LOGISTICS OF THE U.S. WHEAT INDUSTRY

by

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DISCLAIMER

PREFACE

The United States has produced an excess supply of wheat for over a century. The excess wheat supply and the development of an extensive transportation network has enhanced the U.S.'s regional and world-wide wheat trade capabilities. Wheat moves through several channels from the time it leaves the farm gate to the time it arrives in the hands of domestic or foreign consumers. The logistics system of wheat encompasses all operations such as storage, transportation, and marketing. These operations impact the availability and prices of wheat in different markets. The objective of this report is to describe the basic workings of this complex wheat logistics system. Special emphasis is placed on the transportation aspect of U.S. wheat logistics.

Advances in production technologies and transportation have increased the United State's ability to produce, store, and transport wheat. Several improvements combined with regulatory reform have occurred within the rail, truck, and barge industries, increasing each mode's efficiency. Each of the modes have a unique cost structure and is preferred for different lengths of haul. In general, rail is the dominant mode for domestic and export wheat movements.

The price of wheat varies between market locations. Price differentials between markets are frequently equal to the transfer costs (transportation and handling). Other factors, such as wheat quality and availability of transportation also influence price differentials. Furthermore, several events, such as the North American Free Trade Agreement, could potentially impact the wheat and transportation industries. Fluctuations in the demand for wheat will cause fluctuations in the demand and price of transportation services. Shippers can usually pass on changes in the price of transportation service through either higher or lower prices to producers and consumers at the local market. Since transportation plays a key role in grain marketing, producers, elevator managers, and processors need to watch the markets and transportation costs to determine the best bid price they can receive for their wheat. This report will help these "players" understand the logistics system of wheat.

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CHAPTER 1

INTRODUCTION

The U.S. logistical system has developed into a complex and integrated system of interrelated components that function together to move wheat from farms to domestic and foreign markets. The amount of wheat transported by each transportation mode can be linked largely to the cost and service structures of each mode. Pricing mechanisms vary among modes and allow shippers greater pricing flexibility today than ever in history.

Transportation plays an important role in grain marketing. Price differentials between wheat markets are comprised mostly of transportation and handling costs. Changes in transportation factors, such as pricing, can alter the price of wheat received at the local market. Several current events, such as trade negotiations, have the potential to impact the transportation industry which, in turn, will impact the agricultural industry.

Objective

The objective of this project is to describe the basic workings of a complex wheat logistics system. Basically, logistics describes the functions involved in the storage and movement of an item such as wheat from its point of origin, the farm, to its final destination for consumption. Transportation is significant in wheat logistics because no market could function without the movement of wheat from one location to another. Transportation adds spatial and temporal value to wheat, i.e., wheat where it is demanded and when it is demanded. Although much of the logistical system will be addressed, transportation will be the emphasis of this report.

Organization

This report is divided into five chapters. The second chapter provides a description of the present wheat logistics system. The third chapter explains the complexities of pricing transportation services by the different modes. The fourth chapter provides an explanation of transportation's role in grain marketing. Finally, the fifth chapter is a report summary. Appendix A of this report contains a historical overview of the logistics system. Topics covered in the Appendix include development of the transportation system, a modal share description, regulatory changes in the transportation industry, technology changes, and production, storage, and market cycles.

CHAPTER 2

TODAY'S LOGISTICAL SYSTEM

The U.S. transportation and logistical system allows massive quantities of agricultural products to move quickly and efficiently through several channels into the hands of consumers worldwide. Cost-efficient production methods combined with an efficient domestic logistical system enable the United States to maintain a prominent world status as a major wheat exporting country. Domestic participants rely on the extensive transportation network to move wheat through all the facilities and necessary channels for consumption or export.

Participants and Facilities

Several participants and facilities are involved in the U.S. wheat logistics process. After harvest, producers can either store their grain on farm (U.S. on-farm storage capacity is over 12 billion bushels) or they can move it through the marketing channel. Once wheat leaves the farm gate, it is typically shipped to one of thousands of country elevators which dot the U.S. landscape. Wheat then may be shipped from the country elevator via one of several transportation modes to one of the 278 subterminal, 305 terminal, or 274 river elevators to be stored until it moves to processors or export points (Figure 2.1; Milling & Baking News 1992a). Wheat can also be transported to one of the 65 port elevators for storage or export. Subterminal, terminal, or river elevators each receive grain by truck or rail; however, their outbound transportation differs. Subterminal elevators load out grain in efficient quantities by rail (unit trains), terminal elevators load out grain shipments by truck or rail, and river elevators load out grain shipments by barge. Port elevators can generally receive grain by rail, truck, or barge for loading on ocean-going vessels.

Each of these grain elevators provides a vital link between producers and processors. They price, grade, clean, and blend wheat in preparation for further marketing, and they also provide much of the 9 billion bushels of off-farm storage capacity.

Today's Transportation Network

Wheat can be shipped to one of dozens of destinations through the waterway system or across the United States by rail or truck. The U.S. waterway system includes over 25,000 miles of inland and intracoastal navigable channels (American Waterways Operators 1993). This network consists of three major river systems leading to several port locations (Figure 2.2). Some of the major waterways are the Columbia and Snake rivers in the Pacific Northwest; the Great Lakes and St. Lawrence Seaway in the Upper Midwest; and the massive Mississippi, Ohio, Missouri river system which leads to the Gulf of Mexico (Figure 2.2). Barges moved nearly 500 million bushels of wheat in 1992, which equates to approximately 22 percent of total wheat shipments (USDA 1994b). Nearly all barge movements are to port facilities for export.

The rail network consists of 113,000 road miles and 191,000 track miles (AAR 1993).[1] Today's rail network is displayed in Figure 2.3. All of the major wheat producing regions and nearly all grain elevators in the United States are served by rail. Railroads moved about 1.5 billion bushels of wheat in 1992, which represented about two-thirds of all wheat moved (USDA 1994b). Rail accounts for over half of all wheat export movements and over 80 percent of domestic wheat tonnage movements (Norton et al. 1992).

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[1] Road miles represents the aggregate length of roadway excluding yard tracks, sidings, and parallel lines and track miles includes multiple main tracks, yard tracks, and sidings.

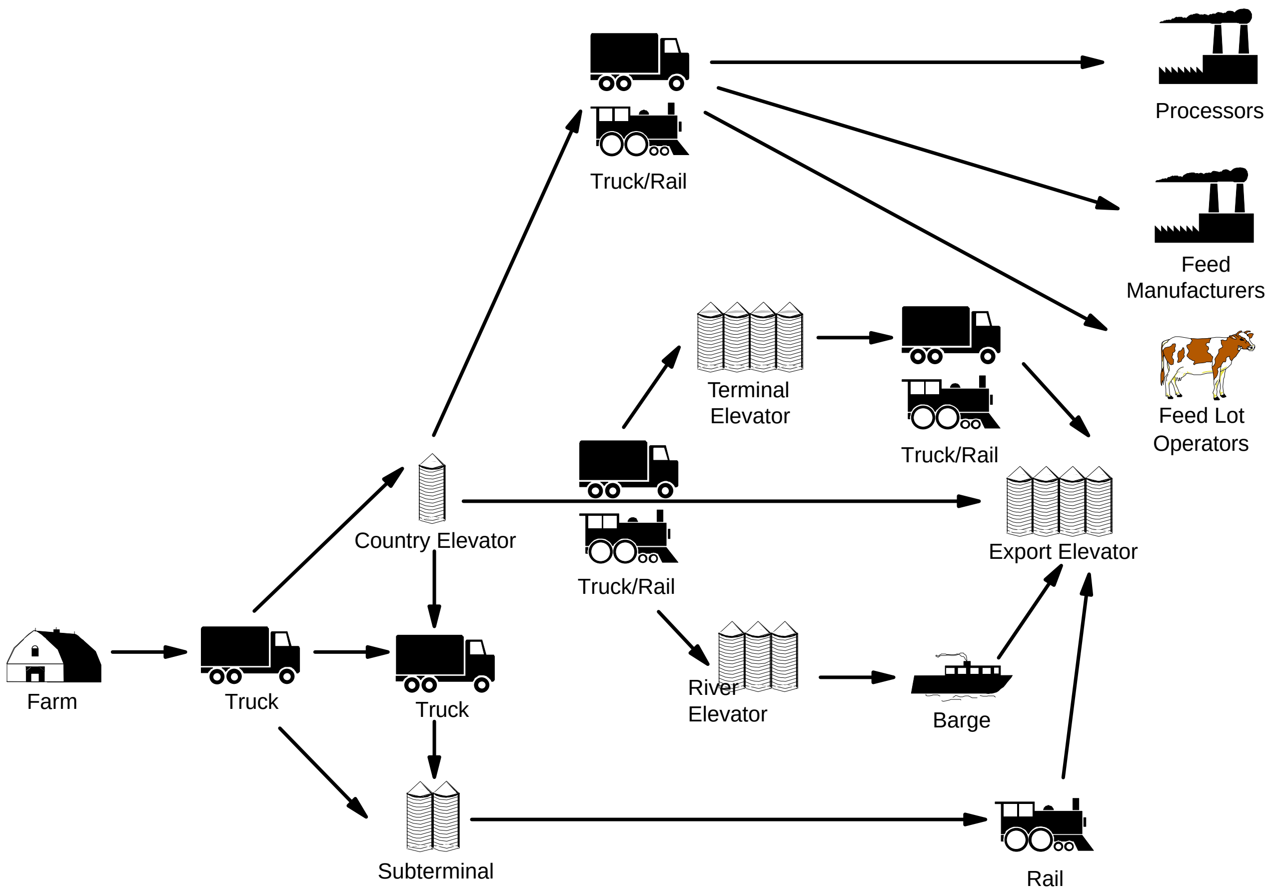

Figure 2.1. United States Logistical Wheat Flow

NOTE: This figure is not all inclusive.

The U.S. highway system is important in wheat shipments. The United States has 3.9 million miles of roads. The National Interstate Highway System consists of only about 44,000 miles (Figure 2.4), with the remainder in primary, secondary or urban roadways. Nearly all grain moves by truck from the farm gate to the elevator. However, beyond the elevator, trucks moved nearly 200 million bushels or 8.5 percent of all U.S. wheat (USDA 1994b). Domestic and export movements by truck vary from year to year, but are significantly lower than rail domestic and export movements.

Today's Leading U.S. Ports and Export Regions

According to the Waterborne Commerce Statistics Center, the top five wheat handling ports during 1992 were the New Orleans port ranges; Portland, Oregon; Houston, Texas; Vancouver, Washington; and Duluth-Superior (U.S. Army Corps of Engineers 1994b). St. Louis, Missouri, was also listed as a major wheat handling port. However, St. Louis acts as a facilitator of waterborne commerce rather than as an actual exporting port. All of these port facilities are served by water, rail, and highway.

Aside from the class of wheat demanded and the export destination, the quantity of grain that could be shipped from each port region differs for several reasons: weather, draft levels, and port elevator capabilities. Weather conditions particularly impact the port of Duluth/Superior more than other U.S. port regions. Duluth/Superior is forced to close for approximately three and one-half months because of the winter freeze conditions. This greatly reduces the amount of grain which can move through the facilities within this region.

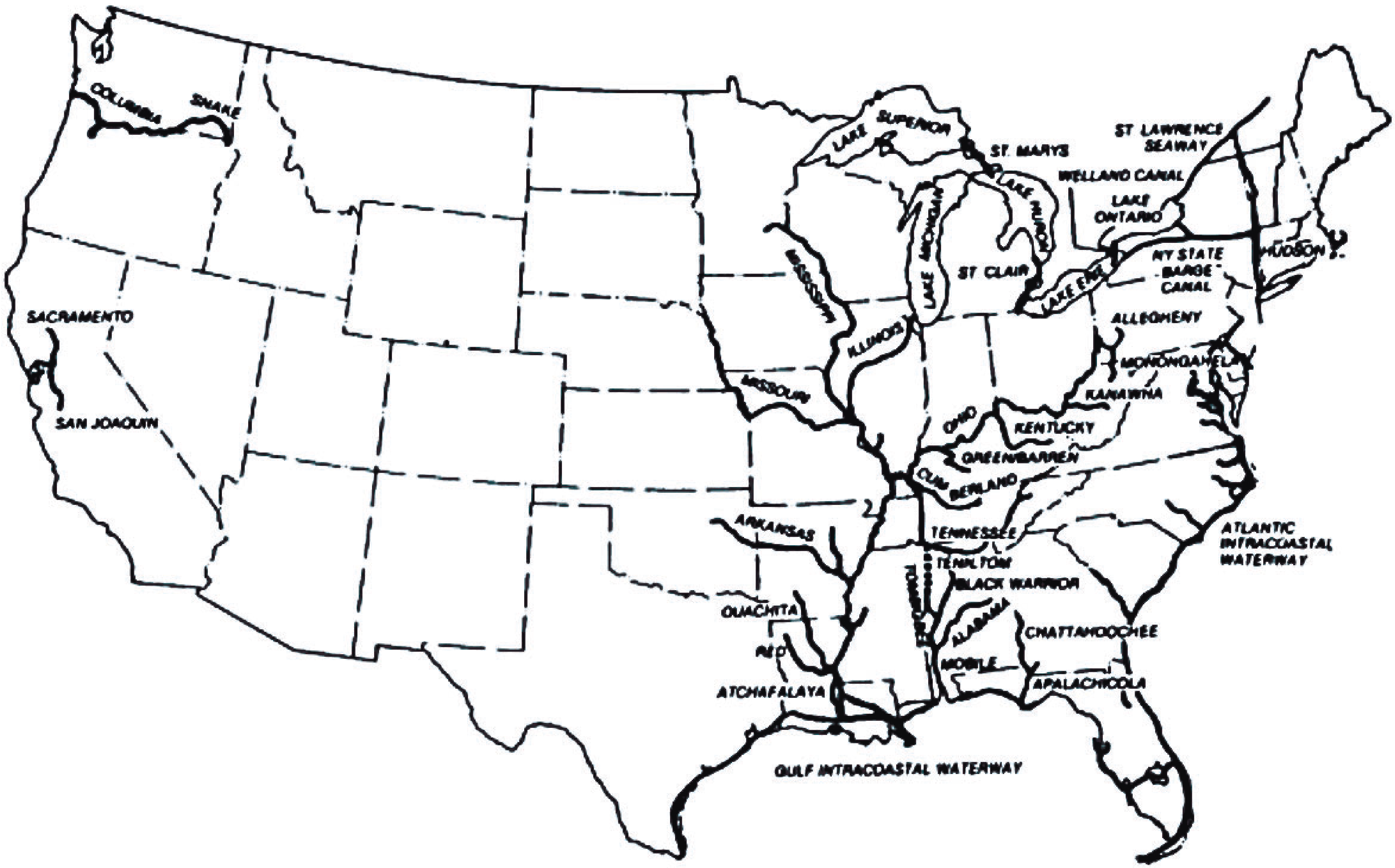

Figure 2.2. The U.S. Waterway System

SOURCE: The American Waterways Operators, Arlington, VA.

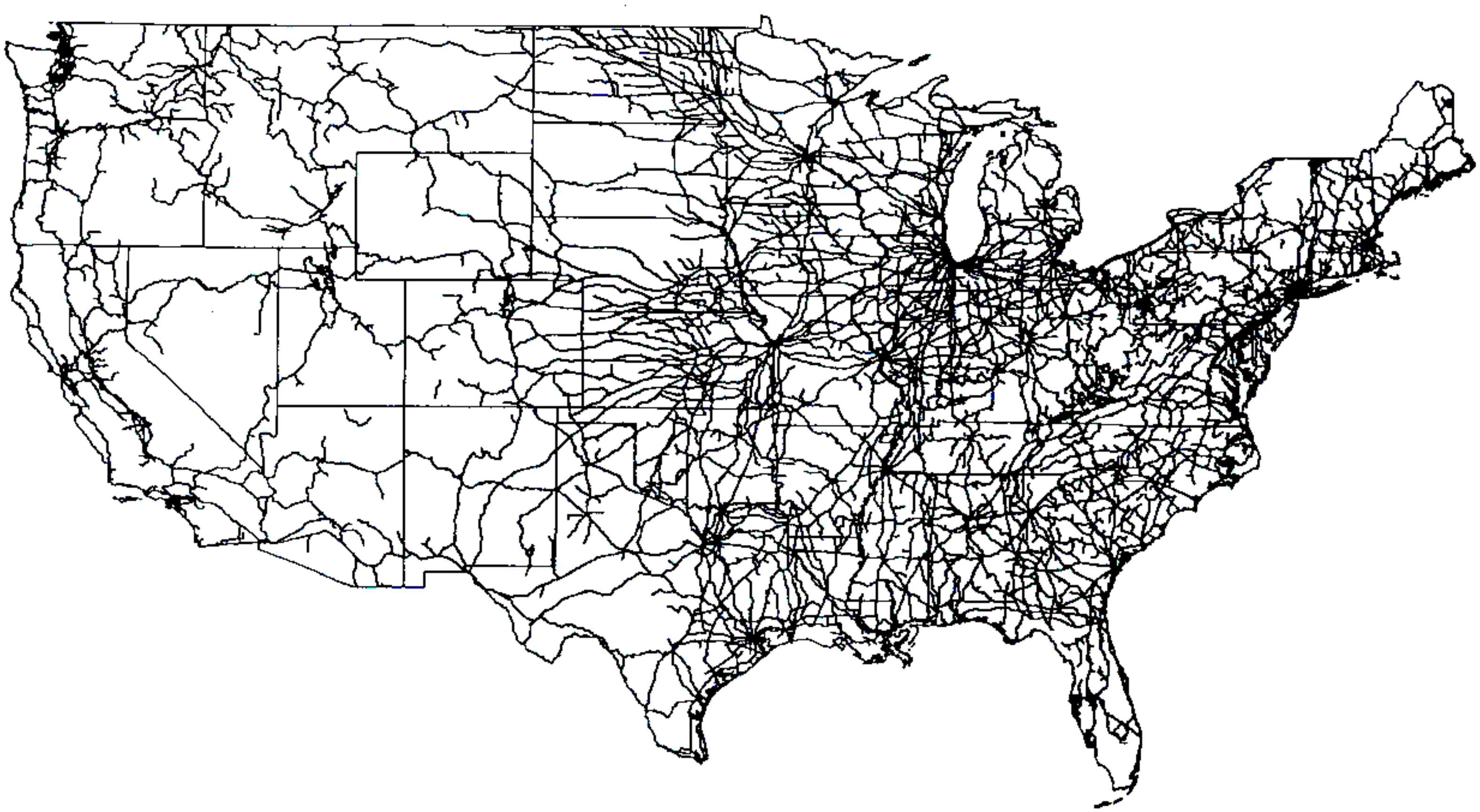

Figure 2.3. U.S. Railway System, 1992

DEVELOPED FROM: Bureau of Transportation Statistics. *Transportation Data Sampler.* Publication BTS-CD-01, Washington, DC, 1993.

Figure 2.4. U.S. Interstate Highway System, 1992

DEVELOPED FROM: Bureau of Transportation Statistics. *Transportation Data Sampler*. Publication BTS-CD-01, Washington, DC, 1993.

Draft levels also determine the amount of wheat that can move through port regions. The major U.S. grain ports illustrated in Figure 2.5 have a draft of 40 feet or more, except for Duluth/Superior, which has a draft of 27 feet. The draft level determines the size of ships that can service the region. The lower draft level of the Duluth/Superior system limits vessel size to 730 feet long and 76 feet wide. Sea-going vessels used in the Duluth/ Superior system can carry approximately 26,000 tons of grain or 867,000 bushels of wheat on the lakes and are usually topped off to a higher ocean cargo weight at Canadian ports at the mouth of the St. Lawrence River (Campbell and Abe 1983). Larger drafts allow larger vessels to carry more wheat and reduce at-sea costs. However, larger ships experience higher port costs, indicating efficient port facilities are needed to realize scale economies (Binkley and Harrer 1981). Ports located along the deep-draft portion of the Columbia River can load Panamax vessels, which have a carrying capacity of between 50,000 to 75,000 dead weight tons (dwt).[2] These Panamax vessels are the maximum size ship that can traverse the Panama Canal (Pearson 1992). Although Panamax vessels may increase the cost efficiency of shipping wheat abroad, their use is limited to destination port facilities capable of receiving them.

Grain handling capabilities of port elevators influence the amount of wheat that will flow through the port region. The efficiency of port elevators depends on the equipment and storage capacity available to receive, unload, store, and reload grain for shipment. Some elevators have the equipment and capacity to unload grain at two railcars per hour while other elevators have the capacity to unload 12 cars per hour. Similarly, some port elevators may have a loading rate of 14,000 bushels per hour while other larger elevators can load a maximum of 120,000 bushels per hour (American Association of Port Authorities 1994). The largest port elevator facilities are located in the Gulf region. These facilities contribute to the significant amount of wheat that flows through the Gulf ports.

[2]Dead Weight Tonnage equates a ton to 2,240 pounds because of the difference between the number of tons of water a vessel displaces when light, or empty, and the number of tons it displaces when submerged to the load line.

Most wheat destined for export moves through the Gulf of Mexico ports. In the 1990s, over half of all U.S. wheat exports moved through Gulf ports (Figure 2.5). The Pacific Northwest accounts for over 30 percent of U.S. wheat exports, and the Great Lakes and Atlantic ports combined account for about 10 percent (Figure 2.5).

Potential Changes in the Transportation Industry

Increases in physical and technological efficiencies are potential changes in the barge, rail, and truck industries which would enhance wheat movements. Recently there has been an increase in the carrying capacity of some barges. Average barges carry about 1,500 tons or approximately 50,000 bushels of wheat. Some barge capacities have been increased to 1,900 tons or over 63,000 bushels of wheat. The larger barge capacity increases efficiency in wheat movements, but these larger barges are relegated to serve non-lock rivers, restricting their operation to the lower portion of the waterway system which is south of St. Louis, Missouri. These increased efficiencies may result in more wheat moving through the Gulf ports.

Increasing grain railcar efficiencies and service guarantees will probably dominate future developments in the railroad industry (Wilson 1993). Grain cars make between 11 and 20 trips per year. Railroads may be able to improve their grain car utilization and increase efficiency by implementing a few tactics. These include better scheduling, performing planned maintenance, improvement in unit train efficiency (especially at terminals), and increased car size from 100 to 110 tons per car (Wilson 1993). Furthermore, railroads may increase their efficiency by offering service guarantees. Several carriers offer provisions for service guarantee to ensure wheat will be delivered by a specific date. Examples include Burlington Northern’s (BN) Certificate of Transportation (COT), Canadian Pacific’s (CP) Protected Equipment and Rate Exchange (PERX) program, and Union Pacific’s (UP) Advanced Car

Ordering System (ACOS).[3] Guaranteed service allows railroads to better plan their car or fleet utilization.

The trucking industry has been using advanced technologies in its operations for some time. Electronic Data Interchange (EDI) and advance communications are proven examples of this trend. There will be a further increase in the use of advanced technologies as the National Intelligent Transportation System matures. The Intelligent Vehicle Highway System (IVHS) is promising solutions to the problems of congestion plaguing the nation's transportation system. Through the use of advanced technology and better coordination and cooperation among public and private agencies, people and goods will be moved through the transportation system more efficiently.

A particular area of importance in IVHS is the Commercial Vehicle Operations (CVO). Intelligent Vehicle Highway System - CVO aims at streamlining truck operations across the nations to eliminate unnecessary delays and compliance burdens. Some of the most promising concepts of IVHS-CVO are: transparent borders, one-stop shopping, and automated truck weight and safety inspection. Transparent borders enables trucks certified in a home-base state to cross state lines, after information is transmitted to other states along their route. Truckers can also obtain operating authority from a designated state agency (one-stop shopping) eliminating the need to communicate with multi-agencies. The process is further enhanced by allowing the use of electronic communication for licensing and operating authority purposes.

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[3]These programs are discussed in the *Pricing of Transportation Services* chapter.

