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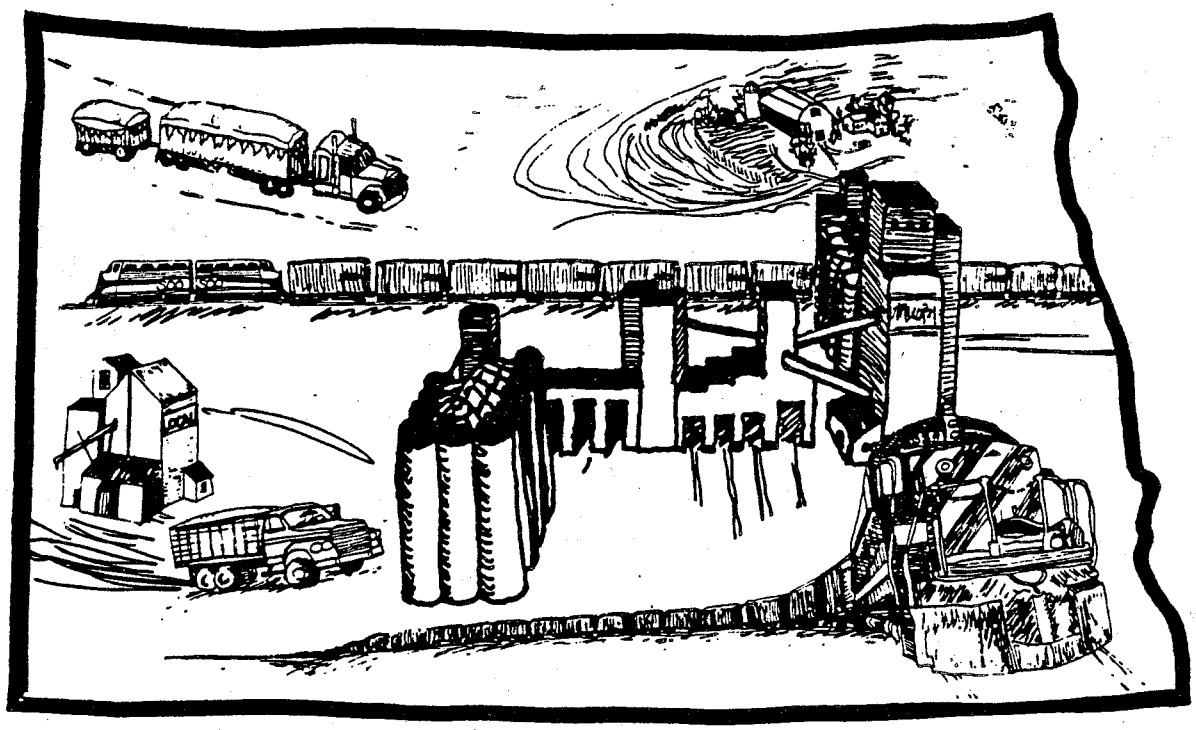
COSTS AND CHARACTERISTICS OF OPERATING INTERSTATE MOTOR CARRIERS OF GRAIN IN NORTH DAKOTA



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HIGHLIGHTS

Truck transportation has become very important to the North Dakota grain industry. Identification of the costs and characteristics of exempt motor carriers allowed evaluation of the performance of the industry.

Average mileage per vehicle was about 88,000 per year. Firms larger than four trucks achieved higher annual mileage as well as larger percent of return trip that was loaded (59 percent compared to 25 percent for the smaller firms). Seventy-eight of the firms had been in business five years or more. Costs per operating mile appeared to be about 92 cents for the industry. Larger firms had a four cent per mile advantage over smaller firms.

Three conclusions were: The industry has become more mature and stable in the past five years after experiencing a significant influx in 1966-76 period. Larger firms have increased in importance and have a competitive advantage over small firms. Variable costs per mile are an important part of total costs.

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AN OVERVIEW

North Dakota Grain Handling, Transportation, and Merchandising Study

North Dakota's branchline system was developed in the late 1800s and early 1900s primarily for the purpose of moving farm commodities to markets outside the state and to bring freight such as farm inputs and other needed goods to the state's communities. The only other form of surface transportation available for moving bulk freight when the rail network was being developed (excluding some minor river transportation) was the horse-drawn freight wagon. The limited distance that a team of horses and wagon could travel influenced the design of the early branchline railroad network. This development pattern resulted in branchlines that were no further apart than 10 to 20 miles, and even the most remote producing areas were accessible to rail transportation.

Development of the country grain merchandising system was also influenced by the limited distance a team of horses and wagon could travel, the relative density of the branchline network, and available technology at that time. This resulted in a large number of country elevators spaced only a few miles apart on grain gathering rail lines. Although much of what existed in the past still exists today in the form of the branchline network, economic and technological forces that influenced its development have changed since the turn of the century. Other factors are currently at work that may influence rationalization of the railroad network and the country grain merchandising system.

Factors which will influence the future grain handling transportation and merchandising system include branchline abandonment, implementation of multiple car and unit train grain rates, and capital replacement decisions.

Other factors include differing rates of cost increases in the two modes, thereby shifting their competitive relationship. Competition between producing regions will also influence the future system. Efficiencies gained as a result of changes in marketing systems by competing producing regions will possibly influence a move to obtain those same efficiencies by other producing regions. The changing technology of farm trucks and the improved quality of our highway system makes it possible for producers to move grain much further today than previously. These forces may very well influence changes in the state's traditional grain merchandising system. Government policies such as railroad deregulation may also have some impact on the system.

As a result of these impending changes that could alter a rather traditional grain handling, transportation, and merchandising system, many private and public decisions will have to be made. These include decisions regarding location, economic viability, size of plant, investment in grain facilities, investment in transportation equipment and infrastructure, efficiencies of merchandising, purchases of farm production equipment, and storage capacity. If such decisions are to be made on an informed basis, it is important that basic information about the industry be developed and published. It was for this reason that the Upper Great Plains Transportation Institute and the Department of Agricultural Economics of North Dakota State University have undertaken a study entitled the "North Dakota Grain Handling, Transportation, and Merchandising Study." Cooperators in the study include Burlington Northern Railroad, Farm Bureau, Farmers Union, Grain Terminal Association, North Dakota Agricultural Experiment Station, North Dakota Department of Agriculture, North Dakota Grain Dealers Association, North Dakota Highway Department, North Dakota Public Service Commission, St. Paul Bank for Cooperatives, and the Soo Line Railroad Company. The purpose of

this study is to provide relevant information to decision makers in meeting the challenge of a changing business environment in handling, transportation, and merchandising grain in North Dakota.

The study is composed of a number of research projects that will result in thirteen separate publications of which this is one. The publications planned for release at varied time intervals are:

- Description of the Existing Country Elevator System
- Cost Analysis of Existing Country and Farm Storage System
- Cost Analysis of Subterminal Elevators
- Existing and Past Patterns of North Dakota Grain Movements
- Description of Rail Rate Structure, Multiple Car Movements, and Rates and Analysis of Shipper Owned Equipment
- Description and Analysis of Exempt Carrier Industry
- Economics of Branchline Operation
- Farm Truck Costs
- Seasonal Behavior of Marketing Patterns for Grain from North Dakota
- Grain Merchandising
- Marketing Using Delayed Pricing Controls
- Analytical Model for Analyzing Economic Efficiencies of Subterminals
- North Dakota Grain Handling, Transportation, and Merchandising Study: Summary, Conclusions, and Policy Implications

These reports, as they are completed, will be available upon request from the Department of Agricultural Economics or the Upper Great Plains Transportation Institute, North Dakota State University.

COSTS AND CHARACTERISTICS OF OPERATING INTERSTATE MOTOR CARRIERS OF GRAIN IN NORTH DAKOTA

by

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Introduction

Agriculture continues to be North Dakota's basic industry. Agriculture contributed an average of 23 percent to North Dakota's Gross State Product from 1963 to 1978 and in most years was the largest contributor.[1] More importantly, the agricultural sector has generated about 75 percent of the state's new wealth over these years.[2]

The productivity and growth of agriculture, especially grain products, is heavily dependent on access to markets for the production, access made possible by the existence of a complex and broad transportation industry. This access is expensive as well as essential; agricultural producers in 1978 paid in excess of 100 million dollars annually to have their goods transported to market.[3]

The transportation industry serving North Dakota is comprised of motor carriers and railroads. With little intramodal competition in local areas

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[1]Korbach, Robert J. and Theodore P. Wolters, "North Dakota Gross State Product," North Dakota Economic Studies, No. 17, Bureau of Business and Economic Research, University of North Dakota, January 1980.

[2]Unpublished data, Greater North Dakota Association, 1980.

[3]Cosgriff, John G. The Cost and Operations of Exempt Motor Carriers in North Dakota, UGPTI Report No. 33, Upper Great Plains Transportation Institute, North Dakota State University, Fargo, 1978.

the activities of motor carriers create intermodal competition with the railroads as well as intramodal competition among themselves. It appears carriers have been quite successful in capturing grain shipments over the years since they have experienced both absolute increases in volume handled and in relative market share of grain shipped in the last six years, except for the last crop year, 1979-80 (Table 1).

TABLE 1. NORTH DAKOTA GRAIN AND OILSEED SHIPMENTS BY RAIL AND TRUCK

Crop Year	Rail	Truck	Total	Truck Percentage
	- - - - - - - 000 bushels - - - - - - -			
1974-75	221,922	53,565	275,487	19
1975-76	236,491	83,793	320,284	26
1976-77	205,129	100,783	305,912	33
1977-78	235,178	123,426	358,604	34
1978-79	271,069	185,165	456,234	41
1979-80	294,342	181,724	476,066	38

SOURCE: Gene C. Griffin, "North Dakota Grain and Oilseed Transportation Statistics, 1979-80," UGPTI Report No. 36, December 1980.

The relative market share of motor carriers and amount of increase varies by location and is affected by type of commodity produced in the area. The principal areas of motor carrier growth appear to be in eastern Crop Reporting Districts (CRDs). Five year average modal shares, covering crop years 1974-75 to 1978-79, are shown in Figure 1 for each of the nine North Dakota CRDs. CRDs 1, 2, 4, 5, and 9 have been heavily dependent on railroad transportation. In each case the railroads moved over 70 percent of the traffic. In CRDs 3, 6, and 8 railroads moved over 50 percent of the grain. Only in CRD 7 had motor carriers captured over 50 percent of the market.

