OPERATING COSTS AND CHARACTERISTICS OF NORTH DAKOTA GRAIN TRUCKING FIRMS

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EXECUTIVE SUMMARY

The performance of the North Dakota grain trucking industry has been mixed during the past decade. Grain shipments by truck have declined from 185 million bushels in 1978-79 to 120 million bushels in 1986-87. In relative terms, truck's modal share of grain traffic has declined steadily from 40.59 percent in 1978-79 to 21.14 percent in 1986-87. Much of the decline can be attributed to the introduction of multiple-car rail rates and the ensuing changes in the grain elevator industry.

The grain trucking firms which have survived the industry decline have improved operationally and lowered costs. From an operations perspective, evidence suggests that grain trucking firms have improved the utilization of their equipment. Increases in the percentage of loaded miles (i.e. revenue generating miles) and the average payload are both indicators of a healthy trucking industry.

Using an economic-engineering costing model, the typical firm's average total operating costs are estimated to be 0.8326 dollars per mile. Expressed in 1986 dollars, this represents a 28.2 percent drop in total operating costs between 1979 and 1986.

The three keys for long-run survival of firms in the grain trucking industry include: (1) concentrating on hauling rate competitive traffic, (2) striving towards obtaining operational efficiencies, and (3) seeking backhauls.

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Frank J. Dooley, Leslie M. Bertram, and Wesley W. Wilson*

I. INTRODUCTION

The movement of grain to market by truck has been and continues to be critical to North Dakota agriculture. Trucks provide grain elevators with a practical transportation alternative to rail, serving as a significant competitive factor in holding down rail rates. However, over the past twenty years the role of the grain trucker in North Dakota agriculture has been changing. Deregulation of the non-agricultural trucking and rail industries has adversely affected the grain trucking industry. In this report, the economic viability of grain trucking is examined in light of the changing roles, costs, and regulations affecting exempt trucking in North Dakota.

This report, which analyzes the costs of moving grain to market by truck, is part of a series of reports comprising the Rail Services Planning study. Central to evaluating an economically efficient transportation infrastructure and modal competition is a comparison of costs. Hence, in addition to providing a snapshot of trucking costs in 1986, this information will also be

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used to examine the competitive environment which exists for Class I and regional railroads and motor carriers within North Dakota. The specific objectives of the report are to:

1. define and compare industry characteristics of North Dakota grain truckers with previous research;

2. estimate and evaluate the operating costs for motor carrier firms hauling grain in North Dakota; and

3. evaluate changes in grain trucking costs over time.

After briefly discussing the data sources, the general industry characteristics of various sized grain trucking firms within North Dakota are examined. Items such as age of the firms, number of miles traveled, and types of commodities hauled were compared to results from previous studies to determine if changes have occurred within the industry during the past decade. The components of fixed and variable costs which contribute to grain trucking total operating costs are analyzed in the next section of the report. Changes in transportation costs that have occurred over the last decade are evaluated in the following section. The report concludes by summarizing the state of grain trucking and identifying keys to long run survival for grain truckers.

II. DATA SOURCES

The information required to evaluate changes in the grain trucking industry was gathered from a variety of sources. Secondary sources of information included previous Upper Great Plains Transportation Institute trucking studies (Cosgriff; Wilson, Griffin, and Casavant), a literature review of motor

carrier costs, grain movement data maintained by the North Dakota Public Service Commission, and the 1987 RCCC Motor Carrier Safety Survey. This information was corroborated through interviews with various trucking experts from the private and public sectors.

The primary source of data for this study was a mail survey of motor carriers hauling North Dakota grain (see Appendix A for a copy of the questionnaire). A combination of fill-in-the-blank and open-ended questions were utilized. The survey was ten pages in length, consisting of 121 questions. Due to the length of the survey, a booklet format was chosen in an attempt to encourage a higher response rate.

The survey questions were divided into four major sections, each addressing a particular concern of the study.[1] Section one was designed to provide general background information about each of the trucking firms, while section two was written to obtain data about each firm's terminal markets. Section three was structured to collect information on the individual firm's operating costs. Section four was designed to obtain information on how backhauling affected the grain trucker's business.

A total of 879 questionnaires were mailed to North Dakota grain truckers in two different increments. The first set of surveys was sent in August 1987 and the second set was mailed in September 1987. In an attempt to increase the response rate,

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[1]Drafts of the survey were reviewed by Jon Mielke, Director of Traffic, North Dakota Public Service Commission.

follow-up phone calls were placed to a sample of non-respondents in December 1987.

The sample frame for the first increment was developed from the 1985 Grain Trucking Directory and consisted of 355 potential respondents. Seventy-four completed surveys and 3 incorrectly addressed surveys were returned from the first sample. It was felt that the response rate might be low because of the length of the survey. Thus, a post card was also enclosed with the survey encouraging firms who would not fill out the survey to simply indicate if they still were a grain trucker.[2] Post cards were returned from 107 truckers, of which 83 were grain truckers and 24 were not. Hence, 77.6 percent of the 278 non-respondents or 216 firms are expected to be grain truckers. The response rate for the first sample was 25.5 percent (74/(216 + 74)).

In an attempt to increase the number of firms represented in this study and to provide a more complete grain trucking directory, the questionnaire was administered to a second, independent sample. The sample frame for the second increment was provided by the North Dakota Motor Vehicle Department and consisted of 524 trucking firms licensed in North Dakota. The trucking firms selected were primarily located in smaller communities. Thirty-three completed surveys, 35 post cards (of which 9 were grain truckers and 26 were not), and 1 incorrectly addressed survey were returned. Following the same methodology as above, 25.7

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[2]This information was also used to develop the 1988 Grain Trucking Directory which is available upon request from the Upper Great Plains Transportation Institute.

percent of the 490 non-responding firms or 126 firms are expected to be grain truckers. Thus, a total of 159 grain truckers are expected in the second sample (126 + 33). This yields a response rate of 20.8 percent for the second sample (33/(126 + 33).

Combining the expected number of grain truckers from the two samples results in a total of 449 expected grain truckers in the industry. The cumulative total of 107 completed surveys out of a potential 449 estimated respondents yielded a response rate of 23.8 percent. In a final attempt to increase the number of firms included in the analysis, 30 of the non-respondent firms were contacted by telephone and were asked to complete and return the survey. Eight firms returned completed surveys, bringing the final response rate up to 25.6 percent.

III. INDUSTRY CHARACTERISTICS

In general, the grain trucking industry has been declining during the last decade in absolute and relative terms. Grain shipments by truck peaked in 1978-79 when over 185 million bushels of grain were shipped by truck (Table 1). By 1986-87, only 120 million bushels of grain were shipped by truck. In relative terms, truck's modal share of grain traffic has declined steadily from 40.59 percent in 1978-79 to 21.14 percent in 1986-87 (Table 1).

Changes in the rail and grain elevator industries have led to the decline in truck traffic. Rail deregulation in 1980, which gave railroads greater pricing and operating flexibility, is probably the chief cause of the decline in truck traffic. In

TABLE 1. North Dakota Grain and Oilseed Movements by Rail and Truck, 1977-78 to 1986-87

Crop Year[1]	Volume Rail	Volume Truck	Percent Rail	Percent Truck
	---thousand bushels--		--- percent ---	
1977-78	235,178	123,426	65.58	34.42
1978-79	271,069	185,165	59.41	40.59
1979-80	294,342	181,724	61.83	38.17
1980-81	251,938	149,147	62.81	37.19
1981-82	317,304	144,558	68.70	31.30
1982-83	340,461	151,210	69.25	30.75
1983-84	393,110	145,709	72.96	27.04
1984-85	375,079	136,847	73.26	26.74
1985-86	355,387	123,004	74.29	25.71
1986-87	450,569	120,750	78.86	21.14

[1]The crop year begins July 1 and runs to June 30 of the following year.

SOURCE: Ogg and Schuster.

addition, the introduction of multiple-car and contract rail rates has caused larger grain shippers to become more dependent upon rail than truck. Finally, grain marketing patterns have also changed. It is well known that motor carriers have an advantage for short haul movements while railroads have an advantage on longer hauls (Wilson). Over the last decade, grain traffic patterns have changed to favor the rail competitive movements. In 1976-77, 78 percent of the grain and oilseeds shipped from North Dakota went to the short-haul markets of Minneapolis-St. Paul and Duluth-Superior (Ogg and Schuster). Ten years later, only 42 percent of the grain and oilseeds moved to these markets (Ogg and Schuster). More grain moved via rail to long-haul markets in the Pacific Northwest and Gulf ports.

Faced with greater rail competition and changing marketing patterns, grain truckers have found it increasingly difficult to compete. The remainder of this section analyzes characteristics such as firm size and concentration, markets served and commodities hauled, and firm performance in order to determine how motor carriers have adapted to changes in the competitive environment.

