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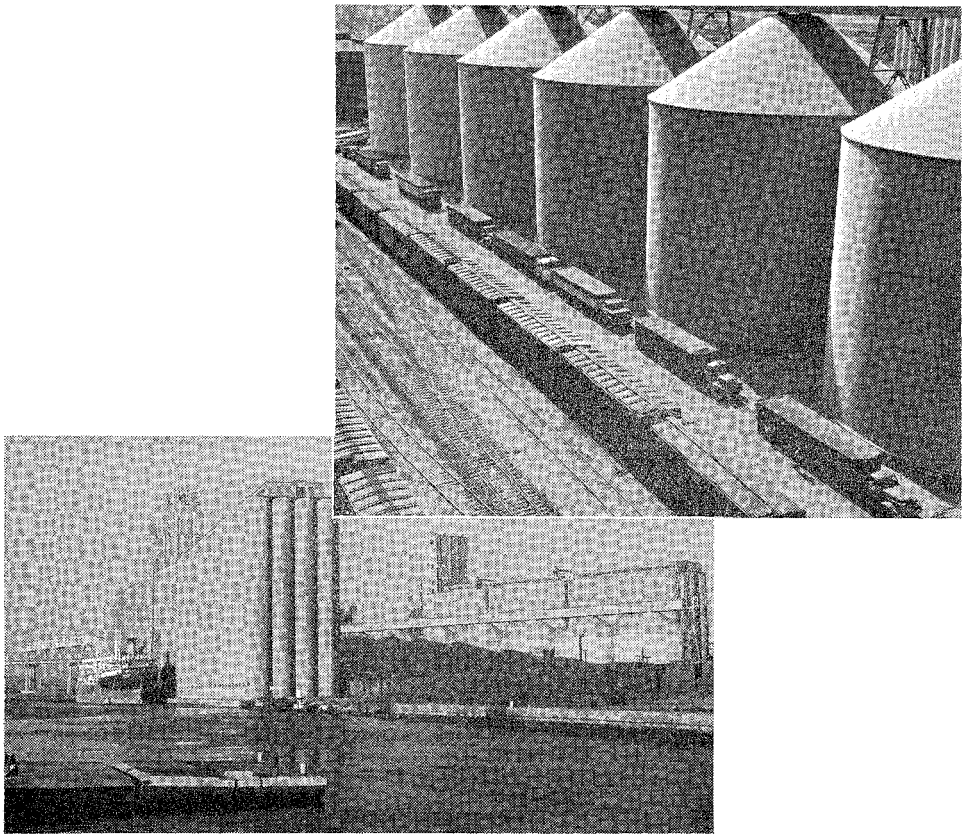
The Effect of Changes in Transportation Costs on Minnesota Wheat Flour Millers and Oilseed Processors



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CONTENTS

The Effect of Changes in Transportation Costs on Minnesota Wheat Flour Millers and Oilseed Processors

J. D. Hyslop and R. P. Dahl

MINNEAPOLIS HAS LONG BEEN ONE of the nation's major flour milling centers. The typical reason given for this prominence has been the large amount of wheat grown in this region. This explanation, though true in itself, does not provide an analytical basis from which to examine locational adjustments in the milling industry. Fundamentally, the basis has been the transportation relationship between wheat and flour.

In the early days wheat was milled close to the growing area in order to benefit from the 30-percent weight loss in the production of flour. Then railroad construction widened the millers' markets. The rail rate structure, designed to move both wheat and flour, stabilized existing marketing channels without regard for differences in the cost of carrying the two products. This contributed to the maintenance of Minneapolis as a milling center.

Following World War I, rail rates on grain and flour and regulated water carrier rates on packaged flour advanced. Meanwhile, lake rates on bulk commodities, subject only to bargaining between carrier and shipper, did not advance. So low rates charged by carriers on the Great Lakes permitted millers in Buffalo, New York, to deliver flour in the East at a lower cost than could their western competitors. As a result, Buffalo became the leading flour producing city in the nation during the 1920's. Production in Minneapolis fell rapidly from an annual average of 1,660,500 tons during 1911-20 to 735,000 tons in 1931-35. Production has remained relatively stable since then.

The continued location of milling in Minneapolis will be encouraged if transportation charges on flour are favorable compared with charges on wheat. As long as railroads carried the bulk of wheat and flour from Minnesota, such a rate relationship was insured. Recently, however, railroads have received vigorous competition from lower cost water carriers, particularly barges. These have captured a significant volume of wheat traffic out of Minnesota.

Oilseed crushing is a more recent industry than flour milling. Its importance has increased in Minnesota as soybean production has risen. Trends in transportation costs of oilseeds relative to oilseed products are also important to Minnesota processors.

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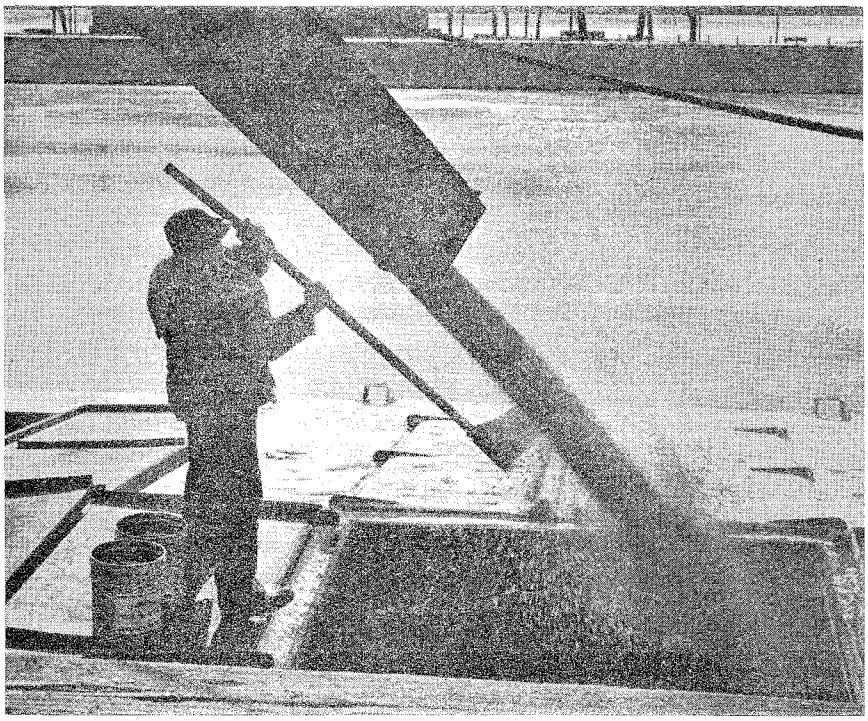


Sampling grain in the loading of a barge on the river.

If transportation charges on processed products increase relative to transportation charges on raw materials, Minnesota will become a higher cost location for processing industries than areas closer to consumers. Objectives of this study are to:

- Examine the effect of competition among carriers on the relationship between shipping costs for wheat and for flour, and the effect on the relative volumes of these products shipped from Minnesota.
- Perform a similar analysis for oilseeds—flax and soybeans—and their products — meal and oil.
- Indicate how this competition may affect the relationship between rail rates on raw materials and on finished products, and what trends in shipments may result from altered rail rate relationships.

Data on volumes of products shipped from Minnesota by rail, and the railroad revenues from these shipments, were obtained from the Interstate Commerce Commission (ICC). (2) * The ICC also provided data on railroad costs. (1) Data on the water movement of these products were provided by the U.S. Army Corps of Engineers. (6) From the latter data, estimates were made of the probable direction of future trends in rail rates.

* Numbers in parenthesis refer to bibliography listings, page 28.

Wheat and Flour

The Grain Rate Structure

An understanding of the railroad rate structure for grain is necessary if the flour milling situation in Minneapolis, with respect to transportation, is to be properly assessed.

The structure grew out of competition for traffic among lines operating in the Midwestern grain belt. It was stabilized through the agitation of farm organizations and market interest groups before governmental regulatory agencies.

