Economic Impacts of Grain Marketing Structural Changes on Export Wheat Logistics System in Northwest Kansas.

Ming H. Chow

L. Orlo Sorenson

Michael W. Babcock

Ming H. Chow is a Research Assistant and L. Orlo Sorenson is a Professor in the Department of Agricultural Economics, and Michael W. Babcock is an Associate Professor in the Department of Economics, Kansas State University.

Ming H. Chow, L. Orlo Sorenson and Michael W. Babcock

ABSTRACT

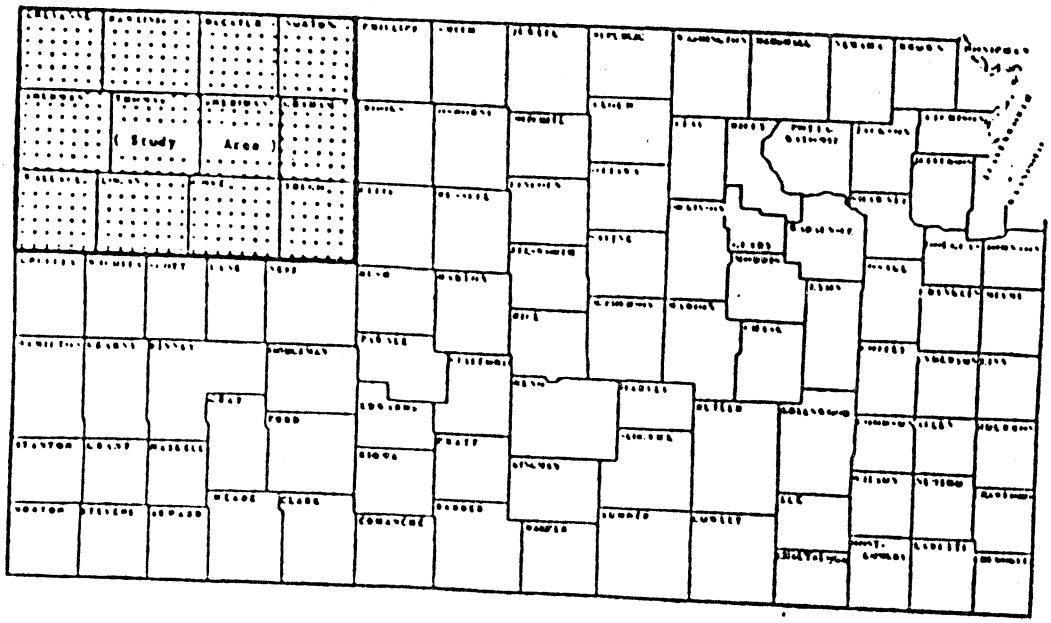
This study evaluates the economic impacts on the export wheat logistics system from marketing structure changes. Without the former Rock Island rail service, results reveal that impact on total system was small while that on a more localized area was greater. Substantial cost savings and significant role played by subterminals indicate the feasibility of constructing trainload facilities in the area.

Cost and availability of storage and transportation are critical factors in determining grain flow patterns. Recent changes in cost and availability of marketing input services, especially transportation services, suggest significant long-term impacts on grain logistics systems. Abandonment of rail service to local communities continues. Rail deregulation provides greater rate and service freedom for carriers and shippers. In the current regulatory environment, rail carriers and shippers have developed lower contract rates for direct movement of grain which may virtually eliminate the single-car transit rate system to principal export ports. The cost efficiency of trainload movement of export grain has been demonstrated in other studies [Baumel et al.][Fuller et al. 1981][Sorenson et al.].

How the grain distribution system adjusts to the absence of rail service in some instances and to apparent cost-reducing unit-train movement of export grain in other cases are of great interest in both public and private sectors. This study analyzes the impacts of both events seperately and in combination for a 12-county area in Northwest Kansas (Figure 1). A lowest-cost system of trainloading facilities for movement of export wheat from the study area is specified by the analytical model both with and without abandonment of significant rail milage.