FIRM SIZE AND CONCENTRATION

Firm Size

The motor carrier firms in this study were segmented into three size categories: owner-operators (one tractor), medium sized firms (2-4 tractors), and large sized firms (5 or more tractors). Owner-operators are the most common type of grain trucking firm in North Dakota. In 1986, 57.9 percent of the firms reported that they owned or leased one tractor (Table 2). Approximately 30 percent of the firms are classified as medium sized firms while the remaining 12.3 percent are large sized firms (Table 2).

There has been some shifting in the size distribution of grain trucking firms during the past decade. The 1976 size distribution is quite similar to the 1986 distribution with 53.6, 34.5, and 11.9 percent of the grain trucking firms being classified as owner-operators, medium sized, and large sized firms, respectively (Table 2). In 1979, the distribution of owner-operator, medium sized, and large sized firms shifted to 37.3, 49.3, and 13.3. percent, respectively (Table 2).

TABLE 2. Size Distribution of and Average Number of Tractors for North Dakota Grain Trucking Firms, 1976, 1979, and 1986

Firm Size	Year		
	1976	1979	1986
	---------Percent---------		
Owner-operator (1 tractor)	53.6	37.3	57.9
Medium sized[1] (2-4 tractors)	34.5	49.3	29.8
Large sized[1] (≥ 5 tractors)	11.9	13.3	12.3
TOTAL	100.0	99.9	100.0
Average Number of tractors	1.54	1.78	2.88
Number of respondents	84	75	115

[1]In the Cosgriff study, medium sized firms were defined to include 2 - 5 tractors and large firms had more than 5 tractors.

SOURCE: 1976 - Cosgriff; 1979 - Wilson, Griffin, and Casavant; 1986 - survey data.

Although there has been little change in the size distribution of firms over time, the average number of tractors per firm has been steadily increasing. The average number of tractors per firm rose from 1.54 in 1976, to 1.78 in 1979, to 2.88 in 1986. This suggests that the larger sized firms are operating more tractors.

Firm Concentration

An examination of the loaded miles by firm size provides insights into the level of intramodal competition within the grain trucking industry. The total loaded miles increased substantially for each firm size category between 1979 and 1986. Overall, the total number of loaded miles logged by grain truckers increased 32.2 percent between 1979 to 1986, rising from 16.4 million to 21.7 million miles (Table 3).

TABLE 3. Distribution of Loaded Miles, by Firm Size, 1979 & 1986

Firm Size	Loaded Miles		Percent	
	1979	1986	1979	1986
Owner-Operator	1,501,804	3,391,535	9.2	15.6
Medium	5,451,909	6,437,966	33.2	29.7
Large	9,463,750	11,882,102	57.6	54.7
Total	16,417,463	21,711,603	100.0	100.0

SOURCE: 1979 - Wilson, Griffin, and Casavant; 1986 - Survey Data

Large firms were most dominant in terms of percent of industry loaded miles in both time periods, having 57.6 percent of all traffic in 1979 and 54.7 percent in 1986 (Table 3). While large firms dominate the industry, owner-operator firms increased their market share by over six percentage points between 1979 and 1986 (Table 3). There are two reasons underlying this improvement. First, the number of owner-operators sharply increased, rising from 37.3 percent of all grain truckers in 1979 to 57.9 percent in 1986 (Table 2). Second, owner-operators have also been successful at increasing their percentage of loaded miles (see Table 10). Thus, owner-operators appear to be competitive in a declining industry.

In response to an open-ended question, trucker's suggested that the movement towards owner-operators and away from medium sized firms may reflect a growing interest in leaving the grain trucking industry. Numerous individuals stated that the rates they received were inadequate to cover the costs associated with

operating a medium sized trucking firm. A few individuals indicated that they were going to remain in business until their equipment broke down and implied that replacement of these vehicles was doubtful.

MARKETS SERVED AND COMMODITIES HAULED

Trip Origins

North Dakota grain trucking firms heavily rely upon North Dakota origins for most of their traffic. In 1986, North Dakota shippers accounted for 73.2 percent of the trip origins for North Dakota grain truckers. This relationship has remained consistent over time. In 1979, "almost 70 percent of the truckers utilized North Dakota origins for over 90 percent of their loads" (Wilson, Griffin, and Casavant).

Smaller sized trucking firms are more dependent upon North Dakota origins than larger sized firms. In 1986, the percentage of North Dakota origins for owner-operators, medium sized firms, and large sized firms were 80.0, 68.6, and 52.2 percent, respectively. Many of the owner-operators indicated that a large proportion of their hauls were for themselves and/or between local elevators within the state. Larger sized firms typically serve more origins and destinations because they operate on a regional or national basis.

Number of Elevators Served

Grain truckers served more elevators in 1986 than they did in 1976. In 1976, 92.8 percent of the grain truckers "reported

that they served one or a few elevators on a regular basis" (Cosgriff). In 1986, 25.5 percent of the grain truckers reported that they served only one elevator, while 74.5 percent of the grain truckers served two or more elevators (Table 4). The typical grain trucker served 2.7 elevators in 1986. There are two conflicting interpretations as to the increase in the number of elevators served. On the one hand, the increase in the number of elevators served may signal a trend within the grain trucking industry towards expanding its market base. On the other hand, this shift may arise because the number of houses within a country grain elevator firm has increased as a result of mergers.

TABLE 4. Number of Elevators Served, 1986

No. Elevators Served	Frequency	Percent	Cumulative Percent
0-1	24	25.5	25.5
2-3	43	45.8	71.3
4-5	17	18.1	89.4
6-7	10	10.6	100.0
TOTAL	94	100.0	100.0

Destinations

Minneapolis/St. Paul was the most common destination in 1986 for all sizes of trucking firms. According to survey data, 35.3 percent of all hauls by North Dakota grain truckers went to Minneapolis/St. Paul (Table 5). After Minneapolis/St. Paul, the most common destinations in 1986 were between North Dakota

TABLE 5. Fronthaul Destinations for North Dakota Grain Shippers, by Firm Size, in Percent, 1986

Destination	Firm Size			
	Owner-Oper.	Medium	Large	All
	---------- Percent ----------			
Minneapolis/St. Paul	36.1	30.4	35.8	35.3
Between ND Elevators	29.7	30.4	11.4	27.1
Duluth/Superior	13.1	13.8	9.5	12.7
Pacific Northwest	10.5	9.4	16.7	11.2
Other Destinations	10.6	16.0	26.6	13.7
TOTAL	100.0	100.0	100.0	100.0

elevators (27.1 percent), other destinations (13.7 percent), Duluth/Superior (12.7 percent), and the Pacific Northwest (11.2 percent) (Table 5). Other destinations are found across the country, including the following states: Arizona, Colorado, Idaho, Iowa, Kansas, Michigan, Montana, Nebraska, Ohio, South Dakota, Texas, and Wisconsin.

Major changes have occurred in the most common destinations between 1979 and 1986. In 1979, the "most common destinations for grain trucked from North Dakota were Duluth/Superior, Minneapolis/St. Paul, and Pacific Northwest port areas" (Wilson, Griffin, and Casavant). The most significant change has been the relative decline of the Duluth/Superior market and the emergence of truck traffic between North Dakota elevators. The latter includes grain trucked from elevators to North Dakota processors.

Similar information, which corroborates the survey data, is available in the North Dakota grain movement data (Ogg and Schuster). There has been a dramatic decline in the amount of grain trucked from North Dakota to Duluth/Superior (Table 6). The percentage of North Dakota grain trucked to Minneapolis/St. Paul and Pacific Northwest markets has declined slightly, while grain trucked to other markets has slightly increased. The major difference between crop years 1979-80 and 1986-87 is the percentage of grain trucked to North Dakota processors. In 1986-87, 43.6 million bushels of grain and oilseeds was trucked from North Dakota elevators to North Dakota processors. This does not include grain trucked between North Dakota elevators.

TABLE 6. North Dakota Grain Trucking Shipment Patterns, in Percent, Various Years

Market	Crop Year		
	1976-77	1979-80	1986-7
	----------Percent----------		
Minneapolis/St. Paul	26.7	22.4	21.1
Duluth/Superior	47.5	50.8	14.9
Pacific Northwest	9.0	8.3	4.3
North Dakota processors	na	na	36.2
Other	16.8	18.6	23.5
TOTAL	100.0	100.1	100.0

na = not available

SOURCE: Ogg and Schuster 1987.

Length of Haul

Closely related to destination choices is the length of haul. For all grain trucking firms, the average one-way length of haul has been relatively constant, falling from 478 miles in 1979 to 457.6 miles in 1986 (Table 7).