By the 1870's Omaha, Nebraska was an important gathering point for grain grown to the west. At that time Chicago was the nation's principal grain market center. Several railroads operated between Chicago and Omaha; but only one, the Chicago, Burlington and Quincy, had track from Chicago to points west of Omaha. Grain, gathered in the country by the Burlington and lines operating strictly west of Omaha, was stored in Omaha elevators until sold. All railroads to the east were free to compete for the carriage of this grain to Chicago.

In order to improve its position regarding this traffic, the Burlington established what is now referred to as the transit privilege. The Burlington considered the movement of grain from the country origin to Chicago as a single shipment with the privilege of stopping enroute for storage. The country shipper paid the full "local" or "flat" rate from his origin to Omaha. But the rate paid on this grain from Omaha to Chicago was not the published flat rate. Instead it was the difference between the "through" rate from the country origin to Chicago and the "local" rate that had been paid for shipment to Omaha. This difference became known as the transit balance.

The operation of the transit balance resulted in savings on freight charges. The "through" rate from country origin to Chicago was normally less than the sum of the local rates; the operation of the transit privilege, in effect, permitted the shipper to pay that "through" rate. So the Burlington took much of the grain traffic between Omaha and Chicago away from its competitors.

In order to recapture this traffic, competing lines established "proportional rates" from Omaha to Chicago. These equalled the average of the Burlington's transit balances. So a grain shipper in Omaha could, upon presenting inbound billing for an equivalent amount of tonnage, ship grain to Chicago on the Burlington by paying the transit balance or on one of the competing lines by paying the Omaha-Chicago proportional. Both the transit privilege and the system of proportional rates were extended by other lines to grain dealers and processors in other market centers.

In the 1920's, depression of farm prices led Congress to ask for rail rate adjustments by the ICC which would recognize this condition and result in lower rates on agricultural commodities. The resulting ICC

investigation, with its subsequent appeals to the Federal courts, lasted until the mid-1930's. The rates coming out of these proceedings were much higher than had been originally expected, because the Great Depression seriously reduced railroad revenues. More important, however, was the basis on which these rates were prescribed.

Other cities bordering on the Great Plains had become important markets for western grain. Their competition for grain traffic was intense, and an important factor in this competition was the level of rail rates affecting each market. The market interests in each city conducted appeals before the ICC, contending that the existing rate structure discriminated against them. In the Western Grain Case, as this investigation was called, firms operating in Minneapolis and the Missouri River markets were shown to have the advantage of both outbound proportionals and transit balances.

Because these transit balances varied over a wide range, depending upon the distances of the country origins from the western markets and Chicago, firms did not know the rates their competitors in the same or in different markets were paying. To eliminate the resulting insecurity, dealers proposed that the transit privilege be removed from grain shipments beyond the Minneapolis and Missouri River markets. Instead, the system of proportionals, the average of the transit balances, was to be used. The ICC concurred—the system of proportionals became the basis for the present grain rate structure. (12)

The operation of the transit privilege and the system of proportionals may best be explained through an example. Figure 1 and table 1 show rates on wheat, in cents per 100 pounds, in effect on July 12, 1963.

Table 1. Rail rates on wheat shipped between Minot, North Dakota and Minneapolis, July 12, 1963

Minot to Minneapolis	Cents per 100 pounds
Sum of local rates:	
Minot to Grand Forks (wheat)	37.0
Grand Forks to Minneapolis (wheat)	28.5
Total	65.5
Minot to Grand Forks (wheat)	37
Grand Forks to Minneapolis (flour)	39
Total	76
Local rates plus transit balance:	
Minot to Grand Forks (wheat)	37
Grand Forks to Minneapolis, transit balance (wheat or flour)	15
Minot to Minneapolis, local	52

Source: Traffic Department, Minneapolis Grain Exchange.

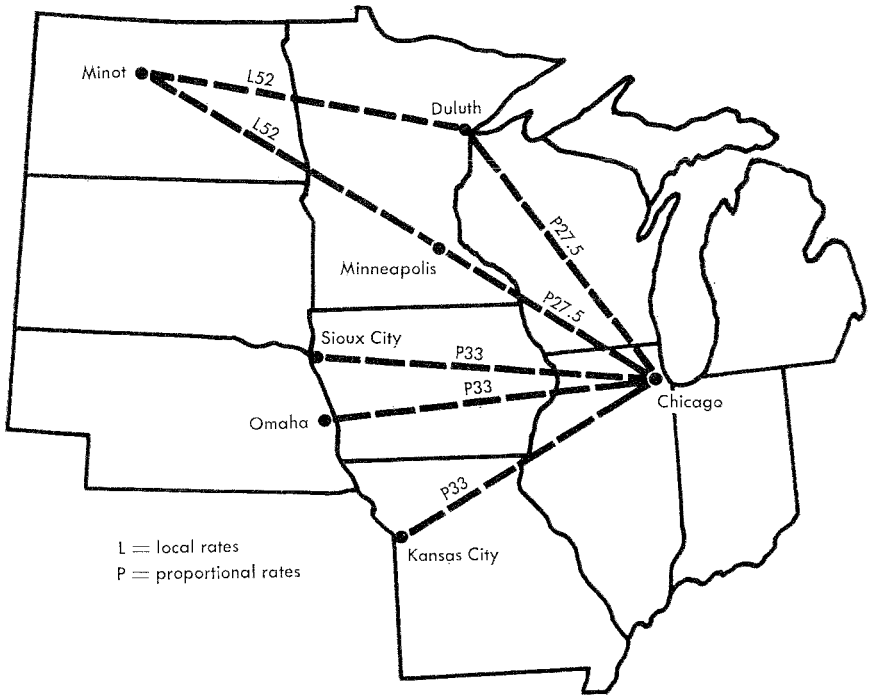


Figure 1. The grain rate structure illustrated.
Source: Traffic Department, Minneapolis Grain Exchange

Assume that a carload of wheat, destined for the East, has originated in Minot, North Dakota, and that the wheat is to be stopped in Grand Forks for storage. When the car is unloaded at Grand Forks, the "flat" rate from Minot, 37 cents per 100 pounds, is paid. At this time the freight bill is registered for transit. When the grain is ready for continued shipment, say to Minneapolis, the inbound billing, showing the flat rate paid from Minot to Grand Forks, is attached to the new bill of lading. The rate paid on the new bill is the transit balance, the difference between the through rate from Minot to Minneapolis and the flat rate from Minot to Grand Forks.

Wheat was moved from Minot to Grand Forks to Minneapolis at a rate of 52 cents per 100 pounds. This was the same rate that was paid on shipments directly to Minneapolis that were not stopped for storage in Grand Forks. If the transit privilege was not available, the stop for storage would have been more expensive. In this case the total charge for shipment to Minneapolis would have been the sum of the two local rates: Minot to Grand Forks (37.0 cents) plus Grand Forks to Minneapolis (28.5 cents) for a total of 65.5 cents.

Milling the wheat into flour at Grand Forks was also covered under transit. The total rate of 52 cents still applied, even though the wheat

was shipped part way as flour. If transit was not available, the stop for milling would have been still more expensive. The total charge would have been 76 cents per 100 pounds: 37 cents per 100 on wheat from Minot to Grand Forks plus 39 cents per 100 on flour from Grand Forks to Minneapolis.

If the grain is stored or milled in Minneapolis before going East, the same procedure is followed. Now, however, the rate on the grain (or its milled product) beyond Minneapolis is not the balance of the through rate from Minot to the destination, say Chicago; it is the Minneapolis to Chicago proportional. In order that this proportional rate apply, the inbound billing must be shown. If not, a higher Minneapolis to Chicago flat rate is charged.

Figure 1 also shows the principle of market equalization. The shipment could come through Duluth rather than Minneapolis at the same rail rates. Market equalization is illustrated with reference to other points. The proportional rates to Chicago are the same from Sioux City, Kansas City, and Omaha.

This schedule of proportional rates apportioned among the major markets, and the transit balances applying at interior points, have reduced locational advantages with respect to rail transportation costs possessed by one milling or market center over any other.

