Railroad Rate Deregulation: Effects on Corn and Soybean Shipments

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The effects of several possible rail-pricing strategies under rail deregulation on the degree of rail captivity of grain elevators and farmers in two areas in Iowa are examined. In phase 1 of the analysis, each elevator was assumed to have received the same amount of corn and soybeans that it did in the 1977-1978 marketing year. In phase 2, the corn and soybeans were assumed to be still on the producing farms, and farmers could shift to alternative markets in response to higher rates. In phase 1, simultaneous rail rate increases of 20-40 percent by all railroad companies above the rail rates in effect during most of the 1977-1978 crop year would have resulted in increased marketing costs to elevators of about 3.5-6.0 cents/bushel of corn and soybeans marketed in the Eastern District and about 7.5-14.5 cents/bushel in the Western District. Measured by the additional marketing costs that resulted from rail rate increases, railroads have more market power over elevators in the Western District than they do in the Eastern District, which is close to the Mississippi River. In phase 2, the same rail rate increases would have resulted in increased marketing costs of about 3.6-6.3 cents/bushel in the Eastern District and about 6.8-13.3 cents/bushel in the Western District, about the same per-bushel increase as in phase 1. However, in phase 2 the cost of hauling the corn and soybeans from farms to elevators was included. The market alternatives available for corn and soybeans located on farms are much greater than for that already delivered to elevators. The analysis showed that the principal beneficiaries of a rate increase by one railroad company would be the competing railroad companies and the elevators located on their tracks, whereas the railroad that raised its rate and the elevators located on its tracks would not benefit by this action.

The average return on investment in the railroad industry in 1978 was 1.6 percent; seven railroad companies lost money, and no major railroad had better than a 9 percent return on investment. During the past 15 years, the highest year for return on investment occurred in 1966, when the railroad industry earned an average of 3.9 percent. Since then, according to the Association of American Railroads' 1979 Yearbook of Railroad Facts, the trend in earnings has in general been declining.

The low earnings of the industry as a whole and the operating losses of several major railroad companies have resulted in continued deterioration of railroad plants and service. In the 1970s, several major railroad companies declared bankruptcy, and the Chicago, Rock Island and Pacific Railroad Company was ordered liquidated. Proposals to improve the earning performance of the railroad industry include restructuring the railroad industry by reducing the number of companies and miles of track, establishing balanced policies toward the competing modes, and reducing economic regulation of the railroad industry. A major element of reduced regulation would be greater rail-pricing freedom.

Many rail shippers have opposed giving the railroad industry additional rate freedom. Much of the resistance to increased rail rate freedom originates in the agriculture sector, particularly from shippers of grain and fertilizer. These shippers believe that they need rail rate protection in agricultural regions that have limited transportation alternatives. They believe that a reduction in regulatory protection as a result of increased rail rate freedom will establish the potential for excessive rail rate increases and discrimination among shippers.

The Staggers Rail Act of 1980 (Public Law 96-448) provides additional rail rate freedom over that permitted by the Railroad Revitalization and Regulatory Reform Act of 1976 (Public Law 94-210). The Staggers Act prohibits shippers from challenging rates on the grounds of reasonableness unless the rail rate exceeds a threshold ratio of revenue to variable cost of 160 percent in 1981 and rises to 180 percent after 1984. In addition, during the first four years after enactment, the act permits a railroad company to raise individual rates 6 percent/year above inflation-induced cost but not more than 18 percent total above inflation. Beginning after the fifth year, railroad companies without adequate revenues may raise rates 4 percent/year above inflation-induced costs.

The purpose of this analysis is to examine the effect of railroad rate increases on grain elevators, farmers, and carriers. The analysis does not attempt to determine whether railroad companies would find it beneficial to increase rates. Rather, the basic question asked in this analysis is, "What would happen to the costs of marketing and transporting corn and soybeans, to rail revenues, and to modal shares of corn and soybean shipments if rail rates are increased?"

The analysis is a case study of two areas in Iowa that produce corn and soybeans (1). One study area is located in eastern Iowa about 90 miles from the Mississippi River and is hereafter referred to as the Eastern District. The second study area is located in western Iowa about 225 miles from the Mississippi River and is hereafter referred to as the Western District. These study areas were selected in part to measure the effect of barge competition on railroad pricing options. Figures 1 and 2 show the railroad and highway networks in both study areas. An elevator is located in every town in both study areas.