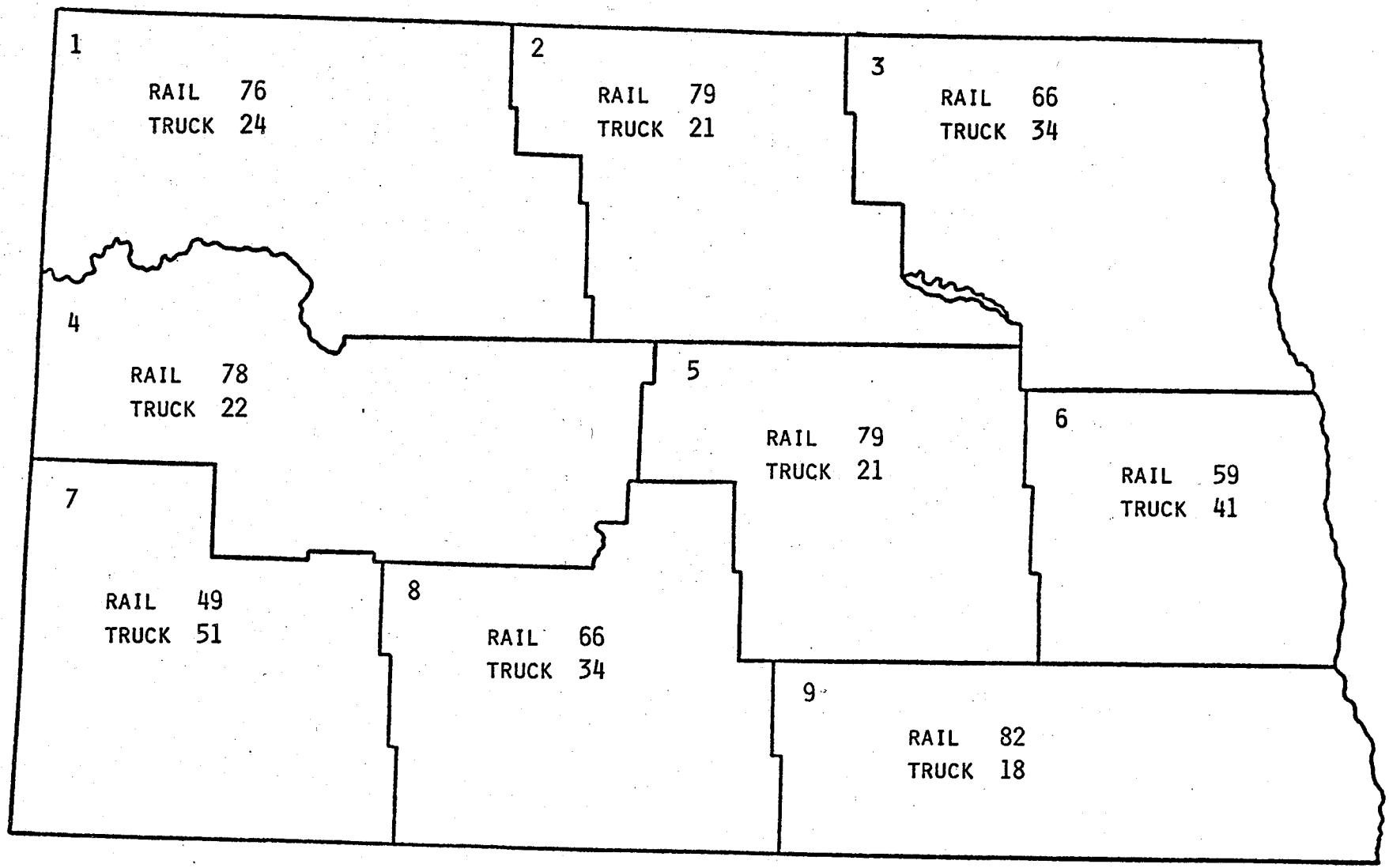

Figure 1. Relative Market Shares of Motor Carriers and Railroads of North Dakota Shipments of Grain Based on Crop-Years 1974-75 to 1978-79

SOURCE: Ken Casavant and Gene Griffin, "An Evaluation of North Dakota Grain Movements," UGPTI Report No. 41, August 1981.

However, as shown in Figure 2, the motor carrier industry had significantly improved its share, capturing 59 percent and 53 percent of CRDs 6 and 3 grain movement respectively. This reinforces the existence of strong intermodal competition between railroads and motor carriers serving the North Dakota grain industry.

Even as motor carriers are increasing in importance to the grain shipper the competitive environment surrounding the transportation industry is undergoing substantial changes. Agricultural motor carriers have always been exempt from rate and route regulation. But changes in regulation and competitive response may affect the performance and role of this "exempt motor carrier" in moving North Dakota grain products.

During the latter half of 1980, two transportation legislative bills were passed by Congress and signed into law by former President Jimmy Carter. The Staggers Rail Act provides for rate flexibility and easier abandonment of branch lines. In North Dakota it could be expected that rates applying to marginal branch lines will be increased, and nonmarginal, unprofitable branch lines will be abandoned. In addition, the railroads serving North Dakota have introduced multiple-car rates which put a strong emphasis on large volume movements from individual elevators. With higher rates on particular branch lines more traffic could accrue to exempt carriers from these lines. Obviously, if a branch line is abandoned all traffic will flow by motor carriers, at least for some distance. Finally, with railroad emphasis on multiple-car movements exempt motor carriers could act as feeder lines to gathering points for multiple-car movements.

The Motor Carrier Act of 1980 was signed into law on July 1, 1980. This bill partially deregulates the regulated sector of the motor carrier industry. The effects of this Act on the previously exempt sector of the industry are numerous. This Act broadens the number of commodities exempt

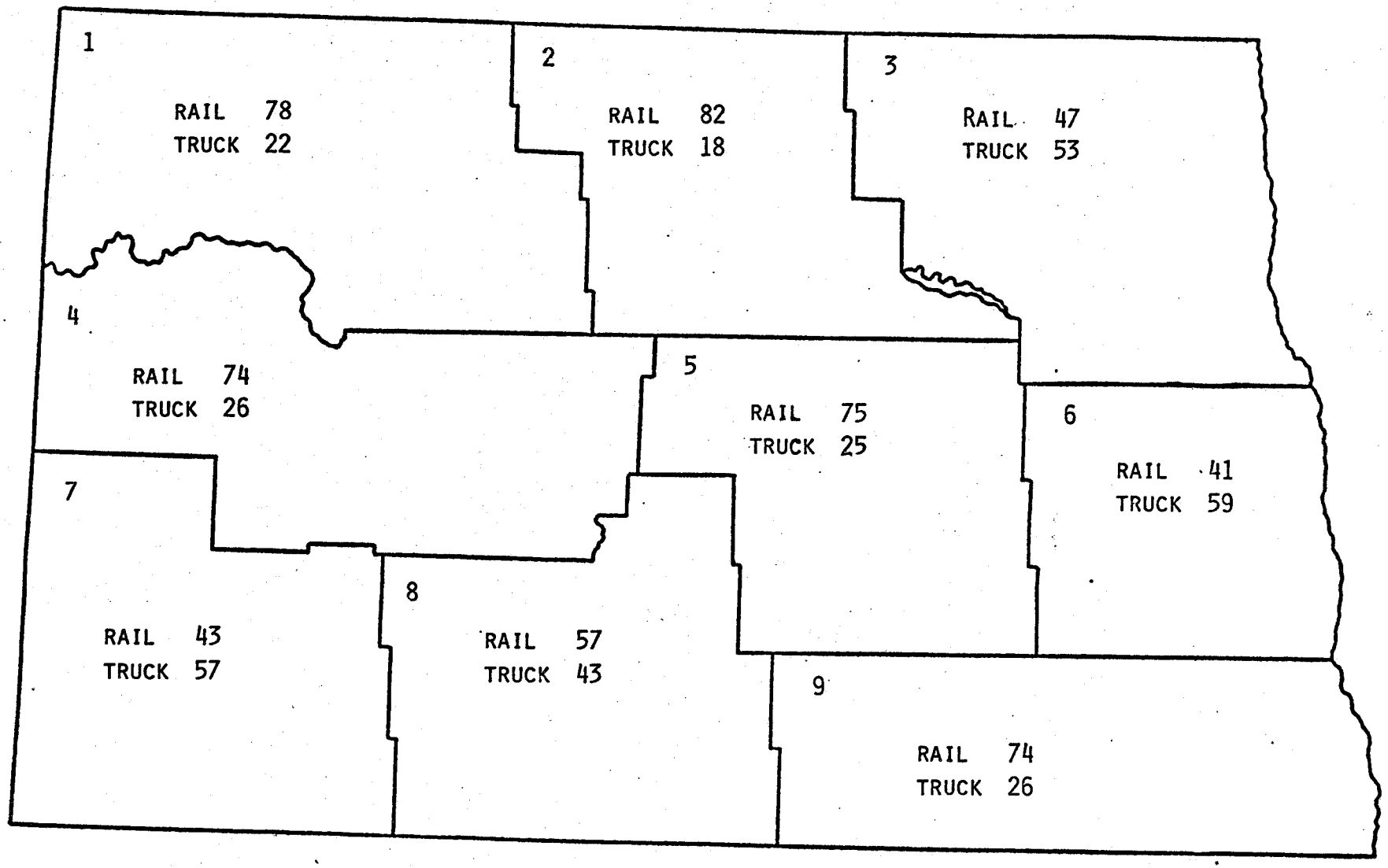

Figure 2. Relative Market Shares of Motor Carriers and Railroads of North Dakota Shipments of Grain for the 1978-79 Crop-Year

SOURCE: Ken Casavant and Gene Griffin, "An Evaluation of North Dakota Grain Movements," UGPTI Report No. 41, August 1981.

from Interstate Commerce Commission economic regulation, eases entry to the regulated sector, provides mixed loads, and eliminates circuitous routing and gateway restrictions.

Easier entry to regulated movements is made possible in several ways as a result of the Motor Carrier Act of 1980. First, if a community has lost rail service (and a carrier has applied for authority within 120 days after the abandonment was approved), if no motor carrier regularly serves the community or if the transportation is for the government (in some cases), or if the transportation is for shipments weighing less than 100 pounds, then the only consideration by the ICC will be if the carrier is fit, willing, and able. In other words, if one of these situation are present a carrier will be granted authority to operate by the ICC if that carrier fulfills the fitness criteria.

Secondly, in the past, an applicant for authority had to prove Public Convenience and Necessity and had to be fit, willing, and able. Under the new Act with the exceptions noted above the carrier must be:

1) fit, willing, and able; and
2) the proposed service must serve a useful public purpose responsive to public demand or need.

The last requirement is presumably less difficult to establish than the prior requirement of public convenience and necessity standard. Prior to the 1980 Act, the burden of proving public convenience and necessity was on the applicant for the authority. The new Act shifts the burden of proof to the protestant. In addition, the diversion of traffic or revenue from the existing carrier is no longer in itself contrary to the public interest. Also, the Act limits the ability of the existing carriers to protest an application.

In short, the potential for backhaul movements is much greater under the new Act. Agricultural haulers may seek operating authority to complement their fronthaul of unprocessed agricultural commodities, livestock, etc. Backhaul opportunities are also increased by another provision that allows owner-operators to carry 50 percent of their tonnage in certain otherwise regulated commodities (subject to constraints as noted above).

Under previous provisions, a particular carrier could not carry mixed loads (loads of regulated and exempt commodities simultaneously). The new Act relaxes this provision. Obviously, a carrier will have the potential for greater backhaul movement because of the relaxation. Circuitous routing and gateway restrictions were also relaxed by the new law. This allows greater utilization of equipment and allows a carrier to take a different route back from the fronthaul destination. The new alternative route may have the potential for a backhaul if operating authority is obtained. Finally, the new Act provides certain agricultural cooperatives to backhaul up to 25 percent of their total annual tonnage in regulated commodities, up from 15 percent previously.