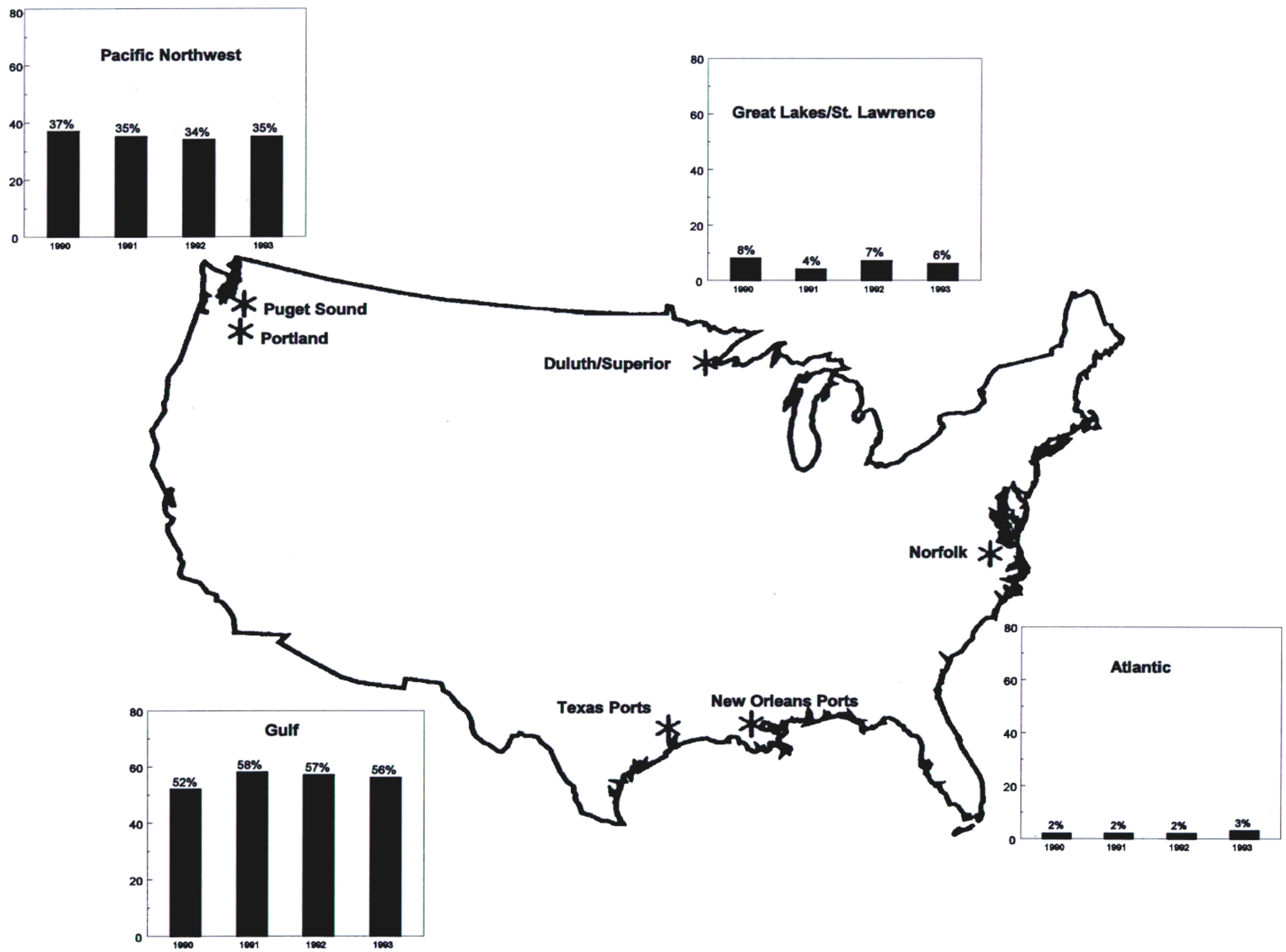

Figure 2.5. Historical Annual U.S. Wheat Exports by Port Region, 1990 to 1993.

SOURCE: U.S. Department of Agriculture. *Grain and Feed Market News.* Agricultural Marketing Service, Livestock & Seed Division, Washington, DC, various issues.

Development of Weigh-In-Motion (WIM) technologies and their implementation in enforcing truck weight limits can eliminate unnecessary truck stops. A truck's gross and axle weights and configuration data can be obtained using WIM equipment while a truck is traveling at highway speed. The information can then be recorded and evaluated to determine whether the truck meets weight regulations.

Although most truck wheat shipments are generally short hauls (up to about 500 miles), the use of these advanced technologies may be useful for wheat shipments moving across state borders or to processors requiring 'quick' wheat shipments to avoid unwanted and unnecessary plant shutdown as a result of low inventory. For example, a specific quality of wheat is important for milling flour, and mills which usually receive wheat shipments by rail or barge may use trucks to move a 'time sensitive' shipment into the mill to avoid the alternative high costs of closing the facility. The advanced technologies would aid in a more timely wheat shipment to the mill because weigh station stops and border crossing delays may be eliminated.

Another important change that could impact all modes is an increase in fuel taxes or user fees. Fuel costs constitute 30 percent of total operating costs for the barge industry and about 20 percent of total operating costs for the trucking industry, but only about 7 percent of total operating costs for rail. If an across-the-board increase in fuel taxes or user fees took place, the pattern of grain traffic flows would likely change toward the most fuel efficient mode.

The U.S. infrastructure also plays an important role in future transportation movements. Waterway improvements could increase the flow of wheat navigating through the system. Several of the locks and dams must be replaced, and this costly process could increase dedicated user fees. In addition, deepening river channels could allow larger barges to navigate through the waterway system, further reducing the cost per bushel of shipping wheat.

Similarly, many rural roads and bridges are deteriorating and need urgent maintenance, which could lead to increased user fees, fuel taxes, and fines to finance these infrastructure repairs. Changes in the rail line network could impact the logistical system. In the past ten years approximately 38,000 miles of rail line were abandoned (Bureau of Transportation Statistics 1993) because of under utilization. If this trend continues and more rail lines that serve rural elevators are abandoned, shipments of grain will have to be diverted to truck, which has a higher unit cost. Furthermore, this diversion in traffic may cause additional damage to the rural road network.

Summary

Overall, the United States has a logistical system that allows wheat to efficiently flow from the farm gate through several marketing channels into the hands of consumers. The U.S. transportation backbone covers many miles and is key to the logistics system. Thousands of miles of rail track cross the country and provide services to nearly all grain handling facilities in the country. Over 25,000 miles of waterways serve major wheat export locations. In addition, hundreds of thousands of highway miles provide access to nearly every farm, grain elevator, and processing plant in the country.

Potential changes within the transportation industry could impact the efficiency of the logistics system. Some possible changes that have been identified are larger barge carrying capacity, increased use of rail service guarantees, use of IVHS-CVO technologies, increases in fuel taxes or user fees, and further deterioration of the transportation infrastructure.

CHAPTER 3

PRICING OF TRANSPORTATION SERVICES

Perhaps one of the more important aspects of the U.S. transportation system is the method by which prices or rates for product shipment are determined. Thousands of shipments of wheat and other grains and products are made each day. Shipments may include a local 400-bushel farm truck shipment of wheat to a grain elevator or a 60,000-ton ocean freighter wheat shipment from New Orleans to Egypt. Between these two extremes in volume are other movements such as semi-truck hauls to subterminals, rail hopper car wheat shipments to U.S. mills, barge movements from inland terminals to export elevators, and a myriad of processed product shipments to consumer outlets worldwide.

Cost of service and demand (value of service) are key factors in determining the rates (prices charged by carriers) for the movement of goods. Differences exist for these factors between modes and among the many carriers within a mode.

Cost Factors

Cost factors can be categorized into commodity cost factors and route cost factors. Commodity cost factors include loading characteristics, susceptibility to loss and damage, volume of traffic, regularity of movement, and type of equipment required. The Uniform Rail Costing System (URCS), which is an accepted method used to estimate railroad average costs such as loss and damage, and 1992 Waybill Data were used to generate some comparable commodity variables (Table 3.1). Similar data for truck and barge are not available.

The loading characteristics of wheat generate reasonable cost impacts because of the shape and density of the grain. The small kernels of wheat allow for efficient use of space. Typically, low weight density objects occupy more space per unit of weight than high density objects, such as wheat. Thus low density objects will cube out before they weight out, i.e., all available cubic space of the truck or railcar is utilized before the maximum gross weight of the vehicle is reached. For example, whole wheat will not take up all of the available space in a 100 ton hopper car before it reaches the maximum lading weight of 100 tons. Alternatively, wheat flour takes up all of the available cubic space of a covered hopper air-slide car and only weighs out at approximately 95 tons. This results in higher rates per 100 pounds for low density commodities such as wheat flour as compared to wheat.

TABLE 3.1. Rail Commodity Densities, Revenues, and Costs, 1992

Commodity	***Density (tons per carload)***	***Average Cars per haul***	***Equipt****	***Average miles travelled***	**Loss & Damage per car $**	***Variable Cost per car $***
Coal	98.5	67	OH	509	.01	552
Wheat	97.5	22	CH	667	1.74	1,092
All Grain	94.9	21	CH	647	1.69	1,006
Chemical Fertilizer	89.3	11	CH	511	1.88	804

* Equipment: OH= Open Hopper, CH= Covered Hopper.

SOURCE: Developed from Uniform Rail Costing System and 1992 Waybill data.

The stowability of wheat is excellent because it can be layered without concern for damage. The low susceptibility to loss and damage translates into fewer claims for damage; therefore, rates can be lower on the transport of bulk commodities such as coal and grain than on higher value and damage-sensitive manufactured goods. On average, loss and damage claim payments for wheat are about $1.74 per carload (Table 3.1), much lower in comparison to shipments of manufactured products, such as machinery, which has a loss and damage cost of $23.32 per carload.

Costs also vary because of traffic volume, regularity of movement, and the equipment required. A large volume of traffic moving over a certain line justifies low rates because operating and capital costs can be spread over more units, thereby allowing lower rates (Locklin 1966). Carriers can efficiently schedule equipment and personnel if the volume of traffic is predictable. This would allow carriers to reduce unit costs of the traffic handled. Coal is probably the most efficiently hauled commodity by the railroad. Efficiencies of power, labor, and car utilization exist because the movements are fairly regular and the average number of cars within each train is about 67 (Table 3.1). Wheat shipments are not as predictable as coal because of seasonality of production and demand. This affects the way transportation providers forecast and schedule rail service, which may reduce grain car utilization.

Coal usually moves in a standard open hopper railcar. Wheat movements are similar to coal since standardized equipment is used. However, wheat moves in a covered hopper car. Standardized open and covered hopper cars are quick and efficient to load, move, and unload, increasing utilization of the railcars. Wheat shipments generally move in unit trains of 25 cars or more, which helps to reduce costs because of the efficiencies gained with larger movements. Nonetheless, the variable cost of a carload of coal is about half the cost of a carload of wheat. The large difference in variable cost between coal and wheat may be attributed to the larger number of cars making up a coal train and the predictability of the coal shipments. Wheat shipments are not as regular as coal, primarily because of the seasonality of the crop.

Route cost factors also make a difference in pricing. Route cost factors include operating conditions, traffic density, and distance. First, operating conditions may vary by route, which affects cost of operation. For example, conditions such as rainfall, snowfall, temperature, and grades and curves of track, which vary significantly on different routes, may make operation more difficult and costly. Second, traffic density is also an important factor, since high-density routes may allow total costs to be lower as fixed costs can be spread over more units. Third, the cost of providing service usually increases as the distance increases, although not usually in direct proportion, because the unit cost per mile decreases.

Every transportation operation requires the use of a terminal of some sort. The terminal is where the commodities are assembled, connections are made between routes and modes, vehicle maintenance may be performed, and administrative activities may be executed. The complexity of the terminal varies by mode of transportation, size of the firm, the commodities hauled, and the range of services provided. Nevertheless, terminal investment and operating costs make up a portion of total costs. Consequently, firms incur some of these terminal costs regardless of the amount of traffic handled, and terminal costs represent a portion of the fixed costs that must be recovered for a carrier to maintain business.

Distance is important in determining the least cost mode of transportation for domestic wheat movements. Rail, truck, and barge movements each have different cost structures (Figure 3.1) that give each mode advantages in certain markets characterized by length-of-haul. Terminal and line-haul costs comprise the costs involved in each given movement. Terminal costs do not vary with distance but with volume, i.e., loading of the commodity. However, as the distance traveled increases, terminal costs make up a smaller portion of the per unit cost. Line-haul mile costs, such as fuel, are directly related to distance. Wheat shipments by truck are characterized by lower terminal costs and higher line-haul mile costs. Therefore, trucks are generally the preferred mode over the shorter distance marked OA in Figure 3.1.

Railroads experience higher terminal costs because of terminals, tracks, locomotives and cars, and track maintenance. However, railroads have a higher carrying capacity and they are relatively more fuel and labor efficient than trucks, resulting in lower line-haul mile costs. As rail travels a longer distance, terminal costs are spread over more miles, therefore lowering shipment costs per unit. Railroads experience greater efficiencies than trucks for longer distances, AB in Figure 3.1.

Barge shipments of wheat are characterized by even higher terminal costs than rail, but again due to fuel and other savings achieved by larger volumes, barges generally experience lower line-haul costs. Barge shipments have the lowest per unit cost when associated with distance and are the preferred mode for distances greater than OB in Figure 3.1.

While these basic cost relationships underlie the competitiveness among modes, many circumstances exist where any one of these modes is competitive over what would have appeared to be a competing mode's "best" range of operation. Whether caused by drought and low river levels, favorable taxation of fuel for a carrier, equipment supply problems, tax incentives, a competitive environment, or dozens of other special situations, the length-of-haul ranges most favorably operated by a mode may vary significantly.

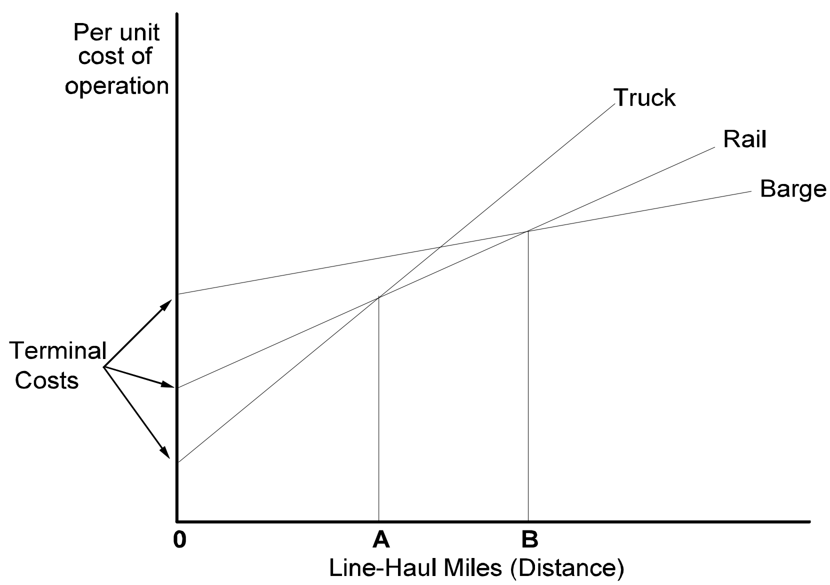

Figure 3.1. Transportation Mode Shipment Cost Structure

Demand Factors

Commodity demand factors and service requirements are important in rate setting. Factors such as the value of the commodity, transit time, product perishability, and reliability of service impact rates. The rates charged for the movement of bulk, unprocessed commodities like wheat are normally lower than the rates charged for manufactured goods like electronic equipment. Lower demand for a commodity may also result in lower rates. On the other hand, higher demand warrants higher rates. Demand for wheat is sporadic particularly because of government export programs. For example, when the United States Department of Agriculture (USDA) announces Export Enhancement Program (EEP) subsidies, the demand for transportation services to move the wheat shipments to port facilities for export increases. If carriers anticipate an EEP announcement they may be inclined to increase rates. However, rate increases are subject to shippers' willingness to pay in the barge and truck industry and ICC approval in the rail industry. Finally, customers may have special quality requirements for transportation services such as low loss and damage or a specified transit time because of product perishability or inventory constraints. Special requirements such as these may command a premium.

Competitive Environment

Each mode of transportation is subject to different types of competition in the setting of rates: intermodal, intramodal, geographic, or product competition. Intramodal competition occurs when two or more carriers within the same mode of transportation compete against one another for traffic. Similarly, intermodal competition occurs when alternative modes of transportation, such as barge, truck, or rail, are present and compete actively against one another for shipments.

The other two forms of competition, geographic and product competition, are not well determined/defined. Studies have recorded their existence (Bitzan and Tolliver 1993). Geographic competition exists if products available to the receiver are also available from different sources where a different carrier connects the receiver with that source (Bitzan and Tolliver 1993). Product competition exists when receivers of a commodity can substitute other commodities for the commodity being shipped and the substitute commodities can be transported by a different carrier. Bread wheat is a commodity with geographic and some product competition. Breads have few substitutes for the wheat ingredient; however, different types of wheat can sometimes be substituted for one another. For example, hard red spring wheat grown in North Dakota can be substituted for winter wheat grown in Nebraska or Kansas or vice-versa. On the other hand, wheat used for feed has several substitutes, such as barley or corn, which may be grown within the region. Therefore, the geographic and product competition could be quite intense.

Product and geographic competition share some commonalities. Durum transportation encounters little product and geographic competition because there are few substitutes for durum used to make pasta (product competition) and durum is primarily grown in North Dakota (regional competition). Therefore, durum (and other crops that do not experience these forms of competition) may have higher rates charged for its movement.

For each shipment of wheat, the carrier charges either the shipper or receiver (usually the shipper) some amount for provision of transportation services. The mechanisms by which each of the transportation modes arrives at transportation prices (rates) differs. Each mode has unique characteristics and inherent cost advantages which allow it to provide service to specific areas of the wheat market. The following sections examine modal transportation pricing practices.

Barge Transportation Pricing

Historically, market participants would trade barge freight over the telephone (Baumel and Kober 1991). The trades were based on tariff rates. In 1976, Tariff No. 7 was canceled during an investigation by the U.S. Justice Department's Antitrust Division into accusations of unlawful price fixing by Waterway Freight Bureau members (Baumel and Kober 1991). Today, Tariff No. 7 remains the benchmark on which rates are determined. Barge freight is still traded over the phone, but additional methods for trade have developed. Barge rates can be traded in an organized “call” session which is a cash market, or they can be traded based on the barge freight rate index futures contract. In addition, a barge freight rate index futures was briefly traded in 1992 at the Chicago Board of Trade. The barge freight rate index futures is listed as inactive because fewer than 10 of these contracts have been traded to-date. The Barge Freight Call Session located at the Merchants Exchange in St. Louis has attracted more trading activity. Buyers and sellers come together and settle contracts for capacity in cash terms. The Merchants Exchange is not included in the transaction; however, it does have an arbitration committee to handle any problems that may arise.

There are two Barge Freight Call Sessions. A southbound session handles grain bound for Louisiana/Mississippi River ports, and a northbound session handles shipments of any bulk exempt commodity from Mississippi River ports in Louisiana. Seventeen contract trading terms exist for each Barge Freight Call Session, including shipment date, quantities, minimums, points of origin and destination, demurrage, products carried, insurance, payment terms, alteration of bids/offers, and Merchants Exchange charges.

Basis trading benchmarks have been assigned to various grain loading ports along the rivers (Figure 3.2). These benchmarks serve as a basis for trading with bids/offers being quoted as a percentage of the benchmark. Monday through Friday, for five to 45 minutes, buyers and sellers of barge freight services may make bids/offers one at a time by open outcry.

A typical barge exchange example may occur as follows. First, company A offers to supply one barge the week of August 21 on the Missouri River at 210 percent of the benchmark. Next, Company B bids for a barge on the Missouri River at 205 percent, also for the week of August 21. In addition, Company C bids 210 percent for one barge on the Missouri River the week of August 21. Company A’s and C’s trade match. Suppose the barge is loaded at St. Louis, Missouri, where the benchmark is $3.99;

the cost would be $8.38 per net ton or 25 cents per bushel. The benchmark rate is multiplied by the percentage to attain the cost per ton for the shipment.

Ocean freight rate index futures are also available. The index began trading in 1986 on the Baltic International Freight Futures Exchange (BIFFEX) in London, England. Essentially, the contract is used to hedge against unwanted price or rate volatility for ocean freight movements. The index is used for international movements and is beyond the scope of this report.

Rail Transportation Pricing

For decades, railroads' freight rates were the most highly regulated transportation rates among modes. Before legislative changes in the 1970s and in 1980, railroads were required to justify freight rate changes only when they were formally protested before the Interstate Commerce Commission in what were often lengthy, costly, and adversarial forums between carriers and shippers.

Railroads today have more flexibility to adjust rates to meet market conditions. A more deregulated environment has allowed carriers to price according to demand, which has helped the railroad industry regain profitability. The rates railroads charge for service varies in different markets. Railroads set rates based on costs and also on the price-elasticity of demand within the region served. Price-elasticity of demand measures the percentage change in quantity demanded given a percentage change in the rail rate, while other factors remain constant. An increase in rail rates will decrease the quantity of service demanded by various amounts, thereby impacting the total revenue of the railroad company that implemented the rate increase.

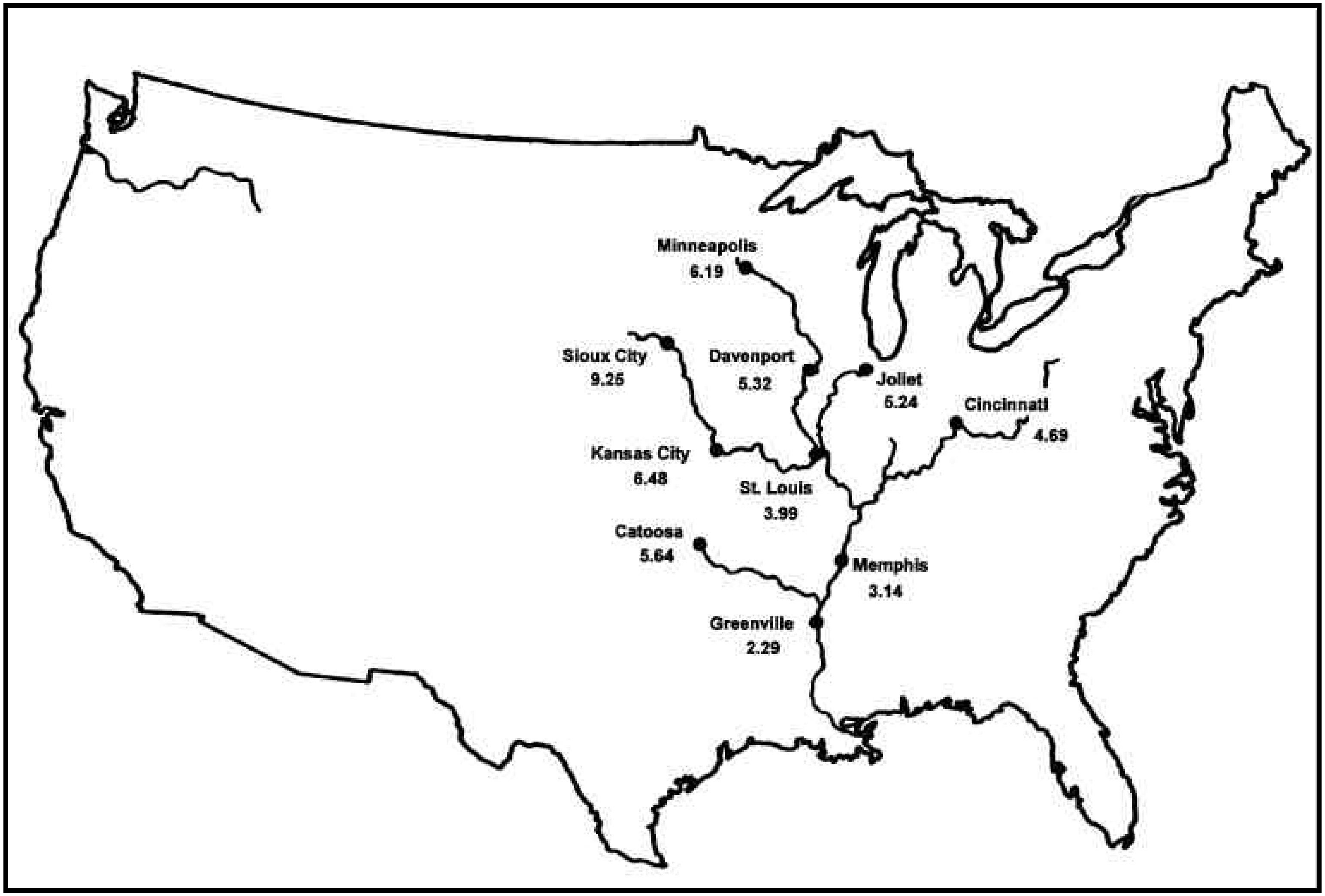

Figure 3.2. Benchmark Barge Rates for the U.S. Barge Industry per Short Ton

Railroads can measure the responsiveness of their customers to rate increases by examining the change in the quantity of service demanded as well as changes in their total revenue. Rail service is elastic if total revenue decreases when rates increase. Rail service is inelastic if total revenue increases when rates increase. The major determinant of the price-elasticity of demand for rail service is the availability of substitutes or alternative transportation. Markets that are price-elastic have alternative methods of transportation available, which allows buyers to divert their shipments to the least expensive mode. Companies that lose their traffic to another company or mode experience decreases in their total revenue. Conversely, markets that lack competition are inelastic, because when higher rates exist and traffic cannot be diverted to another mode, total revenue actually increases. The earning potential of transportation modes where competition is low or nonexistent is higher than where competition is intense.