Although many agricultural shippers assume that increased rail rate freedom will result in higher rail rates, one cannot know precisely what approach railroad companies will take in their new rate freedom. Therefore, the following rail-pricing strategies were analyzed to estimate their effects on the net cost of marketing and transporting corn and soybeans, on rail and truck revenues and ton miles, and on the share of corn and soybeans transported from the study areas by rail and truck:

1. Rail rates according to Interstate Commerce Commission Ex Parte 349 (Increased Freight Rates and Charges, 1978, Nationwide, May 21, 1981) during the 1977-1978 crop marketing year,
2. 20 percent increase in rail rates,
3. 30 percent increase in rail rates,
4. 40 percent increase in rail rates,
5. 20-cent/hundredweight increase in rail rates, and
6. In phase 2, increase in rail rates of 20 percent by one railroad independently.

METHOD OF ANALYSIS

A linear-programming model was used to evaluate the effect of these rail-pricing strategies on the flow of corn and soybeans to alternative markets and on farmers, elevators, railroads, and competing modes. A base solution was computed to optimize the flow of corn and soybeans by using 1977-1978 crop year supplies, Ex Parte 349 rail rates, estimated trucking

Figure 1. Eastern District study area.

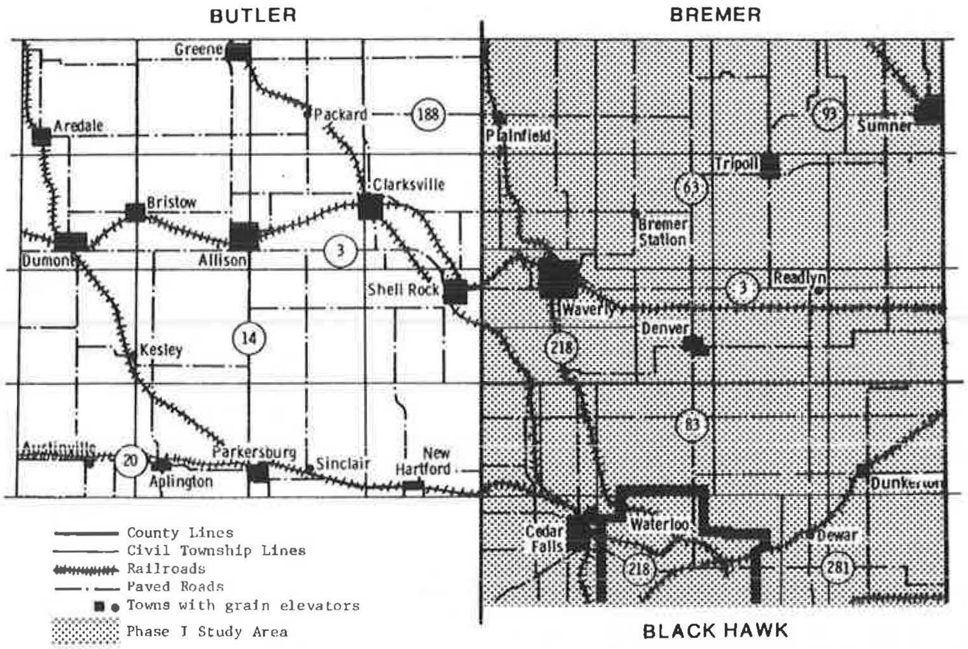
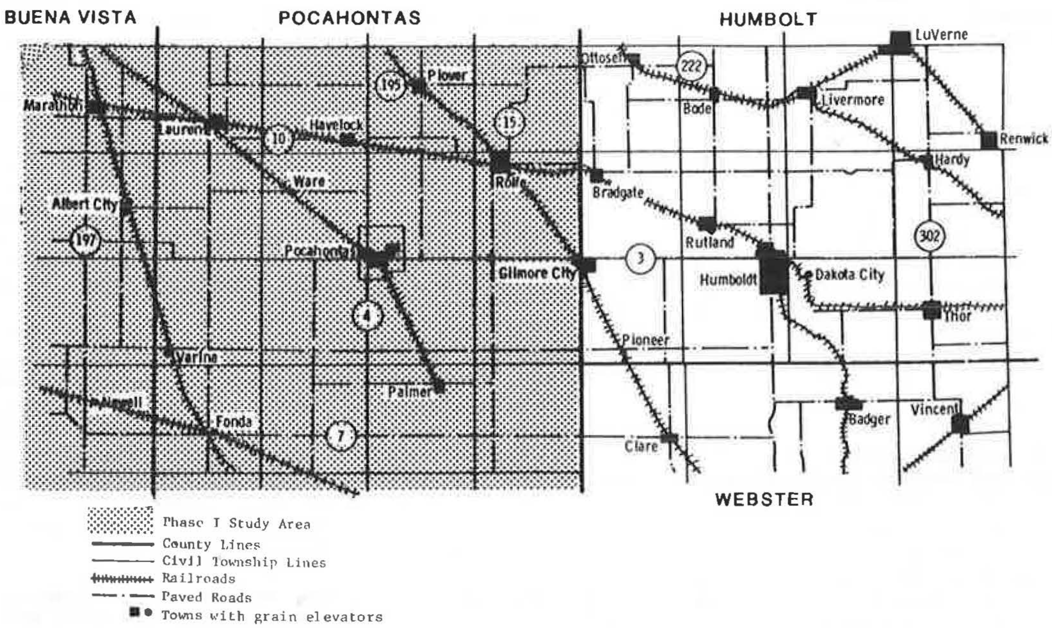


