NORTHERN PLAINS BARLEY RAILROAD TRANSPORTATION AND MARKETING STUDY

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Disclaimer

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I. INTRODUCTION

The Northern Plains region (which consists of Minnesota, North Dakota, and South Dakota) is the leading barley producing area in the nation. In 1985, the region accounted for over 48 percent of the barley produced in the United States.

Barley producers and shippers in the Northern Plains region compete with other supply regions in the United States and Canada for a limited number of markets. As in most endeavors, a knowledge of markets, market participants, market shares, and constraints in the marketing channels is of considerable importance to barley merchandisers, elevator managers, and producers. In addition, data regarding market shares and marketing channels are of keen interest and concern to federal and state agricultural agencies, barley promotional groups, state departments of transportation, and state public service commissions.

A great deal of information is compiled annually by the USDA and state agricultural statistical services regarding barley production, terminal market prices, and prices received by producers. However, with the exception of a few grain exchange reports, there is little published information on the annual volume of barley handled at each market. In fact, for some feed barley markets, there are no published data at all. Perhaps more importantly, there is no published information on market participants and market shares. Consequently, barley merchandisers and producers in each region are operating without complete information of the markets. Better information about markets almost always results in more rational decisions by everyone involved in the marketing channel, and generally improves the efficiency of the markets themselves.

The need for market information is especially important for the Northern Plains region because of shifts in traditional markets and marketing channels. Prior to 1980, almost all of the barley produced in the Northern Plains was shipped to Minneapolis as potential malting barley, or to Duluth for feed. For example, in crop year 1976-77, 90 percent of North Dakota's barley was shipped to Minneapolis and Duluth/Superior.

The characteristics of the Minnesota markets and market participants are generally well-known to most Northern Plains producers and shippers. However, during the 1980's, new feed and malting barley markets began to appear, and the domination of the traditional Minnesota markets began to fade. Again, using North Dakota as an example, approximately 65 percent of the barley shipped during crop year 1988-89 was destined for markets other than Duluth and Minneapolis.

The growing importance of non-traditional markets is one factor underscoring the need for more detailed and comprehensive market data. A second factor is the growing dependence of Northern Plains barley shippers on railroad transportation.

Again, using North Dakota data as an example, in crop year 1976-77, trucks handled 34 percent of all barley shipments, including 42% of the bushels shipped to Portland and 78% to Duluth. However, as Table 1 shows, truck share has dropped precipitously in most markets, falling to just five percent in the Pacific Northwest market. Overall, trucks captured just 18 percent of the barley traffic originating in North Dakota during crop year 1988-89.

These trends are not necessarily negative, nor do they represent a problem, in and of themselves. They simply stress the fact that the Northern Plains is heavily dependent upon railroad transportation. Consequently, knowledge of railroad market volumes and the percentage of railroad volumes generated by various supply regions are of special significance to the Northern Plains.

Table 1 North Dakota Barley Shipments By Rail and Truck and Destination (Thousands of Bushels)										
	Mpls-St. Paul		Duluth-Superior		West		Misc. Markets		Total	
Year	Rail	Truck	Rail	Truck	Rail	Truck	Rail	Truck	Rail	Truck
76-77	37974	1753	5792	20880	74	52	4329	2459	48169	25144
	(96%)	(4%)	(22%)	(78%)	(58%)	(42%)	(64%)	(36%)	(66%)	(34%)
77-78	23111	1895	6145	16249	323	469	11583	3340	41162	21953
	(92%)	(8%)	(27%)	(73%)	(41%)	(59%)	(78%)	(22%)	(65%)	(35%)
78-79	25414	1678	7578	5210	677	527	18656	9910	52325	17325
	(94%)	(6%)	(59%)	(41%)	(56%)	(44%)	(65%)	(35%)	(75%)	(25%)
79-80	27963	1206	15697	6945	301	452	17728	8328	61689	16931
	(96%)	(4%)	(69%)	(31%)	(40%)	(60%)	(68%)	(32%)	(79%)	(21%)
80-81	19535	499	9025	5189	92	2055	19133	7144	47785	14887
	(98%)	(2%)	(63%)	(37%)	(4%)	(96%)	(73%)	(27%)	(76%)	(24%)
81-82	18619	1323	20889	10782	247	910	20189	6844	59943	19858
	(93%)	(7%)	(66%)	(34%)	(21%)	(79%)	(75%)	(25%)	(75%)	(25%)
82-83	17680	3176	8484	4060	179	1586	28994	5946	55337	14768
	(85%)	(15%)	(68%)	(32%)	(10%)	(90%)	(83%)	(17%)	(79%)	(21%)
83-84	18763	2631	27896	10682	3782	509	36784	5599	87225	19420
	(88%)	(12%)	(72%)	(28%)	(88%)	(12%)	(87%)	(13%)	(82%)	(18%)
84-85	20821	2006	20822	5843	8508	965	37750	9314	87901	18128
	(91%)	(9%)	(78%)	(22%)	(90%)	(10%)	(80%)	(20%)	(83%)	(17%)
85-86	17888	2546	7610	565	8444	1110	57775	9498	91717	13719
	(88%)	(12%)	(93%)	(7%)	(88%)	(12%)	(86%)	(14%)	(87%)	(13%)
86-87	27731	1789	8429	1707	42590	259	57444	6392	136194	10148
	(94%)	(6%)	(83%)	(17%)	(99%)	(1%)	(90%)	(10%)	(93%)	(7%)
87-88	23958	3272	8827	7285	5310	315	45453	9979	83548	20851
	(88%)	(12%)	(55%)	(45%)	(94%)	(6%)	(82%)	(18%)	(80%)	(20%)
88-89	20908	1782	7395	2340	6531	318	41631	11806	76467	16248
	(92%)	(8%)	(76%)	(24%)	(95%)	(5%)	(78%)	(22%)	(82%)	(18%)
Source: North Dakota Grain and Oilseed Transportation Statistics 1988-1989										

OBJECTIVES AND RESEARCH DESIGN

An important first step in analyzing barley market dynamics is to gain a more specific understanding of the markets involved and how they have changed over time. From a marketing and policy perspective, it is important not only to look at trends in market share, but to try to identify factors which affect market shares and shifts.

The goal of the research project is to describe barley markets (particularly non-traditional markets) and interregional railroad flows over time. The primary objectives of the study are:

1. To identify the major barley markets nationwide;
2. To estimate the railroad carloads and tons terminated in each market over a five-year period (1984--1988);
3. To estimate the share of railroad carloads terminated in each market which originated from the Northern Plains production region;
4. To estimate the shares of railroad traffic in each terminal market held by other supply regions;
5. To estimate truck and barge shares in major barley markets (to the extent possible);
6. To describe how market shares have changed over time;
7. To explain why markets and market shares have shifted, and to identify any transportation factors which may affect market shares;
8. To assess the transportation advantages and disadvantages of each production region;
9. To identify any constraints or inefficiencies in the transportation/marketing channels.

An ancillary objective of the study is to estimate the net prices received by shippers in each supply region. The net shipper price is defined as the terminal market price minus the transportation rate. The net shipper price is important because the prices received by producers are really a function of two variables: the prices received by shippers and elevator margins. The prices received by producers are important in agricultural decision-making and policy because they affect the producer's expectations of net farm prices for each commodity. Net farm prices (in combination with production costs and related factors) determine which crops a farmer will plant and the proportion of acreage allocated to each[1]. In short, the natural advantages of each production region relate not only to production characteristics and costs, but to transportation advantages or disadvantages.

Part of a region's transportation advantage or disadvantage is simply a function of its proximity to market. However, distance is not the only variable involved. As part of this study, a set of transportation factors will be analyzed which describe the impedance to flow between each production region and each market.

Scope of the Analysis

The analysis will focus primarily on railroad transportation (rather than on truck or truck-barge shipments). There are two major reasons for this approach; the first relates to data limitations.

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[1]W. Wilson describes producer's decisions regarding barley production in the following excerpt from his 1983 publication (page 10). *Producers generally allocate land between crops according to expected net returns per hectare. In other words, hectarage allocation to barley is based on expected profits per hectare relative to alternative crops. Production costs, yields, and prices are the main factors affecting the decision. The latter two are uncertain and are based on expectations. Cost per acre is known with relative certainty prior to production. However, returns are uncertain due to yield and price fluctuations. Other factors which affect the decision to produce barley are a) agronomic factors, b) government programs, but only to the extent they differentiate between grains, c) the utilization of labor and equipment throughout the growing and harvest season which is enhanced due to the early maturity of barley relative to competing crops, d) diversification of production risk, and e) the ability to hedge or lock-in prices for production of other grains. The latter is especially important to barley producers because they have been unable to forward contract cash sales, or hedge. Consequently, their exposure to price risk is greater in barley than in other grains.*

Estimates of the rail carloads of barley originated in each region and terminated in each market are available from the railroad waybill sample. However, similar data for truck and barge tonnages are not uniformly available on a nationwide scale. Therefore, as a practical matter, not all markets can be analyzed in terms of truck and barge shares. The approach taken in this study is to piece together as many elements of overall market shares for as many markets as possible using grain exchange reports and a variety of other data sources. However, it must be recognized that the information base for alternate transportation modes is incomplete and does not have the reliability of the railroad data.

The second and perhaps most important reason for the study's design is that truck and barge share data are somewhat of a moot issue in many markets, especially nontraditional, long-distance markets. In these markets, Northern Plains barley is positioned almost exclusively by rail and is in competition with barley (or corn) from other producing regions, which is also positioned by rail. For example, in the Texas and California markets, Northern Plains rail barley is competing with rail barley from Montana, Wyoming, and other western states. A certain amount of barley is trucked into the southwestern markets from surrounding production areas. However, Northern Plains barley is not really in competition with short-haul truck traffic in these markets (which may be impossible to displace). Instead, the primary marketing and transportation concerns of the region lie with railroad-to-railroad and supply-region competition, which do impact market shares.

Methods and Data

The study utilizes a range of primary and secondary data sources, including USDA and grain exchange data. However, the principal source of data for the study is the Rail Carload Waybill Sample (RCWS) compiled annually by the Interstate Commerce Commission.

The RCWS is a nationwide stratified random sample of all terminating shipments. Each sample waybill observation contains a wide range of information about the shipment including:

1. the originating and terminating regions,
2. the number of tons and cars in the shipment,
3. the railroads in the route,
4. the distance,
5. the revenue,
6. the shipment date.

The Upper Great Plains Transportation Institute has obtained the most recent five years of waybill data from the USDA. The raw USDA files contain the originating and terminating state of each sample shipment. In addition, the Standard Point Location Code (SPLC) is shown for each origin and destination station. In order to gain a fuller understanding of barley markets, the SPLC's have been decoded for all barley origins and destinations. However, the confidentiality of the waybill data is maintained throughout the report. Data and trends are analyzed only by supply and demand regions.

ORGANIZATION OF REPORT

The remainder of the report is organized as follows. First, barley production characteristics and trends are described. Second, barley markets and marketing channels are discussed. Third, interregional volumes and relative market shares are analyzed, primarily from a railroad transportation perspective. Fourth, the market shares of each production region are presented in both graphic and narrative forms. Fifth, estimated net shipper prices for 1987 and 1988 are evaluated. Sixth, transportation factors and their potential effects on marketing channels are analyzed, and the transportation advantages and disadvantages of each region are discussed.

The railroad waybill sample, and the analytical and costing procedures employed in the study, are described in Appendix A. In Appendix B, the relative market shares of corn and feed barley are listed for each of the supply regions and markets evaluated in the study. The reason for the commodity share analysis is that barley and corn are competitors in many feed markets in the United States. Appendix C contains variable cost ratios and fully allocated cost ratios by car size and region.

II. PRODUCTION AND MARKETING CHARACTERISTICS

MALTING VERSUS FEED BARLEY

An important factor in barley production and marketing channels is the distinction between malting and feed barley. Malting barley is used primarily in the production of beer. A portion of the malting barley produced each year is grown under contract. Anheuser-Busch and Coors in particular arrange for much of their malting barley supply through indirect contracts with producers. However, much of the malting barley is still grown independently and is marketed through grain exchanges at Minneapolis or other cities.

Much of the barley planted in the U.S. is planted with the expectation that it will become malting barley. However, some barley produced each year will not meet maltster's standards with respect to variety, protein, kernel plumpness, and color[2]. When this occurs, the crop must either be sold as feed barley or consumed locally.

Feed barley, as the name implies, is used primarily as livestock feed. However, it may also be used for non-feed purposes (such as seed or ethanol). Some feed barley is consumed locally by livestock and is therefore not traded on any exchange or market. The remainder of the feed barley crop is typically marketed at Duluth, Stockton, Forth Worth, or other exchanges.

The distinction between malting and feed barley can be quite important to the producer since there are different prices associated with each. Producers receive a premium for malting barley which may be quite significant during a given year. Thus, the producer's net farm price is typically higher for malting barley than for feed. As will

[2] These standards, it should be noted, do not represent official U.S. standards or grades but are standards established each year by maltsters.

be discussed later, a concerted effort is made in this study to keep malting barley flows and market prices separate from those of feed barley.

Barley production in the Northern Plains is primarily concentrated in western Minnesota, eastern and central North Dakota, and north-eastern and north-central South Dakota. Nationwide, barley production is concentrated in four major supply regions, which are discussed next.

U.S. BARLEY PRODUCTION REGIONS

Four major barley supply regions can be identified in the United States. These regions are:

Northern Plains: Minnesota, North Dakota, and South Dakota;

Mountain: Montana, Wyoming, Colorado, Utah, and Idaho;

West Coast: Washington, Oregon, and California;

Northeast: Wisconsin, Michigan, and Illinois.

In 1988, the Mountain region had the highest level of barley production in the United States, supplying over 38 percent of the barley produced (Figure 1). The second largest producer in 1988 was the Northern Plains region, which supplied 26.7 percent of the nation's barley. The West Coast Region produced nearly 23 percent of America's barley in 1988, the Northeast region supplied 1.3 percent[3], and 10.8 percent was produced in other regions.

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[3]Production statistics for the Northeast region do not include Illinois, as production statistics were not available for this state.

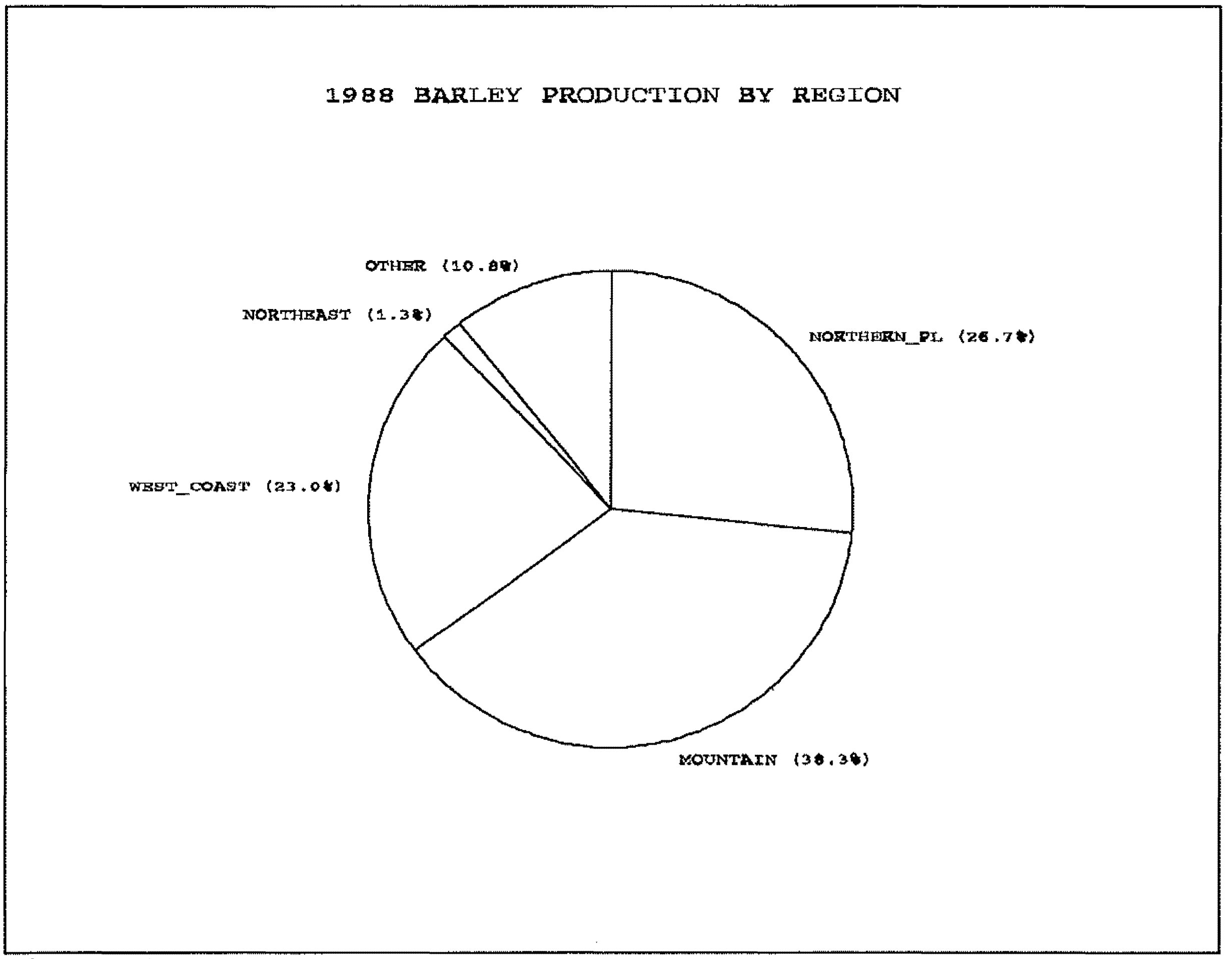

Figure 1

The Northern Plains region produced over 250 million bushels of barley in 1984 (Figure 2). Production in this region reached a period high of 290 million bushels in 1985, from which it dropped to levels of 270 million bushels and 220 million bushels in 1986 and 1987, respectively. In 1988, because of drought conditions, the Northern Plains region produced only 77 million bushels of barley.

During the 1984--1987 period, the Mountain region produced the second largest amount of barley, consistently producing between 150 million bushels and 200 million bushels. However, in 1988, the Mountain region lead the nation in barley production, producing 110 million bushels.

The West Coast region produced 110 million bushels of barley in 1984. However, the level of production in this region steadily declined to 67 million bushels in 1988.

The Northeast region produced between 4 and 8 million bushels annually during the 1984-1988 period.

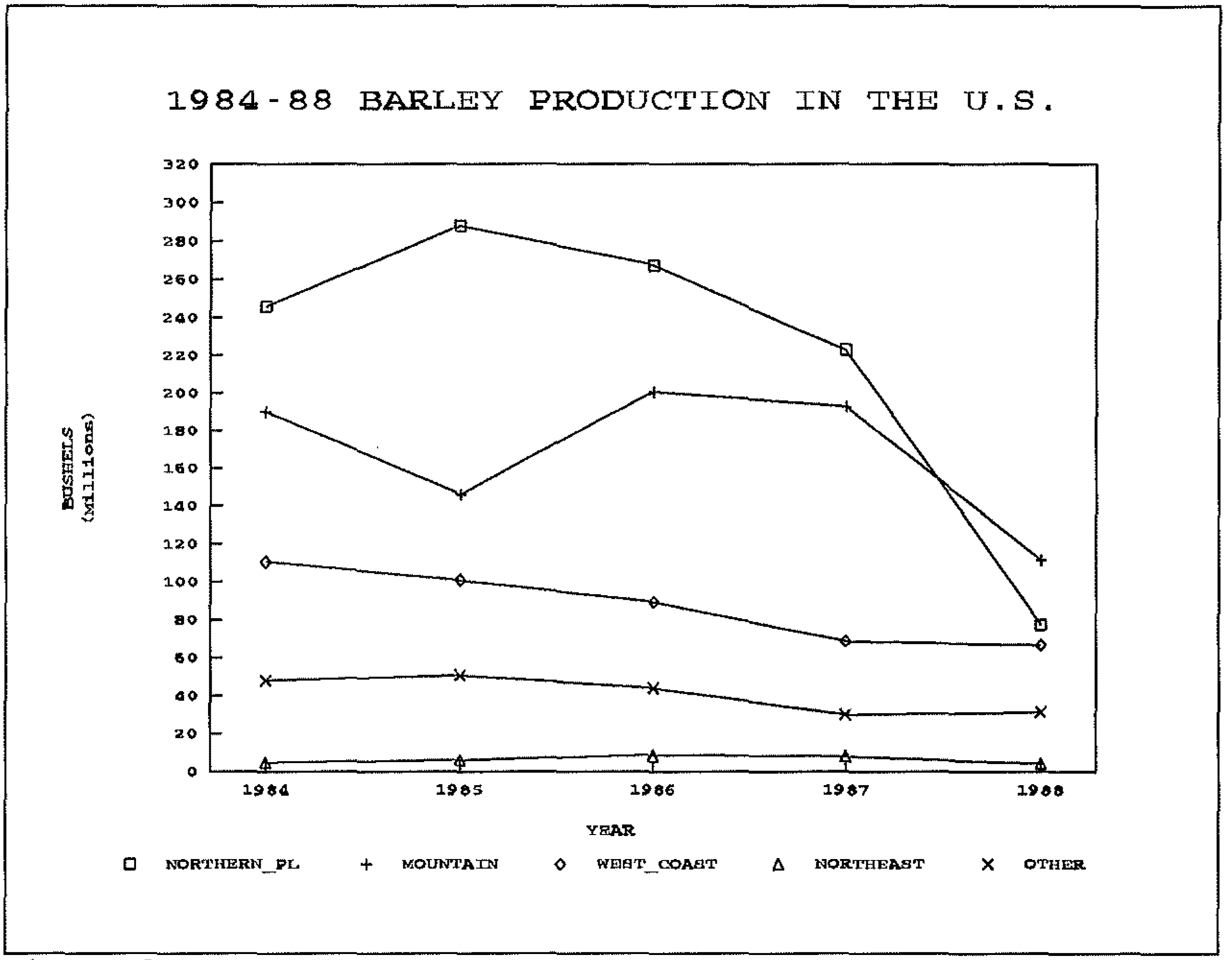

Figure 2

The Northern Plains region was the dominant producer of barley in the United States from 1984 through 1987 (Figure 3). But since 1985, when the Northern Plains was responsible for 48.7 percent of America's barley production, the region's share of U.S. barley production has been declining. As Figure 3 shows, this decline has occurred while the Mountain region's share has been increasing. However, 1987 and 1988 were drought years, and the Northern Plains region was hit hardest by the drought. Consequently, these trends should be interpreted within the context of short-term climatic aberrations.

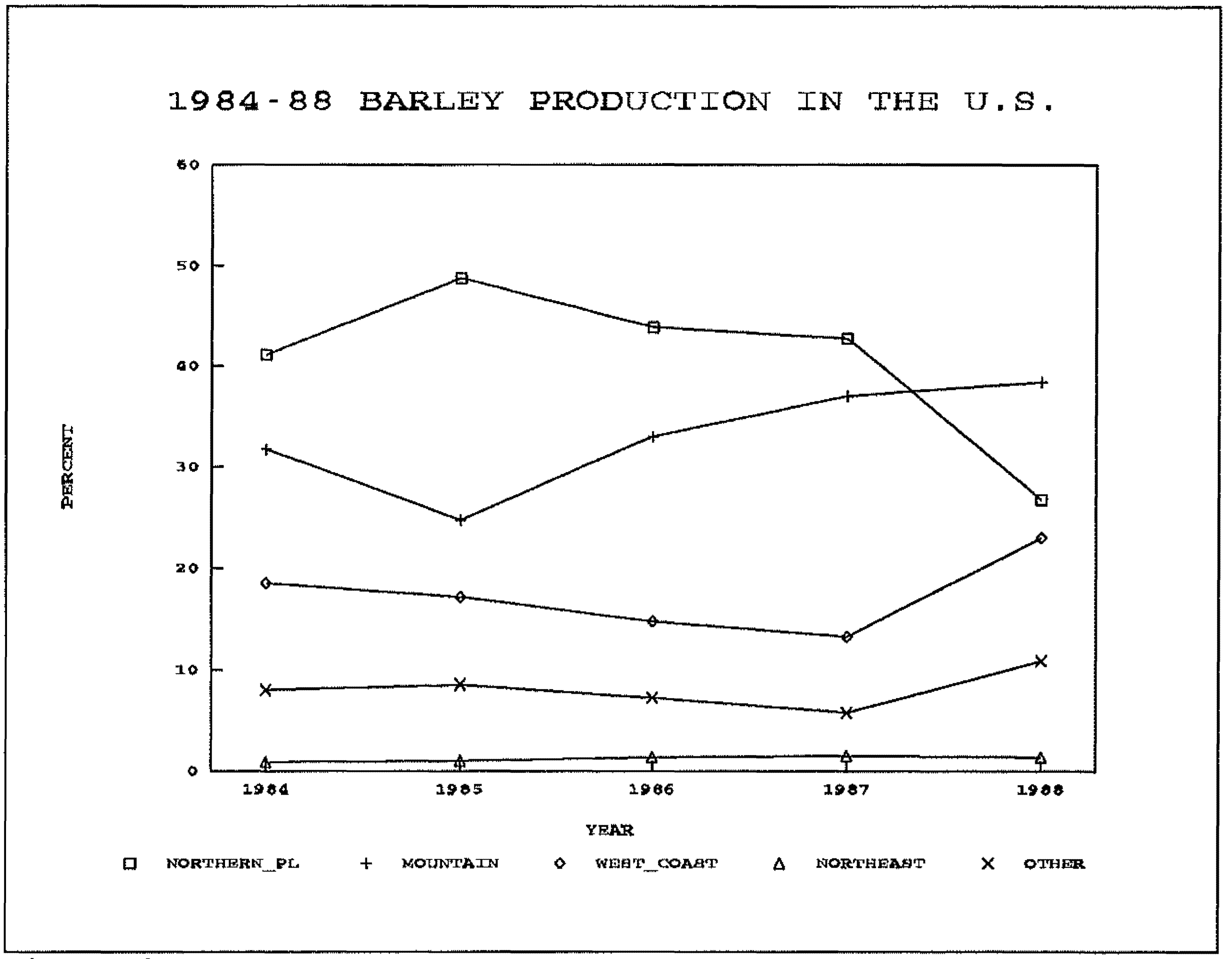

Figure 3

II. RAIL BARLEY MARKETS

Six major rail barley markets are identified in this analysis. These markets are defined as follows:

Mid-Continent: Illinois and Missouri;

Gulf: Texas and Oklahoma;

Midwest: Minnesota, North Dakota, and Wisconsin;

Mountain:	Montana, Wyoming, Colorado, Utah, and Idaho;
Pacific Northwest:	Washington and Oregon;
Pacific Southwest:	California and Arizona.

In 1988, the Midwest region was by far the largest rail barley market in the United States (Figure 4). Over sixty percent of all rail barley moved in the U.S. was terminated in the Midwest region. Much of this barley was probably used for malting purposes.

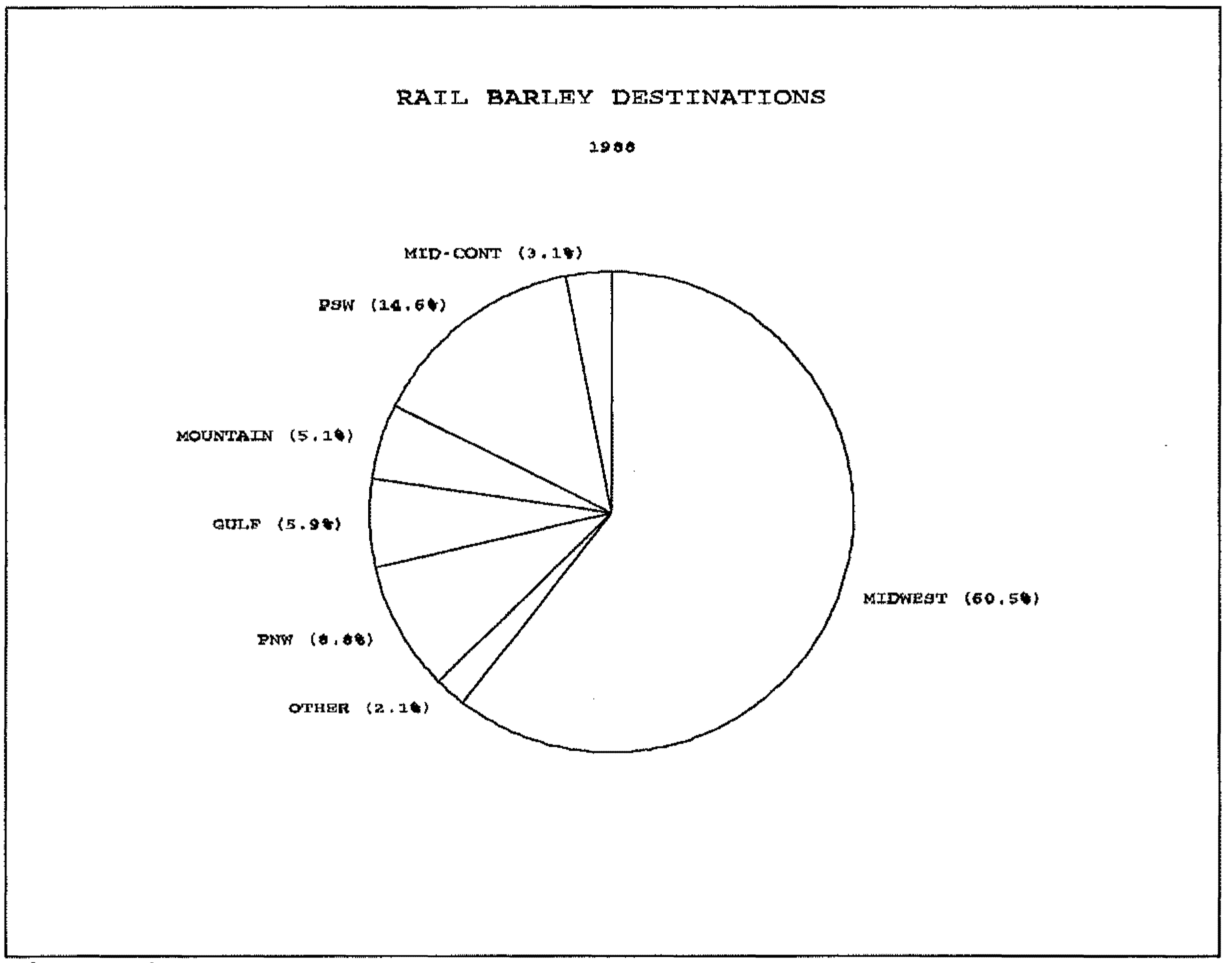

Figure 4

The Pacific Southwest received the second largest share of rail barley in 1988 -- over fourteen percent. Most of this barley was probably used for feed.