In 1982, winter wheat production contributed over 60 percent of total production or two thirds of the total market value of major crops produced in the study area [Chow]. A large portion of Kansas wheat is sold from farms and utimately to various destinations distant from production locations [Babcock et al.][Leath et al.]. Country elevators and inland terminals perform storage and merchandising services between production

Figure 1. Location of the Study Area in Northwest Kansas.



areas and final destinations.

The study area is served by the Union Pacific railroad, the Burlington Northern, and a line of the former Rock Island currently operated by the Kyle railroad. The Missouri Pacific has a short line serving a small region in the northeast corner of the study area. Continuation of service over the former Rock Island line is uncertain. This is a major segment of the rail network serving the area.

Upgrading of country elevator facilities into subterminals appeared to offer potential for marketing cost reduction. Reported patterns of price bids for winter wheat in the area suggest cost economies for a newly established subterminal elevator at Colby, Kansas.

This study concentrates on export wheat which is about 43 percent of total wheat production in the area. Focusing on the impact of alternative movement of export wheat is only partial recognition of the potential total impact of marketing alternatives on producers and the marketing logistics

system of the area. However, changes most likely to occur will have a siginificant and perhaps more immediate impact on export movement.

I. The Empirical Model

A capacitated network simulation model was developed for analysis of the export logistics system [Fuller et al. 1978][Hilger et al.]. The analytical model includes all shipping and storing locations including production origins, country elevators, subterminals, inland terminals, river elevators and port terminals. Wheat production of the study area for 1990 was projected by multiplying the 1990 forecast of Kansas production by the historical average production share of the study area. This analysis focuses on export wheat which is less than 50 percent of total area production. Wheat quality of less than 12 percent protein content was designated as export wheat.

The study area is divided into 6X6 mile production origins resulting in 330 origins. Fifty country elevator locations and fourteen potential subterminal sites were included in the model. Eight inland terminal locations: Atchison, Hutchinson, Kansas City, Salina and Wichita, Kansas, Denver, Colorado, and Catoosa and Enid, Oklahoma, were identified as terminal elevator locations. Atchison and Kansas City, Kansas and Catoosa, Oklahoma have river elevators for barge shipment while rail and truck facilities are available at all other inland terminal locations. Final export markets are assumed to be the port terminals at the Gulf of Mexico and on the Pacific Coast. Five export areas: Louisiana Coast, North Texas, South Texas, Southern California and Northwest Pacific ports are chosen as final destinations for export wheat.

The annual time period over which export wheat is delivered is from June

1 to May 31 of the next year. Three delivery time points and two storage time periods are used in the model. The first time point for delivery from a given location (origin) to a subsequent location (destination) is at harvest time (assumed July 1). This period does not involve storage. The harvest season is from June 1 to June 30. The second delivery time point is midway through a storage period extending from July 1 to September 30. The third delivery time point is midway through a storage period extending from October 1 through May 31.

Storage costs associated with the second and the third shipping time point are based on the length of storage period and unit cost of storage in the facility in which storage occurs. If shipment occurs within the harvest time, no storage is charged at the point of origin. At the second shipping time point, storage is charged for one-half the harvest season plus one-half the storage period in which shipment occurs. For the final shipping time point, storage is charged for one-half of the harvest season plus the post harvest period and one-half of the storage period in which shipment occurs.

The analytical model used many exogenous variables so that many subproblems of estimating appropriate values for exogenous variables are required. The unit shipping costs for all transport modes between origins and destinations, the unit storage costs and the unit handling costs at all potential storage locations are required cost variables. Other predetermined exogenous vasriables are the shipping restriction for various transport modes from various locations in various time periods and the storage limitations at various locations.

