportation charges. Analyses of actual market reports are also being made to determine, so far as possible, the actual changes found in the markets. It is hoped that a combination of these two approaches may give convincing indications of the effect of transportation charges upon agricultural prices and distribution.

Analyses of market information to date have primarily involved potatoes. The significant findings are presented in the sections that follow.

TRANSPORTATION CHARGES AND GEOGRAPHIC WHOLESALE PRICE DIFFERENTIALS — IDAHO POTATOES

Wholesale prices of Idaho potatoes in such widely separated markets as New York City, Chicago, and Los Angeles are tied closely together by the difference in the railroad charges from Idaho to each of those markets. For example, as shown by table 12, the average wholesale price of Idaho potatoes during the last 7 years in Los Angeles was $3.18, as compared with $4.24 in New York City. The spread between those two wholesale prices amounted to $1.06. The difference between the transportation charges accounted for 73 cents, and a balance of 33 cents per 100 pounds was left. Similar comparisons between Chicago and Los Angeles, and New York City and Chicago, showed an even smaller differential in wholesale prices after deducting the

[17] See section, Effects of Transportation Cost Differ From Effects of Most Other Costs and Appendix.

actual transportation charges. The average for the 10 years preceding the war (shown in table 12) reveals an unaccounted-for differential that is about half as large as the one shown for the latter period.

TABLE 12.—*Average wholesale price, transportation charge and differential, per hundredweight, for Idaho potatoes, three selected markets, average 1933–48* [1]

Season average and markets	Wholesale price	Transportation charge	Balance
	Dollars	*Dollars*	*Dollars*
Average 1933–41:			
New York City	2. 32	1. 10	1. 22
Los Angeles	1. 62	. 52	1. 10
Chicago	1. 92	. 78	1. 14
Average 1942–48:			
New York City	4. 24	1. 26	2. 98
Los Angeles	3. 18	. 53	2. 65
Chicago	3. 67	. 89	2. 78
Differential :			
Average 1933–41:			
New York City—Los Angeles	. 70	. 58	. 12
New York City—Chicago	. 40	. 32	. 08
Chicago–Los Angeles	. 30	. 26	. 04
Average 1942–48:			
New York City–Los Angeles	1. 06	. 73	. 33
New York City–Chicago	. 57	. 37	. 20
Chicago–Los Angeles	. 49	. 36	. 13

[1] Crop year 1933–34 to 1948–49.

Most of the increase in the unaccounted-for differential was coincident with price control during the war. The full significance of the small remaining differential, however, cannot be judged without more refined analysis, mainly of the type used in the customary "costs and margins" study of individual markets to isolate accurately each of the various elements of cost and to insure comparability among all the data, especially with respect to grade and quality.

Wholesale price quotations currently available for each of the three markets are not strictly comparable. Furthermore, local cartage and other incidental costs, that are a part of the total transportation costs, have not been included in the present figures on transportation charges. Additional expenditures for greater refinement in the transportation data appear unwarranted until greater refinement is available in the price series, particularly with respect to prices for identical grades of products and services.

These findings, however, apparently support the theoretical conclusion that prices for approximately identical products even in widely separated markets tend to differ from each other by the difference in transportation charges, plus perhaps differences in marketing costs among the various markets.

TRANSPORTATION CHARGES AND PRICE SPREADS BETWEEN SHIPPING-POINT PRICES AND WHOLESALE PRICES—POTATOES

In view of the finding in the preceding section that the geographic differentials among wholesale prices are closely tied to transportation charges, it is evident that the spread between shipping-point prices and wholesale prices is also closely related to transportation charges. The shipping-point price for the same grade and quality of potatoes tends to be uniform for all markets to which they are shipped from this location. Consequently, differences among those price margins necessarily are approximately equal to variations in wholesale prices. However, specific statistical information is given, as a presentation in this form may prove to be more useful for some types of analysis.

Table 13 shows that the difference in the spread between shipping-point and wholesale prices for Idaho potatoes during the last 7 years ranged from $1.03 in Los Angeles to $1.60 in New York. Transportation charges accounted for virtually all of the price spread in the Los Angeles market and for all but 34 cents per 100 pounds of the price spread in the New York City market. The fact that transportation charges slightly exceeded the price spread in the Los Angeles market during the 10 years immediately preceding the war period probably can be attributed to some slight noncomparability in the data, rather than to a significant negative differential.