The third largest terminal market for rail barley in 1988 was the Pacific Northwest (PNW). This region terminated nearly nine percent of all rail barley shipped in the U.S. in 1988.

The Gulf, Mountain, and Mid-Continent regions terminated 5.9, 5.1, and 3.1 percent of all U.S. rail barley, respectively. Most of the barley going to the Gulf region was probably used for feed or export, while most of the barley going to the Mid-Continent region was probably used for feed and malting. Barley shipments terminated in the Mountain region could have been used for either feed or malting purposes, so no breakdown of the data has been attempted.

In 1988, markets in the Midwest region received nearly five million tons[4] of barley by rail. This was the highest shipment volume recorded for any region during the period. As Figure 5 shows, the Midwest's rail volume ranged between 3.3 million and 4.2 million tons from 1984 through 1987.

The Pacific Northwest region received nearly 700 thousand tons of barley by rail in 1988. This compares with the 1,604,880 tons and 2,279,852 tons received in 1986 and 1987, respectively. In comparison, the Pacific Southwest region received between 900 thousand and 1.3 million tons of barley by rail annually during the 1984-1988 period.

The Mountain region received between 400 thousand tons and 700 thousand tons annually during this period, while the Mid-Continent region's volume ranged between 100 thousand tons and 250 thousand tons. The Gulf region received only 9,040 tons of rail barley in 1984. However, the Gulf's volume rose to a level of 470,008 tons in 1988.

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[4]All ton figures reported are short tons.

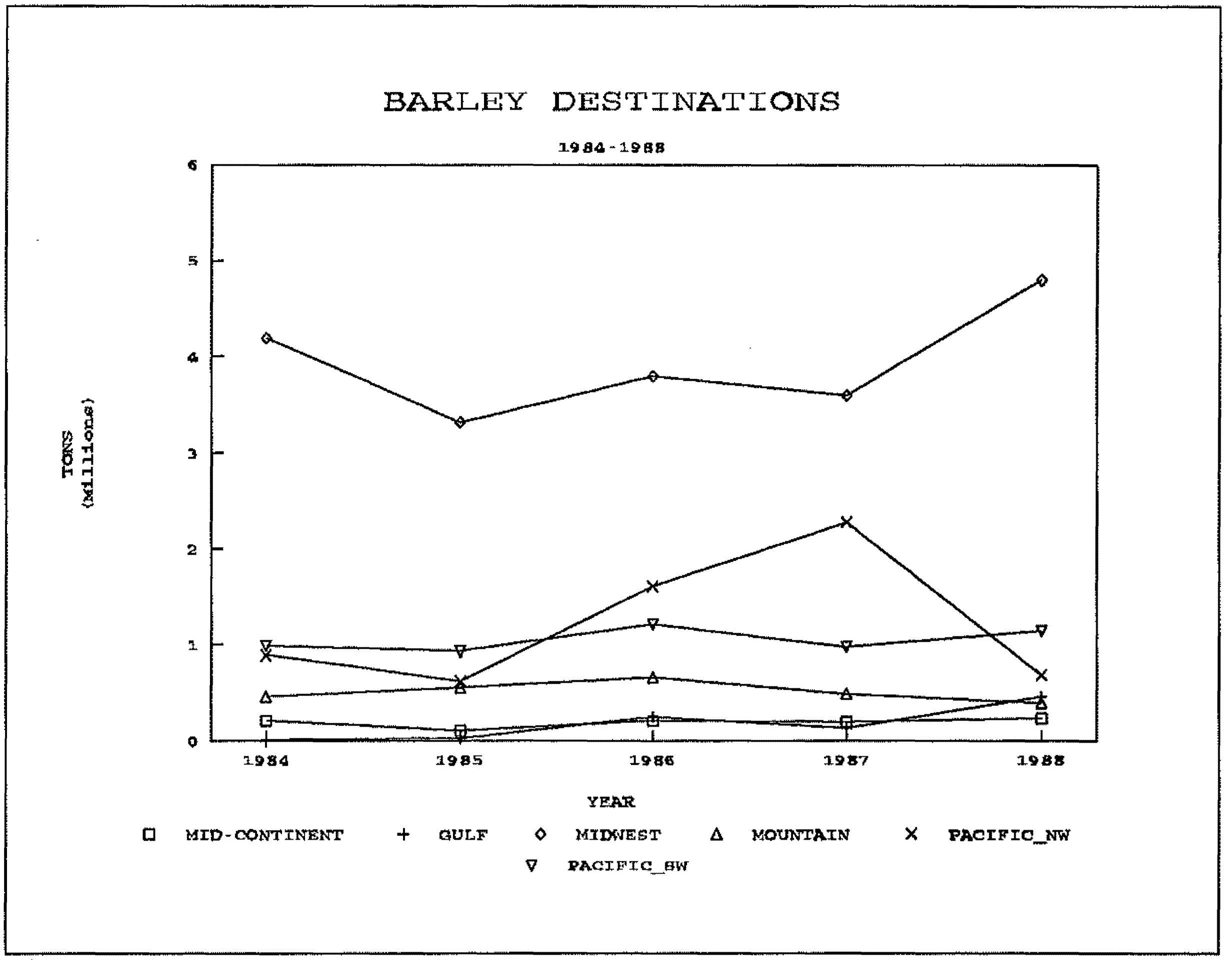

Figure 5

The percentage of U.S. rail barley movements terminated in the Midwest region was nearly the same in 1988 as it was in 1984 (Figure 6). However, the percentage was lower in 1986 and 1987 as a greater percentage of rail barley was terminated in the Pacific Northwest region. The other four regions' percentages of rail- terminated barley remained relatively constant throughout the 1984-88 period.

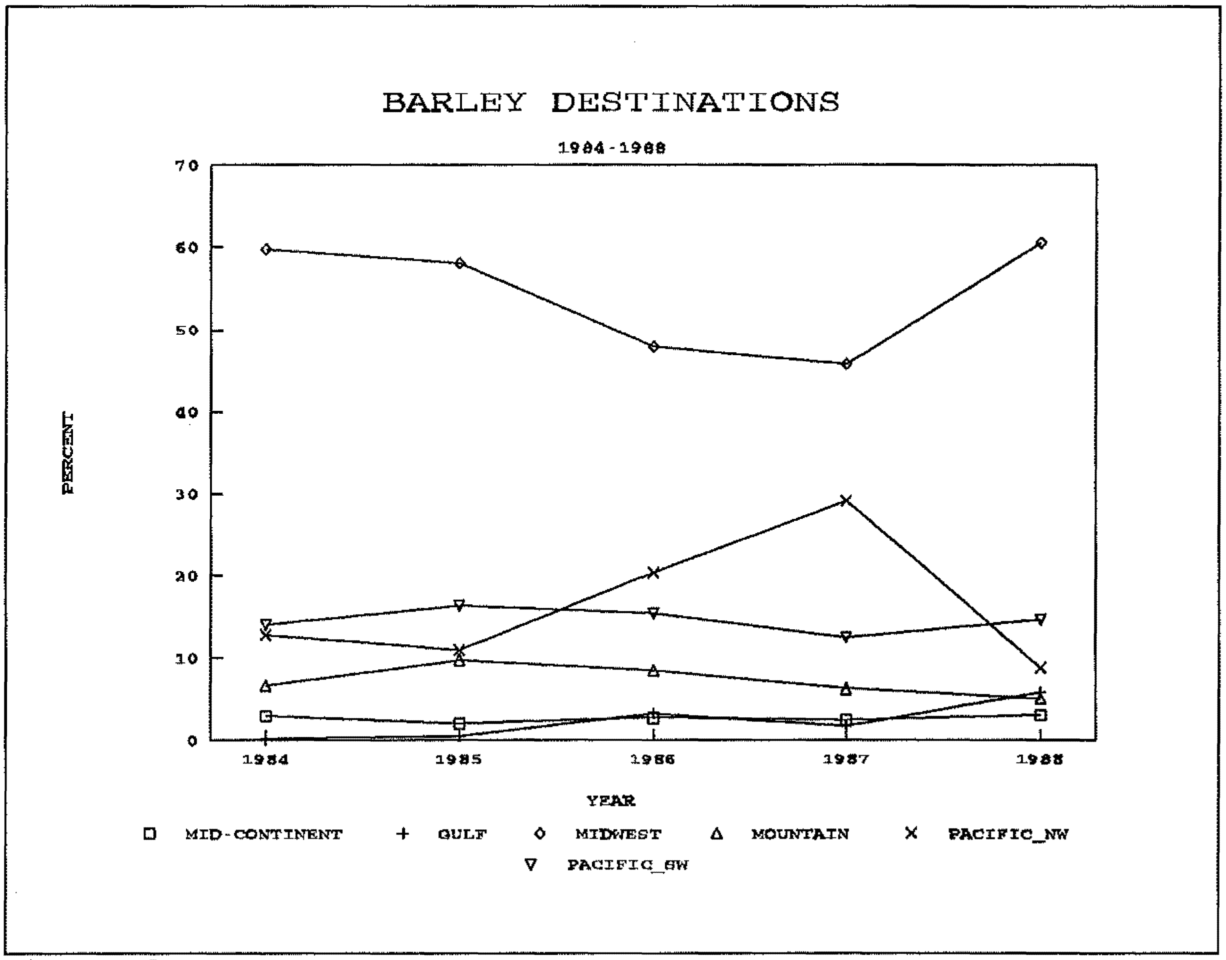

Figure 6

To summarize, the relative importance of Midwest barley markets has remained relatively constant over time. Although the PNW's share jumped significantly from 1985 to 1987, it declined again in 1988. The market shares of rail-terminated barley remained relatively constant for the other four destination regions during the period.

In the next section of the report, the proportion of rail barley shipments originated in each supply region is shown for each of the major markets.

III. RAIL MARKET SHARES OF BARLEY PRODUCING REGIONS

CURRENT MARKET SHARES

The Northern Plains region originated a dominant share of the rail barley shipments to the six major market regions in 1988 (Figure 7). In 1988, the Northern Plains' share of the rail barley market stood at 65.3 percent.

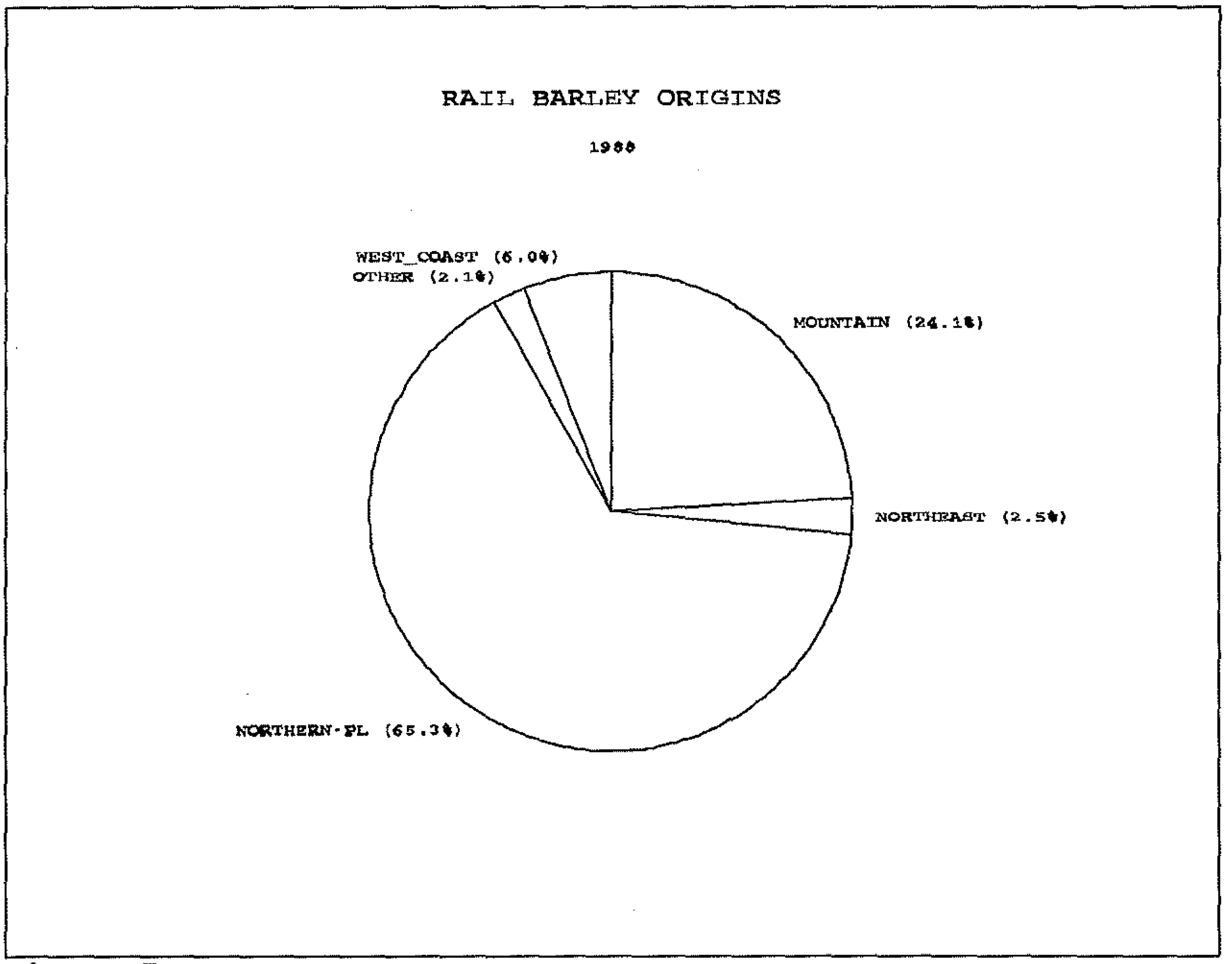

Figure 7

As Figure 7 depicts, the Mountain region supplied the second largest quantity of rail-terminated barley in the U.S. in 1988. Over twenty-four percent of all the barley shipped by rail during this year was supplied by the Mountain region.

The West Coast and Northeast regions supplied 6.0 percent and 2.5 percent of the rail barley volume in 1988, respectively.

TRENDS IN MARKET SHARES

In 1984, the Northern Plains region supplied over 4 million tons of barley by rail (Figure 8). This volume rose fairly steadily, reaching a level of 5.2 million tons in 1988. This is an interesting trend in light of the fact that this region produced less barley in 1988 than in 1984. This in an indication that barley stocks were high in 1988.

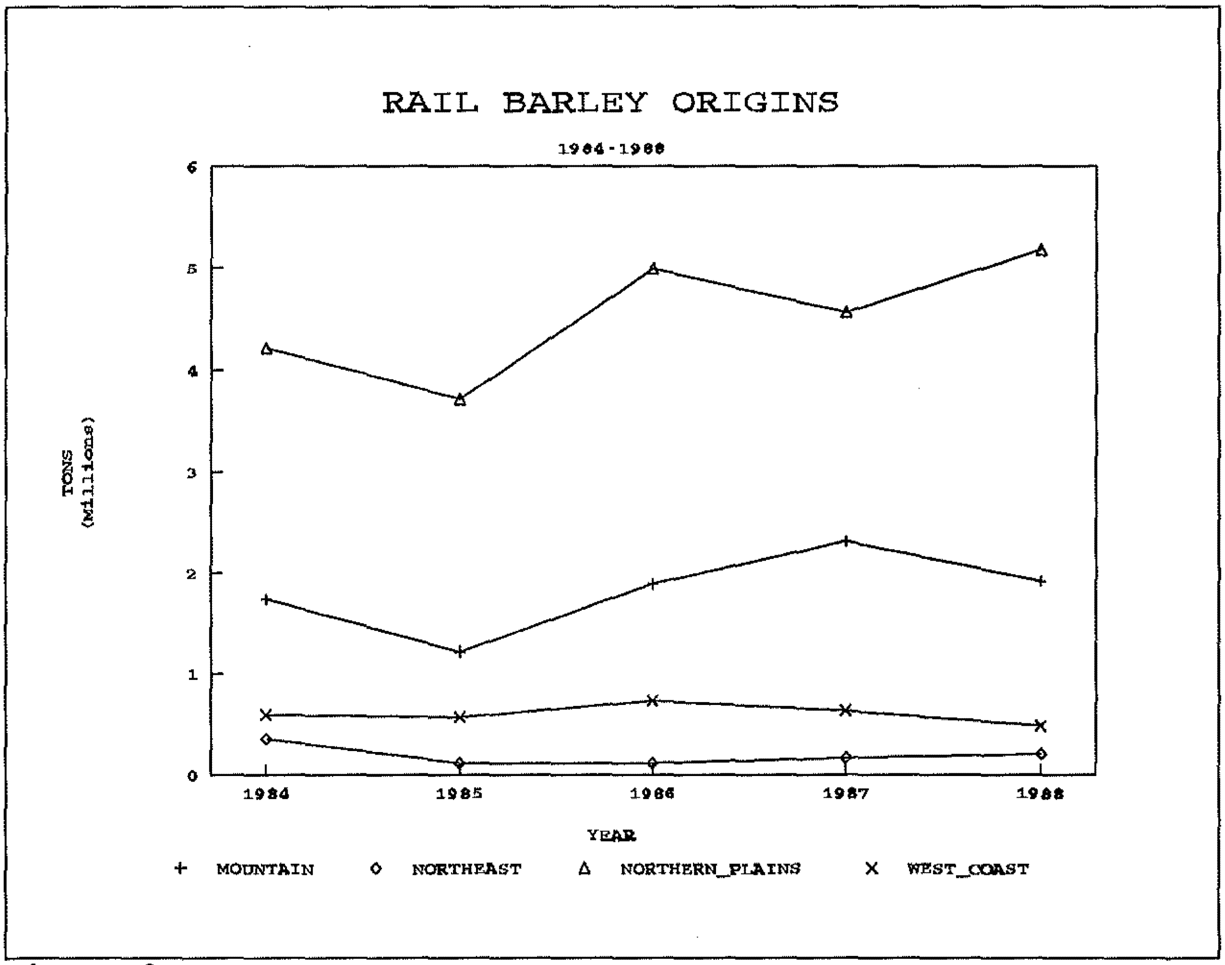

Figure 8

The Mountain region supplied 1,738,187 tons of rail barley in 1984. After reaching a period high of 2,313,039 tons in 1987, its shipment volume fell to approximately 1.9 million rail tons in 1988.

The remaining two regions' volumes of rail barley remained relatively constant during the 1984-88 period. The West Coast region supplied between 470 thousand tons and 723 thousand tons during this period, while the Northeast region supplied between 115 thousand tons and 350 thousand tons of rail barley.

The Northern Plains region's share of rail barley supply has steadily increased since 1984, with the exception of 1987 (Figure 9). The Northern Plains' share of rail barley stood at 59.96 percent in 1984, and despite some fluctuation rose to 65.34 percent in 1988. The loss in market share in 1987 resulted from a gain in market share by the Mountain region during the same year. However, the Northern Plains' market share has since rebounded, and the Mountain region's share has declined.

The other two supply regions' market shares have remained relatively constant throughout the 1984-88 period.

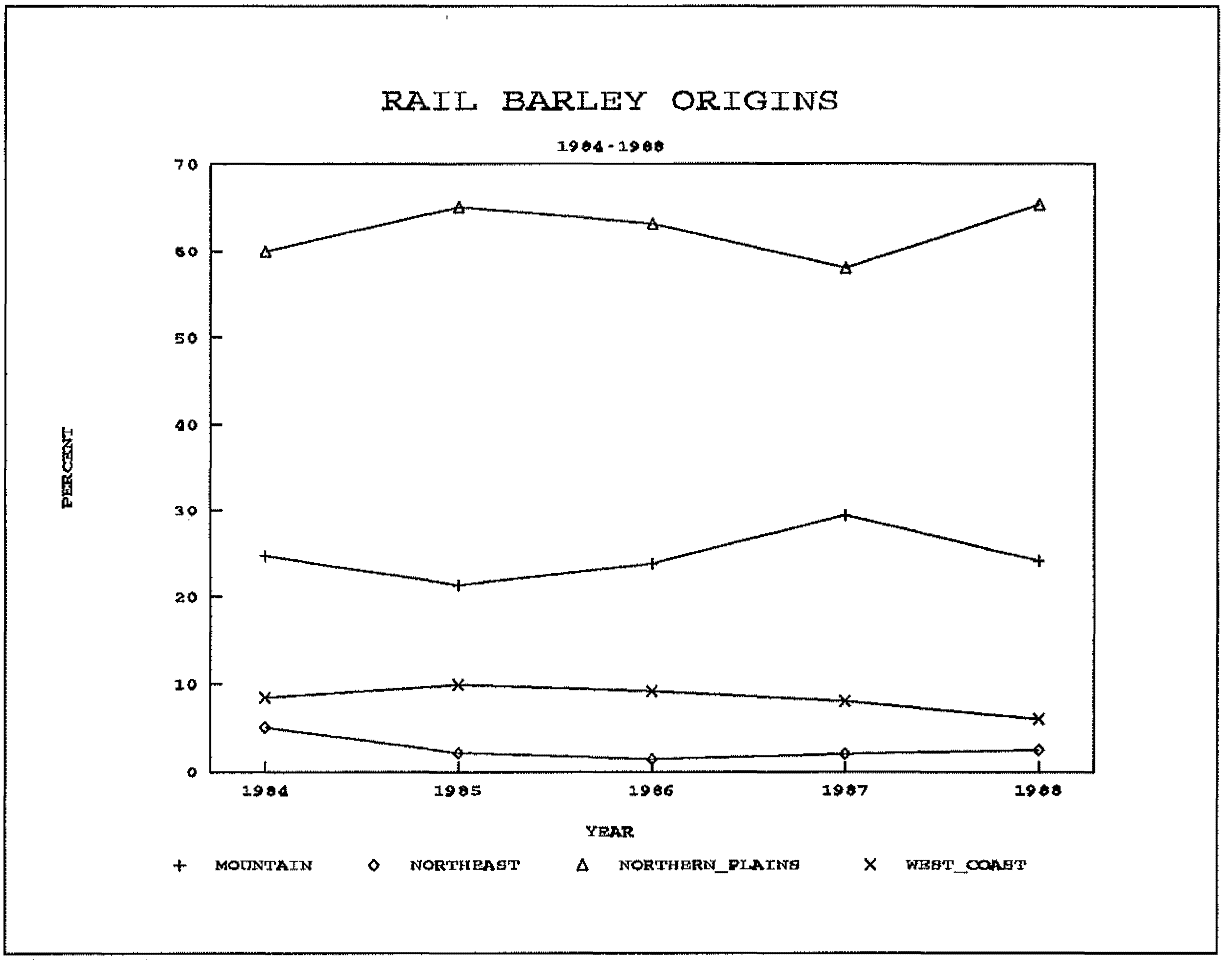

Figure 9

Market Share in the Midwest Region

In 1988, the majority of the barley terminated by rail in the Midwest region was supplied by the Northern Plains (Figure 10). The Northern Plains owned over eighty-three percent of the Midwest rail market in 1988. Much of this market dominance may be explained by the close proximity of producers to Midwest demand centers.

The Mountain supply region owned a 14.3 percent share of the Midwest rail market in 1988, while the Northeast region owned a 1.6 percent share.

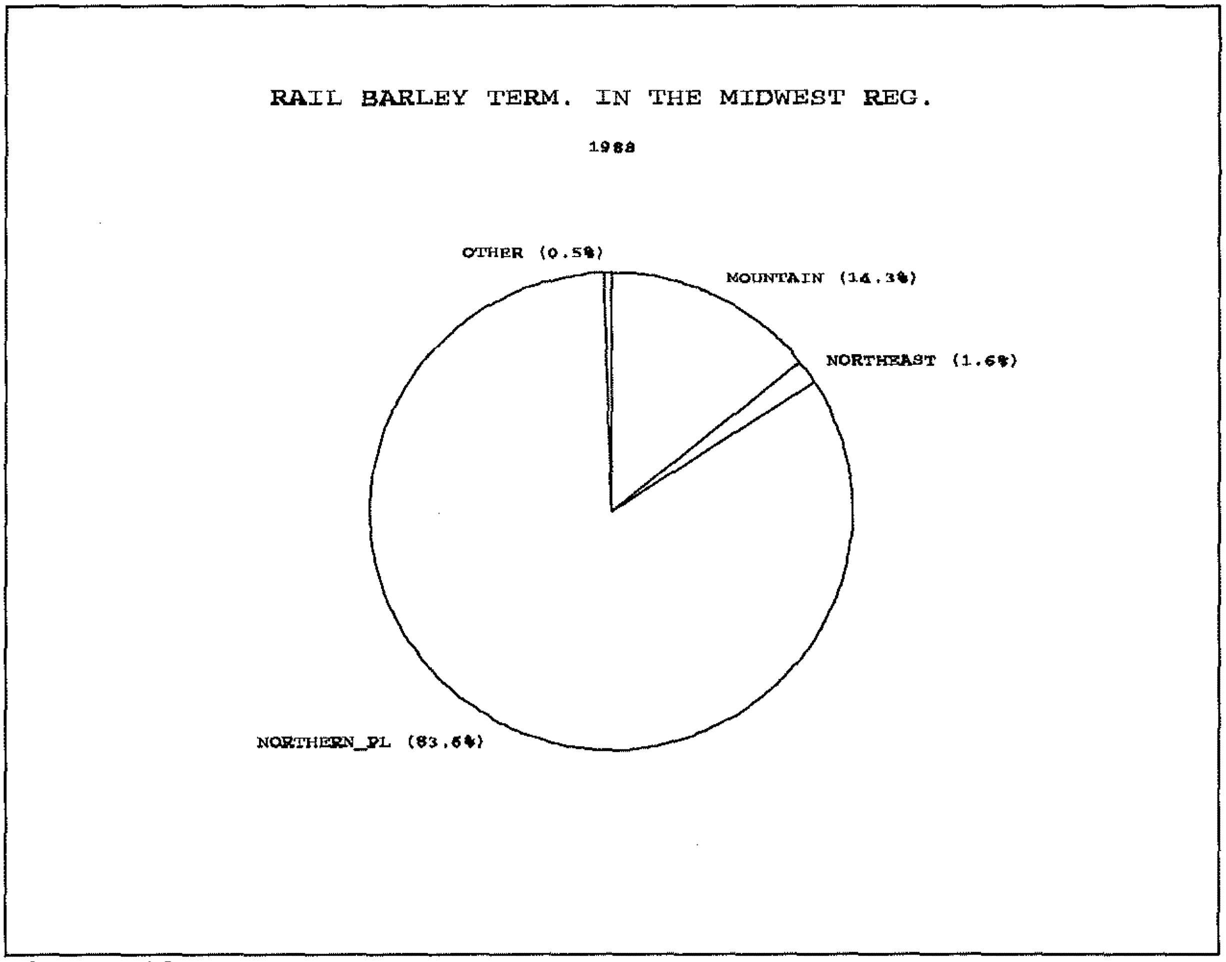

Figure 10

In 1984, the Northern Plains supplied over 3.7 million tons of barley to the Midwest region by rail (Figure 11). After supplying only 3.0 million tons of barley in 1985, the Northern Plains region steadily increased its supply of rail barley to the Midwest region. As Figure 11 shows, the Northern Plains region supplied over 4 million tons of barley to this market by rail in 1988.

The Mountain region supplied nearly 700 thousand tons of barley by rail to Midwest markets in 1988. There were several fluctuations in supply volumes between 1984 and 1987. As Figure 11 shows, the Mountain region shipped between 222 thousand tons and 470 thousand tons to the Midwest region by rail during each year of the period.

The Northeast region supplied between 38 thousand tons and 90 thousand tons to the Midwest region by rail during the 1984 - 1988 period.