TABLE 7. Average One-Way Length of Haul, by Firm Size, 1979 and 1986

Firm Size	Average One-Way Length of Haul (in miles)	
	1979	1986
Owner-operator	434	425.5
Medium Sized	469	407.8
Large Sized	635	729.7
WEIGHTED AVERAGE	478	457.6

SOURCE: 1979 - Wilson, Griffin, and Casavant; 1986 - Survey data

In general, the average one-way length of haul is less for owner-operators and medium sized firms because they tend to serve the traditional short haul markets of Minneapolis/St. Paul and Duluth/Superior. The average one-way length of haul is 415.8 miles to Minneapolis/St. Paul and 381.6 miles to Duluth/Superior. Larger firms on the other hand haul more grain to long distance markets such as the Pacific Northwest. The average one-way length of haul to the Pacific Northwest is 1023.1 miles. A final factor affecting the differences in length of haul for various sized firms is the length of haul to other markets. The average

one-way length of haul to other markets for owner-operators and medium sized firms is 291.0 miles, while the average one-way length of haul to other markets for large sized firms is 960 miles. Other markets for owner-operators and medium sized firms include more shipments between North Dakota elevators while other markets for large sized firms include destinations across the country.

Commodities Hauled

Overall, grain truckers earn the majority of their income hauling exempt agricultural commodities. In 1986, the typical North Dakota grain trucker earned 74.9 percent of his income from exempt agricultural commodities, 20.7 percent from regulated commodities, and 4.4 percent from other sources (Table 8). There has been little change since 1976, when 78.5 percent of the hauls were of exempt agricultural commodities (Cosgriff). Therefore, despite having better access to backhaul markets, agriculture continues to be the economic mainstay for North Dakota grain truckers.

There are major differences in the income sources for different sized firms. Owner-operators earned 83.1 percent of their income from exempt commodities, but only 14.0 percent from regulated commodities (Table 8). Medium sized firms also rely on exempt commodity hauls to earn the majority of their income, but to a lesser extent than owner-operators. Exempt commodities accounted for 69.4 percent, regulated commodities for 24.4 percent, and other hauls for 6.2 percent of medium sized firms'

TABLE 8. Percentage Distribution of Income Sources for North Dakota Grain Trucking Firms, by Firm Size, 1986

Income Source	Firm Size			
	Owner-Oper.	Medium	Large	All
	---------- Percentage ----------			
Exempt Commodities	83.1	69.4	49.5	74.9
Regulated Commodities	14.0	24.4	43.3	20.7
Other Sources	2.9	6.2	7.2	4.4
TOTAL	100.0	100.0	100.0	100.0

incomes (Table 8). Income sources for large sized firms were the most well balanced between exempt and regulated commodities. These firms earned 49.5 percent of their income from exempt commodities and nearly as much income from regulated commodities (43.3 percent).

PERFORMANCE OF GRAIN TRUCKING FIRMS

Various measures of performance exist which provide indications as to the health of a particular industry. By comparing these measures with results from previous studies, it is possible to ascertain strategies which may allow firms to improve their performance. Measures of utilization include annual mileage per truck, percent loaded miles, and average weight. Other measures of performance include age of the firm and managerial practices such as leasing.

Annual Mileage per Truck

Increasing annual mileage is an important means for increasing utilization of equipment, and thereby lowering average fixed costs. Over the last decade, major shifts in the annual mileage per truck have occurred amongst the various sized firms. The average annual mileage per truck for all firms fell from 88,188 miles in 1979 to 79,547 miles in 1986 (Table 9). Thus, the utilization of a typical grain truck has fallen by almost 10 percent since 1979.

TABLE 9. Average Annual Mileage per Grain Truck, by Firm Size, various years

Year	Firm Size			
	Owner-Oper.	Medium	Large	All
	-- Average Annual Mileage per Grain Truck --			
1976[a]	94,555	83,673	73,269	81,911
1979	87,369	88,261	90,180	88,188
1986	74,864	85,699	91,671	79,547

[a]In the Cosgriff study, medium sized firms were defined to include 2 - 5 tractors and large firms had more than 5 tractors.

SOURCE: 1976 - Cosgriff: 1979 - Wilson, Griffin, and Casavant; 1986 - survey data.

In 1986, the average annual mileage per truck ranged from 74,864 miles for owner-operators to 85,699 miles for medium sized firms to 91,671 miles for large sized firms (Table 9).[3] Over the

[3]In a national survey of motor carriers hauling produce from Florida, the average annual mileage was 115,000 miles (Beilock).

past ten years, the annual mileage has declined sharply for owner-operators, remained constant for medium sized firms, and increased for large sized firms (Table 9).

A comparison of the average annual mileage for 1976, 1979, and 1986 suggests that larger sized firms have been more successful in increasing their utilization of equipment than medium sized firms and owner-operators. The results suggest that while not true in the past, larger grain trucking firms are now using their equipment more efficiently than owner-operators in North Dakota. The adoption of different management strategies may explain this result. Larger sized firms are focusing upon long distance markets such as the Pacific Northwest or Gulf Coast ports while smaller firms are concentrating on providing local service such as hauling grain from satellite elevators to subterminals (Table 5).

Loaded Miles

Loaded miles are a second measure of utilization. Increasing the percentage of loaded miles (i.e., revenue generating miles) is an obvious ingredient to being a successful grain trucking firm. In general, the percentage of loaded miles increased for grain truckers from 1979 to 1986. Overall, the percentage of loaded miles increased slightly from 65.0 percent in 1979 to 71.7 percent in 1986 (Table 10).[4]

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[4]On a national basis, only 64 percent of the miles traveled by motor carriers hauling produce were loaded (Beilock).

TABLE 10. Percent of Average Loaded Miles per Grain Truck, by Firm Size, 1979 and 1986

Year	Firm Size			
	Owner-Oper.	Medium	Large	All
	---------- Percent ----------			
1979	62.0	63.0	80.0	65.0
1986	68.6	73.6	81.0	71.7

SOURCE: 1979 - Wilson, Griffin, and Casavant; 1986 - survey data.

There is a difference in the percentage of loaded miles related to firm size. The smaller sized grain trucking firms have had greater success in increasing their percentage of loaded miles than larger firms. However, larger firms still have a higher percentage of loaded miles. In 1986, loaded miles were greatest for the largest sized firms, with 81.0 percent loaded miles (Table 10). Medium sized firms and owner-operators had 73.6 and 68.6 percent loaded miles, respectively (Table 10).

Average Weight per Load

The average weight per load or payload indicates the ability to utilize the capacity of a truck load. In 1986, the average payload for owner-operators, medium sized firms and large sized firms was 51,762, 51,097, and 47,964 pounds, respectively. The average payload in 1976 was approximately 48,000 pounds (Cosgriff). Thus, most firms have improved their performance by carrying larger loads.

There are two reasons which explain why the average payload has increased over time. First, the introduction of lighter

weight equipment, such as aluminum trailers, has reduced the weight of equipment. The savings in equipment weight can be used to haul additional cargo. Second, when possible truckers load their vehicles to the maximum weight restriction. The average payload has increased because weight load restrictions have increased over time. The weight restriction for trucks operating on the interstate system has increased from 73,280 pounds in 1976 to 80,000 pounds in 1986 (North Dakota Century Code 39-12-05).[5]

The difference between the average payload per truck for owner-operators and large sized firms may also be explained in part by their commodity mixes. Owner-operators primarily haul exempt agricultural commodities while the larger sized firms haul a mix of exempt and regulated commodities (Table 8). The average payload per truck is greater for owner-operators because the physical density of exempt agricultural commodities is typically greater than the physical density of regulated commodities.

Length of Time in Business

The length of time a firm has been in business measures the stability of firms within an industry. An increase in the average firm age suggests that the grain trucking industry has become more stable over time.

The average firm age for all grain trucking firms has significantly increased between 1979 and 1986 (Table 11). The largest sized firms have been operating longer than the other

[5]Trucks operating on designated highways may legally haul up to 105,000 pounds.

TABLE 11. Average Age of North Dakota Grain Trucking Firms, by Firm Size, Various Years

Year	Firm Size			
	Owner-Oper.	Medium	Large	All
	---------- years ----------			
1976[a]	7.0	9.0	17.0	9.0
1979	7.5	8.0	13.5	8.5
1986	12.2	15.8	17.9	13.9

[a]In the Cosgriff study, medium sized firms were defined to include 2 - 5 tractors and large firms had more than 5 tractors.

SOURCE: 1976 - Cosgriff; 1979 - Wilson, Griffin, and Casavant; 1986 - survey data.

sized firms. The average number of years in trucking for a large firm is 17.9 years, 15.8 years for medium sized firms, and 12.2 years for owner-operators (Table 11). Quantitatively, this relationship has been consistent over time.

The increased stability can be attributed to less rapid entry and exit from the industry. In other words, the industry is more stable because either fewer new firms are being established, fewer older firms are going out of business, or both. Given the relative decline of the grain trucking industry since 1980, most of the increased stability probably arises from fewer new firms entering the grain trucking industry. In addition, older established firms are less likely to go out of business because their revenue sources are more reliable than those of newer firms (see Wilson).