TABLE 13.—*Spread between shipping point and wholesale prices compared with transportation charges per hundredweight for Idaho potatoes, three selected markets, average* 1933–48

Season average and market	Spread between shipping-point and wholesale price	Transportation charge	Differential
	Dollars	*Dollars*	*Cents*
Average 1933–41:			
New York City	1. 20	1. 10	0. 10
Chicago	. 80	. 78	. 02
Los Angeles	. 50	. 52	—. 02
Average 1942–48:			
New York	1. 60	1. 26	. 34
Chicago	1. 03	. 89	. 14
Los Angeles	. 54	. 53	. 01

[1] Crop year 1933–34 to 1948–49.

This close correspondence between railroad transportation charges and shipping point to wholesale price spreads is even more clearly seen by the annual data illustrated by figure 3. The solid area shows the railroad rate from shipping-point to wholesale market, and the shaded portion shows the balance. A few "negative" balances appear, probably caused by imperfections in the data.

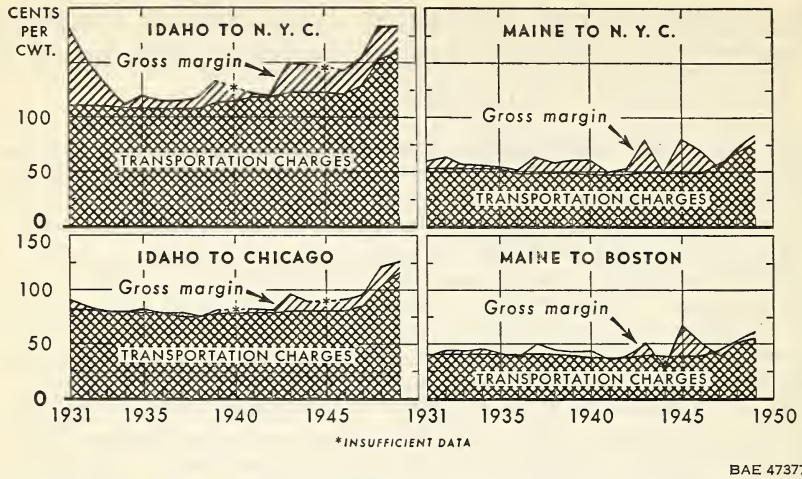

FIGURE 3.—Transportation charges and margins between shipping-point and wholesale prices for potatoes, from Maine and Idaho to three wholesale markets, 1931–49.

The major contribution of this chart to the information presented above is the year-to-year parallelism between railroad charges and the shipping point to wholesale price spreads, despite wide fluctuations in the wholesale prices and large differences in the actual railroad rates. However, the chart also indicates that the relationship is not necessarily mechanical. For example, significant increases in the price spread for Idaho potatoes occurred in New York coincident with price controls, but it virtually failed to materialize in the Los Angeles price spread. The margins above transportation costs also rose abruptly at that time for Maine potatoes in New York, Boston, and several other markets. Since then, these Maine potato margins above transportation charges have been somewhat sporadic. Recently they have been near or below the prewar margin. Probably competitive pressure accounts for a considerable part of the minor differences among markets and types of potatoes. The major differences are clearly controlled by transportation charges.

The close relationship between the shipping point to wholesale price spread and railroad charges may be generalized beyond the two producing areas discussed. The scatter diagram (fig. 4) illustrates this general relationsip; it is based on price spreads for 13 combinations of origins and markets. Origins were located in 7 widely separated producing States—Florida, North Carolina, Maine, Minnesota, Colorado, Idaho, and California. The wholesale markets were New York, Boston, Chicago, and Los Angeles. The origins and destinations selected were designed to represent diverse producing areas, differing marketing seasons, and differing transportation charges between shipping point and wholesale market.

