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Effect of Rail Rate Deregulation:

The Case of Wheat Exports From the South Plains

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SUMMARY

The Staggers Rail Act of 1980 allows railroads greater rate-setting flexibility. The purpose of this study is to determine the effectiveness of intramodal and intermodal competition in limiting rail rate increases. The study focuses on export wheat movement in the Southern Plains.

The intramodal analysis concentrates on the effectiveness of other railroads in restraining a dominant railroad from increasing rates, assuming that railroads would compete, i.e. would not adjust rates in unison. In general, results indicate that competition could effectively restrain rate increases by the dominant rail carriers. The exception is in that portion of the study area where the dominant carrier operates the only rail line. In this area, railroads could increase rates 5 percent. This study found that intramodal competition, if made to work, could restrain rail rate increases by a dominant railroad; however, it should be noted that the trend toward increased rail line abandonment and railroad company mergers will tend to reduce the potential effectiveness of intramodal competition.

The intermodal analysis addresses railroads adjusting rates in unison and studies the effectiveness of truck and truck-barge competition in restraining rail rate increases. In the short run, railroads through selective rate increases would be able to increase annual revenue and revenue-above-variable cost. In portions of the Texas and Oklahoma panhandles, railroads can increase rates 15 to 30 percent or an average of $.09 per bushel. The increased distance of these locations from an Arkansas river elevator decreases the effectiveness of truck-barge competition, which was the most effective form of intermodal competition. In the long run, the railroads' ability to increase rates would be substantially reduced by intermodal competition. New investment in river elevator capacity would allow for additional flows via the truck-barge combination.

KEYWORDS: Railroad rates/freight rates/deregulation of railroads/competition/wheat transportation/Southern Plains/Texas.

Effect of Rail Rate Deregulation:

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INTRODUCTION

Agriculture is an important user of rail services for shipping products to market and for moving production supplies to rural communities. The level and structure of rail rates affect returns to farmers as well as farmers' competitive positions in distant markets. Farm products tend to be bulky and heavy relative to their value; accordingly, transportation charges make up a substantial portion of marketing costs.

Much of the early discontent with railroads was centered in agricultural regions, particularly the new regions of the west where monopolistic price discrimination was most easily practiced by the railroads. Because of unavailable or inaccessible forms of competing transportation and numerous small shippers, railroads were able to exploit their monopolistic position (Meyer et al., 1959). Agrarian political action in the 1860's resulted in unsuccessful regulatory efforts by states but set the stage for the cornerstone of federal transportation regulation, the Act to Regulate Commerce, which was passed in 1887. The Act requires that all rates be "just and reasonable" and provides that "every unjust and unreasonable charge" is unlawful. Other sections deal with discrimination, pooling, publication of rates, and the unlawful practice of charging higher rates on short hauls than long hauls. In addition, the Act created the Interstate Commerce Commission (ICC), an agency with powers to enforce provisions of the Act. By the 1930's, the growth of alternative transportation modes and the corresponding decline in railroads' traffic share led to the economic decline of many rail carriers. Since this time, much of the Federal railroad legislation has been designed to curtail the economic demise of the nation's railroad industry.[1] Unfortunately, legislative attempts to rehabilitate the rail industry have not been completely successful, and the economic condition of many carriers continues to worsen.

A large and growing body of literature has criticized the Interstate Commerce Commission and inefficiencies generated by the regulatory process (Friedlaender, 1969; Moore, 1975). This literature argues that the outdated regulatory process hinders railroads' ability to adjust to an altered competitive environment. These experts contend that the growth in alternative modes has removed the railroads' previous monopoly position; accordingly, protective legislation is no longer required. This persuasion, coupled with the current economic climate, has yielded the Staggers Rail Act of 1980, an Act designed "to allow . . . competition and demand . . . to establish . . . rates for transportation" (U.S. House of Representatives, 1980). This deregulatory action permits greater reliance on the marketplace for purposes of rate determination. Accordingly, many producers and agricultural shippers are convinced they will be susceptible to additional regional or geographic discrimination because of ineffective competition from competing modes.[2]

This study was designed to determine the effectiveness of competitive forces to limit rail rate increases in the South Plains hard-winter-wheat producing region. The study area has historically exported about 75 percent of production; accordingly, the analysis centers on this movement, and on the ability of intra- and intermodal competition to constrain rail rate increases.[3] Analysis proceeds under two alterna-

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[1]Examples include the Emergency Transportation Act (1933), and the Transportation Acts of 1940 and 1958.

[2]A previous study by Sorenson, *et al.*, 1973, indicates that railroads' current grain rate structure reflects regional discrimination.

[3]Friedlaender, 1969, indicates that price competition (intramodal) would be an unlikely course of action with deregulation — even if the deregulatory action abolished rate bureaus.

tive assumptions regarding the rate-setting behavior of railroads in the region.

In the intramodal analysis, the assumption is that the dominant railroad alters its rates without corresponding changes from other transportation firms in the region. In this case rate competition exists between railroads. This analysis measures the ability of a single carrier to improve its profitability without collaborative action from competing railroads; i.e., the dominant firm finds competing rail carriers unwilling to follow its rate increases. Since other modes may increase haulage as the dominant railroad adjusts rate levels upward, an element of intermodal competition exists in the intramodal analysis.

The intermodal competitive analysis centers on the ability of competing modes to constrain rail rate increases. In this analysis, it is assumed that no rate competition exists between railroads, in which case the dominant railroad becomes a price leader. Competing railroads follow the price leadership of the dominant firm and adopt similar rate increases. It is assumed that competing modes do not make rate changes in response to the railroad's rate increases.

The intramodal analysis is carried out for the short run, while the intermodal analysis is examined in the short and long run. In the short run analysis, each port area reflects historic flows from the study region to that port area. Since these port areas' existing capacity can accommodate the region's current export levels, no new capital is required to increase port capacity. Accordingly, this situation is representative of the short run. To analyze more fully the effect of intermodal competition, the analysis is extended to allow for new capital in river and port elevator facilities. Historically, nearly all of the study region's wheat exports have been rail-transported to North Texas ports; accordingly, most of the current port capacity is limited to this area. Because the barge rate from the study area to the Lower Mississippi River port is substantially less than to North Texas ports, an incentive to invest in additional Arkansas River elevator and Mississippi River port facilities may develop as railroads adjust rates upward. For this reason, the intermodal analysis includes a long-run perspective.

Three specific scenarios are examined in this study. These include:

(1) Effectiveness of intramodal competition to limit rail rates in the short run, referred to as intramodal analysis,

(2) Effectiveness of intermodal competition to limit rail rates in the short run, referred to as short run intermodal analysis,

(3) Effectiveness of intermodal competition to limit rail rates in the long run, referred to as long run intermodal analysis.