Rail rates are usually quoted through one of three mechanisms: tariffs, contract rates, and forward pricing.

Rail Tariffs

For decades, railroads were required to publish their rates in a "tariff" or schedule of rates and file those documents with the ICC. Tariffs are still the basis for publishing the majority of wheat rail rates today. Two particular features directly influence the tariff rate: number of cars loaded at each shipment and the gathering point/final destination of the haul.

Multiple car trains, from 26 to 120 car trains, became predominant in the 1980s. Essentially, unit train loadings decrease the railroad's costs because terminal time and costs are kept to a minimum since several stops to assemble a train are not necessary. The railroad's cost savings from unit trains allow it to pass a reduced rate on to shippers who load larger trains. These same shippers must have available or must invest in facilities capable of loading those unit trains under given time constraints. If they cannot meet time constraints they are subject to demurrage penalties.[4]

The most crucial information relating to wheat shipments shown in Figure 3.3 include the origin city, destination city or cities, and the rate to be charged. The rate breakdowns appear in four columns. Typically, the column breakdown refers to different size shipments such as single-, 5-, 26-, and 52-car rates. However, the following example differs from the default rate breakdown because a two-destination option is allowed. In the tariff example shippers can expect to pay $3,333 per carload to ship 1 to 25 cars of wheat from Ismay, Montana, to Pendleton, Oregon, as indicated in column 1 (Figure 3.3). Column 2 illustrates if shipment sizes increase to 26- through 51-car movements, the rate from Ismay,

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 ------------------------------------------------------------------------------
| BURLINGTON NORTHERN RAILROAD CO. | ISSUED: MAR 23, 1994        BOOK: 4      |
| AGRI COMMODITY UNIT - SUITE 2800 | EFFECT: APR 01, 1994     SECTION: C      |
| 777 MAIN ST, FT WORTH, TX 76102  |                              PAGE: 7      |
| ICC BN 4022-H                    | (C)(P)                   REVISION: 4      |
| MTRB 349             IL CC 196   |                          ITEM: 43541      |
------------------------------------------------------------------------------
| WHEAT                                                 |  STCC: 01-137-XX    |
------------------------------------------------------------------------------
|TO:  PENDLETON, OR                                                           |
|-----------------------------------------------------------------------------|
| FROM                                 |RATES - DOLLARS PER CAR|              |
| ROAD| OPSL    |STATIONS            ST|COL 1|COL 2|COL 3|COL 4|C|NOTES|ROUTE|
------------------------------------------------------------------------------
| BN  | 09515.00|INVERNESS           MT| 2841| 2533| 2286| 2226| |     | 167 |
|                                                                             |
| BN  | 09520.00|JOPLIN              MT| 2833| 2525| 2278| 2218| |     | 167 |
| BN  | 09720.00|KALISPELL           MT| 1714|    .|    .|    .| |     | 167 |
| BN  | 09390.00|KERSHAW             MT| 2814| 2507| 2260| 2199| |     | 167 |
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Figure 3.3. Sample Railroad Tariff Rates

SOURCE: Burlington Northern. *ACRES: Agricultural Commodities Information Retrieval System.* Fort Worth, TX, 1994.

[4]Railroads allow a given amount of time for a shipper to load and unload rail cars. When the time period is exceeded a penalty fee is charged per car per day. The penalty is used to encourage the utilization of a valuable asset.

Montana, to Pendleton, Oregon, would decrease to $3,025 per car. The column 3 rate of $2,778 applies to 52-car movements with the possibility of two destinations whereas the column 4 rate of $2,718 is lower because it is the regular 52-car rate with a single destination. The rates between Ismay, Montana and Pendleton, Oregon are joint rates. A joint rate is one agreed upon by two or more carriers and applies between a point on the line of one and a point on the line of another. In this example, Burlington Northern must transfer the wheat shipment from its line at a given interchange point to the Union Pacific Railroad, which has a rail line to Pendleton, Oregon.

Multiple car rates are not available at every origin because not all facilities are capable of loading this capacity, i.e., Kalispell, Montana (Figure 3.3). Other information shown includes the date the rate went into effect (April 1, 1994) and other related information. Along with the rate tables shown in Figure 3.3, many rates and requirements relating to this rate data are printed elsewhere in the tariff, including minimum shipment sizes, route to be taken, any penalties such as for overloading, and other details applicable to the shipment.

Today, there are still gathering points, intermediate points, and market points for grain shipments (Figure 3.4). Traditionally, there has been more competition on the outbound leg of the movements (intermediate point to market point) than on the inbound leg (local/gathering point to intermediate point). This is due to the larger number of carriers available at these markets. For example, wheat grown in North Dakota and sold in Chicago would be gathered and moved on an inbound rate to the intermediate point of Minneapolis by Burlington Northern (BN) or the Soo Line railroads. Other carriers such as the Chicago and North Western (CNW), which are present in Minneapolis and serve the final destination market, would compete with BN or the Soo by publishing low outbound rates to Chicago.

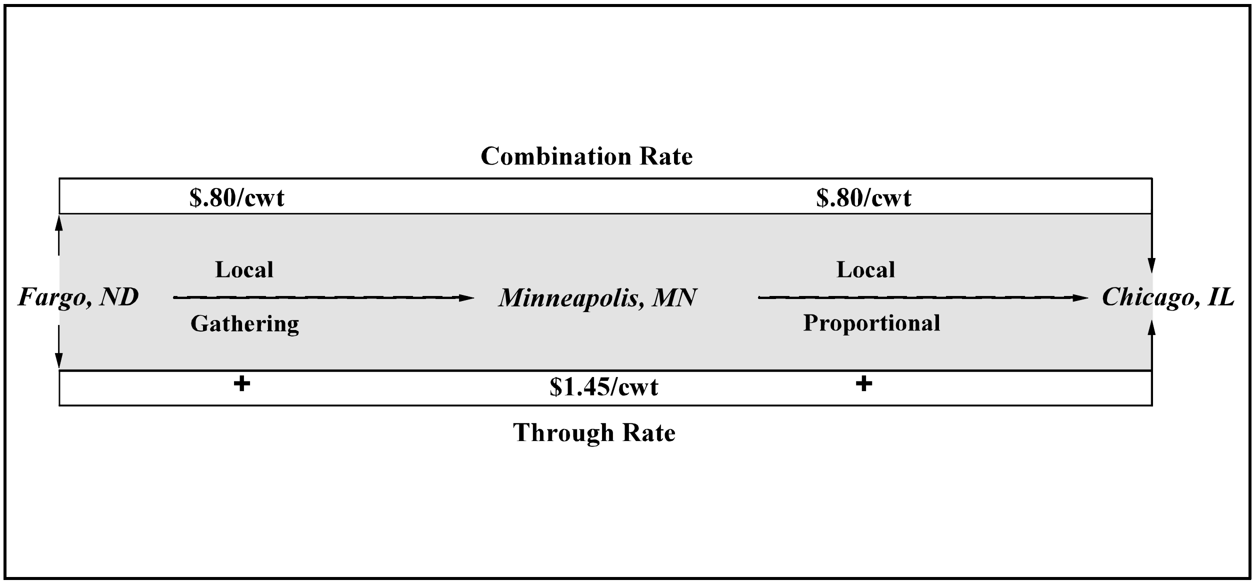

Figure 3.4. U.S. Grain Rate Structures

The gathering point and the final destination also impact the rate structure. Historically, grain was gathered at the local market and shipped to an intermediate point such as Minneapolis, Sioux City, Omaha, or Kansas City for blending, storing, cleaning, or milling. After this process was completed, the grain was shipped to the final marketplace or to the ports for export. Railroads published “through rates” to indicate the rate for grain movement from the local market to the final destination market.

The outbound rate is the same regardless of the origin. Therefore, the longer the distance between the origin and the intermediate point, the lower the outbound rate is as a proportion of the total freight charge. The outbound rate becomes known as the “proportional rate.” Here is a more specific example of how railroads can use these rates as a competitive tool. If BN or Soo had an inbound rate from Fargo, North Dakota, to Minneapolis, Minnesota, of $.80/cwt and an outbound rate to Chicago of $.80/cwt, the total cost would equal $1.60/cwt. To compete for the outbound haul, CNW may offer a rate of $.70/cwt to beat BN’s rate of $.80/cwt. To combat this competition, BN or Soo may develop a “through rate” of $1.45 (effectively lowering the outbound rate to $.65/cwt). Those shippers who select BN or Soo to move wheat from North Dakota to Minneapolis and onward to Chicago receive a lower rate by remaining on the same railroad, thus lowering their outbound rate as a proportion of the total freight charge. Tariff listings for proportional shipments are used by most railroads.

Railroads consider dozens of factors when determining the appropriate rate level for a particular shipment. Factors such as competing railroad rates, demand for transportation services, competing barge or truck rates, cost of the shipment, and many other pieces of information will determine the range within which a rate will be charged.

Rate reasonableness is a vital factor railroads must consider when determining rates to charge shippers. Implementing the Staggers Act of 1980 allowed railroads to freely set rates where there is no "market dominance."[5] The Interstate Commerce Commission (ICC) is determining the procedures and methods to best gauge market dominance. A method that has been used in court cases (i.e., McCarty Farms, Montana, wheat and barley shippers vs the BN) is the revenue-to-variable cost ratio (R/VC). In present law, if the ratio is greater than a threshold R/VC of 1.80, then market dominance may exist. However, if R/VC is less than 1.8, market dominance is determined to not exist, and the shipper cannot continue with the complaint about the rate. However, even if the R/VC is greater than 1.8, the challenged rail carrier may be able to establish that competition does exist. The average wheat R/VC ratio is 1.44. However, this ratio varies significantly by region.

Railroads are now able to implement tariff rate reductions on a one-day notice or a rate increase on 20 days notice. Rates published in tariffs such as the wheat rates shown in Figure 3.3 still account for a large portion of the wheat transported in the United States. However, other mechanisms do exist for establishing and reporting prices producers pay for rail transportation.

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[5]There is not a consensus on the meaning of market dominance. However, it generally refers to a situation in which a railroad or group of railroads experience a lack of competition that would otherwise place a ceiling on rates.

Rail Rate Contracts

Before 1976, railroad rates were required by law to be published in a tariff, resulting in total disclosure. Railroads were forbidden by law to enter into any confidential arrangements with shippers for some special rate or other shipping arrangement. The Railroad Revitalization and Regulatory Reform Act (4R Act) of 1976 changed this policy making rail rate contracts permissible. The ICC implemented a rule-making in 1978 which clarified the rail rate contract policy. This policy was further modified by the Staggers Act of 1980 when confidential bilateral contracts became legal and only a limited amount of information was required to be filed as public with the ICC.

Wheat shipment under confidential contracts became popular during the mid 1980s, when by some research and practitioner estimates, over 40 percent of wheat and other grains were shipped by rates negotiated in contract rather than tariff form. However, contracts for these volumes became less popular when the ICC required additional information to be made public and when grain shipment levels increased in the late 1980s.

Opinions regarding confidential contracts differed among shippers and carriers. Primarily, large shippers favored confidential contracts because they could negotiate lower rates and special arrangements with carriers. Smaller shippers opposed the confidential contracts because they did not have “enough market power” or they could not move large enough volumes of grain to negotiate low rates or special arrangements like their large counterparts. In turn, some railroads favored confidential contracts because they could negotiate special rates or services with large volume customers and perhaps even expand their market share. Nonetheless, some carriers disliked the contracts because they reduced the railroad’s rate-making leverage and enhanced the leverage of large agribusiness firms. Because of the disparity in opinions of those who used contracts, mixed sentiments still existed when disclosure requirements were imposed.

Forward Pricing of Rail Freight

One of the newest innovations in rail pricing for wheat and other grains is that of forward pricing of rail freight. At least three railroads have implemented programs whereby shippers can lock in capacity or rates or both for some future time. These programs are relatively new and have been the source of considerable controversy. However, they do represent a move toward more flexible, market-based rail rates than those published in a tariff.

The first of these formalized forward pricing programs was the Burlington Northern's Certificate of Transportation program (COT). This program is still in existence. Under this program, the BN offers a specified number of railcars (up to 40 percent of their fleet) for sale for a particular shipment period, and shippers bid for those cars. Shippers or anyone wanting to purchase a COT can phone or fax a bid to the BN during specific hours. COT information, including bid results, are available through a variety of electronic media. The highest bidders are granted negotiable certificates which guarantee railcar capacity as well as the price for that shipment. In effect, the COT provides the successful bidder with assurance of railcar availability and eliminates risk of freight rate fluctuations.

Certificate of Transportation bids are differentiated by geographic region (Northern Wheat Units or Southern Wheat Units), month, and portion of the month (first half or last half). Shippers originating wheat in the hard red spring wheat-producing area bid on Northern Wheat Unit COT trains. Shippers originating wheat in the hard red winter area bid on Southern Wheat Unit COT trains. A certain number of trains are allocated to five nearby months. Bidders must specify first half (FH) or last half (LH) of the COT offer months on which they are bidding for service. The number of units or trains available for purchase on a given day are rationed throughout the bidding period. For example, on May 18, 1994 the number of July units or trains available for purchase were 16; however, 42 units FH and 39 units LH are still available for purchase in future weeks (Table 3.2). This insures that not all the trains are bought immediately.

There are specific requirements on each bid. Each COT offer is comprised of a 26 car multiple-unit. Minimum bids are required on each COT offer; NWU minimums are $52,000 (Table 3.2) and SWU minimums are $39,000. The larger NWU minimum bid is related to the longer travel distance to destination markets such as the Pacific Northwest and the limited competition. The SWU usually travels to closer markets (shorter distances) such as to the Gulf and encounters more intense competition. Certificate of Transportation offers are available until two weeks before the shipping period or until they are sold out. On May 18, 1994 the September COT offers are already sold out (Table 3.2). The quick "sell out" of September offers is a direct result of the seasonal wheat harvest and expected demand to transport that wheat. Once the COT rate is determined, 25 percent of the payment is required. The remaining 75 percent of the payment must be paid five days before the shipping period.

Terms of the bids BN accepts are disclosed for all to see, except for the names of the buyers. Some COT offer months may not receive bids while other months receive a range of bids (Table 3.3).

TABLE 3.2. COT Northern Wheat Units Bid/Offer Program for May 18, 1994

Shipping Period - 1994	Units	Minimum Pricing ($)	Units Remaining
June	56 (1456 cars)	52,000	28 FH, 28 LH
July	16 (416 cars)	52,000	42 FH, 39 LH
August	7 (182 cars)	52,000	7 FH, 0 LH
September	Sold Out	--------	-----------
October	16 (416 cars)	52,000	47 FH, 47 LH

TABLE 3.3. COT Northern Wheat Units Results, May 18, 1994

Shipping Period -1994	Total Bids Accepted	Amount of Successful Bids ($)
June	No Bids	
July	2	52,025; 52,050
August	1	52100
September	Sold Out	
October	4	52000; 52000; 52010; 52025

Canadian Pacific (CP) implemented its Protected Equipment and Rate Exchange (PERX) program in 1993. Canadian Pacific designates approximately 30 percent of its hopper cars for PERX transactions. PERX is similar to BN's COT program in that shippers place bids to guarantee rates and equipment. The minimum bid for PERX is $250 below the tariff rate. Market conditions are important in determining if PERX (and other forward pricing rail mechanisms like COT) cars will trade at a premium or a discount. For example, if harvest is late, demand for cars will be low, so cars may be traded at a discount for a given period.

Union Pacific (UP) has an Advanced Car Ordering System (ACOS) in place. The ACOS program is different than the previous two forward pricing programs. Union Pacific shippers receive a quarterly listing of their previous four-year car loadings and a four-year average (Table 3.4). Shippers can order all or part of the four-year average car loadings for each month's delivery. In addition, shippers can roll unused car loadings over into the next month as long as UP receives notice. Orders are accepted on a continuous basis up to one month before the placement month, i.e., orders for January placement are accepted through November. Advanced Car Ordering System guarantees cars for delivery during a certain month; however, rates are not set through this program. Shippers can negotiate through contract or use the tariff to determine their rate.

TABLE 3.4. Example of Union Pacific Quarterly Customer Car Loading Base

Month	1990	1991	1992	1993	4 Year Average
October	12	10	10	16	12
November	10	14	8	12	11
December	16	14	18	12	15

Guaranteed freight is another method for assuring future car supply. Shippers who own rail cars may enter into a private contractual agreement and lease their rail cars to carriers with the intent of receiving some level of rail car utilization i.e., 1.5 turns per month. For example, if a shipper (grain company) owns and leases 20 rail cars to a railroad and the railroad in turn guarantees the shipper 1.5 turns per month for each car, the shipper can expect to receive 30 rail cars to load each month. The railroad pools the private cars into their fleet and the shipper receives cars to load which are the same type of car they have leased to the carrier. Rates may be charged according to a tariff or a contract specification.

Truck Transportation Pricing

Rates (prices) charged for truck transport of wheat are determined in what is perhaps the most openly competitive marketplace of all the transportation modes. Literally thousands of semi-trucks compete with each other for mostly shorter-distance hauls. No organized market or “exchange” exists within which buyers and sellers of truck transportation negotiate wheat rates; rather, individual negotiations among elevator managers, truckers, brokers, and grain buyers determine the price to be charged to ship a truckload of wheat. Supply-and-demand conditions on a particular day for the commodity and especially the status of competitors (including both trucks and railroads) will determine the rate to be charged. More specifically, the variable or "out-of-pocket" costs provide the floor to truck rates. The maximum price charged is limited to what competitors charge.

Rates charged by truckers for wheat shipment are distance related. That is, rates will increase roughly in proportion to the distance of the trip. Because of the competitive nature of truck transport and the higher variable costs of shipment, rates will often reflect the additional fuel and other costs incurred by hauling farther. Exceptions to this may include hauls less than 100 miles where loading, waiting, and other fixed costs become a higher proportion of shipment costs. In either case, truck rates are often cost based. Even though rates are cost based, trucks are essentially "price takers" rather than "price makers." Trucks are "price takers" because of the large number of trucking companies offering service and the ease of entry and exit within the industry. Trucks can respond quickly to changes in price and demand by moving to areas where service is needed.

Trucks are especially effective competitors in short-haul markets or in cases where a sale may be time sensitive. Trucks play an effective role in short-haul local repositioning of wheat between elevators to local feed markets and other local or regional destinations.

Little historical data exist on truck rates for wheat shipments, so attempting to track truck rates over time is not productive. In general terms, however, truck rates have followed the competitive rail rates to compete for a portion of wheat shipments. Trucks do face constraints from their cost structure, shorter-haul nature, and capacity limitations. Trucks have been relegated to relatively minor status in the overall wheat transport market. In 1992, the latest year for which nationwide market share data are available, trucks handled an estimated 8.5 percent of all U.S. wheat shipments (USDA 1994b). However, almost every wheat shipment has moved by truck at one point or another in the logistics channel.

Summary

Transportation pricing is a complex issue, yet thousands of shipments of goods move easily within the United States every day. Cost and demand factors are key to determining the rate shippers are charged to move their goods by each mode. Different mechanisms are used by each mode to determine its rate. Truck transportation pricing is perhaps the most competitive of the modes as trucks compete with each other for hauls. Rail transportation pricing has changed from highly regulated rates to a freer rate setting environment. Barge rates are determined in an organized “call,” a very competitive session. At the session, buyers and sellers of freight transportation meet to settle contracts in cash terms. Each mode differs significantly from the other in rate determination because each mode has special characteristics which set it apart from the others.

CHAPTER 4

TRANSPORTATION'S ROLE IN GRAIN MARKETING

Wheat prices vary in nearly every location throughout the United States and the world. Wheat prices are lower in the producing Midwestern region and higher in the populated consuming coastal regions. Higher wheat prices in consuming regions result from demand and supply relationships and transportation and handling costs. Demand for wheat exists because there is a demand for feed wheat and also a demand for products made from wheat, such as pasta, breads, and cakes. There is a wheat supply deficit in the consuming coastal regions of the United States. Transportation plays a key role in connecting excess grain from producing regions and the demand for grain in consumption and processing regions.

In this chapter, some causes for wheat price differentials, major components of the basis, a way to avoid transportation price risk, and some transportation issues that may impact grain prices are presented.

Spatial Price Relationships

Wheat prices are different throughout the world, which results from regions with surplus wheat compared to regions with a wheat deficit. In general, wheat prices are lower in the inland wheat-producing regions and higher in the grain-deficit populated and port regions. Spatial price relationships between wheat-producing and consuming regions explain the price differentials. Transfer costs, which include loading or handling and transportation charges, are the most important variable determining spatial price relationships (Tomek and Robinson 1985). Price differentials between regions cannot exceed transfer costs because of arbitrage. If the price difference between two regions is greater than the transfer costs, buyers will purchase commodities from the low-priced market and ship them to the high-priced market, which will raise prices in the former and reduce them in the latter.

Forces of supply and demand impact the price of wheat. Supply and demand are brought together in central markets such as Minneapolis, Chicago, or Kansas City. These central markets became prominent because they have large storage capacities, a concentration of milling facilities, futures markets, and major rail hubs.

The role of the central market appears to be changing. Wheat used to be shipped to central markets to be graded and processed, but now wheat shipments more frequently bypass these central markets and move directly between origin and destination. These markets still perform invaluable functions in price setting using the futures markets.

The price producers receive for wheat at the country elevator is derived from the central markets less transportation and handling costs. Country elevator managers watch the prices in several markets to determine where the demand is the greatest, as indicated by a higher price. Country elevator managers deduct transfer costs to the higher priced market. The price country elevator managers receive from other markets determines the bids they can offer local producers.

For example, on April 26, 1994 the country elevator manager in Gladstone, North Dakota, offered producers $4.94 per bushel for 14 percent protein dark northern spring (DNS) wheat. After investigating the wheat prices at larger markets, it is evident how Gladstone formulated this bid for DNS wheat.

Dark northern spring 14 percent protein was priced at $5.16 at Minneapolis and $6.13 at Portland, which suggests transfer costs of $.22 cents and $1.19 at respective markets (Figure 4.1). Actual transportation tariff rates indicate that transportation costs between Gladstone and Minneapolis are about $.65 per bushel for a 52-car train while they are about $1.05 per bushel for a 52-car train between Gladstone and Portland. On this particular day, the Gladstone elevator manager should sell grain to markets in the Portland area because the $.14 per bushel difference ($1.19 price differential - $1.05 tariff rate) reflects handling costs. A country elevator manager selling to the Minneapolis market on this particular day would experience a $.43 per bushel loss ($.22 price differential - $.65 tariff rate). Elevators east of Gladstone may sell to the Minneapolis market, depending upon the price differential. Somewhere between North Dakota and Minnesota there is an imaginary line which splits the wheat movements destined for the East and the West.

The country elevator in Gladstone is a terminal elevator which can load 52-car trains. Elevators that cannot load multiple-car trains do not have access to the same freight rates and cost savings unit-train loading elevators have. Country elevators that are not located along a rail line or cannot load multiple-car trains may move wheat by truck to an elevator with multiple-car loading facilities, such as Gladstone. Terminal elevators frequently serve as a price reference point on which smaller elevators base their bid to producers. Once again transportation and handling costs between the two facilities are the key differential determining the bid to producers. On average elevator margins are between 8 and 14 cents per bushel.

Elevators managers throughout the United States watch different regional markets to formulate their bids to local producers. For example, a country elevator manager in Sterling, Kansas watches the bids at the nearby Hutchinson terminal elevator, the Kansas City terminal, the Gulf terminal, and the nearby futures contract. The elevator manager selects the best market on which to base the local bid to producers. The manager formulates the bid by subtracting freight and handling costs from Sterling, Kansas to the best price terminal location.