All quotations were based on U. S. grade no. 1, insofar as available, to eliminate price differences that were caused solely by grade differences. However, absolutely strict comparability among the price

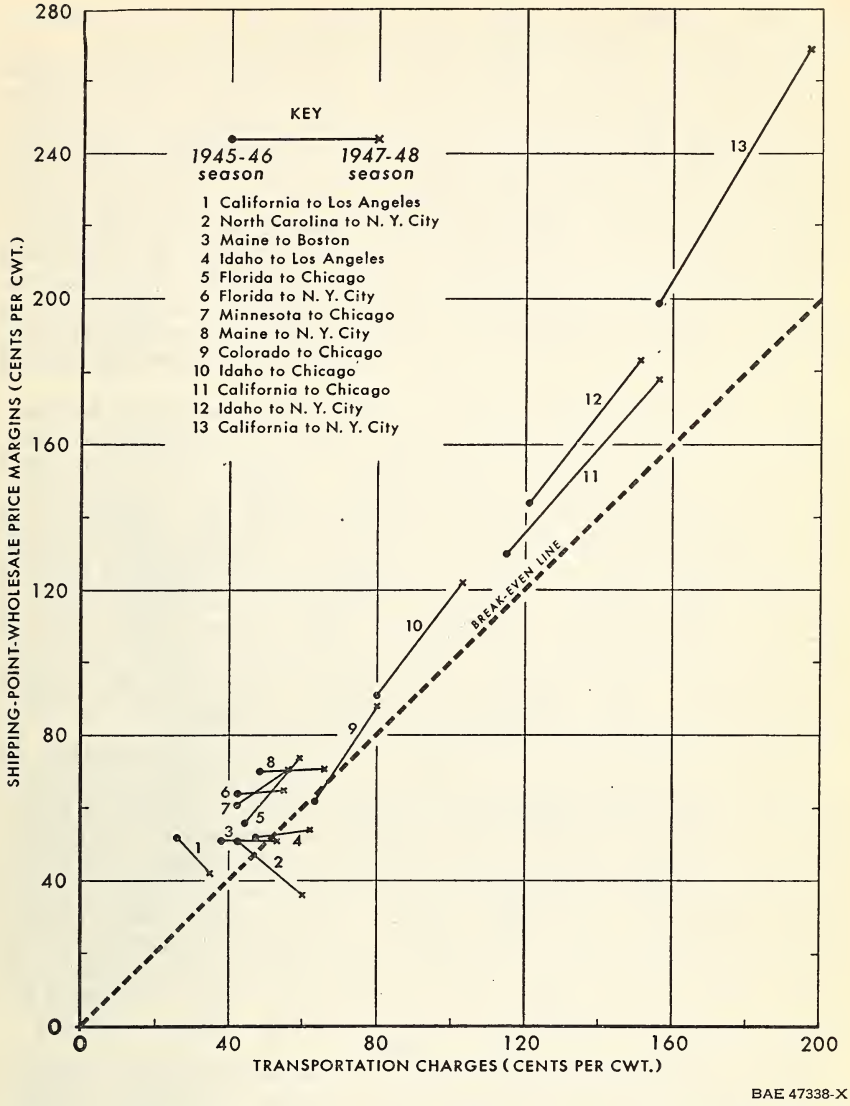

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FIGURE 4.—Relationship between transportation charges and shipping point and wholesale price margins for potatoes between selected origins and destinations.

quotations is not attainable, and this probably accounts for some minor differences seen on the scatter diagram.

The circles on the diagram represent price margins and transportation charges between a specific origin and market during the last season before the increases started in railroad rates. X's represent the more recent season prices and rates. The lines that connect the circles and X's indicate the change that occurred between price mar-

gins and transportation charges for each of the 13 combinations of producing areas and wholesale markets included in the study.

The vertical height of the circle (or X) shows the actual margin between shipping-point and wholesale price. The horizontal position (from left to right) shows the rail rate (plus charges for protective services when needed) for that movement. The straight dotted line, designated as the "break-even line" shows the point at which the wholesale price margin would precisely cover the railroad charges without leaving any margin for other costs or profits. The line is useful mainly as a visual guide to see approximately the slope that each of the lines connecting circles and X's should take if margins rose precisely the same amount as the increase in railroad rates. It serves also as a guide to indicate the extent to which the margins-above-transportation-charges increase more rapidly than does the actual amount involved in transportation.

