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ABSTRACTS

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POTENTIAL IMPACT OF UNIT TRAIN CONTRACTING ON EQUILIBRIUM GRAIN ELEVATOR SIZE: CASE OF THE TEXAS PANHANDLE

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ABSTRACT

From 1887 through 1980, the railroad industry operated in a highly regulated environment. During this regulated era an egalitarian rate structure evolved, whereby small and large shippers faced the same rate structure and were treated similarly.

Passage of the Staggers Rail Act of 1980 brought about a change in railroad industry regulation. The Staggers Act allows contracting to take place and enabled railroad companies to provide shippers rate concessions in exchange for guaranteed volume shipments. The purpose of this study is to determine how rate structures which reflect economies in shipment size impact the equilibrium elevator size in the Texas Plains.

Two models were developed to characterize the cost structure of the grain elevator industry. The first, represents a pre-Staggers rate structure, and the second represents a post-Staggers structure. Results of the two cost models are compared to evaluate how optimum elevator size will change as a result of Staggers Rail Act provisions. Results indicate the optimum elevator size will double. Clearly, this development will have an impact on the structure and possibly the performance of the country elevator industry.

Key Words: Contracting, Rate structure, Elevator, Staggers Rail Act, Optimum plant size, Unit train

INTRODUCTION

Railroads have been one of the most heavily regulated industries in the United States. The passage of the Act to Regulate Commerce in 1887 and the establishment of the Interstate Commerce Commission, (ICC), brought about this regulation. The ICC had far-reaching jurisdiction over pricing, mergers, abandonments and service in the industry. [1]

In general, the regulated rate structure exhibited an egalitarian philosophy. The law, by various provisions, sought to prevent personal discrimination. As a result, large and small grain shippers generally faced the same rate structure regardless of the quantity shipped per year or per shipment. [2]

On October 1, 1980, Congress approved the Staggers Rail Act

I wish to thank Dr. Stephen Fuller for his guidance and suggestions during my research

which began a new age of railroad regulation. Section 208 of the act allows railroads and shippers to enter into contracts to provide specified services under specified rates and conditions. Railroads are allowed to enter into contracts for a wide range of rate and service agreements, including car utilization, guaranteed car supply, guaranteed service, volume allowances and stable rates. [3]

In the South and Central Plains a transit grain rate structure evolved during the pre-Staggers era. The single-car rate structure allowed for storage in-transit at inland terminal locations. The rate on direct shipment from a country elevator to export location was equal to the sum of the rates from country elevator to inland terminal and from inland terminal to export area. It follows that a grain shipper's transportation charge on export-destined grain was not unfavorably affected by transshipment at inland terminal locations. However, as a result of the Staggers Rail Act, there was an opportunity for shippers to enter into contracts and receive rate concessions for shipping grain in large lots from country elevator locations to port elevators.

The new rate structure was facilitated by shipment in unit trains and multi-car lots. Unit trains are multi-car shipments of 75 to 100 cars which move from a single origin to a single destination. Movements in large lots offer improved efficiency through reduced labor requirements and by eliminating the need to dismantle trains and switch cars between trains. Multi-car shipments of 25 and 50-cars also offer increased efficiency.

Unit train shipments lend themselves to large volume shipments from surplus grain producing regions to export locations. Because export terminals have relatively small storage capacity, unit trains can be used to bring in large volumes of grain which may be loaded directly onto ocean-going vessels.

As a result of the Staggers Rail Act and its contracting provisions, economic forces seem to have been set in motion which may alter the equilibrium or optimal country elevator size. Economical plant size is determined by the simultaneous consideration of three cost components. They are (1) the costs of assembly or collection from scattered origins to the point of plant location (2) plant costs and (3) the plant-to-market transportation costs. [4] Prior to deregulation, the cost of assembly and plant costs were most important since the plant-to-market transportation costs were identical for all plants within a given area. In which case, the optimum organization involved balancing decreasing plant costs against the farmers increasing assembly costs. However, with the contracting provisions made available with deregulation, the plant-to-market transportation costs (export rates) decline because of the opportunity to ship in larger units. Thus, the third component of costs come to bear. A priori, the declining shipment cost will have the affect of increasing optimal country elevator size.

OBJECTIVES

Unit trains are an efficient method of transporting grain. There appears to be an opportunity for grain elevators to expand existing plants or build new plants that facilitate the loading of large multicar lots. In doing so, elevators take advantage of the economies associated with a larger shipment size.