Figure 2. Western District study area.



costs, and prices paid at alternative markets during the 1977-1978 marketing year. Alternative solutions were computed in which rail rates were increased but all other variables remained constant. The effect of the higher rail rates on farmers, elevators, railroads, and competing modes was estimated by calculating the differences between the base solution and the alternative solutions that used higher rail rates. Differences between the base solution and each alternative solution that used higher rail rates were computed for total transportation and marketing costs, ton miles of corn and soybeans hauled by rail and truck, total transportation revenues earned by rail and truck, and total rail and truck ton miles of corn and soybeans shipped by various groups of elevators.

The analysis was divided into two phases. In phase 1, each elevator in each study area was assumed to have received the same volume of corn and soybeans as it did in the 1977-1978 marketing year, and it was assumed that the level of investment in elevator facilities was constant. In phase 2, the corn and soybeans marketed in the 1977-1978 marketing year were assumed to be located on farms so that farmers could shift corn and soybeans among elevators in response to changing rail rates. Also, elevators or farmers (or both) could invest in new grain-storage facilities. Farm origins were defined as areas 6 miles^2. The size of the study areas for the phase-2 analysis was increased to provide farmers a wider range of market options. Table 1 shows the number of elevators in each district and the total bushels of corn and soybeans received and shipped during the 1977-1978 marketing year. Data on elevator capacities, bushels received and shipped, and market destinations were obtained by personal interviews. Figures 3 and 4 show the 1977-1978 corn flow from elevators in the phase-2 analysis for each study district.

Phase-1 Objective Function

The general objective of each phase-1 computer solution was to maximize total net revenue to all elevators within each study area for the 1977-1978 crop year, given the prices paid for corn and soybeans at alternative markets, the transportation rates specified for each solution, and the constraints imposed on the model. Ex Parte 349 rail rates, effective during 1977-1978, were used in the base solution. Alternative solutions were based on rates higher than the Ex Parte 349 level. The differences in the estimated values of the base computer solution and each alternative computer solution represent the estimated effects of the higher rail rates on corn and soybean flows, marketing and transportation costs, modal shares and revenues, and on different groups of elevators.

Table 1. Elevators and corn and soybean shipments during the 1977-1978 marketing year.

Study Area	No. of Elevators	Corn and Soybean Receipts (bushels 000 000s)	Corn and Soybean Shipments (bushels 000 000s)
Eastern District			
Phase 1	16	18.1	17.9
Phase 2	32	33.1	29.9
Western District			
Phase 1	13	31.3	30.3
Phase 2	28	57.7	56.5

Figure 3. Corn flow from Eastern District in 1977-1978 marketing year from elevators in phase 2.

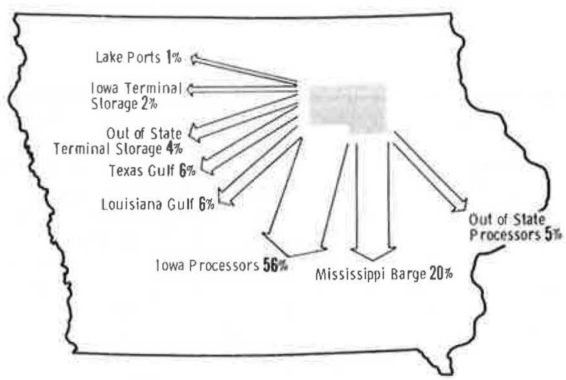
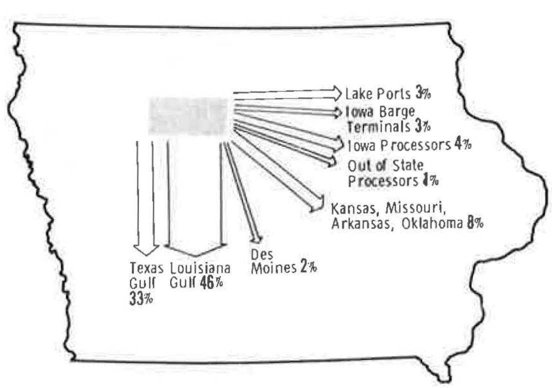


Figure 4. Corn flow from Western District in 1977-1978 marketing year from elevators in phase 2.