That the height of the circles and X's (the price spread between shipping point and wholesale markets) depends primarily upon transportation charges may be seen by the clear tendency of the circles and X's to rise as the transportation charges increase. In fact, on the basis of a simple linear correlation, 96 percent of the variance in the price margin is associated with the variance in transportation charges.

Nevertheless, there is indication that price spreads increase proportionately more rapidly than do transportation charges. This is shown by the divergence between the trend of the circles and X's and the break-even line. It is shown also by tables 12 and 13. Here the balance of the price spread, after deducting transportation charges, varies directly with transportation charges. This raises a fundamental question concerning the cause of this situation.

Apparently grounds are inadequate for believing that variations in transportation charges between various producing areas and wholesale markets cause these differentials in price spreads in excess of transportation charges, despite the significant mathematical relationship that can be demonstrated. The actual cause is unknown, although the more plausible explanations indicate that transportation (not just rates) probably is the primary factor. For example, loss, damage, and deterioration (not reimbursable by the carriers) normally should be higher on longer hauls. Consequently, the increased margins may be an offset for such value losses in the product plus additional expenses involved in regrading and repackaging. Time in transit is normally longer on more distant hauls.

As time normally increases the risk of adverse price movements, higher margins to offset the higher risks may have become customary. As length of haul and transportation charges for a specified product tend to be closely related, it is possible that distance and time taken together, rather than rates, may be the principal cause of the apparent statistical relationship between rates and the price spread in excess of rates.

More or less uniform percentage mark-ups by wholesalers (so-called pyramiding of costs) have been suggested. However, the importance of this factor is doubtful. Apparently, there is no evidence to indicate that the margin above transportation charges (in cents per 100 pounds) varies with delivered costs in each market over a period of time, which

could be the case if the mark-up were a uniform percentage of costs. Furthermore, trade practice among wholesalers and other intermediate handlers appears generally to favor a fixed mark-up in dollars per carload or some other suitable quantity rather than in percentage of a current cost or price.

No firm conclusion has been reached regarding the fundamental cause for margins in excess of transportation charges to be higher in the markets to which transportation charges are high than in the markets in which transportation charges are low. However, this issue is minor as compared with the basic finding that the shipping-point to wholesale price margin is clearly associated with transportation charges, despite variations in length of haul, season, relative location of source of supply and market, or moderate variations in quality and consumer acceptance of potatoes.

SELECTIVE READJUSTMENTS BEGINNING

Because the increased transportation charges and the widened price spreads vary among producing areas and their markets, the relative balance among the markets has changed. This results in shifts of volume from producing areas, to their respective markets. For example, according to trade reports, the increased differential for California potatoes has forced curtailment of the anticipated volume of shipments to East Coast markets. This has resulted in greater quantities reaching Chicago and nearer markets, and thereby prices and returns to California farmers have been lowered. The effect of these rate increases improves the competitive position of producers located near their markets and places distant producers at a further competitive disadvantage.

Practical opportunities for quick readjustment are few. Relative volumes can be shifted readily among established markets. This involves no particularly unique problems, as moderate shifts are commonplace in the ordinary day-to-day marketing process when a producing area supplies more than one market or when buyers purchase from more than one source of supply. This will soften the impact of the full rate increase, but it has narrow limits, depending upon the ability of nearer markets to absorb increased quantities at reasonable prices.

A second immediate major opportunity is diversion of traffic from a higher- to a lower-rate carrier, if one can be found and if adequate capacity and facilities are available at both point of origin and destination. Shippers of Maine potatoes apparently have diverted so much tonnage to motortrucks for hauls from Maine to other New England points that the railroads have voluntarily reduced rail rates in the area 10 to 16 percent in an effort to stop (or at least to reduce) this diversion. Railroad rates at the end of August 1949, were reduced 35 percent on eastbound dressed turkeys, except in the East Central and North Atlantic areas, and 11 to 16 percent on westbound movements of dressed poultry and eggs between Chicago and western points in July. Several railroads on August 1, 1949, reduced rates by about 27 percent on fluid milk in tank cars from points in the New York milkshed to New York City. This was a reduction to meet truck

competition which was said to be currently hauling 75 percent of the milk moving into New York City as compared with 50 percent before the war.