Under the transit privilege flour can be shipped for the same rate as wheat, even though it costs the railroads more to ship flour. Only a nominal charge is made for transit, even though costs are involved in providing the service. Rail rates on grain and flour are often the same through several markets, even though the distance through one market may be greater. These elements in the railroad rate structure tend to put millers in different parts of the country on an equal basis concerning railroad transportation.

The railroad rate structure on grain functioned well and accomplished its objectives until the postwar period. Then the railroads were confronted with increased competition from water carriers and trucks. These carriers base their rates on the cost of providing the service; consequently, higher rates are charged on the higher cost service. This competition has made locational factors in processing more significant.

Recent Trends in Transportation

Analysis of rail data on the movement of wheat and flour out of Minnesota confirms the preceding description of the rail rate structure. Figure 2 shows the trend of rail rates on shipments of wheat and flour from Minnesota between 1948 and 1961. The term "rates" in this case represents average revenues per ton. The ICC's *Carload Waybill Statistics* present data on total tons, total rail revenue, and total ton miles[1] for shipments of wheat and flour from Minnesota for those years. Dividing total revenue by total tons yielded average revenues for each

[1]See Appendix A for the revenue, volume, and distance aggregates which were used to construct the average revenue and average length of haul series.

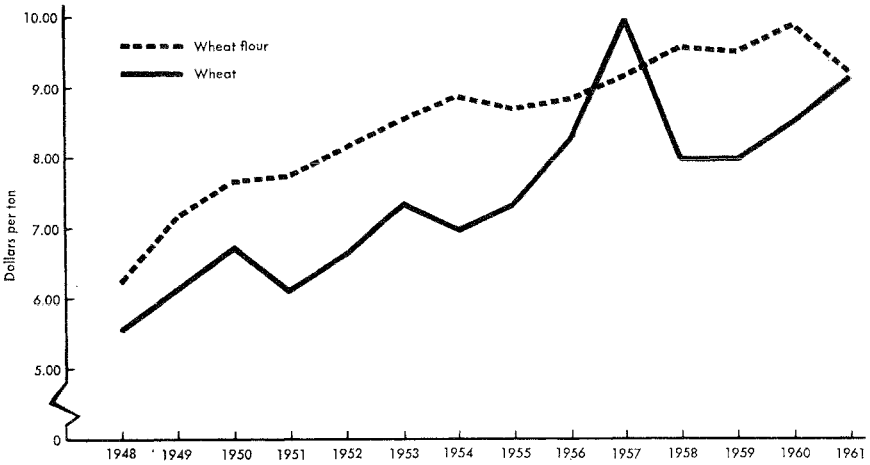


Figure 2. Average transportation charges per ton on wheat and wheat flour shipped out of Minnesota by rail, 1948-61.

year. These figures were adjusted for variations in the average length of haul.[2] "Rates" on both wheat and flour exhibited pronounced upward trends between 1948 and 1961.

It is not readily apparent from figure 2 data that rates on wheat and flour have moved together. In order to display this relationship, the adjusted wheat "rates" were subtracted from the adjusted flour "rates;" this difference is shown in figure 3. Although there was some year-to-year variation, the difference did not display any trend — the railroad transportation charges on flour did not increase more than those for wheat. The existing railroad rate structure insures the equality of rates on wheat and flour.

Published tariffs show that water carrier rates on grain and grain products were considerably lower than rail rates (table 2). For example, the per bushel charges for barge shipment from Minneapolis to New

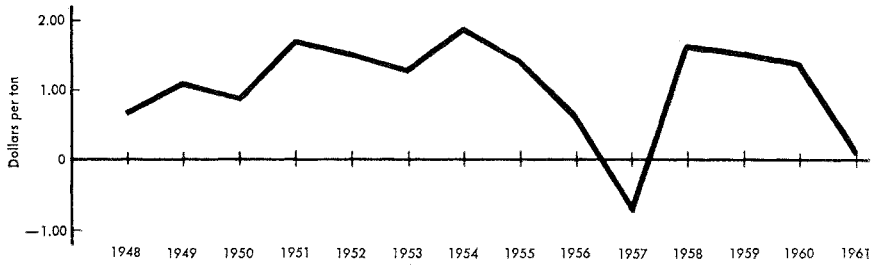


Figure 3. Difference, in dollars, between transportation charges on wheat and on wheat flour shipped out of Minnesota by rail, 1948-61.

[2]See Appendix B for details of the adjustment of average revenue for variations in length of haul.

Table 2. Comparative rail-water wheat rates from Minnesota points to selected markets, in cents per bushel,* selected years

	Rail	Water	Water/rail
	cents per bushel		
Minneapolis to:			
Wilmington, N.C. (1957)	69.6†	—	54.3§
Gainesville, Ga. (1958)	68.1†	—	47.5[11]
New Orleans, La. (1961)	54.3†	14.7	—
	33.9‡	—	—
Duluth to:			
New York, N.Y. (1957)	45.9†	29.6¶	—
Wilmington, N.C. (1957)	69.6†	61.9**	—

* Per ton and per 100-pound rates were converted to per bushel charges on the basis of a 60-pound bushel for wheat.
† Domestic rates.
‡ Export rates.
§ Barge to Memphis, Tennessee; rail beyond.
[11] Barge to Guntersville, Alabama; rail beyond.
¶ Upper Lakes boat to Oswego, New York; barge beyond. Great Lakes charges were approximations for the 1958 navigation season.
** Upper Lakes boat to Buffalo, New York; rail beyond.
Sources: For 1957 charges, (9); for 1958 charges, (8); and for 1961 charges, rail: Minneapolis Grain Exchange and barge: published tariff.

Table 3. Tons of wheat and flour carried from Minnesota by water, 1948-61 *

Year	Wheat			Wheat flour
	Lake	River	Both	(river and lake)
	tons			
1948	2,595,182	—	2,595,182	1,551
1949	3,096,444	—	3,096,444	3,639
1950	1,617,183	20,904	1,638,087	1,519
1951	3,417,214	66,229	3,483,443	612
1952	2,350,612	81,534	2,432,146	881
1953	1,787,880	38,020	1,825,900	504
1954	2,061,726	141,474	2,203,200	2,341
1955	1,945,700	161,976	2,107,676	2,361
1956	2,474,662	147,033	2,621,695	724
1957	1,857,458	174,528	2,031,986	—
1958	1,777,343	134,359	1,911,702	—
1959	1,885,761	350,473	2,236,234	1,315
1960	1,977,619	267,689	2,245,308	4,320
1961	2,786,208	414,966	3,201,174	33,774

* Includes shipments on the Great Lakes from Duluth-Superior and on the Mississippi River from St. Paul-Minneapolis and Minnesota River origins.
Source: (6).

Orleans were as low as one half those of the export rail rates. Even for shipments accomplished by both rail and water (e.g., Minneapolis to Wilmington, N.C.), the combined rates were considerably lower than the all-rail rates.

In addition, much of the water movement of grain is done at charges lower than those published. Most grain traffic in bulk on rivers and all of the Great Lakes traffic are free from economic regulation. Competitive pressure on rates has increased, so the published barge tariffs probably act primarily as upper limits on rates.

Table 3 shows the tonnages of wheat and flour shipped from Minnesota by water between 1948 and 1961.

Note, particularly, the growth of wheat traffic shipped by water carriers on the river. If shippers of flour had used water carriers as extensively as shippers of wheat, it could not be argued that the overall transportation cost of shipping flour was greater than that for shipping wheat. However, from table 3 data it is obvious that this was not the case. The volume of wheat shipped by the lower cost water carriers has been much greater than the volume of wheat flour. So average transportation charges, which are weighted by volumes carried, are clearly lower for wheat than for flour.

Volume of Wheat Flour Production and Shipment from Minnesota

Associated with the higher transportation charges for wheat flour have been changes in the volume of wheat flour produced in Minnesota and in the volume shipped from Minnesota. Table 4 lists data on production and shipments by both rail and water during the period studied. Minnesota production as a percent of U.S. flour production is illustrated in figure 4.