The objective of the research is to determine how the optimum grain elevator size is affected when contracting is allowed between shippers and railroad companies. To achieve this objective, one scenario which assumes all grain elevators ship at the same rate will be contrasted with a second scenario involving multi-car grain shipments and associated rate concessions.

In addition, the study attempts to determine how a grain elevator's geographical market area would change when contracting is allowed. This will be compared to the optimum market area size which would evolve without the contracting option. The comparison will determine how producers length of haul will be affected.

An effort is made to determine how sensitive the optimum elevator size is to changes in several important variables. These variables are the density of grain production and per mile costs associated with grain assembly. The sensitivity of the optimal plant size to these two variables will be measured by estimation of elasticities.

STUDY REGION

The study area is comprised of 23 counties in the upper Texas Panhandle. Wheat, corn and sorghum are the primary grain crops grown in the region. However, the large feedlot industry located in the region makes it a deficit area for corn and sorghum. For purposes of this study, these two crops remain unimportant.

This study region is a major supplier of export wheat. Wheat from this area is harvested before that of the upper Great Plains. This, combined with the fact that the study region is relatively close to export terminals in Houston and Galveston, make export the primary outlet for the region's wheat production.

Wheat from the area has historically been sent to inland terminal elevators located in Enid, Oklahoma and Fort Worth, Texas for storage. From these elevators, wheat was shipped to export markets or domestic use. In 1977, 98 percent of the wheat produced in the upper Texas Panhandle was destined for export and nearly all of this grain exited from the ports of Houston and Galveston. [5]

Wheat flow from the Panhandle has historically been dominated by rail shipments. [6] Truck usage is minimal due to the extended length of haul to port terminals. Barge transportation is irrelevant, because no navigable waterways are located in the region.

THEORY AND MODEL

Average plant costs, average distribution or plant-to-market cost, and average assembly cost are the three relevant costs to be included in the analytical model. [8] To carry out the analysis, two models are constructed. The first model reflects the pre-Staggers distribution rate structure that involved no contracting. The second scenario takes the contracting option into consideration. Thus, the only difference between the two models is the shape of the distribution cost function.

Figure 1 represents the first scenario where country elevator cost structure does not include the rail contracting option. The average total cost curve (ATC) is estimated by summing each of the three underlying curves, the average assembly cost (AAC), average distribution cost (ADC), and average plant cost (APC). The minimum point on the ATC curve represents least-cost plant volume, from which optimal plant size can be determined. [4] The average total cost curve is U-shaped, with per bushel cost decreasing up to a point and increasing thereafter. By inspecting the underlying cost functions, we can determine why this occurs.

The average plant cost function represents the cost of receiving, storing, and loading grain into rail cars for shipment. Economies of size exist in the grain elevator industry. As a result, the average plant cost function has a negative slope.

Distribution cost (ADC) is incurred when moving grain from the plant site to a final destination. In figure 1 it is a horizontal line indicating the rate structure before contracting. As volume increased, railroads were unable to offer rate concessions, so the rate remains constant.

The average accumlation or assembly cost function (AAC) shows the cost of moving grain from nearby production areas to the plant site. This cost increases at all levels, but does so at a decreasing rate. As the volume needed to satisfy a plant size increases, the market area expands geometrically. Thus, the distance traveled to acquire additional quantities increases at a decreasing rate. [4]

The accumlation costs increase and at some point they offset the cost savings associated with increasing plant size. Accumulation costs cause diseconomies that eventually limit least-cost elevator size.

The second scenario, represented in figure 2, takes into account the rail contracting option. As indicated earlier, railroads give rate concessions to shippers for moving larger volumes of grain. This is shown in the model as a decreasing distribution cost function.

Average plant cost and average accumulation cost remain unchanged while the distribution cost function shifts downward and has a negative slope when contracting occurs. The average distribution cost curve will flatten when the maximum shipment is reached. At some larger volume, the increasing accumulation costs will offset increased efficiencies associated with average plant and distribution costs and forces the average total cost upward. See Appendix for a brief description of procedure to estimate the relevant cost relationships.