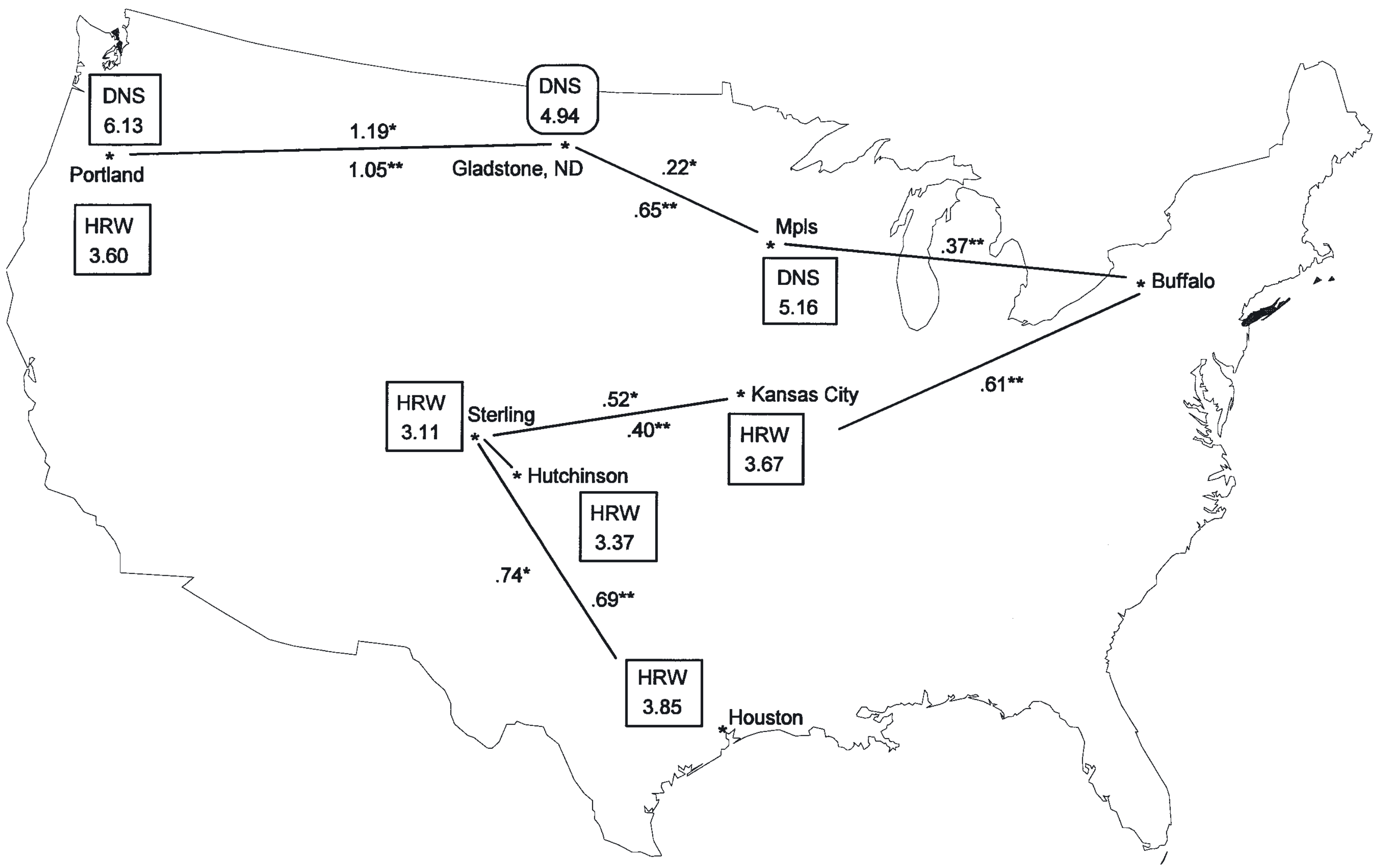

Figure 4.1. Cash Price Differentials

Note: * = Price differential per bushel; ** = Transportation cost per bushel; DNS = Dark Northern Spring Wheat - 14 percent protein; HRW = Hard Red Winter - Ordinary protein

Most elevator managers watch transportation rates closely before they determine the local bid, particularly if they are responsible for transportation costs. Elevator managers who do not watch transportation rates closely sell grain ‘Free On Board’ (F.O.B.) origin to grain companies. This means the grain company is responsible for moving the grain from the country elevator (origin) to the destination location, paying all transportation costs. Selling F.O.B. origin may be advantageous for the country elevator because several large grain companies purchase and move large quantities of freight from carriers and can negotiate a lower rate than the country elevator manager could negotiate. The cost savings enable the country elevator to offer a higher price bid to local producers. There are specific central markets and terminal markets on which local price bids to producers are determined. As elevator managers watch these markets and know their transportation and handling costs, producers will receive the best bid possible for their grain.

Regional price differences may deviate from transfer costs for short or extended periods. Some reasons for the price differences include buyer preference for grain quality, interest costs, handling costs, availability of storage, and availability of transportation equipment. Although there are several possible reasons for a regional price differential, the focus of this discussion is on the availability of transportation equipment.

Availability of transportation equipment may cause price differentials to exceed typical transfer costs between two markets. The capacity constraints can be more severe in the rail industry because about two-thirds of all wheat is shipped by rail. During harvest the demand for rail service is at a peak and supply of cars is sometimes tight. Alternatively, country elevator managers may be forced to deliver wheat by truck to the high demand market locations. The increased transportation costs due to using trucks may be absorbed by lower bid prices offered to producers. However, if the price offered to producers is too low, they will store their grain or search longer distances for an elevator that has rail service available and can offer a higher price.

Transportation shortages cause some inefficiencies in the grain logistics system. Elevators are the first channel of the flow of wheat from farm to markets. When elevators are faced with a transportation shortage it may impede their ability to handle grain flows. To a large extent elevator profits are based on the amount of grain they move through their facilities. During a period of time when there is a lack of transportation capacity, elevators cannot deliver grain, causing a shortage of storage capacity, and as a result they cannot purchase grain from farmers. The short-term decrease in demand at the local market results in lower wheat price bids. Furthermore, a bottleneck at the elevators will affect processors that have purchased grain from those elevators that cannot receive railcars.

Basis

Basis is defined as the difference between a cash price and the futures price (B=C-F) of a particular commodity on a given futures exchange. The futures price represents the price offered for a futures contract. A futures contract is a legally binding agreement which calls for delivery of a specified quantity and quality of grain at a specified place in a designated month in the future. Wheat futures contracts are offered for March, May, July, September, and December. Each month relates to the seasonality of harvest, marketing, or consumption patterns of grain through the year (Cramer and Heid 1983). A futures price is locked in when a contract is bought or sold; otherwise, futures prices fluctuate based on market supply and demand information.

The cash price and the futures market price tend to converge as the contract delivery month approaches. For example, Figure 4.2 illustrates a “normal” relationship between the cash price and March futures price from January through March. In January, the area or the difference between the cash and futures price is large (Figure 4.2). This difference narrows as the delivery date approaches, at which time the difference equals the cost of transportation. In March, at the time and place of delivery, the cash and futures prices are the same (except for transportation cost), because if the price were higher in one of the markets, traders would buy or take delivery in the low price market and sell or make delivery in the high price market, which would minimize any price difference. In reality, the relationship between the cash price and the futures price is more variable than the linear relationship portrayed in Figure 4.2.

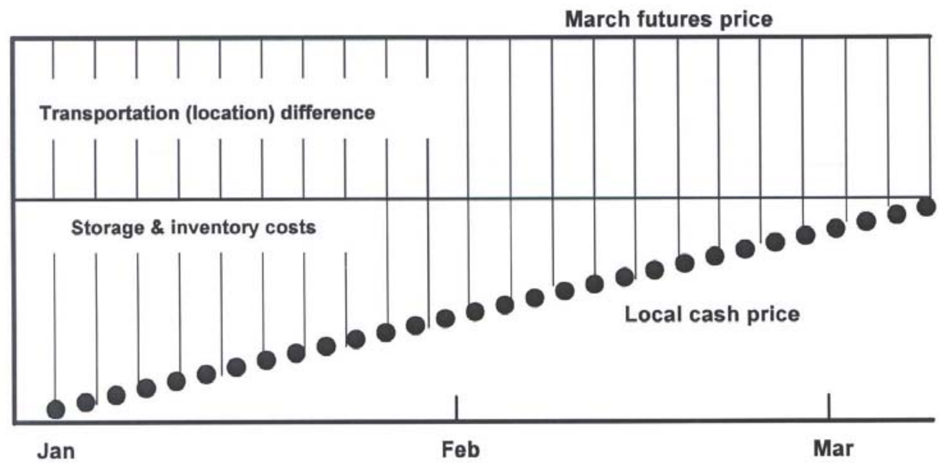

Figure 4.2. Cash Price and Futures Price as the Delivery Month Approaches

SOURCE: Chicago Board of Trade. *Understanding Basis The Economics of Where and When.* Chicago, IL.

The basis is made up primarily of transportation and storage and handling costs (Figure 4.2). Several factors impact and cause the basis to fluctuate. Some of these factors include (Ulrich 1987):

1. Supply of the commodity at a particular location.
2. Demand for the commodity at a particular location.
3. Cost of transportation between a particular location and the futures market.
4. Variations in grade between the commodity at a particular location and the futures market.
5. Availability of substitutes of the commodity at a particular location.

Although all of these factors impact the basis, only impacts from changes in the cost of transportation between a particular location and the futures market are considered while all other factors are held constant for purposes of this report.

There is a general belief that availability of transportation impacts basis. Limited transportation capacity may increase price differentials or marketing margins and reduce country prices in relation to terminal market prices. Country elevator managers testified that in response to the railcar shortage experienced during the marketing year 1989/90, they reduced their cash grain bids to producers (ICC).

They suggested that during tight railcar demand periods and when viable transportation alternatives do not exist, local cash prices fall relative to central market or futures prices, which causes the local basis to widen. The local basis is equivalent to the local cash price minus the futures price.

Adverse weather conditions also impact transportation and the basis. Weather conditions such as droughts, floods, and severe cold weather cause diversions and lulls in grain transportation. Drought conditions which may cause decreased water levels can limit waterway transportation and divert grain movements to more expensive modes of transportation.

For example, shippers that typically move wheat to the Gulf via the cost-efficient waterway system may have to divert traffic to rail. Barge movements are cost efficient for long hauls and are the chosen mode when allowable. The increased transportation cost will be absorbed by the different players in the wheat logistical system. The degree to which any one player will bear the burden of this increase will depend on the elasticities of demand at different points in the system. It is likely that the ultimate shipper (producer) will absorb some of the increase as well as the consumer and possibly even the middleman.

As the local price falls relative to the central or futures market, the basis widens. The flood of 1993 caused some of the waterway segments to close and some rail lines were underwater and damaged by the flood resulting in similar effects on the local basis. Elevators that would typically move wheat by barge or rail had to divert movements to more costly truck. Shippers would only divert wheat movements to truck if transportation costs could be covered. Elevator managers had to lower their bid to producers; however, they would have to maintain a high enough bid to entice producers to sell. Once again, a lower country elevator price relative to a central or futures market widens the basis.[6]

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[6]This applies to normal markets; inverted markets are peculiar and present different challenges to producers and merchandisers.

Transportation Price Risk

Producers can avoid fluctuations in transportation and handling costs by entering into a basis contract and shifting the risk to the elevator. A basis contract locks in a basis for a specified period of time. The cash price within this period is determined by subtracting the basis quoted by the elevator from the nearby futures price. Some basis contracts may specify that the seller is responsible for transportation costs. However, elevator managers can reduce their transportation price risk by locking in future transportation rates via a forward contracting mechanism. This may enable elevators to offer producers a better basis contract. The elevator manager's geographic location will be important in determining which mode of transportation would allow the lowest rate. Elevator managers located along the river system would be inclined to lock in barge rates by forward contracting barge services for a specific time and at a specific rate.

Transportation Issues and Grain Prices

Grain marketing is continually changing and perhaps has never been more dynamic than it is now. There are several events that could impact the future of agriculture: passage of the North American Free Trade Agreement (NAFTA); the Uruguay Round of negotiations under the General Agreement on Tariffs and Trade (GATT); and USDA export programs.

Regional and international trade pacts are critical issues to the agricultural communities. In 1989, the Canadian - United States Trade Agreement (CUSTA) was implemented and relaxed trade barriers between the two countries. In some respects, the CUSTA was a prologue to the NAFTA, demonstrating regional trade negotiations. The congressional passage of NAFTA and the consensus of the GATT negotiations are major issues that have uncertain implications for the American farmer. There are differences in economic structure and governmental roles among countries. Distinctions occur within the marketing systems and infrastructure capacities which influence the logistical system in each country. An efficient cross-border infrastructure between nations is crucial for increased trade. Without the proper cross-border infrastructure, trade by all modes of transportation may be constrained.

North American Free Trade Agreement

The goal of NAFTA is to remove barriers that restrict free trade among the United States, Canada, and Mexico. The major players in the agreement are the United States and Mexico because many farm issues between the United States and Canada were addressed in the CUSTA. Mexico and the United States have used tariff and nontariff methods to protect their domestic markets. However, under NAFTA, these methods will be phased out over the next five to 10 years. If NAFTA's goals are achieved and trade increases among the United States, Canada, and Mexico, certain transportation and infrastructure issues must be resolved.

U.S. - Canadian Trade: Transportation and Infrastructure Issues

The United States and Canada have the world's largest trading partnership. The two countries trade a variety of goods, including grains and oilseeds. U.S. wheat exports to Canada have been relatively inconsistent over the past decade due to poor growing conditions and drought years in each country. In 1991, U.S. wheat exports to Canada reached their highest level of 716,000 bushels but remain far less significant than Canadian wheat exports to the United States, which have grown consistently over the past decade, to 20.5 million bushels in 1991.

The United States and Canada differ notably in grain handling, marketing, and transportation. United States producers market their own grain through a market competitive system, such as a large number of buyers, sellers, and processors. Strong competitive forces have resulted in a relatively efficient marketing system. In Canada, grain is sold and marketed through an agency, the Canadian Wheat Board

(CWB). A lack of competition in the Canadian wheat market has allowed handling costs to remain high relative to U.S. handling costs. Canadian wheat price setting is not open to public scrutiny.

The U.S. and Canadian rail pricing systems for grain shipments differ considerably. Under Canadian law, the Western Grain Transportation Act (WGTA) introduced a rail rate subsidy mechanism whereby shippers pay only a portion of the total rail shipment cost and the government pays the remaining balance directly to the railroad. The subsidy covers east-west movements of grain to Vancouver and Thunder Bay. The subsidy is a subject of controversy between the United States and Canada. U.S. wheat interests have complained that Canadian rail subsidies have contributed to Canada's ability to undersell U.S. wheat within the U.S. (Greene 1994).

Johnson and Wilson (1994) developed a simulation model to measure impacts on the North American barley market. One of their models included impacts on North American barley from eliminating the Canadian rail subsidy. Results indicated eliminating the subsidy would not benefit U.S. producers but would actually have opposite effects. If the WGTA subsidy were eliminated, shippers would incur the full cost of rail movements. The increased cost would be passed on to producers as lower barley prices. The lower Canadian barley prices would increase the southward flow of barley into the higher-priced U.S. market.

Wheat trade between the United States and Canada occurs by truck, rail, or water. Border delays may cause inefficiencies for shippers, resulting in higher costs. Most of the border delays between the United States and Canada are due to institutional issues and infrastructure inadequacies (U.S. DOT 1993).

The institutional issues are mainly due to border crossing procedures and differences in laws and regulations between the countries. Differences in highway weight limits between U.S. states and Canadian provinces need to be addressed. Road weight limits are more conservative in the United States than in Canada. Canadian provinces allow a gross vehicle weight of between approximately 87,000 and

137,000 pounds on their roads while most U.S. states allow 80,000 pounds. The United States needs to evaluate the consequences of allowing higher weight limits on its roads or on designated corridors. Increased weight limits could allow increased economies for grain shippers because the transportation cost per bushel would decrease. The reduction in transportation costs could be passed on to producers as higher wheat price bids. However, the transportation cost reduction could be offset if increased user fees were imposed to pay for the additional road maintenance necessary because of the higher weight limits.

Many border crossing facilities have limited capacity. Most of these facilities were built in the early 1930s and lack modern-day communication equipment, such as a fax machine (U.S. DOT 1993). Lack of modern communication and other devices can cause inefficiencies by slowing down the border crossing process. Most of the highways connecting the two countries are adequate; however, some improvements could help to reduce border crossing delays. Border crossings need to be connected to more major roads, and some area highways need to be widened and improved.

North-south railroad capabilities apparently are underutilized and underdeveloped. Greater efficiencies could be achieved with improved rail crossings (U.S. DOT 1993). The main reason for greater efficiencies by rail is that multiple car trains can cross the border and be processed and cleared simultaneously. The low unit train processing time could reduce shippers' costs which could, in turn, be passed on to producers as higher wheat prices.

U.S. - Mexican Trade: Transportation and Infrastructure Issues

In general, the combination of NAFTA and changes in the Mexican economy could benefit U.S. grain and oilseed producers. It appears the Mexican agricultural sector has either stagnated or declined since the early 1980s, with agricultural growth lower than population growth.

“The Mexican population is much younger and growing more than twice as fast as the U.S. population. Growing incomes and a relatively young, rapidly growing population are a potent recipe for boosting food demand” (Milling & Baking News 1992c).

U.S. grain exports to Mexico have averaged about 6 million tonnes (over 13 billion pounds),[7] roughly three-fourths of Mexico’s total grain imports. In the short term, a spurt in Mexico’s food demand would create only a slight increase in U.S. grain exports. In the long term as incomes grow in Mexico, the United States may experience a significant increase in grain export demand.

Truck weight limits and railcar utilization are potential issues between the United States and Mexico. Mexico allows higher gross vehicle weight limits on its highways than the United States allows. This truck weight limit controversy between the United States and Mexico is similar to the controversy between the United States and Canada and similar issues would be expected to arise. The availability of rail transportation equipment may become a problem if exports increase on a continuous basis. Domestic controversies already exist about railcar availability, and these could heighten if more U.S. wheat travels into Mexico via domestic railcars. The Union Pacific (UP), one of the railroads that interconnects with Ferrocarriles Nacionales de Mexico (FNM) , the Mexican railroad, reported a railcar turn-around time between the United States and Mexico of between 11 to 14 days (Caron 1994). Delays in the return of railcars from Mexico will result in inefficiencies in the U.S. logistical system and may increase costs to shippers. However, if the increase in demand continues, railroads may have an economic incentive to expand their railcar fleet size. However, railroads are cautious about increasing their fleets because of the high cost of railcars, approximately $40,000 per car.

The U.S. border facilities are better equipped than the Mexican facilities. Since World War II, the development of infrastructure on the U.S. side of the border has greatly exceeded the border area in Mexico.

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[7]There are 2204.6 pounds in each metric ton.

A significant infrastructure investment program is underway within Mexico to upgrade critical links to the border. The Mexican Government budgeted $118 million for border infrastructure improvements over the 1992-1994 period. Mexico is also seeking private investment for infrastructure improvements. It is difficult for authorities to expand the Mexican border infrastructure already in place because of existing physical structures along each side.

The United States is nearing completion of a Southwest Border Capital Improvement program. The program will increase the capability of the number of trucks that can enter the U.S. border facilities from Mexico from 1.8 million to 8.4 million annually (USDA 1992). Upgrading the infrastructure will alleviate some border crossing congestion; however, it cannot be a remedy for all border problems.

Capacity constraints and delays can be attributed at least partially to border crossing procedures. The USDA noted additional steps are needed to speed up the processing of paperwork for trucks to cross the border. Greater use of computer capabilities could expand pre-filed document clearance, which would speed up the crossing procedures significantly. A reduction in processing time could improve shippers' efficiency by reducing their costs. In turn, these cost savings could be passed on to producers as higher wheat bids.

In 1993, Protexa Burlington International (PBI), jointly owned by Burlington Northern (BN) and Monterey, Mexico-based Grupo Protexa, linked the United States and Mexico via rail-barge bulk movements. This was the first integrated rail-barge service of bulk movements connecting the interior markets of Canada, the United States, and Mexico. Each movement is under a single freight bill and door-to-door service is provided from Galveston, Texas to Coatzacoalcos, Mexico. Furthermore, PBI is considering expanding to another Mexican port, Veracruz, which is close to Mexico City. Efficiency of wheat movements among the three countries should be increased by this integrated system. The increased demand for wheat combined with efficiencies of the rail-barge movements could result in higher local wheat bids to U.S. wheat producers.

General Agreement on Tariffs and Trade

The General Agreement on Tariffs and Trade (GATT) is a multilateral world treaty among more than 80 countries. The purpose is to liberalize and expand trade through negotiated reductions in trade barriers (Knutson et al. 1990). Eight GATT negotiation conferences or "rounds" have been held since 1960. The most prominent agricultural issue at the most recent Uruguay Round was the on-going support (subsidy) battle between the United States and the European Union (EU). Over the next six years, both trading areas have agreed to decrease their government support. During this time, they will be monitored by GATT. The outcomes of the recent GATT negotiations are speculative, as are GATT's impacts on the transportation industry.

The USDA projects U.S. wheat export volume will increase by 7 to 11 percent by the year 2000 (relative to 1992). A large portion of this increase is contingent upon reduced European subsidies and improved access in import markets (USDA 1994a). The percentage of increase or decrease in exports resulting from GATT is difficult to predict because so many market factors, e.g., adverse weather, impact supply and demand. Whatever the export outcome, the demand for transportation will be impacted. Increased exports would increase demand for transportation.

USDA Export Programs

Changes in USDA export programs, such as the Export Enhancement Program (EEP), clearly influence the agricultural and transportation industries. Additional export enhancements help to boost or support wheat market prices through increased demand just as reduced enhancements tend to lower market price.

The unpredictable nature of EEP causes difficulty within the transportation industry. During surges of export demand, elevators primarily moving wheat by rail may experience a shortage of railcars, causing complications with moving grain to export markets.

Railroad officials have indicated that there may be fewer railcar shortages if demand and shipments were more predictable. However, it is not economical for railroads to acquire enough railcars to meet the high peaks in demand and allow the cars to be idle during the remainder of the year.

The barge industry also experiences greater fluctuations in barge rates when exports fluctuate. High export demand causes barge rates to increase, thereby increasing shippers' costs. Shippers may recover these costs by offering lower cash bids to producers at the local market.

If there are surges in export demand, the trucking industry may experience an increase in their wheat movements. Truck rates can fluctuate based on demand; therefore, the rates would also be expected to increase as export demand increases.

Summary

Wheat prices vary throughout the United States. Price differentials exist between production and consumption regions. Generally, prices are higher near the populated coastal wheat deficit regions and lower in the Midwestern wheat surplus region. Transfer costs (transportation and handling) make up most of the price differential between these regions. Regional price differences may deviate from typical transfer costs for a number of reasons such as preference for a specific grain quality, changes in interest and handling costs, availability of storage, and availability of transportation equipment. Shortages of transportation equipment may force shippers to use an alternative, more costly mode of transportation. The temporary increase in transportation costs will more than likely be reflected in a lower country elevator bid to producers. The price differential between the producing and consuming regions will be greater than the most efficient transfer cost.

Several events will impact the transportation industry and the agricultural industry. Trade policies such as NAFTA and GATT will have implications on these industries, participants in the agreements anticipate an overall increase in trade, but the outcome is uncertain. There may be some impact on the demand for grain and the demand for transportation. Increased exports of grain should result in higher producer prices. An increase in demand for transportation may cause rates to fluctuate and possibly increase.

CHAPTER 5

SUMMARY

The United States has always produced a surplus of wheat. Development of the transportation network has enhanced the movement of wheat between regions in the United States and the rest of the world. Today's transportation network consists of over 25,000 miles of waterway, 191,000 miles of rail track, and 3.9 million miles of roads. The transportation network is a vital link in the logistical system as wheat moves from the farm gate to elevators, processing plants, and ultimately to consumers.

In 1992, more than 2 billion bushels of wheat were transported in the United States for domestic and export destinations (USDA 1994b). Railroads hauled nearly 70 percent of this wheat, barges about 21.5 percent, and trucks the remaining 8.5 percent. Traditionally, rail and barge have dominated export movements, while rail and truck have dominated domestic movements.

Much of the variation in transportation modal shares is attributable to demand and cost factors and the competitive environment. Wheat is a low-value bulk commodity, and shippers want to select the most cost-efficient transportation mode to move their product.

Trucks provide premium service and the shortest transit time. However, the capacity constraints and cost structure of trucks make them more costly for long-haul wheat movements than rail or barge. Low terminal costs and higher line-haul mile costs make trucks the preferred wheat transport mode over shorter distances.

Railroads have a higher terminal cost because of locomotives, tracks, and track maintenance. However, they have a higher carrying capacity and are relatively more fuel efficient, realizing lower line-haul costs. Thus, railroads are more cost efficient than trucks for wheat movements over longer distances.

Barge shipments have higher terminal costs than rail, but their larger volume carrying capacities result in lower line-haul costs. Barges are the most efficient transportation mode for large-volume, long-distance wheat shipments.

Pricing mechanisms of transportation services of the three modes are complex. The regulatory reforms of the early 1980s increased freedoms in setting rail and truck rates. Buyers and sellers of truck services negotiate a rate between themselves for the haul. Railroads consider the modal competition of each region, which influences the price elasticity of demand for rail service, to set rates. Rates are generally lower where intermodal and intramodal competition is more intense. Barge rates are traded in an organized “call” session or cash market. Rates fluctuate with the supply-and-demand conditions of the marketplace.