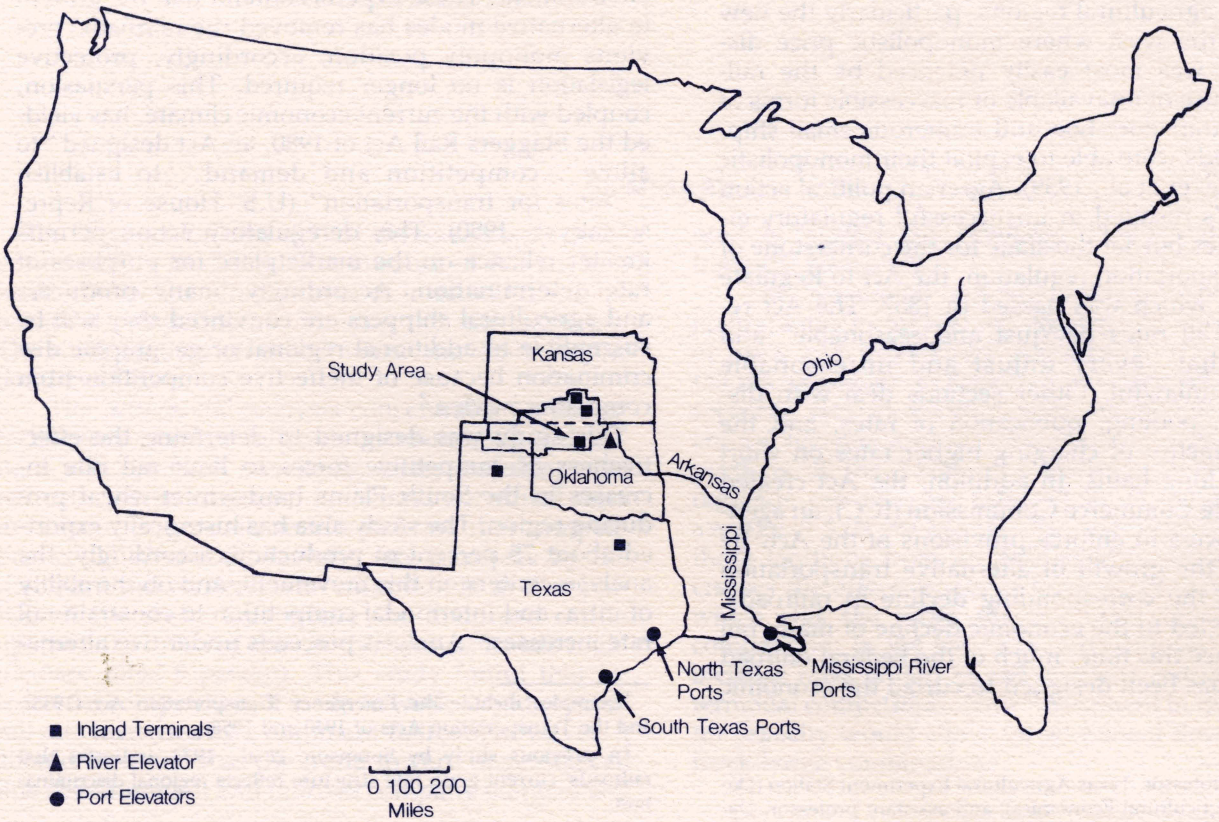
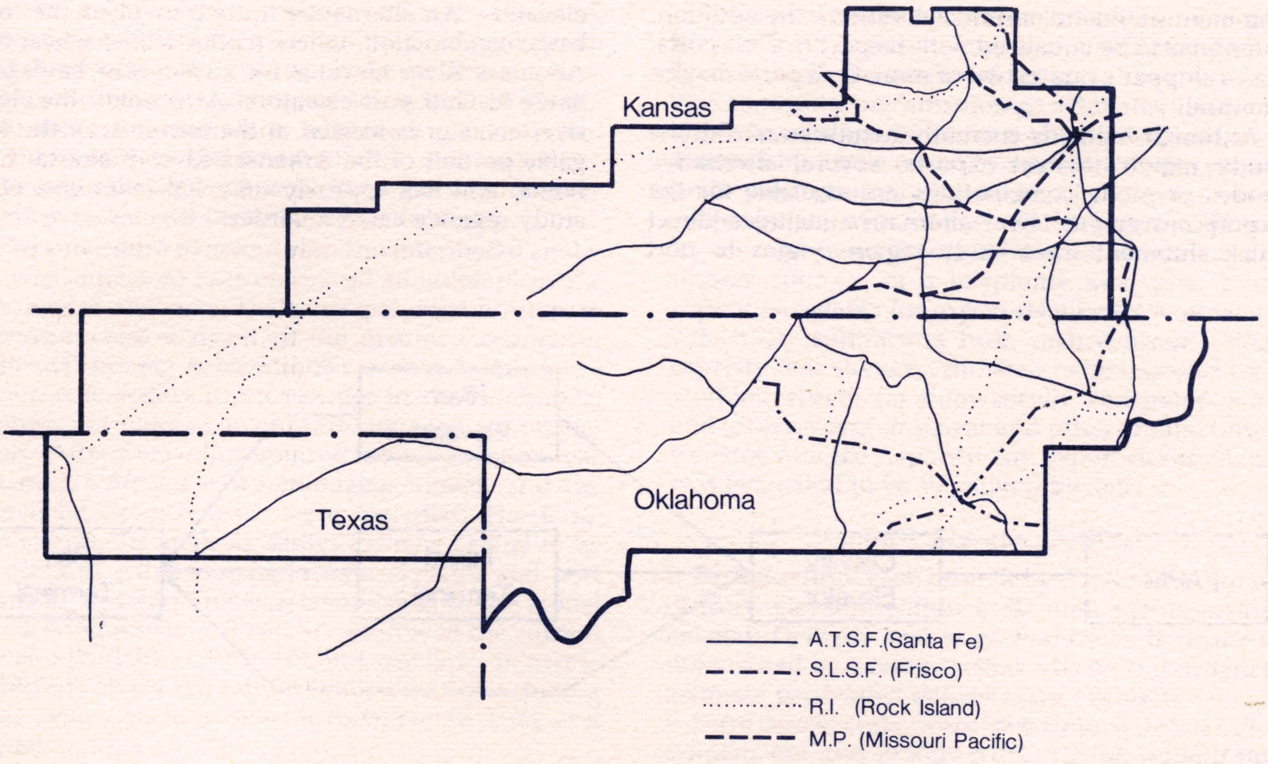


Figure 1. U.S. Outline Map of Study Area.



The Study Region

A contiguous 27-county region in portions of Kansas, Oklahoma, and Texas was selected (Fig. 1). The region is approximately 288 miles in length, 144 miles at its widest location, and is located an average of 625 miles from the principal Texas Gulf ports. The region has historically had annual wheat production of approximately 160 million bushels; 75 percent of production has been destined for export markets. Within this region there are 347 country elevators which operate at 244 locations. In addition, there are 34 inland terminals (secondary holders), which operate at five locations and receive wheat from study region country elevators. Historically, about 90 percent of the study region's export-destined wheat has moved to North Texas ports. North Texas ports include the eight export elevators located at Houston, Galveston, Beaumont, and Port Arthur, Texas. The remainder of the export-destined wheat has exited through South Texas (8 percent) and Mississippi River ports (2 percent) (Fig. 1).

Railroads operate 2,200 miles of track within the region and are the dominant transporters of the region's wheat production (Fig. 2). Four railroad companies operate in the study area; these include the Atchison, Topeka, and Santa Fe (Santa Fe); Chicago, Rock Island, and Pacific (Rock Island); Missouri Pacific; and St. Louis-San Francisco (Frisco).[4] The dominant carrier, Santa Fe, operates about 54 percent of the region's track and annually handles about half the region's rail wheat movement. The Rock Island, Missouri Pacific, and Frisco railroad companies operate 575, 245, and 185 miles of track, respectively (Fig. 2). All four railroad firms operate in the eastern third of the region, while only the Santa Fe and Rock Island traverse the western two-thirds of the region.