RESULTS

There are four sections of results. In Table 1 are estimated plant, distribution and accumulation costs associated with various plant volumes and sizes. In this scenario distribution costs are represented by the pre-Staggers rate structure. Second, in Table 2 is shown the optimum plant size which will result because of unit train contracting. Third, a comparison of the average length of haul needed to facilitate the optimum plant size with respect to changes in density of grain production and per mile cost of accumulation is evaluated.

Optimal Plant Volume with Pre-Staggers Rate Structure

The costs shown in Table 1 are based on wheat production density that represents the study region mean (2500 bu./square mile). The distance required for shipping grain to export does not alter the shape of the cost curves, but is required to calculate distribution cost. It is assumed that the unit trains will travel 800 miles to move grain from the study region to the port area. Average accumulation costs are also given as a unit cost of 4.0 cents per bushel and per mile costs of 1.0 cents per bushel. [11]

Table 1 shows that each cost follows the expected shape revealed in Figure 1. Average total costs decrease, reach a minimum point, and begin to increase thereafter.

In Table 1, the minimum of the average total cost curve occurs at a volume level of 3.3 million bushels. To facilitate a 3.3 million bushel volume, 1,000 cars, each carrying 3,300 bushels, would need to be shipped per year. This would be accomplished by a 700,000 bushel house. The average total cost would be $1.19 per bushel.

To evaluate this outcome, each of the underlying cost curves can be explained. The average plant cost function (country elevator) shows increasing economies of size at all volume levels. [10] The average plant cost continues to decline throughout all analyzed volume levels.

The distribution cost function changes for each scenario. In Table 1, it is a constant. This is due to regulation that failed to encourage rate concessions for larger shipment sizes. In this instance, distribution costs do not affect the shape of the average total cost curve, but only affect its level.

Average accumulation costs increase with larger volumes, but does so at a decreasing rate. Because the market area expands on all sides, this is expected. At some point, the increasing accumulation cost function will cause the average total cost curve to turn upward. This point represents the optimum plant size and is represented by the 3.3 million bushel volume.

Optimal Plant Volume with Post-Staggers Rate Structure

When contracting is allowed, the optimum plant size volume doubles to a level of 6.6 million bushels (Table 2). The plant will need to facilitate loading of 100-car unit trains, 20 times per year. This will be accomplished by a 1.4 million bushel elevator. Average total cost is reduced by $.09 per bushel ($1.10) as compared to the scenario without contracting.

There is a tendency for plants to increase in size and ship in multi-car lots as a result of contracting. Elevators will gradually increase in size. As the useful life of the current, less efficient plants are consumed, they will exit the industry.

Market Area

The average plant size will double when contracting is introduced, and the market area required to facilitate this increased plant size will also