Transportation costs make up a large portion of the cash price differentials among wheat markets. Sometimes the price differential between markets is greater than the transportation and handling costs because of changes in growing conditions and changes in the availability of transportation. Changes in the availability of transportation equipment may impact the bid price offered at the local elevator.

Several events could potentially impact transportation and, as a result, the agriculture industries: the North American Free Trade Agreement (NAFTA), the Uruguay Round of negotiations under the General Agreement on Tariffs and Trade (GATT), and USDA export programs. Free trade is the common theme among these events. To increase trade among countries, certain transportation and infrastructure issues must be addressed.

The goal of NAFTA is to increase trade among the United States, Canada, and Mexico. The proper infrastructure among nations must be in place to accommodate increased trade. Some deficiencies exist in the border crossing procedures between the United States and Canada and the United States and Mexico. Improved border crossing procedures, i.e., increased computer and communication capabilities, between countries could speed up the border crossing procedure and enhance the efficiency of wheat exports. Increased efficiencies may reduce shippers’ costs and be passed on to producers as higher country elevator bids. Furthermore, border crossing infrastructure improvement programs should allow more vehicles to cross borders each year, increasing efficiency and reducing costs because of the increased volume.

The net effect of reduced subsidy supports under GATT is uncertain. Some believe exports will increase, which will increase the demand for transportation. Changes and impacts in USDA programs, i.e., EEP, are also uncertain. Changes in such programs will impact export demand which will impact the demand for the transportation network and equipment. These impacts may, in turn, influence transportation rates, and thus, wheat prices at certain markets.

Producers, grain markets, and processors are impacted by changes in the transportation environment. Users of the transportation network must be informed and must be active in policy decisions. Issues such as rail line abandonment can directly impact producer services which can, in turn, alter the prices they receive for their wheat at the local market.

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APPENDIX A

Historical Overview of Wheat Industry Logistics

HISTORICAL OVERVIEW OF WHEAT INDUSTRY LOGISTICS

The transportation network played an important role in the development of the United States and its agricultural sector.

In this chapter, a review of the development of the transportation system is followed by a description of wheat transportation modal shares, transportation regulatory policy changes that have impacted agricultural transportation, and transportation technology changes. Finally, a basic discussion of wheat production and storage cycles is presented.

Development of the Transportation System

The age of colonization began in America during the 1600s. From the. 1700s onward, America experienced significant and startling changes, such as the Industrial Revolution (Figure A. 1). This era was marked by the general introduction of power-driven machinery. During the 1800s, America began to experience the Transportation Revolution, leading to the development of waterway and railway networks. The following sections provide a brief overview of the development of each of the modal transportation systems.

Development of the Waterway System

The waterway system has played an important role in the nation’s development. Large cities initially developed near areas with waterway access. Even today most of the larger U.S. cities are located on major waterways, either ocean or river. Markets developed near these cities because products were easily moved by water transportation. Three time periods differentiate the advancement of the waterway system in the United States (Howe et al. 1969). These periods spanned from the early 1800s to the present.

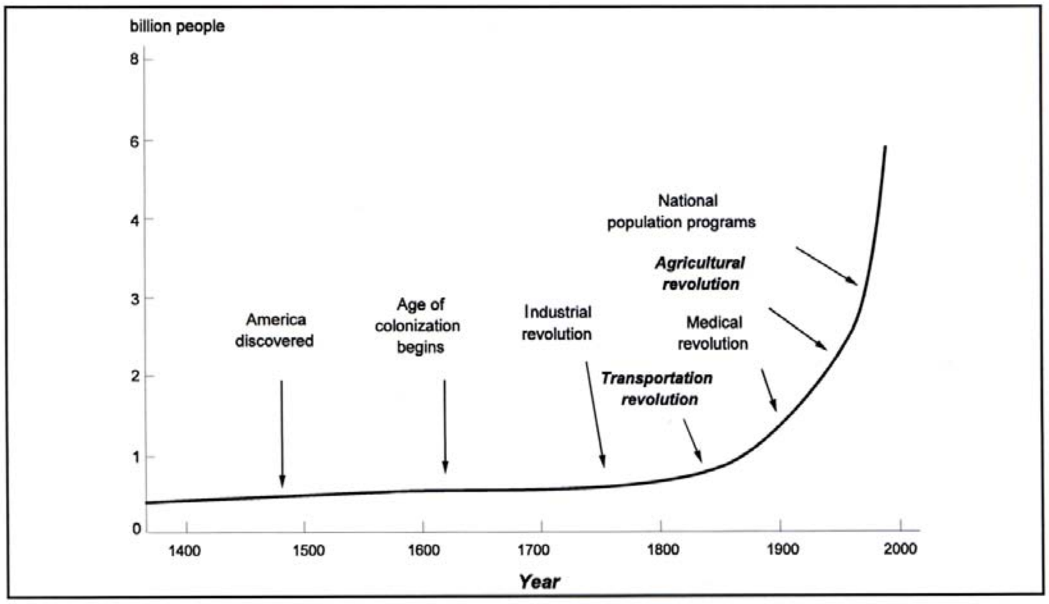
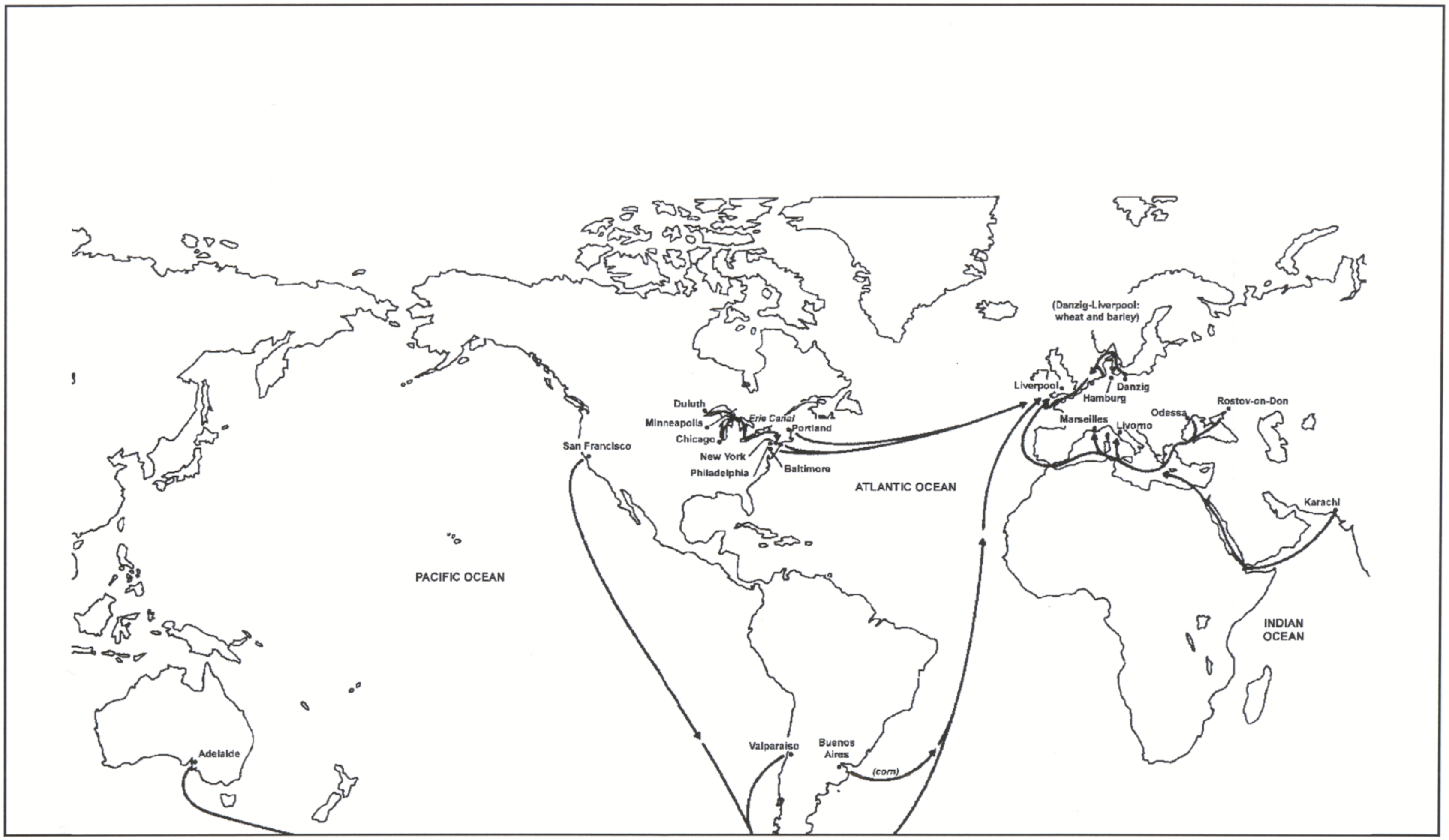


Figure A.1. World Population Growth

SOURCE: Knutson, Ronald D., J.B. Penn, and William T. Boehm. *Agricultural and Food Policy*, 2nd Ed. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1990.

In the early 1800s, rivers provided routes of exploration. Settlers used the rivers to gain access to the hinterlands. As people settled in new locations, they began to produce excess products, such as wheat, and transported the raw materials to cities. The financial rewards of this movement led to efforts to improve the large rivers. Man-made canals were built to link rivers together. New York built the Erie Canal in 1825, extending 364 miles and connecting Buffalo, on Lake Erie, to Albany, on the Hudson River. The Erie Canal was the prime avenue for moving the wheat produced in the Midwest to the populated East for consumption and export (Locklin 1966). The Great Lakes later aided in the linkage between the Midwest and the East Coast. The major world grain routes existing in 1880 included the Erie Canal for moving grain east for export (Figure A.2).



NOTE: Routes indicate wheat unless otherwise specified.

Figure A.2. Major World Grain Routes, 1880

SOURCE: Morgan, Dan. *Merchants of Grain.* New York: Penguin Books, 1979.

The second period of development of the waterway system occurred in the 50 years following the Civil War. Developments in marine science and engineering led to improvements in engines, adaption of the propeller to shallow-draft vessels, and success with the early experiments of towboats and barges (Howe et al. 1969). These developments paved the way for the third era of waterway transportation.

The third era spans from World War I to the present. The war placed a heavy burden upon the nation's transportation system (Lieb 1981). This forced the federal government to consider increasing the nation's transportation carrying capacity by improving the effective use of the waterways, using locks and dams. Essentially, the locks and dams controlled water depth by eliminating fluctuations and maintaining a sufficient depth for heavier barges to pass through. Grain began to divert from rail to the rivers. A new low-cost transportation system had been born with the development of modern marine engines, large barges, and deepening waterways to 9 feet or more.

Just as the construction of the Erie Canal was an important feature of the first era, the opening of the St. Lawrence Seaway highlighted the third era. The St. Lawrence Seaway effectively linked the landlocked Upper Midwest to Europe. Grain grown in the Upper Midwest could be shipped easily through the seaway to Northern Europe and Great Britain ports with shorter distances than through the ports of the Atlantic seaboard. For example, the distance between Baltimore and Liverpool is 3,936 miles while the distance between Detroit and Liverpool via the St. Lawrence Seaway was shorter by 236 miles. This mileage savings may seem small, but it also eliminated the land travel distance of 604 miles from Detroit to Baltimore, resulting in an overall savings of 840 miles, nearly 20 percent of the total distance (LesStrang 1976).

In 1954, improvements on the St. Lawrence River between Montreal, Quebec, and Ogdensburg, New York, were initiated. New and deeper canals, new and larger locks and dams, and deepening of river channels provided a 27 foot channel depth between Montreal and Lake Ontario. The St. Lawrence Seaway made North America more efficient and accessible to world commerce.

Development of the Railway System

The Baltimore and Ohio was the first railroad to operate in the United States in the 1800s. In 1830, less than 22 miles of railroad were in use in the United States. However, with rapid construction in the eastern states, rail mileage quickly increased. By 1860, about 9,000 route miles had been laid, mainly along the eastern seaboard (Allen 1982). The miles of track increased significantly as the railways began to stretch into the Midwest during the 1860s. The railroad industry helped landlocked portions of the Midwest to ship grain to the East more efficiently for consumption and export.

While U.S. rail track miles did not peak until 1916, this early construction period was culminated with the driving of the Golden Spike in 1869. At this occasion, the first transcontinental line was completed in Utah as Union Pacific and Central Pacific tracks were connected. This marked the opening of the Great Plains and the West to development of its natural resource base as exemplified by the grain and mining industries.

The railway system of 1890 reflects the expansion of the rail network during the 1860s, 1870s, and 1880s (Figures A.3 and A.4). The decade of the 1880s was the greatest expansion stage for railroads. The miles of track continued to increase until they plateaued in 1916 with 249,433 rail track miles in operation (Figure A.5).

Main lines, constructed prior to 1900, were the most heavily used rail routes. Branch lines were constructed to serve as feeder lines, moving grain from the country elevators to the main line for the longer hauls. In this early period, farmers hauled their grain in horse-drawn freight wagons. Because of the limited distance horse-drawn wagons could travel in a day, branch lines were built no farther apart than 10 to 20 miles. A maze of branch lines were built in grain-producing areas as developing and intensely competitive railroads duplicated services in much of the grain-producing areas (Zink 1984).

In the 1800s, the U.S. government and state governments promoted construction of railroads through several forms of grants. These railroads served many purposes in the development and settlement of the United States. However, bankruptcies, mergers, and rail line abandonments have caused the number of railroads to fall from over 1100 in 1920 to less than 600 by 1992 (Figure A.6). During the same period the number of Class I railroads also declined.

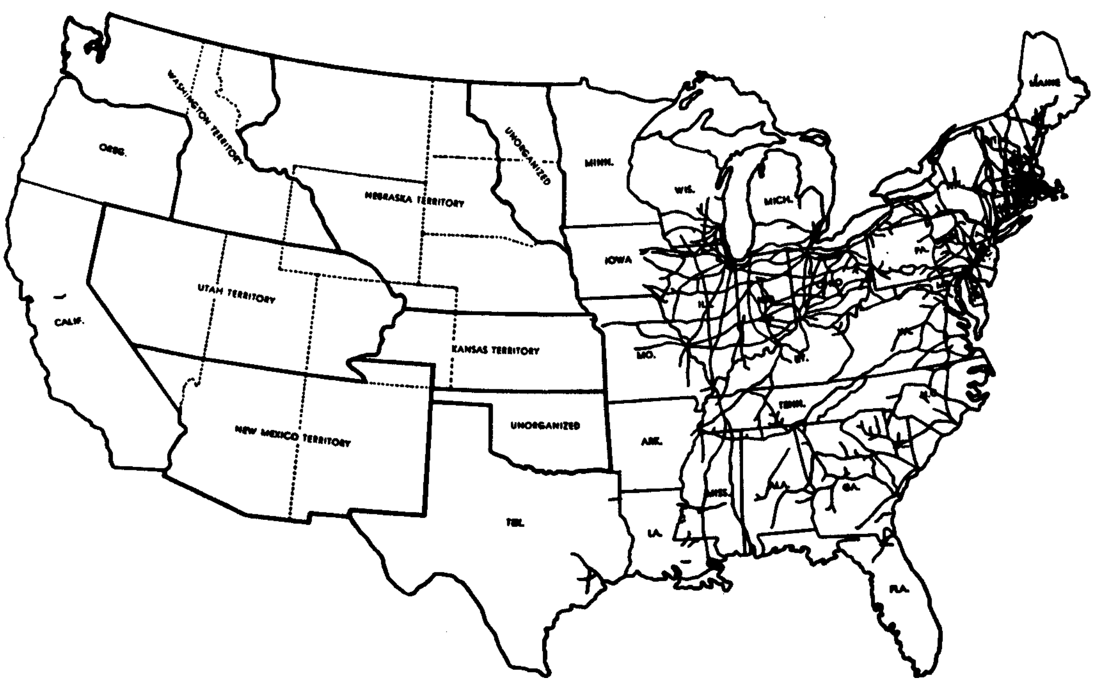


Figure A.3. U.S. Railway System, 1860

SOURCE: Association of American Railroads Library. Information & Public Affairs Department, Washington, D.C.

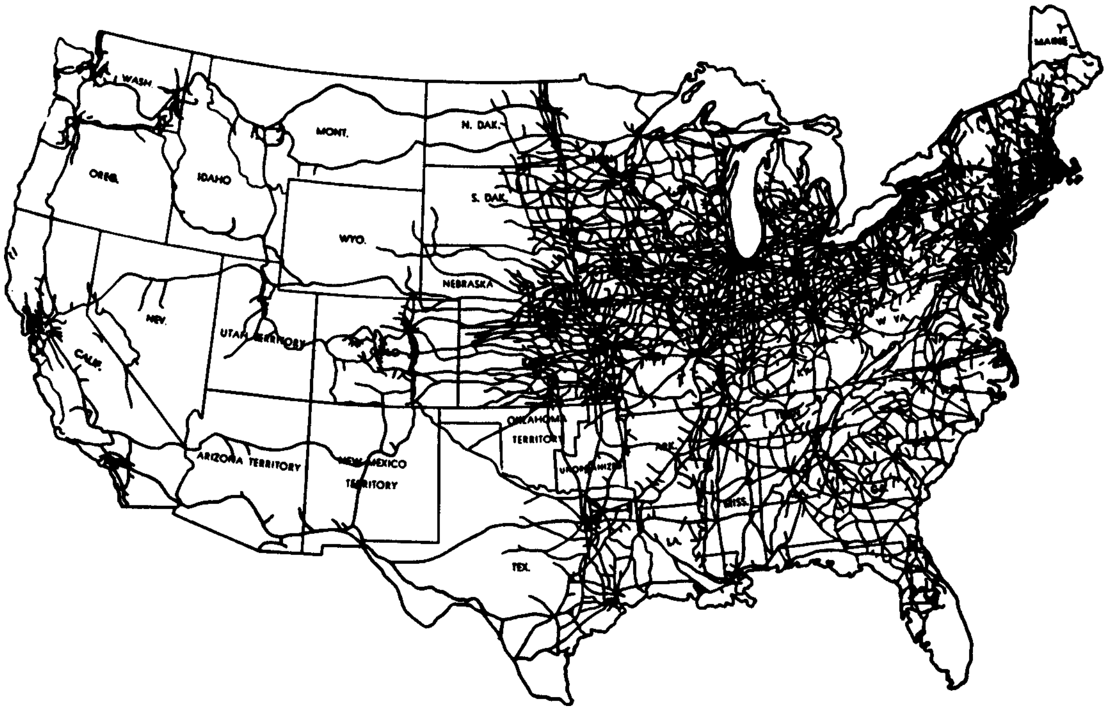
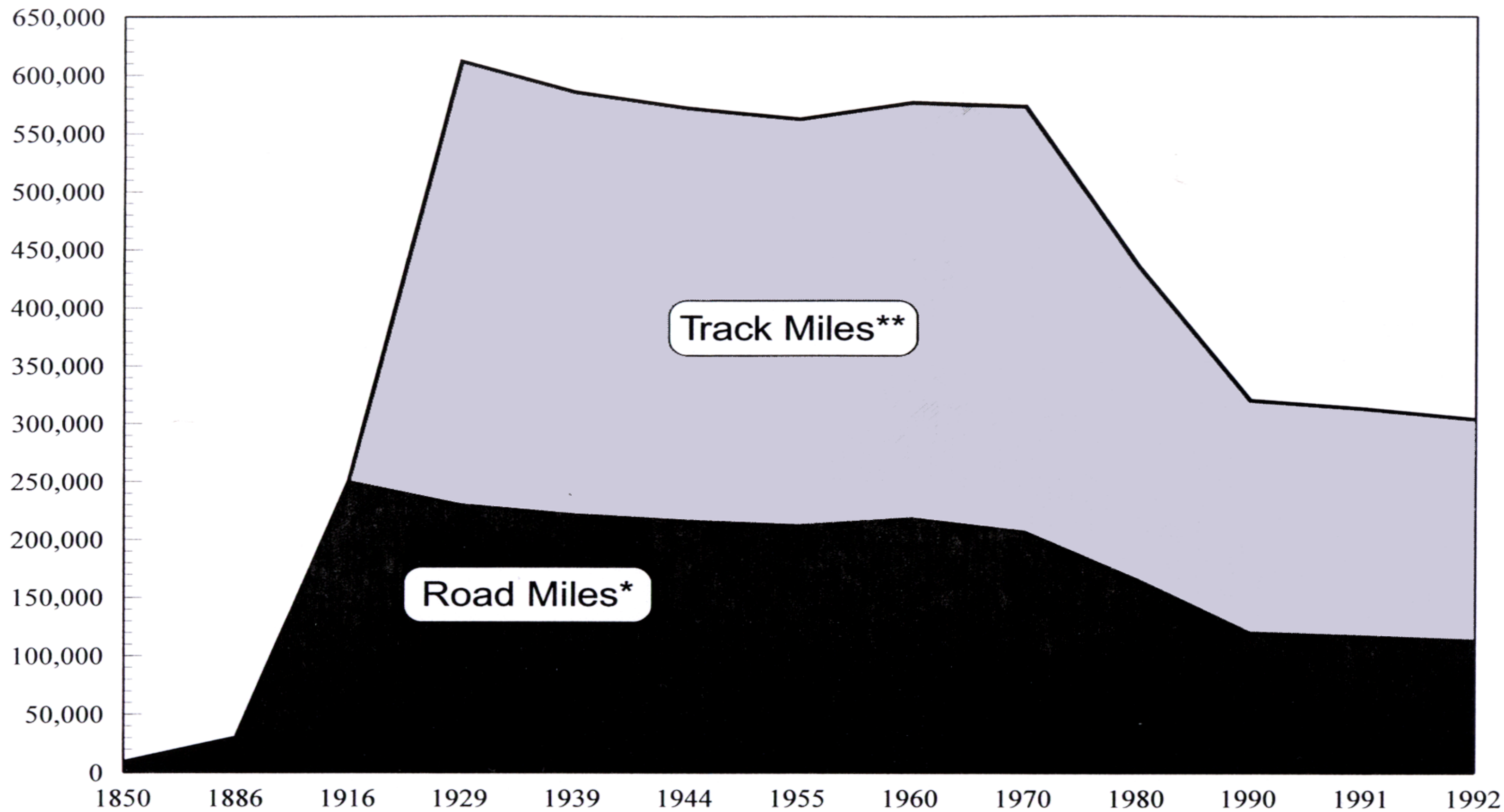


Figure A.4. U.S. Railway System, 1890

SOURCE: American Association of Railroads Library. Information & Public Affairs Department, Washington, DC.

Three classes of railroads exist in the United States today: Class I, Class II (Regionals), and Class III (Locals). The most common criterion to classify railroads has been operating revenue. According to the Interstate Commerce Commission’s definitions, Class I railroads are those which have annual operating revenues in excess of $251.4 million, Class II railroads (Regionals) are those with operating revenues between $20.1 to 251.3 million, and Class III (Locals or Short lines) are those with less than $20 million (AAR 1993).

Each railroad class is important in the movement of agricultural products, but their roles have changed. Class I railroads provided almost all rail service until the specialization of carriers developed more recently. Class I railroads receive traffic from branch lines and short-line railroads and primarily



* Road miles represent the aggregate length of roadway excluding yard tracks, sidings, and parallel lines.
** Track miles include multiple main tracks, yard tracks, and sidings.

Figure A.5. Miles of Road and Track, Various Years

SOURCE: Allen, G. Freeman. *Railways: Past, Present & Future*. New York: William Morrow and Company, Inc., 1982; and Association of American Railroads. *Rail Facts: 1993 Edition.* Washington, D.C., 1993.