The region's single-car rate structure allows for storage-in-transit at the inland terminal locations. Wheat may be shipped from country elevators to Gulf ports on a single through-rate that includes a stopover at inland terminals. The rate on a direct shipment from country elevator to Gulf port is equal to the sum of the rates from country elevator to inland terminal and from inland terminal to Gulf port. It follows that a grain shipper's transportation charge on export-destined wheat is not unfavorably affected by trans-

[4]After this study's completion, several changes occurred in the organization of the study region's railroads. Assets of the Rock Island are currently being liquidated. Service is being maintained on all of the study region's Rock Island lines except for several branch lines in the proximity of Enid, Oklahoma, and a branch line connecting Liberal, Kansas, and Morse, Texas. Approximately 160 of Rock Island's 575 miles are currently receiving no service.

shipment at inland terminal locations. In addition, rates tend to be equalized with respect to Gulf ports, i.e., a shipper's rate to two or more Gulf ports may be identical.

Although railroads currently handle nearly all the study region's wheat exports, several alternative modes or mode combinations are available for the export movement. One alternative includes direct truck shipment from study region origins to port elevators. An alternative routing involves the truck-barge combination, where trucks deliver wheat to an Arkansas River elevator for subsequent haulage by barge to Gulf port elevators. At present, the closest river elevator is located at the terminus of the navigable portion of the Arkansas River (Catoosa, Oklahoma) and lies approximately 100 miles east of the study region's eastern border.

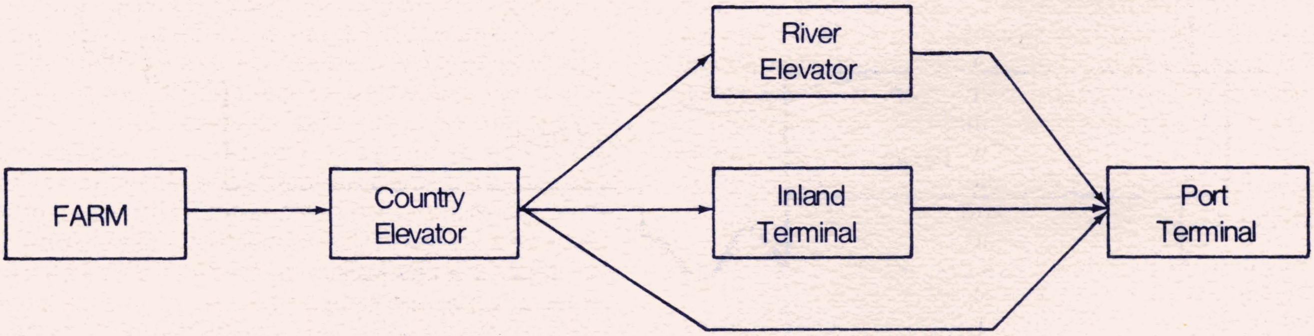


Figure 3. Elements of Analytical Model

Analytical Procedure

The analysis was accomplished with a mathematical programming model that minimized total annual cost and rates associated with the export wheat handling, storage, and transportation system. Because grain shippers would seek to minimize those costs associated with moving export wheat to port areas, the cost minimizing framework was adopted. The model included 1) farm storage costs, 2) country elevator delivery costs, 3) truck, rail, and barge transportation rates which link country elevators, inland terminals, the river elevator, and port terminals, and 4) all elevator facilities, grain handling, and storage costs. Analysis was carried out with a model developed for the Rail Wheat Transportation Efficiency study, performed for the U.S. Department of Transportation Contract No. DOT-FR-65104.

Figure 3 identifies the elements and structure of the cost-minimizing model. The model includes flows from production origins (farms) through country elevators and secondary holders (inland terminals, river elevators) to port terminal destinations. The 27-county region is subdivided into 3-by-3 mile areas (9 square miles) resulting in 3,225 production origins. The harvest-time supply of export wheat at farms may be stored at the farms or shipped directly by farm truck to nearby country elevators. Country elevators within 30 miles of a farm represent potential delivery points. If wheat is farm-stored, producers deliver to country elevators. The model is structured so that wheat must be delivered to country elevators prior to further movement through the system.

The model is constructed so that country elevators may ship to inland terminals, Gulf port terminals, or the river elevator on the Arkansas River (Fig. 3). Truck and rail modes are available for all country elevator shipments except shipments to the river elevator, in which case only truck carriage is available. The river elevator is linked to all Gulf ports via barge transportation.

The export rail rates included in the model connect each country elevator with the alternative Gulf port areas. In order to accomplish the intramodal analysis, the export rate for those country elevators served by the dominant carrier was adjusted in 5 percent increments. After each rate adjustment, the model was used to determine the least-cost flow pattern and associated characteristics of the solution. For each solution the following information was recorded: (1) revenues of the dominant carrier, all other railroads, truck, and barges; (2) variable costs of the dominant carrier and all other railroads; (3) volumes transported by the dominant carrier, other railroads, trucks, and barges; and (4) elevator's grain handling and storage costs. By subtracting the dominant carrier and other railroads' variable costs from their respective revenues, the dominant carrier and other rail carriers' revenue above variable cost was calculated. After each solution, the effect on the dominant carrier and other railroads' revenue above variable cost was observed. If revenue above variable cost were greater than the previous solution, rates were again adjusted 5 percent upward and a new solution obtained. Rates were adjusted upward until the railroad's revenue above variable cost commenced to decrease.

The procedure to accomplish the intermodal analysis was similar to that employed to accomplish the intramodal analysis. The principal modification in procedure was a result of the assumed change in railroads' pricing behavior. Since all railroads were assumed to follow a price leader in the intermodal analysis, all railroad rates were adjusted simultaneously. After each adjustment in rates, a solution was obtained with the cost-minimizing model, and the associated characteristics were recorded. The long-run intermodal analysis allows for new capital to be invested in order to expand river elevator and port terminal capacity. This is accomplished in the model by allowing previous flows to continue at the current elevator (variable) cost levels, but any flows in excess of historic levels can only be estimated by including costs which include new investment in land and capital.

DATA FOR MODEL

All transportation of wheat by rail and barge is represented in the model by rates, while commercial truck haulage is represented by total costs. Because of the competitive environment in which commercial truckers operate, total costs approximate rates. Delivery of wheat to country elevators by producers is included in total costs. Variable costs are included for existing grain handling and storage facilities, whereas total costs are included when new capital is invested for purposes of altering elevator capacity. Rates and costs are applicable to the 1977-78 time period. The following sections relate costs and rates entered into the study region model. All data in the following sections were developed under the U.S. Department of Transportation contract DOT-FR-65104, the Rail Wheat Transportation Efficiency Study, except for data associated with the section, Costs of Adding River and Port Elevator Capacity.

Wheat Supply, Farm and Country Elevator Storage

On the basis of historical production trends, the 1985 wheat output of the 27-county area was estimated to be 156.9 million bushels. On the basis of historical grain flows it was predicted that about 75 percent of the study region's production (118.2 million bushels) would be destined for Gulf ports; the remaining wheat would move into domestic markets. A county's estimated production was distributed among its production origins (3-by-3 mile areas) in accordance with the portion of a county's cultivated land area in each production origin or historical production records.

To estimate existing on-farm storage in the study area, a mail questionnaire was distributed to a 10-percent random sample of farmers. On the basis of survey results, on-farm storage estimates were made. On-farm storage estimates were allocated among farms (3-by-3 mile areas) in accordance with expected grain production of each farm.

Storage capacity for each of the region's 347 country elevators was obtained from an on-site visit, secondary sources, or a telephone interview. Storage capacity available for export-destined wheat was calculated by subtracting from each elevator's storage capacity that storage estimated to be required for: (1) working space, (2) domestically consumed wheat, and (3) carryover of wheat and other grains. Country elevator storage capacity for export-destined grain was estimated to be 92 million bushels.

Country Elevator Delivery

Distance from each farm (3-by-3 mile areas) to each country elevator within a 30 mile radius was calculated. Delivery cost to each elevator by truck was determined by a cost function which used distance to estimate per-bushel delivery cost (Table 1).