Leasing Practices

Leasing practices vary widely by firm size. Leasing is a common business practice amongst the largest sized trucking firms, but relatively rare among owner-operators. Almost 79 percent of the largest firms lease tractors and 35.7 percent lease trailers (Table 12). Only 4.5 percent of the owner-operators lease tractors and only 6.1 percent lease trailers (Table 12). More firms lease tractors (21.1 percent) than trailers (16.7 percent). However, for those grain trucking firms which lease equipment, the typical firm leases more trailers (4.21) than tractors (3.81).

TABLE 12. Percentage of Firms Leasing and Number of Tractors and Trailers Leased, by Firm Size, 1986

	% of Firms Leasing		Average Number Leased	
Firm Size	Tractors	Trailers	Tractors	Trailers
Owner-Operator	4.5	6.1	1.00	1.50
Medium Sized	35.3	29.4	2.17	2.00
Large Sized	78.6	35.7	6.36	10.80
Weighted Average	21.1	16.7	3.81	4.21

IV. COST ANALYSIS

The purpose of this section of the report is to identify and evaluate costs of operation for motor carrier firms 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... A shipper or trucker can also use his own cost components and characteristics to develop estimates of his own costs." (Wilson, Griffin, and Casavant).

Two general methods have been used in previous Upper Great Plains Transportation Institute motor carrier cost studies, the economic-engineering approach and an econometric approach. The economic-engineering approach was used by Casavant and Nelson (1967), Cosgriff (1976), and Wilson, Griffin, and Casavant (1979). Wilson, Griffin, and Casavant also estimated motor carrier costs with an econometric model.

An economic-engineering approach to truck costing begins by synthesizing a "typical trucking firm", e.g., the number of tractors, trailers, etc. Costs are then estimated by applying factor prices (wages, fuel prices, interest costs, etc.) to the various cost elements of the typical firm. Data may be obtained from a variety of sources, including surveys, personal interviews of motor carrier operators, tire dealers, truck dealers, etc., and through reviews of previous cost analysis studies. The econometric approach uses survey data to define the relationship between output measures and cost components.

In this study, the economic-engineering approach is used to estimate motor carrier costs. The costs are developed for a typical North Dakota grain trucking firm which operates with three tractors and four trailers.[6] The average grain trucking

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[6]See Dooley and Bertram, An Economic-Engineering Model for Estimating Motor Carrier Costs, UGPTI Report No. 68, for a detailed discussion of the cost estimation procedure.

firm in North Dakota owns 2.00 and leases .88 tractors for an average total of 2.88 tractors (Table 13). On average, grain trucking firms operate with 4.21 trailers, owning 3.49 and leasing 0.72 (Table 13). The typical North Dakota grain truck moves 79,547 miles per year (Table 13).

TABLE 13. North Dakota Grain Trucking Firm Operating Characteristics, 1986

Characteristic	Level
Number of Tractors Owned	2.00 tractors
Number of Tractors Leased	0.88 tractors
Number of Trailers Owned	3.49 trailers
Number of Trailers Leased	0.72 trailers
Utilization (miles/truck)	79,547 miles
Miles Traveled per Firm	229,095 miles

FIXED COSTS

Fixed or sunk costs are those costs which are incurred regardless of the number of miles traveled. Each cost item is discussed in detail. Fixed costs include: depreciation, return on investment, equipment leasing, license fees, insurance, management and overhead, and housing costs.

Equipment

Trucking firms may own or lease their tractors and trailers. Thus, the determination of equipment costs includes both ownership and leasing costs. Ownership costs consist of depreciation

and return on investment (ROI), while lease costs are the average annual lease payment for a tractor-trailer combination.

Firm equipment costs were developed by first calculating per unit ownership and leasing costs for tractors and trailers. The per unit values were then weighted by the percentage of equipment owned and leased. Finally, equipment costs for the synthesized firm were obtained by multiplying the weighted equipment costs by three tractors and four trailers.

The tractors and trailers were depreciated on a straight line basis. Depreciation was calculated by subtracting the salvage value (Table 14, line 2) from the purchase price (line 1), and dividing this figure by the estimated useful life in years (line 3). The purchase price, salvage value, and estimated useful life are mean values from the survey data.

TABLE 14. Equipment Ownership and Leasing Expense, 1986

Line	Item	Per Tractor	Per Trailer
1	Purchase Price	$74,054.71	$20,240.00
2	Salvage Price	18,763.16	8,360.87
3	Estimated Useful Life	8.62 yr	9.26 yr
4	Equipment Depreciation	$ 6,414.33	$ 1,282.84
5	Equipment ROI	5,104.98	1,573.05
6	Equipment Ownership Cost	$11,519.31	$ 2,855.89
7	Equipment Lease Cost	$14,330.65	$ 3,553.60
8	Percent Ownership	69.54%	82.87%
9	Percent Lease	30.46%	17.13%
10	Weighted Ownership Cost	$ 8,010.53	$ 2,366.68
11	Weighted Lease Cost	4,365.12	608.73
12	Weighted Equipment Cost	$12,375.65	$ 2,975.41
13	Firm Equipment Cost	$37,126.95	$11,901.64

According to survey results, the average purchase price of a new tractor was 74,054.71 dollars and of a new trailer was 20,240.00 dollars (Table 14).[7] The salvage value for a tractor was 18,763.16 dollars and for a trailer was 8,360.87 dollars. The estimated useful life for a tractor and trailer was 8.62 and 9.26 years, respectively. The per unit annual depreciation costs were 6,414.33 dollars for a tractor and 1,282.84 dollars for a trailer (line 4).

Return on investment is the second component of equipment ownership cost. "These charges can be considered either interest on debt capital or return on investment" (Wilson, Griffin, and Casavant). Based on interviews with loan officers from institutions making loans to trucking firms, an interest rate of 11 percent was determined to be representative for 1986.

Return on investment was calculated by dividing the purchase price minus salvage value by two to reach an average investment. This value was then added to the salvage value and multiplied by the interest rate to generate the return on investment cost. The per unit return on investment was 5,104.98 dollars for a tractor and 1,573.05 dollars for a trailer (line 5).

An alternative to tractor and trailer ownership is to lease equipment. Equipment leasing costs for tractor-trailer combinations were also established from survey responses and were

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[7]This is consistent the information provided by local truck and trailer dealers. According to the dealers, the typical price of a new tractor is 74,333 dollars, ranging between 68,000 and 80,000 dollars, while the average price of a new trailer is 23,500 dollars, ranging between 20,000 and 30,000 dollars.

verified with truck leasing firms. According to survey results, the average annual equipment leasing costs for a tractor-trailer combination in 1986 was 17,884.25 dollars. This cost was allocated between the tractor and trailer in the same proportion as the owned equipment cost, or 14,330.65 dollars per tractor and 3,553.60 dollars per trailer (line 7).

Based on survey results, firms own 69.54 percent of their tractors and 82.87 percent of their trailers, fulfilling their additional equipment needs with leased equipment (line 8). The equipment ownership cost (line 6) and equipment lease cost (line 7) were weighted by the percent of equipment owned and leased (lines 8 and 9). This resulted in a weighted annual per unit cost of 12,375.65 dollars for tractors and 2,975.41 dollars for trailers (line 12). The equipment costs for the synthesized firm of three tractors and four trailers was calculated to be 49,028.59 dollars (line 13).

License Fees

State license fees vary according to the states in which the motor carrier operates and by the number of miles traveled in each state. It was determined from survey responses that the average annual license fee and taxes per tractor-trailer combination was 1,379.25 dollars, or 4,137.75 dollars per firm. This value is consistent with the estimates of license fees generated by the North Dakota Motor Vehicle Department.

Insurance

Most grain trucking firms carry full coverage on their new tractor-trailers. This coverage includes: liability, physical damage, and cargo insurance. It was determined through survey responses that the annual insurance cost per tractor-trailer combination was 5,168.13 dollars, or 15,504.39 dollars per firm. The annual insurance cost was consistent with a rate estimate prepared by a local insurance agent. According to the agent, 5,176.00 dollars is a representative annual cost to insure a North Dakota grain tractor-trailer combination.

Management and Overhead

Management cost includes the survey average responses for the annual costs of management and administrative help. Overhead costs include reported annual expenditures for advertising and communications (C.B. radios). Only about 40 percent of the firms reported management, administration, and advertising costs (Table 15). Apparently, many owner-operators fail to allocate any cost for management or administration. Thus, the various cost items were weighted by the percentage of firms reporting the particular cost item. The annual weighted average cost of management and overhead was estimated to equal 10,721.67 dollars (Table 15).

Housing

Housing practices for grain trucks vary widely across trucking firms. Over 35 percent of the firms own a building, 24.3 percent rent, while the remaining 40.2 percent do not house

TABLE 15. Management and Overhead Costs, 1986

Cost Item	Average Cost	Percent Reporting	Weighted Average Cost
Management	$18,843.78	32.2	$ 6,067.70
Administration	10,226.57	40.9	4,182.67
Advertising	1,215.06	31.3	380.31
Communications	197.38	46.1	90.99
TOTAL	$30,482.79		$10,721.67

their equipment. Thus, a weighted average housing cost is calculated, with the cost of owning or renting a building being multiplied by the percentage of firms renting or owning.