Figure 1. Country Elevator Cost Structure Without Contracting

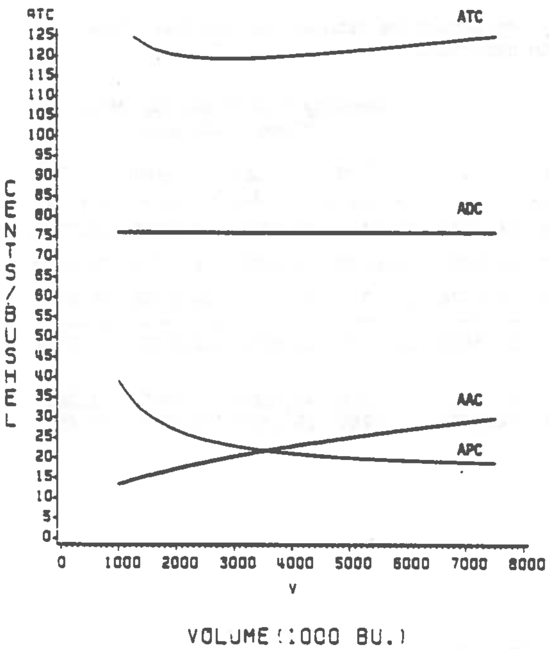

Figure 2. Country Elevator Cost Structure With Contracting

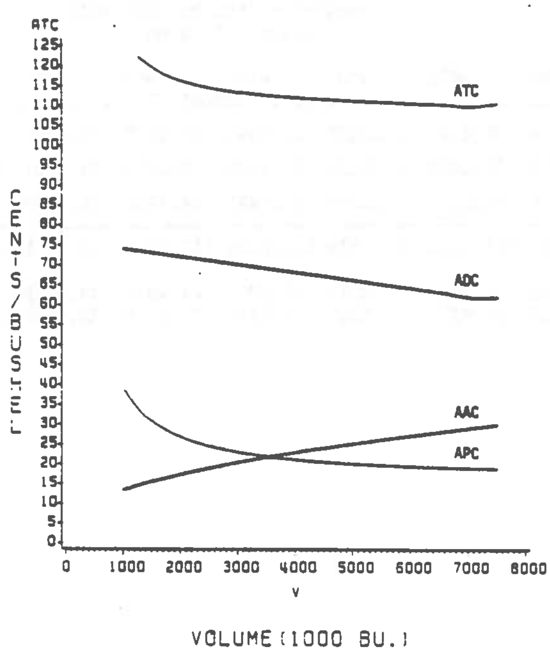

Table 1. Country Elevator Cost Structure Without Contracting: Pre-Staggers Rail Rate Structure.

Density = 2500 Bu./Sq. Mile
Volume (1000 Bu.)

	1650	2475	3300	4125	4950	5775	6600	7500
	¢/bushel							
Avg. Plant Cost	29.3478	24.4848	22.1430	20.8096	19.9805	19.4395	19.0787	18.8205
Avg. Dist. Cost	76.0474	76.0470	76.0470	76.0470	76.0470	76.0470	76.0470	76.0470
Avg. Accum. Cost	16.1106	18.8324	21.1270	23.1485	24.9762	26.6569	28.2212	29.8199
Avg. Total Cost	121.5054	119.3642	119.3169	120.0051	121.0037	122.1434	123.3468	124.6874
Mkt. Area (Sq. Mi)	25.6905	31.4643	36.3318	40.6202	44.4972	48.0625	51.3809	54.7723
Avg. Haul (Miles)	12.1105	14.8323	17.1268	19.1484	20.9760	22.6566	24.2210	25.8196

Table 2. Country Elevator Cost Structure With Contracting: Post-Staggers Rail Rate Structure.

Density = 2500 Bu./Sq. Mile
Volume (1000 Bu.)

	1650	2475	3300	4125	4950	5775	6600	7500
	¢/bushel							
Avg. Plant Cost	29.3478	24.4848	22.1430	20.8096	19.9805	19.4395	19.0787	18.8205
Avg. Dist. Cost	72.8562	71.1850	69.5138	67.8425	66.1713	64.5001	62.8289	61.8289
Avg. Accum. Cost	16.1106	18.8324	21.1270	23.1485	24.9762	26.6569	28.2212	29.8199
Avg. Total Cost	118.3146	114.5022	112.7838	111.8006	111.1280	110.5965	110.1288	110.4693
Mkt. Area (Sq. Mi)	25.6905	31.4643	36.3318	40.6202	44.4972	48.0625	51.3809	54.7723
Avg. Haul (Miles)	12.1105	14.8323	17.1268	19.1484	20.9760	22.6566	24.2210	25.8196

double (1320 sq. miles to 2640 sq. miles). The average length of haul required by farmers will only be 40 percent longer, due to a geometrically increasing market area. Without contracting, the average haul is 17 miles, but increases to 24 miles with the contracting option. The added mileage will cost farmers an average of 7 additional cents per bushel.

As a result, farmers should be paid a higher price at the elevator. The higher price will offset the higher cost they will incur in delivering the grain. Higher prices will give farmers an incentive to haul their grain these longer distances.

Sensitivity Analysis

In building a plant it becomes important to determine how sensitive that plant will be to changes in variables that could affect plant size. Two of these important variables are the density of grain production and per mile cost of accumulating grain. Changes in these variables may cause a plant to become inefficient.

To evaluate the sensitivity of the optimal outcome to these variables, the optimum plant size is traced as density and accumulation cost variables are changed. Density levels of grain production that were contained within a 95 percent confidence interval for the past 10 years were used. Density was increased in increments of 1,000 bushels, starting at 1,500 and ranging up to 8,500 bushels.

To measure the sensitivity of an optimum plant size to changes in density of grain production, an elasticity measure was calculated. It measures how a one percent change in grain production density affects the optimum plant size. The results indicate changes in density have a positive impact on plant size. Each one percent change in density causes the optimum elevator volume to change by .53 percent.

Changes in costs associated with accumulation did not result in the same relatively stable relationship. An elasticity was estimated to measure the stability of plant size with respect to changes in accumulation cost. It was found that changes in per mile costs had a negative effect on optimum plant size. Each one percent increase in per mile accumulation cost generated a-1.05 percent change in optimum elevator size.