Farm truck costs were determined for a 2.5-ton tandem, tag-axle straight truck; a 2-ton straight truck; and a 1.5-ton straight truck. A survey of elevator receipts indicated these truck sizes to be most commonly employed in farm-to-country-elevator delivery. The 2.5-ton truck was found to carry approximately 500 bushels, while the 2-ton and 1.5-ton truck sizes hauled an average of 300 and 250 bushels, respectively. The 2-ton truck was used to deliver 50 percent of country elevator receipts, while the 2.5-ton and 1.5-ton truck sizes delivered 35 and 15 percent of country elevators' respective receipts. Based on these findings, a weighted average delivery cost was estimated for alternative distances.

Farm Handling and Storage Costs

Farm storage cost includes three cost items: (1) cost of placing wheat in storage, (2) cost of wheat storage, and (3) cost of removing wheat from storage. A survey of wheat producers provided information on sizes and characteristics of existing farm storage.

TABLE 1. ESTIMATED FARM TO COUNTRY ELEVATOR DELIVERY COST IN CENTS PER BUSHEL, 1977-78

Distance of Haul (miles)	Assembly Cost (¢/bu)
5	6.86
10	7.75
15	8.60
20	9.46
25	10.33
30	11.19

Source: Prepared for U.S. Department of Transportation under contract DOT-FR-65104, Rail Wheat Transportation Efficiency Study. Contract was with Texas Transportation Institute, Texas A&M University, College Station, Texas.

With this information, cost parameters were calculated using an economic-engineering estimation technique.

The analysis revealed the variable cost of placing wheat in storage was 2.19¢ per bushel while the removal cost was estimated at 1.5¢ per bushel. The variable cost of storing wheat for 12 months was calculated at 8.3¢ per bushel. These costs are for steel bins of 10,000 bushel storage capacity.

Country Elevator, Inland Terminal, and Port Terminal Costs

The Economic Research Service, of the U.S. Department of Agriculture, has conducted a series of studies on cost of grain handling and storage in country elevators, inland terminals, and port terminals. With the use of regression analysis, these costs were updated to 1977-78 and are shown in Table 2. The parameters show the per-bushel costs of receiving and loading grain by truck, rail, and barge at each type of elevator, and per-bushel costs of storage.

The tabled parameters were used in the model, as applicable, except for the variable barge unloading cost of 1.685¢ per bushel, which was used only at Mississippi River port elevators. North Texas ports do not have the necessary equipment to unload barges efficiently, although they do occasionally receive barge-delivered grain. On the basis of North Texas port elevator characteristics, the unloading cost was estimated at 3.0¢ per bushel. Corpus Christi does not have barge unloading facilities.

TABLE 2. ESTIMATED COSTS OF RECEIVING, STORING, AND LOADING GRAIN IN CENTS PER BUSHEL BY ELEVATOR TYPE, 1977-78

Function	Country Elevators	Inland Terminals[1] (cents per bushel)	Port Terminals
Receiving Grain			
Truck			
Fixed Cost	0.373	1.013	1.958
Variable Cost	1.934	1.650	1.309
Total Cost	2.307	2.663	3.267
Rail			
Fixed Costs	-----	1.396	1.265
Variable Cost	-----	2.002	1.317
Total Cost	-----	3.398	2.582
Barge			
Fixed Cost	-----	1.182	.532
Variable Cost	-----	3.938	1.685
Total Cost	-----	5.120	2.217
Loading Grain			
Truck			
Fixed Cost	.565	1.395	5.251
Variable Cost	2.065	1.058	2.089
Total Cost	2.630	2.453	7.340
Rail			
Fixed Cost	.579	1.171	1.640
Variable Cost	2.011	1.514	1.497
Total Cost	2.590	2.685	3.137
Ship/Barge			
Fixed Cost	.096	.348	.498
Variable Cost	.974	.758	.772
Total Cost	1.070	1.106	1.270
Storage			
(annual cost)			
Fixed Cost	16.212	14.635	26.986
Variable Cost	5.545	4.144	5.131
Total Cost	21.757	18.779	32.117

[1]The river elevator was assumed to have the same cost structure as the inland terminal.

Source: *Costs of Storing and Handling Grain in Commercial Elevators, 1970-71, and Projections for 1972-74,* Economic Research Service, U.S. Dept. of Agriculture, ERS-501, March 1972. The updated parameters were based on costs taken from the referenced study.

TABLE 3. ESTIMATED RATE OF COMMERCIAL TRUCK HAULS FOR DISTANCES LESS THAN 350 MILES, IN CENTS PER BUSHEL, 1977-78[1]

Miles of Haul	Per Bushel Rate (¢/bu)
50	11.1
75	13.3
100	15.5
125	17.7
150	19.9
175	22.1
200	24.3
225	26.5
250	28.7
275	30.9
300	33.1

[1]Assumes no backhaul.

Source: Prepared for U.S. Department of Transportation under contract DOT-FR-65104, Rail Wheat Transportation Efficiency Study. Contract was with Texas Transportation Institute, Texas A&M University, College Station, Texas.

TABLE 4. ESTIMATED RATE OF COMMERCIAL TRUCK HAULS FOR DISTANCE EQUAL TO OR IN EXCESS OF 350 MILES, IN CENTS PER BUSHEL, 1977-78[1]

Miles of Haul	Per Bushel Rate (¢/bu)
350	38.3
400	42.2
450	47.1
500	52.0
550	56.8
600	61.7
650	66.6
700	71.5

[1]Assumes 20% backhaul.

Source: Prepared for U.S. Department of Transportation under contract DOT-FR-65104, Rail Wheat Transportation Efficiency Study. Contract was with Texas Transportation Institute, Texas A&M University, College Station, Texas.

Commercial Truck Transportation Rates

There is no economic regulation of truck-transported raw agricultural products involved in interstate commerce, and little economic regulation of these products in intrastate commerce. Because of the relative ease of entering this unregulated market, the agricultural trucking industry approximates pure competition. So when costs are calculated to include a normal return on employed resources, the truck costs are an approximation of rates. Accordingly, estimated truck costs were used for rates.

The types of vehicles operated by grain truckers vary; the most common type among interviewed firms is the diesel-powered, cab-over, twinscrew, tractor-trailer rig. Accordingly, cost estimates were based on this truck type. Two cost (rate) functions were calculated — one for trip distances less than 350 miles, the other for distances of 350 miles or more. Hauls of less than 350 miles were assumed to have no back hauls, while the longer distances (specifically from the study area to Gulf ports) were assumed to have backhauls one out of 5 trips. All loads were assumed to be 860 bushels (80,000 lb. gross vehicle weight).

Tables 3 and 4 show the calculated costs for the short and long-distance hauls, respectively.

Barge Rates

Barge transportation of study area wheat to Gulf port destinations is available at the Port of Catoosa on the Arkansas River. Published barge rates for 1977-78 were used in this study. Waterway transportation rates for bulk grain are closely tied to the Waterways Freight Bureau, Freight Tariff No. 7. Rates for this study were estimated by using the *Guide to Published Barge Rates on Bulk Grain, Schedule No. 8*. Table 5 shows values entered into the model to represent rates for shipping grain by barge from Catoosa to alternative Gulf ports. Historical analysis indicated some seasonality of rates.[5] The tabled rates were applicable for all months except January, February, October, and November. Rates in January and February are 10-20 percent below the tabled rates, whereas rates in October and November are 50-60 percent above those in Table 5. It was assumed that the use of a single rate parameter, applicable for all but 4 months, would not seriously distort annual flows.