The volume of wheat flour produced in Minnesota declined from 15.5 hundred thousand tons in 1948 to 12.4 hundred thousand in 1962 — an average decline of 14.9 thousand tons per year. Flour shipments from Minnesota declined an average 14.9 tons each year between 1948 and 1961. The 1948 flour shipments totaled 1.4 million tons; by 1961 they fell to 1.1 million.

Flour production in Minnesota, as a percentage of total U.S. output, increased from 11.1 percent in 1948 to a high of 12.7 percent during the middle of the Korean conflict. It declined steadily since then to 9.5 percent in 1962.

These developments have taken place concurrently with higher shipping costs for flour relative to those for wheat. This situation is making Minnesota a high-cost location from which to serve distant markets with flour. Millers located closer to major consuming areas are increasingly able to deliver their products at lower transportation costs than are their Minnesota competitors.

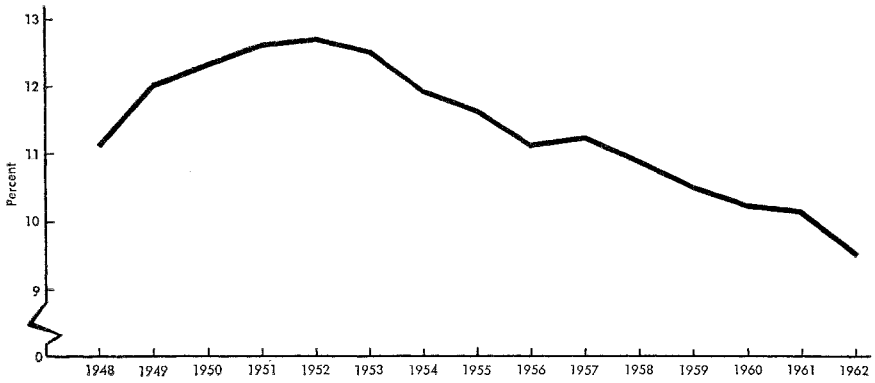


Figure 4. Flour production in Minnesota as a percent of total U.S. output, 1948-62.

Table 4. Wheat flour: production in Minnesota and United States, 1948-62, and wheat flour shipments from Minnesota by both rail and water, 1948-61

Year	Production		Minnesota shipments, rail and water
	United States	Minnesota	
	100 tons		
1948	139,566	15,528	14,041
1949	117,176	14,056	11,415
1950	112,450	13,846	11,551
1951	114,646	14,464	11,907
1952	114,074	14,534	11,651
1953	111,088	13,870	11,775
1954	110,874	13,234	11,294
1955	112,824	13,054	10,467
1956	114,879	12,765	10,100
1957	119,444	13,362	11,319
1958	123,078	13,415	10,716
1959	124,247	13,100	10,592
1960	127,570	13,074	11,294
1961	130,158	13,158	10,822
1962	131,034	12,442	—

Sources: Production: 1948-60, (11); 1961-62, (10). Shipments: (2), (3), and (6).

Oilseeds and Oilseed Products

The transportation charge and volume relationships between oilseeds and their products were examined using techniques similar to those employed with grains and grain products. Included in the oilseed category are soybeans and flaxseed. In the oilseed products category are soybean oil, linseed oil, soybean meal, and linseed meal.

To construct the average rail revenue series, total rail revenues were divided by total rail tonnages; to construct the average length of haul series, total ton miles were divided by total tons. Average rail revenues, adjusted for variations in length of haul, are shown in figure 5.

The fairly wide year-to-year variations in average revenue in each "rate" series prevent comparison of their trends — even after effects of distance are removed.

To see whether the variations in "rates" on oilseeds paralleled those on oilseed products, the adjusted "rate" on oilseeds in each year was

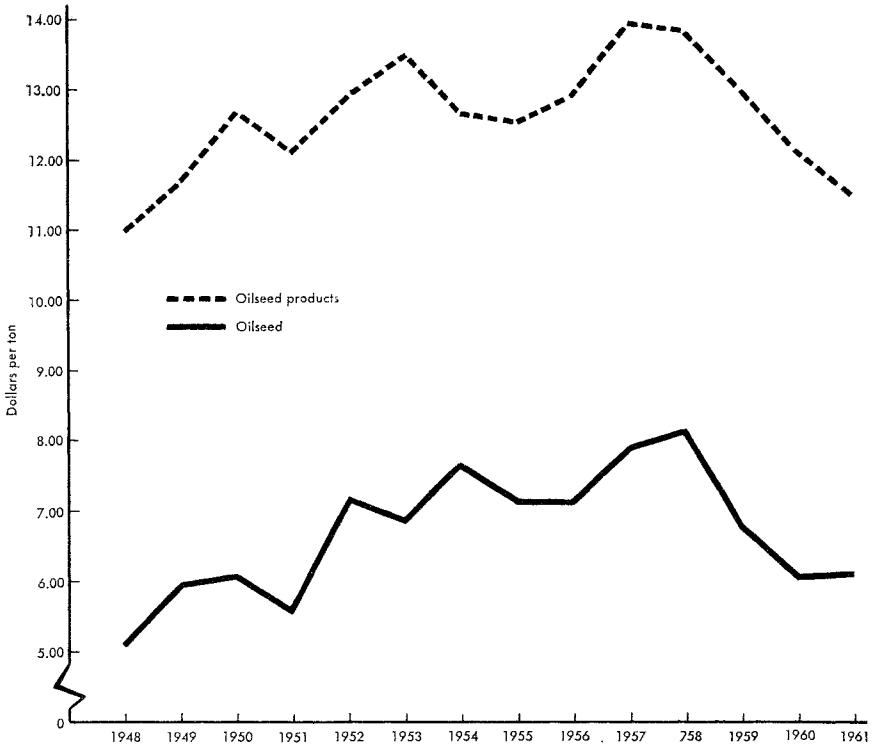


Figure 5. Average transportation charges per ton on oilseeds and oilseed products shipped out of Minnesota by rail, 1948-61.

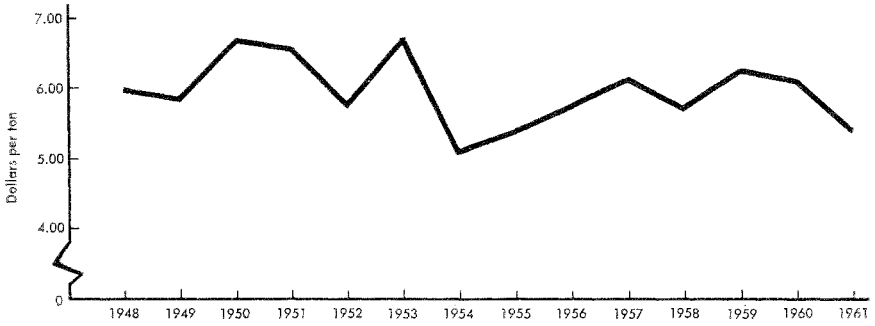


Figure 6. Difference, in dollars, between transportation charges on oilseeds and oilseed products shipped out of Minnesota by rail, 1948-61.