Building ownership costs were calculated in a manner similar to that for equipment costs. The average cost of a building was 18,605.26 dollars. Assuming an average estimated useful life of 26.41 years and a zero salvage value, the annual building depreciation cost was 704.48 dollars (Table 16). According to survey responses, the annual building insurance and tax costs are 728.14 and 535.10 dollars, respectively. Thus, the total annual building ownership cost is 1,967.72 dollars. However, since most truck sheds are multipurpose buildings, only 65.38 percent of this cost, or 1,286.50 dollars, was allocated as truck housing ownership cost. According to survey responses, the average annual housing rental cost was 1,946.64 dollars. Weighted by the percentage of firms owning or renting buildings, the weighted annual housing cost is 929.74 dollars (Table 16).

TABLE 16. Housing Ownership Costs, 1986

Cost Item	Average Cost	Percent Reporting	Weighted Ave. Cost
Building Depreciation	$ 704.48		
Building Insurance	728.14		
Building Tax	535.10		
Total Ownership Cost	$1,967.72		
% of Bldg for Truck	65.38%		
ANNUAL OWNERSHIP COST	$1,286.50	35.5 %	$456.71
ANNUAL RENTAL COST	$1,946.64	24.3 %	473.03
WEIGHTED ANNUAL HOUSING COST			$929.74

Total Fixed Costs

In 1986, the total annual fixed costs for the typical three tractor/four trailer North Dakota grain trucking firm was 80,322.14 dollars (Table 17). Assuming an annual mileage of 229,095 miles per firm, the average fixed cost per mile was .3506 dollars per mile.

TABLE 17. Total Fixed Costs for North Dakota Grain Trucking Firms, 1986[a]

Cost Item	Cost
Equipment Cost	$ 49,028.59
License Fees and Taxes	4,137.75
Insurance	15,504.39
Management and Overhead	10,721.67
Housing Costs	929.74
Total Firm Fixed Costs	$ 80,322.14

[a]The firm is assumed to operate three tractors and four trailers.

VARIABLE COSTS

A firm's variable or out-of-pocket costs are those costs directly related to the number of miles logged. Total variable costs increase as mileage increases. Again, each cost is broken down and discussed in detail. Items of variable cost include: tires, driving labor, maintenance and repairs, and fuel.

Tires

The cost estimate for tractor and trailer tires was calculated using survey data, which was corroborated with interviews of truck tire dealers. According to survey responses, the average cost of a tractor tire was 286.24 dollars, while trailer tires cost an average of 221.12 dollars. The estimated useful life for tractor and trailer tires are 140,760 and 119,447 miles, respectively. Based on per mile costs of 0.20 cents for tractor tires and 0.19 cents for trailer tires, the per mile cost for a tractor-trailer is .0351 dollars. The survey estimate was virtually equal to the per mile cost of .0357 dollars per mile as reported by the truck tire dealers.

Driving Labor

Truck drivers may be paid in many different ways. The two most common methods of payment are according to a percentage of the freight bill (40.0 percent of the firms) and on a per mile basis (30.6 percent). Other methods of payment include per trip, per time period (hourly, weekly, monthly, or annually), per mile plus 10.00 dollars, barter, and simply "dividing up what is left

over after expenses". Since costs could not be established on a per mile basis for the "other" cost classifications in this study, driving labor cost was estimated as the weighted average of percentage of freight bill and per mile costs.

According to survey data, the driving labor cost for firms paying on a per mile basis averages .1806 dollars per mile. Driving labor cost for firms paying on a percentage of freight bill basis was estimated by first determining total revenue for the firm. On a firm by firm basis, total revenue was then multiplied by the percentage of the bill that the driver received for his services, and finally divided by the total annual miles per tractor. The average driving labor cost per mile for these firms is .1917 dollars per mile. The weighted average driving labor cost is .1869 dollars per mile.

Maintenance and Repairs

Maintenance and repair costs include lubricants, tune-ups, engine overhauls, and general repairs. Reliable per-mile estimates of these costs are difficult to establish since most of these costs arise sporadically. Annual maintenance and repair cost information was gathered in the survey of North Dakota grain truckers. The mean annual maintenance and repair cost was 5,717.14 dollars per truck or .0715 dollars per mile.

The maintenance and repairs costs were verified through interviews of Fargo truck dealer salesmen and mechanics. Information was obtained about the frequency of repairs and costs of parts and labor for oil and filter changes, air and fuel

filter changes, grease, transmission oil, anti-freeze, batteries, major engine and transmission overhauls, tarp repairs, and other miscellaneous costs (see Appendix B).

Using the information provided by the dealers, annual maintenance and repair costs were estimated. Depending upon the type of truck, the dealer's estimated maintenance and repair cost varies from .0285 to .0517 dollars per mile. There is some discrepancy between the dealer's maintenance and repair costs and the results from the grain trucker survey. In general, the estimated maintenance and repair costs provided by dealers are lower than the survey results.

Fuel

Fuel cost varied slightly between loaded and unloaded hauls, and the cost difference was accounted for. The average reported fuel costs in 1986 was .942 dollars per gallon. The fuel efficiency of tractors was 4.79 miles per gallon loaded and 5.61 miles per gallon unloaded. Given that the typical grain truck is loaded for 71.7 percent of the total miles, the estimated annual fuel cost is 14,996.58 dollars or .1885 dollars per mile.

Total Variable Costs

In 1986, the total variable cost per mile was .4820 dollars (Table 18). On an annual basis, the typical three tractor/four trailer North Dakota grain trucking firm traveling 229,095 miles per year pays 111,196.72 dollars for tires, labor, maintenance and repairs, and fuel (Table 18).

TABLE 18. Per Mile and Firm Total Variable Trucking Costs, 1986[a]

Cost Item	Per Mile Cost	Firm Total Variable Cost
Tires	.0351 $/mile	$ 8,041.23
Labor	.1869	42,817.86
Maintenance & Repairs	.0715	17,153.22
Fuel	.1885	43,184.41
TOTAL VARIABLE COST	.4820 $/mile	$111,196.72

[a]The firm is assumed to operate three tractors and four trailers.

AVERAGE TOTAL COSTS

In 1986, the typical North Dakota grain trucker's average total cost was .8326 dollars per mile (Table 19). Given that fixed costs per mile depend upon mileage, average total cost also varies with mileage. In other words, firms which drive less than the average of 229,095 miles per year will have higher fixed and average total costs per mile, while those firms with higher mileage will have lower fixed and average total costs per mile. In general, fixed cost per mile rises or falls about 1.545 cents per 10,000 miles under or over 229,095 miles per year. For example, if a firm only averages 200,000 miles per year, the average fixed cost per mile rises to .4016 dollars per mile and the average total cost rises to .8836 dollars per mile (Table 19). On the other hand, a firm which can increase its annual mileage to 260,000 miles per year will decrease its average fixed cost per mile to .3089 dollars per mile or .7909 dollars per mile.

TABLE 19. Average Total Costs and Annual Mileage for North Dakota Grain Truckers, 1986

Firm Annual Mileage	Variable Cost	Fixed Cost per Mile	Average Total Cost per Mile
	---------- dollars per mile ----------		
200,000 miles	.4820	.4016	.8836
229,095 miles	.4820	.3506	.8326
260,000 miles	.4820	.3089	.7909

V. CHANGES IN GRAIN TRUCKING COSTS OVER TIME

The purpose of this section of the report is to evaluate changes in grain trucking costs over time. Such a comparison will provide the grain trucking industry with information as to its success in controlling costs over time. Comparisons are made between the cost estimates of this study and the estimates from the previous UGPTI studies conducted by Cosgriff and Wilson, Griffin, and Casavant.

The cost estimates from the three studies are not directly comparable because of inflation and slightly different costing methodologies. Thus, various United States Department of Commerce Producer Price Indexes (PPI) were used to state cost values from 1976 and 1979 in 1986 dollars. All items of fixed cost, tire, and maintenance and repair costs for 1976 and 1979 were indexed using the PPI transportation equipment index. Labor costs were indexed with the hourly and weekly earnings index for transportation and public utilities employees. Fuel costs were indexed using the PPI for fuels, related products and power.

Four adjustments were required to make fixed costs for the three time periods directly comparable. First, the 1976 costs were recalculated to reflect the total fixed costs on the basis of a three tractor/four trailer firm rather than an individual tractor-trailer basis. Second, the depreciation costs in 1979 were broken down to independently reflect the depreciation and return on investment (ROI) costs for tractors and trailers. Third, ROI for each year was calculated using an interest rate of 11 percent. Finally, the 1986 depreciation costs were recalculated, using the same estimated useful life and salvage values as in the 1976 and 1979 cost studies. The estimated useful life and salvage values in the previous studies were four years and 30 percent of the original value for tractors and six years and 25 percent for trailers.