II. Empirical Results of Abandoning the Former Rock Island (RI) Rail Line.

The impact of abandoning the former RI rail line is based on the changes in the marketing pattern and total logistics system cost of two systems: one with the former RI rail line serving the study area and the other without it. The total system cost includes the collecting, loading, unloading, storage and transporting cost from the production origins to the export ports. There are 10 country elevator sites in the study area which depend exclusively on the RI line for railroad movement. The empirical results indicate that the quantity of wheat receipts for export at these 10 country elevator locations would be reduced by 92 percent with the abandonment of the RI rail line (Table 1). Elevators located at nine of these ten locations did not receive export wheat in the absence of rail service.

Table 1. Export Wheat Receipts at Country Elevator Sites Served Exclusively by the Former RI Rail Line with and without the Rail Line in Operation.

Location name	W/ RI	W/O RI
	Bushels	
Dresden	203,014	-
Jennings	331,240	-
Edson	752,750	-
Goodland	1,468,500	-
Kanorado	952,119	539,952
Breton	243,750	-
Brewster	1,386,159	-
Levant	317,975	-
Rexford	580,650	-
Selden	346,500	-
Total	6,582,657	539,952

Wheat flow pattern changes are mainly reflected within the study area. Without the former RI rail line, farm wheat was shipped farther to country elevators south and/or east of production origins because the major export ports are at the Gulf of Mexico which is located southeast of the study area. Total system cost increased by $513,007 or by 1.35 percent (Table 2) from abandoning the former RI rail line. The average total logistic cost for export wheat was increased 1.6 cents per bushel for the study area.

With or without the former RI rail line, rail movement dominates the long distance movement of export wheat. On a cost basis, commercial trucks can compete with rail over short distances but not on the longer hauls. The model designated truck shipment over distances greater than 75 miles only when direct rail shipment is not available, such as movement from Kanorado, Kansas to Denver, Colorado after removal of rail service. Barge volume was unaffected.

Farm storage increased substantially without the former RI line, resulting in higher combined costs of storing and handling. The volume of export wheat entering farm storage at harvest time increased from 7,799,842 bushels to 12,744,975 bushels (Table 3). This is an increase from 24 percent to 40 percent of total export wheat. System storage cost increased by 25.9 percent or $372,434 (Table 2).

Although the impact of rail abandonment is a cost increase of 1.35 percent for export grain, the impact on a more localized area is greater. A major loss of volume is suffered by elevators at sites relying exclusively on the RI rail line. Sixty production origins delivered most of their export wheat to these ten country elevator sites prior to removal of rail service. Total quantity of export wheat produced in these 60

Table 2. Total System Costs, Handling Costs and Shipping Costs, with and without the Former RI Rail Line in Operation.

ITEM	W/ RI	W/O RI
Storage Costs	$ 1,437,314	$ 1,809,748
Handling Costs	7,560,232	7,623,532
Shipping Costs		
Truck	5,578,060	5,820,767
Rail	22,772,664	22,607,230
Barge	650,407	650,407
Sub-Total	29,001,131	29,078,404
Total System Costs	$ 37,998,677	$ 38,511,684
Average Total Cost (Cents/Bushel)	118.4	120.0

Table 3. Export Wheat Storage on Farms, Country Elevators, Inland Terminals and River Elevators with and without the Former RI Rail Line in Operation.

Location	W/ RI	W/O RI
	---------- Bushels ----------	
Farm	7,799,842	12,744,975
Country Elevator	19,870,407	15,698,853
Inland Terminal	1,973,732	1,211,798
River Elevator	142,528	130,883

origins is 7,619,741 bushels. The increase in trucking costs associated with the 60 origins after rail abandonment was $231,910 or an additional average trucking cost of 3.04 cents per bushel. Farm storage and handling cost at these 60 origins after rail abandonment increased $462,030 or 6.06 cents per bushel. The total additional cost fell on producers in these 60 origins after abandoning the RI rail line would be 9.10 cents per bushel.