Phase-2 Objective Function

The objective of each phase-2 computer solution was to maximize total net revenue to all elevators and farmers within each study area for the 1977-1978 crop year, given the prices paid for corn and soybeans at alternative markets, the transportation rates specified for each solution, and the constraints imposed on the model. The constraints placed on the phase-2 model were identical to those placed on the phase-1 model except that elevator and farm storage capacities were allowed to increase in the phase-2 model.

Prices paid for corn and soybeans at final destinations are a major variable that affects grain flows. Higher rail rates may force a shipper to shift to a market that offers a lower price. The price effect from shifting to alternative markets was incorporated into the model in this analysis. Thus, the additional marketing and transportation costs that result from the higher rail rates include the price effects of shifting to alternative markets, additional handling and storage costs, and additional transportation costs.

The grain industry typically quotes the "basis" rather than the absolute level of grain prices to reflect demands at alternative markets. In this analysis, "basis" is defined as the difference in cents per bushel between the local cash price for grain and the nearby futures contract for the same grain on the Chicago Board of Trade. The basis can be divided into three components: (a) handling and storage costs to the future delivery month, (b) transportation cost to a market destination, and (c) difference between the cash price at the market destination and the nearby Chicago futures price. Therefore, a basis varies by time and by location.

The grain industry prefers to price grain in terms of the basis because the level of futures and cash prices can fluctuate widely from day to day. Although there are some seasonal tendencies in grain prices, the ability to forecast the future price of a grain is more of an art than a science. However, the difference between the futures price and the cash price (i.e., the basis) is much more stable and tends to follow a similar pattern from year to year. The basis tends to decrease or narrow by the amount of reduced storage costs as the delivery month is approached. Because of its stability relative to the actual level of daily cash and futures prices and the predictability of its seasonal movements, the basis is the preferred method of pricing grain. Although the basis is more stable than absolute prices, a local basis may change from time to time for any number of reasons. An increase or widening of the local basis and the concomitant relative decline in the local price could occur because of an increase in transportation costs, a shortage of railroad cars, a shortage of storage capacity, or a lowered demand for grain. A narrowing of the basis and the corresponding relative increase in the local price could occur because of a decrease in transportation costs, a strong demand for grain, or a local shortage of grain.

The linear-programming model was constructed so that it minimized total transportation, handling, and storage costs net of basis improvement over the crop year. By substituting the basis for the prices paid for corn and soybeans at destination markets, minimizing the objective function is equivalent to maximizing total net revenue to all elevators. Proof of this equivalence can be made by defining the basis at a final destination as in Equation 1, the basis at an elevator as in Equation 2, and the maximum net price to an elevator in a time period as in Equation 3:

$$B_{jkt} = FP_{kt} - CP_{jkt} \qquad (1)$$

where

B_{jkt} = basis at destination j for commodity k in time t,
FP_{kt} = Chicago futures price of designated futures contract for commodity k in time t, and
CP_{jkt} = cash price at destination j for commodity k in time t.

$$B_{hkt} = FP_{kt} - NP_{hkt} \qquad (2)$$

where

B_{hkt} = basis at elevator h for commodity k in time t, and
NP_{hkt} = maximum net price at elevator h for commodity k in time t.

$$NP_{hkt} = \max_{j} (CP_{jkt} - T_{hjkt} - H_{hk}) \qquad (3)$$

where

T_{hjkt} = per-bushel transportation cost from elevator h to destination j for commodity k in time t, and
H_{hk} = handling and storage costs at elevator h for commodity k.

By substituting the equivalent of CP_{jkt} from Equation 1 and NP_{hkt} from Equation 2 into Equation 3, Equations 4 and 5 can be derived as follows:

$$FP_{kt} - B_{hkt} = \max_{j} (FP_{kt} - B_{jkt} - T_{hjkt} - H_{hk}) \qquad (4)$$

$$B_{hkt} = \min_{j} (B_{jkt} + T_{hjkt} + H_{hk}) \qquad (5)$$

The sequence of definitions and substitutions illustrates that maximizing the net price at an elevator is equivalent to minimizing the basis at an elevator. The minimum basis at an elevator can be obtained by minimizing over all final destinations the sum of the basis at a destination plus the transportation and handling costs to that destination. An increasing number of farmers are using the basis to decide where and when to sell their crops. Thus, the minimization objective function applies to both elevators and farmers.