In 1986 dollars, fixed costs rose from 119,746.78 dollars in 1976 to 136,139.62 dollars in 1979 (Table 20). Since 1979, fixed costs have sharply declined, falling 25.2 percent to 101,743.01 dollars. Expressed in real terms, every item of fixed cost is lower in 1986 than in 1976 or 1979. Most cost items rose sharply between 1976 and 1979 before falling. Insurance has been declining across the three time periods.

Variable costs per mile in 1986 dollars are also lower in 1986 than they were in 1976 or 1979. In 1986 dollars, variable costs per mile rose from .5492 dollars per mile in 1976 to .6935 dollars per mile in 1979, before dropping to .4820 dollars per mile in 1986 (Table 21).

TABLE 20. Fixed Cost Comparison for 1976, 1979, and 1986[a]

Cost Categories	Year 1976	1979	1986
Depreciation			
Tractor	$41,810.87	$46,219.95	$38,878.72
Trailer	11,416.25	15,406.65	10,120.00
Return on Investment			
Tractor	17,082.73	18,884.15	15,884.74
Trailer	6,278.94	8,473.66	5,566.00
License	5,948.32	6,602.85	4,137.75
Insurance	24,971.45	17,607.60	15,504.39
Housing	1,643.94	5,282.28	929.74
Management/Overhead	10,594.28	17,607.60	10,721.67
Total Fixed Cost	$119,746.78	$136,084.74	$101,743.01

[a]All values are expressed in 1986 dollars. The costs for 1976 were adapted from Cosgriff and indexed by 1.8266. The costs for 1979 were adapted from Wilson, Griffin, and Casavant and indexed by 1.4673.

TABLE 21. Variable Cost Comparison for 1976, 1979, 1986[a]

Cost Categories	Year 1976	1979	1986
	--------- dollars per mile ---------		
Tires[1]	.0402	.0587	.0351
Fuel[2]	.2312	.2607	.1885
Maintenance/Repairs[1]	.0528	.1321	.0715
Labor[3]	.2250	.2420	.1869
Total Variable Costs	.5492	.6935	.4820

[a]All values are expressed in 1986 dollars. The costs for 1976 were adapted from Cosgriff and the costs for 1979 were adapted from Wilson, Griffin, and Casavant.
[1]The PPI transportation equipment cost index for 1976 was 1.8266 and 1979 was 1.4673.
[2]The PPI fuels and related products and power index for 1976 was 1.8204 and 1979 was 1.1848.
[3]The PPI hourly and weekly earnings for transportation and public utilities index for 1976 was 1.8003 and 1979 was 1.4235.

Lower labor and fuel costs were the greatest source of lower variable costs. Since 1979, fuel costs per mile have fallen .0722 dollars in 1986 dollars as a result of improved mileage per gallon and stable fuel prices (Table 21). In 1986 dollars, per mile labor costs have declined by 22.8 percent since 1979. This may be the result of the decline in the grain trucking industry and the large number of owner-operators in grain trucking. Many owner-operators only pay themselves after the other expenses have been paid. In other words, owner-operators may be willing to lower driving labor costs to survive. Tire costs are lower because new tires have longer useful lives.

Average total costs have also declined in real terms. Assuming that a typical three tractor grain trucking firm drives 250,000 miles per year, average total costs have fallen 28.2 percent between 1979 and 1986 (Table 22). In real terms, average total costs have decreased from 1.2378 dollars per mile in 1979 to .8890 dollars per mile in 1986.

TABLE 22. Average Total Cost Comparison for North Dakota Grain Truckers, 1976, 1979, and 1986[a]

Year	Variable Cost	Fixed Cost per Mile	Average Total Cost per Mile
	dollars per mile		
1976	.5492	.4790	1.0282
1979	.6935	.5443	1.2378
1986	.4820	.4070	.8890

[a]Assumes a firm annual mileage of 250,000 miles.

VI. SUMMARY AND CONCLUSIONS

The objectives of this report were to: (1) define and compare industry characteristics of North Dakota grain truckers with previous research; (2) estimate and evaluate the operating costs for motor carrier firms hauling grain in North Dakota; and (3) evaluate changes in grain trucking costs over time.

Overall, the grain trucking industry has been in a general decline during the past decade. Much of the decline in truck traffic can be attributed to changes in the rail and grain elevator industries. Rail has become more competitively priced with truck since the 1980 Stagger's Act. The grain elevator industry has taken advantage of lower rail rates by building multiple-car elevators which are typically more dependent on rail than truck.

An analysis of firm size and concentration suggests a trend towards owner-operator (one tractor) grain trucking firms. In 1986, almost 58 percent of the grain trucking firms were owner-operators. While the larger firms dominate the industry in terms of percentage of loaded miles, owner-operator increased their market share by over six percentage points between 1979 and 1986.

Analysis of the markets served and commodities hauled indicates few changes over time. North Dakota grain truckers continue to heavily rely upon in-state origins for most of their business, with owner-operator firms being the most dependent on North Dakota origins. The number of elevators served by a trucking firm has increased, indicating an expanded market base.

Minneapolis/St. Paul remains the most common destination for grain trucked from North Dakota. The most significant change has been the decline of the Duluth/Superior market and the emergence of truck traffic between North Dakota locations. This latter phenomenon is a result of elevator mergers and the growth of agricultural processing in North Dakota.

The majority of the firms earned their income by hauling exempt commodities. Owner-operators earn over 83 percent of their income hauling exempt commodities, while large firms' income is almost evenly divided between exempt and regulated commodities.

The industry average annual mileage per truck fell from 88,188 miles in 1979 to 79,547 miles in 1986. Larger sized firms have been more successful in increasing their utilization than medium sized and owner-operator firms. This may be occurring because larger sized firms are concentrating on long distance markets such as the Pacific Northwest while smaller firms are concentrating on providing local (short haul) service.

There are indications that the grain trucking firms are improving the utilization of their equipment. Increases in the percentage of loaded miles (i.e. revenue generating miles), and the average payload are both indicators of a healthy trucking industry. Most of the increase in loaded miles occurred with owner-operators (over 6 percentage points), while the largest sized firms continue to have the highest percentage of loaded miles (81.0 percent). Two possible explanations for the in-

creased average payload are technological advances in lighter weight equipment and the higher load weight restrictions on the interstate system.

The average age of grain trucking firms has increased. This indicates a greater stability within the industry with fewer new firms entering and/or fewer old firms exiting. The older firms are less likely to go out of business due to their well established clientele and greater knowledge of the business environment.

Using the economic-engineering costing methodology, the 1986 average total costs were .8326 dollars per mile for the typical firm operating three tractors/four trailers an average of 229,095 miles per year. In real terms, the average total cost has declined 28.2 percent since 1979. All items of fixed and variable cost have declined since 1979.

In conclusion, the grain trucking industry has faced much stiffer competition from rail since the passage of the Stagger's Rail Act in 1980. The grain trucking industry's ability to compete with rail is especially limited in long-distance markets and for commodities which typically move under multiple-car rates.

The keys for long-run survival of firms in the grain trucking industry include: (1) concentrating on hauling rate competitive traffic, (2) striving towards obtaining operational efficiencies, and (3) seeking backhauls. First, motor carriers must continue to be rate competitive with rail for short haul

movements to North Dakota and Minnesota destinations. Motor carriers may also effectively compete with rail for small volume movements, i.e., commodities that typically move in single car consignments. Second, steps towards obtaining cost and operational efficiencies have already been taken by grain trucking firms, as they have lowered their per mile cost and increased their percentage of loaded miles and average payload. However, firms must continue to focus upon operational improvements along with improvements in equipment and the average annual miles per truck. Finally, grain trucking firms must maximize their revenue generating miles, obtaining backhauls whenever feasible.[8]

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[8]See Dooley, Bertram, and Wilson, Backhaul Opportunities for North Dakota Grain Truckers, UGPTI Report No. 69, Upper Great Plains Transportation Institute, North Dakota State University, Fargo, 1988.