Accumumlation cost is much less likely to change than is the density of grain production. The costs associated with moving grain such as labor, fuel, insurance, and repairs does not vary greatly from year-to-year. Therefore, the per mile costs of accumulation should remain relatively stable and not affect the optimum elevator size.

CONCLUSION

The elevator industry located in the Texas Panhandle will be affected by the Staggers Rail Act of 1980. Rate concessions that result from contracting are advantageous enough to cause elevators to increase their plant size in order to facilitate multi-car shipments.

The current elevator industry includes plants which ship single car shipments, as well as a few that have multi-car load out facilities. These small shippers will remain active as long as they are able to cover variable costs. Small operators may simply reduce their operating margins and cover variable costs over the life of the existing elevator. These small shippers will continue to attract grain in the short-run, but will not have an incentive to rebuild the same type of plant once it is fully depreciated.

The optimum plant size will be large in comparison to the elevators currently operating. As elevators increase in size, fewer plants will be needed to facilitate the grain handling function in the study region. This may have some implications on pricing efficiency, since fewer plants and firms may yield a less competitive environment. As a result of the larger plants, farmers will need to increase the distance they must travel to market their grain. On the average, farmers in the Texas Panhandle will need to travel an additional seven miles in moving grain to the elevator site.

The optimal and larger plant size appears to be quite stable relative to changing grain production density levels. However, the optimum plant size is sensitive to changes in per-mile cost of accumulation. Although the sensitivity is relatively great, the degree to which accumulation costs change is small, thus optimum plant size should remain stable.

REFERENCES

1. MacAvoy, Paul W., John W. Snow, Editors. Railroad Revitalization and Regulatory Reform. American Enterprise Institute for Public Policy Research (Washington, D.C.). 1977.

2. Daggett, Stuart, John P. Carter. The Structure of Transcontinental Railroad Rates. University of California Press. 1947.

3. Lerner, Marc. Guide to Coal Rail Contracts. Pasha Publications. 1982.

4. Bressler, Raymond and R.A. King. Markets, Prices and Interregional Trade John Wiley and Sons. 1970.

5. Leath, Mack N., Lowell D. Hill. Grain Movements, Transportation Requirements, and Trends in United States Grain Marketing Pattern During the 1970's. College of Agriculture, University of Illinois. 1983.

6. Leath, Mack N., Lowell D. Hill, Stephen W. Fuller. Wheat Movements in the United States, Interregional Flow Patterns and Transportation Requirements in 1977. College of Agriculture, University of Illinois at Urbana-Champaign. 1981.

7. Johnston, John. Statistical Cost Analysis. McGraw-Hill Book Company, Inc. (London) 1960.

8. Yu-Hesien, Terry. Analysis of Factors Affecting the Optimum Size and Number of Country Elevators in Indiana Purdue University. 1967.

9. Schnake, L.D., C.A. Stevens, Jr. Inland Grain Elevator Operating Costs and Capital Requirements, 1982. Kansas Agricultural Experiment Station. 1983.

10. Texas Custom Rates Statistics. Texas Department of Agriculture and U.S. Department of Agriculture. 1983.

11. Texas Small Grain Statistics. Texas Department of Agriculture and U.S. Department of Agriculture. 1975-1984.

12. Tolliver, Denver. Upper-Plains Rail Costing System. North Dakota State University. 1982.

APPENDIX

Costs associated with various short run wheat-sorghum elevators were available and collected for construction of a long-run average plant cost. [7,9] The cost-volume relationship of the four plant sizes were regressed using an ordinary least-square procedure to find the long-run average plant function. The plant sizes had facilities to accomodate 25, 50, 75 and 100-car shipments, respectively.

Costs for grain accumulation were obtained for custom hauling in the Texas Plains. [10] Based on this data, terminal costs were estimated to be $.04 per bushel and transportation costs $.01 per bushel-mile.

Data needed for the calculation of density were wheat production figures and area in square miles. Production data from the years 1975 through 1984 were gathered for each of the 23 counties in the study region. [11] In addition, the area of each county in square miles was calculated.

Average distribution costs were obtained using a rail costing software program. [12] These cost-volume-mileage relationships were regressed to develop a representative distribution cost function. The distribution function for the egalitarian rate structure remained constant at the single-car rate.