Country elevators that sell corn and soybeans to final markets face negatively sloping demand functions. Other things being equal, as the quantity of corn and soybeans offered to each market increases, the price paid at the market decreases, which makes bids at other markets better alternatives. Unfortunately, accurate estimates of demand functions at each final market do not exist. The corn and soybean prices used in the model are average quarterly bids at each final market. To prevent the quantity of corn and soybeans shipped to each market from exceeding the quantity that each market can receive without significantly affecting its bid price, the quantity of corn and soybeans that can be shipped to each market was constrained in the model.

Corn and soybean markets historically served by the elevators within a study area are divided into three major categories: inland terminal storage markets, processing markets, and export markets. Corn and soybean receipts at processing markets are constrained in the aggregate to be between 90 and 110 percent of their 1977-1978 quarterly levels. Export markets are constrained identically. Receipts at individual corn or soybean processors, Great Lakes export markets, and inland terminal storage markets are constrained to be equal to or less than 110 percent of their 1977-1978 quarterly levels. Barge shipments of corn and soybeans from each study area to barge-loading elevators are constrained to be between 80 and 130 percent of their 1977-1978 quarterly shipments.

In the phase-1 analysis, the storage capacity, beginning crop-year stocks, quarterly receipts, and ending crop-year stocks of corn and soybeans at each elevator are fixed at their 1977-1978 levels. In the phase-2 analysis, the total 1977-1978 supply of corn and soybeans on each farm must be shipped to an elevator or stored in on-farm storage facilities in the first time period--harvest 1977. The phase-2 analysis permits additional on-farm and elevator storage facilities to be built to accommodate any expansion in the 1977 storage capacity of on-farm and elevator storage facilities demanded. Thus, farmers could shift corn and soybean shipments among elevators and time periods in response to changing rail rates. Additional on-farm and elevator storage costs were converted to an annual fixed investment cost by using Equation 6 (2):

$$AFIC = P\left\{i(1+i)^n[(1-i)^n - 1]^{-1}\right\} - S\left\{i[(1+i)^n - 1]^{-1}\right\} \qquad (6)$$

where

AFIC = annual fixed investment cost,
P = purchase price,
S = salvage value,
n = service life, and
i = interest rate.

RESULTS

Table 2 shows the values of the objective function for each solution in the phase-1 analysis. Simultaneous rail rate increases of 20-40 percent by all railroad companies above the Ex Parte 349 rail rates in effect during most of the 1977-1978 crop year would have resulted in increased marketing costs for elevator operators of about 3.5-6.0 cents/bushel of corn and soybeans marketed in the Eastern District. The same level of rail rate increases in the Western District would have resulted in increased marketing costs of about 7.5-14.5 cents/bushel of corn and soybeans. The additional marketing costs incurred by elevator operators in the Western District would have been about twice as large as those incurred by elevator operators in the Eastern District. Measured by the additional marketing costs that result from rail rate increases, railroad companies have more market power over elevator operators in the Western District than they do in the Eastern District. A major reason for the differences in market power is the distance to the Mississippi River. An analysis of the effects of the higher rail rates on different groups of elevators indicates that the elevators most likely to absorb large increases in rail rates before shifting to another mode of transportation or to another market or both were elevators that

1. Ship multiple-car or unit grain trains,
2. Ship more than 70 percent of their corn and soybeans by rail,
3. Ship corn and soybeans more than 300 miles to market, or

4. Ship under relatively low-cost rail rates and have ratios of revenue to variable cost of less than 1.6.

Rail rate increases of 20 cents/hundredweight would result in hauling less corn and soybeans by rail and more by truck. The 20-cent/hundredweight increases would result in doubling the rail rates for some short-distance movements and would cause increases of a much smaller percentage in rates for longer distances. Thus, long-distance shippers were more likely to absorb large increases in rail rates than were short-distance shippers.

The elasticity of demand for rail transport of corn and soybeans was calculated by using the percentage of rate increases and the ton miles of corn and soybeans shipped by rail. The elasticity of demand is defined as the ratio of the percentage of change in quantity transported by rail divided by the percentage of change in rail rates. In the Eastern District's solution of a 20 percent rail rate increase, the quantity of rail ton miles declined by 21.6 percent. Thus, the estimated elasticity of demand for rail services in the Eastern District is 1.07; this is an elastic demand at the Ex Parte 349 rail rate level with the 20 percent rate increase. In the Western District, the elasticity of demand was estimated to be 0.05 at the 20 percent rate increase. This is highly inelastic.