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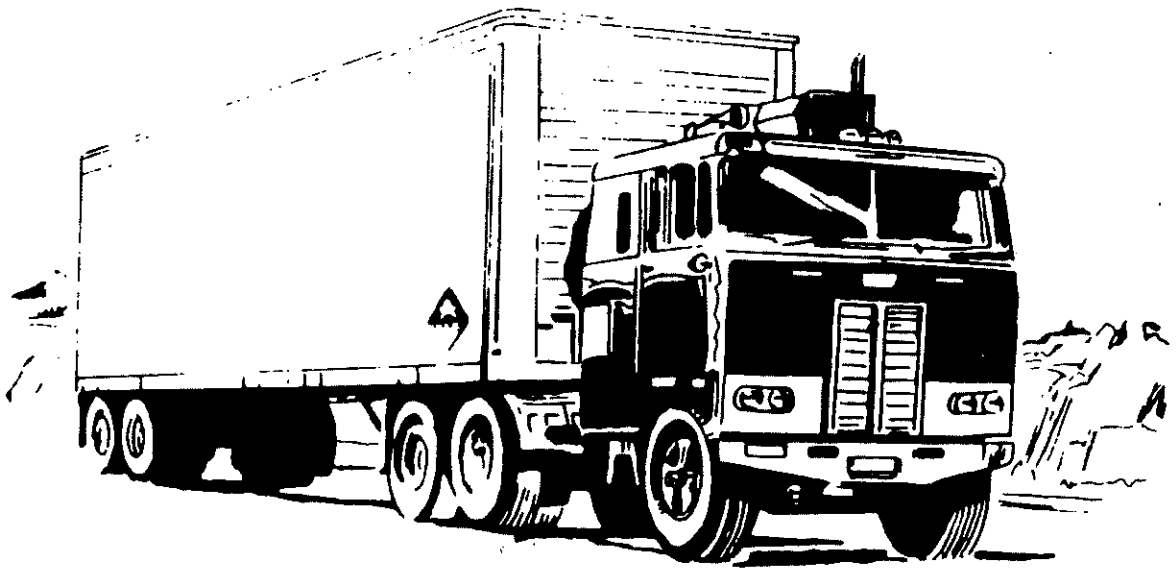
APPENDIX A

A SURVEY OF NORTH DAKOTA GRAIN TRUCKERS

A SURVEY OF NORTH DAKOTA GRAIN TRUCKERS



Upper Great Plains Transportation Institute
North Dakota State University
Fargo, North Dakota 58105
August 1987

I. YOUR RESPONSES TO THE FOLLOWING QUESTIONS WILL HELP US DESCRIBE THE GENERAL CHARACTERISTICS OF NORTH DAKOTA'S TRUCKING INDUSTRY. WE GUARANTEE THAT ALL INFORMATION WILL BE KEPT CONFIDENTIAL.

1. What county do you live in? _____

2. How long have you operated in North Dakota? _____ YEARS

3. What elevators do you serve on a regular basis?

_____ _____ _____

_____ _____ _____

4. How many tractors do you operate?
   OWN _____
   LEASE _____
   TOTAL _____

5. How many trailers do you operate?
   OWN _____
   LEASE _____
   TOTAL _____

6. How many miles nationwide did your trucks log in 1986?
   _____ MILES

   What percentage of these were loaded? _____ %

7. What percent of your loads originate in North Dakota?
   _____ %

8. What is the average weight of your loads? _____ POUNDS

9. What percent of your income is earned from:

HAULING EXEMPT COMMODITIES	_____ %
HAULING REGULATED COMMODITIES	_____ %
OTHER SOURCES	_____ %
TOTAL	100 %

10. What percent of your trips hauling grain are to:

DULUTH/SUPERIOR	_____ %
MINNEAPOLIS/ST. PAUL	_____ %
PACIFIC NORTHWEST	_____ %
BETWEEN ELEVATORS IN NORTH DAKOTA	_____ %
OTHER (please specify) _____	_____ %
TOTAL	100 %

II. THE NEXT SET OF QUESTIONS WILL HELP US UNDERSTAND MORE ABOUT TRUCKING GRAIN TO VARIOUS TERMINAL MARKETS. PLEASE ANSWER THE QUESTIONS **ONLY** FOR THE DESTINATIONS YOU SHIP TO.

1. Do you haul grain to Duluth/Superior?
   _____ YES (please answer the questions on this page)
   _____ NO [turn to page 3]

   A. What is the one-way distance to Duluth/Superior?
      _____ MILES

   B. What is the average rate you receive for

      WHEAT? _____ CENTS/CWT
      BARLEY? _____ CENTS/CWT
      SUNFLOWER? _____ CENTS/CWT

   C. How often do you return from Duluth/Superior with a backhaul? _____ PERCENT OF THE TIME

   D. How far out of the way will you drive to obtain a backhaul? _____ MILES

   E. What product do you backhaul most often from Duluth/Superior? _____

   F. Where do you typically haul this product to? _____

   G. What is the average rate you receive for a loaded backhaul? _____ CENTS/CWT

   H. Are your backhauls from Duluth/Superior set up before you leave North Dakota?
      _____ YES _____ NO

   I. On average, how much time will you spend waiting or looking for a backhaul from the time you are unloaded at your fronthaul destination to the time you are ready to return with the backhaul?

      _____ HOURS _____ MINUTES

   J. On average, how many possible backhaul loads do you hear about when searching each trip? _____

   K. On average, how long do you wait to unload at Duluth/Superior terminal elevators?

      _____ HOURS _____ MINUTES

2. Do you haul grain to Minneapolis/St. Paul?

_____ YES (please answer the questions on this page)
_____ NO [turn to page 4]

A. What is the one-way distance to Minneapolis/St. Paul?
_____ MILES

B. What is the average rate you receive for

WHEAT? _____ CENTS/CWT
BARLEY? _____ CENTS/CWT
SUNFLOWER? _____ CENTS/CWT

C. How often do you return from Minneapolis/St. Paul with a backhaul? _____ PERCENT OF THE TIME

D. How far out of the way will you drive to obtain a backhaul? _____ MILES

E. What product do you backhaul most often from Minneapolis/St. Paul? _____

F. Where do you typically haul this product to? _____

G. What is the average rate you receive for a loaded backhaul? _____ CENTS/CWT

H. Are your backhauls from Minneapolis/St. Paul set up before you leave North Dakota?
_____ YES _____ NO

I. On average, how much time will you spend waiting or looking for a backhaul from the time you are unloaded at your fronthaul destination to the time you are ready to return with the backhaul?

_____ HOURS _____ MINUTES

J. On average, how many possible backhaul loads do you hear about when searching each trip? _____

K. On average, how long do you wait to unload at Minneapolis/St. Paul terminal elevators?

_____ HOURS _____ MINUTES

3. Do you haul grain to the Pacific Northwest (Portland, Seattle, Snake River, etc.)?

_____ YES (please answer questions on this page)
_____ NO [turn to page 5]

Please identify which Pacific Northwest market you haul to.

_____

A. What is the one-way distance to this destination?
_____ MILES

B. What is the average rate you receive for

WHEAT? _____ CENTS/CWT
BARLEY? _____ CENTS/CWT
SUNFLOWER? _____ CENTS/CWT

C. How often do you return from the Pacific Northwest with a backhaul? _____ PERCENT OF THE TIME

D. How far out of the way will you drive to obtain a backhaul? _____ MILES

E. What product do you backhaul most often from the Pacific Northwest? _____

F. Where do you typically haul this product to? _____

G. What is the average rate you receive for a loaded backhaul? _____CENTS/CWT

H. Are your backhauls from the Pacific Northwest set up before you leave North Dakota?
_____ YES _____ NO

I. On average, how much time will you spend waiting or looking for a backhaul from the time you are unloaded at your fronthaul destination to the time you are ready to return with the backhaul?

_____ HOURS _____ MINUTES

J. On average, how many possible backhaul loads do you hear about when searching each trip? _____

K. On average, how long do you wait to unload at Pacific Northwest terminal elevators?

_____ HOURS _____ MINUTES

4. Do you haul grain to other markets?

_____ YES (please answer questions on this page)
_____ NO [turn to page 6]

Please identify this market. _____

A. What is the one-way distance to this destination?

_____ MILES

B. What is the average rate you receive for

WHEAT? _____ CENTS/CWT
BARLEY? _____ CENTS/CWT
SUNFLOWER? _____ CENTS/CWT

C. How often do you return from this destination with a backhaul? _____ PERCENT OF THE TIME

D. How far out of the way will you drive to obtain a backhaul? _____ MILES

E. What product do you backhaul most often from this destination? _____

F. Where do you typically haul this product to? _____

G. What is the average rate you receive for a loaded backhaul? _____ CENTS/CWT

H. Are your backhauls from this destination set up before you leave North Dakota?
_____ YES _____ NO

I. On average, how much time will you spend waiting or looking for a backhaul from the time you are unloaded at your fronthaul destination to the time you are ready to return with the backhaul?

_____ HOURS _____ MINUTES

J. On average, how many possible backhaul loads do you hear about when searching each trip? _____

K. On average, how long do you wait to unload at this destination terminal elevators?

_____ HOURS _____ MINUTES

III. NEXT, OPERATION COSTS CONTINUE TO INCREASE EACH YEAR AND VARY FROM FIRM TO FIRM. PLEASE PROVIDE INFORMATION ABOUT YOUR COMPANIES COSTS AND OPERATIONS FOR THE YEAR 1986.