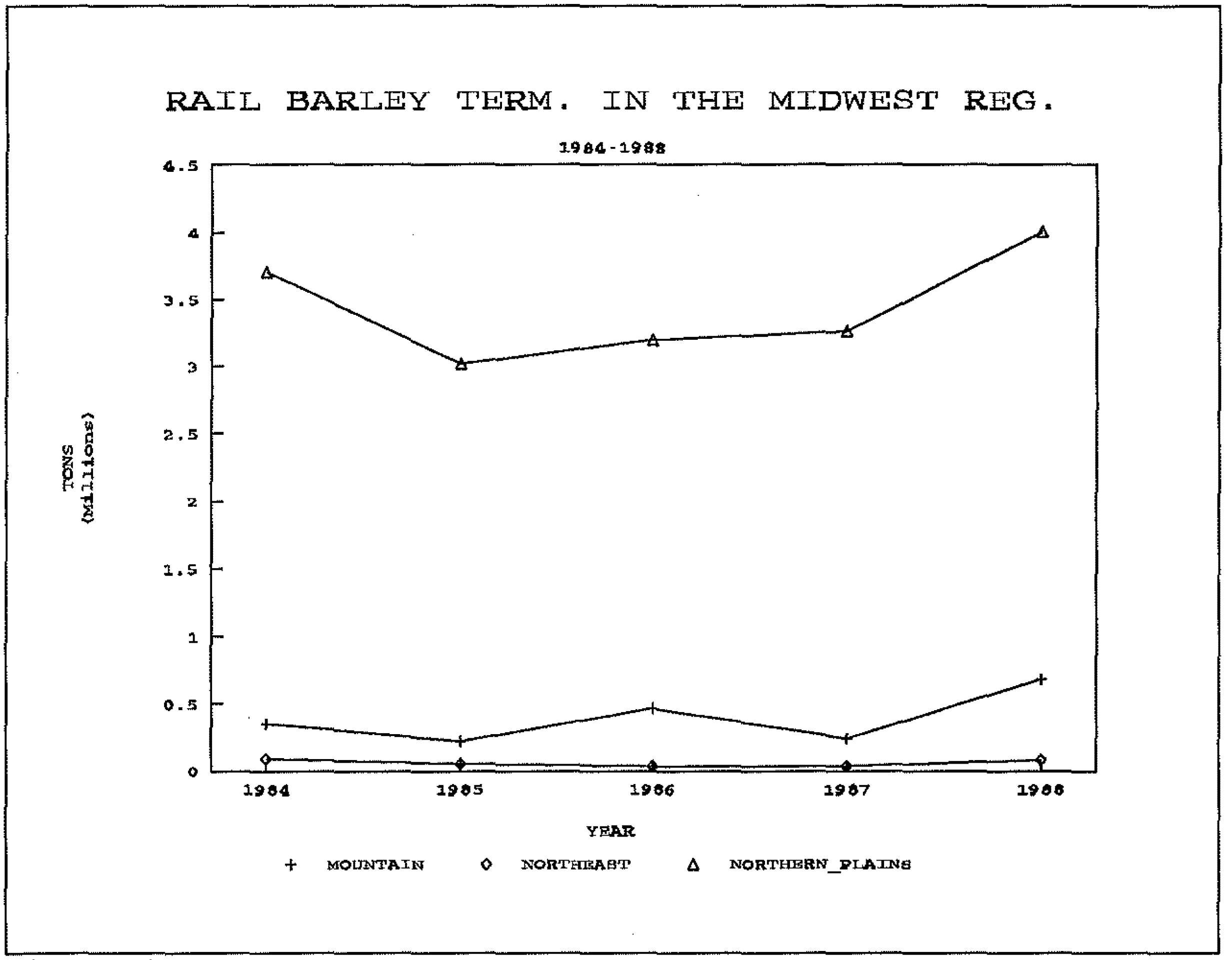

Figure 11

Throughout the 1984-88 period, the Northern Plains region dominated the Midwest rail market (Figure 12). The Northern Plains' share of the rail barley supplied to Midwest markets fluctuated between 83 and 91 percent during this period. A prominent trend throughout the 1984-88 period was the interrelatedness of market shares; the Northern Plains region's share of the Midwest market moved exactly opposite to that of the Mountain region. These trends, in conjunction with the fact that the Northeast region's share remained constant, illustrate the fact that the Northern Plains region's only major competitor in the Midwest rail market is the Mountain region.

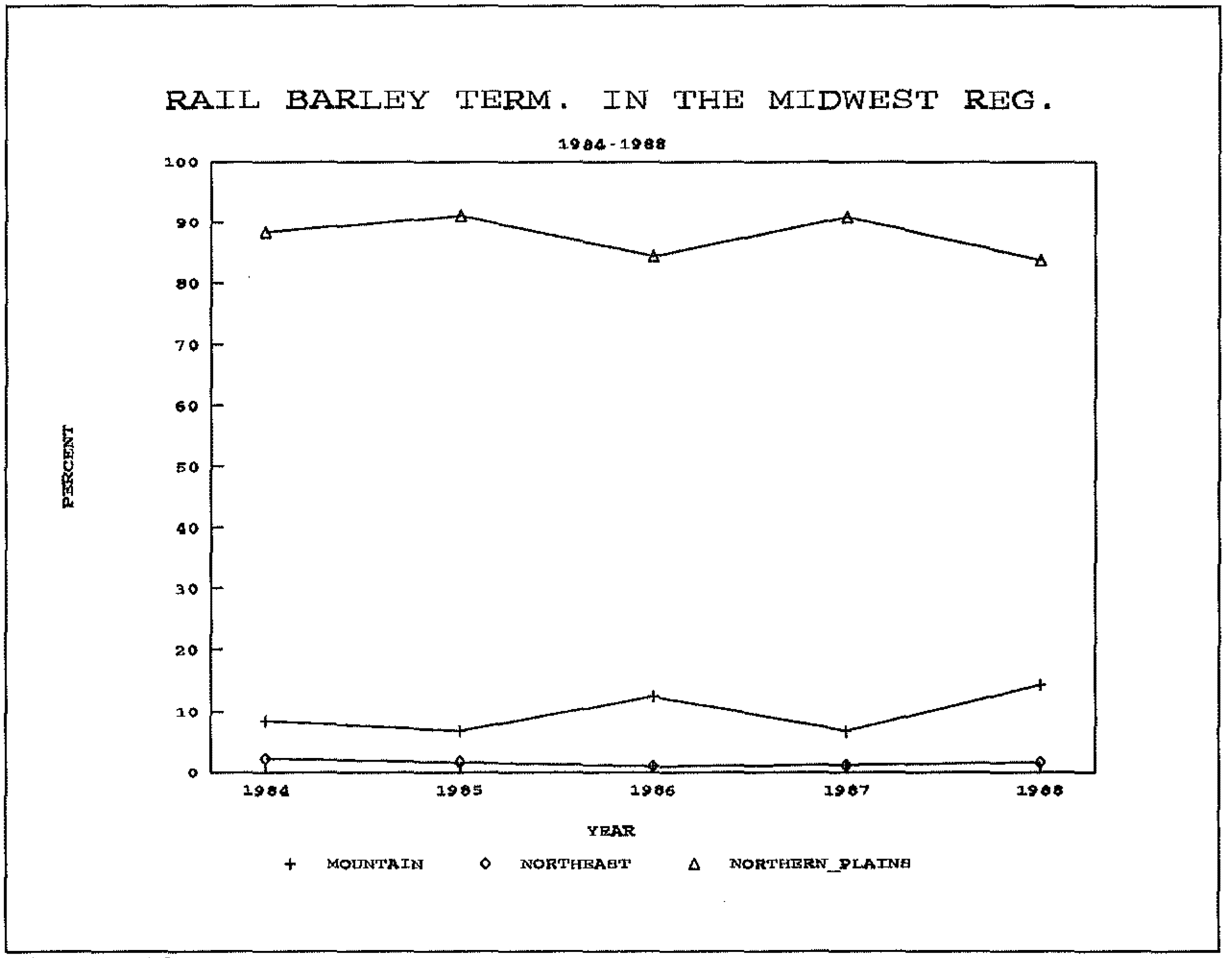

Figure 12

Since the markets for malting barley and feed barley are separate, it is important to try to calculate separate market shares for each. In order to gain insights into the amount of barley which is used for malting purposes in various markets, barley shipments by rail to cities where malt houses are located are assumed to be used for malting purposes.

In 1988, 52.1 percent of the barley shipped by rail to the Midwest region was terminated at malting locations (Figure 13). This represents a decline from a period high of 58.6 percent in 1987.

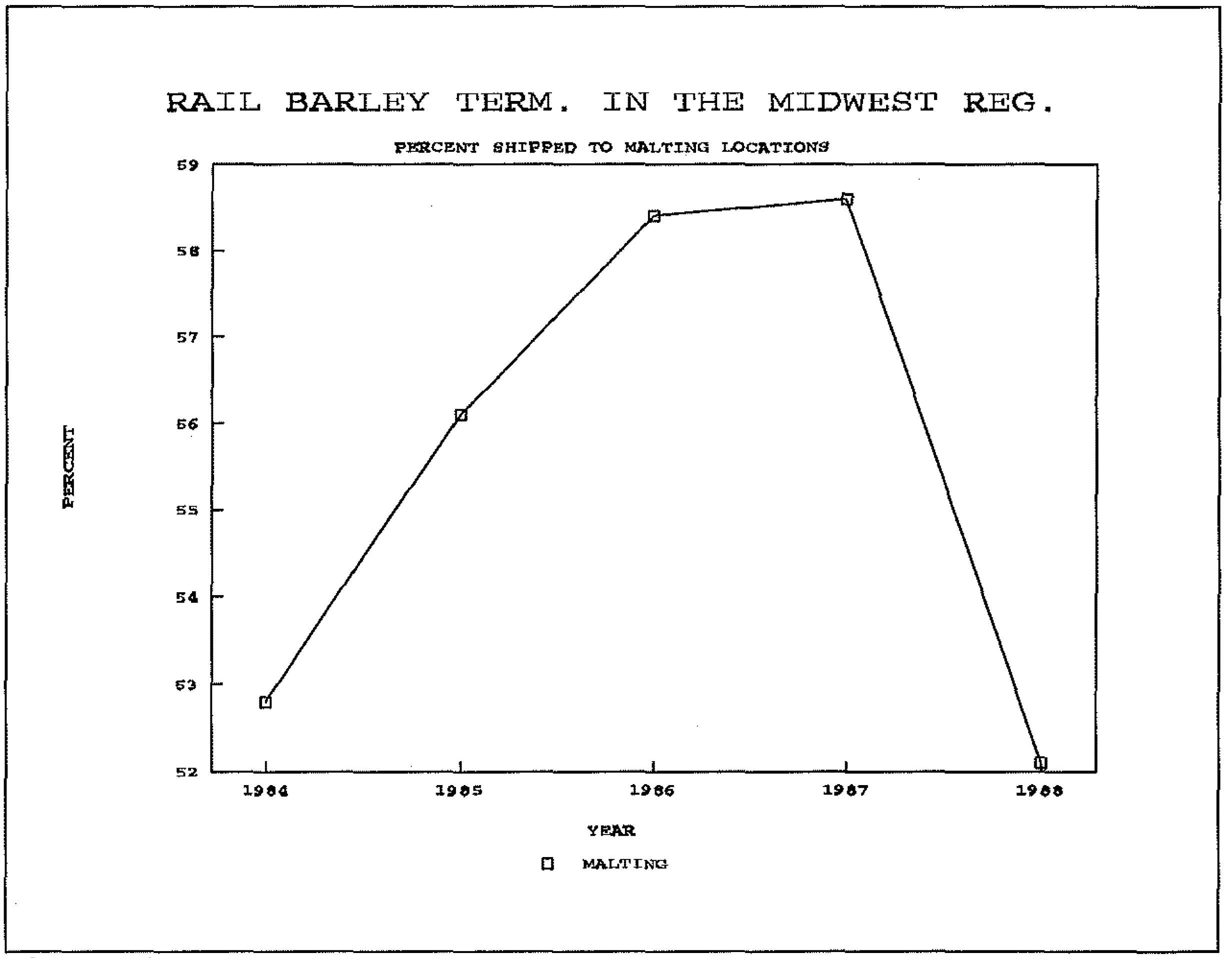

Figure 13

The majority of the barley terminated at malting locations in the Midwest region has historically been supplied by the Northern Plains region (Figure 14). During the 1984-1985 period, the Northern Plains region supplied between eighty-six and ninety-two percent of the barley terminated in this market. The Mountain region's share of the Midwest market has moved opposite that of the Northern Plains', while the Northeast region's share has remained steady (although not very significant). This indicates that the Northern Plains' main competitor in the malting markets of the Midwest is the Mountain region.

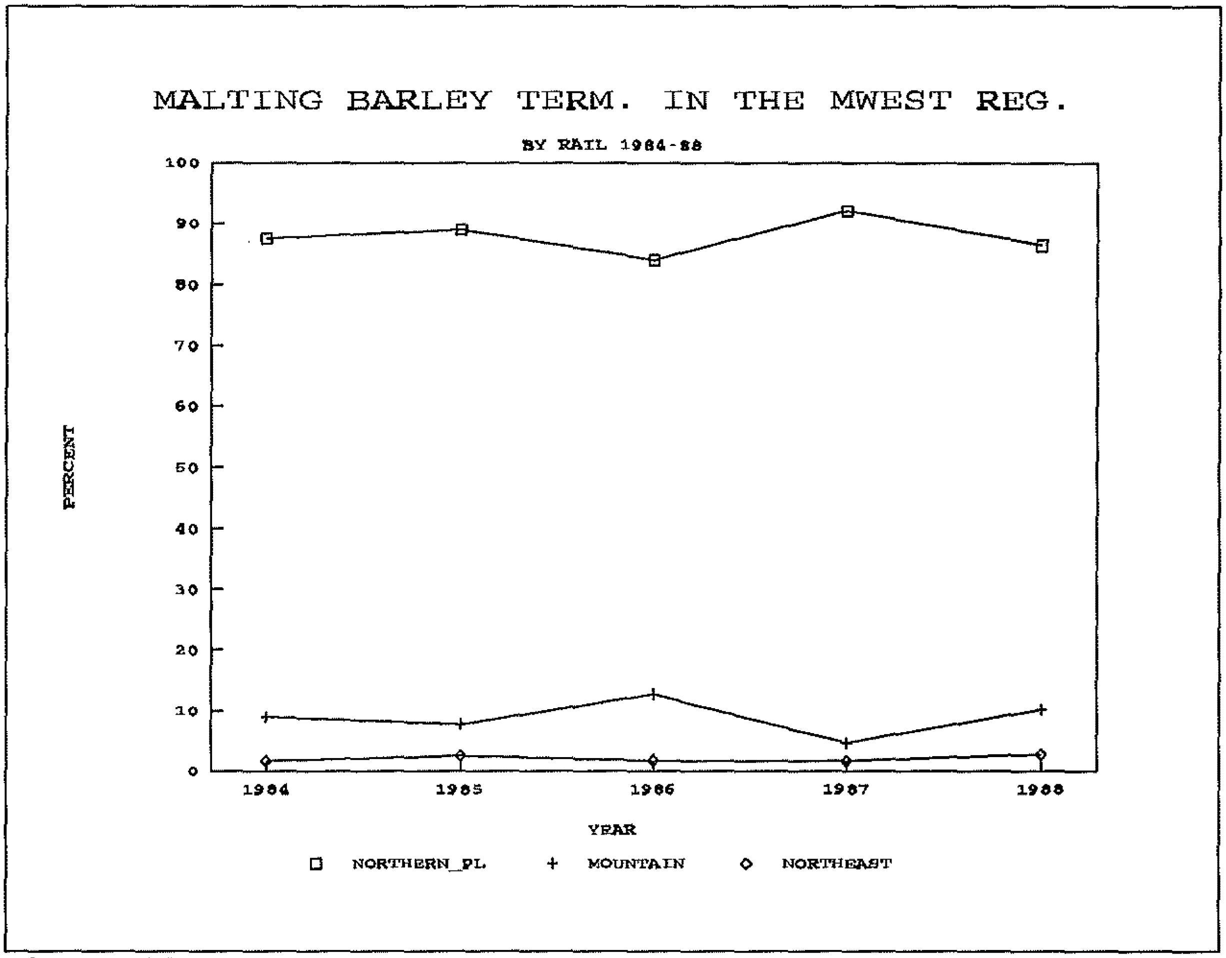

Figure 14

A similar trend is shown for feed barley terminating in the Midwest region between 1984 and 1988 (Figure 15). From 1984 to 1988, the Northern Plains region supplied between eighty and ninety-four percent of the feed barley moving by rail each year to the Midwest market. Again, the Mountain region's share of this market moved opposite the share of the Northern Plains region between 1984 and 1988. This phenomenon, along with the insignificant share held by the northeast region, indicates that the Northern Plains region's main competitor in the Midwest feed barley market is the Mountain region.

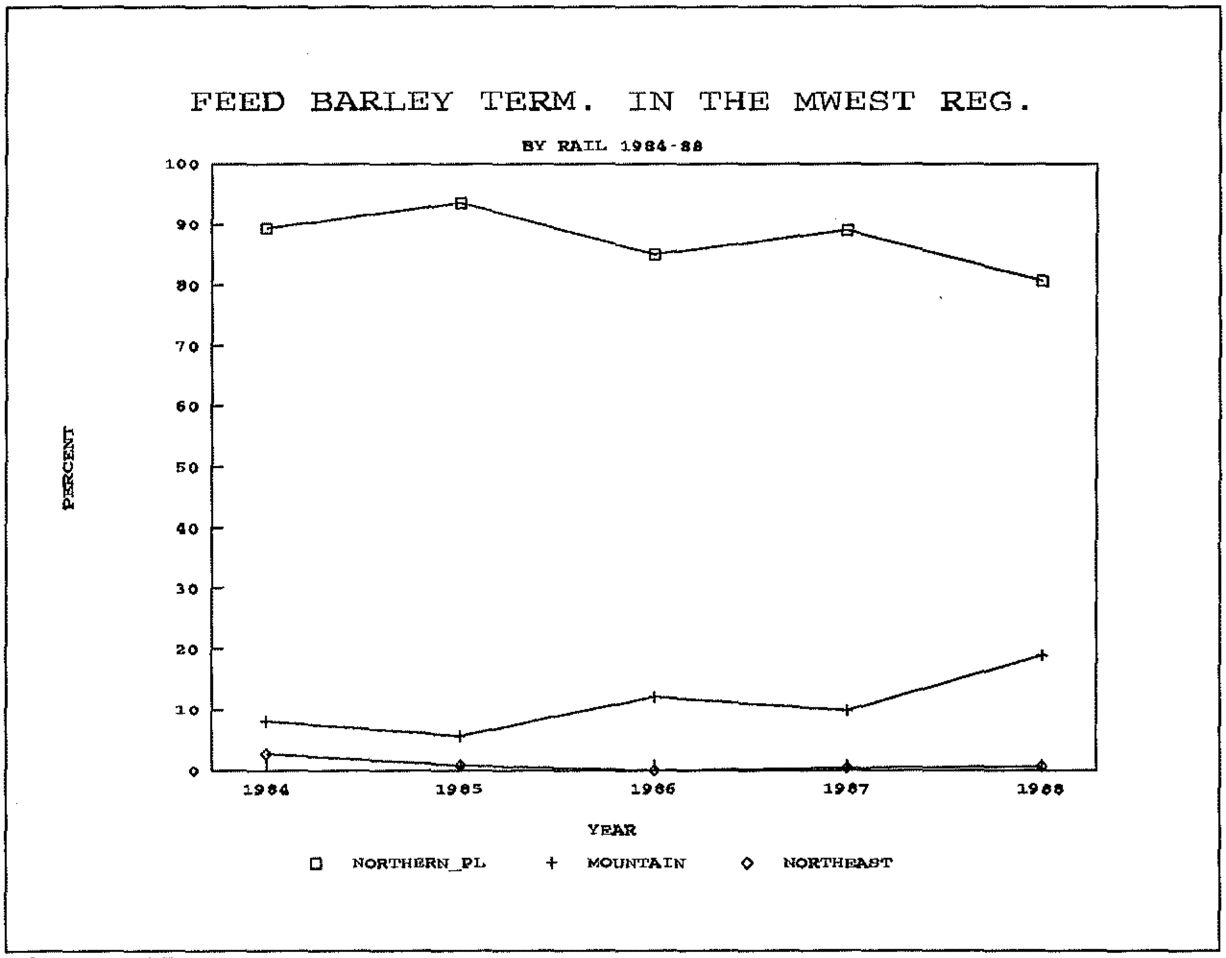

Figure 15

Market Share in the Pacific Northwest Region

The West Coast supply region dominated the Pacific Northwest rail market in 1988 (Figure 16). The West Coast region supplied over forty-seven percent of the barley received by rail in the Pacific Northwest in 1988. Again, much of this dominance may be explained by the close proximity of producers to the Pacific Northwest demand centers.

The second leading supply region in the Pacific Northwest market in 1988 was the Mountain region. The Mountain region supplied over thirty-three percent of the rail barley received by the Pacific Northwest in 1988.

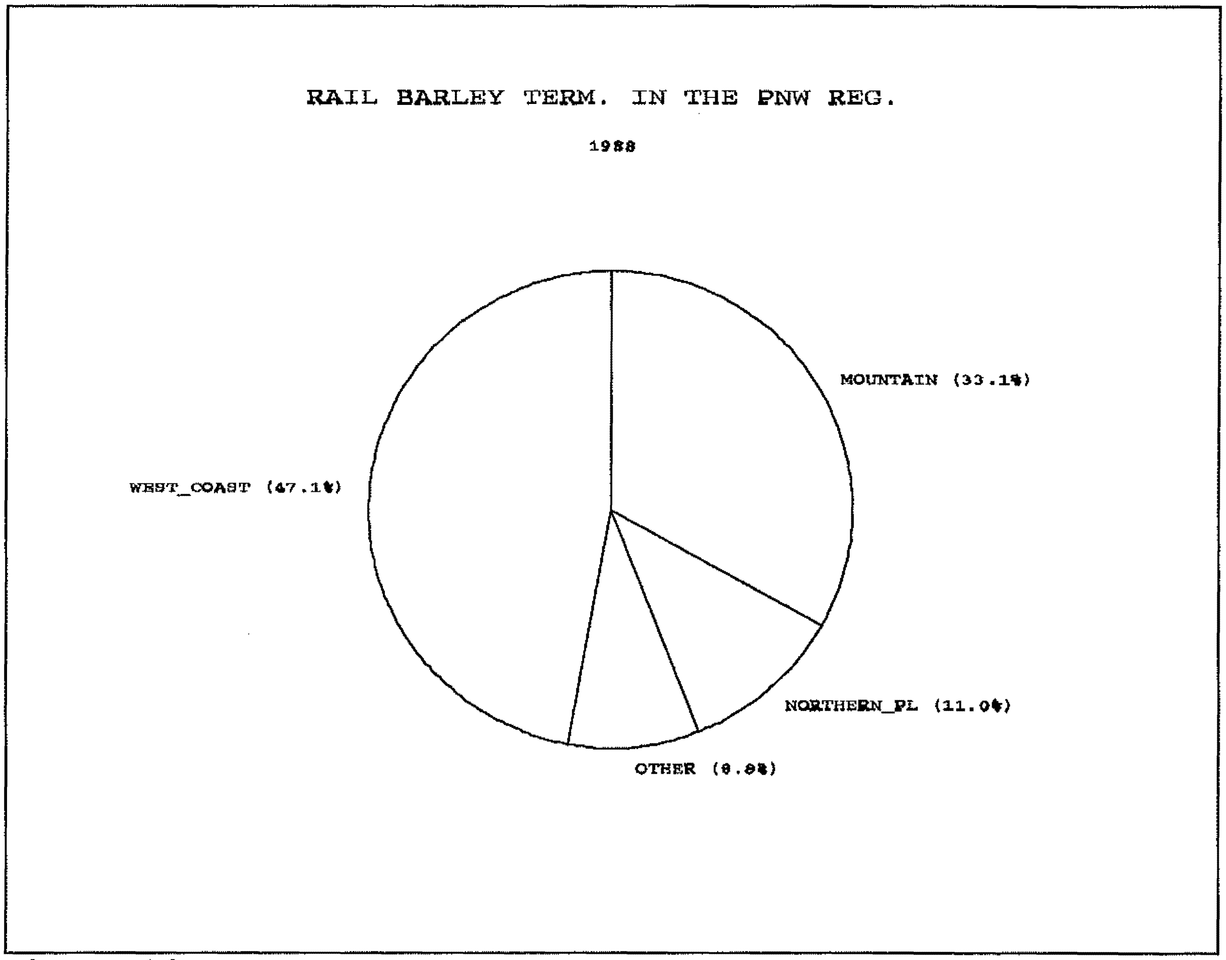

Figure 16

The Northern Plains region ranked third in this market, supplying eleven percent of the PNW-terminated barley in 1988.

The amount of rail barley terminated in the Pacific Northwest by Northern Plains suppliers fluctuated greatly throughout the 1984-1988 period (Figure 17). In 1984, the Northern Plains region supplied approximately 214 thousand tons of barley by rail to the Pacific Northwest. After supplying a period high of 797 thousand rail tons to this market in 1987, the Northern Plains' volume dropped to only 76 thousand tons of barley in 1988. This occurred as total rail barley shipped to the Pacific Northwest Market declined in 1988.

The Mountain region's supply of rail barley to the PNW has also been erratic. The Mountain region supplied 174 thousand tons of barley to the Pacific Northwest by rail in 1984. After supplying a high of 1.05 million rail tons in 1987, the Mountain region's volume dropped to 230 thousand tons of barley in 1988.

The West Coast region's share of PNW rail barley has remained relatively steady throughout the 1984-1988 period, fluctuating between 300 thousand tons and 500 thousand tons per year.

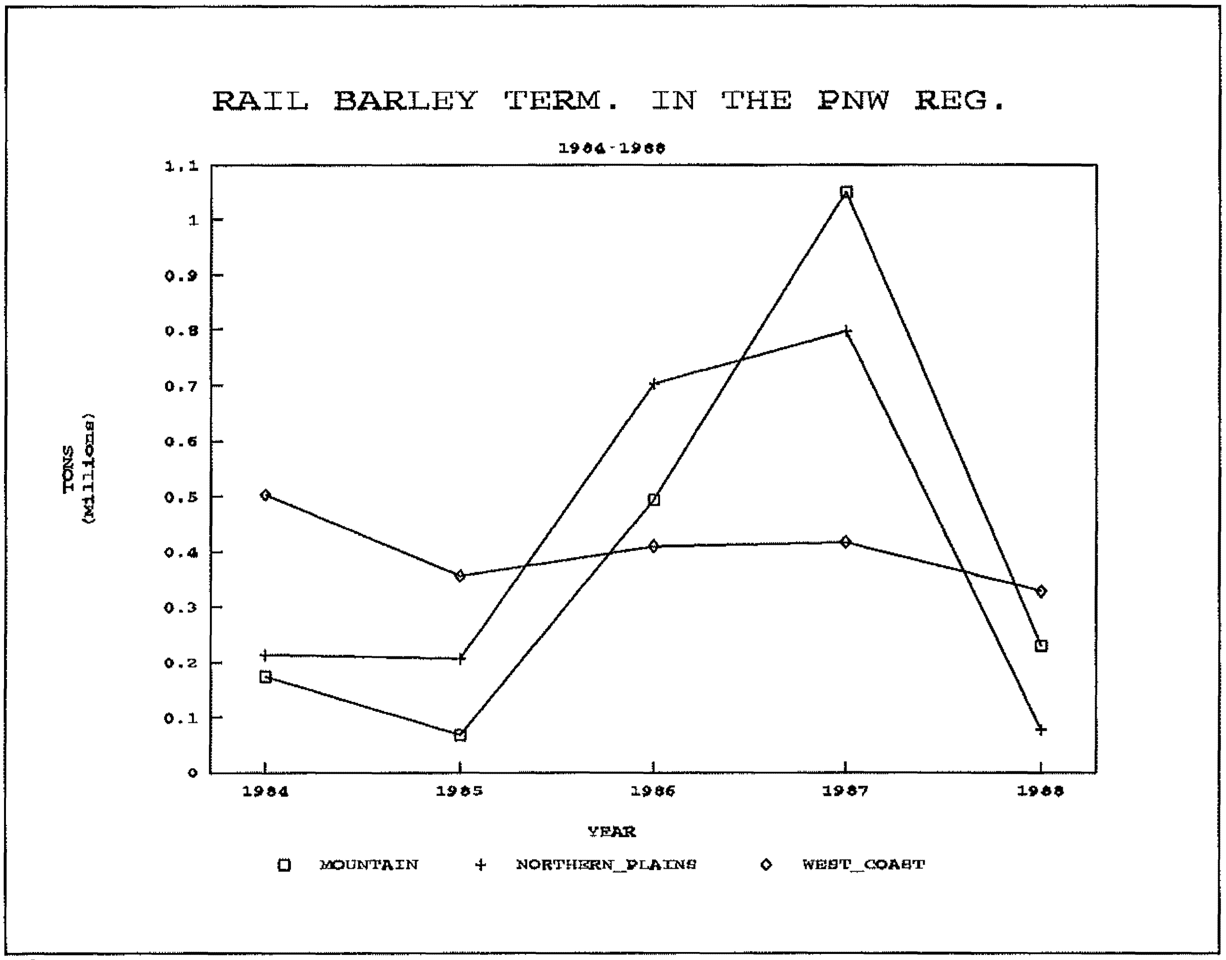

Figure 17

In 1984, the Northern Plains region owned the second largest share of the Pacific Northwest market at 23.9 percent (Figure 18). In an upward trend, the Northern Plains' market share rose to a period high of 43.7 percent in 1986. This shift occurred at the same time that the West Coast region's share of the PNW market was dropping from a high of 56.2 percent in 1984 to 25.5 percent in 1986. While the West Coast region's share continued to drop to a period low of 18.3 percent in 1987, the Northern Plains region's share dropped to 35 percent in 1987. During the same period, the Mountain region's share continued to rise, reaching a high of 46.1 percent. This trend illustrates the Mountain region's strong recovery from a period low of 10.8 percent in 1985. In 1988, the West Coast region's share rose sharply to a level of 47.1 percent, coinciding with a slight drop in the Mountain region's share, and a large drop in the Northern Plains' share of the Pacific Northwest market.