TABLE 5. ESTIMATED RATE OF SHIPPING WHEAT BY BARGE FROM CATOOSA, OKLAHOMA, TO ALTERNATIVE GULF PORTS, IN CENTS PER BUSHEL, 1977-78

From Catoosa, Oklahoma To	Cents Per Bushel
Mississippi River Ports[1]	16.92
Houston, Galveston, Beaumont, Port Arthur	26.82
Corpus Christi	37.26

[1]Includes Ama, Baton Rouge, Destrehan, Myrtle Grove, New Orleans, Reserve, and Westwego, Louisiana

Source: Prepared for U.S. Department of Transportation under contract DOT-FR-65104, Rail Wheat Transportation Efficiency Study. Contract was with Texas Transportation Institute, Texas A&M University, College Station, Texas.

Rail Rates

Export rail rates were collected for all those country elevator locations served by railroads. The rates were for 1977-78 and were those associated with Ex Parte 343. Rates were collected from Boards of Trade, country elevator operators, and railroad companies.

Railroad Cost

To estimate railroads' revenue above variable cost, it was necessary to estimate per bushel variable cost associated with each rail movement. Total variable cost (per bushel variable cost × volume) is subtracted from total revenue (per bushel rate × volume) to estimate revenue above variable cost. Because of the study region's single-car rate structure, only single-car costs were estimated. Pegrum notes that railroads' fixed costs cannot be assigned to any particular rail movement; they are nontraceable. Accordingly, any estimate of per-bushel fixed cost is arbitrary (Pegrum, 1973). For this reason, only variable costs were calculated. Revenue above variable cost represents a contribution to the fixed or nontraceable costs. Variable costs were not entered into the model for purposes of determining the grain flow pattern. Grain flow patterns were determined with rates. After flow patterns had been determined with rates, variable costs were used to determine the railroads' cost of providing this service.

Variable rail cost estimates are based upon costs published in the Interstate Commerce Commission's Statement No 1C1-74, *Railroad Carload Cost Scales, 1974*. This document is based on an application of Rail Form A, reflecting the 1974 operations of Class I line-haul railroads. The railroad freight rate index, constructed by the Bureau of Labor Statistics, was used to update estimated rail cost parameters to 1977. To facilitate the estimation of the variable cost parameters, a rail cost algorithm, developed for the U.S. Department of Transportation Contract DOT-FR-65104, was used. The computerized algorithm estimates costs by reconstructing the formulae of the Interstate Commerce Commission's cost scales according to instructions for adjusting cost estimates in the *Rail Carload Cost Scales, 1974*. To estimate each rail movement cost, it was necessary to specify the value of 21 variables. These variables include: number of cars in shipment, origin, destination, routing, way train and through train mileage, value of grain loss and damage, car-days in movement, and switch engine minutes per car.

[5]Information obtained from O. K. Grain Co., Catoosa, Oklahoma.

Costs of Adding River and Port Elevator Capacity

To accomplish the long-run intermodal analysis, it was necessary to allow for new investment in additional river and port elevator capacity. The lower Mississippi River port elevators and the Arkansas River elevators are operating at near capacity. Thus, there is limited opportunity to increase barge-delivered grain to this port area. Because of this situation, it was necessary to estimate the fixed costs associated with the removal of these constraints.

Estimated land costs for an Arkansas River elevator and a Mississippi River port terminal were obtained from the Tulsa River Authority and the New Orleans Corps of Engineers, respectively. The Tulsa River Authority indicated that all land in the terminus area of the river had to be leased from the Authority for an annual lease fee of $2,400 per acre. Approximately 8 acres would be required for a facility. It was assumed that capital invested in land has an opportunity cost of 10 percent and the river facility would handle approximately 20 million bushels per year. On the basis of these assumptions, the cost of land at Catoosa was calculated to be $0.001 per bushel. The New Orleans Corps of Engineers related that land adjacent to the Mississippi River and of sufficient size to accommodate an export house had a value of approximately $2.0 million. It was found that Mississippi River port elevators have in recent years handled an average of 125 million bushels per elevator. Accordingly, land costs were estimated at $0.002 per bushel.

The per-bushel fixed costs in Table 2 are elevator replacement costs and are used to represent the fixed cost of new investments. The tabled inland terminal costs are assumed to be representative of river elevator costs. To estimate per-bushel fixed storage costs, the per-bushel annual fixed storage cost parameter was divided by a turnover ratio. The river and port elevators had an estimated turnover ratio of 14 and 25, respectively. An elevator's turnover ratio is calculated by dividing its annual volume by the elevator's storage capacity. The river elevator ratio was based on the recent experience of the existing river elevator in the study area and a comparison with Iowa elevators. The port elevator turnover ratio is an average turnover ratio calculated for all Mississippi River port elevators.

To calculate the river elevator's and port terminal's per-bushel fixed storage costs, their respective per-bushel annual fixed storage costs of 14.635¢ and 26.986¢ were divided by turnover ratios of 14 and 25, respectively. These values were aggregated with the per-bushel land costs and the appropriate per-bushel fixed receiving and loading costs in order to calculate the total per-bushel fixed cost. The total fixed cost for the river and port elevators was estimated at 2.407¢ and 2.112¢ per bushel, respectively. The variable costs of operating the new facilities are those shown in Table 2.

Wheat Export Demand by Port Area

Export demand for the study region's exportable wheat production was estimated for each port area by time period. These estimates were based on the study region's historical grain flow pattern. Table 6 indicates the results of these predictions. These demand estimates were used to accomplish the intramodal analysis and the short run intermodal analysis.

RESULTS

Effectiveness of Intramodal Competition

The purpose of this analysis is to determine the effectiveness of intramodal competition in restraining the dominant rail carrier from increasing its rate level. The analysis is based on the assumption that competing railroads will not alter their rates in the same manner as the dominant carrier. The Santa Fe line operates about 1,200 miles of the study region's 2,200 miles of track and is the dominant rail carrier. (See Figure 2 for identification of Santa Fe lines.)

The analysis involves altering Santa Fe's export rate for each served country elevator in 5 percent increments and recording the associated outcome. All other transportation rates are assumed constant at the current level. The results are shown in Table 7 and Figure 4.

Analysis indicates that the dominant carrier in the region (Santa Fe) would lose substantial revenue and volume if it were to adjust its rates uniformly upward throughout the 27-county area. By increasing rates 5 percent above current levels, Santa Fe's revenue would decrease from $30.6 to $17.2 million while

TABLE 6. ESTIMATED 1985 EXPORT DEMAND FOR STUDY AREA WHEAT PRODUCTION BY TIME PERIOD[1]

	Port Areas (1,000,000 bushels)				
Time Period	Houston	Galveston	Beaumont - Pt. Arthur	Corpus Christi	New Orleans
1	3.53	.96	1.13	0.24	0.21
2	9.37	2.86	2.56	0.93	0.27
3	66.54	8.98	10.38	7.84	2.40
Total	79.44	12.80	14.07	9.01	2.88

[1]Estimated port demands are based on 1976-77 crop flow data

Source: Prepared for U.S. Department of Transportation under contract DOT-FR-65104, Rail Wheat Transportation Efficiency Study. Contract was with Texas Transportation Institute, Texas A&M University, College Station, Texas.