A. 1986 Trucking Expense

1. On average, how much did these items cost per truck in 1986?

$_____ STATE LICENSE FEES PER TRUCK
$_____ INSURANCE COST PER TRUCK
$_____ MAINTENANCE AND REPAIRS PER TRUCK (batteries,grease, oil & filters, tune-ups, tarps and other minor repairs)

2. How are your drivers paid? (check all that apply)

_____ A. RATE PLUS $10
_____ B. PER MILE HOW MUCH? _____ ¢/TRIP
_____ C. PER TRIP HOW MUCH? _____ $/TRIP
_____ D. PERCENT OF FREIGHT BILL HOW MUCH? _____ %
_____ E. OTHER (please specify) _____

3. How many full time drivers work for you? _____

4. What was your total labor cost for all drivers in 1986?

$_____

5. What is your approximate total subsistence cost for each driver in 1986? (like meals, lodging, etc.)

hired drivers _____ DOLLARS
owner _____ DOLLARS

6. Do you pay your drivers for idle time? (waiting for loading or unloading) _____ YES _____ NO

7. What rate do you use? _____ DOLLARS/HOUR

B. 1986 Trucking Operations

1. What was the average miles driven per truck in 1986?
_____ MILES PER TRUCK

2. What is the average speed your truckers drive?
_____ MPH

3. What was the average price paid for diesel fuel in 1986? _____ $/GALLON

4. How many miles per gallon do you average when you are loaded with grain?
_____ MILES/GALLON

5. How many miles per gallon do you average when empty?
_____ MILES/GALLON

6. What is the average price you pay for tractor tires?
_____ $ PER TRACTOR TIRE

7. How many miles will tractor tires last? _____ MILES

8. What is the average price you pay for trailer tires?
_____ $ PER TRAILER TIRE

9. How many miles will trailer tires last? _____ MILES

10. On average, in what year were your tractors manufactured? 19__

On average, in what year were your trailers manufactured? 19__

11. From the time you bought your last tractor and trailer, how long would you expect them to last?

trailers: _____ MILES _____ YEARS
tractors: _____ MILES _____ YEARS

12. Assume you will be trading in one of your tractors and trailers in August 1987:

A. What year and model is the tractor?
_____ YEAR _____ MODEL

B. What year and type is the trailer?
_____ YEAR _____ TYPE

C. What is the trade-in value of the tractor?
$_____

D. What is the trade-in value of the trailer?
$_____

E. What do you estimate it would cost to purchase a new tractor? (not including trade-in value)
$_____

F. What do you estimate it would cost to purchase a new trailer? (not including trade-in value)
$_____

D. OTHER COSTS

1. What is your average annual total cost of management and supervising personnel? _____ DOLLARS

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

3. Do you advertise? _____ YES _____ NO

   If yes, how much does it cost in an average year?
   $_____

4. Do you own or lease any communication equipment? (C.B., etc.)
   _____ YES _____ NO

   If yes, what does this cost you per year on an average?
   _____ DOLLARS

5. Are your trucks stored indoors?
   _____ YES, IN A BUILDING I OWN
   _____ YES, IN A BUILDING I RENT
   _____ NO

6. If you own your truck garage:

   A. How much of the building is used for truck storage? _____ PERCENT

   B. What did the building cost you?
   _____ DOLLARS

   C. What does the insurance cost you on your building?
   _____ DOLLARS PER YEAR

   D. What is the approximate total annual taxes on the garage? _____ DOLLARS

   E. How long will your garage last? _____ YEARS

   F. If you rent, how much is rent per month?
   _____ DOLLARS PER MONTH

7. What was your total equipment leasing cost in 1986?
   $_____

8. Has your use of leased equipment increased or decreased in recent years?
   _____ INCREASED
   _____ DECREASED
   _____ NO CHANGE

IV. FINALLY, OUR GOAL IS TO ENCOURAGE AND HELP TRUCKERS OBTAIN MORE BACKHAULS. IN ORDER TO DO THIS WE NEED TO BETTER UNDERSTAND FRONTHAULS, BACKHAULS, AND THE RATES INVOLVED.

1. How are most of your fronthaul loads set up?
   _____ ELEVATOR CALLS ME.
   _____ I CALL THE ELEVATOR.
   _____ COMMISSION FIRM CALLS ME.
   _____ I CALL THE COMMISSION FIRM.
   _____ A BROKER CALLS ME.
   _____ I CALL A BROKER.
   _____ OTHER, PLEASE SPECIFY. _____

2. How often do you have a backhaul? _____% OF MY TRIPS

3. Do you ever use a broker to set up backhauls?
   _____ YES _____ NO

   If yes, what is the brokers percentage charge? _____%

4. Do you ever operate under a lease with a regulated carrier for backhauls? _____ YES _____ NO

   If yes, what percent of the revenue do you receive?
   _____%

5. Does your company have a person who specializes in setting up loads? _____ YES _____ NO

   If yes, how much is this person paid per year? $_____

6. What factors discourage you from obtaining a backhaul?

   _____ THE PROCESS OF OBTAINING OPERATING AUTHORITY
   _____ TIME INVOLVED IN SETTING UP A BACKHAUL
   _____ LOWER RATES
   _____ HIGH BROKER COMMISSIONS
   _____ EQUIPMENT PROBLEMS
   _____ OTHER, PLEASE SPECIFY _____
   _____

7. Do you charge lower rates on the fronthauls when backhauls are available?
   _____ YES _____ NO

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

9. Do you have operating authority from the ICC?
   _____ YES _____ NO

   IF YES, FOR WHAT COMMODITY? _____
   WHAT GEOGRAPHIC AUTHORITY? _____

10. Do you have operating authority from any state agency?
_____ YES _____ NO

IF YES, FOR WHAT COMMODITY _____
WHAT GEOGRAPHIC AUTHORITY _____

11. Who are your regular customers?

ELEVATORS	_____%	
FARMERS DIRECTLY	_____%	
OTHER (PLEASE SPECIFY)	_____%	_____
TOTAL	100%	

12. Finally, what do you feel are the most important issues and concerns facing exempt truckers today?

APPENDIX B

SURVEY OF TRACTOR/TRAILER DEALERS

TRUCK COST QUESTIONNAIRE

Assume that the typical grain trucking firm consists of three tractors and four trailers. Hopper bottom are the most common type of trailer. Each combination travels 80,000 miles annually. The percentage of trips to each particular market are as follows:

Minneapolis/St.Paul	35.3%
between North Dakota Elevators	27.1
Duluth/Superior	12.7
Pacific Northwest	11.2
Other Destinations	13.7
Total	100.0%

** All figures quoted are estimates.

Dealer Name: _____

Date: _____

Tractor Brand: _____

Trailer Brand: _____

New Tractor Cost: _____

New Trailer Cost: _____

Leased Tractor-Trailer Cost: _____

Periodic Maintenance Costs: _____

Oil:

How Often is the Oil Changed (in miles): _____

How Many Quarts are Used per Change: _____

Cost per Quart: _____

Labor Cost per Change: _____

Oil Filters:

Is the Filter Replaced with every Oil Change: _____

If no, how often is the Oil Filter Changed (in miles): _____

Cost per Oil Filter: _____

Labor Cost per Replacement: _____

Grease:

How often is the Vehicle Greased (in Miles): _____

How many Pounds are Used per Grease Job: _____

Grease Cost: _____

Labor Cost per Grease Job: _____

Transmission Oil:

How often is Tranmission Oil Changed (in miles): _____

Oil Cost: _____

Labor Cost per Transmission Oil Job: _____

Anti-Freeze:
How many Gallons are used per Year: _____

Cost per Gallon: _____

Labor Cost: _____

Batteries:
How long do the Batteries Last (months): _____

Cost per Battery: _____

Labor Cost per Replacement: _____

Air Filters:
How often is the Air Filter Replaced (in miles): _____

Cost per Air Filter: _____

Labor Cost per Replacement: _____

Fuel Filters:
How often is the Fuel Filter Changed (in miles): _____

Cost per Fuel Filter: _____

Labor Cost per Change: _____

Major Overhauls:
How often is a Major Engine Overhaul Necessary (in miles): _____

Cost per Major Overhaul: _____

Labor Cost per Overhaul: _____

Transmissions:

How often is a Major Overhaul necessary on the Transmission (in miles): _____

Cost for Transmission Maintenance: _____

Labor Cost for Transmission Maintenance: _____

Other Costs

What other costs are incurred by an average trucking firm _____

How much do these Other Costs Approximately Equal _____

Tarps:

Regular:

How often is the Tarp Replaced: _____

Cost per Regular Tarp: _____

Rollover:

How often is the Tarp Replaced: _____

Cost per Rollover Tarp: _____

Tires: Size 11-24.50

Tractor:

Estimated Useful Life of:

Steering: _____

Drive Wheel: _____

Cost per Tire: _____

Labor Cost to Change Tires: _____

Trailer:

Estimated Useful Life: _____

Cost per Tire: _____

Labor Cost to Change Tires: _____

Insurance:

What is the approximate yearly cost of insurance on a tractor-trailer combination: _____