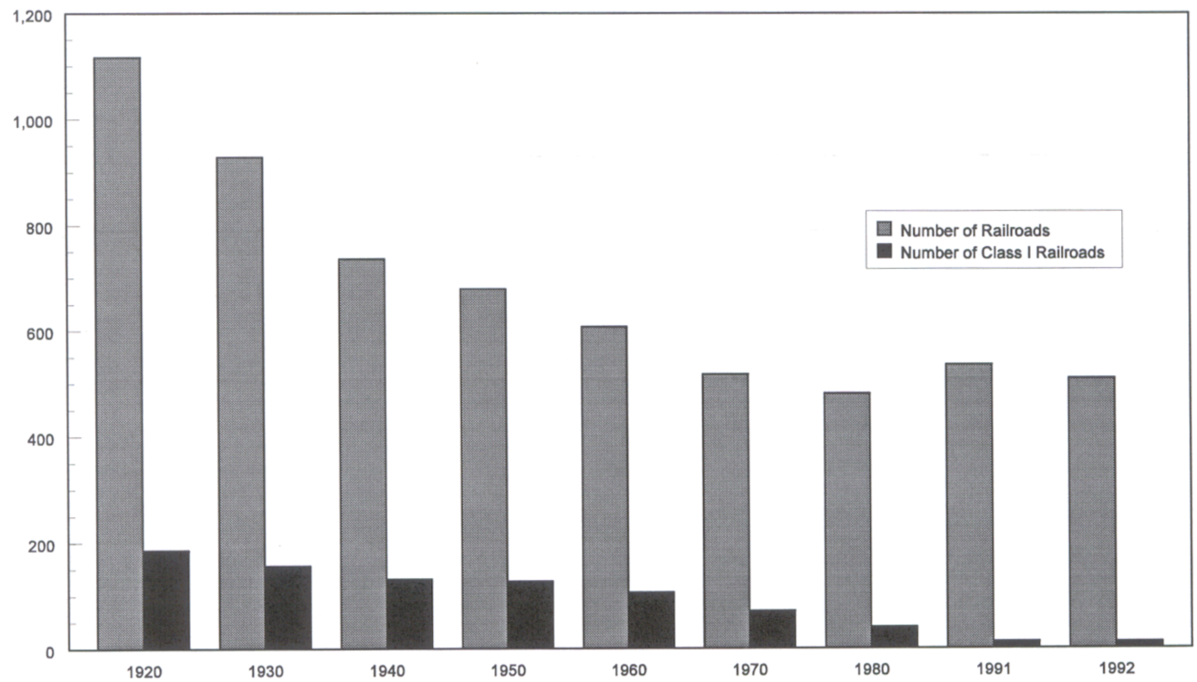


Figure A.6. Historical Number of Railroads for Various Years

SOURCE: Association of American Railroads. *Rail Facts: 1993 Edition.* Economics and Finance Department, Washington, D.C., 1993.

move long-haul shipments on the main lines and serve both domestic and export markets. Each Class I carrier serves a large region of the United States. Some of these regions are served by more than one Class I carrier, which results in competitive pressures among the railroads. The regional and local railroads tend to serve more localized markets on the branch lines throughout the United States and act as feeders of freight to the main lines for longer hauls.

The number of Class I railroads appears to be stabilizing at 12 with 33 regionals and 464 locals in 1992. One main reason for the stabilization in number of railroads is the spin-offs of locals or short line railroads. Short lines is another term for locals, and sometimes regionals are also referred to as short lines. Short lines develop when larger railroads sell off portions of their rail lines to smaller companies.

The main reasons for short-line spin-offs are economic. Branch lines with decreasing or low traffic levels can be costly operations for Class I carriers. Necessary capital expenditures may be too high, and some railroads may have to defer maintenance on certain lines. Deferred maintenance can make the lines hazardous to operate, which would result in lower travel speeds and lighter carloads (Zink 1984). The revenue received from these lines may not even cover the variable costs of operation. For these reasons the Staggers Rail Act[8] of 1980 allowed railroads to eliminate portions of their system that created an economic burden for the railroad (Zink 1984). This ruling allowed many railroads to abandon unprofitable segments of their rail line. The spin-off to short lines has effectively been an alternative to rail line abandonment.

Much of the success of short line railroads is attributed to their ability to tailor services and rates to the needs of local shippers. Because of this tailored service, short lines can compete for local traffic more effectively than large carriers which manage thousands of miles of track (U.S. DOT 1989). In addition, small railroads tend to have a more flexible cost structure than larger railroads. The viability of short lines stems from three sources of cost savings for the short line: non-unionized labor, equipment, and maintenance of way (MOW). Labor costs are favorable for short lines because of more flexible work rules, smaller crews, and lower wages and benefits. Although some do, short lines are not required to grant union status to their employees.

Non-unionized short lines experience fewer complications than union railroads encounter, which helps increase their cost efficiency. Both union and non-union railroads must comply with certain Federal Railway Association (FRA) regulations such as hours of service. However, unionized railroads have additional restrictive work rules. Furthermore, national union wage levels vary insignificantly by geographic region. Aside from the complications of union negotiations, the distinction in wage levels

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[8]The Staggers Rail Act of 1980 is discussed in the regulatory section.

between union and non-union railroads clearly provides non-union short lines an added advantage. A non-union short line only needs to pay a wage that will attract qualified employees.

Equipment costs are also generally lower for short lines. Short lines tend to purchase “second hand” equipment from Class I carriers, which reduces their capital investment in equipment. Because short lines operate on a smaller scale, this used equipment is more cost effective in their operations. Furthermore, short lines can operate with smaller, less expensive locomotives than Class I carriers. The MOW costs for short lines are lower because they are able to maintain their track for the specific volume and nature of the local traffic flow rather than meeting the maintenance standards that are required for the Class I carrier. The MOW costs are an estimated 20 percent less for short line operators than for Class I railroads. The savings for short lines results from lower costs for tie installation and ballast costs because of lower labor costs (Dooley and Tolliver 1989).

Truck Transportation and Highway Development

In 1911 there were 2,000 farm trucks in the United States; the number increased to almost 1.5 million in 1945 (Schlebecker 1975). The trucking industry would not have changed grain marketing as significantly without the federal and state government’s road building projects (Schlebecker 1975). For example, between 1910 and 1945, hard-surfaced road in Washington increased from 91 to 4,200 miles (Casavant 1971). In the post World War II era, the National Highway System was conceptualized and initiated. From 1950 to 1968, federally aided highways increased from 641,000 miles to 911,000 (Schlebecker 1975).

The construction of a road system and ultimately the National Highway System allowed the trucking industry to become a full competitor to the rail and barge industries for grain movement. The higher speeds and controlled access of the National Interstate Highway system provided for faster and more efficient movement by truck than the older two-lane and local roads. A 400-mile trip to deliver a truck load of grain in one day is common, and the timely service helps to provide the transportation capacity and a competitive alternative for producers. Truck transportation is a competitive alternative to rail and barge for short distances, and it can act as a feeder to barge and rail loading facilities.

Transportation Modal Share

The transportation backbone of the United States covers many miles. There are 147,000 miles of rail that crisscross the country and provide services to nearly all its grain handling facilities. There are over 25,000 miles of waterways, of which many serve major wheat export locations. In addition, hundreds of thousands of roadway miles provide access to nearly every farm, grain elevator, and processor in the country.

In 1992, nearly 70 million tons or more than 2 billion bushels of wheat were moved in the United States (USDA 1994b). As wheat moves across the nation and the world, each mode of transportation plays a role. In 1992, railroads moved over 47 million tons of wheat, over two-thirds of the wheat moved in the United States. Barges transported 21.5 percent, and trucks hauled the remaining 8.5 percent (USDA 1994b).

Barge Transportation

Large-scale commercial barge shipment of wheat (and other commodities) has been achieved because of the development of commercial navigation via the construction of locks and dams on the nation’s major river systems. Little detailed or specific information exists on the early role of barges in wheat transportation, but recent historical data on modal share of barges in wheat shipment indicate a significant role. United States Department of Agriculture (USDA) data indicate barges shipped 19 percent of all U.S. wheat transported to both domestic and export markets in the late 1970s (Figure A.7; Norton, et al. 1992). Barge share of shipments increased in the early 1980s as total wheat shipments soared. By 1981, barges carried 25 percent of all wheat shipments, with some fluctuations and a slight downward trend in the latter 1980s and the early 1990s.

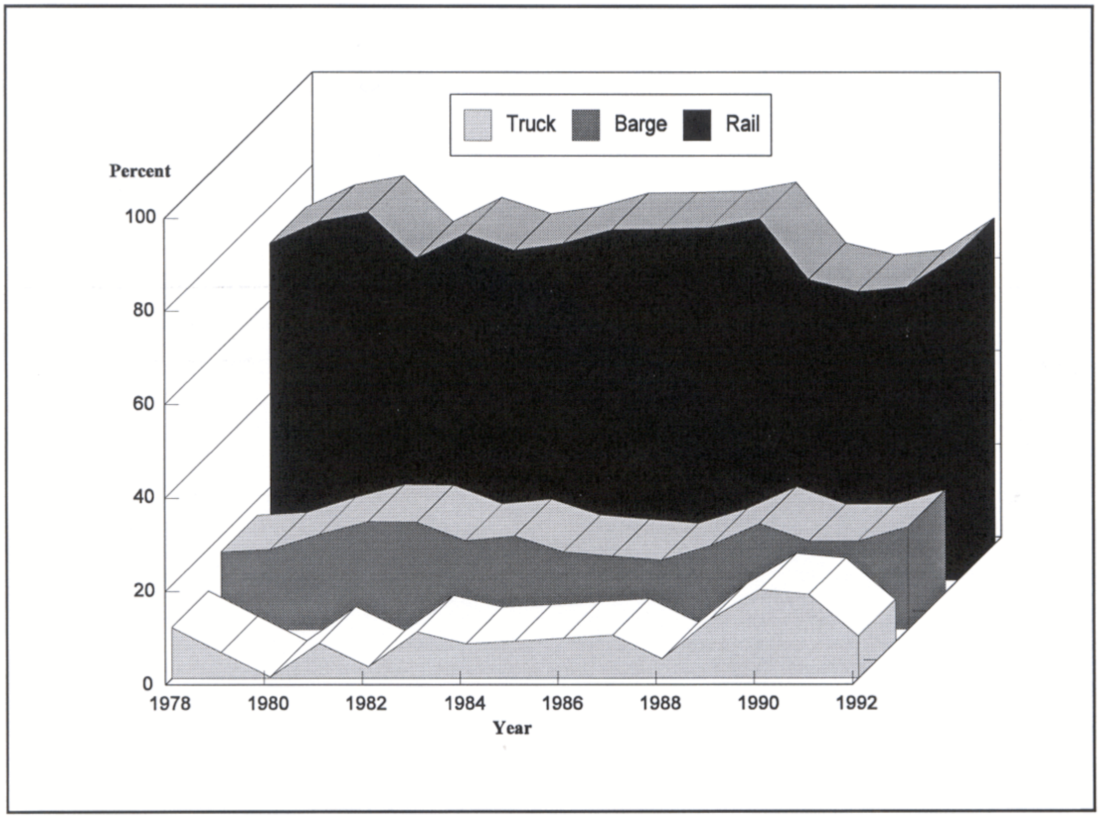

Figure A.7. Modal Share of Wheat Transport, United States 1978-1992

SOURCE: Norton, Jerry, Paul J. Bertels and Freeman Buxton. *Transportation of U.S. Grains: A Modal Share Analysis.* USDA, Transportation and Marketing Division, Washington, DC, 1992, and Data Update, 1994.

Rail Transportation

Railroads have been significant in wheat transportation. In the late 1970s, railroads hauled approximately 75 percent of all wheat in the United States and have maintained a large share throughout the 1980s (Figure A.7). The large rail modal share can be attributed to several factors such as the large number of rail line miles that cross the United States, which allows rail service from many origins (elevators) to many destinations (processors), and the cost efficiency of long-haul rail service.

Truck Transportation

Nationwide, trucks have accounted for a relatively small share of all wheat transported. Between 1978 and 1989, trucks moved less than 10 percent of the wheat (Figure A.7). Updated data showed the truck share increased to 18 and 19 percent in 1990 and 1991, but dropped to 9 percent in 1992 (USDA 1994b). Truck shares are not based on actual survey data, but are estimated as total wheat shipments minus barge and rail shipments. While the data on truck grain share are not as reliable as those for rail and barge, it is safe to say that trucks play a minor role in long-haul wheat movements. Their limited role is due mainly to their higher costs, which is covered in more detail in the *Pricing of Transportation Services* chapter.

Farm trucks are used to haul grain from the field to storage facilities, either on the farm or in commercial elevators. After the grain arrives at the elevator, commercial trucks are one option available for the grain to move further in the marketing chain. Little nationwide data exists on the historical share of wheat transported by trucks to processing or storage facilities. However, some localized data do exist. In the hard red spring wheat producing state of North Dakota, trucks accounted for less than 10 percent of grain transported to markets in the mid- 1950s. However, wheat movements by truck increased to 20 percent in the mid-1960s, and by 1978-79, trucks had about 40 percent of all grain shipments. Truck modal share grew rapidly during that period because of the differences in rate structure between rail and truck caused by government rail rate regulation and modal cost differences. Before 1980, rail rates were often rigid while truck rates were more flexible. Thus, motor carriers became a strong competitor with rail for the movement of agricultural commodities. The truck modal share began to decline after 1980 following implementation of the Staggers Rail Act, as shown in Figure A.8 for North Dakota. Wheat movement by truck in North Dakota has continued to decrease to about 12 percent in 1993 (Figure A.8).

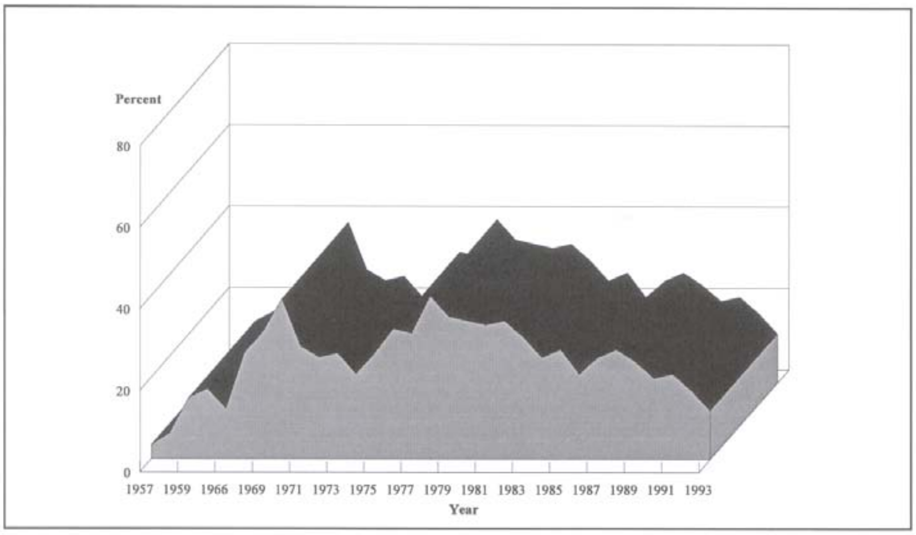

Figure A.8. Truck Share of Wheat Transport, North Dakota 1957-1993

SOURCE: Upper Great Plains Transportation Institute, North Dakota Grain and Oilseed Transportation Statistics. North Dakota State University, Fargo, various years.

Transportation Regulatory Changes

Government policy during the early economic history of the United States was centered on encouraging free trade within the country (Binkley et al. 1981). Many countries in Europe had set up trade barriers which were detrimental to their economic development. The United States wanted to avoid those problems by adopting efficient transportation policies. Therefore, during the time the Northwest Territory was being settled a significant policy arose, a policy of promoting trade and economic development and, in fact, making the waterways (the existing form of transportation) “forever free.” The policy was the ordinance of 1787, which stated:

> ...The navigable waters of the Mississippi and the carrying places in between the same shall be the common highways, and forever free, as well as to the inhabitant of the said territory, as to the citizens of the United States (Binkley et al. 1981).

The "forever free" waterways was a controversial policy because, over the years, a large amount of public monies was spent on improving navigation within the United States. Various groups thought beneficiaries of the inland waterway improvements should pay for the costs (Binkley et al. 1981). User fees were implemented on water transportation in the latter part of the twentieth century.

Over the past 100 years, several major pieces of legislation have reformed the regulatory framework of the transportation industry. A once highly regulated industry, transportation has shifted toward less "government intervention" and more "market driven prices." Rail, truck, and barge industries have all experienced regulatory reform. To an identifiable extent, the movement of wheat has been impacted by all these regulatory policies.

Waterway Regulations

Dry-bulk commodities have generally been exempt from waterway regulations. The only regulation that impacted wheat before the 1970s was Part III of the Interstate Commerce Act of 1940, which specified that only three or fewer exempt dry-bulk commodities could be carried in one tow. The United States has always been a major exporter of wheat, so this regulation was not a difficult obstacle.

The first waterway regulation with significant impacts on wheat was the Inland Waterways Revenue Act of 1978. The act imposed an initial excise tax on fuel of 4 cents per gallon in 1980. By 1985, the maximum level of 10 cents per gallon was reached. An estimated 10 to 20 percent of operating and routine maintenance costs for the water system would be recovered through the tax (Martin and Casavant 1979). The Water Resources Development Act of 1986 further increased the waterway fuel taxes. The rate is scheduled to increase to 20 cents per gallon by 1995 (Tolliver and Zink 1991).

Additional fuel tax increases were proposed by the Clinton Administration for deficit reduction. The current 19 cents per gallon fuel tax was proposed to increase to $1.19 per gallon, which is about a six fold increase. This could have been detrimental to the waterway industry, which is already operating at very slim margins (American Waterways Operators 1993). Although this fuel tax was not implemented, it does not eliminate it from future policy discussions.

Railroad Regulatory Acts

The first regulatory act impacting the railroad industry was the Interstate Commerce Act of 1887 to combat rate wars that were transpiring among railroads and to eliminate perceived unfair pricing and service policies that were resulting from locational monopoly power. The Interstate Commerce Commission (ICC) was established as the regulatory environment of the railroad industry. The ICC's tasks were to govern the rates so they would remain "just and reasonable" and to ensure shippers were not discriminated against.

In the early stages, this policy worked well. However, as highways and inland waterways emerged, the railroads lost their virtual monopoly. In addition, during World War I, the government took over the railroads. After the war, a new policy was needed to return the railroads to private ownership. Essentially, the Transportation Act of 1920 returned the railroad industry to private ownership and broadened the ICC's powers to set minimum rates and to control entry and exit from rail routes. This was accompanied by increasing competition from the relatively unregulated highway and waterway systems.

During the 1970s, two regulatory acts that impacted the rail industry were enacted. First, the Regional Rail Reorganization Act of 1973 (3R Act) established the U.S. Railway Association (USRA; Keeler 1983). The rail industry was experiencing financial difficulty, particularly in the northeastern United States. The USRA planned the reorganization and transition to public ownership of the troubled railroads in northeastern United States. In addition, the USRA had to determine what parts of the northeastern rail system were worth keeping. The agency recommended the amount of federal grants and loans the railroads needed to operate the system in the near future and recommended how to rebuild and revitalize the industry to make it self-sustaining. The USRA also set up a program for subsidizing low-density and unprofitable rail service.

More regulation followed in 1976 when the Railroad Revitalization and Regulatory Reform Act (4R Act) was enacted to rescue many railroads that were going bankrupt. However, bankruptcy was not the only problem railroads faced at this time. The years of declining profits had resulted in deferred maintenance of rights-of-way and plant and equipment deterioration (U.S. GAO 1990). Safety and service deteriorated as a result of prolonged deferrals in maintaining the rail system and replacing capital investment. By 1976, Class I railroads had accumulated over $4 billion in deferred maintenance and delayed capital expenditures. The industry would have accumulated an estimated capital shortfall between $13 and $16 billion by 1985 if their poor financial performance continued (U.S. GAO 1990). The 4R Act had two aims: to provide government subsidies and to implement reforming regulation.

The regulatory reform gave railroads more commercial freedom in setting rates, abandonments, and mergers (Keeler 1983). Four aspects concerning rates would impact rail shippers. They were 1) no rate above variable costs would be considered unreasonable unless it could be proven otherwise, 2) regulations were eliminated where railroads had no monopoly power, 3) any railroad firm not earning a compensatory return on investment should be allowed to increase rates, and 4) wherever there was not market dominance for the firm, they were free to increase or decrease rates within a 7 percent “zone of reasonableness” without regulatory approval.

“The ICC emasculated the provision giving railroads 7 percent flexibility in rates for traffic in which railroads had no market dominance, arguing that practically anywhere the industry has the discretionary power to raise rates in this way it has such dominance.” (Keeler 1983)

Further regulatory reform shortened the time the ICC must deal with applications for mergers and also the time they could deliberate if an abandonment could take place. The ICC had decided that no railroad can be forced to provide service where it loses money.

Second, subsidy programs were a large portion of the 4R Act. Five million dollars was to be used to subsidize money-losing branch lines over a four-year period: $600 million was to be used to rehabilitate main lines for financially weak railroads; $1 billion was offered as guaranteed loans for the same purpose; $1.75 billion was given to upgrade Amtrak's Boston-Washington route; and $2.1 billion was given to Conrail for use during 1976 to 1980 (Keeler 1983).

In addition, those who were setting the regulations and authorizing the subsidies had to improve information about needs of the industry and about the effectiveness of the policies. This requirement was the impetus for the ICC's developing a new costing methodology which gives a clearer idea how costs varied with output so the industries' cost of capital could be measured more accurately. The railroads and those who were responsible for the policy of the 4R Act were not satisfied with the effects and outcome of the act. This was one reason for implementing the Staggers Act of 1980.

The Staggers Act of 1980 was one of the most significant pieces of legislation in rail history (Keeler 1983). The act substantially reduced economic regulation in the rail industry, impacting the rail industry and the agricultural industry. The purpose of the act was to give the railroads a means to recoup inflationary cost increases quickly and to increase railroad revenues, while protecting captive traffic (Griffin 1983). These objectives influenced the rate structure and services of the railroad industry.

Three types of rates were defined in the Staggers Act: rates that are exempt from ICC regulations where the railroad does not have market dominance; those that are subject to ICC regulations because market dominance exists; and contract rates (Griffin 1983). Market dominance was to be determined case by case in each instance where a railroad was challenged by a shipper or the ICC. The Staggers Act brought about a great deal of rate flexibility, particularly through the encouraged use of the contract rates.

Before 1980, rates were collectively developed between railroads at bureau meetings and approved by the ICC. Rates were often based on what traffic would bear; in markets where more competition existed, rates would be lower. Under the Staggers Act, few grain movements were assumed to exist where railroads had a monopoly because long-distance truck competition existed virtually everywhere. Staggers actually gave railroads more flexibility to lower or raise rates to be more market based.

The Staggers Act required railroads to give shippers 20 days notice, which is down from the 30 days notice before Staggers, of rate increases and one days notice of any rate decrease that would occur. Rate increases or decreases could result in losses or gains to grain merchandisers. For example, if rates increase and a merchandiser has already purchased wheat from a producer and hedged on a futures contract, the merchandiser would have no way of recovering the rate increase. On the other hand, if a rate decrease occurred, the merchandiser could experience a gain.

Other changes in pricing influenced railroads' profitability. The methods of pricing are covered more in depth in the Pricing of Transportation Services chapter. Efficiency oriented pricing, such as unit-train rates, allowed railroads to reduce rates on larger shipments of commodities because of the reduced per unit costs. Innovative pricing was also important to the railroad. Grain movement lost to trucks and or barges prompted railroads to use innovative pricing techniques and to offer "through rates" from points of origin to final destination.

Rail services differ for some shippers because of the Staggers Act. Some shippers may receive predictable service because of increased efficiency with the use of unit trains and contract rates. On the other hand, shipping points that are not accessible to these rates may suffer from reduced service. In addition, up to 40 percent of rail cars may be allocated for agricultural goods under contract service. During times of peak demand for transportation capacity, those who have a contract may receive more timely service than those who do not have a contract. Yet, those with contracts during periods of surplus cars may not be able to take advantage of reduced rates.

The Staggers Act is recognized as a major cause for improvements in equipment, safety, and services of the railroad industry. Rail facilities have improved as capital spending increased from about $950 million in 1980 to $3.5 billion in 1985 (U.S. GAO 1990).[9] Capital spending for these items has declined since 1985, but it still remains above spending levels of the 1970s (U.S. GAO 1990). Investment in track repair and equipment has improved the safety of the industry. Statistics indicated there was a 50 percent decline in the number of accidents caused by track defects between 1982 and 1987 (U.S. GAO 1990). Service improvements, attributable at least partially to capital investments and better utilization of equipment, are addressed further in the *Technology Changes* section of this chapter.

Another important note on the Staggers Act is the decrease in rail rates, particularly for farm products. Farm products have benefited more than other goods moved by rail. Rates for all farm products moved by rail decreased by 44 percent during 1980 through 1987 (Table A. 1). A study conducted by the Association of American Railroads indicated that five years after Staggers, real grain rates had declined on average by 26 percent (AAR 1986).

The percentage change in rates may vary by regional location. For example, in 1980, a 52-car shipment of wheat from Minot, North Dakota, to Portland, Oregon, cost $2.50 per cwt or $1.50 per bushel, but in 1993, this same shipment cost $1.74 per cwt or $1.04 per bushel. This represents a nominal decrease of 30 percent and a 46 percent decrease in real terms.

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[9]These figures are not completely comparable because in 1983 ICC adopted depreciation accounting for track and structures.