These new regulatory changes, when combined with inflationary cost increases, energy increases, and potential of higher highway user fees creates need for information on the cost structure and operating characteristics of the motor carrier industry serving the North Dakota grain industry. With railroads abandonment prevalent and subterminal development eminent, the role of motor carriers may well be changing.

Objectives

The general purpose of this study was to evaluate the performance and operating characteristics of the motor carrier industry moving North Dakota grain. Specific objectives were to:

1) Identify the structure and operating characteristics of the exempt motor carrier industry carrying North Dakota grain.

2) Identify costs of operation for exempt motor carrier firms hauling North Dakota grain.

3) Evaluate impacts on costs of alternative managerial actions, such as amount of loaded backhaul, level of annual mileage, etc.

4) Evaluate viability of this industry over time.

Data Source

The primary source of data for this study was a mail survey of the motor carriers carrying North Dakota grain (see Appendix A for a copy of the questionnaire). A mail questionnaire was sent to 744 motor carrier firms. The list was developed from the "Grain Trucking Directory, 1979" published by the Upper Great Plains Transportation Institute and North Dakota Grain Dealers Association, supplemented by a list of exempt motor carriers compiled by the North Dakota Public Service Commission. Of the 744 questionnaires, 50 were returned as "addressee unknown" or "out-of-business," reducing the estimated population to 694. After two mailings, a 144 or 21 percent of questionnaires were returned. Of these 144, 76 or 53 percent contained enough completed information to develop costs and operating characteristics. Paired t-tests were applied to the two mailings and were found to be insignificantly different from one another. These results made it possible to pool the two mailings and to draw inferences from this sample to the entire population.

This major survey was supplemented by three telephone surveys. The three surveys dealt with estimating the loaded and unloaded weight capacity of exempt motor carrier tractor-trailers, calculation of a price deflator

for fuel costs, and development of economic-engineering cost functions. In this latter survey, estimates of motor carrier cost components were collected from truck dealers, insurance agencies, tire outlets, etc.

Structure of the Report

This report is divided into three interrelated sections. The general characteristics of the motor carriers moving grain out of North Dakota are presented in the first section. A cost analysis is then presented, utilizing both the economic-engineering and statistical techniques of cost function determination. In this section the impact of backhaul, annual mileage variation, etc. are examined. The viability and changes in the industry over time are examined in the third section. Summary and conclusions of the study conclude the report.

Industry Characteristics

The characteristics reported in this study are based on responses obtained from 75 trucking firms operating as interstate agricultural carriers in North Dakota during 1980. As indicated earlier, statistical testing of respondents versus nonrespondents (first mailing versus second mailing) indicated no bias could be identified. Hence, sample results can tentatively and reasonably be identified as characteristics of the entire population or industry.

Firm Size and Concentration

The motor carriers in this study were segmented into three size strata, owner-operator (one tractor), medium sized firms (two to four tractors), and large firms (five or more tractors). Almost 50 percent or 49 of the firms fell into the medium size firm, compared to 37 percent and 13 percent for the owner-operator and large firms (Table 2).

TABLE 2. NORTH DAKOTA TRUCK FIRM RESPONDENTS, BY SIZE

Category	# of Firms	Percent
Owner-Operator (1 tractor)	28	37
Medium (2-4 tractors)	37	49
Large (5 or more tractors)	10	13
Total	75	100%

The larger firms traveled more total annual miles per firm, over 1 million, as expected, but also obtained slightly more mileage per vehicle each year, over 90,000 miles, than did the smaller size firms (Table 3). Owner-operator vehicles traveled an average of 87,000 miles, quite close to that realized by the medium-sized firms.

TABLE 3. AVERAGE YEARLY FIRM MILEAGE AND YEARLY VEHICLE MILEAGE, BY SIZE, NORTH DAKOTA, 1980

Size	Per-Vehicle (Annual Miles)	Per Firm
Owner-Operator	87,379	87,379
Medium	88,261	234,347
Large	90,180	1,130,200
Total	88,188	298,926

Large size firms travel almost five times as many firm miles per year than medium-size firms and 13 times as many miles as owner-operator firms. Large firms are only 10 percent of the firms but travel over 50 percent of the miles in the industry. Conversely, owner-operators represent 37 percent of the firms but only travel 10 percent of the total mileage.

Examining the loaded mileage market shares gives some information on intramodal competition in the industry. The large firms had almost 58 percent of the market, measured in terms of the percent of industry loaded miles (Table 4).

TABLE 4. DISTRIBUTION OF LOADED MILES, BY FIRM SIZE, NORTH DAKOTA, 1980

Size	Loaded Miles	Percent
Owner-Operator	1,501,804	9.2
Medium	5,451,909	33.2
Large	9,463,750	57.6
Total	16,417,463	100%

Owner-operator firms had less than 10 percent of loaded mileage while the medium firms had about one-third. A noticeable degree of concentration in loaded mileage is evident in Table 5. The largest firm captured almost 15 percent of the mileage in this sample while the largest four firms had almost 40 percent of the mileage. Significantly, the largest 20 firms of the 75 firms had over 70 percent of the total loaded mileage, leaving only 30 percent of the loaded mileage for the other 55 or 73 percent of the firms.

TABLE 5. DISTRIBUTION OF LOADED MILES BY SELECTED CONCENTRATION STRATA CARRIERS, NORTH DAKOTA, 1980

Carrier No.	Loaded Miles	Percentage
Largest	2,500,000	15.2
Largest Four	6,480,000	39.5
Largest Eight	9,317,750	56.8
Largest Twenty	11,699,169	71.3
Total	16,417,463	100%

Although this ratio may appear high, the geographical and seasonal dispersion and extreme mobility of the motor carrier industry in North Dakota probably negates the perceived market power associated with such concentration ratios.

Backhaul and Trade Area

The ability to get loads in both directions of a movement has a strong impact on firm efficiency and competitive ability. There appears to be significant market economies available to large firms since this size category had 59 percent of their return mileage loaded or 80 percent of total miles loaded (Table 6). Owner-operators and medium sized firms had only 24 and 25 percent of their return trip mileage loaded, respectively.

Another indication of the success and/or activity level of motor carrier firms is the area from which loads are generated and the average length of haul. The average trade area served had a radius of 310 miles with a tremendous difference between small and larger firms. Medium-size firms' trade area averaged a radius of only 216 miles compared to the large firms whose market area averaged a radius of 721 miles, almost three times larger than the other firms.

TABLE 6. TOTAL AND RETURN MILES TRAVELED AND TRADE AREA SERVED BY FIRM SIZE, NORTH DAKOTA, 1980

Size Category	Percent Loaded Mileage		Radius of Trade Area Served
	Return Trip	Total Movement	
Owner-Operator	24	62	275
Medium	25	63	216
Large	59	80	721
Total	29	65	310

The location of the firm affects the length of haul but this variable also indicates the trade area served by the firm. As indicated in Table 7, larger firms had a substantially longer length of haul, 635 miles, compared to 434 and 469 miles for the owner-operator and medium firms, respectively.

TABLE 7. AVERAGE LENGTH OF ONE-WAY HAUL BY FIRM SIZE, NORTH DAKOTA, 1980

Firm Size	Trip Mileage
Owner-Operator	434
Medium	469
Large	635
Total	478

Trip Origin and Destination

Grain truckers in this study relied heavily on North Dakota origins for most of their traffic. Over 47 percent of the truckers relied solely on North Dakota grain movements (Table 8). In fact, almost 70 percent of the truckers utilized North Dakota origins for over 90 percent of their loads. This dependence held for both owner-operator and medium-size firms with only the large firms showing less utilization; only 50 percent of the large firms originated 91 percent or more of their loads from North Dakota compared to 71 percent of the smaller firms.

TABLE 8. LOADS ORIGINATED IN NORTH DAKOTA, BY FIRM SIZE, NORTH DAKOTA, 1980

Size	Percent of Loads Originating in North Dakota					
	0-30	31-50	51-70	71-90	91-99	100
Owner-Operator	2	1	2	4	5	15
Medium	3	0	1	6	8	18
Large	2	1	0	2	3	2
Total	7	2	2	12	16	35
Percent	(9)	(3)	(3)	(16)	(22)	(47)

The most common destinations for North Dakota grain movements were Duluth/Superior, Minneapolis/St. Paul, and Pacific Northwest port areas. Minneapolis/St. Paul was the most popular of these markets and commanded the highest level of specialization by truckers (Tables 9-12). About 60 percent of the motor carriers delivered over half of their loads to Duluth/Superior, compared to 18, 1 and 0 percent respectively for Minneapolis/St. Paul, Pacific Northwest, and Lewiston, Idaho market areas. Only 27 percent of the truckers went to Duluth/Superior very seldom while Minneapolis/St. Paul, Pacific Northwest, and Lewiston, Idaho markets had many truckers who delivered little grain to these destinations. No firms specialized solely in movements to the Pacific Northwest or Lewiston, Idaho, although 20 percent of the truckers did have some movement to these ports.

TABLE 9. LOADS DELIVERED TO DULUTH/SUPERIOR, BY FIRM SIZE, NORTH DAKOTA, 1980

Size	Percent of Firm Volume				
	0	1-25	26-50	51-75	76-100
	(number of firms)				
Owner-Operator	1	6	3	3	15
Medium	3	7	5	5	17
Large	2	1	1	5	1
Total	6	14	9	13	33
Percent of all firms	(8)	(19)	(12)	(17)	(44)

TABLE 10. LOADS DELIVERED TO MINNEAPOLIS/ST. PAUL, BY FIRM SIZE, NORTH DAKOTA, 1980

Size	Percent of Firm Volume				
	0	1-25	26-50	51-75	76-100
	(number of firms)				
Owner-Operator	3	16	4	2	3
Medium	1	22	6	5	3
Large	0	6	3	0	1
Total	4	44	13	7	7
Percent of all firms	(5)	(59)	(18)	(9)	(9)

TABLE 11. LOADS DELIVERED TO PACIFIC NORTHWEST, BY FIRM SIZE, NORTH DAKOTA, 1980

Size	Percent of Firm Volume				
	0	1-25	26-50	51-75	76-100
	(number of firms)				
Owner-Operator	25	3	0	0	0
Medium	30	6	1	1	0
Large	5	4	1	0	0
Total	60	3	2	1	0
Percent	(80)	(16)	(3)	(1)	(0)

TABLE 12. LOADS DELIVERED TO LEWISTON, IDAHO, BY FIRM SIZE, NORTH DAKOTA, 1980

Size	Percent of Firm Volume				
	0	1-25	26-50	51-75	76-100
	(number of firms)				
Owner-Operator	26	2	0	0	0
Medium	30	6	2	0	0
Large	4	5	0	0	0
Total	60	13	2	0	0
Percent	(80)	(17)	(3)	(0)	(0)

Size of firm did affect some of the destinations utilized. Large firms shipped to western markets significantly more than the smaller carriers. These large firms also relied heavier on the Duluth/Superior market than on other markets.

Length of Time in Business

A measure of the performance of the motor carrier industry is the stability of firms as revealed by the length of time a firm had been in business at the time of the survey. As indicated in Table 13, the average age of these motor carrier firms was 8-1/2 years. Seventy-eight percent of the firms had been in business for five years or more and over one-third had been in the trucking business for over ten years.