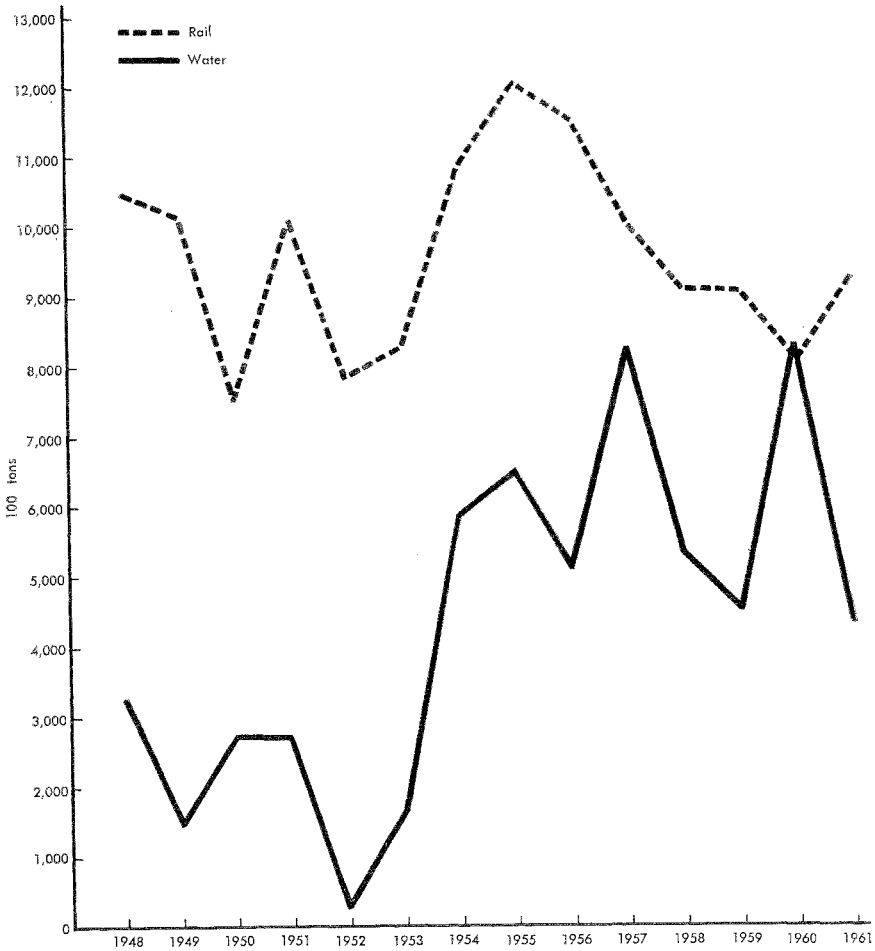


Figure 7. Volume of oilseeds and products shipped out of Minnesota by rail and water, 1948-61.

subtracted from the corresponding "rate" on oilseed products. This difference was plotted against time (figure 6). The difference between "rates" on oilseed products and on oilseeds exhibited no significant trend over time. Therefore, rail "rates" on oilseed products apparently did not increase relative to "rates" on oilseeds during the period studied.

As with wheat and flour, the whole story of transportation charges cannot be told in terms of railroads alone. Since 1948, water carriage of oilseeds and their products has increased relative to rail movement (figure 7). In 1948, more than 1 million tons of oilseeds and their products were shipped by rail while 323,000 tons were moved by water. By 1961, rail volume declined to 936,000 tons; waterborne volume was 438,000 tons, falling from 783,000 tons in 1960. How this water carriage was divided between shippers of oilseeds and shippers of their products is shown in table 5.

The relationship between the shipment of oilseeds and the shipment of oilseed products by water has been similar to that noted for grain and grain products. Water carriage of oilseeds increased by 95,000 tons between 1948 and 1961 — from 319,000 to 414,000. Shipment of oilseed products by water increased 20,000 tons — from 4,000 to 24,000 — during that same period. Therefore, a rate series which includes water carrier charges would be weighted in favor of oilseeds versus their products.

There is a difference of degree, however, between this situation and that of wheat and wheat flour. Oilseed product shippers have made

Table 5. Volume of oilseeds and their products shipped from Minnesota by water, 1948-61

Year	Oilseeds	Oilseed products — meal and oil		
		Meal	Oil	Total
	tons			
1948	319,166	3,754	—	3,754
1949	145,772	3,754	1,800	5,554
1950	275,573	—	403	403
1951	262,458	—	1,265	1,265
1952	20,106	—	2,509	2,509
1953	161,960	—	722	722
1954	534,519	—	39,645	39,645
1955	571,456	—	39,541	39,541
1956	422,365	—	47,765	47,765
1957	733,529	—	81,742	81,742
1958	488,375	—	31,700	31,700
1959	416,711	—	20,408	20,408
1960	731,661	—	51,551	51,551
1961	414,213	—	23,622	23,622

Source: (6).

greater use of water transportation relative to shippers of their raw material than have wheat flour shippers. This is clearly indicated by comparing table 5 with table 3. In 1960, for example, oil accounted for 6.6 percent of total water shipments of oilseeds and products. During that year, wheat flour accounted for less than 0.2 percent of total wheat and flour shipments by water.

The conclusion drawn from this comparison is that oilseed product shippers have possessed relatively greater access to water as a transportation alternative than have shippers of flour. So the availability of water transport has not put oilseed processors at the same relative disadvantage as it has wheat flour millers.

Some transportation rate advantage attributable to water has accrued to oilseed shippers relative to shippers of oilseed products. As a result, a decline in shipments of oilseed products from Minnesota would be expected during 1948-60. But this was not the case—there was a significant increase in these shipments (table 6).

Two reasons can be advanced to explain this expansion of shipments in the face of rising transportation costs:

• The combination of a nearby source of raw materials and a relatively localized market for meal. Soybean production has expanded rapidly in Minnesota since World War II. Flaxseed production is concentrated in Minnesota, North Dakota, and South Dakota. Also, in each year of the period studied, over one-half of all rail shipments of oilseed meal origi-

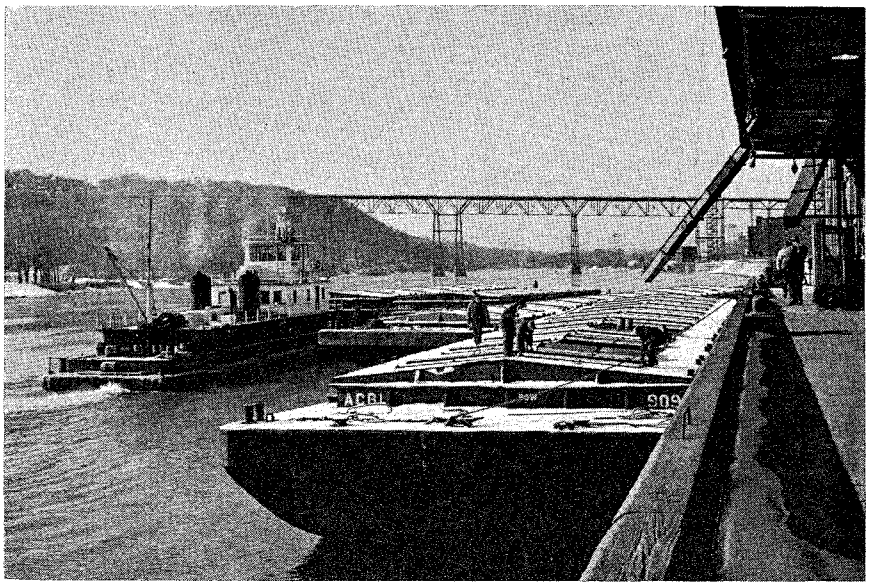
Table 6. Volume of oilseeds and their products shipped from Minnesota by rail and water, 1948-61

Year	Oilseeds	Oilseed products*
	100 tons	
1948	7,852	5,876
1949	5,604	6,068
1950	4,530	5,754
1951	5,796	6,976
1952	2,602	5,488
1953	3,977	5,949
1954	10,157	6,776
1955	10,677	7,471
1956	8,968	7,307
1957	9,949	8,289
1958	6,282	8,012
1959	6,123	7,285
1960	8,560	7,392
1961	5,742	7,992

* Excludes animal feeds, n.e.c.
Source: (2), (3), and (6).

nating in Minnesota had their destinations in Iowa, Minnesota, and Wisconsin. Therefore, transportation cost savings are realized when oilseeds are crushed in Minnesota rather than shipping them elsewhere for crushing and then shipping the meal back.

• The weight loss in processing associated with the extraction of oil. Oil markets tend to be farther away than meal markets. Oil yield accounts for about 17 percent of the weight of soybeans and about 36 percent of the weight of flaxseed. This indicates weight losses in processing of greater than 80 percent and 60 percent, respectively. Transportation costs are saved when the 80 percent and 60 percent are not shipped with the oil; that is, when the oil is extracted near the point of raw material source.