TABLE A.1 Average Real Rail Rate Percent Changes

Category	1978-80	1980-87	1978-87
Farm Products	14.23	-44.01	-36.05
Coal	9.36	-10.19	-1.78
Chemicals	4.49	-20.06	-16.47

ADAPTED FROM: United States General Accounting Office Report to Congressional Requesters. *Railroad Regulation: Economic and Financial Impacts of the Staggers Rail Act of 1980.* 1990.

Competition has been a factor in the decrease in rail rates. Not only do railroads compete with trucking and barge companies, they also compete against one another for traffic. The Staggers Act eliminated rate bureaus and, thus, the setting of rates in cooperative form. Competition among railroads is a key determinant of rail rates for wheat shipments that have several rail alternatives. Rail rates for wheat can be closely approximated by the spread between prices paid for wheat at grain elevators in the Plains States and delivered prices at export points such as Portland and Houston (U.S. GAO 1990). Although overall real rates have decreased since Staggers, the wheat spreads between the Northern Plains and South Central Plains differ. The Northern Plains have fewer competing railroads than in areas like the South Central Plains where more railroads offer services. Thus, differences in the spreads occur because of availability of competition among railroads (U.S. GAO 1990; Figure A.9).

Further impacts of Staggers were increased rail line abandonments. Since 1981, approximately 38,000 miles of rail line have been granted abandonment approval (Bureau of Transportation Statistics 1993; Figure A.10). Before a rail line can be abandoned, the railroad must prove that it is an unprofitable line. Some of the unprofitable abandoned lines have been in rural areas.

Rural abandonments leave grain elevators located along the line without rail service and forces them to truck the grain on the roadway system. Nearly four large semi truckloads are needed to haul the equivalent of one rail car of grain (Iowa Department of Transportation 1993). For landlocked regions of the country, this adds costs because of extra loading and unloading costs, even if the commodity can be hauled a short distance to a rail loading facility (Bitzan and Tolliver 1993). A secondary impact is the additional wear and tear of the roadway infrastructure caused by increased truck traffic. These rural roads were not designed for the density and truck configuration of this traffic.

Trucking Regulations

Three basic categories of regulations impact the trucking industry: 1) vehicle size and weight, which is intended to protect the infrastructure; 2) economic, which relates to control of rates, service, and entry or exit; and 3) safety of vehicles and drivers, which protects users (Ming and Griffin 1985). The vehicle size and weight regulations impact the wheat industry the most.

The first regulations of the trucking industry dates back to 1913. Truck weight limits were implemented in Maine, Massachusetts, Pennsylvania, and Washington to protect highway pavements and bridges. Gross vehicle weight (GVW) limits ranged between 18,000 and 28,000 pounds. All states had adopted a truck weight limit of some kind by 1933 (Transportation Research Board 1990). Axle weight limits varied from 16,000 to 24,640 pounds, while GVW limits ranged between 16,000 to 48,000 pounds. Although GVW limits varied, most states held axle and wheel limits fairly constant. As late as 1974, 18,000 pounds was the maximum axle weight allowed on interstate highways (Transportation Research Board 1990). However, in 1974, several states increased their single axle vehicle weight to 20,000 pounds, for tandem axles to 34,000 pounds and their GVW to 80,000 pounds. Some states chose not to increase their limits to these levels; but in 1982, Congress required all states to meet these maximum weight limits.

Farmers are greatly impacted by these weight limits. The capacity of farm trucks has increased with the increase of highway weight limits so farmers could haul larger quantities of grain on the same truck. However, current load limits of 80,000 pounds GVW have limited further increases in equipment utilization. There are trade-offs between increased efficiencies due to larger loads and additional costs due to increased damage to the highway structure. In some states, most notably Western states, heavier weight limits have been grandfathered in but require special configuration of the trucking equipment.

Economic regulation of the trucking industry arose with the passage of the Motor Carrier Act of 1935 (MCA), somewhat as a result of the railroads clamoring for equity. Under the act, unprocessed agricultural commodities, i.e., bulk wheat, were exempt from regulation (Harper 1982). Seasonality of the flow of agricultural commodity movements was one of the reasons for their exemption. Controlling entry into the trucking of agricultural commodities was expected to reduce flexibility and responsiveness of carriers to the changing agricultural movement needs (Harper 1982).

The transportation rates of unregulated unprocessed agricultural commodities were expected to be lower than the rates of regulated movements (Harper 1982). There was some disagreement over what constituted processed products, but bulk wheat movements were definitely exempt. Even as legislative action in the transportation industry continued, the impact on wheat was minimal due to the original and continuing exemption from regulation in the 1935 Act.

The Motor Carriers Act of 1980 (MCA of 1980) relaxed economic regulation within the motor carrier industry. Wheat transportation was impacted by the MCA of 1980 because the act allowed carriers of exempt commodities to carry non-exempt commodities for back haul. Agricultural carriers who could find a load for the back haul were able to cover their total costs more readily, and to spread those costs over both trip directions, which was evident in the rates. For example, grain moved by truck 500 miles one way may cost $2.16 per mile; however, if another commodity could be back hauled, the total cost could be reduced by about half (Tolliver and Bitzan 1994).

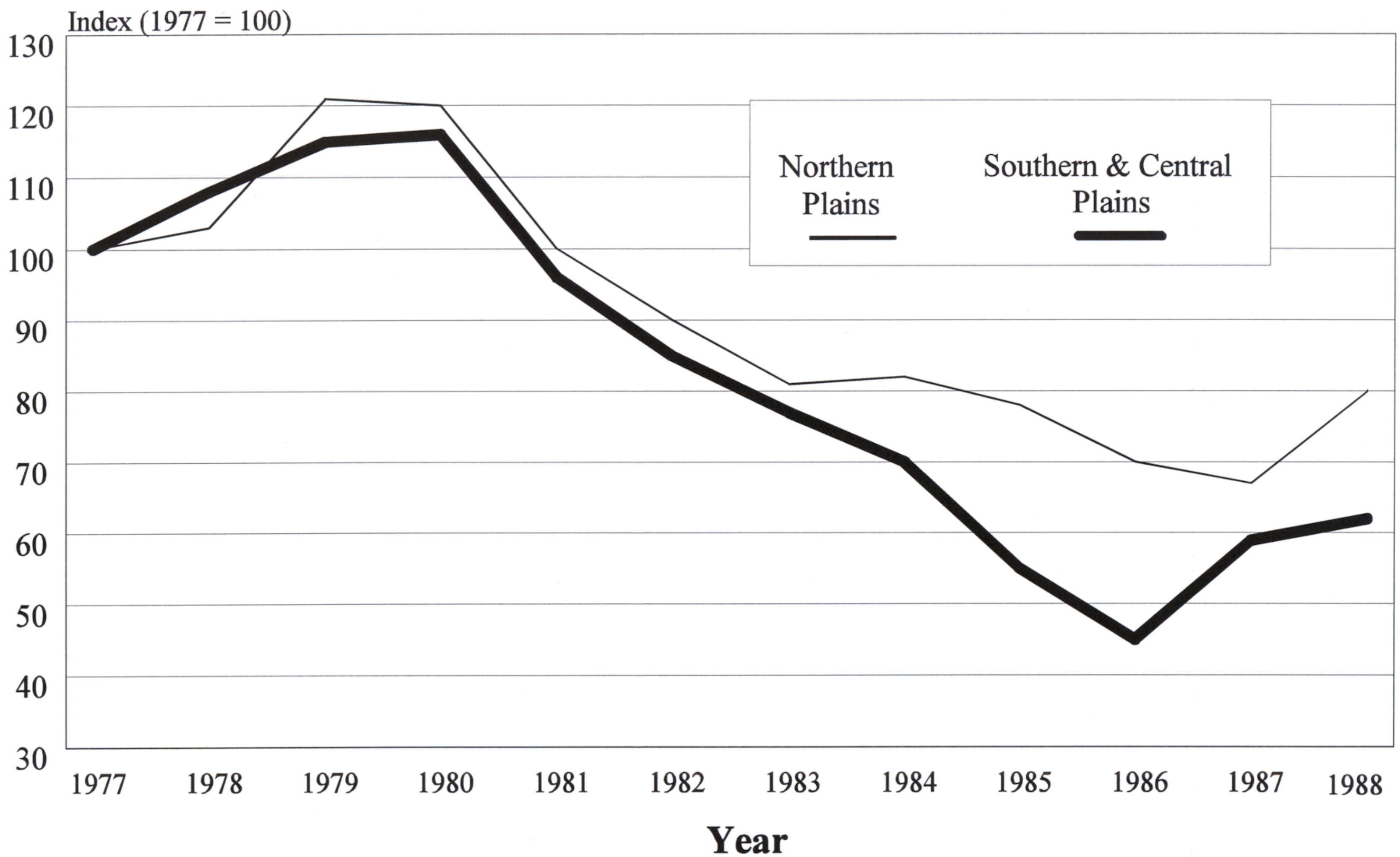

Figure A.9. Wheat Price Spread Index in Plains States

SOURCE: U.S. General Accounting Office. *Railroad Regulation: Economic and Financial Impacts of the Staggers Rail Act of 1980*. Washington, DC, 1990.

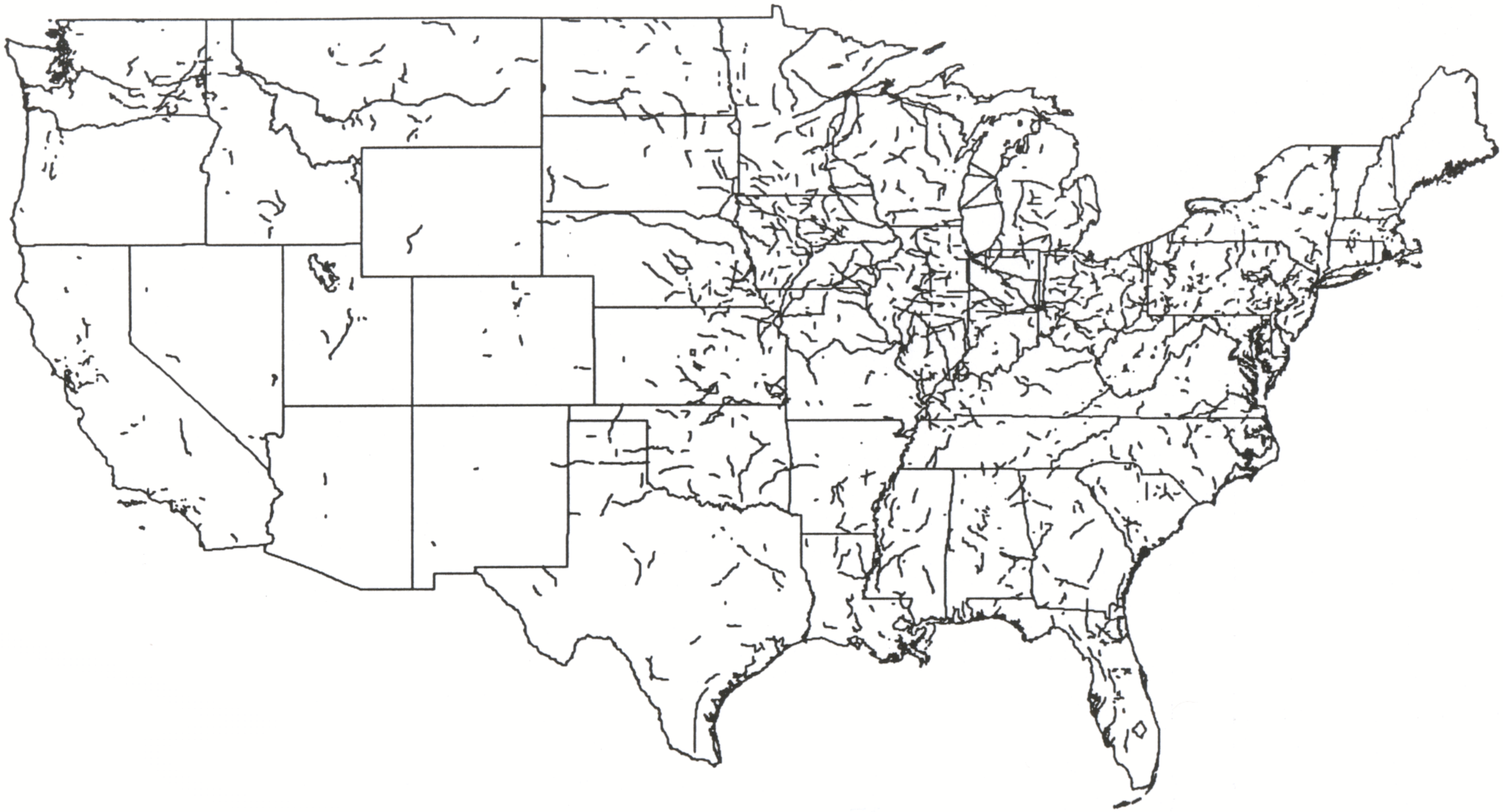

Figure A.10. U.S. Rail Lines Abandoned, 1981 to 1992

DEVELOPED FROM: Bureau of Transportation Statistics. *Transportation Data Sampler.* Publication BTS-CD-01. Washington, DC, 1993.

Technology Changes

Technology and innovation are at the root of nearly all change. Each mode of transportation has experienced equipment and management changes. In the next few pages, some of the technological creations in waterway, rail, and truck equipment are presented.

Waterway Equipment and Infrastructure

Locks and dams are important to the operations of the waterway system. The U.S. Army Corps of Engineers owned and/or operated over 270 lock chambers at 228 sites in 1993. One hundred sixtythree of these lock chambers are located along the Mississippi river system. Not all of the U.S. Army Corps of Engineers-owned locks are in service, mainly because they have exceeded their life expectancy. As of January 1994, 48 percent of all lock chambers exceeded their 50-year design lives (U.S. Army Corps of Engineers 1994a). Wheat grown in the Upper Midwest flows down the Upper and Lower Mississippi, particularly for export through the gulf. The locks permit vessels to move from one level of water to another between enclosed gates, which lower and raise the water. From a lower level, a ship or barge moves through an open gate into the lock. The gates are closed. Valves are opened and water flows into the chamber, lifting the ship. As soon as the vessel reaches the higher level the upper gates open and the tow moves out. The Corps of Engineers is responsible for operating and maintaining this navigation system and for planning and constructing new system elements (Tolliver and Zink 1991).

Covered hopper barges carry wheat through the waterway system. Construction of hopper barges was significant in the late 1970s and 1980s. In 1982, over 2,500 hopper barges were constructed (Figure A.11). In 1987 the barge fleet was over 11,000 covered hopper barges and over 6,000 open hopper barges in service (Figure A.12). The number of covered hopper barges declined slightly in 1993 to 10,538 while the number of open hopper barges increased to 8,135 (U.S. Army Corps of Engineers 1994a). The construction of barges is a function of the demand for barge service, i.e., wheat barge movements.

Sustained high demand for service frequently results in high barge rates. The additional demand and higher rates as well as tax incentives entices additional barge construction.

From 1975 to 1983, the number of covered barge operators increased as tax advantages for new equipment attracted many investors. This building boom created a surplus of barges in the industry. The grain embargo of 1980 and the oversupply of barges resulted in financially difficult times for the barge industry. By 1987, large barge lines had begun to acquire smaller lines, reducing the number of barge companies. In the 1980s approximately 1,800 barge and towing companies existed. The number of companies had declined to 600 by 1993 (American Waterways Operators 1994).

Horizontal integration (cross modal mergers) has been the result of some of the mergers. One example of horizontal integration is the merger of CSX railroad and ACBL barge company. ACBL and CSX have ranked among the top transportation companies within their respective mode over the past several years.

There are two potential implications of these mergers. On one hand, cost savings may result as integration may allow CSX and ACBL to streamline their operations and provide more seamless service. On the other hand, the increase in concentration of transportation modes could result in less competition and greater pricing advantage to transportation providers.

Another factor impacting the barge industry’s service to the wheat industry is weather. In 1988, the waterway system suffered from the drought conditions which plagued the Midwest. Much of the wheat which typically would have moved by water was diverted to other modes, mainly rail. Barge operators reported losses between $150 to $200 million because of the drought during the summer of 1988. On the other extreme, the barge industry suffered financial losses of between $150 to $200 million in 1993 because of flood conditions (American Waterways Operators 1993).

Railway Equipment and Supply

About 57,000 steam powered locomotives were in service in 1929. In 1934, America's first diesel-electric engine powered a passenger train. In the next 50 years, the diesel-electric engine slowly replaced the steam-powered engine. By 1992, about 18,000 diesel-electric locomotives had replaced all steam-powered locomotives (AAR 1993). Diesel electric locomotives have greater pull power capabilities than their steam-run predecessor. The increased power capabilities enable the locomotives to pull more rail cars without much additional cost, increasing the efficiency of each haul.

Railroads moved grain in standard boxcars for many years. Boxcars are a closed railcar with capabilities of hauling approximately 50 tons of grain, or about 1,700 bushels. Boxcars have a door on the side, which makes loading and unloading difficult. About 674,000 boxcars were in service in 1957, providing a carrying capacity of nearly 33 million tons. In the late 1960s to early 1970s, the more familiar hopper cars became more prominent among railroads and other private companies.

Hopper cars move grain more efficiently because of their larger size and better loading and unloading capabilities. Modern hopper cars carry 100 to 110 tons of grain, or more than 3,300 bushels, which is loaded through openings on the top of the car. They are usually unloaded by gravity through vents on the underside of the car. Hopper cars can be sealed tight, preventing leakage which occurred through the side doors of the traditional boxcars. Nearly all grain moved by rail is carried by hopper cars. Today, about 100,000 hopper cars are continuously in service to move grain (Sosland 1994).

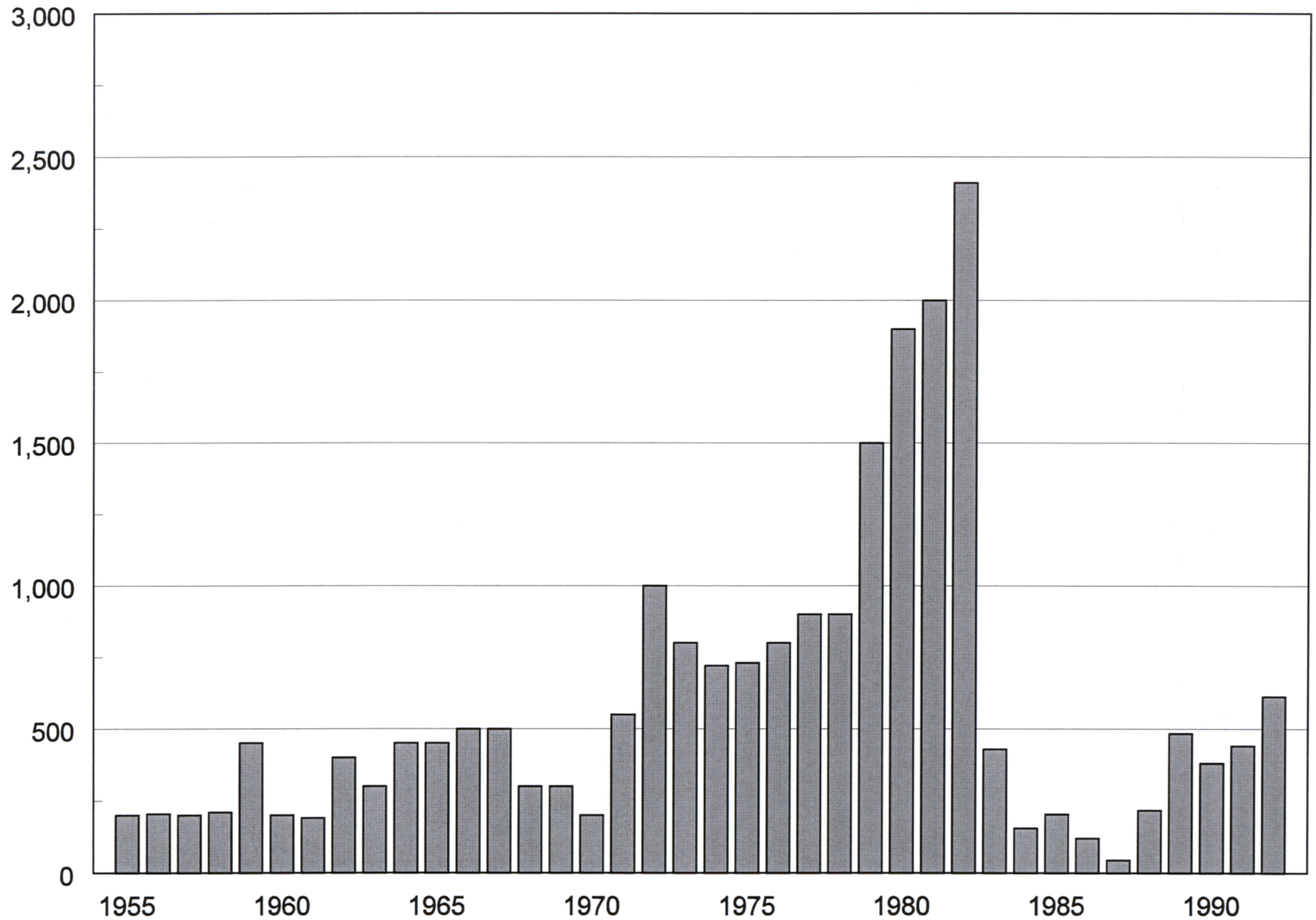

Figure A.11. Hopper Barge Construction, 1955-1992

SOURCES: Thomas Torretti. "What's Ahead for the U.S. Barge Industry." *Fertilizer Industry Roundtable Proceedings*, Washington, DC, 1988; and The American Waterways Operators, Arlington, VA.

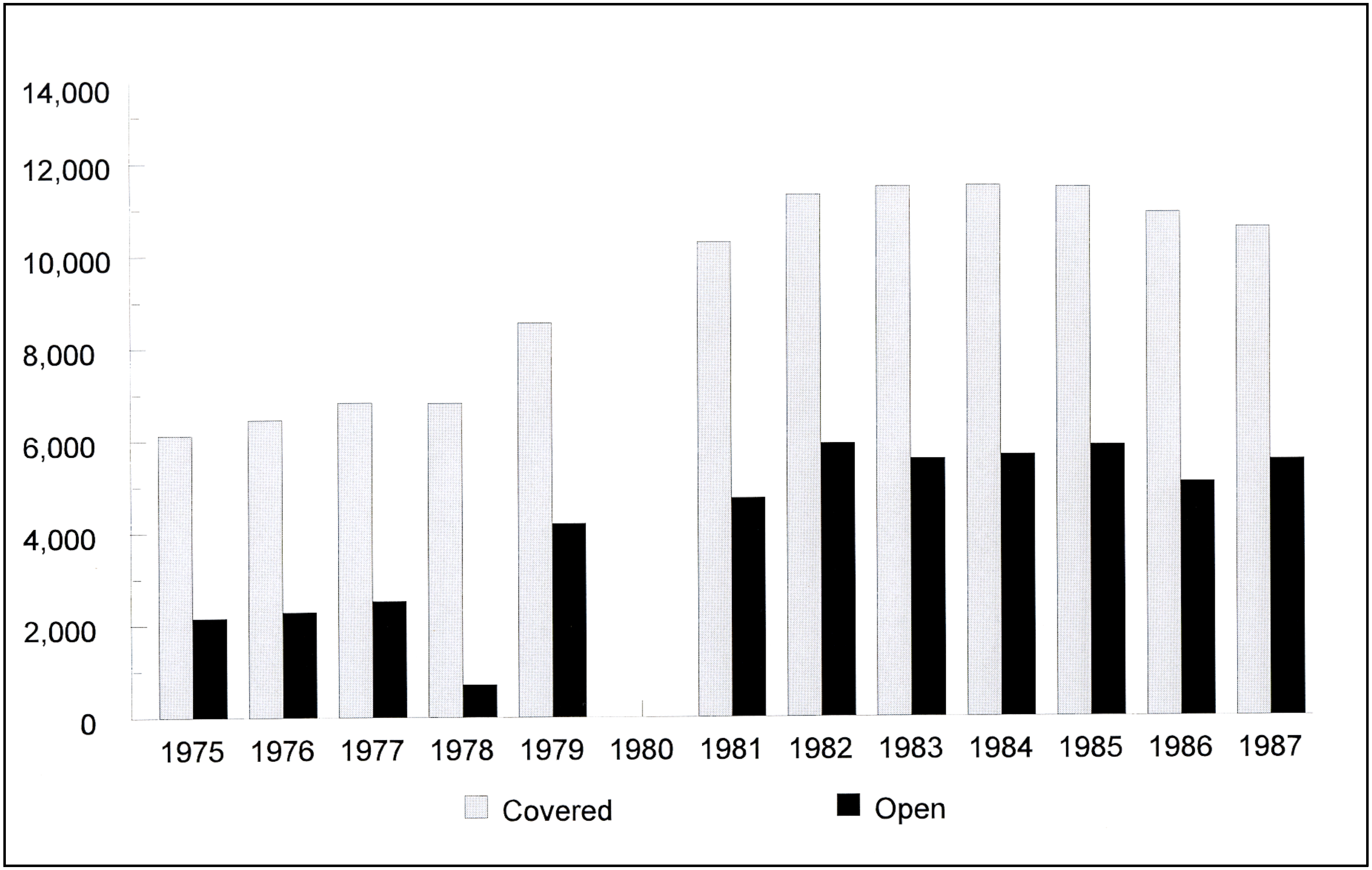

Figure A. 12. Number of Covered and Open Barges, 1975 to 1987*

* 1980 data were not available.