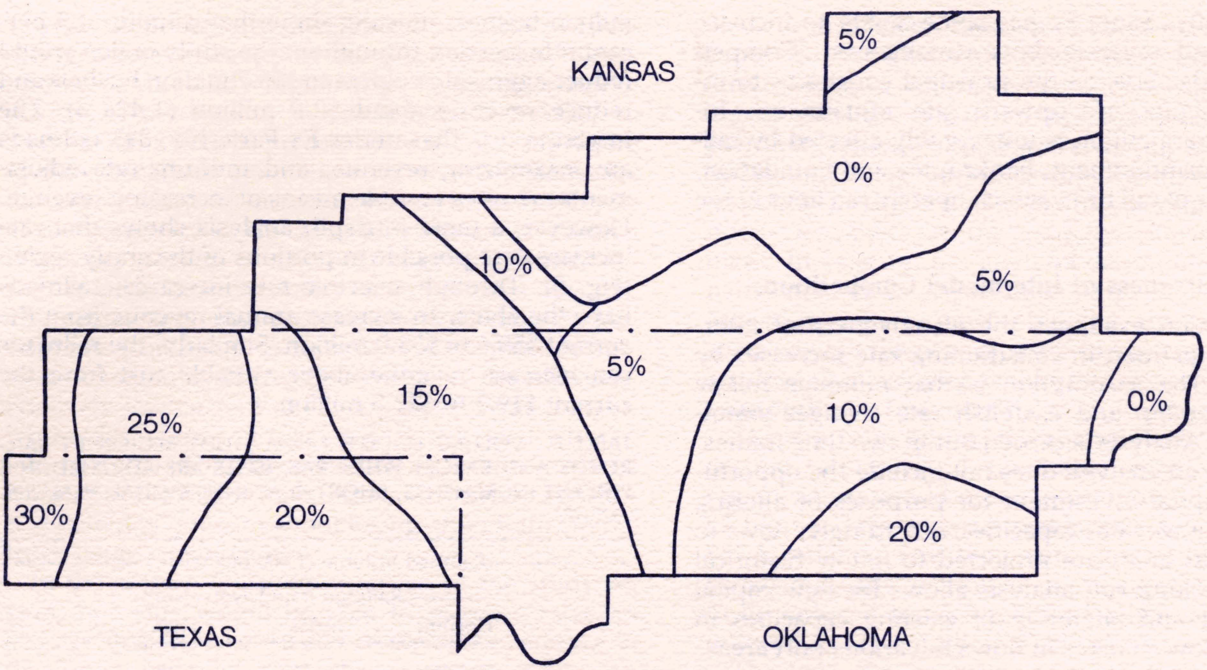


Figure 4. Percentage Increase in Rail Rates Available to the Dominant Carrier in Various Areas of the Study Region, Intramodal Analysis.

TABLE 7. VOLUME HAULED FROM STUDY REGION BY SANTA FE, OTHER RAILROADS AND BARGES WHEN SANTA FE'S RATES ARE ADJUSTED IN 5 PERCENT INCREMENTS, INTRAMODAL ANALYSIS, 1977-78[1]

Railroad Volume (1,000 bushels)					
Santa Fe			All Other Railroads		
Santa Fe Rate Level			Santa Fe Rate Level		
Current	105%	110%	Current	105%	110%
62,951	33,474	17,533	51,545	79,660	93,657
Barge Volume (1,000 bushels)					
Mississippi River			North Texas		
Santa Fe Rate Level			Santa Fe Rate Level		
Current	105%	110%	Current	105%	110%
2,880	2,880	2,880	824	2,186	4,130

[1]Tabled flow patterns result when Santa Fe uniformly adjusts rates at all served locations in the study region.

volume would decrease from 63.0 to 33.5 million bushels. Ninety-five percent of Santa Fe's lost volume would be carried by competing rail carriers (Table 7). The remaining 5 percent would be carried via the truck-barge combination.

Although competitive forces would limit a general rate increase by Santa Fe, this railroad does possess an ability to increase revenue and revenue-above-variable-cost with a 5 percent rate increase in the southcentral portion of the region (Fig. 4). Santa Fe operates all area lines in this portion of the study region; accordingly, when its rates are increased or decreased, the Santa Fe's gain or loss in traffic is not substantial. When Santa Fe increases rates, the increase in per-bushel revenue and revenue-above-variable-cost more than offsets the decrease in volume; total revenue and total revenue above variable cost is increased. By adjusting rates upward 5 percent, Santa Fe increases the rate level an average of $.025 per bushel in the southcentral area. With selective rate increases, Santa Fe has the ability to increase its revenue above variable cost from $9.6 to $9.7 million in the 27-county region.

Table 7 identifies expected barge flows for alternative Santa Fe rate levels. Results show the predetermined export demand at the lower Mississippi River port area to be satisfied by barge-delivered wheat. In addition, as Santa Fe's rate levels are adjusted upward, an increasing portion of the wheat demand of North Texas ports (Houston, Galveston, Beaumont, Port Arthur) is carried via barges; however, in all situations the barge-carried volume is less than 4 percent of total port area demand.

The intramodal analysis indicates the demand for Santa Fe's service to be elastic in most portions of the study region. When price (rate) levels increase, total revenue decreases. Accordingly, Santa Fe has limited ability to increase revenue and revenue above variable cost through upward adjustments in rate levels. The only exception is in the southcentral portion of the region, where a 5 percent upward rate adjustment increases revenue above variable cost. This region is relatively isolated from competing railroads;

consequently, Santa Fe has some ability to increase revenue and revenue-above-variable-cost. Competing railroads serve as the principal constraint to increase in Santa Fe's upward rate adjustments. Intramodal competition is unfavorably effected by railroad line abandonment, bankruptcy and liquidation, and merger of rail firms which operate rail lines in the same area.

Effectiveness of Intermodal Competition

This section examines the effectiveness of intermodal competition in constraining rate increases by railroads. The assumption is that railroads follow price leadership and establish rate changes simultaneously. Analysis is carried out in two time frames. The short run analysis does not include the opportunity for capital investment for purposes of altering port or river elevator capacities; accordingly, flows to various port areas are projected to follow historical levels. The long run analysis allows for new capital investment and alteration of existing capacities in order to allow changes in flows to various port areas.

Short Run Intermodal Analysis

In this analysis all railroad companies are assumed to adjust their rates up or down simultaneously, and flows to the various port areas are projected at historic levels. The analysis is designed to determine the effectiveness of truck and truck-barge competition in restraining rail rate increases.

At current rate levels, region railroads are generating $55.6 million of revenue and transporting 114.5 million bushels. Results show that a uniform 5 percent rate increase throughout the study region would reduce aggregate volume to 106.7 million bushels and reduce revenue about $2.0 million (Table 8). The implication is that under Ex Parte No. 343 railroads are maximizing revenue, and uniform rate adjustments are not a feasible means of increasing revenue. However, a more in depth analysis shows that rate increases are possible in portions of the study region (Fig. 5). Through selective rate increases, railroads have the ability to increase annual revenue from the current $55.6 to $58.0 million. Similarly, the railroads can increase revenue above variable cost from the current $19.3 to $22.5 million.

TABLE 8. VOLUME HAULED FROM STUDY REGION BY RAILROADS AND BARGES WHEN RAIL RATES ARE ADJUSTED IN 5 PERCENT INCREMENTS, SHORT RUN, INTERMODAL ANALYSIS, 1977-78[1]

Railroad Volume (1,000 bushels)					
Railroad Rate Level					
Current	105%	110%			
114,496	106,662	85,184			
Barge Volume (1,000 bushels)					
Mississippi			North Texas		
Railroad Rate Level			Railroad Rate Level		
Current	105%	110%	Current	105%	110%
2,880	2,880	2,880	824	8,658	30,136

[1]Tabled flow patterns result when all railroads uniformly adjust rates at all served locations in the study region.