Most of the barley terminated in the PNW is used for feed and export purposes. Any quantitative estimate of the barley used for malting in this area would violate waybill confidentiality restrictions. Therefore, no such analysis is attempted.

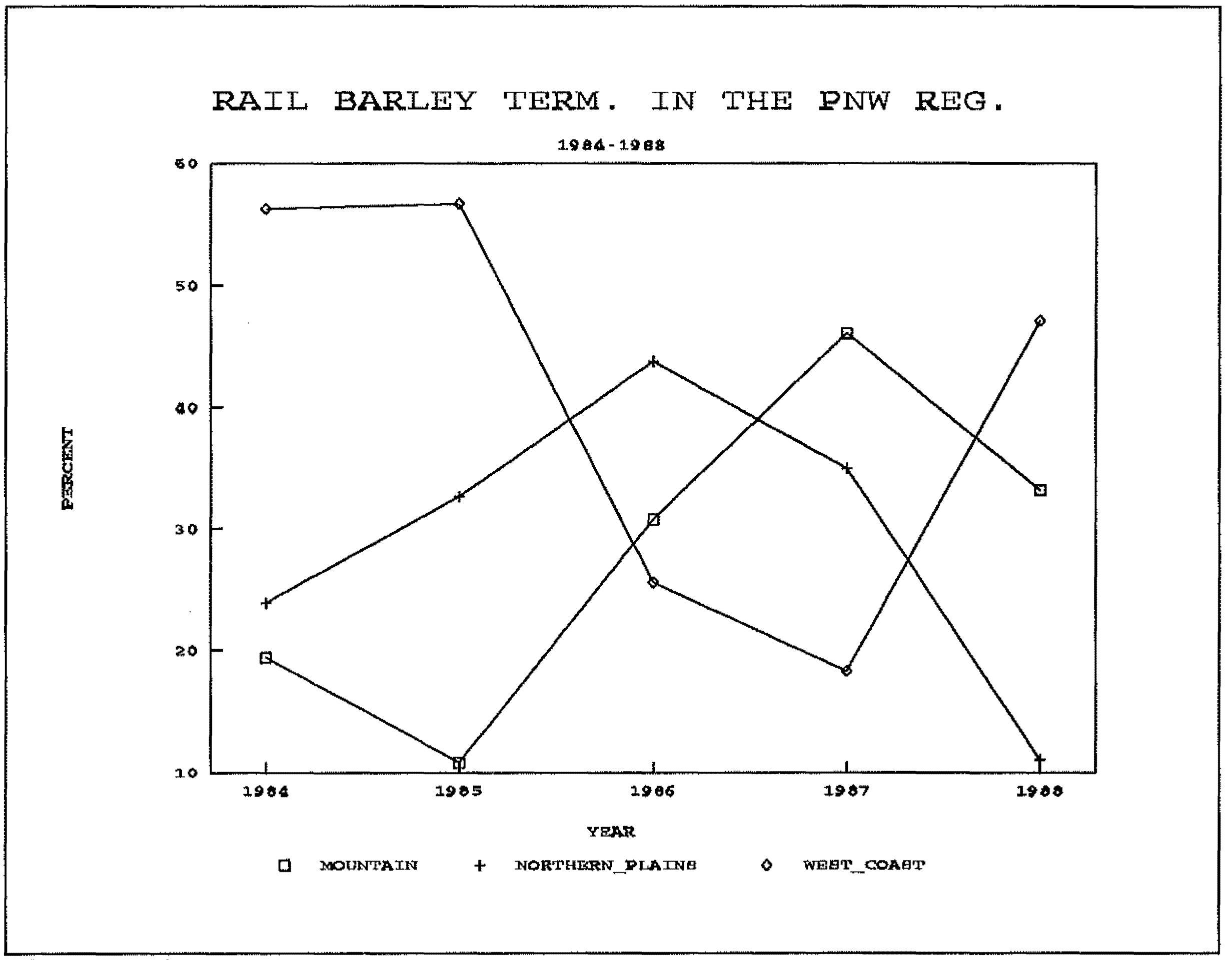

Figure 18

Market Share in the Pacific Southwest Region

The Mountain region supplied the majority of the rail barley terminated in the Pacific Southwest (PSW) region in 1988 (Figure 19), supplying nearly fifty-four percent of the volume in this market. The second leading supply region for PSW rail barley in 1988 was the Northern Plains region, supplying over thirty percent of the terminated rail barley.

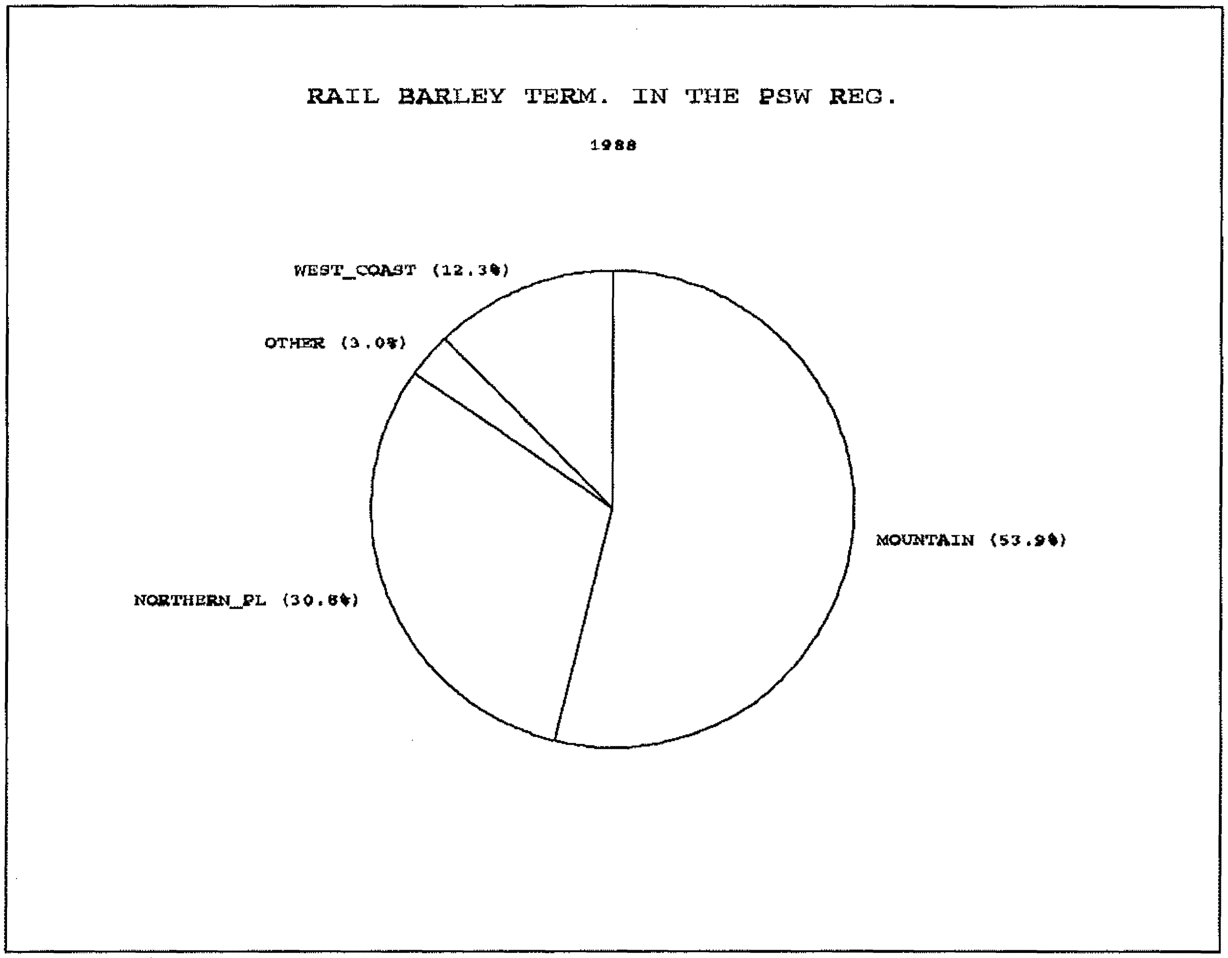

Figure 19

The Northern Plains region supplied 355 thousand tons of barley to the Pacific Southwest region in 1988 (Figure 20). However, this represents a decline in volume from a period high of 487 thousand tons in 1986.

The Mountain region supplied nearly 800 thousand tons of barley by rail to the Pacific Southwest in 1984. After supplying a period low of 427 thousand tons in 1986, the Mountain region increased its volume in the PSW market to 621 thousand tons in 1988.

The West Coast region supplied a period low of 70 thousand tons of barley to the Pacific Southwest by rail in 1984. This volume quadrupled by 1986, reaching a high of 281 thousand tons. However, it has since declined to a level of 142 thousand tons in

1988.

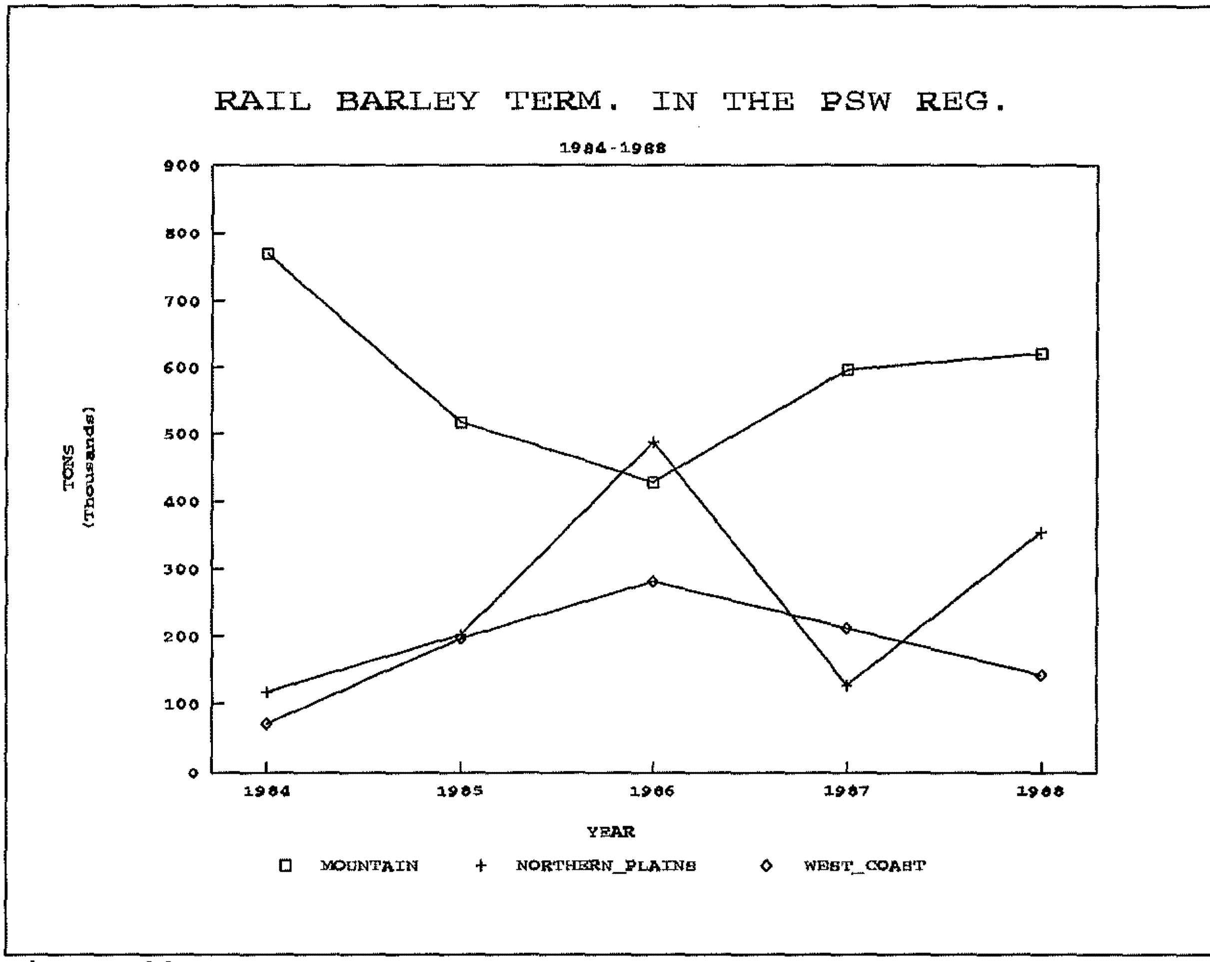

Figure 20

The Northern Plains region's share of the Pacific Southwest market stood at 11.8 percent in 1984, but rose to 40.2 percent in 1986 (Figure 21). This upward trend coincided with a drop in the Mountain region's share from 77.8 percent in 1984 to 35.2 percent in 1986. The Northern Plains' share of the PSW market dropped to a level of 13 percent in 1987, while the Mountain region's share rose to 60.9 percent. In 1988, the Northern Plains' market share rebounded somewhat, while the Mountain region's share declined. Throughout the 1984-88 period, the West Coast region's share remained relatively constant. As Figure 21 illustrates, the Northern Plains' main competitor in the

Pacific Southwest market is the Mountain region. The market shares of these two supply regions have moved opposite to one another throughout the period.

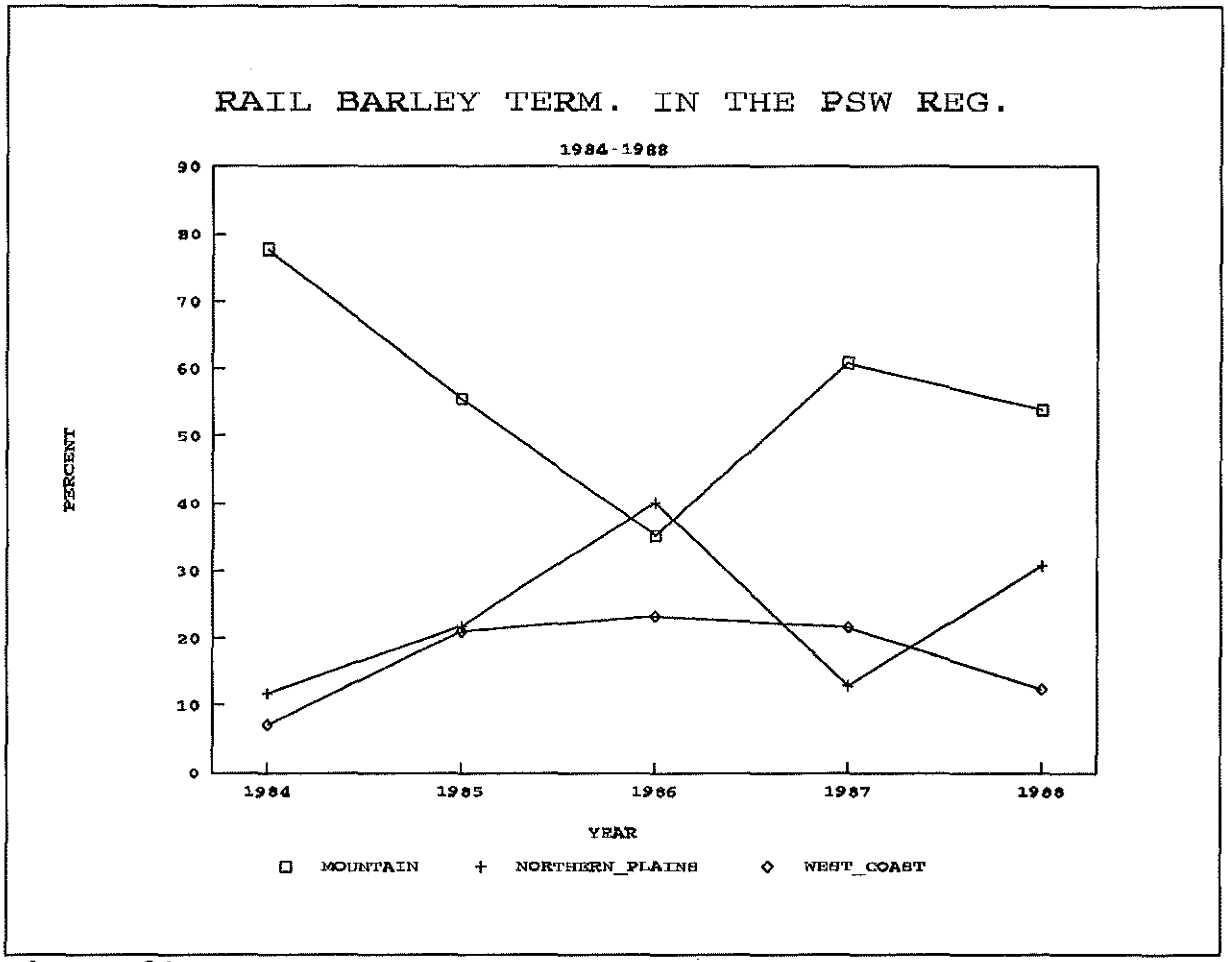

Figure 21

The West Coast Region was the only other major supply region in this market, terminating over twelve percent of the rail barley traffic in the Pacific Southwest in 1988. Most of the barley terminated in the Pacific Southwest is used for feed purposes. Although some malting occurs in Los Angeles, the amount is difficult to quantify because of the large feed volumes terminating in the area. Furthermore, the only known malting location in this region is Los Angeles, and any quantification of malting volumes would violate confidentiality restrictions.

Market Share in the Gulf Region

Nearly all of the rail barley terminated in the Gulf region in 1988 was supplied by the Northern Plains region (Figure 22). The Northern Plains region supplied over ninety-one percent of the rail barley shipped to the Gulf region in 1988.

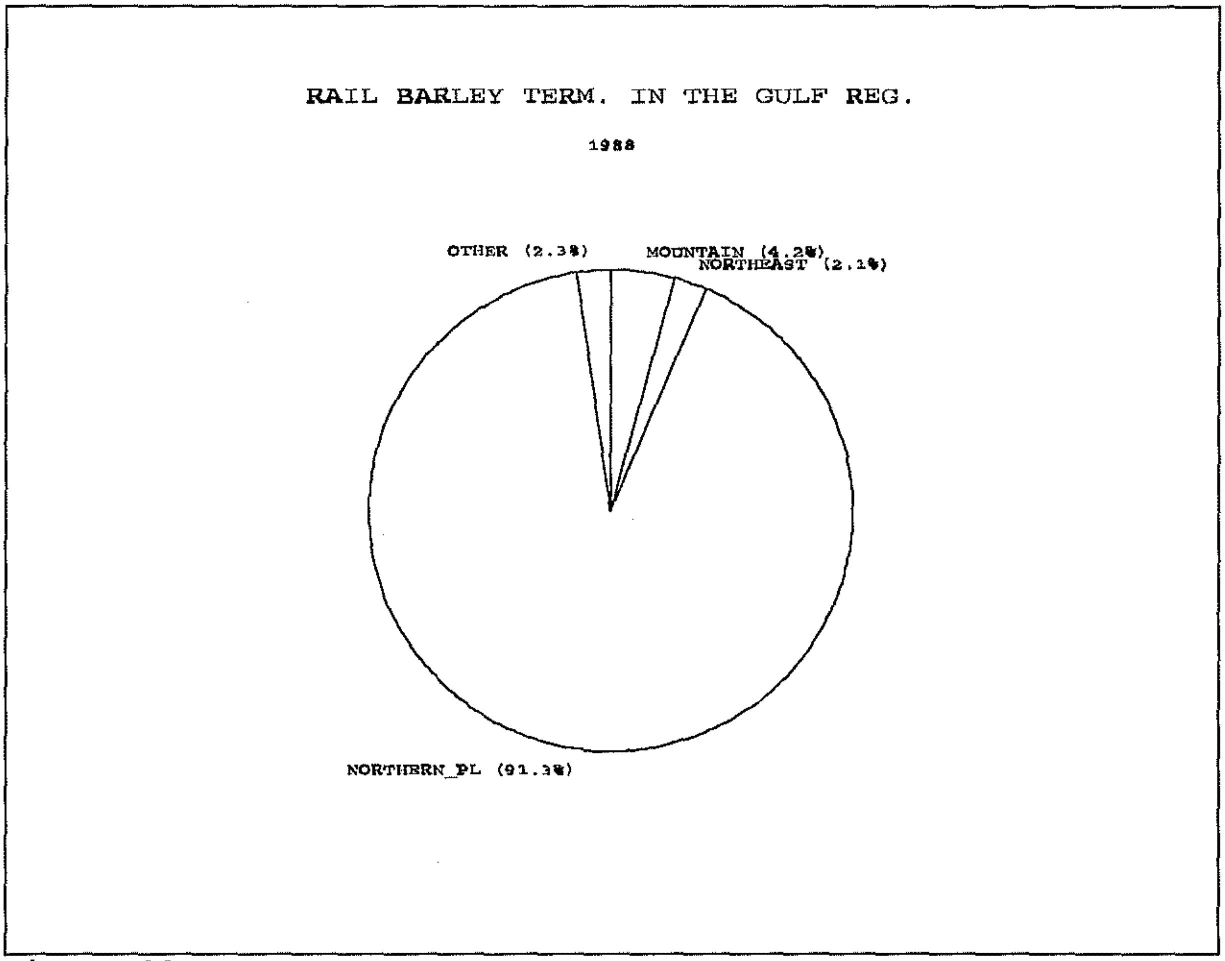

Figure 22

The Mountain region and the Northeast region supplied 4.2 percent and 2.1 percent of the rail barley shipped to the Gulf region in 1988, respectively.

In 1984, the Northern Plains region did not participate in the Gulf market (Figure 23). However, by 1986, the Northern Plains region had penetrated this market to the level of 249 thousand rail tons of barley. After a drop in supply to 101 thousand tons in

1987, the Northern Plains' rail volume jumped to 429 thousand tons in 1988.

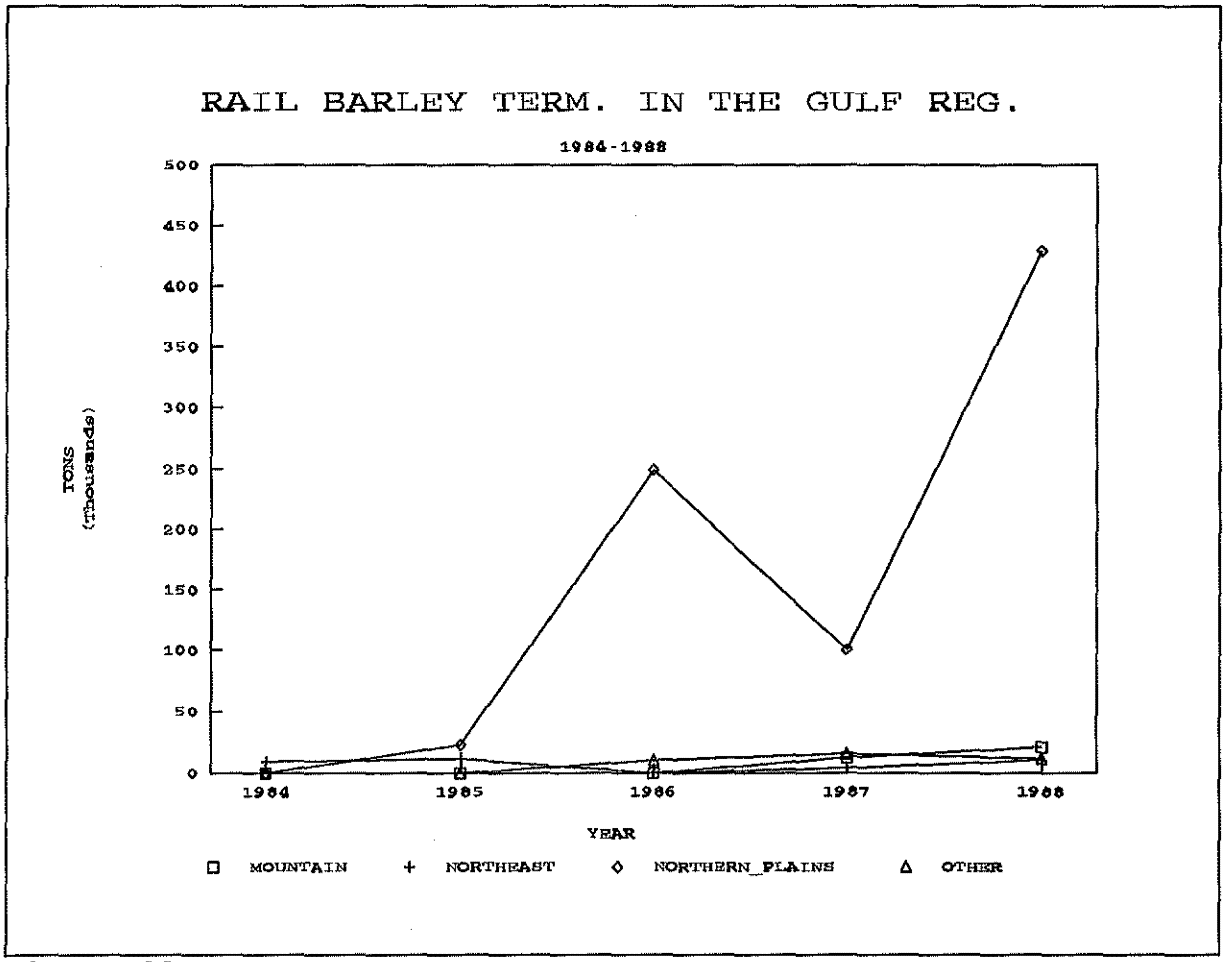

Figure 23

In 1984, all of the barley shipped to the Gulf region was supplied by the Northeast region (Figure 24). However, only .13 percent of all rail barley shipped nationwide was terminated at Gulf markets in 1984.

As the level of barley shipped to the Gulf increased (reaching 5.9 percent of nationwide rail shipments in 1988), the Northern Plains region began to dominate this market. In 1986, the Northern Plains supplied over ninety-six percent of the rail barley terminated in the Gulf region. This share dropped somewhat in 1987, as the Mountain region and miscellaneous supply points gained some market share. However, the

Northern Plains region's share rebounded to 91.3 percent in 1988.

Nearly all of the barley terminated in the Gulf region is used for feed or export.

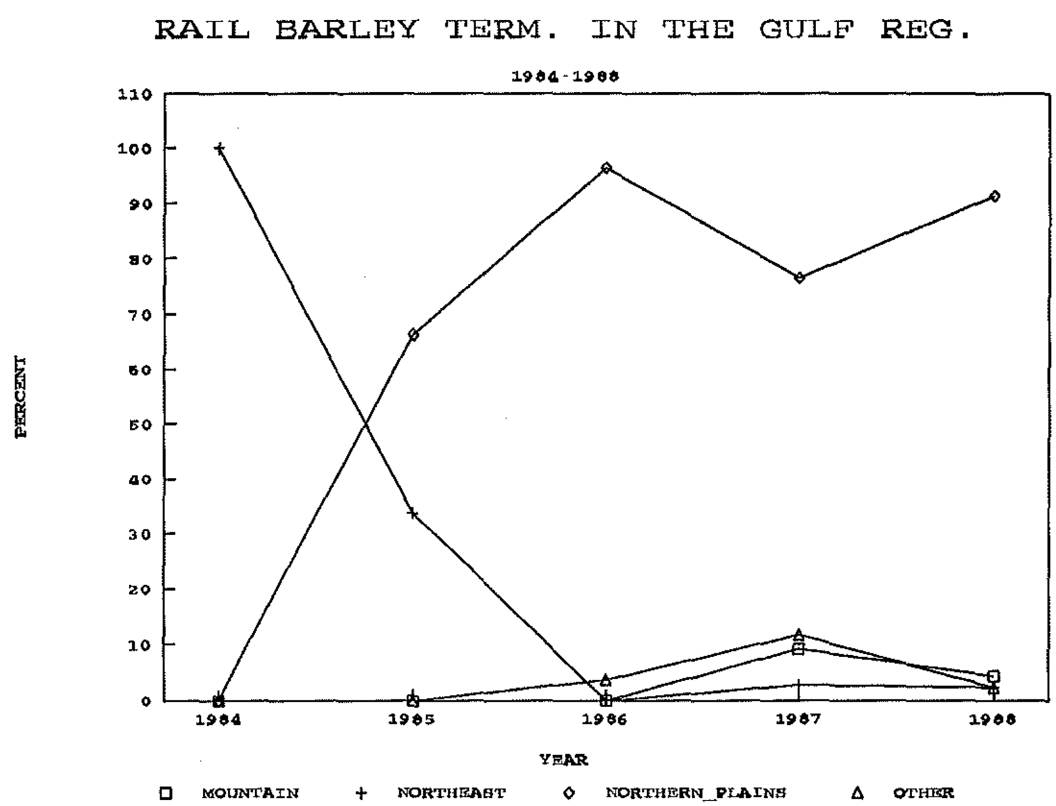

Figure 24

Market Share in the Mountain Region

In 1988, the majority of the barley terminated by rail in the Mountain region (82%) originated in the Mountain region (Figure 25). Again, this dominance reflects the close proximity of rail supply and demand points.