TABLE 13. LENGTH OF TIME IN BUSINESS, BY FIRM SIZE, BY PERCENT, IN NORTH DAKOTA, 1980

Years	Owner-Operator	Medium	Large	Total
		(percent)		
Five or more	71	78	100	78
Ten or more	25	28	80	34
Fifteen or more	7	8	40	12
Twenty or more	4	6	30	8
Average Life in Years	7-1/2	8	13-1/2	8-1/2

Larger firms, as could be expected, were much more stable than the smaller firms. For example, 80 percent of the large firms had been in business for ten or more years compared to 28 and 25 percent for the owner-operator and medium-size firms, respectively. In every age category, the larger firm was more stable than its smaller competitors.

Commodity Carried

Motor carriers are often characterized not only as a grain trucker but more specifically as a wheat or sunflower trucker. The grain truckers in North Dakota apparently do not specialize in only one commodity, but if they do, that commodity is wheat (Table 14). Twenty-seven percent of the firms carried wheat on over three-fourths of their movements and 55 percent carried wheat on over 50 percent of their loads. Only 6 percent of the truckers depended on another commodity (sunflower) as heavily as wheat. Sunflower was the second most common commodity carried by truckers with barley a distant third. Over half of the truckers moved no flax or oats.

TABLE 14. COMMODITIES CARRIED BY EACH TRUCKING FIRM, BY PERCENT OF LOADS, NORTH DAKOTA, 1980

Percent of Loads	Wheat		Sunflower		Barley		Flax		Oats	
	# of Firms	% of Loads	# of Firms	% of Loads	# of Firms	% of Loads	# of Firms	% of Loads	# of Firms	% of Loads
0	4	5	14	19	30	40	40	53	51	68
1- 25	12	16	27	36	42	56	32	43	22	30
26- 50	18	24	29	39	3	4	3	4	1	1
51- 75	21	28	2	3	0	0	0	0	1	1
76-100	20	27	2	3	0	0	0	0	0	0

Managerial Options

Managers of these firms were asked if they utilized leasing as a means of changing capacity in their firms to meet demand. It is evident that the use of leased equipment is not too prevalent in the industry (Table 15). Only 15 percent leased tractors while 20 percent leased trailers. Twelve percent of the firms did indicate their level of leasing had been recently increased while only 3 percent or two firms used leasing during peak seasonal demand. Thirty percent of the larger firms utilized leasing compared to only 12 percent of the medium and owner-operator firms.

TABLE 15. USE OF LEASING, NUMBER OF FIRMS, BY FIRM SIZE, NORTH DAKOTA, 1980

Size	Leased Tractor	Leased Trailer	Increased Leasing	Peak Period Leasing
Owner-Operator	2	5	2	0
Medium	6	7	5	1
Large	3	3	2	1
Total	11	15	9	2
Percent	(15)	(20)	(12)	(3)

Another managerial option to generate loads is to lower rates if a backhaul is guaranteed or probably available. Over one-fifth of the motor carriers used this option (Table 16). Of particular note is that 32 percent of the medium size truckers lowered fronthaul rates when a backhaul was available compared to only about 10 percent of the owner-operators and large firms.

TABLE 16. INCIDENCE OF RATE DECREASES ON FRONTHAUL RATE IF BACKHAUL IS AVAILABLE, BY FIRM SIZE, NORTH DAKOTA, 1980

Size	Yes	No
Owner-Operator	3	24
Medium	11	24
Large	1	9
Total	15	57
Percent	(21)	(79)

Cost Analysis

The purpose of this section is to identify and analyze the costs of operating motor carriers hauling grain in North Dakota. Such information can be helpful to shippers and truckers in evaluating adequacy of rates being paid in order to maintain capacity in the industry. As questions of subterminal construction or consolidation of elevators arise, cost of local trucking will also be needed. A shipper or trucker can also use his own cost components and characteristics to develop estimates of his own costs.

The approach is to develop econometric models of the survey data that define interrelationship between output measures and cost components. An economic-engineering method of determining cost relationships for a "typical" firm will be subsequently used to compare and evaluate the econometric

cost functions. Finally, the economic-engineering costs will be used to identify impacts on costs of alternative firm activities, such as annual mileage, owner-operator labor, etc.

Econometric Analysis

Total annual costs and average total costs were developed for four output measures; total miles, gross ton-miles, net ton-miles, and hundredweight miles. The structural equations for these output measures were then estimated for the alternative firm sizes utilized throughout this report.

The costing methodology utilized is detailed in Appendix B. Special statistical testing procedures are explained and documented. The determination of total cost components and their calculations are presented in Appendix C.

Due to multicollinearity and heteroscedastistic problems in using raw data, the dependent variable in the estimating equations (total costs and average total costs) and one of the independent variables (quantity of output) were transformed using natural logarithms. The results presented in this section are based on regressions performed on the transformed data (Appendix B).

A limited number of cost components of the dependent variable total cost were synthesized using estimates calculated from the survey data. The potential effect or bias from using this procedure does not seem significant since the number of observations replaced by estimates was minimal in most cases (Appendix C).

The estimated cost equations were of the general form:

EQ-1:

$$TC = b_0 + b_1 Q + b_2 FS - b_3 UTIL - b_4 ALH + b_5 AGE$$

EQ-2:

$$ATC = b_o + b_1 Q - b_2 FS - b_3 UTIL - b_4 ALH + b_5 AGE$$

Where: TC = Total costs expressed in natural logarithms

ATC = Average total costs expressed in natural logarithms

Q = Total annual miles and/or hundredweight miles, expressed in natural logarithms

FS = Firm size expressed in terms of the number of drivers

UTIL = Utilization of equipment, expressed in terms of the number of miles per tractor per year

ALH = Average length of haul

AGE = Age of tractors

b_1-n = Estimated parameters

Total Cost Equations

The regression results for the four total cost equations (EQ-1) are given in Table 17. These total cost regressions indicate strong relationships between the total cost variable and selected dependent variables. The firm size variable is the only variable not statistically significant and this was only when the output measure was gross ton-miles and total annual miles. When net ton-miles and hundredweight miles were used as the quantity of output variable, the firm size variable was significant. This appears consistent with expected relationships because these quantity of output variables are both calcualted on a loaded mile basis and larger firms generally have a substantially higher ratio of loaded miles to total miles than smaller firms. Therefore, the positive and significant relationship between total cost and firm size was expected.

All signs of the four cost equations were as expected with the exception of the age of tractor variable. This sign was expected to be

TABLE 17. COEFFICIENT ESTIMATES OF THE TOTAL COST EQUATIONS (EQ-1), NORTH DAKOTA FIRMS, 1980

Dependent Variable	Quantity of Output Variable	b_0	Miles b_1	Firm Size b_2	Utilization b_3	Average Length of Haul b_4	Tractor Age b_5	R^2	F Value
1) TC	Total Miles	5.661381*	.9680813*	.009218234	-.0000049255*	-.000220557*	-.028075*	94	212.07
2) TC	Gross Ton-Miles	3.695204*	.876262*	.015170	-.0000040655*	-.000313172*	-.035615*	93	177.82
3) TC	Net Ton-Miles	5.583113*	.779193*	.025739*	-.0000030796*	-.000331082*	-.041276*	91	137.10
4) TC	Cwt.-Miles	3.248859*	.779193*	.025739*	-.0000030796	-.000331082*	-.041276*	91	137.10

*Denotes significance at the 5 percent level.

positive because operation and maintenance costs of newer equipment was expected to be less than for older equipment. While this might be true, it appears the high depreciation costs and interest charges associated with newer equipment may override any lower maintenance costs so, in sum, older equipment is less costly.

Miles driven per vehicle and length of haul were also significant and negative. This supports the expected relationship that more miles per vehicle and a longer trip length allow more efficient use of the capital investment, thus decreasing costs of operation on a per mile basis.

The marginal or incremental costs of increased output can also be identified from the equations. The elasticity of total cost with respect to the quantity of output is indicated by the b_1 coefficient. That coefficient ranges from about .78 to .96 indicating an extremely high degree of variable to fixed cost ratio.

Average Cost Equations

The regression results for the four average total cost equations (EQ-2) are shown in Table 18. Although the relationships are not as strong as in the total cost functions the signs of parameters were as expected. Again, for the same reasons suggested earlier the age of equipment had an unexpected sign. The regression results indicate that there is not a significant relationship between firm size or quantity of output variable. All the other coefficients were significant, indicating the costs per mile are dependent on age of equipment, length of haul and operational efficiency of each vehicle. These findings suggest that economies of scale (equipment number) are not significant but economies of size (equipment utilization) is a significant determination of costs.

TABLE 18. COEFFICIENT ESTIMATES OF THE AVERAGE TOTAL COST EQUATIONS (EQ-2)

Dependent Variable	Quantity of Output Variable	b_0	Miles b_1	Firm Size b_2	Utilization b_3	Average Length of Haul b_4	Tractor Age b_5	R^2	F Value
5) ATC	Total Miles	5.661381*	-.034187	.009218234	-.0000049255*	-.000220557*	-.028075*	53	15.51
6) ATC	Gross Ton-Miles	5.713592*	-.033697	.008652079	-.0000049819*	-.000218399*	-.027739*	53	15.48
7) ATC	Net Ton-Miles	5.620486*	-.028386	.007986935	-.0000050364*	-.000219156*	-.027508*	53	15.45
8) ATC	Cwt.-Miles	5.705522*	-.028386	.007986935	-.0000050364*	-.000219156*	-.027508*	53	15.45

*Denotes significance at the 5 percent level.

Average costs per mile for the industry and for each of the size categories were developed for each of the quantity of output variables (Table 19). It is evident that larger firms experienced slightly lower costs per mile than smaller firms (90 cents) on all quantity of output variables. The owner-operator firms had a per mile operating cost in 1980 of about 94 cents compared to 92 cents for the medium-size firms.

TABLE 19. ESTIMATED AVERAGE TOTAL COSTS PER MILE, BY FIRM SIZE, 1980

Regression Number	Total	Owner-Operator	Medium	Large
		(cents per mile)		
5	91.05	94.30	91.86	89.89
6	91.07	94.12	92.05	89.99
7	91.20	93.92	92.20	90.21
8	91.20	93.92	92.20	90.21

Economic-Engineering Analysis

The methodology utilized in the Casavant-Nelson and Cosgriff studies was utilized in developing motor carriers cost structure. This allows comparison of the three "pictures" of the motor carrier industry at three points in time. The economic-engineering approach to cost determination involves synthesizing a "typical trucking firm" by interviewing local equipment dealers, tire dealers, governmental agencies, and reviewing previous cost studies.

The model costs developed here are for a three tractor-four trailer firm approximating the average firm identified in the survey of North Dakota truckers. The general approach to each cost component is presented here. For a more complete discussion, see the studies by Casavant-Nelson and Cosgriff.

Fixed Costs

Fixed costs are those which will be incurred during the year regardless of mileage. Each cost is presented in sufficient detail so the method of arriving at the synthesized cost is clear. Hopefully, the analysis will provide a method that existing or potential trucking firms can use to compute their own costs. Fixed costs include: depreciation on capital investment; interest charges or return on investment; license fees and taxes, insurance, housing costs and management or overhead expenses.

Depreciation: Tractors were depreciated on a four year straight line basis with a salvage value equal to 30 percent of the original purchase price. Trailers were depreciated over six years with a salvage value equal to 25 percent of original purchase price.