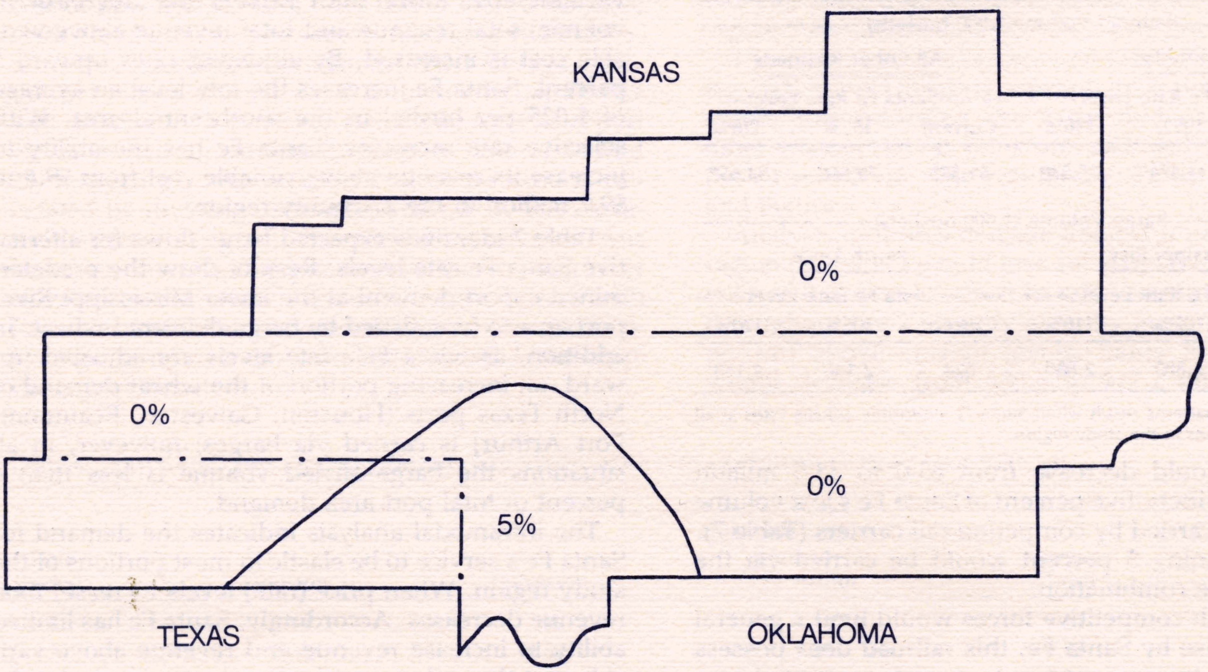


Figure 5. Percentage Increase in Rail Rates Available to Collaborating Railroads in Various Areas of the Study Region, Short-Run Intermodal Analysis.

Analysis indicates that railroads have the greatest ability to increase rates in the Oklahoma and Texas portion of the study region (Fig. 5). In the western portion of the region, railroads have the ability to increase rates 15 to 30 percent. The increased distance of these locations from the river elevator decreases the effectiveness of intermodal competition. In spite of the proximity of the river elevator to the eastern Oklahoma portion of the study region, railroads appear to possess some ability to adjust rates upward. This seems to be best explained by the relatively low rail rates (compared to Kansas origins) that are currently charged by railroads. Because of the railroads' relatively low current rates, compared with competing modes, some rail rates may be adjusted without loss of traffic. This rate structure may have evolved because of the region's proximity to the river elevator and railroads' concern about losing grain traffic to the truck-barge combination.

In the eastern Oklahoma portion of the study region, railroads would be able to increase rates an average of $.045 per bushel. Railroads operating in the Texas and Oklahoma Panhandle counties can increase rates an average of $.09 per bushel.

Table 8 shows barge volume at alternative railroad rate levels. This table reveals the truck-barge combination and not direct truck movement to be the most effective constraint to rail rate increases. The truck-barge combination is responsible for taking all grain volume lost by railroads as rail rate levels are adjusted upward.

At current levels, the study region sends 3.7 million bushels to Gulf ports via the truck-barge combination. Approximately 2.9 million bushels of this volume flows to the lower Mississippi River port area, while the remaining volume moves to North Texas ports. If railroads were to adjust their rates to maximize revenue above variable cost, barge flows to North Texas ports would increase to 5.8 million bushels. As rail rates are adjusted upward, all additional truck-barge flows are directed to North Texas ports; this flow is the result of an assumption accompanying the short run analysis. In the short run analysis, historical port demand levels are fixed to each port area; accordingly, the barge-carried grain is directed to the North Texas port area.

Historically, most of the study region's export wheat has flowed to North Texas ports. As rail rates were adjusted upward in the short run intermodal analysis, the barge traffic bypassed the lower Mississippi River ports to be delivered to North Texas ports. The movement to North Texas ports is at an additional rate of $.099 per bushel. The long run intermodal analysis allows for new investment in river elevator and lower Mississippi River port capacity to capture the lower barge rates that link Catoosa, Oklahoma, with the lower Mississippi River port elevators.

Long Run Intermodal Analysis

In this analysis, railroad companies are assumed to coordinate rate changes, and new investment in river elevator and lower Mississippi River port capacity is expected. The analysis is designed to determine the effectiveness of intermodal competition in constraining rail rate increases when capital may be invested to permit increased barge flow between Catoosa, Oklahoma, and the lower Mississippi River port area. The analytical model is constructed to determine the economic feasibility of the capacity-increasing investment. In essence, the analysis determines, for alternative rail rate levels, whether barge rate to the lower Mississippi River port plus the annual costs associated with the new capacity-increasing investment are less than barging to North Texas ports or rail-transporting wheat directly to Gulf port areas.

The short run intermodal analysis indicates that, at current rate levels, 114.5 million bushels of study region wheat would move to port areas via railroads (Table 8). This volume yields railroad revenue of $55.6 million. The long run, intermodal analysis shows railroads' market share, at current rate levels, to be reduced to 66.7 million bushels and revenue reduced to $31.6 million (Table 9).

The long run analysis shows that all region railroads would be unfavorably affected at current rate levels except in the western portion of the study region (Fig. 6). There, because of the increased distance from the river elevator, railroads could increase rates 5 to 20 percent. At current rate levels, railroads could expect to lose their market share in the eastern portion of the study region because the truck-barge combination would transport 51.5 million bushels of the study region's export-destined wheat to lower Mississippi River port elevators. In contrast, the short run intermodal analysis shows only 3.7 million bushels of study region wheat production to be transported via the truck-barge combination.

On the basis of the long run intermodal analysis, there is an economic incentive to invest capital in additional Arkansas River elevator and lower Mississippi River port elevator capacity so as to direct additional grain to lower Mississippi River ports via the truck-barge combination. The altered flow pattern would be accomplished with new investment; study region exports would cover $1.4 million of the annual fixed cost of the capital.

TABLE 9. VOLUME HAULED FROM STUDY REGION BY RAILROADS AND BARGES WHEN RAIL RATES ARE ADJUSTED IN 5 PERCENT INCREMENTS, LONG-RUN INTERMODAL ANALYSIS, 1977-78[1]

Rail Volume (1,000) bushels)	
Railroad Rate Level	
Current	105%
66,713	50,768
Barge Volume (1,000 bushels)	
Railroad Rate Level	
Current	105%
51,487	67,432

[1]Tabled flow patterns result when all railroads uniformly adjust rates at all served locations in the study region.