Substantial diversion of Florida citrus especially has occurred, and diversions of other fresh fruits and vegetables are reported from a number of areas. For example, railroad rates on Florida oranges to New York City and Chicago were reduced on November 12 and 15, 1949, specifically to meet truck and boat competition. Presumably, these diversions are the major reason that a number of rate reductions on selected movements are currently under consideration by railroad rate bureaus. These actions for selective readjustments are not unusual as an aftermath of successive rate increases.

In addition to the diversion to for-hire motortrucks, a significant trend toward private trucking operations by farmers, cooperatives, processors, and distributors, has been noted. This alternative is neither so immediate nor so relatively simple as the one mentioned previously, as it involves investment in equipment, additional labor and time of the producer or shipper in handling problems in addition to his main production or marketing problems. But, in some instances, this alternative has considerable merit.

Trade reports indicate widespread consideration and some significant action by processors to meet the changed conditions in a wholly different way. Western packers are said to be finding that transportation costs may have priced them out of their eastern markets. Eastern packers are confronted by the same problem for their western markets. Consequently, to avoid losing those markets, some "tolling" arrangements are said to have been made. Broadly speaking, tolling involves an agreement between, say one western and one eastern packer, by which each packer produces and distributes his own product in his home market. In addition, the products for the eastern packer's western market are supplied by the western packer to the specifications and under the label of the eastern producer. Similarly, the western packer's eastern market is supplied by the eastern packer. Each maintains his own sales and other marketing activities in both sections of the country. By this means, prohibitively high transportation costs are avoided. In fact, if tolling were to be extensively used, it could significantly reduce the total transportation service needed, and thereby reduce carrier revenue despite attempts by carriers to obtain larger revenues from higher rates.

A number of other packers are reported to be decentralizing their packing operations by acquiring or building plants located near their markets. Others are reported to be curtailing the volume of their leading products because of inability to compete in distant markets. They are currently diversifying their output in the hope that they can dispose of the products in areas relatively close to the plants. These and other selective readjustments can be anticipated with reasonable certainty to become increasingly important for several years, at least.

As judged by trends in railroad rates following the sharp increases during and after World War I, these selective rate readjustments might be substantial for a few commodities or between a limited number of points. As an illustration, note the sharp cut in cotton rates between 1928 and 1933 in contrast to the general level for fruits and vegetables

and wheat. However, transportation charges in general are exceedingly stable and unresponsive to changes in business activity. Consequently, historical precedent, at least, would support the belief that the net effect of probable future selective rate readjustments would be to lower the general level of rates by only a relatively small percentage over the next few years. These readjustments may help somewhat to lessen the readjustments of the agricultural economy to fit the current rate structure, but substantial further readjustment of prices, processing plants, and distribution among markets are likely to be the inevitable consequences of the recent changes in transportation rates and particularly in rate differentials.

APPENDIX

Technical Notes Regarding Mathematical Basis for Estimating Effect of Transportation Costs Under Given Assumptions

The following technical notes relate specifically to the estimate of the effect of transportation costs presented in tables 10 and 11 together with the accompanying text.

1. *Source of supply and markets*

The illustration considered only one source of supply and two markets—one distant from the source of supply and the other nearer, with a difference in transportation charges to the two markets.

2. *Quantity formulas*

Adopting Q to indicate total shipments from source of supply and Q_1 and Q_2 representing the unloads at the two markets, the basic quantity formula is:

(a) $Q=Q_1+Q_2$

3. *Relationship between price and quantity*

For this illustration, "unit elasticity of demand" was used in each market. Stated differently, it was assumed that a doubling of supply in one market would cut the price in half, or conversely that a 50-percent reduction in quantity would double the price. This is roughly the degree of elasticity generally expected at retail, but it is more elastic than is generally found for agricultural products at wholesale. It does have the advantage of not introducing changes in consumer expenditures because of changes in quantities sold. Under an "inelastic" demand normally associated with agricultural products, total consumer expenditures (in dollars) *decrease* with *increases* in quantities sold. With unit elasticity of demand, the most useful formula becomes:

(b) $P_1Q_1=M_1=$a constant
(c) $P_2Q_2=M_2=$a constant

The subscripts (*1*) and (*2*) indicate the distant and near markets, respectively; P is wholesale price, Q is quantity, and M is wholesale market value which is constant for each market but may be a different value for market (1) than for market (2). In fact, the relative sizes of the two markets shown in tables 10 and 11 are based on the relationships between M_1 and M_2 when assigned dollar values.