The tractors considered in this analysis were estimated to cost $60,000, so total investment in tractors was $180,000. Four trailers were estimated to cost a total of $84,000. Depreciation was calculated by dividing purchase price minus salvage value by the years of useful life. This resulted in annual depreciation costs per year of $42,000.

Return on Investment: These charges can be considered either interest on debt capital or return on equity investment. Return was calculated at 18 percent, based on interest charges or opportunity return on long-term investments during the 1980 period. They were calculated by dividing the purchase price minus salvage value by two to get average investment over the period. This value was added to the salvage value and then multiplied by the interest rate to generate the return on investment cost per year of $30,510.

License Fees and Taxes: License, permit costs, and taxes depend on the states where the motor carrier drives and how many miles or trips are driven in each state. It was estimated, based on interviews with

state agencies, truckers, and truck dealers, that the annual cost for each tractor-trailer combination on the road would be $1,500, yielding an annual license fee and tax cost component for this model firm of $4,500.

Insurance: Most truckers carry full coverage insurance on their new tractor-trailer. Such coverage includes: liability, physical damage, and cargo insurance. Insurance agencies estimated per truck rates of $3,000 for tractors and $1,000 for trailers, yielding an estimated annual insurance cost of $12,000.

Housing Costs: Housing costs include: investment cost and depreciation in any garage facility, tools, utilities, and miscellaneous expenses associated with operating a grain trucking business. Estimates were developed from survey data and supplemental interviews with trucking firms. These resulted in an estimate of annual housing and miscellaneous costs of $3,600.

Management and Overhead Expenses: These expenses were based on the Cosgriff study and expenses identified in the recent survey of the industry. These costs of management, administration, and overhead were estimated to be about $12,000 annually.

Total Fixed Costs: The synthesized total annual fixed costs for this three tractor-four trailer model firm can then be summarized as below:

Depreciation	$ 42,000
Interest on Investment	30,510
License Fees	4,500
Insurance	12,000
Housing Costs, Etc.	3,600
Management	12,000
Total Fixed Costs	$104,610

Variable Costs

Variable costs are directly related to mileage. These costs include: tires, fuel, maintenance and repairs, and driving labor.

Tire Cost: The motor carrier has a wide range of alternatives when selecting tires. Estimates of tire cost and associated mileages were developed for recapped, fabric, and radial tires. These data, combined with survey estimates and previous studies yield an estimated per mile cost of four cents.

Fue Cost: Fuel consumption by trucks does not vary significantly when loaded or unloaded. Fuel cost of $1.10/gallon was estimated for diesal fuel consumed by trucking firms in early 1980. This, when combined with an average of five miles per gallon, yielded an estimated per mile cost of 22 cents.

Maintenance and Repair: It is quite difficult to obtain reliable maintenance and repair estimates from motor carriers. Estimates of engine lifetime, overhaul costs, and other repairs were combined to generate an estimated maintenance and repair cost. This was then contrasted to other study estimates. The final synthesized estimate used in this study was nine cents per mile.

Driving Labor: The cost per mile for drivers' wages was determined through interviews with trucking firms, review of other studies, and comparison to survey data. Drivers' wages were estimated to be 17 cents per mile.

Total Variable Cost Per Mile: The variable costs can then be summarized as:

Tires	$.04
Fuel	.22
Maintenance	.09
Labor	.17
Total Variable Costs	$.52 per operating mile

Total Costs Per Mile

Total per mile trucking costs decreases as annual mileage increases (Table 20). Average per mile costs are estimated at $1.22 when the firm travels only 150,000 miles (50,000 per vehicle) per year. If mileage per firm is increased to 450,000 (150,000 per vehicle), costs drop 39 percent, to $.75 per mile.

TABLE 20. ANNUAL MILEAGE AND TOTAL TRUCKING COSTS, NORTH DAKOTA, 1980

Number of Miles		Total Cost Per Mile
Firm	Vehicle	
150,000	50,000	$\frac{150,000\ (\$.52) + \$104,610}{150,000} = \$1.22$
225,000	75,000	$\frac{225,000\ (\$.52) + \$104,610}{225,000} = \$\ .99$
300,000	100,000	$\frac{300,000\ (\$.52) + \$104,610}{300,000} = \$\ .87$
450,000	150,000	$\frac{450,000\ (\$.52) + \$104,610}{450,000} = \$\ .75$

Comparing these costs to the average vehicle mileage reported by the surveyed motor carriers indicates the synthesized model costs are reasonable estimates of actual costs. For example, the average annual per vehicle mileage of about 88,000 yields an estimated cost of $.92 per mile, compared to the econometrically estimated $.91 from the survey results.

The level of variable costs developed in the economic-engineering technique is substantially lower than that econometrically estimated, 56 percent compared to over 76 percent. However, since depreciation can more correctly be assigned as a function of miles than time, as was assumed in this economic-engineering approach, it is appropriate to consider depreciation expenses as a variable or out-of-pocket expenses. This increases the variable cost estimate to 74 percent of total costs, substantially closer to the econometric estimate.

Alternative Truck Cost Options

Total trucking costs could be influenced by many items such as: (a) a modification in accounting practices or management decision; (b) higher wage rates; (c) energy price increases; (d) the purchase of used equipment; and (e) backhaul possibilities. Based on 75,000 annual miles per vehicle the effects of these options are discussed below and are presented in Table 21.

TABLE 21. EFFECT OF DIFFERENT OPTIONS ON PER MILE TRUCKING COSTS

Option	Per Mile Variable Cost	Per Mile Fixed Cost	Per Mile Total Cost
1. Base Rate	$.52	$.40	$.92
2. Fixed costs not considered	.40	.00	.40
3. Increase in labor costs by 50 percent	.605	.40	1.005
4. Double fuel costs	.74	.40	1.14
5. Purchase of used equipment	.60	.34	.94
6. Backhaul possibilities (Frequency)	Reduction Factor Applied to Base Rate		
0	1.00		$.92
25%	1.25		.74
50%	1.50		.61
75%	1.75		.53
100%	2.00		.46

Modifications in Accounting Practices or Management Decisions

The fixed cost component ($.40) might not be charged to grain transportation if the trucks are used as part of a farm operation or other business and absorbs the truck's annual fixed costs. If such a situation were to occur, per mile costs of hauling grain would be reduced to $.52, the variable cost.

Higher Wage Rates

The cost per mile for labor used in calculating the base rate of $.92 was obtained from existing firms. If wage rates were to increase by 50 percent because of unionization or other structural change, the new wage rate would be 25.5 cents per mile. Total truck transportation costs per mile would increase to over $1.00 per mile.

Energy Price Increases

Considering the present worldwide energy situation it is in the realm of possibility for fuel costs to double in the future. If this occurs, total transportation costs per mile would increase to $1.14 per mile.

Purchase of Used Equipment

Because of the high cost of interest a reasonable alternative is for trucking firms to rely more heavily on used equipment. Such a purchase would decrease depreciation costs as well as interest on investment requirements. A 50 percent decrease in capital investment could decrease such costs by 40 percent, dropping fixed costs per mile from $.40 to $.34. Experience indicates that variable costs would increase because of higher fuel and maintenance costs. Thus, close attention would have to be paid to the trade-off between variable and fixed costs.

Backhaul Possibilities

The Motor Carrier Act of 1980 has increased the possibility of backhaul for the grain trucker. A range of backhaul opportunities from 100 percent frequency down to 25 percent frequency is used in Table 22 to indicate how the amount of backhauling affects cost per mile. With as few as 25 percent of the return trips loaded, the costs that must be borne by the fronthaul are reduced substantially.

Industry Change Over Time

The viability of the motor carrier sector serving North Dakota's grain industry is obviously important to grain producers in the state. As indicated earlier in this report, motor carriers have become substantial movers of much of North Dakota's grain and oilseed products. These trucking firms have provided intense competition for railroads and for each other. The availability of this capacity and competitive activity while the marketing structure of North Dakota grain merchandising evolves appears to be critical for the future.

The availability of three cost studies, done over a 15-year time span, allows a unique opportunity to trace changes in characteristics of the industry over time, thus giving an insight into industry viability and competitive capability. The three studies are: (1) Casavant, Ken L. and David Nelson, An Economic Analysis of the Costs of Operating Grain Trucking Firms in North Dakota, Agricultural Economics Report No. 54, July 1967, (2) Cosgriff, John G., The Cost and Operations of Exempt Motor Carriers in North Dakota, UGPTI Report No. 33, November 1978, and (3) this survey in 1980. The data sets are for the years 1966, 1976, and 1980; a span of 15 years.

The stability of the industry can be evaluated by examining the length of time in business. The distribution of firms in the industry for the three time periods are indicated in Table 22. It appears that while stability of the industry may have increased in the last five years, it had significantly decreased from 1966 to 1976. This decrease in maturity, evident throughout the age distribution, was probably caused by new firms entering in the industry during the 1966-76 period. Since we do not have specific information concerning firms who entered and existed within the time periods, a precise statement can not be made.

TABLE 22. LENGTH OF TIME IN BUSINESS, THREE TIME PERIODS, NORTH DAKOTA

Length of Time	1966	1976	1980
		(percent)	
5 Years or More	88	62	78
10 Years or More	70	36	34
15 Years or More	44	22	12
20 Years or More	30	13	8
Average (Years)	Not Available	9	8.5

An indication of efficiency and equipment utilization is the annual mileage attained by firms or vehicles. As shown in Table 23, the utilization of equipment has increased steadily over time, increasing from 61,400 miles in 1966 to 88,188 miles in 1980. Total firm mileage increased from 222,000 miles to almost 299,000. In both of these time periods the average firm size was a three-tractor and four-trailer firm.

TABLE 23. AVERAGE ANNUAL MILES FOR VEHICLE AND FIRM, THREE TIME PERIODS, NORTH DAKOTA

Time Period	Vehicle	Firm
	(miles)	
1980	88,188	298,926
1976	81,911	245,733
1966	61,400	222,000

Another measure of efficiency in market economies is the amount of backhaul mileage that is loaded by the trucking firm. The ability of firms to find backhauls appears to have varied over the years (Table 24). The percent loaded backhaul mileage has increased from 24 percent in 1966 to 29 percent in 1980. The decrease in rate to 20 percent in 1976 suggests

TABLE 24. PERCENT OF RETURN TRIP LOADS, THREE TIME PERIODS, NORTH DAKOTA

Time Period	Percent
1980	29
1976	20
1966	24

that as new firms entered the market they were less successful in finding backhaul loads. These data also suggest that more mature firms are more capable of increasing loaded backhaul percentage. This is supported by the larger (mature) firms who, in 1980, were able to load 59 percent of return movements compared to medium and small firms who averaged 25 and 24 percent, respectively.

Summary and Conclusions

Motor carrier transportation is very important to the grain products industry in North Dakota. The amount of grain and oilseed moved by motor carriers has increased in North Dakota in terms of both the absolute and relative modal share over the past six years, reaching a high of 41 percent in the 1978-79 crop year. The competitive environment of the transportation industry is undergoing substantial changes due to recent deregulation of both rail and truck transportation by the Staggers Rail and Motor Carrier Acts of 1980. The competitive interaction between these modes may affect the role and performance of the grain dealer in North Dakota; information on costs, characteristics, and viability of the industry will be useful to shippers, elevator managers, producers, and carriers.