The Northern Plains region owned the second largest share of the Mountain market, supplying 16.8 percent of the rail barley terminated in this region in 1988.

However, the Northern Plains is the only other significant supplier in this market. The West Coast region supplied just 0.8 percent of the rail barley terminated in the Mountain region in 1988.

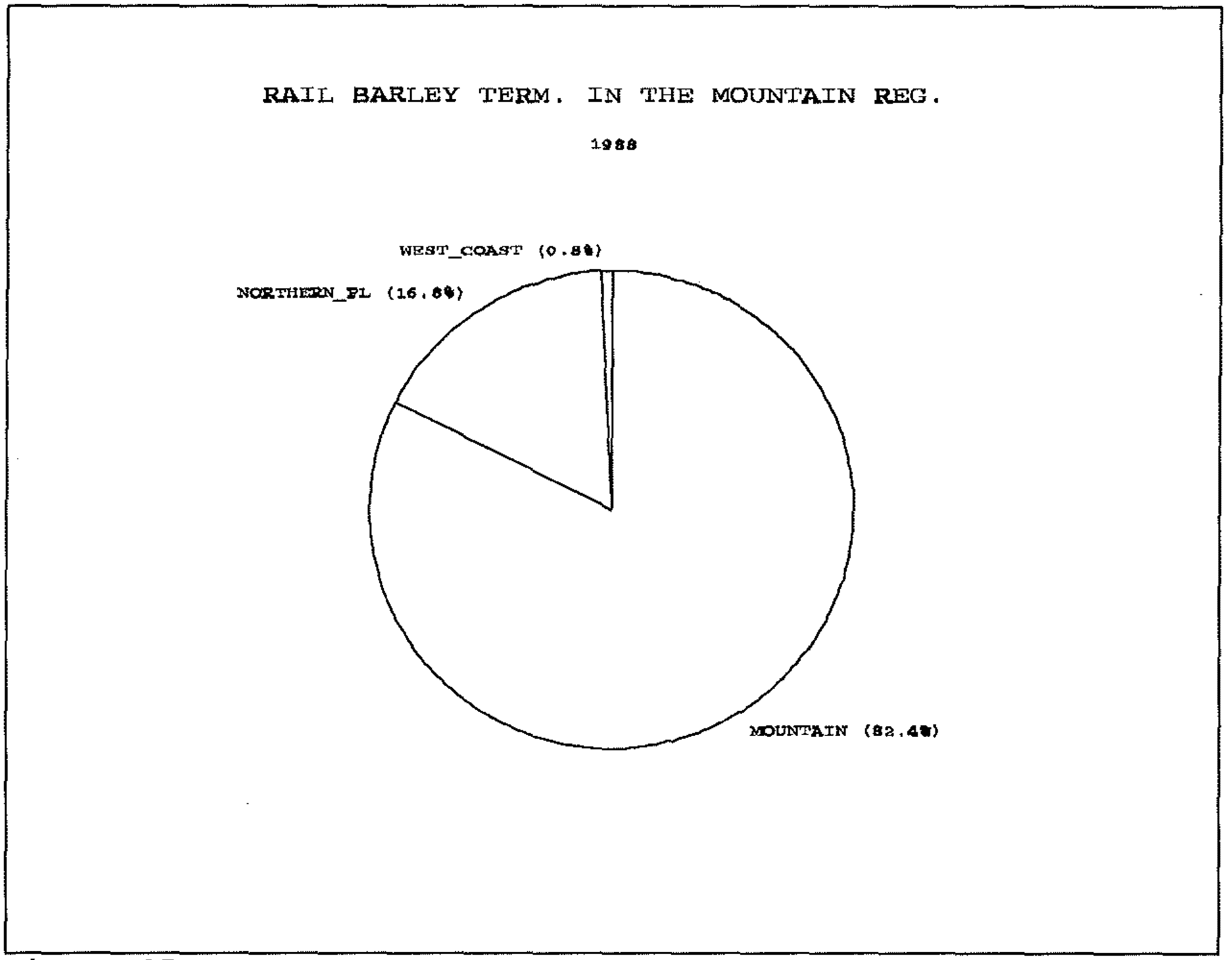

Figure 25

In terms of absolute volume, the Northern Plains region supplied only 43 thousand tons of barley by rail to the Mountain region in 1984 (Figure 26). The Northern Plains increased its volume in this market to approximately 167 thousand tons in 1985 and again in 1986. However, the Northern Plains' market share dropped to approximately 70 thousand tons in 1987 and in 1988.

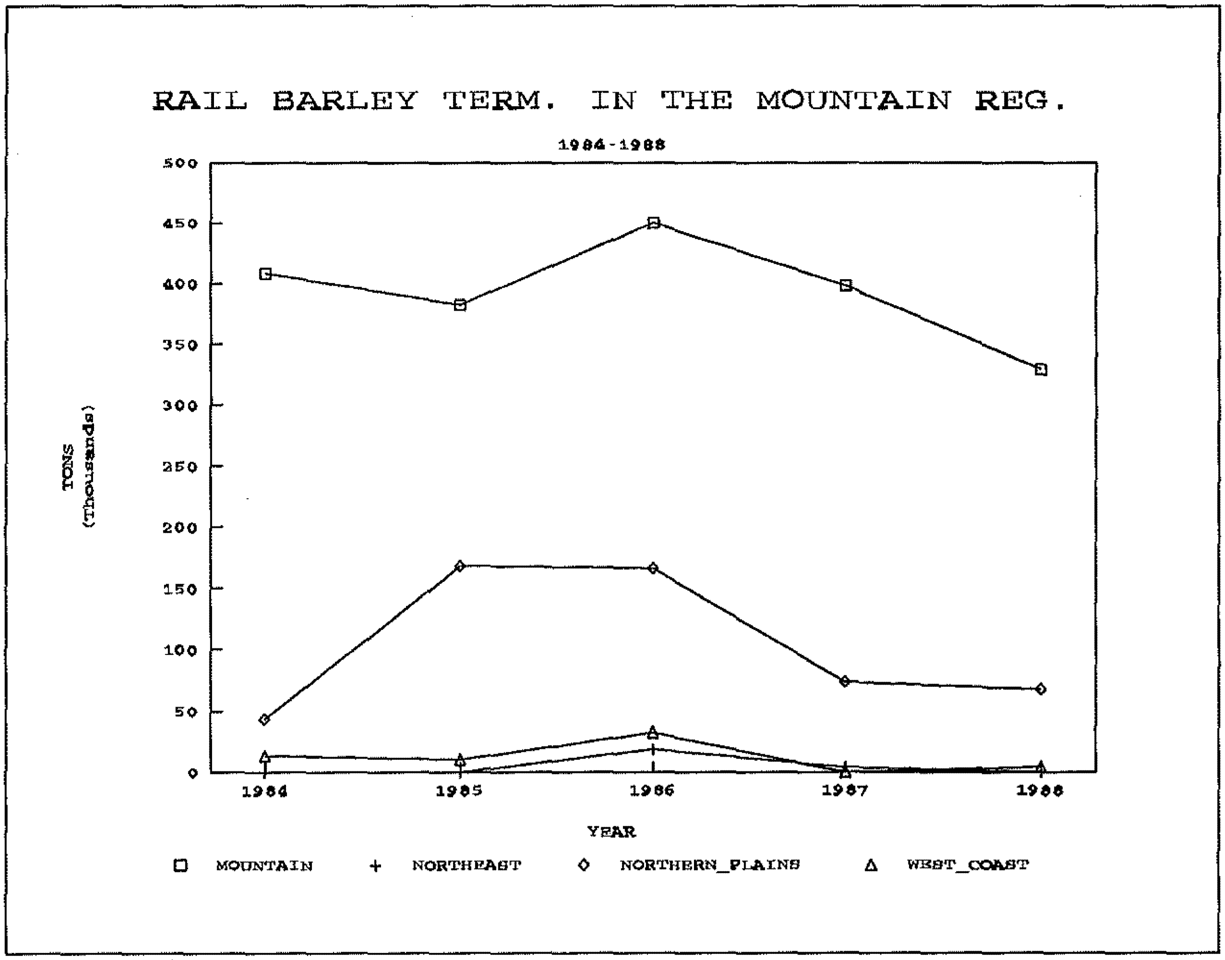

Figure 26

In contrast, Mountain region producers supplied between 330 thousand and 450 thousand tons of rail barley to this market each year during the 1984-1988 period.

As Figure 27 shows, Mountain region suppliers dominated their own market throughout the 1984-88 period. Furthermore, all of the fluctuations in the Mountain region's market share have coincided with opposing market share fluctuations by the Northern Plains supply region. In essence, as the data depict, the Mountain region's major competitor for local markets is the Northern Plains.

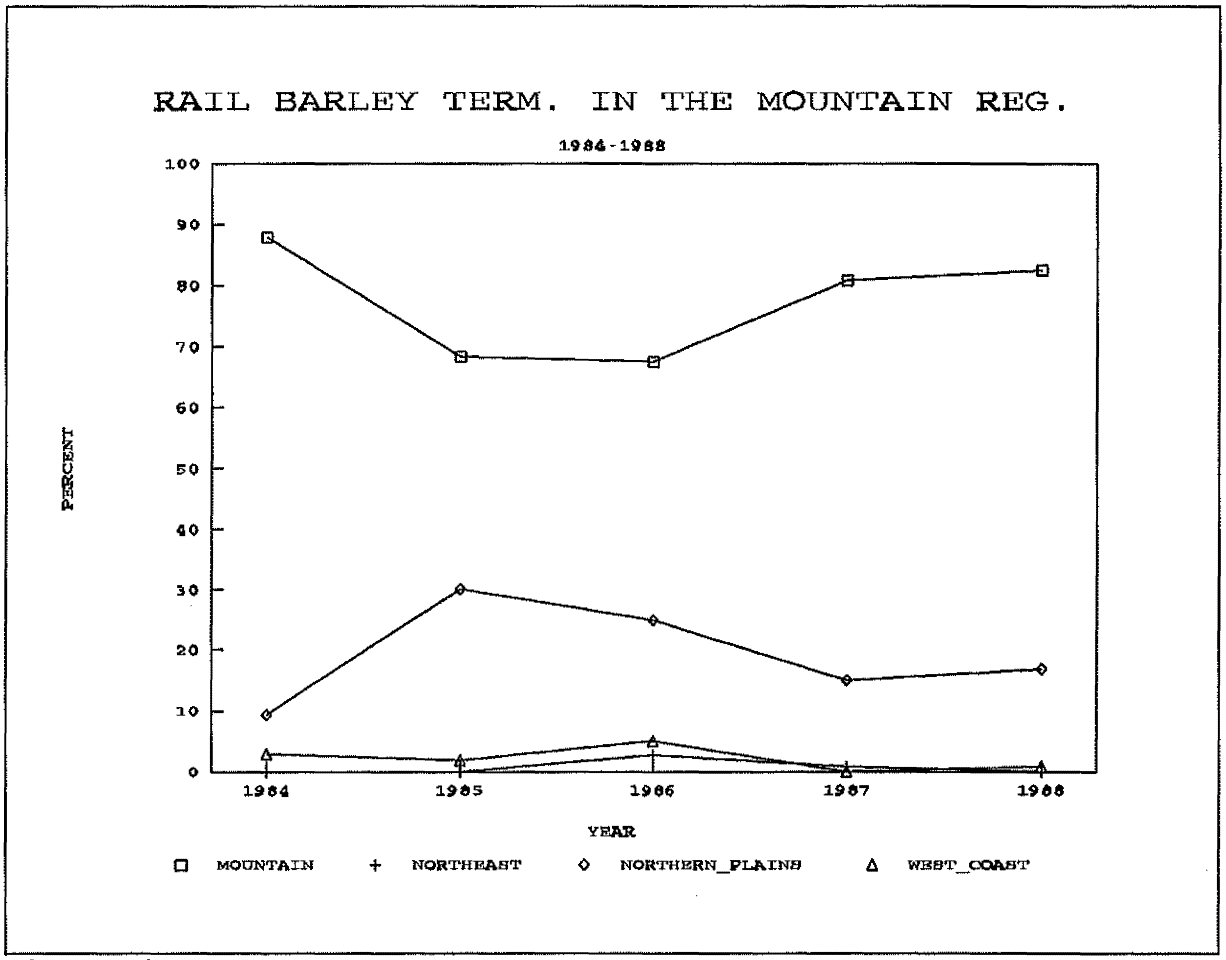

Figure 27

In 1988, 58.6 percent of all rail barley terminated in the Mountain region was shipped to malting locations (Figure 28). However, this malting percentage represents a decline from a period high of 70.1 percent in 1987. In 1985 and 1986, approximately forty percent of rail barley shipments were terminated at malting locations, compared to 55.5 percent in 1984.

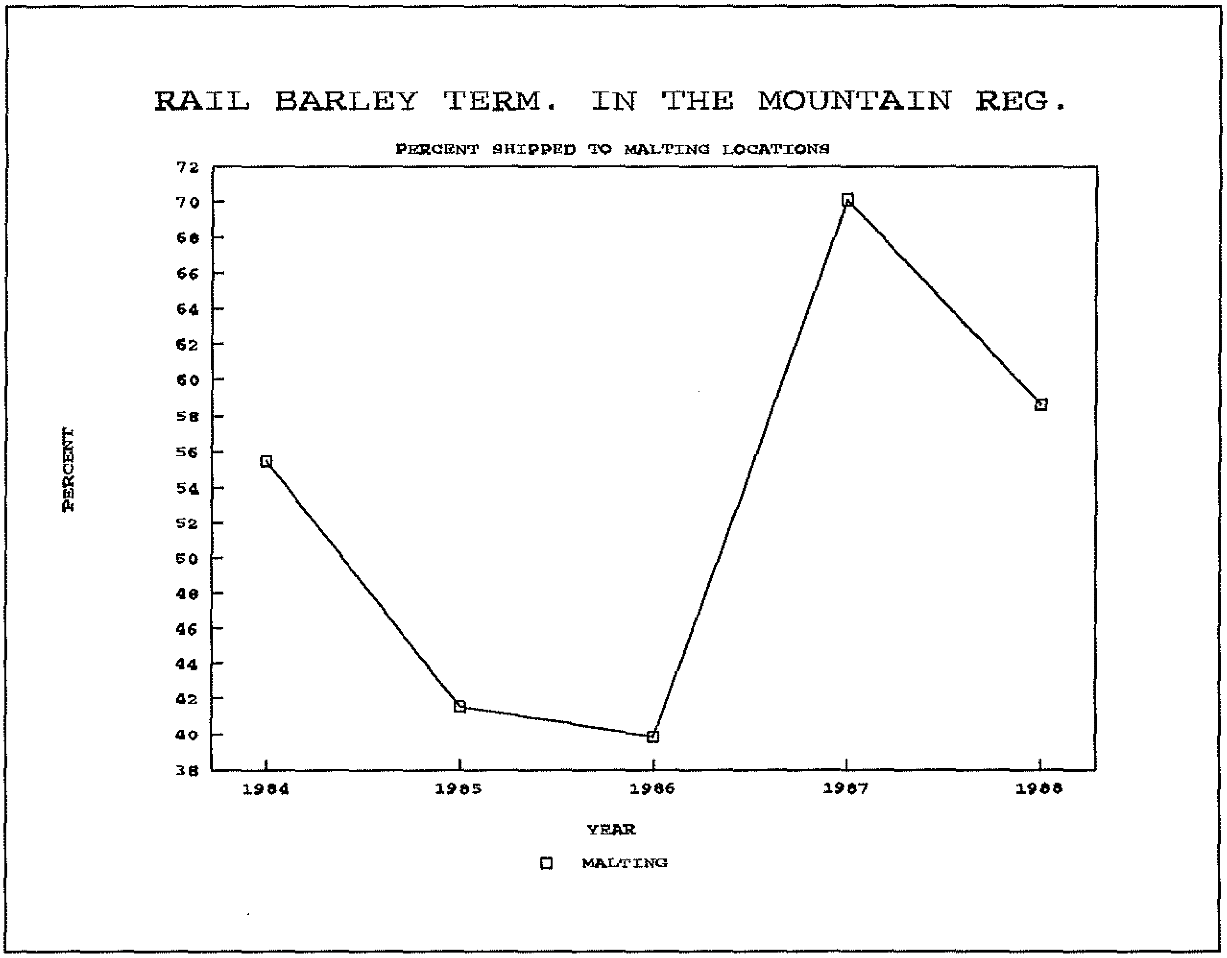

Figure 28

Most of the rail barley terminated at malting locations in the Mountain region between 1984 and 1988 was supplied by producers in the Mountain region (Figure 29). The Northern Plains region supplied between zero and sixteen percent of the market during this period. The Northern Plains' market share moved opposite to that of the Mountain region throughout the period. As the data illustrate, Northern Plains producers represent the only major competition for Colorado, Idaho, Montana, Utah, and Wyoming producers in the malting barley markets of the Mountain region.

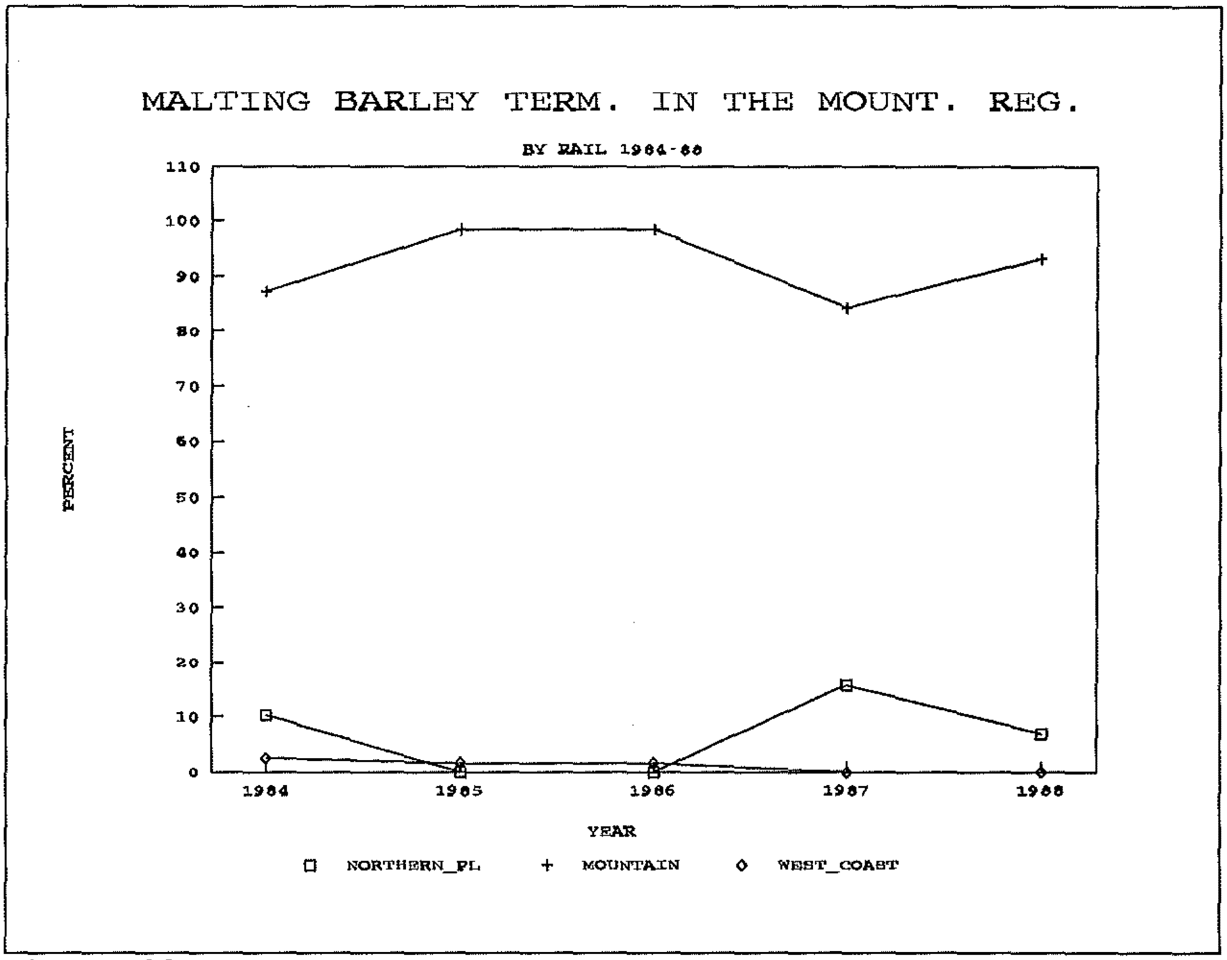

Figure 29

In 1988, Mountain region producers supplied 66.9 percent of the barley terminated at feed locations in the Mountain region, while the Northern Plains region supplied 31.1 percent (Figure 30). Throughout the 1984-88 period, the Northern Plains region and the Mountain region have been the two major suppliers of feed barley to this market. The West Coast and the Northeast regions have supplied some feed barley, but again, the two major participants in this market have been the Mountain region and the Northern Plains.

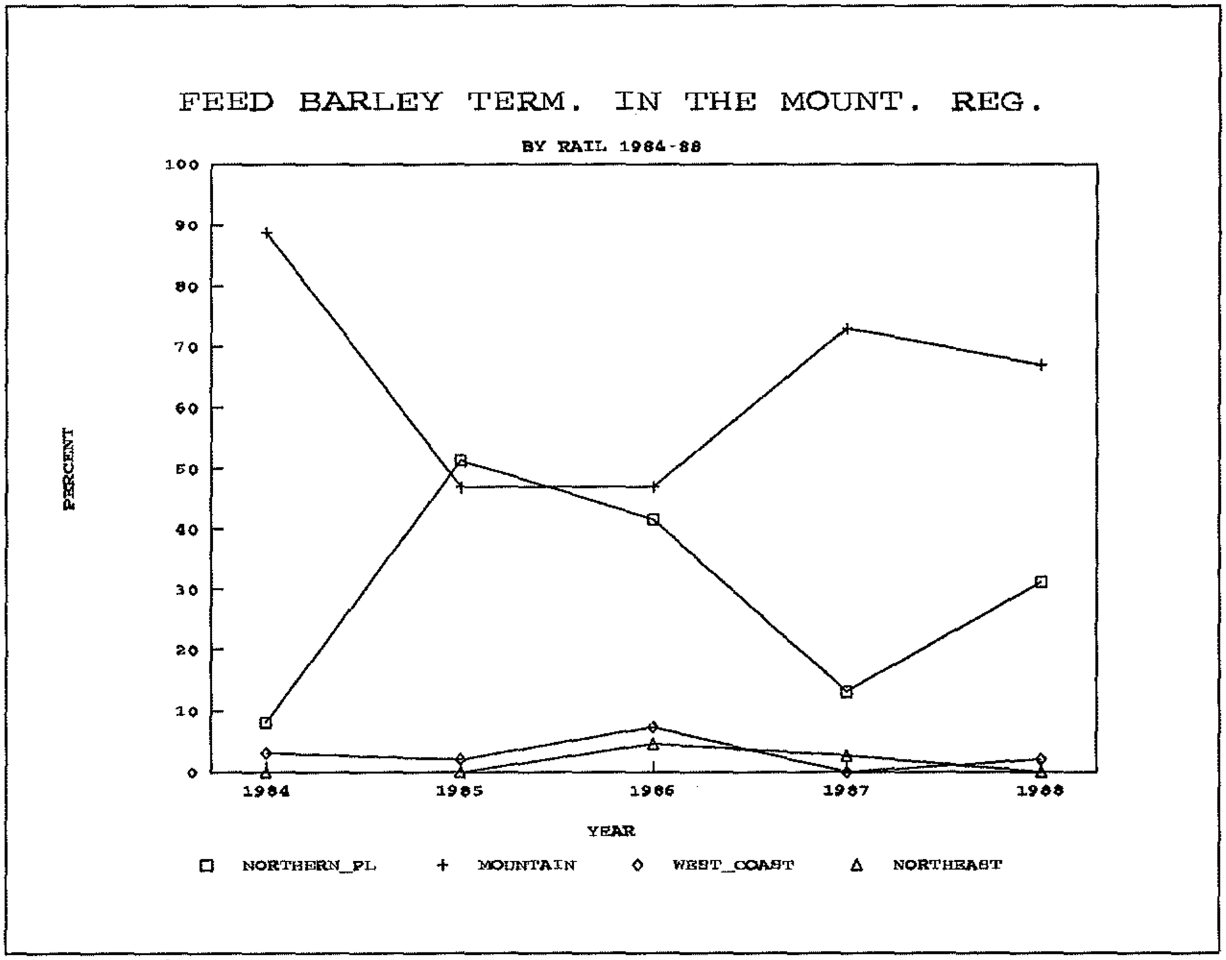

Figure 30

Market Share in the Mid-Continent Region

In 1988, the Northern Plains region dominated the Mid-Continent rail market for barley. As Figure 31 shows, the Northern Plains region held a 80.9 percent share of this market in 1988.

The Mountain region owned the second largest share of the Mid-Continent market in 1988 (8.9 percent), while the Northeast region owned the third largest share (8.6 percent).

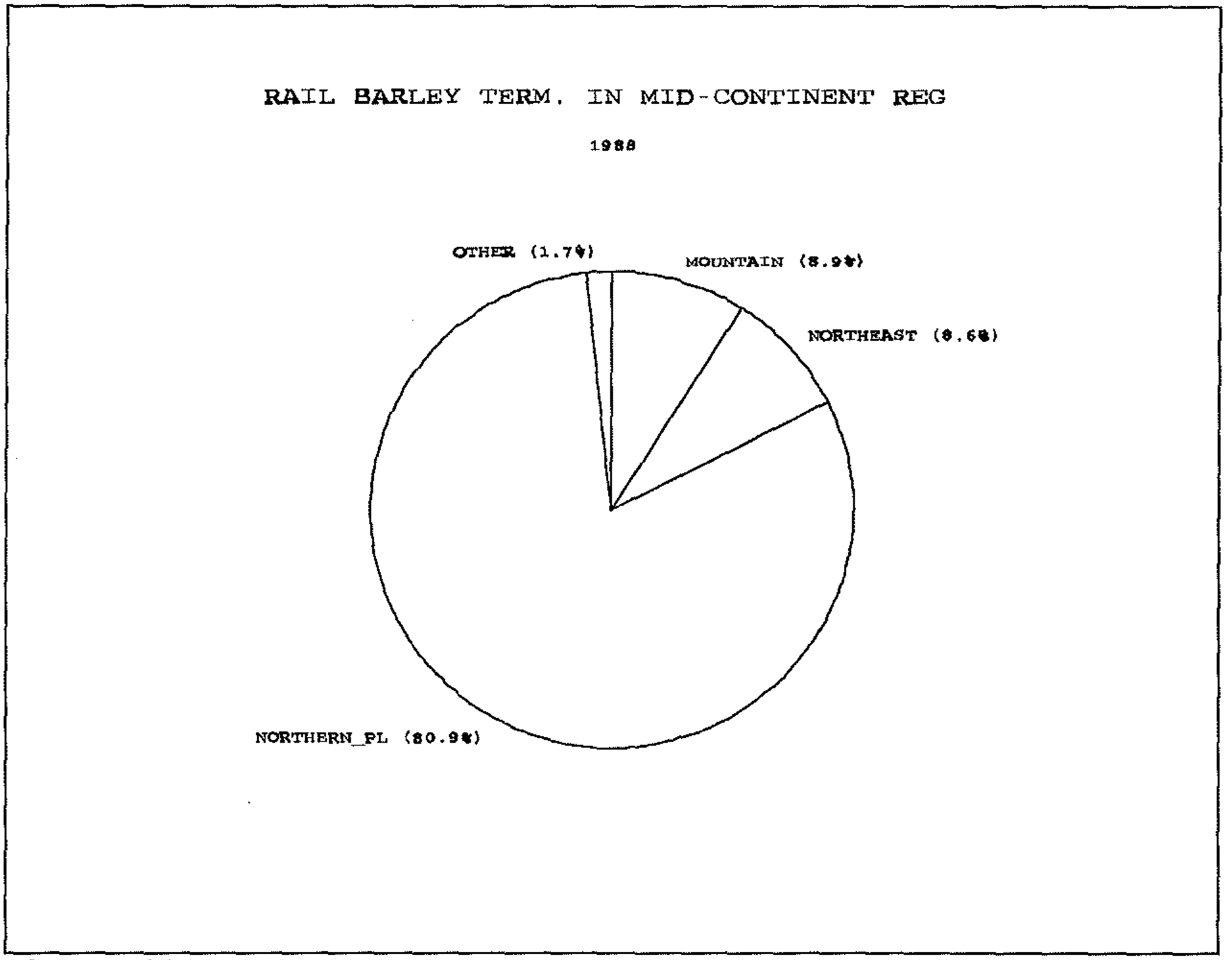

Figure 31

The Northern Plains region supplied only 69 thousand tons of rail barley to the Mid-Continent region in 1984 (Figure 32). However, the volume of rail barley supplied to this market by Northern Plains producers has since increased to a level of 195 thousand tons in 1988.

The Northeast region supplied 106 thousand tons of rail barley to the Mid-Continent market in 1984. However, this level dropped to a period low of 13,600 tons in 1987, before rebounding slightly to 20,700 tons in 1988.

The Mountain region supplied 34,788 tons of the rail barley terminated in the Mid-Continent region in 1984. The Mountain region's market share reached a high of 45 thousand tons in 1986 before dropping to 21,500 tons in 1988.