4. *Transportation charges and differentials*

Transportation charges may be indicated by R, whereby R_1 is the charge to market (1) and R_2 is the charge to the other market. Adopting D to represent the difference between the charges to the two markets, then:

(d) $D=R_1-R_2$

5. *Relationship between wholesale prices in the two markets*

As shippers are assumed to have free access to both markets and there is competition among the sellers, the f. o. b. farm price for products will be identical for shipments to both markets. Hence, taking C as all other marketing charges:

(e) Farm price $=P_1-R_1-C_1=P_2-R_2-C_2$

In view of the fact that this illustration is designed to estimate the effect of transportation charges and changes in those charges, all other costs have been held constant. Hence C_1 and C_2 do not change and have been made equal to each other in order to avoid introducing extraneous factors. However, it is obvious from the formula that any difference between C_1 and C_2 would have the same effect as a difference between R_1 and R_2. Furthermore, a change in the difference between C_1 and C_2 (with no change in the difference between R_1 and R_2) would have the same effect as a change in the transportation differential. These observations are particularly significant in view of the importance of the differential in transportation charges in the following formula:

(f) $P_1=P_2+D$

Formula (f) was derived from formula (e) by setting C_1 equal to C_2 and formula (d) in which R_1-R_2 equals D (transportation charge differential).

6. *Derivation of solution*

Equation (b) may be restated as $P_1=\frac{M_1}{Q_1}$ and equation (c) as $P_2=\frac{M_2}{Q_2}$. These two equations may then be substituted in equation (f), which then becomes:

(g) $\frac{M_1}{Q_1}=\frac{M_2}{Q_2}+D$

As there are only the two markets, $Q_1+Q_2=Q$ (total shipped from source of supply) or $Q_2=Q-Q_1$. Substituting this in equation (g), the formula becomes:

(h) $\frac{M_1}{Q_1}=\frac{M_2}{Q-Q_1}+D$

Equation (h) then simplifies to a final form that is useful for computations:

(i) $Q_1^2-\frac{(M_1+M_2+DQ)}{D}Q_1+\frac{M_1Q}{D}=0$

7. *Substitution of values*

A numerical value for the quantity shipped to market (1) can be obtained by using any values one wishes to assume for sizes of market (M_1 and M_2), any transportation charges (R_1 and R_2) and any total quantity shipped from the farm level (Q). Having found a specific value for Q_1, then Q_2 is the balance shipped from source of supply, and the prices in the two markets are determined by equations (b) and (c). To determine the effect of changes in any factor, solve the equations for assumed conditions before the change. Give a specific new value

to the factor to be tested, and recalculate. The difference between the two results measures the impact of the change in the one factor.

8. *Further comments regarding causal factors*

Attention already has been directed to the fact that any *difference* between the marketing costs (other than transportation) in one market and another has the same effect as a difference between transportation charges to the two markets. As may be seen by equation (i), transportation charges enter the formula *only* as differentials—not as actual rates. Consequently, so long as quantities from source of supply do not change, relative prices between wholesale markets and quantities reaching those markets are affected only by the differentials in transportation charges (and differentials in other marketing charges) but not by the actual level of those charges (dollars per 100 pounds). In contrast to wholesale prices, farm return is directly and vitally affected by the *level* of transportation charges, as shown by tables 10 and 11. This arises from the fact that transportation and other marketing costs are a deduction from wholesale prices, whereas those wholesale prices are determined primarily by demand conditions in each market (which is independent of costs) and supplies reaching each market which are responsive to *relative* prices between alternative markets but fairly nonresponsive to changes in profitability.

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