The general purpose of this study was to evaluate the performance and operating characteristics of the motor carrier industry moving North Dakota grain. Specific objectives were to: (1) identify the structure and operating

characteristics of the exempt motor carrier industry; (2) identify costs of operation for exempt motor carriers; (3) evaluate impacts on costs of operation of alternative managerial options; and (4) evaluate viability of the industry over time.

The primary data source was a mail survey of grain truckers in North Dakota. Of the identified population of 694 grain trucking firms, 144 questionnaires or 21 percent were returned. Seventy-six questionnaires were useable in each analysis and form the basis of this report. Statistical tests indicated this sample represented the total population well enough to allow inferences to be drawn. The survey was supplemented by three telephone surveys to generate additional data.

Almost 50 percent of the firms were medium size (two-four tractors) compared to 37 and 13 percent for the owner-operator (one tractor) and large firms (five or more tractors), respectively. The larger firms acheived 90,000 annual miles per vehicle compared to 87,000 for the smaller firms. Even more pronounced was the difference in loaded miles; among firm sizes, large firms had 58 percent of the industry's loaded mileage compared to 33 and 9 percent for the medium sized and smaller firms respectively. Of the backhaul movement, large firms had 59 percent loaded, compared to the industry average of 29 percent and a smaller firm average of 25 percent.

The same size difference was found in examining trade area served and average length of haul. The medium-size firms' trade area had an average radius of only 216 miles compared to 721 miles for the large firms. Larger firms also had a 50 percent longer length of haul (635 miles) compared to about 450 miles for the smaller firms.

Grain truckers relied heavily on North Dakota grain for their traffic. Over 47 percent of the truckers moved from North Dakota origins only, but almost 70 percent relied on North Dakota origins for 90 percent of their

loads. The most common destination was Duluth/Superior, where 60 percent of the carriers delivered over half of their loads. Large firms shipped to western markets more often than smaller firms.

The average age of the trucking firms was 8-1/2 years. Seventy-eight percent of the firms had been in business for five years or more. Over one-third had been in business for ten years. Eighty percent of the large firms had been in business for ten or more years compared to 28 and 25 percent for the owner-operators and medium-size firms, respectively.

Motor carriers typically haul more than one commodity, but if they specialize, it is usually in hauling wheat. Fifty-five percent carried wheat for over half of their loads. Sunflower was the second most common commodity.

Leasing of equipment to meet demand was not too prevalent. Tractors were leased at times by 15 percent of the firms while 20 percent leased trailers. Over 20 percent of the truckers lowered rates if a backhaul was available. Medium-sized firms lowered rates more often, (32 percent of their loads) than either the owner-operator or large firms.

Econometric estimation of costs of operation identified variables that significantly affected costs. These were firm size, age of tractor, mileage, average length of haul, and equipment utilization. Variable costs were estimated to be between 78 to 96 percent of total costs. Average total costs per mile were about $.91 for the industry. Larger firms had slightly lower costs per mile ($.90) than the owner-operator ($.94) or medium-size firms ($.92).

The economic-engineering cost methodology found average total costs per mile to be $.92 with variable costs estimated at 56 percent (74 percent if depreciation was considered a function of use).

Loaded backhaul and increased annual mileage per vehicle significantly decreased costs of operation.

The industry appears to have become more mature and stable in recent years after decreasing in stability during the 1966-76 period. The industry has also increased efficiency as judged by number of miles per vehicle and percent of return trip mileage that was loaded. Average vehicle mileage increased from 61,400 in 1976 to 88,188 in 1980. Loaded backhaul increased from 20 percent in 1976 to 29 percent in 1980.

Several general conclusions can be drawn from this study. (1) Larger trucking firms definitely increased in importance to the grain industry in North Dakota. These firms seem to use market economics to increase economies of utilization (size) rather than scale to achieve better overall performance and market share in the industry. They have longer hauls, larger trade areas, and go to western market areas more than the smaller firms. (2) The industry has regained and even passed the stability witnessed in 1966. During 1966-76, a substantial increase in entry of firms occurred, but by 1980, the larger, older firms seemed to have regained market share. (3) The higher variable cost characteristics of this industry suggest that rates lower than average total cost per mile may not allow trucking firms to remain in the industry.

APPENDIX A

Cost and Methods of Moving Grain by Truck in North Dakota (Survey)

BELOW ARE SOME GENERAL QUESTIONS TO DESCRIBE THE INDUSTRY.
PLEASE ANSWER THE QUESTIONS WITH INFORMATION ON ALL YOUR TRUCKS.

1. Do you serve North Dakota as a grain carrier? _____yes _____no

   If yes, how many years? _____years
   If no, please return survey.

2. What percent of your loads originate from North Dakota? _____%

3. What was your total mileage last year (1979)?

   _____loaded _____unloaded

4. From what large of an area do you generate loads? _____miles

5. What products other than grain do you haul?

   _____lumber
   _____steel
   _____machinery
   _____fertilizer
   _____other (please specify)

6. What is your most common trip length? (one-way from origin to destination) _____miles

7. Do you charge lower rates on the fronthauls when backhauls are available? _____yes _____no

8. If yes, typically how much lower? _____% lower

9. How much of each grain do you haul? _____% wheat
   _____% barley
   _____% sunflower
   _____% oats
   _____% flax
   _____% other (please specify)
   100%

10. TRACTOR & TRAILER COSTS HAVE INCREASED SIGNIFICANTLY IN THE PAST FEW YEARS. TO ESTIMATE THESE COSTS COMPLETELY, IT IS IMPORTANT TO UNDERSTAND THE TYPE OF EQUIPMENT USED IN YOUR CURRENT OPERATION.

A. What types and number of trailers do you own?

_____grain trailer
_____livestock trailer
_____refrigerated van trailer
_____dry van trailer
_____tank trailer
_____fertilizer trailer
_____flatbed with sides for hauling grain
_____flatbed without sides
_____other (please specify)
_____

B. How many of each do you own?

tractors _____ trailers_____

C. What is the average original cost of the necessary equipment to haul the commodity?

tractors _____dollars trailers _____dollars

D. What year of manufacture is your equipment?

Tractors	Trailers
1) _____	1) _____
2) _____	2) _____
3) _____	3) _____
4) _____	4) _____
5) _____	5) _____
6) _____	6) _____
7) _____	7) _____
8) _____	8) _____

E. Do you ever lease equipment for your use?

Tractors	Trailers
yes_____ no_____	yes_____ no_____
average miles/year_____	average miles/year_____
monthly cost _____	monthly cost _____
other costs _____	other costs _____

F. What was your total leasing cost in 1979 if equipment was leased? $_____

G. Has your use of leased equipment increased or decreased in recent years?
_____increased
_____decreased
_____no change

H. During peak periods do you lease additional trailers or tractors?
_____yes _____no

I. What is the average life of:
trailers: _____miles _____years
tractors: _____miles _____years

11. KEEPING TRACTORS AND TRAILERS IN GOOD CONDITION IS IMPORTANT BUT EXPENSIVE

A. Do you have a garage to store your trucks? _____yes _____no

B. If yes, how much of the building is used for truck storage?
_____%

C. What did the building cost you? _____dollars

D. What does the insurance cost you on your building?
_____dollars per year

E. How long will your garage last? _____years

F. If you rent, how much is rent per month? _____dollars per month

G. What is the approximate total annual taxes on the garage?
_____dollars

H. How much does your garage equipment (tools, etc.) cost you?
_____dollars

12. How many miles per gallon do you average?
loaded _____m.p.g. unloaded _____m.p.g.

13. WHAT PERCENT OF YOUR TRIPS HAULING GRAIN ARE TO:

A.	Duluth-Superior	_____%
B.	Minneapolis/St. Paul	_____%
C.	Pacific Northwest (Portland)	_____%
D.	Lewiston, Idaho	_____%
E.	Other (please specify)	_____%
	_____ Total	100%

14. OPERATING COSTS CONTINUE TO INCREASE SIGNIFICANTLY EACH YEAR AND VARY GREATLY FROM FIRM TO FIRM.

A. Cost of Operation (1979 costs please)

What did these items cost your for your operations on an average during 1979?

$_____license fees _____utilities
_____insurance (truck) _____misc.
_____other

B. Total Maintenance Costs

	Number of Each	Cost Per/Unit
Tarps	_____	_____
Oil (gals.)	_____	_____
Grease (lbs. or gals.)	_____	_____
Repairs	_____	_____
Other (batteries, tools etc.)	_____	_____

C. How many of each tire did you use in 1979?

	How Many	Cost Per Tire	Average Lifetime of Tire
Radial	_____	_____	_____
Recapped	_____	_____	_____
Standard	_____	_____	_____

D. Do you have chains for your truck? yes_____ no_____

E. If yes, how much did they cost? (average)

new_____ used_____

F. How long will they last? (average)

_____years (new) _____years (used)

G. What is the average price paid for diesel fuel?

#1 fuel _____$/gallon #2 fuel _____$/gallon

H. What percent of each do you use? _____% #1 fuel
_____% #2 fuel
100% total

15. FINDING GOOD DRIVERS IS VERY IMPORTANT IN TRUCKING

A. How many truck drivers do you hire? _____

B. How are your drivers paid?

	Amount Per Unit	Total Cost for All Drivers for the year
Per Mile	_____	_____
Per Trip	_____	_____
# of Freight Bill	_____	_____
Other	_____	_____

C. What is your approximate total subsistence cost for drivers per year? (like meals, lodging, etc.)

hired drivers _____dollars
owner _____dollars

D. Do you pay your drivers for idle time? (waiting for loading or unloading) _____yes _____no

E. What rate do you use? _____dollars/hour

F. What is your average annual total cost of management and supervising personnel? _____dollars

G. What is your annual total cost of administrative help (includes clerks, mechanics, typists, warehouse laborers, etc?)

_____dollars

H. Do you advertise? _____yes _____no

I. How much does it cost in an average year? _____dollars

J. Do you own or lease any communication equipment? (C.B., etc.)

_____yes _____no

K. If yes, what does this cost you per year on an average?

_____dollars

16. YOUR CONCERNS AND OPINIONS ARE VALUABLE IN DEVELOPING A PRODUCTIVE AND STABLE TRUCKING INDUSTRY IN THE FUTURE.

A. Which firm do you feel is most efficient?

_____owner-operator
_____multiple-truck operation
_____either of above

B. Have you expanded or contracted your firm size recently?

_____yes _____no which_____

How many? _____more or less tractor(s)
_____more or less trailer(s)

C. Do you plan to increase your size in the near future?

_____yes _____no

D. Any special reason for this? _____

E. Which problem do you feel will be (or is) most critical for grain truckers? (rank them with #1 being most critical).

_____high fixed costs (payments)
_____no grain to haul
_____long waiting time to dump out terminals
_____fuel cost
_____differing state laws

F. What do you feel is needed most by truckers in the futute? (please rank them)

_____more fuel efficient engines
_____double bottoms
_____faster turn around time
_____regulated rates (floor & ceiling rates)
_____other (please specify)

G. Who are your regular customers?

elevators	_____%
farmers directly	_____%
other (please specify)	_____%
total	100%

H. What do you feel works well in obtaining more loads?

_____provide reliable service
_____reduce rates
_____advertise
_____call managers & request loads
_____other (please specify) _____

- -

Thank you for completing this questionnaire:

If you would like a copy of the results, please fill in your full mailing address.