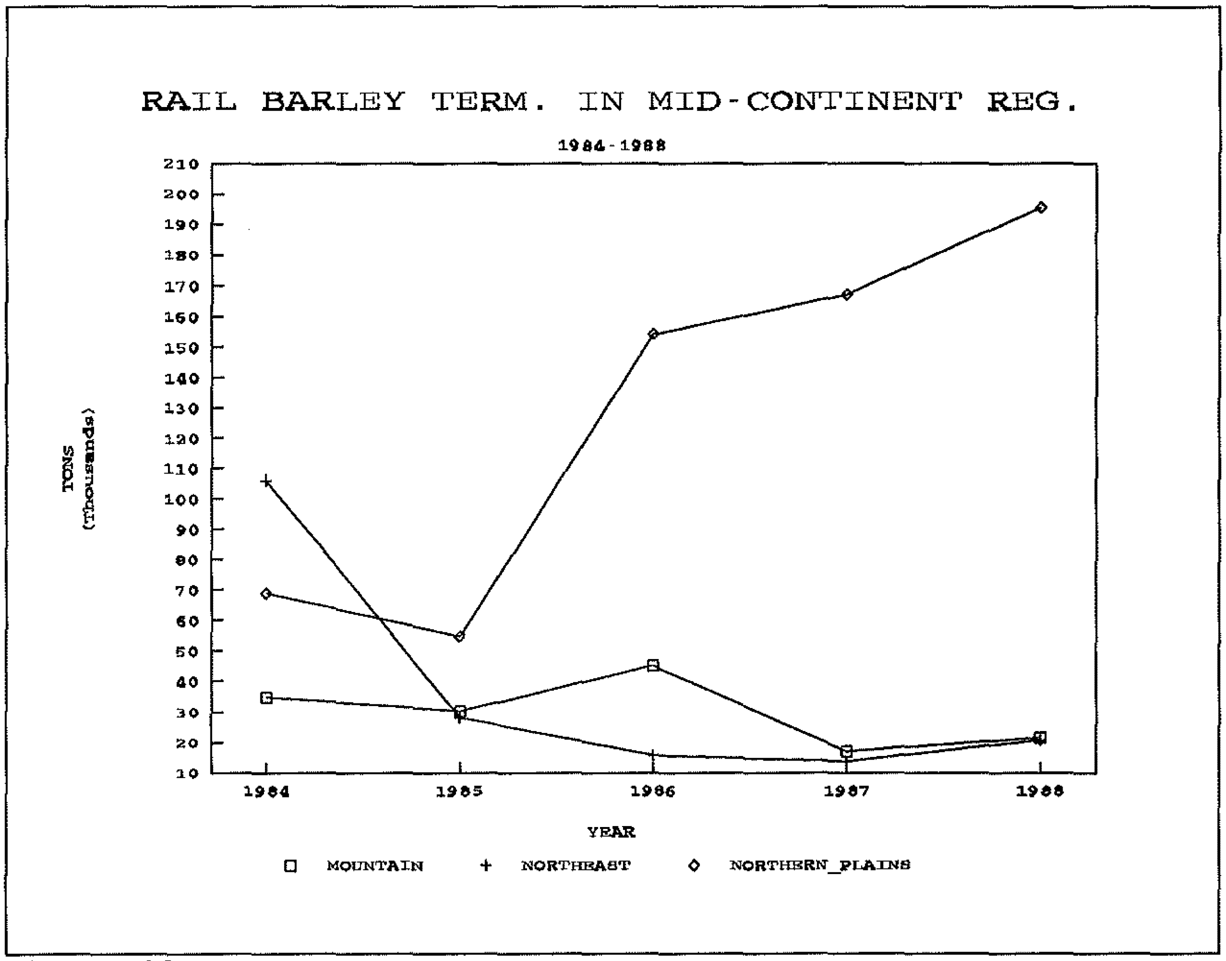

Figure 32

In 1984, the Northeast region dominated the Mid-Continent rail market for barley, holding a 50.6 percent market share (Figure 33). In 1985, this share dropped to 25 percent of the market, while the Northern Plains' share rose to 48.3 percent (after standing at 32.9 percent in 1984). The Mountain region's market share also rose slightly during this period.

Since 1985, the Northern Plains region has steadily gained market share in the Mid-Continent region, while both the Northeast and the Mountain regions' shares have declined.

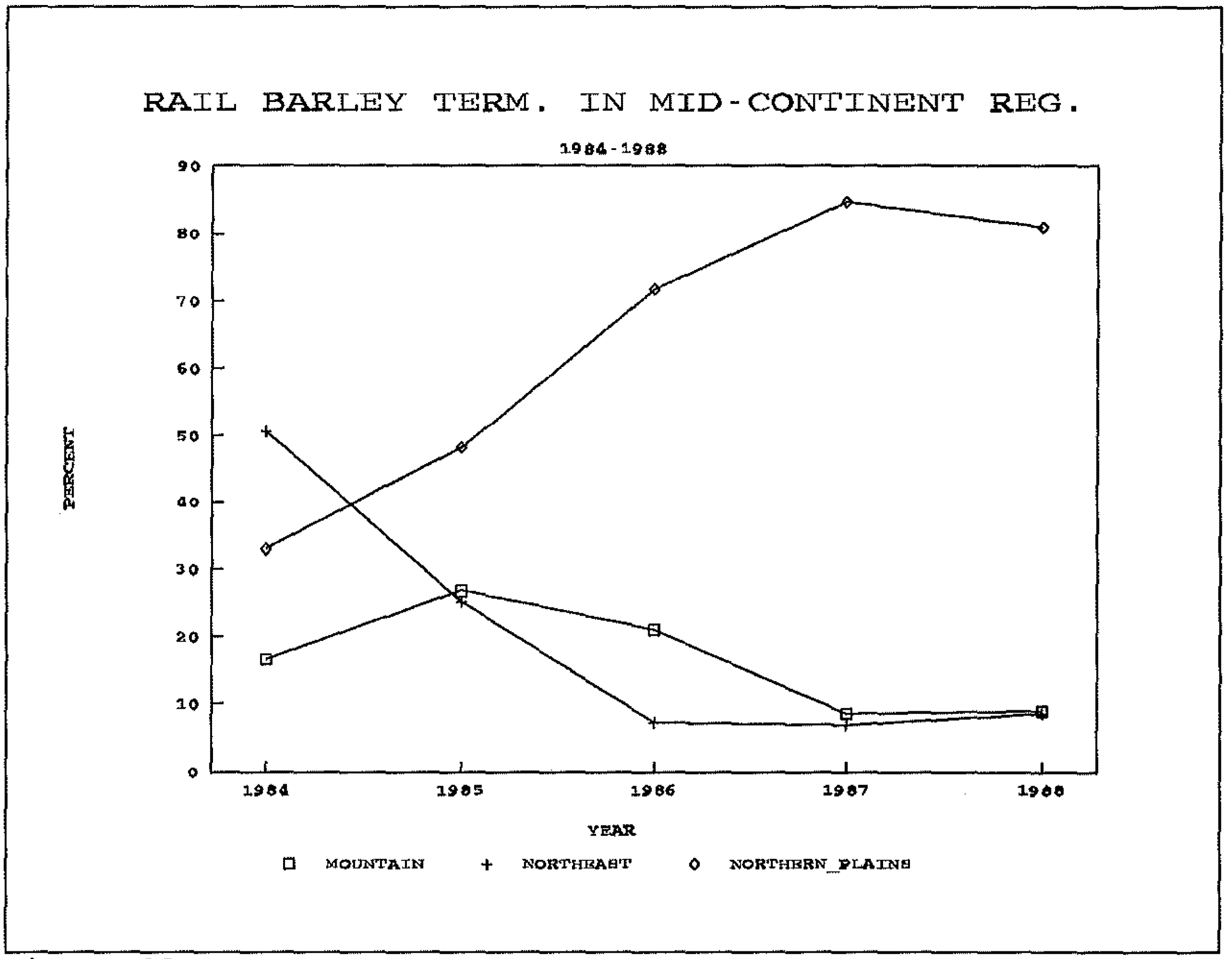

Figure 33

Chicago is the only city in the Mid-Continent region which has a malting facility. Thus, any quantification of malting barley volumes in this region would violate the confidentiality requirements of the waybill sample.

MODAL SHARES

The previous section of the report focused exclusively on railroad market volumes. In this section of the analysis, data for alternate modes are presented. However, as noted previously, truck and barge data are both scarcer and less reliable than railroad waybill data.

The truck and rail shares of barley terminated in the Duluth, Minneapolis, and California markets in 1988 are presented in Table 2. These are the only markets where both truck and rail barley volumes are available. In addition, barge shipments of barley and rye terminating in the Pacific Northwest are presented in Table 3. Origin area market shares are available for only two states: Montana and North Dakota. Nevertheless, these data are presented and analyzed in this section.

In 1988, the Duluth market received over 750 thousand tons of barley from truck and rail shipments (Table 2). Nearly 58 percent of this volume moved by rail.

The California market received over 1.1 million tons of barley during 1988. Almost all of this volume (96 percent) was transported by rail. Rail dominance in the California market may be explained in part by the large demand in this market relative to the local supply of barley and, consequently, the length of haul from distant producing regions.

The Minneapolis market received over 1.3 million tons of barley in 1988. Again, the majority of this volume (91.4 percent) arrived by rail. This may have been due to the restrictive nature of the transportation demands for malting barley.

TABLE 2: 1988 RAIL AND TRUCK TOTALS FOR BARLEY SHIPPED INTO SELECTED TERMINAL MARKETS IN TONS (AND PERCENTAGES)

TERMINAL MARKET	RAIL	TRUCK
DULUTH	439,113 (57.9%)	318,825 (42.1%)
CALIFORNIA	1,059,240 (96.0%)	43,943 (4.0%)
MINNEAPOLIS	1,211,847 (91.4%)	113,453 (8.6%)

Sources: Federal-State Market News Service, Mpls. Grain Exchange

The Pacific Northwest region received over 580 thousand tons of barley and rye by barge in 1988. Because barley and rye shipment statistics are not separated from each other in the waterborne commerce data, it is difficult to tell exactly how much of this volume was actually barley. If this volume were 100 percent barley, the barge volume in this market could be compared to the 700,000 tons of barley delivered by rail to obtain generalized modal shares. However, even if the barge data were completely accurate, they do not account for any short-haul truck traffic to export facilities in the area.

TABLE 3: 1988 BARGE TOTALS FOR BARLEY AND RYE SHIPPED INTO THE PACIFIC NORTHWEST MARKET (IN TONS)

PORT	TONS
KALAMA	115,843
LONGVIEW	15,623
PORTLAND	433,617
VANCOUVER	15,652
PACIFIC NORTHWEST TOTAL	580,735
Source: U.S. Army Corp. of Engineers	

Truck and rail volumes of barley shipped from Montana to terminal markets are shown in Table 4 for the period 1984--1988. In the following narrative, the Montana totals are compared to the North Dakota values shown earlier in Table 1.

In 1988, over 53 million bushels of barley were shipped from the state of Montana. Nearly 75 percent of this volume was originated by railroads.

Since 1985, when the truck share of barley shipped from Montana was greater than that of railroads, rail barley share has grown rapidly. As Table 4 shows, the railroads' modal share was greater in every terminal market during each year of the period, with the exception of the Mountain region. Truck shares in this market can be explained by the fact that the Mountain market includes Montana, and most local shipments within the state are made by truck. Also, many truckers are probably hauling short-distances to barge transloading facilities in Idaho. These shipments to Idaho can be made inexpensively, as many of these shipments are backhauls from lumber shipments to Montana. However, as Table 4 depicts, railroads handled at least 70 percent of the barley traffic to the Pacific Northwest, the Midwest, and the Pacific Southwest markets during each year of the period.

The shipment statistics for North Dakota (displayed in Table 1) paint a similar picture. From crop year 1983-84 through crop year 1988-89, railroads originated at least 80 percent of the barley traffic each year. In fact, in crop year 1986-87, railroads held an impressive 93 percent market share. In 1988, North Dakota elevators shipped approximately 16 million bushels of barley by truck, and 76 million bushels of barley by rail.

While Montana and North Dakota shipments do not account for the entire volume of truck shipments nationwide, a look at trends in these two states may suggest the probable proportion of truck-to-rail shipments in other interior production regions. The data for these two states illustrate the historic and continuing railroad domination of barley traffic in the Northern Plains and Mountain supply regions. Again, this is not necessarily a negative transportation factor. However, it does underscore the need to examine railroad transportation conditions and factors, which is done later in the report.

TABLE 4: MONTANA BARLEY SHIPMENTS BY RAIL AND TRUCK AND DESTINATION (BUSHELS)												
	PACIFIC NW		MIDWEST		PACIFIC SW		MOUNTAIN		OTHER		TOTAL	
YR	RAIL	TRUCK	RAIL	TRUCK	RAIL	TRUCK	RAIL	TRUCK	RAIL	TRUCK	RAIL	TRUCK
84	5,744,451 (81.3%)	1,405,147 (19.7%)	7,309,264 (84.3%)	1,358,904 (15.7%)	5,141,504 (58.3%)	3,675,413 (41.7%)	1,750,188 (15.2%)	9,784,738 (84.8%)	2,105,657 (87.3%)	307,194 (12.7%)	22,051,064 (57.1%)	16,531,396 (42.9%)
85	573,298 (58.0%)	414,651 (42.0%)	2,691,696 (88.0%)	365,275 (12.0%)	6,318,566 (69.8%)	2,737,827 (30.2%)	880,998 (7.2%)	11,355,892 (92.8%)	95,436 (13.1%)	635,179 (86.9%)	10,559,994 (40.5%)	15,508,824 (59.5%)
86	13,522,342 (98.4%)	225,756 (1.6%)	3,859,989 (91.5%)	358,929 (8.5%)	5,347,193 (70.0%)	2,074,368 (30.0%)	1,408,074 (14.2%)	8,473,278 (85.8%)	95,939 (23.1%)	319,942 (76.9%)	24,233,537 (67.9%)	11,452,273 (32.1%)
87	27,355,704 (97.5%)	691,762 (2.5%)	5,546,755 (96.1%)	222,126 (3.9%)	5,654,707 (80.4%)	1,374,654 (19.6%)	2,141,957 (22.3%)	7,482,076 (77.7%)	619,685 (96.3%)	23,922 (3.7%)	41,318,808 (81.8%)	9,794,540 (19.2%)
88	5,122,294 (93.2%)	372,337 (6.8%)	4,741,800 (96.3%)	575,224 (3.7%)	3,946,991 (94.8%)	759,852 (5.2%)	5,529,928 (32.1%)	11,714,092 (67.9%)	499,130 (56.1%)	390,032 (43.9%)	39,840,143 (74.7%)	13,476,433 (25.3%)

SOURCE: MONTANA WHEAT AND BARLEY COMMITTEE

The purpose of the foregoing data and analysis has been to describe barley markets and to trace interregional flows over time. However, this is only one portion of the analysis. The positioning of barley in various markets, as well as producer's price expectations and land allocations, are influenced by the net prices received by shippers. In the next section of the report, net shipper prices are analyzed for major supply regions and markets.

IV.PRICE ANALYSIS

While prices received by producers are the traditional focus of market studies, this analysis looks at prices received by shippers. There are two major reasons for this approach. First, it avoids many of the complications that an analysis of elevator margins entails. Second, it is appropriate because a major focus of this study is on the transportation competitiveness of the Northern Plains region in barley marketing. Elevator margins play little or no role in this assessment.

The price received by a shipper can generally be computed from the following equation:

(1) $SP = MP - TC$

where:
SP = the net price received by shippers
MP = the market price
TC = the transportation charge

The prices received by shippers can be influenced by many factors. First, the net price is logically a function of the markets that the shipper participates in. Market participation, in turn, is dependent upon the proximity of the shipper to various markets, transportation capacity, and a range of other factors. Theoretically, a shipper who is closer to a particular market should have a competitive advantage in that market because transportation charges are typically distance-related. However, this may not always be the case. A shipper who is close to a particular market but has fewer transportation alternatives may actually pay higher transportation rates into that market than his competitors.

Transportation factors such as the number of interchanges for a given movement and the number of cars in a shipment may also indirectly impact net shipper prices through their influence on transportation rates. These factors are examined in a later section of the report.

A third factor which may influence prices received by shippers is the timing of a shipment. Producers in areas with limited transportation competition and capacity may not be able to sell grain at its highest price if freight cars or barges are in tight supply. Although a potential factor, car supply constraints are *not* addressed in this analysis.

A fourth factor impacting the prices received by shippers is barley quality. As noted earlier, buyers may pay premiums for high quality barley.

Several other factors (such as buyer loyalty to particular regions or suppliers) also influence the prices received by shippers. However, these factors are difficult to quantify, and are therefore not addressed in this study.

Using Equation 1 and the railroad waybill sample, prices received by shippers in each supply region have been approximated. Because it is difficult to determine prices paid for barley in states which do not have market exchanges, the prices received by shippers are approximated only for those states which have grain exchanges. Also, because of the many non-quantifiable factors that influence malting barley sales, only feed barley prices are evaluated. Consequently, the Minneapolis barley price is not used in this analysis.

The terminal market prices used to approximate net shipper prices are as follows:

Minnesota - Duluth Market Price

Oregon - Portland Market Price

California - The Average of the Stockton Market Price and the Los Angeles Market Price

Finally, market prices paid for barley are assumed to be the price on the day the shipment was originated. While this is not completely accurate, it should allow for a reasonable matching of market prices and transportation rates.

Tables 5 and 6 show 1987 and 1988 calendar year average prices received by shippers, the corresponding transportation charges, and the short line distance[5] of movements, by region. The 1984, 1985, and 1986 averages are not shown because the transportation revenues listed on the waybill tapes may not necessarily reflect the actual charges during this time period. Contracts for the transportation of barley were widespread between 1984 and 1986. Therefore, waybill revenues for these years are likely to overstate transportation charges. However, many barley contracts have been phased-out. Thus, the 1987 and 1988 waybill revenues should closely reflect the actual rates.

TABLE 5: 1987 AVERAGES FOR PRICES RECEIVED BY SHIPPERS, TRANSPORTATION CHARGES, AND SHORT LINE MILES FOR FEED BARLEY TERMINATING IN MN, OR, AND CA (BY REGION)

REGION	SHIPPER PRICE (PER BU.)	TRANSPORTATION CHARGE (PER BU.)	SHORT LINE MILES
NORTHERN PLAINS	1.33	0.41	568
MOUNTAIN	1.71	0.49	1044
WEST COAST	2.00	0.29	394
OTHER	1.68	0.37	560

[5]The short line distance is the shortest rail distance between the origin and destination of the movement.

TABLE 6: 1988 AVERAGES FOR PRICES RECEIVED BY SHIPPERS, TRANSPORTATION CHARGES, AND SHORT LINE MILES FOR FEED BARLEY TERMINATING IN MN, OR, AND CA (BY REGION)			
REGION	**SHIPPER PRICE (PER BU.)**	**TRANSPORTATION CHARGE (PER BU.)**	**SHORT LINE MILES**
NORTHERN PLAINS	1.87	0.48	682
MOUNTAIN	1.81	0.67	1157
WEST COAST	2.24	0.30	452
NORTHEAST	2.07	0.21	155
OTHER	1.25	1.05	702

In 1987, shippers in the Northern Plains region received the lowest prices for feed barley of any production region in the United States. Some of this difference can be explained by higher transportation charges in comparison to the West Coast and other regions. However, most of the difference is probably due to the fact that the Northern Plains region generally received lower market prices for feed barley at Duluth. This differential can be illustrated by adding the average shipper price to the average transportation charge to generate an average market price. The average market price for the Northern Plains region was only $1.74 in 1987, while the average market price for the Mountain region (the Northern Plains region's main competitor) was $2.20[6].

There are several possible reasons for this. While shippers in the Mountain region shipped longer distances on average than Northern Plains shippers, it is unlikely that the large difference in average market price was due to different interregional volumes. It is more likely that shippers in the Mountain region sold in the market at times when prices were high, while shippers in the Northern Plains had more difficulty in doing so. Again,

[6]This process is equivalent to computing a weighted-average terminal market price.

this may have been due to several factors including covered hopper car shortages, poor merchandising decisions, or non-rail logistical constraints. Another possible reason for the differences in prices between regions may have been differences in barley quality.

In 1988, shippers in the Northern Plains fared better than shippers in the Mountain region (price-wise). Northern Plains shippers received six cents per bushel more on average than their competitors in the Mountain region. However, the average market price for Northern Plains barley was 13 cents less than the average market price for Mountain region barley. Shippers in the Northern Plains region obtained higher net prices in 1988 by hauling shorter distances and spending an average of 19 cents less on transportation than shippers in the Mountain region. While these results could be interpreted to suggest that Northern Plains shippers could increase their net prices by improving the timing of their sales, this is not a realistic conclusion or strategy. The higher prices received by Mountain region shippers in 1988 are probably based on the California market where a large portion of the local demand for barley must be satisfied by distant sources. Thus, California buyers must pay a premium to attract barley to their market. Furthermore, when the higher transportation charges are subtracted from the market price, the net prices received by shippers in different markets tend to equalize to some degree.

The purpose of the foregoing section of the analysis has been to document and analyze the average net prices received by barley shippers in various supply regions. Both the rail market share (discussed in Sections 2 and 3) and net shipper prices can be impacted by transportation conditions and factors. So, in the next section of the report, a set of railroad transportation factors is examined. The objective of the analysis is not to criticize any railroad or group of railroads. Rather, the intent of the analysis is to paint a picture of transportation conditions in each market and to determine whether any transportation factors are creating inefficiencies in the marketing channels.

V. RAILROAD TRANSPORTATION FACTORS IN BARLEY DISTRIBUTION

The transportation analysis in this section consists of two phases. In the first part, a set of general factors (including rates and distances) is evaluated. The major factor considered is revenue per mile. In the second phase of the analysis, the resource costs associated with the positioning of barley by rail are estimated and analyzed. Although car supply and transportation capacity are important factors in transportation competitiveness, they cannot be analyzed within the scope of this project.

TRANSPORTATION FACTOR ANALYSIS

The first transportation factor considered is revenue per hundredweight per mile (revenue/cwt-mile).[7] Regardless of the supply region and market, revenue/cwt-mile reflects comparable transportation charges on a per-weight per-distance basis. Factors that may influence revenue/cwt-mile include the distance, the number of carriers in the route, the cars in the shipment, the lading weight of the shipment, and other carrier economic or decision factors. In addition, the intensity of intramodal and intermodal competition can be a significant factor in shaping the railroad rate structure.

The second factor analyzed is the junction frequency. The junction frequency reflects the number of carriers in the route and the number of interchange switches. The more times a car is interchanged, the higher the switching costs will be. For this reason, the junction frequency may tend to increase revenue/cwt-mile.

[7]The revenue/cwt-mile is calculated based on short line miles.

Trip distance is the third factor analyzed[8]. Theoretically, the distance of a movement should have a negative influence on revenue/cwt-mile; that is, the revenue/cwt-mile should decrease with distance. This is because carriers realize economies of distance. Typically, a large portion of terminal costs are fixed for a given movement. Thus, as the length of haul increases, fixed costs decrease as a percentage of total costs. Consequently, unit costs per mile tend to decline with distance. Furthermore, if there is a relationship between revenues and costs, then revenues per mile should also decline with distance.

Finally, in addition to examining trip distance, the difference between trip distance and short-line distance is analyzed. Short-line miles represent the minimum rail distance between two points. Thus, the difference between short-line miles and trip distance represents the circuitous mileage in excess of the optimum for each movement. Because carriers want to keep movements on their own lines as long as possible, short-line miles are often not the actual distance of haul. Any spread between short-line miles and trip distance reflects a potential for reducing distance and therefore the cost per mile. While it is recognized that several other transportation factors influence revenue/cwt-mile they are not discussed in this section because of data limitations.

Tables 7 through 21 summarize the transportation factors discussed in the previous paragraphs for the years 1984 through 1988. Regional averages are calculated for revenue per hundred weight per mile, junction frequency (Junc. Freq.), short line distance, and total (trip) distance by shipment size.

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[8]Trip distance includes circuitry or out-of-line routing.

TABLE 7: SUMMARY OF SELECT TRANSPORTATION FACTORS IN 1984 FOR 1 and 2 CAR SHIPMENTS				
	1984 AVERAGES			
REGION	REV./ CWT-MILE (¢)	JUNC. FREQ.	SHORT LINE DIST. (MILES)	TRIP DIST. (MILE)
NORTHERN PLAINS	0.37	0.27	365	370
MOUNTAIN	0.24	0.66	873	889
WEST COAST	0.48	0.21	380	403
NORTHEAST	0.47	0.44	371	376

TABLE 8: SUMMARY OF SELECT TRANSPORTATION FACTORS IN 1984 FOR 3-15 CAR SHIPMENTS				
	1984 AVERAGES			
REGION	REV./ CWT-MILE (¢)	JUNC. FREQ.	SHORT LINE DIST. (MILES)	TRIP DIST. (MILE)
NORTHERN PLAINS	0.25	0.14	442	447
MOUNTAIN	0.32	0.57	673	681
WEST COAST	0.19	0.00	309	323
NORTHEAST	0.10	0.00	265	278

TABLE 9: SUMMARY OF SELECT TRANSPORTATION FACTORS IN 1984 FOR 16+ CAR SHIPMENTS				
	1984 AVERAGES			
REGION	REV./ CWT-MILE (¢)	JUNC. FREQ.	SHORT LINE DIST. (MILES)	TRIP DIST. (MILE)
NORTHERN PLAINS	0.18	0.30	699	709
MOUNTAIN	0.21	0.29	1156	1179
WEST COAST	0.12	0.00	377	379
NORTHEAST	0.09	0.00	682	709

TABLE 10: SUMMARY OF SELECT TRANSPORTATION FACTORS IN 1985 FOR 1 AND 2 CAR SHIPMENTS

	1985 AVERAGES			
REGION	**REV./ CWT-MILE (¢)**	**JUNC. FREQ.**	**SHORT LINE DIST. (MILES)**	**TRIP DIST. (MILE)**
NORTHERN PLAINS	0.36	0.42	497	503
MOUNTAIN	0.22	0.60	957	976
WEST COAST	0.42	0.16	426	434
NORTHEAST	0.52	0.50	531	539

TABLE 11: SUMMARY OF SELECT TRANSPORTATION FACTORS IN 1985 FOR 3-15 CAR SHIPMENTS

	1985 AVERAGES			
REGION	**REV./ CWT-MILE (¢)**	**JUNC. FREQ.**	**SHORT LINE DIST. (MILES)**	**TRIP DIST. (MILE)**
NORTHERN PLAINS	0.21	0.01	383	388
MOUNTAIN	0.27	0.53	743	749
WEST COAST	0.21	0.09	362	367
NORTHEAST	0.09	0.00	310	322

TABLE 12: SUMMARY OF SELECT TRANSPORTATION FACTORS IN 1985 FOR 16+ CAR SHIPMENTS

	1985 AVERAGES			
REGION	**REV./ CWT-MILE (¢)**	**JUNC. FREQ.**	**SHORT LINE DIST. (MILES)**	**TRIP DIST. (MILE)**
NORTHERN PLAINS	0.17	0.09	694	699
MOUNTAIN	0.15	0.31	1038	1045
WEST COAST	0.11	0.00	381	387
NORTHEAST	0.09	0.57	771	772

TABLE 13: SUMMARY OF SELECT TRANSPORTATION FACTORS IN 1986 FOR 1 AND 2 CAR SHIPMENTS				
	1986 AVERAGES			
REGION	**REV./ CWT-MILE (¢)**	**JUNC. FREQ.**	**SHORT LINE DIST. (MILES)**	**TRIP DIST. (MILE)**
NORTHERN PLAINS	0.30	0.54	679	687
MOUNTAIN	0.20	0.47	860	876
WEST COAST	0.42	0.12	494	504
NORTHEAST	0.29	0.31	415	422

TABLE 14: SUMMARY OF SELECT TRANSPORTATION FACTORS IN 1986 FOR 3-15 CAR SHIPMENTS				
	1986 AVERAGES			
REGION	**REV./ CWT-MILE (¢)**	**JUNC. FREQ.**	**SHORT LINE DIST. (MILES)**	**TRIP DIST. (MILE)**
NORTHERN PLAINS	0.25	0.14	691	697
MOUNTAIN	0.24	0.76	949	958
WEST COAST	0.18	0.03	475	481
NORTHEAST	0.10	0.00	798	807

TABLE 15: SUMMARY OF SELECT TRANSPORTATION FACTORS IN 1986 FOR 16+ CAR SHIPMENTS				
	1986 AVERAGES			
REGION	**REV./ CWT-MILE (¢)**	**JUNC. FREQ.**	**SHORT LINE DIST. (MILES)**	**TRIP DIST. (MILE)**
NORTHERN PLAINS	0.15	0.20	915	942
MOUNTAIN	0.11	0.05	923	932
WEST COAST	0.13	0.00	387	402
NORTHEAST	0.15	0.00	462	462

TABLE 16: SUMMARY OF SELECT TRANSPORTATION FACTORS IN 1987 FOR 1 AND 2 CAR SHIPMENTS				
	1987 AVERAGES			
REGION	REV./ CWT-MILE (¢)	JUNC. FREQ.	SHORT LINE DIST. (MILES)	TRIP DIST. (MILE)
NORTHERN PLAINS	0.34	0.26	405	411
MOUNTAIN	0.16	0.72	1009	1019
WEST COAST	0.38	0.12	410	414
NORTHEAST	0.77	0.36	351	354

TABLE 17: SUMMARY OF SELECT TRANSPORTATION FACTORS IN 1987 FOR 3-15 CAR SHIPMENTS				
	1987 AVERAGES			
REGION	REV./ CWT-MILE (¢)	JUNC. FREQ.	SHORT LINE DIST. (MILES)	TRIP DIST. (MILE)
NORTHERN PLAINS	0.26	0.27	535	545
MOUNTAIN	0.21	0.69	780	786
WEST COAST	0.15	0.00	361	364
NORTHEAST	0.20	0.00	403	415

TABLE 18: SUMMARY OF SELECT TRANSPORTATION FACTORS IN 1987 FOR 16+ CAR SHIPMENTS				
	1987 AVERAGES			
REGION	REV./ CWT-MILE (¢)	JUNC. FREQ.	SHORT LINE DIST. (MILES)	TRIP DIST. (MILE)
NORTHERN PLAINS	0.15	0.73	974	981
MOUNTAIN	0.11	0.12	956	968
WEST COAST	0.12	0.00	377	394
NORTHEAST	0.16	0.00	614	615

TABLE 19: SUMMARY OF SELECT TRANSPORTATION FACTORS IN 1988 FOR 1 AND 2 CAR SHIPMENTS

	1988 AVERAGES			
REGION	**REV./ CWT-MILE (¢)**	**JUNC. FREQ.**	**SHORT LINE (MILES)**	**TRIP DIST. (MILE)**
NORTHERN PLAINS	0.32	0.30	587	595
MOUNTAIN	0.16	0.64	1050	1066
WEST COAST	0.37	0.14	517	521
NORTHEAST	0.43	0.04	272	272

TABLE 20: SUMMARY OF SELECT TRANSPORTATION FACTORS IN 1988 FOR 3-15 CAR SHIPMENTS

	1988 AVERAGES			
REGION	**REV./ CWT-MILE (¢)**	**JUNC. FREQ.**	**SHORT LINE (MILES)**	**TRIP DIST. (MILE)**
NORTHERN PLAINS	0.31	0.18	518	530
MOUNTAIN	0.19	0.34	962	983
WEST COAST	0.16	0.00	356	361
NORTHEAST	0.15	0.00	582	596

TABLE 21: SUMMARY OF SELECT TRANSPORTATION FACTORS IN 1988 FOR 16+ CAR SHIPMENTS

	1988 AVERAGES			
REGION	**REV./ CWT-MILE (¢)**	**JUNC. FREQ.**	**SHORT LINE (MILES)**	**TRIP DIST. (MILE)**
NORTHERN PLAINS	0.20	0.28	776	780
MOUNTAIN	0.28	0.37	1232	1256
WEST COAST	0.12	0.00	376	378
NORTHEAST	0.13	0.00	808	808

In 1984, carriers received higher revenues/cwt-mile for 1 and 2 car barley movements originating in the Northern Plains than for movements originating in the Mountain region. One and two car movements originating in the Mountain region (the Northern Plains' greatest competitor) generated .13 cents less that those originating from the Northern Plains. The other two regions also exhibited higher revenue/cwt-mile than the Mountain region for 1 and 2 car shipments. There is one factor which appears to have influenced the lower revenue/cwt-mile realized in the Mountain region for 1 and 2 car shipments (in comparison to the Northern Plains region). This factor is an average of more than twice the distance for Mountain region movements in comparison to those for the Northern Plains. However, the higher junction frequency for the Mountain region may have increased revenue/cwt mile somewhat.