Since World War II barges have become increasingly important in the movement of grains and oilseeds from Minnesota.

Future Volume Trends Under Conditions of an Altered Railroad Rate Structure

The first part of this bulletin discussed changes in transportation charges on wheat and oilseeds and their products that occurred from 1948 to 1960. It also dealt with changes in volume shipped over the same period.

An increase in transportation charges on wheat flour relative to those on wheat, due to the availability of water carriage, was clearly demonstrated — as was the decline in volume of flour shipped from Minnesota. The relationship between charges for shipping oilseeds and those for shipping meal and oil was not as clear. Some increase in oilseed product charges relative to those on soybeans and flax combined apparently occurred. There are overriding reasons why shipments of oilseed products could continue to increase, which they did, in the face of a slight rate advantage accruing to oilseed shippers. These include: the increasing production of oilseeds in this area, tremendous weight loss in oil processing, and the relatively localized market for meal.

This section concerns future trends of product shipments under conditions of a radically altered railroad rate structure.

In addition to the institutional features of the rail rate structure, such as the transit privilege and the system of proportional rates, railroad rates have traditionally been based more on the value of the service performed than on the cost of performing the service. So high value products can absorb higher transportation costs than can low value products, and rates have tended to be set accordingly.

Although railroads continue to carry tremendous quantities of grains and oilseeds out of Minnesota, large inroads on this volume have been made by competing agencies. Operating on the value-of-service principle, high rail rates on grains and grain products have traditionally permitted water carriers to compete effectively for outbound movements. Trucks, operating primarily in intrastate movement between country elevators and terminals, have also taken much grain volume away from railroads.

A hint that railroads are starting to retaliate is shown in an attempt to modify this situation. On April 8, 1960, the Great Northern, Northern Pacific, and Soo Line Railroads established rates with ICC approval carrying reductions of up to 9 cents per bushel under prevailing rates on wheat, rye, and flaxseed. These applied from country origins in northern Minnesota, extreme northern South Dakota, and eastern North Dakota into Minneapolis and Duluth.

Grain moving under these rates was not permitted to be shipped beyond these markets by rail. Disposition of this grain was limited to

water, truck, or local consumption. If a dealer wished to ship grain onward by rail, the old higher inbound rate, combined with the outbound proportional, applied. In addition, the grain could not be milled in transit on its way to Minneapolis or Duluth, but storage in transit was permitted. These restrictions on rail movement were later removed although the lowered rates were retained.

This attempted modification of the railroad rate structure was made in response to increased truck competition on the inbound shipment of grain. Undoubtedly, the issue is not settled. The competition from other agencies is causing a downward pressure on rail rates; a shift toward cost of service rather than value of service in rate making may be the coming trend.

Assuming this surmise is correct, knowledge of the relationship between railroad costs and revenues, apportioned among the commodities under consideration, provides a basis for predicting relative sizes of possible rate adjustments. That is, it provides an answer to the question: Can rates on wheat flour be lowered as much as rates on wheat, and similarly for oilseeds and their products? This answer, in turn, supplies the foundation for suggesting possible trends in future commodity movements.

Information on railroad costs and the ratios of revenues to out-of-pocket and fully distributed costs, by commodity, is provided by the ICC. (1) Data are reported by freight territory of origin. For this study, the territory of origin is the Western Territory (see figure 8). This is defined by the ICC as the combination of the three rate territories west of the Mississippi River: Western Truckline, Southwestern, and Mountain-Pacific. Unfortunately, data are not reported by state of origin—the Western Territory is vast and Minnesota is only a small part of it.

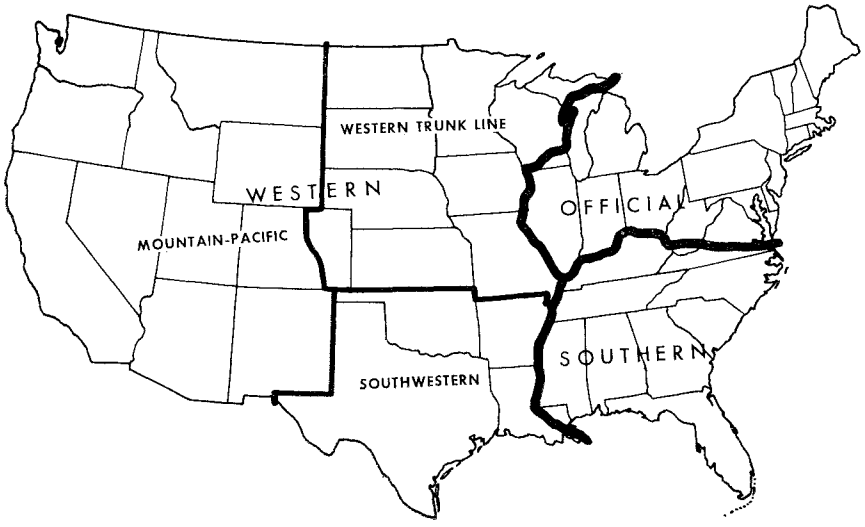


Figure 8. Freight rate territories of the United States.

However, for reasons which are discussed later, conclusions based on the territorial data also apply to Minnesota.

The ICC computes out-of-pocket costs at 80 percent of the operating expenses, rents, and taxes. They also include an allowance for return at 4 percent on one-half of the road property and on all equipment. Fully distributed costs are the sum of the out-of-pocket and constant costs. Constant costs are assigned to commodities on a pro rata ton and ton-mile basis regardless of kind or class. Constant costs include 20 percent of the operating expenses, rents, and taxes assigned to carload freight services and any deficits incurred in the handling of less-than-carload and passenger services.[3]

Out-of-pocket costs are roughly analogous to variable costs, the relevant costs in the short-run, for rate decision-making. Problems of definition and allocation (especially among individual commodities and specific runs) prevent the two from being strictly equivalent. In the short-run (that time period too short to permit the railroad to alter its plant and equipment), costs may be divided into two groups: constant costs and out-of-pocket costs.

Out-of-pocket costs vary directly with the amount of transportation service offered. Constant costs do not vary with output and are largely sunk costs. That is, they have to be paid even if the railroad quits operating. If the railroad quits operating, its losses equal these sunk costs. So in the short-run, rates covering out-of-pocket costs and contributing to the payment of constant costs are accepted by the railroad.

The ratios of revenue to out-of-pocket and to fully allocated costs for the 4 years 1949, 1952, 1956, and 1959 are shown in table 7.[4] A slight downward trend, although apparent, was not large enough to necessitate presentation of data for additional years.

Table 7 shows that average revenues exceed out-of-pocket costs by considerably more for wheat than for flour. For example, revenue as a percent of out-of-pocket costs in 1959 was 219 for wheat and 110 for wheat flour. There are two principal reasons for this:

1. Out-of-pocket costs per ton are higher on flour than on wheat. For example, in 1959 the average out-of-pocket cost per ton on wheat from the Western Territory was $3.30, while on wheat flour it was $7.37.

2. Wheat flour is shipped almost exclusively on transit balances and proportional rates. But wheat rates, as presented here, include the relatively high gathering rates from country origin to first market.

The second factor must be taken into account when assessing Minnesota's locational position with respect to transportation. Only outbound shipments were considered in the analysis of "rate" trends presented earlier. Processors in other locations also must pay the high gathering rates. The prior analyses included no shipments within Minnesota,

[3] These definitions of costs were paraphrased from the prefaces of the 1949 and 1959 editions of *Distribution of the Rail Revenue Contribution by Commodity Groups*, (1).

[4] See Appendix A for volume, revenue, and cost aggregates from which these ratios were constructed.