III. Empirical Results for Constructing Subterminals in the Study Area.

This analysis includes the additional option of constructing subterminals in the study area. Two analyses were conducted, i.e., 1) constructing subterminals with the RI rail line serving the study area, and 2) constructing subterminals without the RI rail line. The optimal locations and number of subterminals were based on heuristic optimal solutions. These solutions are obtained through consecutive iteration of the directed network model.

The model started with trainload shipments including no expansion cost at any of the fourteen potential subterminals in the initial run. The annual expansion cost for constructing rapid-loading facilities was divided by the quantity of export wheat handled by each subterminal in the initial run to get the unit expansion cost. The unit expansion cost was added to all outbound shipments at the subterminal, and the network was executed again. Subsequent executions of the model proceeded by using results obtained from the last execution.

With additional unit expansion cost, locations which handled insufficient export volume for low unit costs were gradually eliminated from the logistics system. The final result was reached when a stable pattern of export wheat movement was obtained, i.e., no change results from

successive iterations. The proposed number of subterminals was reduced from 14 to 6 indicating that the system is sensitive to the additional annual expansion cost. Locations other than these 14 potential subterminal locations are not likely to enter the system as a subterminal because of the relatively large annual expansion cost involved.

With trainload facilities in the study area, the optimized export wheat marketing patterns change substantially. Marketing channels through country elevators, inland terminals and/or river elevators that had played major roles without subterminals experience substantial reduction in volume handled. The cost savings through unit-train shipment and fewer transit points (and lower handling cost) give very little room for other channels to be competitive. Commercial trucks handle a very small volume of export wheat in these logistics systems. Barge shipment was reduced although it always played a minor role in the export wheat system. New Orleans received export wheat by barge as well as unit-trains from subterminals.

Another major effect of constructing subterminals in the study area is the overall savings in average unit handling and shipping cost (cents/bushel). The average unit costs of using 5-car rail shipment were 118.4 and 120.0 cents with and without RI line service, respectively. By using unit-train shipment, the average unit costs, including handling, shipping and upgrading costs, were reduced to 106.0 and 106.4 cents for corresponding cases (Table 4 and Table 5). The savings are 10.5 percent and 11.3 percent for the respective cases.

Proposed subterminals play a major role in exporting wheat from the area. Over 94 percent of total export wheat was shipped out from the study area through subterminals. Marketing channels of farm-subterminal-export

Table 4. Total System Costs with the Former RI Rail Line in Operation with and without Subterminals in the Study Area.

ITEM	W/ SUBTERMINAL	W/O SUBTERMINAL
Storage Costs	$ 1,589,634	$ 1,437,314
Handling Costs	6,939,824	7,560,232
Shipping Costs		
Truck:Farm	5,470,053	5,350,524
Commercial	883,635	227,537
Rail	18,159,861	22,772,664
Barge	485,917	650,407
Sub-Total	24,999,466	29,001,131
Expansion Cost	497,433	-
Total System Costs	$ 34,026,357	$ 37,998,677
Average Total Cost (Cents/Bushel)	106.0	118.4

Table 5. Total System Costs without the Former RI Rail Line in Operation with and without Subterminals in the Study Area.

ITEM	W/ SUBTERMINAL	W/O SUBTERMINAL
Storage Costs	$ 1,602,314	$ 1,809,748
Handling Costs	6,966,874	7,623,532
Shipping Costs		
Truck:Farm	5,514,785	5,570,002
Commercial	993,588	250,765
Rail	18,136,134	22,607,230
Barge	449,821	650,407
Sub-Total	25,094,329	29,078,404
Expansion Cost	491,196	-
Total System Costs	$ 34,154,713	$ 38,511,684
Average Total Cost (Cents/Bushel)	106.4	120.0

port and farm-country elevator-subterminal-export port are the two major routes selected for exporting wheat. Transport modes used for the first channel are farm trucks and unit-trains; transport modes used for the second one are farm trucks, commercial trucks and unit-trains. Farm trucks represent the only transport mode used from farms while unit-train is the only shipping mode used by subterminals. Commercial trucks are used from country elevators to subterminals.