For 3-15 and 16+ car shipments, the Northern Plains region (as well as the West Coast and Northeast regions) had revenues/cwt-mile that were lower than those experienced in the Mountain region in 1984. This was the case despite the much greater distances of Mountain region movements. This may indicate that other factors, such as intermodal and intramodal competition, may have influenced revenues/cwt-mile. However, the revenues/cwt-mile on the waybill records do not necessarily reflect actual revenues/cwt-mile during the 1984-86 period. This is because of widespread use of contract rates during this period.

During 1987 and 1988, the average revenues/cwt-mile were higher in the Northern Plains for all car size shipments (with the exception of 16+ car shipments in 1988). Distance and junction frequency appear to have influenced these trends.

Another trend shown by the data in 1987 and 1988 is that 1 and 2 car barley movements originating in the West Coast and Northeast regions incurred higher revenues/cwt-mile than barley originating in the Northern Plains, on average. This was the case despite a lower average junction frequency per movement for West Coast region movements and roughly equal mileage between the West Coast and Northern Plains movements. Northeast region movements, however, showed higher junction frequency and lower mileage than Northern Plains movements, explaining the disparity.

Multiple car movements originating in the Northern Plains incurred higher revenues/cwt-mile than those originating in the West Coast and Northeast regions during 1987 and 1988. This was the case despite greater distances traveled by Northern Plains movements. However, junction frequency was much lower for West Coast and Northeast multiple car movements during this period.

Because of the great disparities in revenue/cwt-mile averages among regions throughout the 1984-1988 period, a statistical analysis was performed which attempts to explain the disparities in revenue/cwt-mile. A reciprocal transformation model was posited which relates revenue/cwt-mile to the inverse of distance, the load factor of the shipment, the distance from barge loading facilities of the originating state, the Herfindahl-Hirschman index, and a dummy variable for export movements.[9]

The inverse of distance was used as an independent variable because as distance increases, fixed costs become decreasingly less important in relation to average costs per mile. In essence, average costs per mile decrease at a decreasing rate.

The load factor is the net weight per car in a shipment. The revenue/cwt-mile should decrease with increases in weight per car. This is because carriers realize economies of density in shipments. Costs such as the opportunity cost of locomotives and

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[9]Originally the model formulation included junction frequency as an explanatory variable, but its inclusion did not add explanatory power to the model.

train crew wages are relatively fixed with respect to weight. Thus, as the weight per car increases, fixed costs decrease as a percentage of total costs for a given movement. Consequently, the unit costs per cwt decline with increased weight.

The distance from barge loading facilities of the originating state was used as a measure of intermodal competition. The closer shippers are to barge loading facilities, the more likely the chance that truck/barge combinations can effectively compete with railroads. Thus, the distance from barge loading facilities is expected to have a positive effect on revenues; i.e. the greater the distance, the less effective the intermodal competition.

The Herfindahl-Hirschman Index is used to measure intramodal market concentration, and is explained in detail in a later section. Its value is greater when concentration is high and lower when market concentration is low. It is expected to have a positive influence on revenues. This is because with less competition from other carriers, the demand for a carrier's transportation services will be less price elastic.

The dummy variable for export movements is expected to have a negative sign, *a priori*. This is because there is usually more geographic and product competition in export movements. Geographic competition occurs when different railroads serve different competing supply regions. Carriers should have lower rates when stiff geographic competition is present because of the potential to lose movements permanently to other regions. Product competition occurs when a carrier serves a region which supplies a commodity which can be substituted by a different commodity in a different region which the carrier does not serve. Again carrier rates should be lower when facing strict product competition, due to the possibility of losing movements permanently.

The following model is used to estimate revenue/cwt-mile[10]

$$REV/CWT\text{-}MILE=\beta_0+\beta_1\frac{1}{DIST}+\beta_2 LOAD+\beta_3 HERF+\beta_4 BDIST+\beta_5 EXP \quad (1)$$

where:

	DIST =	distance of the shipment.
	LOAD =	the weight per car in the shipment.
	HERF =	the Herfindahl-Hirschman Index of concentration.
	BDIST =	the distance of the origin from barge loading facilities.
	EXP =	a dummy variable representing export movements.

Separate regressions were performed for each car size block within the waybill sample for 1988. By performing separate regressions for each service level (car size block) a more homogenous sample is obtained than using the overall waybill population. The 1988 regression results by service level are shown in Table 22.

The 1 and 2 car estimation shows a strong relationship between the exogenous variables and revenue/cwt-mile. The inverse of distance has a positive sign and is significant at the 5 percent level. This indicates that revenue/cwt-mile decreases at a decreasing rate as distance of the shipment is increased. The load factor has a negative sign, and is also significant at the 5 percent level. This suggests that revenue/cwt-mile decreases as the weight per car increases. This is consistent with prior expectations. The Herfindahl-Hirschman Index has a negative sign and is significant at the 5 percent level. This is the opposite of what was expected, *a priori*. However, this can be explained by the fact that the level of intermodal competition is much more important in single car and small multiple-car shipments than the level of intramodal competition. Trucks are better able to compete for single-car and small multi-car shipments than for unit train traffic. It can be argued that the ability of trucks to compete for smaller shipments is so significant

[10]The Herfindahl-Hirschman Index and the distance from barge loading facilities were also used as estimates of intramodal and intermodal competition in an estimate of revenue per ton-mile by MacDonald.

TABLE 22: 1988 REVENUE/CWT-MILE ESTIMATIONS BY SERVICE LEVEL DEPENDENT VARIABLE= REVENUE/CWT-MILE			
	1-2 CARLOAD SHIPMENTS	**3-15 CARLOAD SHIPMENTS**	**16+ CARLOAD SHIPMENTS**
ADJUSTED R^2	.7943	.7926	.5521
F-VALUE	22198.64*	5156.58*	177.75*
INTERCEPT	0.8977 (70.24)*	0.5534 (35.58)*	3.46 (24.20)*
1/TOTDIS	25.72 (295.84)*	36.09 (149.72)*	34.03 (9.55)*
LOAD	-0.0077 (56.71)*	-0.0053 (30.18)*	-0.0380 (26.57)*
HERF	-0.1754 (23.85)*	0.0406 (4.38)*	0.3231 (3.42)*
BDIST	0.0001 (11.76)*	0.00008 (6.82)*	-0.0004 (2.95)*
EXP	-0.0917 (10.92)*	-0.0685 (10.82)*	-0.1903 (4.75)*
ROOT MEAN SQUARED ERROR	.1735	0.1046	.3136
t-ratios in parentheses * significant at the 5% level.			

that intramodal competition exerts only a minimal effect on rates for single car shipments. It is likely that the negative sign on the Herfindahl-Hirschman Index is the result of the variable measuring something that is not directly included in the model. Finally, the dummy variable for export movements is significant at the 5 percent level and has a negative sign. This is consistent with prior expectations. The high R^2 and F-statistic, along with the low root mean squared error show this estimation to be a good predictor of revenue/cwt-mile.

The 3 to 15 car regression also shows a high R^2, a high F-statistic, a low root mean squared error, and strong relationships between the explanatory variables and revenue/cwt-mile. In this regression all of the explanatory variables have the expected signs and are significant at the 5 percent level.

All of the explanatory variables have the expected sign in the regression for 16+ cars with the exception of the variable measuring the distance from barge loading facilities. This estimate is negative and significant at the 5 percent level. This can be explained by the fact that intermodal competition is less important for multiple car shipments than for smaller car shipments. It is likely that the negative sign for the distance from barge loading facilities is measuring something that is not directly included in the model.

In order to determine the extent to which differences in revenue/cwt-mile between regions can be explained by this model, the average revenue/cwt-mile by service level and region are compared to the average predicted values of revenue/cwt-mile by service level and region for 1988. Over-prediction indicates that other (exogenous) factors are causing revenue/cwt-mile to be lower than if it were determined solely by the variables included in this model. Conversely, under-prediction indicates that other factors are causing revenue/cwt-mile to be higher than would be the case if it were determined solely by the variables included in the model. Comparisons of actual and predicted average values for revenue/cwt-mile by service level and region, along with average distances by service level and region, are shown in Table 23.

TABLE 23: 1988 AVERAGE VALUES FOR REVENUE/CWT-MILE (¢), PREDICTED REVENUE/CWT-MILE (¢), AND TOTAL DISTANCE (MILES) BY REGION AND SERVICE LEVEL			
NORTHERN PLAINS REGION (1988)			
VARIABLE	**1-2 CARLOAD SHIPMENTS**	**3-15 CARLOAD SHIPMENTS**	**16+ CARLOAD SHIPMENTS**
PRED REV/CWT-ML	.31	.30	.20
REV/CWT-ML	.32	.31	.20
DISTANCE	595	530	780
MOUNTAIN REGION (1988)			
VARIABLE	**1-2 CARLOAD SHIPMENTS**	**3-15 CARLOAD SHIPMENTS**	**16+ CARLOAD SHIPMENTS**
PRED REV/CWT-ML	.16	.20	.23
REV/CWT-ML	.16	.19	.28
DISTANCE	1066	983	1256
WEST COAST REGION (1988)			
VARIABLE	**1-2 CARLOAD SHIPMENTS**	**3-15 CARLOAD SHIPMENTS**	**16+ CARLOAD SHIPMENTS**
PRED REV/CWT-ML	.33	.20	.28
REV/CWT-ML	.37	.16	.12
DISTANCE	521	361	378
NORTHEAST REGION (1988)			
VARIABLE	**1-2 CARLOAD SHIPMENTS**	**3-15 CARLOAD SHIPMENTS**	**16+ CARLOAD SHIPMENTS**
PRED REV/CWT-ML	.57	.17	.12
REV/CWT-ML	.43	.15	.13
DISTANCE	272	596	808

For single-car shipments, the Northern Plains region had greater actual averages for revenue/cwt-mile than predicted averages during 1988. This difference was only by .01 cents, however. This relationship was also evident for 3 to 15 car shipments, where actual averages were greater than predicted averages for the Northern Plains by .01 cents in 1988. For 16-60 car shipments, predicted values were equal to actual average values of revenue/cwt-mile for the Northern Plains in 1988.

The Mountain region's 1-2 carload shipment predicted revenue/cwt-mile was the same as actual revenue/cwt-mile. For 3-15 carload shipments, predicted average revenues/cwt-mile were larger than actual values were by .01 cents. The predicted value of revenue/cwt-mile was .05 cents lower than actual average revenue/cwt-mile for 16+ car shipments in the Mountain region.

These results suggest that while some very small disparities exist between predicted and actual average revenues/cwt-mile in the Northern Plains and Mountain regions, the variations in revenues/cwt-mile experienced in these regions are explained by distance, weight, intermodal and intramodal competition, and type of movement (export or not) for the most part.

The Northeast and West Coast regions exhibited considerably more disparity between predicted and actual values in 1988. However, these regions accounted for a much less significant portion of movements than was accounted for by the other two regions.

While the above results show that some disparity exists between predicted and average values for revenue/cwt-mile for various supply regions, the majority of the disparities between regions in actual revenue/cwt-mile can be explained by the previous model. This is particularly true for the Northern Plains region and its greatest competitor, the Mountain region.

One factor besides those included in the model which does influence revenue/cwt-mile is the number of carloads per shipment. Again, this is illustrated in Table 23, as actual revenue/cwt mile decreases between the 1-2 car stratum and the 3-15 car stratum, and again between the 3-15 car stratum and the 16-60 car stratum (for the most part).

The purpose of the foregoing analysis has been to evaluate a set of railroad transportation factors and to compare the levels of these factors across supply regions and market. The primary factor considered was revenue/cwt-mile. Much of the over-prediction and under-prediction of revenue/cwt-mile for the supply regions and markets probably relates to one of the factors yet to be analyzed: the cost structures of the carriers handling the traffic. The effect of intermodal and intramodal competition is evaluated next, with the cost structures of carriers handling traffic to follow.

INTRAMODAL COMPETITION

Intramodal competition refers to the competition for shipments within one mode. In this case it refers to competition between rail carriers. The level of intramodal competition in various supply regions can be measured by two variables: (1) the number of carriers originating barley shipments and (2) the market shares of the largest carriers. Even if there are five railroads in a supply region, if one or two carriers originate the majority of the traffic, then strong effective intramodal competition may not be present.

One measure that captures both of these elements is the Herfindahl-Hirschman Index. This measure, which is used to measure market power, decreases with increasing numbers of carriers and increases with rising inequalities among a given number of carriers. The index will always be between zero and one, with one representing a pure monopoly. Calculation of the Herfindahl-Hirschman index is performed using the following equation:

$$H=\sum_{i=1}^{n} S_i^2 \qquad (2)$$

where: H = Herfindahl-Hirschman Index
S = Market Share

In order to document the extent of intramodal competition within the various supply regions, the 1988 barley waybill sample has been sorted and processed so that the Herfindahl-Hirschman index can be computed. As Table 24 shows, the highest degree of market concentration for carriers was present in the Mountain region in 1988. This region had a Herfindahl-Hirschman index of .48. The next highest concentration of carriers was present in the Northern Plains region (with an index of .38), and the lowest concentration was present in the Northeast region (.24).

These results indicate that carriers may be able to charge higher transportation rates in relation to costs in the Mountain region than in other regions. This is explained by the fact that this region's rail carriers are highly concentrated. However, this hypothesis does not take into account the extent of intermodal competition. A high degree of intermodal competition can make up for a lack of intramodal competition to a certain extent.

TABLE 24: 1988 HERFINDAHL-HIRSCHMAN INDEX, BY SUPPLY REGION

SUPPLY REGION	HERFINDAHL-HIRSCHMAN INDEX
NORTHERN PLAINS	0.38
MOUNTAIN	0.48
WEST COAST	0.34
NORTHEAST	0.24

INTERMODAL COMPETITION

Intermodal competition refers to competition for shipments between modes. Because grain markets are often far away from supply regions, most grain movements must cover long distances. Thus, only those modes which are competitive with rail for long distance shipments represent potential competition for grain traffic. When long-distance competitive modes exist near the origin of a rail grain shipment, strong intermodal competition can exert downward pressure on rates in the same way that strong intramodal competition can.

In order to measure intermodal competition in grain origin states, the distance from barge loading facilities[11] is measured from the center of each state.[12] Average distances by supply region are calculated, and an index is constructed which categorizes supply regions by proximity to barge loading facilities. This proximity index is categorized as follows:

Proximity 1 = 0 to 150 miles
Proximity 2 = 150 to 300 miles
Proximity 3 = over 300 miles

Trucks can't compete with rail over long distances. However, barges can. Thus, when distance from barge loading facilities increases, intermodal competition decreases. Table 25 shows the average proximity to barge loading facilities by supply region.

[11]Barge loading facilities as defined by the Army Corps of Engineers.

[12]This is measured as straight-line distance.

TABLE 25: 1988 AVERAGE DISTANCE FROM BARGE LOADING FACILITIES, BY SUPPLY REGION	
SUPPLY REGION	**BARGE PROXIMITY INDEX**
NORTHERN PLAINS	2
MOUNTAIN	3
WEST COAST	1
NORTHEAST	1

RAILROAD COST ANALYSIS

The revenue/cwt-mile analyzed earlier represents the logistical impedance to flow from a given supply region to a given market. The transportation *rate* charged by a carrier becomes a part of the distribution cost of the shipper. Therefore, the shipper's focus and decision process are based on the published or contract transportation charge. However, the railroad cost per cwt-mile represents the underlying impedance to interregional barley flows. If the railroad cost per cwt-mile is relatively high for a given region or interregional flow, then shippers in that region are at an indirect disadvantage to shippers in other regions. The use of a cwt-mile divisor standardizes the costs of different regions with respect to distance and load factor in the same manner as was done with revenues per cwt-mile earlier.

Part of a region's rail transport disadvantage may lie with a carrier's downward pricing flexibility. In the long-run, prices will theoretically tend towards marginal costs in competitive markets. Even if an average-cost pricing policy is followed, a carrier's downward pricing flexibility is constrained by a cost floor, be it average cost or marginal cost. Consequently, a railroad's capability to pass a transportation rate or capacity advantage on to shippers of a particular region may be constrained by a high movement cost structure.

In the following section of the report, average railroad shipment costs and relationships between carrier costs and revenues are examined. The purpose of this analysis is not to examine or predict the cost of any given movement. Instead, the objective is to look at cost relationships among regions and interregional flows.

Cost Ratios and Definitions

The intent of this analysis is *not* to assess the maximum reasonableness of barley rates in each market. The determination of maximum reasonable rates is a complex regulatory process which involves jurisdictional thresholds such as market dominance (which includes modal share assessments and possible evaluations of product and geographic competition). None of these factors are addressed in this study. Furthermore, as will be discussed later, because of the participation of local and regional carriers in many of the movements, any estimated formula cost (be it Rail Form A or URCS) must be qualified. Therefore, no interpretations regarding jurisdictional thresholds should be drawn from this analysis.

Three ratios are computed and evaluated in this study: (1) a variable cost-to-revenue ratio, (2) a fully allocated cost-to-revenue ratio, and (3) the cost per cwt-mile. The cost-to-rate (or revenue) ratios express variable and fully allocated costs (FAC) as percentages of waybill movement revenues. In almost all cases, the variable cost percentages will be less than 1.0. In most cases, the FAC ratio will also be less than 1.0. When the FAC ratio exceeds 1.0, the carriers (collectively) are not recovering their full cost for the movement. This does not mean that one or more of the carriers in the route is not recovering its full cost. Nor does it necessarily mean that the railroads are failing to recover variable costs. The variable cost ratio can be less than 1.0 even if the fully allocated cost ratio is greater than 1.0.

Two residual factors can be computed from the cost ratios which also have interpretive values. One minus the variable cost ratio gives the percentage that railroad costs can increase (or rail rates decline) before the carrier (or carriers) begin to lose money *in the short-run*. Assuming that carriers can theoretically price down to variable costs, this factor may be thought of as the carrier's short-term pricing flexibility. Similarly, if the FAC ratio is less than 1.0, then one minus the FAC ratio represents the carrier's intermediate-to-long-term downward pricing flexibility.

Prices, of course, are not necessarily related to any type of cost -- be it marginal cost, variable cost, or fully allocated cost. Furthermore, cost-price relationships in a given market are heavily influenced by intramodal and intermodal competition. Nevertheless, the short- and long-term pricing flexibility implied by the variable and FAC cost ratios are partial indicators of a supply region's relative railroad transport advantage (or disadvantage).

Costing Formulas and Methods

Each 1988 sample barley waybill movement has been costed with the Uniform Railroad Costing System (URCS). In Ex Parte No. 431 (Sub-No. 1), served September 20, 1989, the ICC adopted URCS as its general purpose costing tool, and released a new microcomputer version of Phase III (its shipment costing software). Phase III procedures and waybill costing methods are discussed further in Appendix A.

The variable costs and fully allocated costs generated from Phase III of URCS reflect a return on investment equal to the current cost of railroad capital.[13] The variable costs are those costs that vary with output, while the fully allocated costs include the costs that vary with output as well as those that don't. The variable unit costs reflect a return on 50 percent of the roadway investment base and 100 percent of the equipment investment base. The fully allocated costs include the remainder of the return on roadway investment, other fixed system and overhead costs, and the average loss and damage expense for each ton of barley originated. Thus, if a carrier is not recovering fully allocated cost, it does not mean that the rates are noncompensatory in the short-run. However, in the long-run, all costs must be recovered including the replacement cost of equipment. The URCS costs do not reflect replacement valuation of equipment or roadway. The freight car return on investment (ROI) reflects an old depreciated covered hopper car fleet. Consequently, URCS freight car unit costs probably understate the ROI necessary to replace the covered hopper car fleet over time, perhaps considerably. Thus it follows that the freight car costs reflected in the three ratios may be substantially understated. Therefore, the URCS estimates discussed in the following paragraphs should be interpreted in this light.

The results of the waybill costing analysis are displayed in Tables 26 and 27.[14] As Table 26 depicts, the estimated FAC exceed the revenues for 12 of the 18 interregional flows analyzed. Five of these flows originated from the Northern Plains region, three from the West Coast region, and two from the Mountain and Northeast regions. Three of

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[13]The costs generated in this study use the same assumptions that were used in the costing for the McCarty Farms case in Montana. While the McCarty Farms case used Rail Form A, this study uses URCS as it is likely that any future ICC case will require the use of URCS.

[14]These results are separated by service level in Appendix C.

the noncompensatory FAC flows terminated in the Pacific Southwest region and three in the Gulf region, while two of these flows terminated in each of the PNW, Mid-Continent, and Mountain regions. As Table 26 shows, the estimated revenues generated by barley flows from the Northern Plains to the Mountain, Gulf, Pacific Southwest, Mid-Continent and Pacific Northwest markets did not recover the estimated fully allocated costs of the traffic in 1988.

TABLE 26: 1988 URCS WAYBILL COST-RATE RATIOS, COST/CWT-MILE, AND REV/CWT-MILE BY ORIGIN AND DESTINATION REGION (WEIGHTED AVERAGES)*					
SUPPLY REGION	**MARKET REGION**	**VARIABLE COST RATIO**	**FULLY ALLOCATED COST RATIO**	**FAC/ CWT-MILE (CENTS)**	**REVENUE/ CWT-MILE (CENTS)**
MOUNTAIN	GULF	0.96	1.35	0.10	0.07
MOUNTAIN	MID-CONT.	0.51	0.72	0.12	0.18
MOUNTAIN	MIDWEST	0.49	0.70	0.12	0.17
MOUNTAIN	MOUNTAIN	0.46	0.65	0.24	0.38
MOUNTAIN	PACIFIC NORTHWEST	0.60	0.84	0.13	0.15
MOUNTAIN	PACIFIC SOUTHWEST	0.92	1.30	0.13	0.11
NORTHEAST	GULF	0.76	1.07	0.13	0.12
NORTHEAST	MID-CONT.	1.06	1.52	0.23	0.18
NORTHEAST	MIDWEST	0.63	0.92	0.61	0.63
NORTHERN PLAINS	GULF	1.05	1.58	0.12	0.08
NORTHERN PLAINS	MID-CONT.	0.89	1.39	0.27	0.24
NORTHERN PLAINS	MIDWEST	0.54	0.81	0.30	0.35
NORTHERN PLAINS	MOUNTAIN	1.12	1.82	0.17	0.09
NORTHERN PLAINS	PACIFIC NORTHWEST	0.72	1.08	0.13	0.12
NORTHERN PLAINS	PACIFIC SOUTHWEST	0.97	1.41	0.13	0.09
WEST COAST	MOUNTAIN	0.76	1.05	0.17	0.16
WEST COAST	PACIFIC NORTHWEST	0.76	1.06	0.82	0.57
WEST COAST	PACIFIC SOUTHWEST	1.12	1.56	0.23	0.15

*The variable and fully allocated ratios were computed directly from the shipment revenue and cost estimates for each movement. In contrast, the FAC/cwt-mile and revenue/cwt-mile have been standardized with respect to distance and weight. Thus, the ratio of FAC/cwt-mile to revenue/cwt-mile will not necessarily be the same as the fully allocated cost ratio shown in column 4.

Four interregional flows were also found to be noncompensatory in the short-run using URCS variable costs, including two Northern Plains flows (to the Gulf and to the Mountain region). However, in all of the four flows, the variable cost ratios were only slightly above 1.0.

As Table 26 depicts, several of the variable cost ratios are less than .75, including two flows originating from the Northern Plains region. The lowest variable cost ratio is for local flows within the Mountain region. The fourth lowest is for flows from the Northern Plains to the Midwest region. Since these two regional definitions encompass some of the same states, many of the movements in this flow are really intraregional in nature (as in the case of the Mountain region).

As noted earlier, a relatively high cost floor limits a carrier's downward pricing flexibility. Thus, as Table 26 shows, there are many flows where carriers have little downward long-term pricing flexibility. Five of these flows originate from the Northern Plains region. Although these findings could be interpreted as a transport disadvantage, Mountain region shippers are facing a similar situation in two of the same markets -- the Gulf and the PSW. The West Coast region shippers are facing a similar situation in three markets, and the Northeast region shippers face this situation in two markets.

Table 27 shows the average variable and fully allocated cost ratios for all movements originating in a particular supply region. As Table 27 shows, the Northern Plains region and the Mountain region have variable and fully allocated cost ratios that are very close to each other and to the national average. As the national averages for these ratios show, carriers have a great deal of downward short-term price flexibility in barley shipments and very little long-term downward price flexibility in barley shipments, on average. This also holds true for carriers in the Northern Plains and in the Mountain region.

TABLE 27: 1988 URCS WAYBILL COST-RATE RATIO, COST/CWT-MILE, AND REVENUE/CWT-MILE BY SUPPLY REGION (WEIGHTED AVERAGES)				
SUPPLY REGION	VARIABLE COST RATIO	FULLY ALLOCATED COST RATIO	COST/CWT-MILE (CENTS)	REVENUE/ CWT-MILE (CENTS)
MOUNTAIN	0.68	0.95	0.14	0.17
NORTHEAST	0.86	1.24	0.40	0.39
NORTHERN PLAINS	0.62	0.94	0.27	0.30
WEST COAST	0.95	1.33	0.49	0.34
NATIONAL AVERAGE	0.67	0.99	0.28	0.29

As Table 27 depicts, the average 1988 revenue/cwt-mile was considerably lower for shipments originated from the Mountain region than for shipments originated from the Northern Plains region. This is a function (for the most part) of lower costs per cwt-mile. While this may present the appearance that a competitive advantage is realized by Mountain shippers, this may not be the case.

Since the overall transportation charge is a function of revenue per cwt-mile and proximity to the market, distance from the market must be considered. The largest barley market in the United States is the Midwest market, and the Northern Plains region has the advantage of proximity in this market. Northern Plains shippers realize lower transportation charges for shipments to this market than Mountain shippers because of this proximity advantage. These factors suggest that no clear picture of transportation advantage or disadvantage can be drawn from the data.