Table 7. The relationship between costs and revenues on shipments originating in the Western Freight Territory, by commodity group, 1949, 1952, 1956, and 1959

Commodity group	1949 Revenue as percent of: Out-of-pocket costs	1949 Revenue as percent of: Fully distributed costs	1952 Revenue as percent of: Out-of-pocket costs	1952 Revenue as percent of: Fully distributed costs
Wheat	238	137	232	134
Wheat flour	118	76	122	78
Oilseeds	247	146	252	151
Oilseed products	159	100	158	103

Commodity group	1956 Revenue as percent of: Out-of-pocket costs	1956 Revenue as percent of: Fully distributed costs	1959 Revenue as percent of: Out-of-pocket costs	1959 Revenue as percent of: Fully distributed costs
Wheat	226	142	219	146
Wheat flour	108	76	110	81
Oilseeds	229	148	162	110
Oilseed products	145	103	125	94

Source: Interstate Commerce Commission.

thereby preventing double counting and eliminating most wheat shipments carrying high gathering rates.

The first factor is most important. The higher cost of shipping grain products clearly puts a lower limit on flour rates that is much higher than the lower limit on wheat rates.

That the Western Territory relationships apply quite well to Minnesota is demonstrated in table 8. Outbound domestic proportionals from Minneapolis are at about the same level above out-of-pocket costs as are grain rates in the Western Territory as a whole. It is unlikely that the ratios of grain product rates to out-of-pocket costs are nearly as high as those for grains.

Certain qualifications must be mentioned before the relationships can be accepted. The first has already been discussed — that the existence of relatively high gathering rates in the grain revenue-cost ratios for the Western Territory does not prevent these ratios from being applied in general to Minnesota.

The second involves the nature of railroad costs and the demand for railroad services. Knowledge of the revenue-cost by itself is not sufficient to prescribe the profit-maximizing rate level. Due to competition, this level is undoubtedly lower than present rates. The cost-revenue

Table 8. Ratios of railroad revenues to costs on domestic shipments to selected destinations from Minneapolis, 1957

Minneapolis to:	Domestic		Export	
	Revenue as percent of out-of-pocket costs	Revenue as percent of fully distributed costs	Revenue as percent of out-of-pocket costs	Revenue as percent of fully distributed costs
	percent			
Baltimore				
Wheat	214	132	164	102
Soybeans	202	128	187	118
New York				
Wheat	218	135	165	102
Soybeans	206	130	187	118
Wilmington, N.C.				
Wheat	323	184	—	—
Soybeans	311	180	—	—

Source: (9).

ratio can indicate the extent to which rates can be lowered and which products can absorb reductions. Therefore, these two qualifications do not alter the general application of this argument. Grain can absorb greater rate reductions than can grain products.

Implications of these relationships are obvious. Interagency competition forces rates down; rates on grains will probably fall farther than those on grain products; and transportation advantages of shipping grain rather than flour from Minnesota will increase. The volume trend of flour shipments that was exhibited from 1948 to 1961 will undoubtedly continue — perhaps even accelerate.

The picture for oilseeds and their products is not so obvious. The cost-revenue ratios for oilseeds are more favorable than for their products, but they are closer than are the wheat versus flour ratios. Reasons for the continued increase in oilseed product shipments from Minnesota were discussed earlier. Rail rate declines on oilseeds relative to their products are not likely to cause a decline in oilseed crushings in Minnesota.

In addition, shippers of oilseed products have made use of the water carrier alternative to a much greater extent than have shippers of grain products. These factors should continue to make oilseed crushing a raw material-oriented industry. As long as soybean production in Minnesota continues to increase, and flaxseed production remains concentrated in this area, a decline in processing in Minnesota is not foreseen.

Summary

Minnesota's importance as a location for wheat flour milling and oilseed crushing is significantly affected by transportation costs. The cost of transporting raw materials relative to finished products affects the competitive position of processing firms.

The institutional effect of the traditional railroad rate structure has insured the equality of rail transportation costs for wheat and flour and for oilseeds and their products. However, the opportunity of some shippers to use lower cost water carriage has disrupted this equality.

Between 1948 and 1961 the volume of wheat carried by water from Minnesota was vastly greater than the volume of flour similarly moved. This water carriage is reducing the charges of shipping wheat from Minnesota relative to the charges on flour shipments. During this same period, shipments of flour from Minnesota declined an average of 14,900 tons per year. Flour production in Minnesota during this period decreased, both absolutely and as a fraction of total U.S. production.

An identical analysis on oilseeds and their products revealed similar, but not so pronounced, trends. Oilseed product (meal and oil) production in Minnesota increased during this 1948-61 period in spite of the slight transportation charge advantage of shipping oilseeds rather than meal and oil. Some reasons for this increase were the relatively localized nature of the market for oilseed meals and the high weight loss in processing for oil.

Examination of the railroad revenue-cost ratios in carrying wheat and flour indicates that rail revenues relative to costs are much higher for wheat than for flour. This implies that, as intercarrier competition forces rates downward, wheat rates can absorb greater decreases than can flour rates. Should the railroad rate structure be altered as a result, the falling trend of flour shipments from Minnesota should continue or even accelerate.

Again, these revenue-cost ratios of oilseeds and their products are similar to those of wheat and flour. However, the oilseed-oilseed product ratio comparison is much closer than is the wheat-flour comparison. So a decline in oilseed crushing in Minnesota, as a result of a transportation disadvantage, is not foreseen.

Appendix A—Volume, Cost, and Revenue Data Used in This Analysis

Table 1. Wheat: shipments from Minnesota by rail; total tons, total ton-miles, total rail revenue, average revenue per ton, average length of haul per ton, 1948-61

	1948	1949	1950	1951	1952	1953	1954
Total tons.. (100 tons)	8,442	5,727	4,261	11,135	9,631	5,314	5,141
Total ton-miles ... (100 ton-miles)	3,670,700	3,060,800	2,049,500	9,697,000	7,170,000	2,308,100	2,565,500
Total revenue (100 dollars)	40,101	33,687	28,541	87,173	73,445	34,386	33,695
Average revenue per ton (dollars)	4.75	5.88	6.70	7.83	7.63	6.47	6.55
Average length of haul (miles)	435	534	565	871	744	434	499
	1955	1956	1957	1958	1959	1960	1961
Total tons.. (100 tons)	5,877	7,571	9,487	4,284	5,952	2,796	9,074
Total ton-miles ... (100 ton-miles)	2,494,200	4,416,500	6,280,500	1,973,300	4,617,500	1,290,300	5,258,300
Total revenue (100 dollars)	37,376	62,567	98,903	31,244	54,463	21,781	82,706
Average revenue per ton (dollars)	6.36	8.26	10.43	7.29	9.15	7.79	9.11
Average length of haul (miles)	424	583	662	461	776	461	579

Source: (2) and (3).

Table 2. Wheat flour: shipments from Minnesota by rail; total tons, total ton-miles, total rail revenue, average revenue per ton, average length of haul per ton, 1948-61

	1948	1949	1950	1951	1952	1953	1954
Total tons... (100 tons)	14,025	11,379	11,536	11,901	11,642	11,770	11,271
Total ton-miles ...11,529,700 (100 ton-miles)		8,294,300	8,616,900	9,503,400	9,141,300	9,284,700	9,009,100
Total revenue (100 dollars)	93,458	78,560	86,647	95,700	96,509	102,795	102,554
Average revenue per ton (dollars)	6.66	6.90	7.51	8.04	8.29	8.73	9.10
Average length of haul (miles)	822	729	747	799	785	789	799

Table 2. (continued)

	1955	1956	1957	1958	1959	1960	1961
Total tons (100 tons)	10,443	10,093	11,319	10,716	10,579	11,251	10,484
Total ton-miles (100 ton-miles)	7,767,000	7,757,900	8,286,000	8,063,600	8,153,200	8,171,900	7,630,300
Total revenue (100 dollars)	88,842	89,193	101,041	11,735	100,754	107,581	93,063
Average revenue per ton (dollars)	8.51	8.84	8.93	9.49	9.52	9.56	8.88
Average length of haul (miles)	744	769	732	752	771	726	728

Source: (2) and (3).