Table 3 shows the values of the objective function for each solution in the phase-2 analysis. On the basis of the results of the phase-2 analysis--when corn and soybeans were assumed to originate on the farm--rail rate increases of 20-40 percent would result in increased marketing costs of about 3.6-6.3 cents/bushel of corn and soybeans marketed in the Eastern District. This was about the same per-bushel price increase as in the phase-1 analysis. However, the phase-2 analysis included the cost of hauling the corn and soybeans from farms to elevators, whereas the phase-1 analysis excluded the farm-to-elevator transportation costs. In addition, the center of the Eastern District in the phase-2 analysis is located somewhat further from the Mississippi River than the center of the phase-1 Eastern District. If the phase-2 Eastern District had been exactly the same geographic size and had had the same mix of elevator types as the phase-1 Eastern District and if the farm-to-elevator transportation costs had been included in the phase-1 analysis, logic would have led to the conclusion that railroads have less market power over farmers than over elevators. The marketing alternatives for corn and soybeans still on farms are much greater than for corn and soybeans already delivered to elevators.

Similar results were obtained in the Western District. The additional marketing costs in the Western District were about 6.8-13.3 cents/bushel under the phase-2 analysis compared with 7.4-14.5 cents/bushel in additional costs in the phase-1 analysis. Thus, the per-bushel increase in marketing and transportation costs was about the same in phases 1 and 2 of the analysis. The phase-1 analysis, however, did not include the farm-to-elevator transportation costs. There is little difference in the mix of elevators among the elevators in phases 1 and 2 in the Western District. If the phase-2 study area had been the same geographic size as the phase-

Table 2. Estimated value of objective function for five computer solutions, Eastern and Western Districts, phase 1.

	Eastern District			Western District		
		Change in Net Price, Transportation, and Handling Costs Due to Rail Rate Increases			Change in Net Price, Transportation, and Handling Costs Due to Rail Rate Increases	
Solution	Total Transport and Marketing Costs and Futures Basis ($)	Dollars	Cents per Bushel	Total Transport and Marketing Costs and Futures Basis ($)	Dollars	Cents per Bushel
Base	8 209 456			12 491 745		
Rate increase of						
20 percent	8 838 696	629 240	3.51	14 684 777	2 193 032	7.4
30 percent	9 078 682	869 226	4.85	15 768 539	3 276 794	11.0
40 percent	9 276 095	1 066 639	5.95	16 825 018	4 333 273	14.5
20 cents/hundredweight	9 183 018	973 562	5.43	15 613 208	3 121 463	10.5

Table 3. Estimated value of objective function for six computer solutions, Eastern and Western Districts, phase 2.

	Eastern District			Western District		
		Change in Net Price, Transportation, Handling, and Facility Costs Due to Rail Rate Increases			Change in Net Price, Transportation, Handling, and Facility Costs Due to Rail Rate Increases	
Solution	Total Transport and Marketing Costs and Futures Basis ($)	Dollars	Cents per Bushel	Total Transport and Marketing Costs and Futures Basis ($)	Dollars	Cents per Bushel
Base	19 006 253			33 467 784		
Rate increase of						
20 percent	20 108 584	1 102 331	3.64	37 305 603	3 837 819	6.79
30 percent	20 542 044	1 535 791	5.07	39 168 067	5 700 283	10.09
40 percent	20 876 703	1 870 450	6.18	40 998 909	7 531 125	13.33
20 cents/hundredweight	20 905 004	1 898 751	6.27	39 151 413	5 683 629	10.06
One railroad only, 20 percent rate increase	19 218 018	211 765	0.70	34 588 619	1 120 835	1.98

1 study area and if farm-to-market transportation costs had been included in the phase-1 analysis, logic would have led to the conclusion that railroads have less market power over farmers than over elevators. This is because farmers must incur the fixed costs of transporting their grain regardless of where they sell it. Therefore, farmers only incur the marginal costs of transporting their grain to more-distant elevators or markets in response to higher rail rates. Elevators, on the other hand, incur the full cost of trucking their grain to other markets plus the costs of handling the grain the second time. The phase-2 results also suggest that railroad companies have more market power in areas farther from the Mississippi River than in areas closer to it.

The analysis of the effects of the higher rail rates on different groups of elevators and farmers indicates that the elevators and farmers most likely to absorb large increases in rail rates before shifting to another mode of transportation or to another market are those that

1. Ship multiple-car or unit grain trains,
2. Ship more than 70 percent of their corn and soybeans by rail,
3. Ship corn and soybeans more than 300 miles to market, or
4. Ship under relatively low-cost rail rates and have ratios of revenue to variable cost less than 1.6.