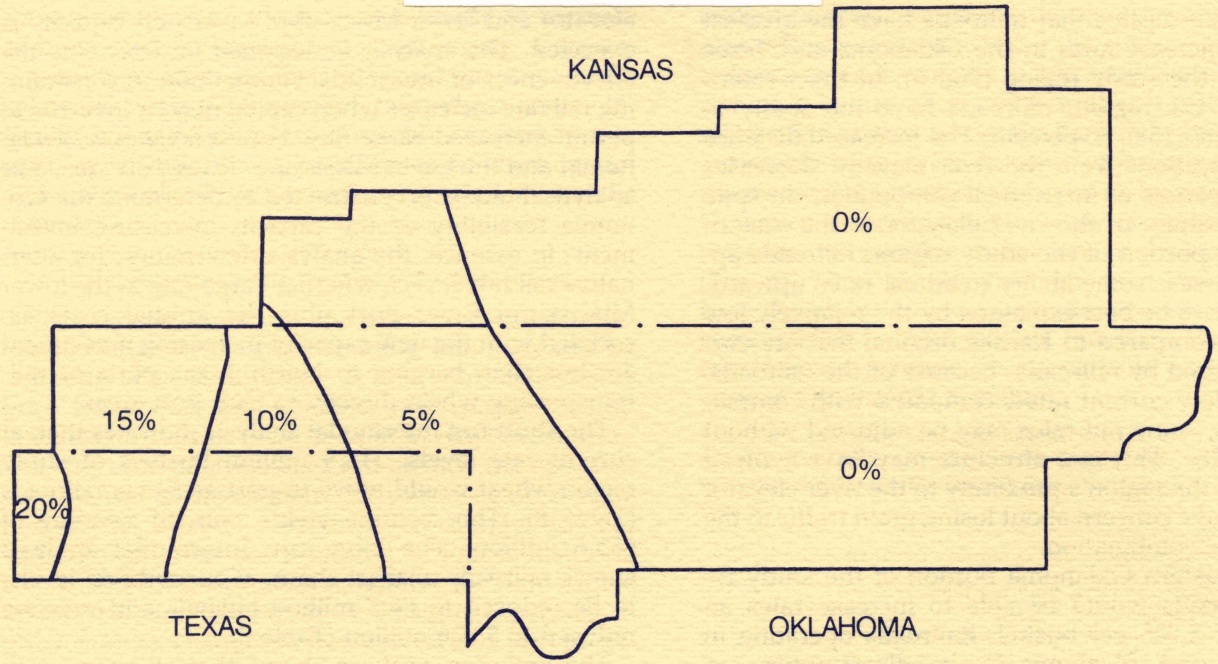


Figure 6. Percentage Increase in Rail Rates Available to Collaborating Railroads in Various Areas of the Study Region, Long-Run Intermodal Analysis.

Results of the long run analysis indicate that greater quantities of study region grain should be flowing to Gulf ports via the truck-barge combination than is occurring. That is, at current rate levels (Ex Parte No. 343) the analysis showed 51.5 million bushels moving via the truck-barge combination to Gulf ports when the region is actually transporting only 3-5 million bushels to this destination via the truck-barge combination. The Arkansas River project was completed in 1971; accordingly, sufficient time has elapsed to invest capital and increase flow levels to that approximated by the long run solution. One plausible explanation for the divergence is the risk associated with investing additional capital in river elevator facilities. Because a large portion of railroad costs are fixed and nontraceable, railroads can operate at relatively low rates in those areas where competitive threats exist. It follows that a firm contemplating a river elevator investment, with a 25 to 30 year life, would be reluctant to invest because of railroads' ability to keep rates relatively low in the region. This concern may prevent a firm from investing in facilities necessary to accommodate the anticipated flow level.

CONCLUSIONS

The purpose of this study is to determine the effectiveness of intramodal and intermodal competition in limiting rail rate increases under conditions of rail rate deregulation. The study focuses on export wheat movement in the Southern Plains. The intramodal analysis concentrates on the effectiveness of intramodal competition in restraining an individual railroad from increasing rate levels. The intermodal analysis focuses on the effectiveness of intermodal competition in constraining collaborating railroads from simultaneously adjusting rail rate levels upward. The effectiveness of intermodal competition in restraining rail rate increases is examined in a short and long run time frame.

Intramodal analysis centers on the assumption that the dominant railroad's rate increases will not be followed by competing lines. In general, results indicate that competing railroads would be the most effective form of competition for a railroad attempting to increase its rate level. It is estimated that 95 percent of the volume diverted from the rate-increasing railroad would be directed to competing railroads, while the remaining 5 percent would be transported via the truck-barge combination. Results show the dominant carrier has limited ability to increase revenue and revenue-above-variable-cost through upward rate level adjustments. The only exception is in the south-central portion of the study region, where the dominant carrier has ability to adjust rates upward by 5 percent: this results in an average rate increase of $.025 per bushel in this portion of the study region. It follows that intramodal competition is hindered when a region's rail line ownership is spatially concentrated.

The intermodal analysis addresses the situation where railroads adjust rates in unison, and studies the effectiveness of truck and truck-barge competition in restraining rail rate increases. Friedlaender believes this scenario to be most representative of the situation under conditions of deregulation (Friedlaender, 1969).

The short run intermodal analysis allows for no land or capital investment for purposes of altering port or river elevator capacities; accordingly, flows to various port areas are projected to continue at historical levels. Analysis shows that railroads can increase rates 5 to 30 percent. The most effective form of competition is the truck-barge combination which transports wheat diverted from railroads through upward rate adjustments. The railroads' ability to increase rates at a particular location is largely dependent on proximity to the river elevator. At the region's westernmost portion, rail rates may be increased up to 30 percent. The average rail rate increase in the western portion of the study region would be $.09 per bushel. Effectiveness of the truck-barge combination is partly restricted in the short run due to the assumed limitations on river elevator and lower Mississippi River port capacity.

The long run intermodal analysis allows for investment in river elevator and lower Mississippi River port capacity in order to improve the effectiveness of the truck-barge combination. In essence, the analysis determines for alternative rail rate levels, whether barge rate to the lower Mississippi River port plus annual cost associated with the capacity-increasing investment is less than barging to North Texas ports, or rail-transporting wheat directly to Gulf port areas. Results indicate an economic incentive to invest in additional Arkansas River elevator and lower Mississippi River port elevator capacity as rail rates are adjusted upward. The long run intermodal analysis indicates the truck-barge combination can provide restraints on rail rate increases above those observed in the short run analysis. Results show that railroads could not increase rates above current levels, except in the western portion of the study region, where rates can be increased 5 to 20 percent. It is difficult to determine precisely how effective truck-barge competition would be in the long run. Because of railroads' cost structure, they can operate at relatively low rates, thus creating some risk associated with investment in river facilities. Conversely, railroads would not want to increase rates substantially so as to encourage investment in additional river facilities since the investment could provide strong competition.

Extrapolating the results of the 27-county study to the entire hard red winter wheat belt (including portions of Kansas, Oklahoma, Texas, Nebraska, and Colorado) can only be done with caution. Subregions in the study area exhibit differences in competitive forces; so would the multi-state region. In the eastern portion of the belt (northcentral Oklahoma, central Kansas, and southeastern Nebraska) the density of competing lines appears sufficient to restrict any particular railroad from arbitrarily adjusting rates upward. The density of competing lines in the western portion of the belt is less; accordingly, there is a greater opportunity for selective rate increases by an individual railroad. If railroads were to set rates in a collaborative manner, they would probably be able to increase revenue and revenue-above-variable-cost for areas in the western portion of the hard red winter wheat belt. The region's eastern portion would have greater access to the barge-navigable Missouri River, and the truck-barge combination would tend to limit rail rate increases. As indicated by the analysis, railroads' ability to increase rate levels would be reduced in the long run due to capacity-increasing investment in river facilities.

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