Name _____

Address _____

City/State _____

Zip Code _____

APPENDIX B

Statistical Testing and Cost Methodology

Total annual costs for 1979 were calculated from the responses to the questionnaire in Appendix A. These 1979 costs were updated to December 1980, and regressed against quantity of output and firm size variables.

Updating Procedure

The questionnaire's annual total costs were stated at 1979 levels. They were then updated using the average All Commodities Price Index for 1979 and the All Commodities Price Index for December 1980. (Indices of fuel and labor were compared with no significant difference found.) The update ratio was calculated as shown below:

$$\text{Update Ratio} = \frac{(280.3 - 235.6)}{235.6} + 1$$

$$\text{Update Ratio} = 1.189728$$

$$\text{Update Ratio} = 1.189728$$

where:

280.3 = December 1980 All Commodities Producer's Price Index

235.6 = Average All Commodities Producer's Price Index

The update ratio was applied to the 1979 aggregated total cost figure to reflect December 1980 annual costs.

Missing Values

To aggregate the cost data reported in the survey on an annual basis, a limited number of variable values missing from the data base were replaced by values estimated from the sample. Generally, the replacement of missing values with an estimated value only took place where the particular costs could not be assumed as zero (e.g., driver wages) or the value was needed in the calculation of such a cost (e.g., depreciation of a tractor). Other costs such as advertising were assumed as zero if no response was

given. The nature of the "synthesized" values and the extent to which they were used in cost calculations is indicated in Appendix C.

Model Specification

The total cost functions and average total cost functions were estimated using the specified models EQ-1 and EQ-2. Due to multicollinearity and heteroscedastistic problems the econometric models were transformed using natural logarithms on the dependent variables. As described below, the resultant transformed econometric model circumvented these two problems.

Multicollinearity is a term used to denote the presence of a linear relationship among the explanatory variables, and is a severe problem if the accuracy and/or stability of the estimated parameters (betas) are affected. The degree of multicollinearity was estimated by calculating correlation coefficients between the independent or explanatory variables (Table B-1). There is a relatively strong relationship between the firm size variable and the various quantity of output variables. Using transformed data the relationship is somewhat diminished between those variables (Table B-2). However, using correlation coefficients by themselves is not a satisfactory test for the existence of multicollinearity problems because of the degree of subjectivity involved in such a determination.

Various measures have been used to determine at what level a correlation-coefficient is significant between two independent variables. In this study, the data were sorted by the quantity of output variable and selected observations were placed in another data set. Regressions were performed on the two data sets using the same model. A Chow test was then applied to determine whether or not there was a significant difference between the coefficients obtained from the two data sets. The underlying concept is

TABLE B-1. CORRELATION COEFFICIENTS BETWEEN INDEPENDENT VARIABLES USING NON-TRANSFORMED DATA, NORTH DAKOTA FIRMS, 1980

	Total Miles	Gross Ton-Miles	Net Ton-Miles	Cwt. Miles	FS	UTIL	ALH	AGE
Total Miles	1	N.A.	N.A.	N.A.	-.77206	-.36014	.33044	-.17033
Gross Ton-Miles	N.A.	1	N.A.	N.A.	.74982	.30621	.35737	-.17033
Net Ton-Miles	N.A.	N.A.	1	N.A.	.73140	.27300	.37009	-.1704
Cwt. Miles	N.A.	N.A.	N.A.	1	.73140	.27300	.37009	-.1704
FS	.77206	.74982	.73140	.73140	1	.09004	.14593	-.14819
UTIL	.36014	.30621	.27300	.27300	.09004	1	.11001	-.10813
ALH	.33044	.35737	.37009	.37009	.14593	.11001	1	-.08433
AGE	-.17033	-.17123	-.17046	-.17046	-.14819	-.10813	-.08438	1

TABLE B-2. CORRELATION COEFFICIENTS BETWEEN INDEPENDENT VARIABLES USING TRANSFORMED DATA, NORTH DAKOTA FIRMS, 1980

	Total Miles	Gross Ton-Miles	Net Ton-Miles	Cwt. Miles	FS	UTIL	ALH	AGE
Total Miles	1	N.A.	N.A.	N.A.	.69900	.51343	.33626	-.22300
Gross Ton-Miles	N.A.	1	N.A.	N.A.	.69610	.49289	.36943	-.19895
Net Ton-Miles	N.A.	N.A.	1	N.A.	.68803	.47453	.38743	-.17917
Cwt. Miles	N.A.	N.A.	N.A.	1	.68803	.47453	.38743	-.17917
FS	.69900	.69610	.68803	.73140	1	.09004	.14593	-.14819
UTIL	.51343	.49298	.47453	.37009	.09004	1	.11011	-.10813
ALH	.33626	.36943	.38743	.38743	.14593	.11011	1	-.0843
AGE	-.22300	-.19895	-.17917	-.17917	-.14819	.10813	-.08438	1

that if multicollinearity is a significant problem there should be a significant difference between the two coefficient estimates. The Chow test involves the calculations of the following F-statistic:

$$F^* = \frac{e^2p - (e_1^2 + e_2^2 \quad /k}{(e_1^2 + e_2^2)/(n_2 - 2k)}$$

where: e_p = error term of the pooled data set (both sets combined)
e_1 = error term of the larger data set
e_2 = error term of the smallest data set
n = sample size
k = number of estimated parameters

This F-statistic was then applied to the null hypothesis: there is no difference between the coefficients obtained from each sample (data set), with $V_1 = k$ and $V_2 = (n_1 + n_2 - 2K)$ degrees of freedom. The F-statistics resulting from this Chow test are shown in Table B-3. In each model shown

TABLE B-3. CALCULATED F-STATISTICS FOR TESTS OF THE SEVERITY OF MULTICOLLINEARITY

Equation	Non-Transformed	Transformed
1	.903898	1.2014
2	1.2045	1.54167
3	1.2007212	1.36189
4	1.2007212	1.36189
5	1.0716	1.2014
6	1.059826	1.167793
7	1.050105	1.14517
8	1.050105	1.14517

the null hypothesis cannot be rejected using either data sets. In other words, the potential impacts of multicollinearity do not appear to be severe.

One of the assumptions of the linear regression model is that the error term has a constant variance, known as the assumption of homoscedasticity. If the error terms do not have a constant variance then the error term is said to be heteroscedastistic. To test the models for violation of this assumption the Goldfeld-Quandt test was used.

The procedure involved ranking the observations by the respective quantities of output. One-fourth of the central observations were omitted from the analysis. The remaining observations were then segmented into two data sets, one set containing observations with low levels of output and the other containing higher levels of output. Regressions were performed on the two data sets using the same model. A ratio of the sum of squares-error term was then calculated as the F-statistic with $V_1 = V_2 = (n_1 + n_2 - 2K)$ degrees of freedom, where n_1 is the number of observations in the first data set, n_2 is the number of observations in the second data set and K is the number of estimated parameters. The results, shown in Table B-4, indicate that heteroscedasticity was a problem in the non-transformed data but could not be identified as a problem in the transformed data set.

TABLE B-4. CALCULATED F-STATISTICS FOR TESTS OF HOMOSCEDASTICITY

Equation	Non-Transformed	Transformed
1	25.706	2.1205
2	29.739	1.54168
3	23.553	1.36189
4	23.553	1.36189
5	3.36097	2.1205
6	3.3813	2.2243
7	3.31289	2.2634
8	3.31289	2.2634

APPENDIX C

Total Cost Component Derivation

DETERMINATION OF TOTAL COST

This appendix contains definitions of total costs and provides a description of the calculations of various cost components. As stated in Appendix B, a limited number of values missing from the data set were replaced by estimated values. Table C-1 identifies the variables replaced by mean values of the sample, the number of observations missing and that value of the variable.

TABLE C-1. PARAMETER ESTIMATES OF SELECTED VARIABLES FOR ECONOMETRIC COST FUNCTIONS, NORTH DAKOTA, 1980

Variable	Number of Observations Missing	Mean Value
Useful Life of Tractor	28	1,228,959 miles
Useful Life of Trailer	30	1,016,740 miles
Cost of Tractor	2	$43,003
Cost of Trailer	2	$16,757
Cost per Gallon of #1 Diesel	24	$112.5
Cost Per Gallon of #2 Diesel	3	$107.3
Percent of #1 Diesel Used	3	10 percent
Percent of #2 Diesel Used	3	90 percent
Miles Per Gallon Loaded	1	4.6 miles
Miles Per Gallon Unloaded	4	5.4 miles
Annual Insurance Per Trailer	10	$ 2,843
Average Yearly Wages Per Driver	35	$13,035

Cost Calculations

Vehicle Depreciation

There were several methods that could have been chosen to determine depreciation: straight-line, sum-of-years digits, declining balance, and service-output. Of these the last method was chosen. The assumption

of this method is that depreciation of vehicles is more a function of usage than time. Annual depreciation under this method is calculated as follows:

$$\text{Depreciation} = \frac{(\text{cost} - \text{salvage value})^* \text{ units of output in one year}}{\text{estimated useful life}}$$

In the case of tractors and trailers the unit of output is miles. The salvage value used was 30 percent of original cost for tractors, and 25 percent of original cost for trailers.[1]

If a particular carrier did not provide a response to either the cost of their vehicles or to the average useful life (in miles) of their vehicles, the mean value of the other respondents was used (Table C-1).

The depreciation on the storage building was calculated on a normal straight-line basis reflecting the fact that the nature of depreciation, in this case, is due more to time rather than usage. Structures cost, and durability of the buildings may vary. Therefore, the owner's perception of the lifetime of the building was used in the cost calculation. If either the useful life or the percentage of the building used for storage was missing the mean values from the survey were used (Table C-1).

Discussions with the Fargo City Assessors indicated salvage value for these purposes can be best estimated by the present value of $1, N years in the future, using a 10 percent discount rate which was calculated as follows:

$$PV = \frac{1}{(1.1)n}$$

The formula used for the calculation of depreciation follows:

$$ADSTOR = \frac{COSTBUIL - \frac{1}{(1.1)n}(COSTBUIL) \quad (PRTROSTR)}{N}$$

---

[1]David H. Maister, The Owner-Operator: Independent Trucker (D.C. Health and Co., Lexington, MA, 1975), p. 25.

Where: ADSTOR = annual depreciation of storage facilities
COSTBUIL = the original cost of the building
PRTRPSTR = percent of building used for storage
N = years of estimated useful life

Depreciation of Garage Equipment

Garage equipment was depreciated using a straight-line method as well. However, salvage value is assumed to be insignificant and as such is not part of the calculation. In addition, the survey did not make available the respondents perception of a useful life. For this reason, the useful life was taken from the IRS Asset Depreciation Range guidelines (eight years). The calculating equation then was:

$$ADGE = \frac{Toolscos}{8}$$

Where: ADGE = annual depreciation of garage equipment
Toolscos = cost of garage equipment

Fuel Costs

Annual fuel costs were taken directly from the survey if possible. The survey made available the cost per gallon if #1 and #2 diesel fuel and the percentage used of each grade of fuel. From there a weighted cost per gallon of fuel was calculated as shown below:

$$WCOF = (Pu1*CO1) + (Pu2*CO2)$$

Where: WCOF = weighted cost of diesel fuel
Pu1 = percentage of #1 diesel fuel used
Pu2 = percentage of #2 diesel fuel used
CO1 = cost of #1 diesel fuel
CO2 = cost of #2 diesel fuel

If one of the four elements of this equation was missing, the mean value of the sample was used (Table C-1).