Commercial trucking costs increased over the no-subterminals case by $656,098 and $742,823 with the RI line and without the RI, respectively. The savings from rail shipping cost are $4,612,803 and $4,471,096 for case with and without the RI rail line. Reduction in storage and handling cost also increased savings for the total logistics system. The total savings of subterminals in the logistics system with and without the former RI rail line were $3,972,320 and $4,356,971.

IV. Summary and Conclusions

In the area analyzed in this study, total system cost changes associated with the RI abandonment are small. However, it is important to realize that the increase in trucking and storing costs are additional cost burdens for those producers who delivered wheat to country elevators on the former RI rail line. Country elevators on the former RI rail line lost their export wheat receipts substantially. This is an impact on the local marketing system rather than on the global logistics system. Similar results can be expected for the domestic market since most domestic markets are also located at a relatively long distance from the study area. The future of the RI rail line should not be determined solely by these results. Other factors need to be considered such as increases in highway

maintenance costs incurred from additional use of farm trucks and additional social cost of air pollution and safety of local residents.

The total savings from using unit-train movement shows substantial evidence for constructing trainload loading facilities in the study area. The additional annual expansion costs of constructing trainload facilities is small relative to the total savings from inclusion of subterminals in the logistics system. The significant role played by subterminals and substantial saving resulting from trainload facilities indicates future expansion of trainload loading facilities in the study area.

One of the major assumptions for rail deregulation is the existence of a high degree of competition. Under deregulatory environment, the exercise of competitive pricing in rail industry is expected to increase. The absence of the former RI rail line will reduce competition. This study indicates that it may not be economic to maintain the RI rail line for export wheat movement, measuring in terms of total system costs. However, it is the rail tariff rates which grain shippers consider for grain shipment. Maintaining competition will lower rail rates and will benefit grain producers and grain shippers.

The significant cost savings to railroads of large volume shipment provide ground for lower contract rates for large shippers (subterminal elevators). The development of secret contract rates which reduce the competitive ability of small shippers requires studies. In the short run, grain producers are expected to benefit from higher price due to lower transportation cost. Whether this is also the case in the long run is still inconclusive.

References

1. Babcock, M. W., L. O. Sorenson, "Improving Production Area Logistics for Wheat.", Kansas State University, June 1982.

2. Baumel, C. P., J. J. Miller, T. P. Drinka, "The Economics of Upgrading Seventy-one Branch Rail Lines in Iowa.", American Journal of Agricultural Economics, 59(1977):pp. 61-70.

3. Chow, M. H., "Economics Impacts of Structural Changes in the Wheat Logistics System: Exporting Winter Wheat from Twelve Counties in Northwest Kansas.", Ph.D. Disseration, Kansas State University, 1984.

4. Fuller, S. W., C. V. Shanmugham, "Network Flow Models: Use in Rural Freight Transportation Analysis and a Comparison with Linear Programming.", Southern Journal of Agricultural Economics, 10(1978):pp. 183-188.

5. Fuller, S. W., L. O. Sorenson, M. A. Johnson, R. Oehrtman, "Alternative Wheat Collection and Transportation Systems for the Southern U.S. Plains.", Western Jounal of Agricultural Economics, 1981:pp. 91-101.

6. Hilger, D. A., B. A. McCarl, J. W. Uhrig, "Facilities Locations: The Case of Grain Subterminals.", American Journal of Agricultural Economics, 59(1977):pp. 674-682.

7. Leath, M. N., L. D. Hill, S. W. Fuller, "Wheat Movements in the United States, Interregional Flow Patterns and Transportatin Requirements in 1977.", North Central Regional Research Publication No. 274, January 1981.

8. Sorenson, L. O., S. W. Fuller, "An Economic Analysis of the Use of Unit Trains for Exporting Wheat from Kansas, Oklahoma, and Texas.", Agricultural Research Report No. 82-586-D, Kansas State University, October 1982.