Table 3. Oilseeds: shipments from Minnesota by rail; total tons, total ton-miles, total rail revenue, average revenue per ton, average length of haul per ton, 1948-61

	1948	1949	1950	1951	1952	1953	1954
Total tons (100 tons)	4,660	4,146	1,774	3,171	2,401	2,357	4,429
Total ton-miles (100 ton-miles)	2,690,700	1,322,200	458,300	1,849,800	753,700	605,500	1,838,400
Total revenue (100 dollars)	32,716	23,360	9,161	24,150	16,332	14,066	36,192
Average revenue per ton (dollars)	7.02	5.63	5.16	7.62	6.80	5.97	8.17
Average length of haul (miles)	577	319	258	583	314	257	415

	1955	1956	1957	1958	1959	1960	1961
Total tons (100 tons)	4,962	4,744	2,614	1,398	1,956	1,243	1,600
Total ton-miles (100 ton-miles)	2,110,400	2,241,800	773,500	502,800	440,800	302,100	336,000
Total revenue (100 dollars)	38,640	38,843	19,115	11,449	10,893	6,228	7,599
Average revenue per ton (dollars)	7.79	8.19	7.31	8.19	5.57	5.01	4.75
Average length of haul (miles)	425	473	296	360	225	243	210

Source: (2) and (3).

Table 4. Oilseed products: shipments from Minnesota by rail; total tons, total ton-miles, total rail revenue, average revenue per ton, average length of haul per ton, 1948-61

	1948	1949	1950	1951	1952	1953	1954
Total tons (100 tons)	5,838	6,049	5,750	6,922	5,463	5,942	6,380
Total ton-miles (100 ton-miles)	3,720,900	4,275,300	3,733,400	5,323,900	4,314,200	4,550,300	4,290,900
Total revenue (100 dollars)	51,487	64,436	61,378	81,760	71,201	78,802	70,357
Average revenue per ton (dollars)	8.82	10.65	10.67	11.81	13.03	13.26	11.03
Average length of haul (miles)	637	707	649	757	790	766	673

	1955	1956	1957	1958	1959	1960	1961
Total tons (100 tons)	7,076	6,849	7,442	7,695	7,081	6,876	7,756
Total ton-miles (100 ton-miles)	5,843,200	5,206,400	6,156,300	6,420,500	6,520,600	5,989,700	7,018,100
Total revenue (100 dollars)	93,788	86,210	109,035	112,729	106,814	92,583	103,398
Average revenue per ton (dollars)	13.25	12.59	14.65	14.65	15.08	13.46	13.33
Average length of haul (miles)	826	760	827	834	921	871	905

Source: (2) and (3).

Table 5. Railroad revenues, out-of-pocket costs, and fully distributed costs; carloads originating in Western Freight Territory to all destinations, 1949, 1952, 1956, and 1959

	Volume	Rail revenue	Out-of-pocket costs	Fully distributed costs*	Ratio of revenue to out-of-pocket costs	Ratio of revenue to fully distributed costs
	100 tons	100 dollars			percent	
1949						
Wheat	305,037	1,917,621	805,944	1,394,880	238	137
Wheat flour	65,981	455,070	384,718	595,263	118	76
Oilseeds	29,779	157,638	63,822	108,278	247	146
Oilseed products	23,382	213,445	134,046	200,744	159	106
1952						
Wheat	313,334	2,155,465	928,481	1,620,878	232	134
Wheat flour	60,204	474,395	390,217	607,947	122	78
Oilseeds	33,548	198,874	78,803	131,471	252	151
Oilseed products	23,845	225,873	143,077	219,476	158	103

Table 5. (continued)

	Volume	Rail revenue	Out-of-pocket costs	Fully distributed costs *	Ratio of revenue to out-of-pocket costs	Ratio of revenue to fully distributed costs
1956	100 tons		100 dollars		percent	
Wheat	272,703	1,807,745	801,449	1,277,011	226	142
Wheat flour	57,210	436,199	402,932	575,286	108	76
Oilseeds	35,525	229,840	100,328	155,446	229	148
Oilseed products.	22,608	215,294	148,886	207,310	145	103
1959						
Wheat	276,966	2,002,546	912,524	1,368,714	219	146
Wheat flour	65,484	552,360	503,100	678,224	110	81
Oilseeds	44,004	206,525	128,334	187,970	162	110
Oilseed products.	27,542	266,560	213,409	282,475	125	94

* Calculated by dividing revenue by the ratio of revenue to fully distributed costs.
Source: (1).

Table 6. Railroad charges, out-of-pocket costs, and fully distributed costs in cents per bushel; Minneapolis to selected destinations, 1957

	Domestic			Export		
Minneapolis to:	Revenue	Out-of-pocket costs	Fully distributed costs	Revenue	Out-of-pocket costs	Fully distributed costs
Baltimore			cents per bushel			
Wheat	44.10	20.64	33.35	33.90	20.64	33.35
Soybeans	44.10	21.82	34.53	40.80	21.82	34.53
New York						
Wheat	45.90	21.10	34.12	34.80	21.10	34.12
Soybeans	45.90	22.31	35.32	41.70	22.31	35.32
Wilmington, N.C.						
Wheat	69.60	21.54	37.84	—	—	—
Soybeans	69.60	22.37	38.66	—	—	—

Source: (9).

Appendix B—Adjustment of Average Revenue Series for Variations in Length of Haul

The relationship between average revenue, average length of haul, and time is shown by the regression equations:

Wheat	$X_1 = 2.1331 + 0.005960\ X_2 + 0.2522\ X_3$
Wheat flour	$X_1 = 0.8889 + 0.007743\ X_2 + 0.2260\ X_3$
Oilseeds	$X_1 = 2.8067 + 0.008930\ X_2 + 0.09180\ X_3$
Oilseed products	$X_1 = 0.3041 + 0.01518\ X_2 + 0.05924\ X_3$

where in each equation: X_1 is the average revenue per ton; X_2 is the average length of haul per ton; and X_3 is time in years.

In plotting figures 2 and 5, the influence of X_2 (average distance) was removed by a procedure adapted from Willard W. Cochrane and Harland C. Lampe, "The Nature of the Race Between Food Supplies and Demand in the United States, 1951-75." *Journal of Farm Economics,* page 205, May 1953. The mean value of the variable, X_2, was subtracted from the actual value of the variable for each year; the difference was multiplied by its regression coefficient; and the product was subtracted (algebraically) from the actual value of the average revenue for each year to yield adjusted average revenues. In figures 2 and 5 these adjusted average revenues are plotted against time.

Bibliography

(1) Interstate Commerce Commission. Bureau of Accounts, Cost Finding and Valuation. 1960. *Distribution of the Rail Revenue Contribution by Commodity Groups.*

(2) ————. Bureau of Transport Economics and Statistics. Annual. *Carload Waybill Statistics, State-to-State Distribution, Manufactures and Miscellaneous and Forwarder Traffic (C.L.), Traffic and Revenue.* Washington, D. C.

(3) ————. Annual. *Carload Waybill Statistics, State-to-State Distribution, Products of Agriculture.* Washington, D.C.

(4) ————. 1954. *Waybill Statistics, Their History and Uses.* Statement No. 543. Washington, D.C.

(5) Pickett, V. C., and R. A. Vaile. 1933. *The Decline of Northwest Flour Milling.* University of Minnesota Press, Minneapolis, Minn.

(6) U.S. Army Corps of Engineers. Annual. *Waterborne Commerce in the United States.*

(7) U.S. Department of Agriculture, Agricultural Marketing Service. 1961. *Grain Transportation in the North Central Region.* Marketing Res. Rept. 490. Washington, D.C.

(8) ————. August 1960. *Grain Transportation Statistics for the North Central Region.* Stat. Bull. 268. Washington, D.C.

(9) ————. April 1959. *Potential Effects of St. Lawrence Seaway on Costs of Transporting Grain.* Marketing Res. Rept. 319. Washington, D.C.

(10) U.S. Department of Commerce, Bureau of Census. 1961 and 1962. *Current Industrial Reports.* Series M20A.

(11) ————. 1949-60. *Statistical Abstract of the United States.*

(12) Winter, J. C. February 2, 1960. "General History and Theory of the Railroad Grain Rate Structure." Paper presented at the Agricultural Industries Forum, University of Illinois, Urbana, Ill.

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