Typically, elevators that ship multiple-car or unit trains of corn and soybeans have lower rail rates to distant export ports than do elevators that ship smaller units. The percentage of rate increases applied to these lower rates results in smaller absolute rate increases than when it is applied to higher-cost small shipments. Moreover, most of the rail rates that have ratios of revenue to variable cost less than 1.6 were for multiple-car or unit-train shipments to export ports. Also, elevators that ship by low-cost multiple-car and unit trains of corn and soybeans ship most of their grain by rail. As a result, only farmers who sell to and elevators that ship corn and soybeans in multiple-car and unit trains shared all four of the preceding characteristics.

By using rail ton miles as a measure of quantity, the estimated elasticities of demand for rail transport under the phase-2 20 percent rate-increase solutions are 1.06 in the Eastern District and 0.19 in the Western District. Thus, the elasticity of demand for rail transport is less inelastic in the Western District when the corn and soybeans are still on the farm than when they have been delivered to elevators.

In the phase-2 analysis, rates of one railroad company were increased 20 percent over the base solution rates, whereas all other rates were held constant. In that computer solution, the rates of the Chicago and North Western Transportation Company (C&NW) were raised because about 50 percent of the elevators in both districts are located on C&NW tracks. When only one company's rates were raised 20 percent, total corn and soybean marketing costs would have increased only 0.7 cent/bushel in the Eastern District (compared with 3.6 cents/bushel when all railroad companies raised their rates) and slightly less than 2 cents/bushel in the Western District (compared with 6.8 cents/bushel when all railroad companies raised their rates). The reason for the small increases in marketing and transportation costs is that farmers would have bypassed elevators located on C&NW tracks. Table 4 shows the impact of the higher rail rates on C&NW rail revenues and ton miles as well as revenues and ton miles for competing companies that did not raise their rates. C&NW rail revenues and ton miles would have declined more than 80 percent in both districts, whereas rail revenues and ton miles for competing companies would have increased 36 and 70 percent, respectively, in the Eastern District and 130 and 140 percent, respectively, in the Western District. Elevators located on competing railroad company tracks would have received and shipped about 17 percent more corn and soybeans in the Eastern District and 105 percent more corn and soybeans in the Western District. Thus, the principal beneficiaries of a one-railroad rate increase would be the competing railroad companies and the elevators located on the competing railroads' tracks. Farmers who sold their grain to elevators on C&NW tracks in the base solution would minimize the effects of the one-railroad increase in rates by shifting their grain sales to elevators located on competing companies' tracks. The principal losers would be the railroad that raised its rates and the elevators located on its tracks.

If we assume that railroad companies possess market power in various degrees and locations, it is not certain that they will fully exercise rate freedom under a deregulation scenario. If the corn and soybeans have been delivered to elevators, a 20 percent rail rate increase by all railroad companies operating in the Eastern District would reduce total railroad revenues from corn and soybeans about 13 percent, whereas rail ton miles would decline about 21 percent. If the corn and soybeans were still located on farms, a 20 percent rail rate increase by all railroad companies would reduce rail revenues about 18 percent and rail ton miles about 21 percent in the Eastern District. It is not possible to determine railroad profitability from gross revenues

Table 4. Impact of higher rail rates on number of shipments, rail revenues, and ton miles for C&NW and competing companies.

	Base Solution		One Railroad and 20 Percent Rate Increase			
Item	C&NW Elevators	All Other Elevators	C&NW Elevators	Percentage of Change from Base Solution	All Other Elevators	Percentage of Change from Base Solution
Eastern District						
Total corn and soybean shipments by rail and truck (bushels)	11 116 800	19 098 200	7 985 600	-28.5	22 279 400	16.7
Total rail revenue paid ($)	2 638 485	4 102 604	504 667	-80.9	5 592 184	36.3
Rail ton miles (000s)	137 928	134 248	22 893	-83.4	228 421	70.1
Western District						
Total corn and soybean shipments by rail and truck (bushels)	35 322 800	21 179 800	13 079 800	-63.0	43 422 800	105.0
Total rail revenue paid ($)	11 950 749	7 760 276	2 255 770	-81.1	17 839 245	129.9
Rail ton miles (000s)	990 573	596 608	143 329	-85.5	1 428 280	139.4

and ton miles. But, since both rail revenues and ton miles would decline by approximately the same amount and given the high fixed costs of the railroad industry, it is likely that there would be less revenue to cover the fixed costs. In this case, rail profits would likely decline. In the short run, it may be possible to raise rates 20 percent in the winter when the Mississippi River is frozen and still maintain total corn and soybean rail shipments and increase rail profits. In the long run, however, higher winter rates would encourage elevator operators and farmers to sell more grain at harvest or build more storage or both so that corn and soybean sales could be shifted to spring and summer shipments. If one railroad company raised its rates independently in the Eastern District, enough corn and soybean revenue and ton miles would be lost to result in lower rail earnings.