Table 27 also shows that carrier pricing of barley movements appears to be justified by costs in most instances. While the Northern Plains region has the lowest fully allocated cost ratio of all the regions on average, the ratio is still quite high (.94). Thus, while carriers may have downward price flexibility in the long run on some interregional movements, they do not have downward price flexibility in the long run, overall.

VI. MARKET SHIFTS AND TRANSPORTATION FACTORS

The previous section of the report focused on the transportation factors influencing the positioning of barley in different markets. This section of the report summarizes the findings of the previous section, assesses the transportation advantages and disadvantages of barley production regions, and explains other factors which may have influenced market shifts.

No definitive conclusions can be drawn regarding the relative railroad transportation advantages or disadvantages of the Mountain and Northern Plains regions. Average revenue per cwt-mile tends be to lower for shipments originating in the Mountain region. However, these lower revenues per cwt-mile appear to be justified by the lower railroad costs per cwt-mile for barley traffic originated in this region. Although the Mountain region may realize lower transportation charges per cwt-mile than the Northern Plains region on average, overall transportation charges to the Midwest market (the largest barley market in the United States) are lower for Northern Plains shippers because of proximity to market. Both regions are relatively transportation-disadvantaged in the new long-distance feed markets (such as the PSW and the Gulf), where the average carrier revenue is less than the fully allocated shipment costs.

Railroad variable cost-to-revenue ratios are below .55 for Northern Plains barley flows in the Midwest market. However, based on the absolute railroad volumes and market shares documented in the report, it appears to have had little or no effect on the positioning and market share of Northern Plains barley in the Midwest market. Therefore, the only apparent consequence of the low variable cost-to-revenue ratios in this market is their potential effect on net shipper prices. Because of the competitive nature of the grain elevator industry in the Northern Plains, it is likely that any effects on net shipper prices will be passed on to producers.

Overall, there is no evidence to suggest that the Northern Plains is not competitive with other regions in railroad transportation. In fact, railroad transportation appears to have helped Northern Plains shippers penetrate and sometimes gain substantial market share in new feed barley markets (such as the Gulf, Mid-Continent, and PSW). However, the data also show that the Northern Plains' market shares have sometimes fluctuated greatly in the new markets. In some cases, Northern Plains shippers appeared to have hit their market peaks in 1986. Because of their dependence on railroad transportation, Northern Plains shippers and producers may be particularly impacted by marginal competitive shifts between railroads, regions, and modes of transport.

Several factors influence the shifts in market shares and market demand besides transportation rates, the supply of transportation, and the distance of supply regions from the market. Factors such as export demand, the change in relative portions of barley and corn used for feed purposes, and changes in the productivity of producers in regions close to the market all affect the positioning of barley in the United States.

Export demand has a great effect on the amount of barley demanded in various terminal markets. Gulf and Pacific Northwest markets are particularly sensitive to export demand, and therefore demand less barley in times of low export demand. Because export demand is so pervasive in export dominated regions, the amount of barley shipped to these ports may fluctuate greatly from year to year without changes in transportation factors. This variability in export demand appears to be the source of the loss in shipments to the Pacific Northwest in 1988. There was high export activity in 1987 (3,024,000 metric tons of barley). However, the activity level dropped in 1988 to 2,090,000 metric tons of barley.[15]

Feed barley originated in the Northern Plains not only competes with feed barley from other supply regions, but also with corn grown throughout the United States. The demand for feed barley is actually one component of the overall demand for feed grains. In essence, barley and corn are substitutes. However, they are not perfect substitutes. Each grain has its own relative feed value or efficiency, its own production and quality characteristics, and other unique factors which create a demand for it as feed grain. However, transportation capacity problems, freight rates, and other factors which impede the interregional marketing and flow of either crop can result in the substitution of one commodity for the other. Relative price changes between the two commodities can also lead to the substitution of one commodity for the other. The relative price changes between corn and barley, and factors increasing the preference of one commodity over another may have influenced barley shipment volumes throughout the report.

Several examples of relative shifts in feed barley and corn shares are seen throughout the 1984-88 period (Appendix B). The Gulf market for barley was virtually non-existent in 1984 and 1985 as only .3 and 2 percent of the total rail barley and corn used for feed or export was barley in these years respectively. As barley was gradually substituted for corn in feed uses in the Gulf, the Gulf market grew as a rail barley market. In 1988, this market received over 470,000 tons of barley by rail accounting for 8 percent of the total rail corn and barley used for feed or export. The rail corn and feed

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[15]Norton and Klindworth.

barley shares terminating in the Mid-Continent region remained relatively constant throughout the 1984-88 period. Between 1984 and 1987 it appears that a lot of feed barley was being substituted for corn in the Midwest market. However, overall rail-terminated shipments of both feed barley and corn were declining in this region. In 1988, feed barley as a percentage of total rail corn and feed barley declined, while the absolute amount of feed barley shipped by rail to this region increased. This coincided with an increase in barley received by rail in the Midwest region in 1988. In the Mountain region, the percentage of rail feed shipments comprised of barley decreased greatly between 1984 and 1988. However, this did not coincide with a large drop in rail feed barley shipments to this market. It occurred as the total of corn and feed barley received by rail increased greatly. In the Pacific Northwest, rail feed barley accounted for a small percentage of the total rail corn and barley received in this market for feed or export in 1984. This percentage increased greatly in 1987, but dropped to its 1984 level in 1988. This coincided with an increase in total rail barley received in the Pacific Northwest in 1987 and a decrease in 1988. The corn and feed barley shares in the Pacific Southwest remained fairly steady during the 1984-88 period. Total rail barley shipments to the Pacific Southwest did as well.

Changes in the productivity of producers close to the market can have a large effect on market share. If producers close to the market can produce barley in equal quality to other producers at high levels, those producers will be able to gain a large share of the market due to their proximity advantage. In 1988, this phenomenon occurred, as West Coast producers produced more barley in relation to Northern Plains and Mountain shippers than in previous years due to drought conditions in the Northern Plains and Mountain regions. Because of the close proximity of the West Coast region to the Pacific

Northwest market, the West Coast region gained market share in the Pacific Northwest region while the Northern Plains and West Coast regions lost market share in this region.

VII. CONCLUSION

Since 1980, many non-traditional barley markets have opened up for Northern Plains producers. Most of these new markets (such as the Gulf, the PSW, and the PNW) are only accessible to Northern Plains shippers by rail. In many of these new markets, Northern Plains producers are competing with producers in Montana, Idaho, and other Mountain region states.

In 1988, the Northern Plains dominated railroad shipments of barley to various markets, holding a 65.3 percent share. In absolute terms, the Northern Plains' rail volume grew fairly steadily throughout the period (from 4.2 million tons in 1984 to 5.2 million in 1988). During this period, the Northern Plains' share of the Midwest rail market remained high and relatively constant. In 1988, Northern Plains' shippers originated nearly 84 percent of the rail barley volume terminated in the Midwest region. The Northern Plains ranked third in the PNW market in 1988, trailing both the West Coast and Mountain regions. Although the Northern Plains' volume in the PNW market jumped precipitously from 1985 to 1987, it plummeted again in 1988, falling to only 11 percent of the rail barley market.

One of the most impressive examples of market penetration during the period occurred in the Pacific Southwest market. In 1984, the Northern Plains supplied only 11.8 percent of the PSW rail feed barley market. However, the Northern Plains' share jumped to 40.2 percent in 1986, and after nose-diving somewhat in 1987, rebounded to 31 percent in 1988.

Although the PSW market growth was impressive, it cannot match the Northern

Plains' penetration and domination of Gulf region markets during this period. In 1984, no Northern Plains barley moved to the Gulf by rail. In contrast, over 429,000 tons moved by rail to Gulf markets in 1988. Although there are three other suppliers in the Gulf market, the Northern Plains held a 91 percent market share in 1988. A similar trend occurred in the Mid-Continent market region, where the Northern Plains' rail market share soared from 32 percent in 1984 to over 90 percent in 1988. These trends must be put in proper perspective however, as these are some of the smaller markets.

The Mountain region is the Northern Plains' strongest competitor in the PSW, Gulf, PNW, and Midwest rail barley markets. In several of the markets, the shares of the two competing supply regions have moved opposite to one another over time.

No definitive conclusions can be drawn regarding the relative railroad transportation advantages or disadvantages of the Mountain and Northern Plains regions. Average revenue per cwt-mile tends be to lower for shipments originating in the Mountain region. However, these lower revenues per cwt-mile appear to be justified by the lower railroad costs per cwt-mile for barley traffic originated in this region. Although the Mountain region may realize lower transportation charges per cwt-mile than the Northern Plains region on average, overall transportation charges to the Midwest market (the largest barley market in the United States) are lower for Northern Plains shippers because of proximity to market. Both regions are relatively transportation-disadvantaged in the new long-distance feed markets (such as the PSW and the Gulf), where the average carrier revenue is less than the fully allocated shipment costs.

Railroad variable cost-to-revenue ratios are below .55 for Northern Plains barley flows in the Midwest market. However, based on the absolute railroad volumes and market shares documented in the report, it appears to have had little or no effect on the positioning and market share of Northern Plains barley in the Midwest market. Therefore, the only apparent consequence of the low variable cost-to-revenue ratios in this market is their potential effect on net shipper prices. Because of the competitive nature of many grain elevators in this region, it is likely that this potential effect on net shipper prices will be passed on to producers.

Overall, there is no evidence to suggest that the Northern Plains is not competitive with other regions in railroad transportation. In fact, railroad transportation appears to have helped Northern Plains shippers penetrate and sometimes gain substantial market share in new feed barley markets (such as the Gulf, Mid-Continent, and PSW). However, the data also show that the Northern Plains' market shares have sometimes fluctuated greatly in the new markets. In some cases, Northern Plains shippers appeared to have hit their market peaks in 1986. Because of their dependence on railroad transportation, Northern Plains shippers and producers may be particularly impacted by marginal competitive shifts between railroads, regions, and modes of transport.

In summary, the Northern Plains' hold on new barley markets is completely dependent upon railroad transportation, and is tenuous at best. However, the growth of the new feed and malting barley markets gives both Northern Plains shippers and railroads the opportunity for growth and increased profits. The loss of these new markets would hurt not only Northern Plains' producers, but also the carriers which originate and handle the barley.

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California	Oregon
Colorado	South Dakota
Idaho	Utah
Michigan	Washington
Minnesota	Wisconsin
Montana	Wyoming
North Dakota	

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APPENDIX A

RAILROAD WAYBILL SAMPLE: DESCRIPTION AND ANALYSIS

The purpose of this appendix is to describe the railroad waybill sample in greater detail, to discuss the Uniform Railroad Costing Systems (URCS), and to describe the costing and data analysis procedures used in the study.

WAYBILL SAMPLING RATES AND EXPANSION FACTORS

The waybill strata that are applicable to barley shipment levels were listed in Table 12 of the report, along with their respective sampling rates. Population values for each stratum are estimated by multiplying the sample value by the inverse of the sampling rate (known as the expansion factor). For example, the expansion factor for single-car shipments is 40.

The expansion factor is used as a weight for each stratum when computing weighted means or sums. In this analysis, the expansion factors are used to compute weighted revenues, costs, and other variables. More details regarding waybill expansion factors and computational procedures can be found in Sidney and Fine (1982).

URCS PROCEDURES AND ISSUES

The URCS is a software package which generates estimates of variable and fully allocated costs (FAC) for a given movement. In this analysis, each sample waybill observation has been costed with URCS.

The costing process utilizes the batch mode of Phase III of URCS. Phase III is a microcomputer costing program developed by the ICC. A full description of Phase III and the batch control files can be found in the Phase III users' guide (see: ICC, 1990).

There are several issues which should be noted regarding the use of URCS in this analysis. The issues relate to:

1. local and regional railroads,

2. way train miles,

3. circuity, and

4. "make-whole" adjustments.

When local or regional railroads appear in the movement route, they are defined as either a western (Region 7) or an eastern (Region 4) carrier. "Regional" URCS unit costs are then used to estimate railroad costs for the local or regional leg of the movement.

It is recognized that this procedure does not produce accurate estimates of local and regional railroads costs. Local and regional carriers typically have significantly lower cost structures than Class I railroads[16]. Consequently, the URCS costs computed for these legs of waybill movements are probably overstated. However, this may not always be true. Due to diseconomies of size or density, some local railroad cost structures may be as high or higher than those of Class I carriers.

Overall, 5.7 percent of the barley ton-miles in 1988 originated on local and regional railroads. This fact should be kept in mind when interpreting the results.

Worktable E of URCS contains values for circuity (out of line distance) and way train miles. Typically, these E-Table values become the default values for a costing application. However, for waybill costing applications, they must be changed.

The distance fields on the waybill tapes contain estimates of the actual route miles, including circuity. Thus, the default circuity factor must be set to 1.0, else the program will overestimate train miles. However, because of the manner in which way and through miles are computed internally within Phase III, the use of a circuity factor of 1.0 will result in an understatement of way train miles and a resultant overstatement of through train miles. Therefore, the average way train miles (including circuity) must be

[16]See: Tolliver, Dooley, and Zink, 1988.

calculated externally, and entered as an extended parameter value. This is the approach which has been followed in this analysis. Both the circuity factor and the average way train miles have been entered as extended parameters for each leg of the waybill movement.

The formula for computing way train miles is:

WTM = EAVDWT/AVCIR * CTCIRC/AVELR

where:

WTM = Loaded way train miles

EAVDWT = Average E-Table way train miles

AVCIR = Average circuity factor for all car types and movement types

AVELR = Average empty-loaded car-mile ratio for all car types and movement types.

CTCIRC = Circuity factor for the applicable car type.

When multiple-car or trainload shipments are costed with Phase III of URCS, the program automatically implements switching and station clerical cost adjustments. Since these adjustments reflect the relationships between multiple-car and trainload costs and system average costs, the difference between the lower estimates and the unadjusted URCS costs should be added to the single-car costs. This process is known as "making whole" the residuals. Otherwise, when single-car, multi-car, and trainload costs are summed for a railroad, region, or traffic class, they will understate the actual costs for the group.

URCS make-whole adjustment factors are not yet available, and therefore cannot be applied in the study. Thus, it is recognized that single-car URCS costs are understated in this analysis. Consequently, the readers' interpretations should be adjusted accordingly.

In short, the absolute accuracy of the cost-revenue relationships in this study must be qualified. However, the cost relationships among regions should not be greatly affected, since each interregional flow has been costed with the same formula using the same procedures.

A set of computer programs was developed for the study. The program modules revolve around Phase III of URCS. The overall costing program or process consists of five major steps. First, each waybill record is read into computer memory, and the data items needed for costing are extracted and saved. Some of the data elements must be reformatted and transformed before they can be used. The primary function of this initial step is to transform a single waybill record potentially containing multiple railroads' data into a movement format in which each carrier's shipment attributes constitute a separate record. For example, a sample waybill movement might involve three carriers. In the raw waybill file, the values for each carrier (such as the distance and revenue division) are stored in a single record. The waybill access procedure assigns each carrier a movement type (e.g. originated-and-delivered, received-and-terminated, etc.) and outputs its attributes as a separate record.

The second procedure utilizes both Worktable E data and the processed waybill record. The purpose of this step is twofold: (1) to compute the way train miles for each leg of the movement, and (2) to write a file in the exact format required by Phase III of URCS. The way train mileage calculation was described earlier. The computed value and the null circuity factor are added to each record as extended parameters.

In the third step of the process, Phase III is executed with the transformed waybill file named as the batch control file. An output file structure is specified such that only the variable and fully allocated costs and a few of the major input parameters are written to the file. Again, the Phase III record structure specifies a separate record or output line for each carrier.

In the fourth step of the process, the results of the Phase III run are summarized for each movement. The movement values are then merged with the initial waybill record which contains the expansion factor, revenues, and other necessary data.

In the fifth and final step of the process, weighted average revenues and costs are computed for each stratum and market. As discussed previously, the sample values are weighted by the expansion factor for the applicable stratum. This process generates weighted aggregates or sums which reflect the different sampling rates of the waybill strata.

APPENDIX B
AN ANALYSIS OF BARLEY AND CORN RAIL MARKET SHARES

Feed barley originated in the Northern Plains not only competes with feed barley from other supply regions, but also with corn grown throughout the United States. The demand for feed barley is actually one component of the overall demand for feed grains. In essence, barley and corn are substitutes. However, they are not perfect substitutes. Each grain has its own relative feed value or efficiency, its own production and quality characteristics, and other unique factors which create a demand for it as feed grain. However, transportation capacity problems, freight rates, and other factors which impede the interregional marketing and flow of either crop can result in the substitution of one commodity for the other.

The purpose of this appendix is to document the relative market shares of barley and corn. The same market definitions are used as those which were employed in the main text of the report.

The data are displayed in tabular form in the following set of tables. Each year constitutes a separate table. For each destination region, the expanded waybill tons for barley and corn are shown in column three of the tables. In column four, the percentage of volume or market share is shown for each commodity.

As noted earlier, many factors affect feed commodity market shares. Transportation capacity and rates are only two possible factors. Therefore, no conclusions can be inferred regarding the impacts of transportation factors on barley and corn market shares. This fact notwithstanding, current feed commodity market shares and trends can be developed from the tables should the reader so desire.

RAIL MARKET SHARES OF FEED BARLEY AND CORN (1984)			
MARKET	**COMMODITY**	**TONS**	**COMMODITY PERCENTAGE**
GULF	BARLEY	9,040	0.3
GULF	CORN	3,108,806	99.7
MID-CONTINENT	BARLEY	Confidential	Confidential
MID-CONTINENT	CORN	Confidential	Confidential
MIDWEST	BARLEY	1,978,934	45
MIDWEST	CORN	2,379,304	55
MOUNTAIN	BARLEY	206,502	54
MOUNTAIN	CORN	176,596	46
PACIFIC NORTHWEST	BARLEY	Confidential	Confidential
PACIFIC NORTHWEST	CORN	Confidential	Confidential
PACIFIC SOUTHWEST	BARLEY	Confidential	Confidential
PACIFIC SOUTHWEST	CORN	Confidential	Confidential
OTHER	BARLEY	212,205	1
OTHER	CORN	25,246,209	99

RAIL MARKET SHARES OF FEED BARLEY AND CORN (1985)			
MARKET	**COMMODITY**	**TONS**	**COMMODITY PERCENTAGE**
GULF	BARLEY	33,972	2
GULF	CORN	2,157,670	98
MID-CONTINENT	BARLEY	Confidential	Confidential
MID-CONTINENT	CORN	Confidential	Confidential
MIDWEST	BARLEY	1,457,296	49
MIDWEST	CORN	1,491,024	51
MOUNTAIN	BARLEY	327,172	49
MOUNTAIN	CORN	337,220	51
PACIFIC NORTHWEST	BARLEY	Confidential	Confidential
PACIFIC NORTHWEST	CORN	Confidential	Confidential
PACIFIC SOUTHWEST	BARLEY	Confidential	Confidential
PACIFIC SOUTHWEST	CORN	Confidential	Confidential
OTHER	BARLEY	94,184	0.4
OTHER	CORN	25,519,892	99.6

RAIL MARKET SHARES OF FEED BARLEY AND CORN (1986)			
MARKET	**COMMODITY**	**TONS**	**COMMODITY PERCENTAGE**
GULF	BARLEY	257,940	9
GULF	CORN	2,566,864	91
MID-CONTINENT	BARLEY	Confidential	Confidential
MID-CONTINENT	CORN	Confidential	Confidential
MIDWEST	BARLEY	1,577,687	59
MIDWEST	CORN	1,082,133	41
MOUNTAIN	BARLEY	401,244	26
MOUNTAIN	CORN	1,166,334	74
PACIFIC NORTHWEST	BARLEY	Confidential	Confidential
PACIFIC NORTHWEST	CORN	Confidential	Confidential
PACIFIC SOUTHWEST	BARLEY	Confidential	Confidential
PACIFIC SOUTHWEST	CORN	Confidential	Confidential
OTHER	BARLEY	112,344	0.4
OTHER	CORN	27,120,232	99.6

RAIL MARKET SHARES OF FEED BARLEY AND CORN (1987)			
MARKET	**COMMODITY**	**TONS**	**COMMODITY PERCENTAGE**
GULF	BARLEY	131,852	2
GULF	CORN	5,426,172	98
MID-CONTINENT	BARLEY	Confidential	Confidential
MID-CONTINENT	CORN	Confidential	Confidential
MIDWEST	BARLEY	1,490,878	63
MIDWEST	CORN	862,453	37
MOUNTAIN	BARLEY	146,884	7
MOUNTAIN	CORN	1,925,381	93
PACIFIC NORTHWEST	BARLEY	Confidential	Confidential
PACIFIC NORTHWEST	CORN	Confidential	Confidential
PACIFIC SOUTHWEST	BARLEY	Confidential	Confidential
PACIFIC SOUTHWEST	CORN	Confidential	Confidential
OTHER	BARLEY	126,238	0.4
OTHER	CORN	34,630,151	99.6

RAIL MARKET SHARES OF FEED BARLEY AND CORN (1988)			
MARKET	**COMMODITY**	**TONS**	**COMMODITY PERCENTAGE**
GULF	BARLEY	470,008	8
GULF	CORN	5,208,245	92
MID-CONTINENT	BARLEY	Confidential	Confidential
MID-CONTINENT	CORN	Confidential	Confidential
MIDWEST	BARLEY	2,296,566	44
MIDWEST	CORN	2,889,068	56
MOUNTAIN	BARLEY	165,380	11
MOUNTAIN	CORN	1,389,813	89
PACIFIC NORTHWEST	BARLEY	Confidential	Confidential
PACIFIC NORTHWEST	CORN	Confidential	Confidential
PACIFIC SOUTHWEST	BARLEY	Confidential	Confidential
PACIFIC SOUTHWEST	CORN	Confidential	Confidential
OTHER	BARLEY	141,256	0.4
OTHER	CORN	33,129,739	99.6

APPENDIX C
1988 URCS WAYBILL COST-RATE RATIOS, COST/CWT-MILE, AND REV/CWT-MILE BY ORIGIN AND DESTINATION REGION AND SERVICE LEVEL

1988 URCS WAYBILL COST-RATE RATIOS, COST/CWT-MILE, AND REV/CWT-MILE BY ORIGIN AND DESTINATION REGION FOR 1 AND 2 CAR SHIPMENTS (WEIGHTED AVERAGES)*

SUPPLY REGION	MARKET REGION	VARIABLE COST RATIO	FULLY ALLOCATED COST RATIO	FAC/ CWT-MILE (CENTS)	REVENUE/ CWT-MILE (CENTS)
MOUNTAIN	MIDWEST	0.51	0.73	0.12	0.16
MOUNTAIN	MOUNTAIN	0.53	0.75	0.25	0.34
MOUNTAIN	PACIFIC NORTHWEST	0.58	0.81	0.12	0.15
MOUNTAIN	PACIFIC SOUTHWEST	0.89	1.26	0.13	0.11
NORTHEAST	GULF	0.76	1.07	0.13	0.12
NORTHEAST	MID-CONT.	1.07	1.53	0.23	0.18
NORTHEAST	MIDWEST	0.65	0.95	0.65	0.67
NORTHERN PLAINS	GULF	1.02	1.53	0.12	0.08
NORTHERN PLAINS	MID-CONT.	0.90	1.41	0.27	0.24
NORTHERN PLAINS	MIDWEST	0.55	0.83	0.32	0.35
NORTHERN PLAINS	MOUNTAIN	1.12	1.81	0.17	0.09
NORTHERN PLAINS	PACIFIC NORTHWEST	0.73	1.10	0.13	0.12
NORTHERN PLAINS	PACIFIC SOUTHWEST	0.95	1.38	0.12	0.09
WEST COAST	MOUNTAIN	0.76	1.05	0.17	0.16
WEST COAST	PACIFIC NORTHWEST	0.77	1.08	1.14	0.77
WEST COAST	PACIFIC SOUTHWEST	1.12	1.56	0.23	0.15

1988 URCS WAYBILL COST-RATE RATIO, COST/CWT-MILE, AND REVENUE/CWT-MILE BY SUPPLY REGION FOR 1 AND 2 CAR SHIPMENTS (WEIGHTED AVERAGES)				
SUPPLY REGION	**VARIABLE COST RATIO**	**FULLY ALLOCATED COST RATIO**	**COST/CWT-MILE (CENTS)**	**REVENUE/ CWT-MILE (CENTS)**
MOUNTAIN	0.70	0.99	0.14	0.15
NORTHEAST	0.83	1.19	0.43	0.43
NORTHERN PLAINS	0.63	0.95	0.29	0.31
WEST COAST	0.99	1.38	0.55	0.37
NATIONAL AVERAGE	0.68	1.01	0.31	0.30

1988 URCS WAYBILL COST-RATE RATIOS, COST/CWT-MILE, AND REV/CWT-MILE BY ORIGIN AND DESTINATION REGION FOR 3-15 CAR SHIPMENTS (WEIGHTED AVERAGES)*

SUPPLY REGION	MARKET REGION	VARIABLE COST RATIO	FULLY ALLOCATED COST RATIO	FAC/ CWT-MILE (CENTS)	REVENUE/ CWT-MILE (CENTS)
MOUNTAIN	GULF	0.96	1.35	0.10	0.07
MOUNTAIN	MID-CONT.	0.46	0.63	0.12	0.19
MOUNTAIN	MIDWEST	0.47	0.67	0.12	0.17
MOUNTAIN	MOUNTAIN	0.41	0.58	0.21	0.35
MOUNTAIN	PACIFIC NORTHWEST	0.68	0.96	0.13	0.14
MOUNTAIN	PACIFIC SOUTHWEST	1.06	1.47	0.12	0.09
NORTHEAST	MIDWEST	0.45	0.72	0.18	0.24
NORTHERN PLAINS	GULF	1.10	1.66	0.12	0.08
NORTHERN PLAINS	MID-CONT.	0.83	1.31	0.28	0.26
NORTHERN PLAINS	MIDWEST	0.49	0.73	0.19	0.34
NORTHERN PLAINS	MOUNTAIN	1.15	1.84	0.17	0.09
NORTHERN PLAINS	PACIFIC NORTHWEST	0.66	.97	0.13	0.13
NORTHERN PLAINS	PACIFIC SOUTHWEST	1.11	1.64	0.17	0.10
WEST COAST	PACIFIC NORTHWEST	0.71	1.00	0.15	0.16

1988 URCS WAYBILL COST-RATE RATIO, COST/CWT-MILE, AND REVENUE/CWT-MILE BY SUPPLY REGION FOR 3-15 CAR SHIPMENTS (WEIGHTED AVERAGES)				
SUPPLY REGION	**VARIABLE COST RATIO**	**FULLY ALLOCATED COST RATIO**	**COST/CWT-MILE (CENTS)**	**REVENUE/ CWT-MILE (CENTS)**
MOUNTAIN	0.64	0.90	0.14	0.18
NORTHEAST	1.11	1.60	0.15	0.14
NORTHERN PLAINS	0.58	0.87	0.19	0.30
WEST COAST	0.71	1.00	0.15	0.16
NATIONAL AVERAGE	0.62	0.90	0.17	0.26

1988 URCS WAYBILL COST-RATE RATIOS, COST/CWT-MILE, AND REV/CWT-MILE BY ORIGIN AND DESTINATION REGION FOR 16+ CAR SHIPMENTS (WEIGHTED AVERAGES)*					
SUPPLY REGION	**MARKET REGION**	**VARIABLE COST RATIO**	**FULLY ALLOCATED COST RATIO**	**FAC/ CWT-MILE (CENTS)**	**REVENUE/ CWT-MILE (CENTS)**
MOUNTAIN	GULF	0.96	1.35	0.10	0.07
MOUNTAIN	MID-CONT.	0.86	1.21	0.11	0.09
MOUNTAIN	MIDWEST	0.49	0.69	0.11	0.17
MOUNTAIN	MOUNTAIN	0.18	0.25	1.80	7.14
MOUNTAIN	PACIFIC NORTHWEST	0.49	0.70	0.17	0.32
MOUNTAIN	PACIFIC SOUTHWEST	0.87	1.22	0.12	0.10
NORTHEAST	MIDWEST	0.36	0.51	0.13	0.25
NORTHERN PLAINS	GULF	1.10	1.68	0.12	0.07
NORTHERN PLAINS	MID-CONT.	0.84	1.23	0.13	0.11
NORTHERN PLAINS	MIDWEST	0.51	0.74	0.17	0.24
NORTHERN PLAINS	MOUNTAIN	1.12	1.82	0.18	0.10
NORTHERN PLAINS	PACIFIC NORTHWEST	0.69	1.02	0.13	0.12
NORTHERN PLAINS	PACIFIC SOUTHWEST	0.98	1.39	0.11	0.08
WEST COAST	PACIFIC NORTHWEST	0.97	1.36	0.15	0.11
WEST COAST	PACIFIC SOUTHWEST	0.72	1.01	0.18	0.18

1988 URCS WAYBILL COST-RATE RATIO, COST/CWT-MILE, AND REVENUE/CWT-MILE BY SUPPLY REGION FOR 16+ CAR SHIPMENTS (WEIGHTED AVERAGES)				
SUPPLY REGION	**VARIABLE COST RATIO**	**FULLY ALLOCATED COST RATIO**	**COST/CWT-MILE (CENTS)**	**REVENUE/CWT-MILE (CENTS)**
MOUNTAIN	0.64	0.89	0.15	0.28
NORTHEAST	0.99	1.41	0.13	0.13
NORTHERN PLAINS	0.66	0.98	0.16	0.20
WEST COAST	0.95	1.33	0.15	0.12
NATIONAL AVERAGE	0.69	1.00	0.15	0.21