The survey also made available both the miles traveled loaded and unloaded as well as the miles per gallon loaded and unloaded. From these the number of gallons used in 1979 was calculated. If either the miles per gallon loaded or unloaded was missing the mean values of the sample were used instead. The annual fuel cost was calculated by simply multiplying the weighted cost of fuel by the number of gallons used.

Driver Wages

The survey made available the number of hired drivers. The first step in the calculation process was to ascertain whether or not the owner should be included as a driver. In this case an owner was assumed to be a driver if the owner was paid a subsistence cost or if there were no hired drivers. The wage cost applicable to the owner-operator was considered to be the average wage per mile that was paid to hired drivers. It should be noted that in addition to this owner-operator "wage cost", the calculation of total costs occurring to the owner-operator also included a return on investment.

If no drivers were hired or if the carrier did not respond to the question, the mean value of the sample was used. This resulted in the owner-operator receiving about 13.17 cents per mile.

Tire Cost

Annual costs were calculated by multiplying the number of tires used times the cost per tire. If the carrier did not indicate his cost per tire, an average cost was developed from the survey. If a carrier did not indicate the number of tires used per year their tire costs were estimated using the following regression equations:

Log (Tire Cost) = 9.633492 + .361741 [LOG (total miles)] + .079606 (# of tractors), all parameters were significant at the 5 percent level.

Oil and Grease

The costs of oil and grease were synthesized on the assumptions of an oil change and grease every 10,000 miles, 44 quarts of oil used per change, two pounds of grease used per every 10,000 miles, and prices of $1.20 per pound of grease and $1.25 per quart of oil. These figures result in oil costing about $.55 per mile and grease .024 cents per mile. The figures that were used in the development of these per-mile costs were derived by surveying suppliers in February 1981.

Tarps and License Fees

The cost of tarps and license fees were requested in the questionnaire. If missing, these costs were synthesized using mean figures, multiplied by the number of trailers and tractors.

Insurance

Insurance is mandatory in North Dakota. For this reason, an insurance cost was "synthesized" if the carrier did not respond. Because of a range of estimates, this cost was estimated using a "trim" mean of the insurance cost per tractor. In this case, 5 percent of the observations were deleted from the low side and 10 percent from the high side, yielding a 1979 insurance cost per tractor of $2,629.62 per year.

Other Storage Costs

Storage costs may include the annual depreciation on a storage building, the annual depreciation on the storage building equipment, the annual rent (if the garage was rented), and the annual taxes and insurance applicable to the storage building.

The annual rent (if any) for a storage building was calculated by simply multiplying the monthly rent paid times twelve months. However,

only the portion applicable to the storage of the truck, rather than other equipment shortage, should properly be included in the aggregate cost figure. The annual rent figure was multiplied by the applicable percentage of storage space used for storage of the truck. An average survey figure of 74 percent was used if a carrier did not respond (Table C-1). The costs of insurance and taxes on the storage building were calculated in the same manner.

Other Costs

The following is a list of costs which were assumed to be zero if a carrier did not provide a response. These represent costs which could not be assumed as existing without a response from a carrier since capital equipment and other operating costs varied widely.

vehicle leasing costs
utility costs
miscellaneous costs of operations
other fuel costs
cost of chains
advertising costs
cost of communication equipment
repair costs (not identified elsewhere)
other cost (e.g., batteries, tools)
annual cost of management, supervisory, administrative, and mechanical personnel
subsistence costs

Interest Charges and Imputed Rate of Return

For the purposes of calculating total costs, interest expenses on equipment and the rate-of-return applicable to the carriers were combined. The rate of interest charged to truckers with a 20 percent down payment was found to be about 18 percent by interview with five area truck dealers. The five-year average rate-of-return on equity received by agricultural carriers as reported by the American Trucking Association is 14.1 percent. From these figures a weighted rate was calculated as follows:

80 percent x 18 percent = 14.4 percent
20 percent x 14.1 percent = 2.82
17.22 percent

The 80 percent (1-down payment) figure was applied to the 18 percent rate of interest because over the finance period interest is figured on an "add-on" interest basis. This means that interest is figured on the principal and is constant over the time period of the loan.

The 20 percent figure was applied to the 14.1 percent. It represents the return on equipment as well as working capital.

(COSTTRAC)	Cost of Tractor		xx
(COSTTRAI)	Cost of Trailer		xx
(COSTBUIL)	Cost of Storage Building	xx	
(PRTROSTR)	*Percentage Used for Truck	*xx	xx
(TTOLSCOS)	Cost of Garage Equipment		xx
(ESCOST)	Cost of Equipment and Storage		xxx
	Weighted Percentage		.1722
(RTNINVT)	Return on Investment and Interest Expense Without Respect to Working Capital		xxx
(WC)	One Months Working Capital as Defined in the Following Section	xxx .141	
	*Return on Equity		xx
(ICRI)	Total Interest Charges and Return on Equity		xxx

Working capital was defined as one month's cash operating expenses which includes all costs developed to this point with the exception of depreciation costs. The 14.1 percent rate of interest was applied to the monthly cash operating expenses for the return on working capital.

APPENDIX D

Economic-Engineering Survey

Economic-Engineering Survey
Cost of Equipment

New	Tractor	Trailer
GMC General	$54,000 + $4-$10,000	Western $21,000 + $1,500
INT. Transtar	$55,000 + $5,000	Does not sell
Kenworth (Cabover)	$61,500 + $7,500	Timpte $21,000 + $2,000
Peterbilt	$60,000	$15,000
Midwest Mack	$55,000	$21,000
Used (Range)		
International	$7,500 - $45,000	--
Kenworth	$4,800 - $49,000	--
GMC	$7,000 - $42,000	$3,000 - $20,000
Peterbilt	$4,000 - $50,000	$2,500 - $16,800
Midwest Mack	$5,000 - $50,000	$5,000 - $20,000

Extension to Trailer	Dollars
Peterbilt	$ 750
Midwest Mack	$1,500
Hall GMC	$2,000
Int.	$2,000
Kenworth	$1,300 - $1,800

Oil (Change every 10,000 miles) 8-10 changes per year

Hall GMC	*	24 quart capacity - $1,00/quart
International	*	44 quart capacity - $1.40/quart
Kenworth		44 quart capacity - $1.25/quart
Peterbilt		48 quart capacity - $1.30/quart
Midwest Mack		56 quart capacity - $1.33/quart

every 25,000 miles

Grease - every week $2.00/pound

	every 10,000 miles	use about 30 lbs./yr.	$ .65/pd.
	every 6,000 miles	two pounds	$2.00/pd.
Peterbilt	every week	1.5 lbs. per week	$.65
Midwest Mack	every 5,000 miles		$25/year

Anti-Freeze - only added, never changed

5 gal. per year added	$3.50/gal.
5 gal. per year added	$4.50
5 gal. per year added	$4.00

Batteries

GMC	4 batteries	$120 each
Kenworth	4 batteries	$ 80 each
Int.	3 batteries	$130-170 each
Peterbilt	4 batteries	$ 40 each
Mack	4 batteries	$ 55 each

Air Cleaners - Change 2-3 times per year

GMC	$45 - $70 each
Kenworth	$4.50 x 2 = $10.00
Peterbilt	$50 - $60
Mack (change 5 times 1 yr.)	$50

Fuel Filters - 10-12 fuel filters per year

Int.	$4.50
GMC	$26 - $60
Kenworth	$5.00
Peterbilt	$3 - $4
Mack	$30

(sell a kit of water, fuel, oil filters)

Oil Filters - change 10-12 times per year

GMC	$17 - $80
Int.	$6.50
Kenworth	$15.00
Peterbilt	$10.00

Major Overhauls

Peterbilt	every 350-450,000 miles	$4,500 - $6,500
Mack	every 350,000 miles	$5,000
GMC	every 400,000 miles	$7,000
Int.	300,000	$6,000
Kenworth	200,000	$3,000 - $5,000

Transmissions - overhauls

GMC (every four years) $4,000/4 = $1,000 per year

Transmission Oil - change one time per year

5 gal.	$3 - $4 gal.
5 quarts	$1.50/qt.
196 lbs./year	$ .65/lb.

Tarps	Regular	Rollover
Peterbilt	$350	$ 650
Mack	$300	--
Int.	$300-$400	--
Kenworth	$310	$1,000
GMC	$300	$ 800

Chains - (do not sell them often)

1 chain	$ 65	
Peterbilt - nylon straps & wrenches	$250/4 wheels	$62.50/tire

Financing	New		Used	
Peterbilt	4-5 yrs.	18%	3 yrs.	18%
Mack	5 yrs.	15%	3 yrs.	16.5%
GMC	4-5 yrs.	15.5%	2-3 yrs.	18%
Int.	5 yrs.	18%	3 yrs.	18.20%
Kenworth	4 yrs.	15.5%	3 yrs.	17%

Tires - almost all truckers use 11.-24.5

OK Tire Store	Radials	Non-Radials
drive wheels	$305.00	$235.00
trailer wheels	$282.00	$185.00
Goodyear		
front	$316.00	$238.00
drive wheels	$318.00	$268.00
trailer	$288.00	$210.00
Fargo Tire		
steering	$288.43	$225.51
drive wheels	$283.74	--
trailer	$266.00	$238.00

Possible Buildings for Storing Trucks

1. Butler - straight wall

   30' x 75'
   floor drain
   heating
   electricity
   insulation
   $34,000

   30 x 24 everything
   _____ the same as above
   $13,000

2. Aztec Steel Building - Miracle Building

   curved structure
   35' x 74'
   cement
   door
   insulation
   $24,700

3. Behlen

   30 x 70
   concrete
   electricity
   $18 - $20,000

CB Costs

1. Radio Schaak — 40 channel digital realistic
   $139 - $180
   $400 single side brand
   $279 realistic

2. NoDak Stores

   $ 60.00 Sharp - GE Cobra
   $130.00 Cobra Sideband

North Dakota License for trucking

Pounds	Commercial	Dollars
76,000		$1,051
80,000		$1,121
	Farm Use	
76,000		$ 336.00
80,000		$ 356.00
	Minnesota Motor Vehicle	
76,000		$1,134.50
80,000		$1,040.00

Insurance Costs

1. Nodak Mutual Insurance Co.

   $6,000/truck for full coverage

2. Lloyds Ltd. full coverage $4,599 premium

   Example of full coverage -

   limits 100,000 coverage per person, 300,000
   accident bodily injury
   100,000 property damage (100/300/100)
   includes no fault - uninsured motorist
   $1,000 deductible collision
   includes fire, theft, hail, wind
   $5,000 coverage cargo with $250 deductible
   300 miles radius

3. Sweeney Insurance

   $5,000 for full coverage (premium)

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