In the Western District, the probability is higher that railroad companies would more fully exercise their rail-rate freedom. Rail rate increases would result in substantially higher rail revenues, whereas ton miles would decline slightly. This would increase rail profits sharply. However, if one railroad company independently raises its rail rates while all other rail rates and variables remain constant, the company that raised its rates would lose more than 80 percent of its gross revenues and rail ton miles of corn and soybean shipments. Thus, it would seem to be unprofitable for one railroad company to raise its rates independently. This conclusion must be tempered somewhat, because some of the rail competition that existed in both study areas in 1977-1978 no longer exists. The Chicago, Rock Island and Pacific Railroad Company has ceased operation in both areas since the analysis. One method of preventing railroad-company abuse of market power under deregulation is to remove antitrust exemption from railroad rate bureaus, which would prevent railroad companies from simultaneous rate-making activities. Railroad companies would be required to publish rates only on independent action. Joint rates on end-to-end line-haul movements would need to be negotiated on a one-to-one basis. In a deregulated environment, however, railroad rate bureaus could still have the function of mechanically printing and distributing railroad price lists. The Staggers Rail Act of 1980 prevents rate-bureau discussion or voting on single-line rates except for general rate increases and precludes the latter after 1983.

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Fuel Efficiency in Freight Transportation

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Barge transportation is the most fuel-efficient method of moving the raw materials and semifinished products needed by the nation's economy. This study reviews the record of extensive research on this vital issue and provides findings that lend new perspective to energy efficiency in transportation. A number of studies of fuel efficiency have been sponsored over the past several years by the U.S. Departments of Transportation and of Energy. These studies show that shallow-draft water transportation consumes considerably less energy in producing equivalent freight transportation than do alternative modes. Even when circuity (the lack of straight-line water routes between cities) is taken into account, the energy efficiency of the barge and towing industry is superior. These analytical findings are confirmed by a survey of barge operators and reinforced by specific examples—grain movements from Minneapolis to the Gulf Coast and a total of 25 million tons in coal movements to steam-generating plants of the Tennessee Valley Authority. All bulk-transport modes make significant contributions to the nation's distribution system in a highly fuel-efficient manner. Any transportation energy policy must recognize and promote the use of the inherent advantages of all the fuel-efficient modes of transportation.

Nearly 25 percent of domestic freight traffic and more than 16 percent of all intercity freight moves by water (1, p. 8; 2, p. 91). An analysis of published studies, carrier filings with the Interstate Commerce Commission (ICC), and data from railroad and waterway companies shows that, on the average, after both rail and water circuity have been taken into account, domestic water carriers consume less energy in producing equivalent work than does the rail mode. In this analysis, the facts on fuel efficiency in freight transportation are reviewed. Particular attention is paid to the rail and water modes.

A wealth of data on efficiency in the use of energy has been developed in recent years, mostly under contracts for the U.S. Department of Energy (DOE) and the U.S. Department of Transportation (DOT) (3, p. 9). Rising cost of fuel, occasional uncertainties of supply, and possibility of catastrophic interruption of fuel supplies from the Middle East have concentrated the attention of transportation companies on improved efficiency.

One major conclusion of a review of the available information is that the vital task of distributing the production of industry and agriculture (thus keeping farms and factories running) is accomplished by using a fraction of the nation's total fuel supplies. It is well understood that more than half the nation's petroleum is consumed by transportation. It is not so well understood that most of this goes for passenger transportation.

Trucks, railroads, and water carriers perform more than 76 percent of intercity freight transportation, but in 1978 they consumed less than 6 percent of the nation's total domestic demand for petroleum (excluding residual fuel oil used mainly in bunkering vessels engaged in foreign trade) (4, p. I-5) and less than 3 percent of the nation's fuel supply. Barging alone consumed about one-half of 1 percent of the nation's fuel supply (5, p. 2-8; 6, p. 32). Petroleum demand for trucks is estimated based on 602 trillion ton miles at 2.343 Btu/ton mile. The Transportation Association of America's value for diesel fuel and distillate is taken as the