SOURCE: Thomas Torretti. "What's Ahead for the U.S. Barge Industry?" *Fertilizer Industry Roundtable Proceedings*, Washington, DC, 1988.

The increase in grain export demand in the 1970s was the impetus for an increase in grain car supplies (Figure A.13). In the 1970s, Burlington Northern alone added 10,000 cars per year, even after adjustments for wrecks and retirements were made. During the early 1980s, U.S. grain exports decreased, leading to a large surplus in grain cars. Only 360 additional cars were added per year during this time, resulting in an annual decline in the car fleet of 5,000 cars per year after adjustments for car retirements and wreckages were made (Baumel 1990). There appeared to be enough railcars to satisfy the consumptive demand. However, in the late 1980s, grain exports increased, with a corresponding increase in the demand for rail cars. This led to a decrease in rail car availability.

As a result of the new and sustained demand for rail cars, rail carriers have cautiously added new cars to the fleets. Class I carriers have purchased nearly 4,700 new standard hopper cars since 1990 (Sosland 1994). Several Class I carriers have indicated plans to continue purchasing rail cars in the future providing the higher level of demand is maintained.

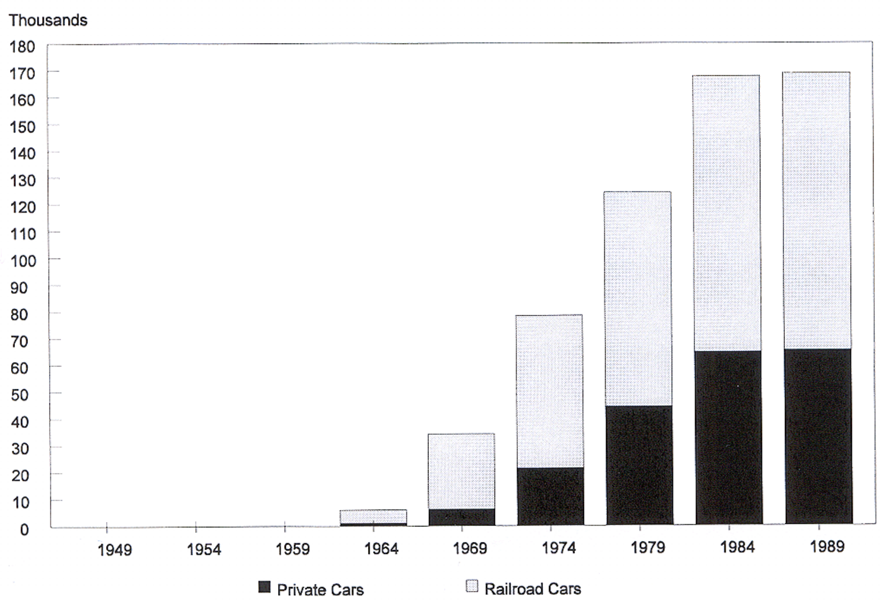

Figure A.13. Cumulative Total of Covered Hopper Cars Installed, 1949-1989

SOURCE: Norton, Jerry and Keith Klindworth. *Railcars for Grain: Future Need and Availability.* USDA, Office of Transportation, Washington, DC, 1989.

Grain hauling capacity of the railroad industry is directly related to the utilization of grain cars. The length of time (i.e., days or weeks) needed to make one car cycle consists of the loading time consumed by the origin elevator, loaded transit time, unloading time consumed by the destination elevator, and empty transit time. In 1981, Burlington Northern's average hopper car fleet cycle time was 13.9 trips per year. By 1991, their utilization rate increased to 20.6 trips per year. This exceeded the industry average, which is between 12 and 16 cycles per year (Baldaccini 1990). The improved utilization rate translates into improved efficiency and return on investment for Burlington Northern (BN) and improved service for the shippers as they receive cars in a more timely fashion. Burlington Northern has attributed better utilization of their cars to: unit trains, an efficient fleet of managed cars "on demand" branch line service, high priority for locomotive and crew allocation and customer incentive programs to reward efficient car loading and unloading (Baldaccini 1990).

Beginning in the late 1980s, increases in exports and the shrinking size of the car fleet led to shipper demands for more cars. Railroads have maintained that efficient use of the existing fleet was a more economical strategy than adding more cars due to the seasonality of grain shipments (Baldaccini). If enough cars were employed to meet peak demand, excess capacity costs would be realized in non-peak periods. This would drive overall rate of return on freight cars down (Bitzan and Tolliver 1993).

The number of rail cars a railroad has available for grain movement usually depends on forecast demand. Most grain car fleets consist of owned cars, long-term leased cars (over one year), and shortterm leased cars. The leased cars are obtained from various private and railroad sources. If an unforeseen market demand presents additional business opportunities, carriers obtain cars from other carriers on the open market. Some railroads have devised rail car auction methods (such as BN's Certificate of Transportation program) to equate the supply and demand of rail cars. This method is explained in the *Pricing of Transportation Services* chapter.

Truck Equipment

Changes in the trucking industry have improved the ability of hauling wheat. Early trucks hauled 70 to 80 bushels. Modern tandem axle trucks have a load haul capacity of about 600 bushels. There are also “pup trailers,” with a capacity of 450 to 600 bushels, which are pulled along behind the truck. Semi trucks are even used today, increasing wheat hauling capacity to about 800 to 1000 bushels.

The advent of hopper bottom truck trailers significantly increased the efficiency of unloading grain. Rather than hoisting the box, grain could be unloaded from beneath the trailer through the distribution shoot. Hopper bottom trailers first came on the market in the early 1970s. The standard sidewall trailer has a capacity of 1,200 bushels. Some hopper bottom trailers have a capacity of over 2,000 bushels, but these are typically not used for wheat because of the 80,000 pound load limit on the road system.

The shipment and equipment characteristics of the rail, truck, and barge modes are compared in Figure A. 14. One average barge capacity is equivalent to 15 jumbo hopper cars or 58 truck loads. In general, larger shipments are more cost efficient, because costs can be spread over more units. However, not every buyer has the inventory capacity to receive a barge or a unit train of wheat, so a truck load may be the only choice.

Production, Storage, and Market Cycles

The logistical system incorporates handling, storage, and transportation of grain. Our more efficient logistics combined with other technological advancements have significantly changed the agrarian way of life. Historically, agriculture was a way of life for many U.S. residents. Prior to, and during the early 1900s each farm worker supplied six individuals with food. The farm population peaked at 32 million in 1916 (Wimberly 1986) and declined to 4.8 million by 1989. Today, less than 2 percent of the 250 million U.S. residents live on farms, and each farm worker supplies food to about 80 people. The shift from subsistence agriculture to specialized production is tied to America's excess production and the ability to store, transport, and trade the commodities it grows.

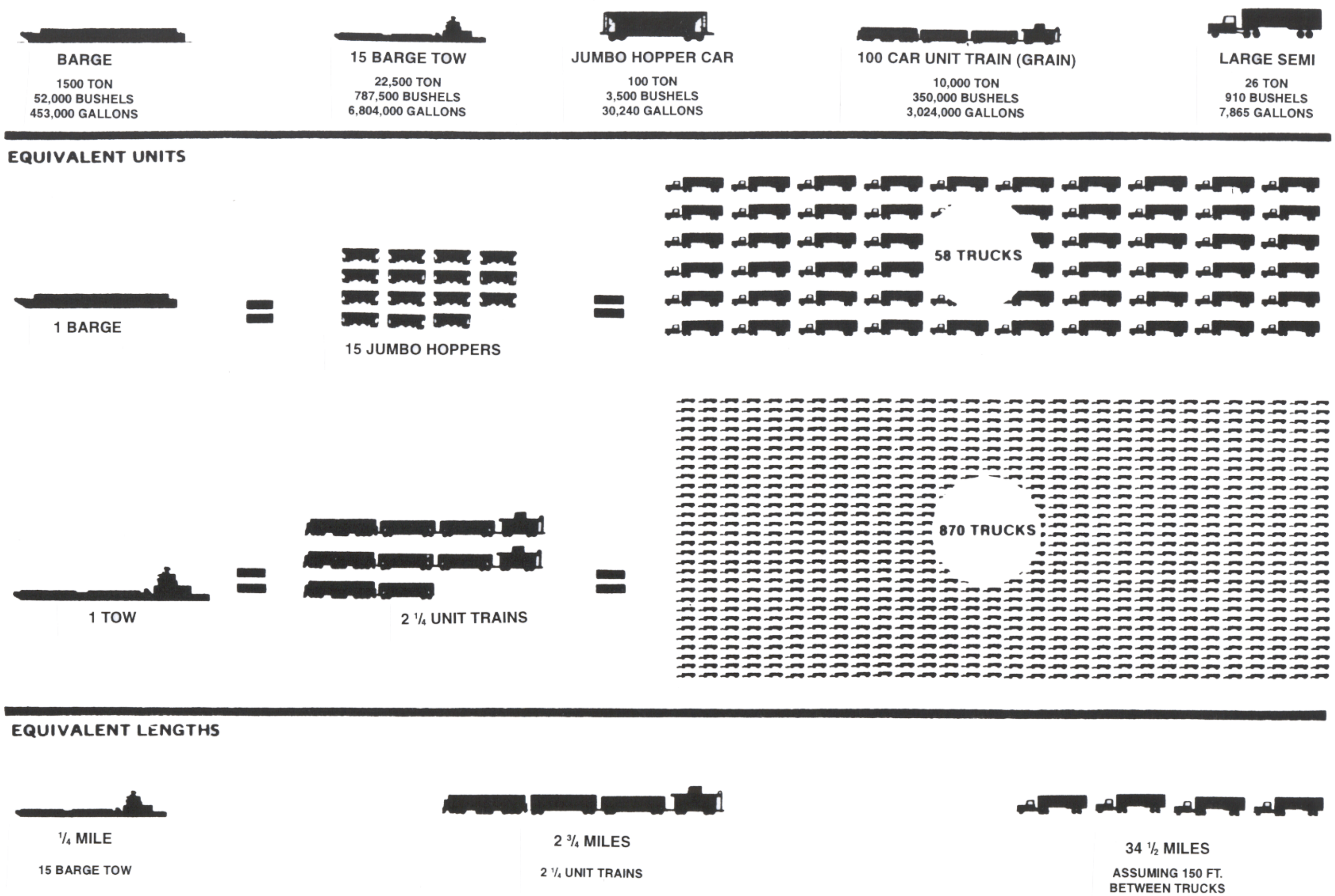

Figure A.14. Comparison between Mode Size

SOURCE: Iowa Department of Transportation, Planning and Research Division. Ames, Iowa, received 1993.

Production

Wheat production has increased from 250 million bushels in 1870 to 2.4 billion bushels in 1993 (Figure A. 15). New technology allowed additional acreage to be farmed. Yields increased, clue to scientific advances, from about 15 bushels per acre in 1950 to over 40 bushels per acre in 1993 (Figure A.16).

The United States grows six wheat classes: hard red spring, hard white, hard red winter, soft white and soft red winter, and durum. Each class grows best in a particular region of the United States. Hard red winter and hard red spring are grown primarily in the Great Plains region; soft red winter is grown in the Eastern region; hard and soft white are grown in the Western region (Figure A. 17).

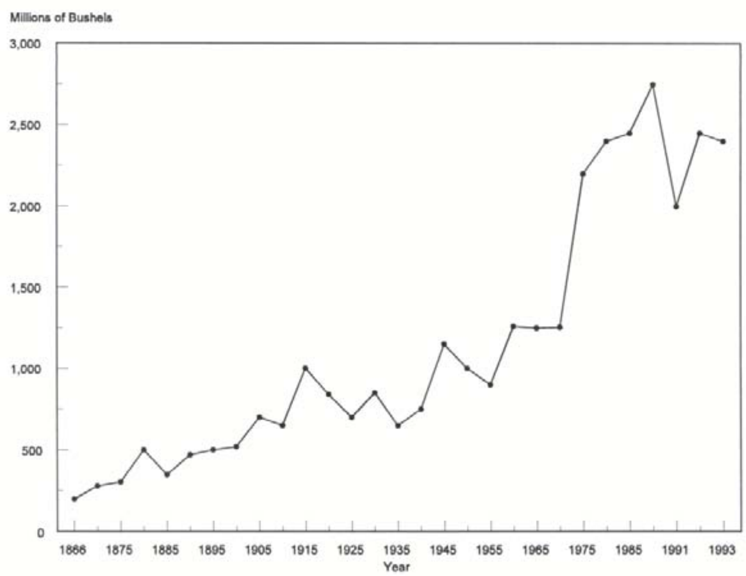

Figure A.15. U.S. Wheat Production, 1866 to 1993

SOURCE: U.S. Department of Agriculture. *Agricultural Statistics.* Washington, DC: United States Government Printing Office, Various Years.

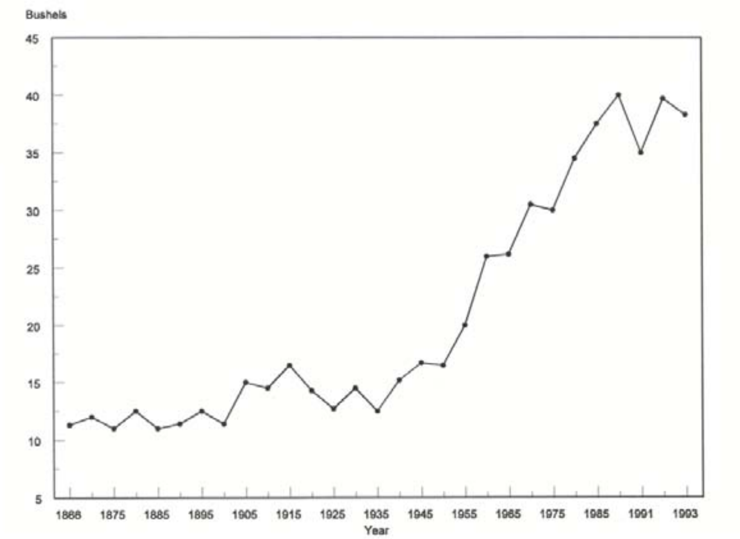

Figure A.16. U.S. Average Wheat Yield per Acre, 1866 to 1993

SOURCE: U.S. Department of Agriculture. *Agricultural Statistics.* Washington, DC: United States Government Printing Office, various years.

Each class has a particular use. Hard wheats are used to produce breads and rolls and. all-purpose flours. Soft wheats are used by bakers and canners in the production of sweet goods, crackers, prepared mixes, gravies, soup, thickened desserts, and flour-based sauces. Durum wheat is milled primarily for semolina pasta.

Although wheat is a staple grain in the diets of Americans, supply has historically exceeded demand, resulting in declining crop prices. After adjusting for inflation, the real price of wheat has been on a downward trend since the 1950s (Figure A.18). Decline in price has been partially offset by increased productivity due to technology changes.

Storage

Storage adds economic value to wheat and is an important component of the grain logistics system. Because of periodic large surpluses there is a need to store commodities throughout the year to meet demand. Storage is either on-farm or off-farm (commercial elevators) capacity. In 19713, the total grain storage capacity was over 13 billion bushels, and was equally split between on-farm and off-farm. The off-farm storage facilities include stocks at mills, elevators, warehouses, terminals, and processors. Storage facilities were located in about 30 of the 50 U.S. states.

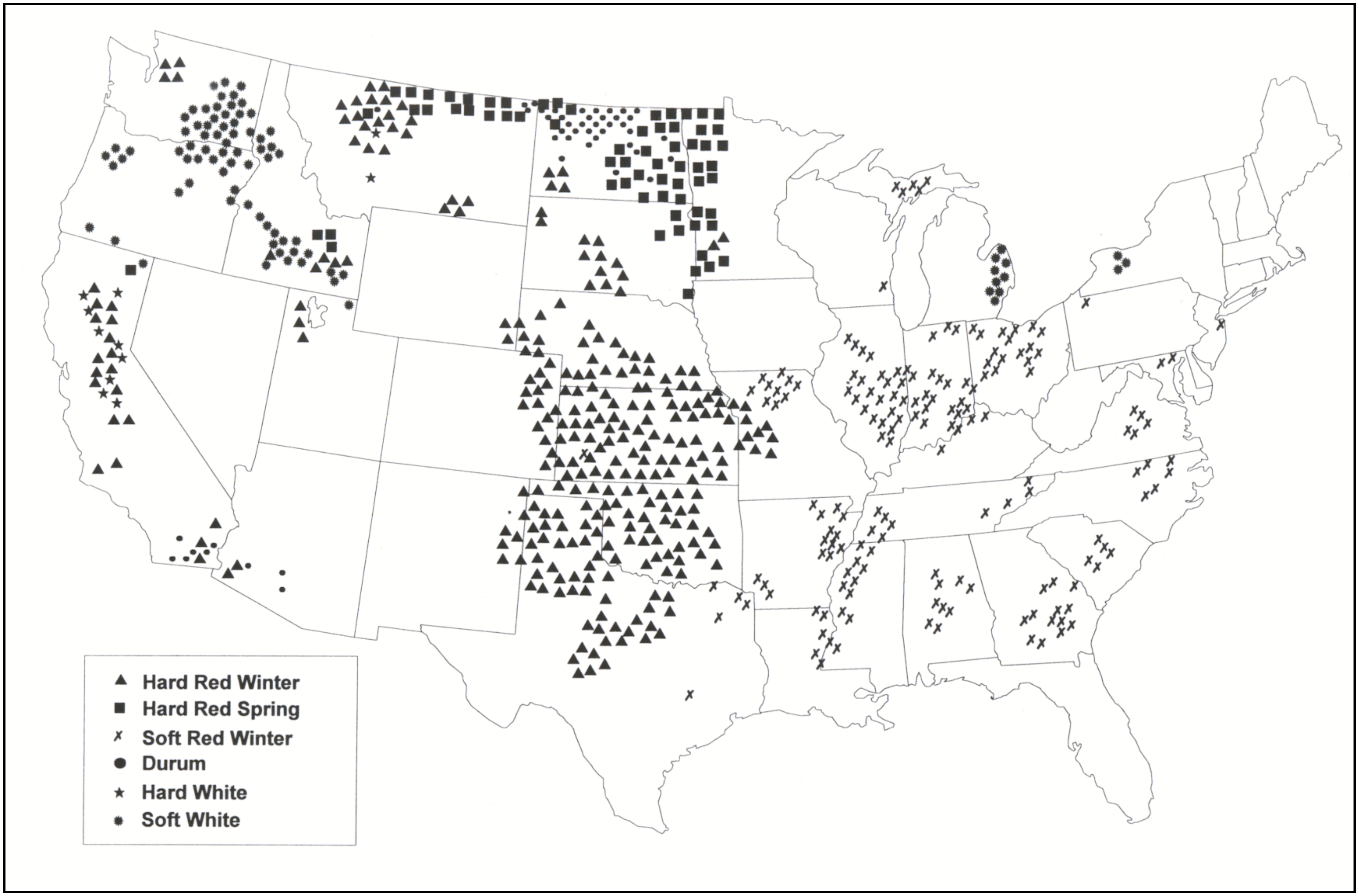

Figure A.17. U.S. Wheat Production Regions

SOURCE: U.S. Wheat Associates, Washington, DC, 1990.

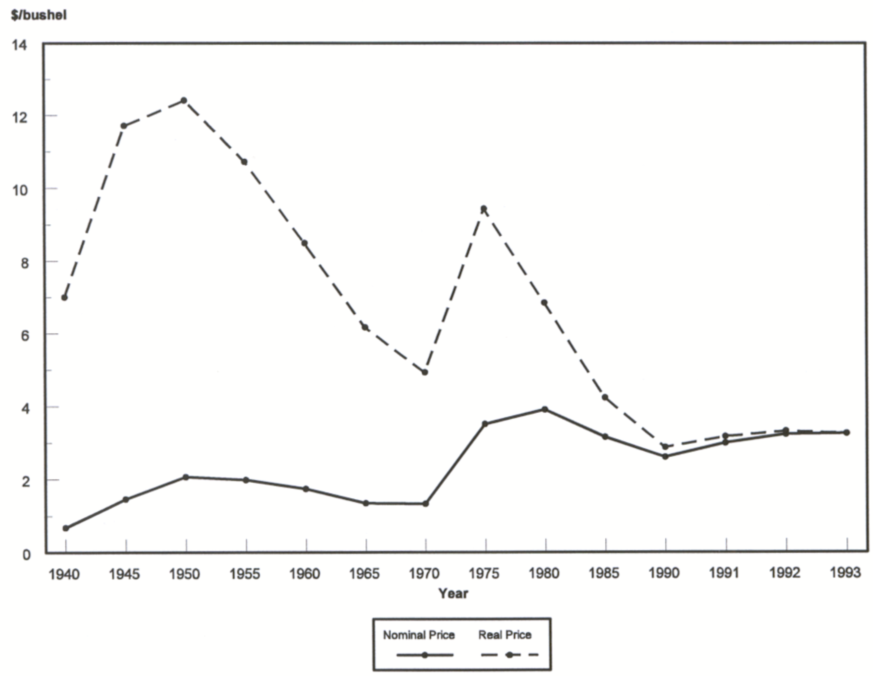

Figure A.18. Nominal and Real Wheat Prices in 1993 Dollars

SOURCE: U.S. Department of Agriculture. *Agricultural Statistics.* Washington, DC: United States Government Printing Office, various years. Consumer Price Index 1993 = 100.

During the 1980s, storage capacity increased, due especially to government storage payments to house the abundant U.S. grain supply. As of December 1, 1992, 35 U.S. states had a storage capacity of nearly 21 billion bushels, 12.1 billion bushels on-farm and 8.7 billion bushels at off-farm sites. Iowa has the largest on-farm storage capacity with 1.8 billion bushels (Figure A.19). Illinois has the largest off-farm storage capacity with 1.1 billion bushels (Figure A.20). Similarly, Illinois has 1,280 off-farm storage facilities, which is the largest number of all the states (Figure A.21). The large amount of storage capacity scattered throughout the United States helps to facilitate coordination of supply and demand of wheat and enhances the marketing process. The United States' large storage capacity aides in an efficient domestic and export allocation and distribution of wheat supplies.

Figure A.19. On-Farm Storage Capacity by State, 1992, in millions of bushels

SOURCE; U.S. Department of Agriculture. *Grain Stocks.* National Agricultural Statistics Board, Washington, DC, 1993.

Figure A.20. Off-Farm Storage Capacity by State, 1992, in millions of bushels

SOURCE; U.S. Department of Agriculture. *Grain Stocks.* National Agricultural Statistics Board, Washington, DC, 1993.

Figure A.21. Number of Off-Farm Storage Facilities by State, 1992

SOURCE; U.S. Department of Agriculture. *Grain Stocks.* National Agricultural Statistics Board, Washington, DC, 1993.

Domestic Markets

The evolution of the logistical system was accelerated by domestic and export markets. Buyers of wheat are dispersed throughout the United States. Thus, storage facilities are dispersed throughout the United States. Changes and expansion in the storage facilities can be linked to shifts in the milling locations of wheat. In the 1800s, thousands of local mills ground wheat into flour in the United States.

A wheat mill was located every four or five miles and served local markets. As the transportation system developed, the number of flour mills steadily declined. This occurred because wheat was traditionally stored close to producers, milled into flour at milling centers such as Minneapolis and Kansas City, and shipped to populated areas for consumption. This arrangement was feasible because of a rail pricing mechanism referred to as ‘transit’ privilege (Wilson 1989). A transit privilege is the ability to stop and process a specific shipment between the point of origin and destination and continue on at the origin through rate. However, during the 1980s, changes in the transportation industry altered the economics affecting the location of milling facilities.

During the early 1980s, the transit privilege diminished and unit train technology was adopted. The cost of shipping wheat declined relative to the cost of shipping flour or millfeed (Wilson 1989). Movements of wheat flour were not suitable for the use of unit train technology because bakery operations prefer smaller shipments to avoid incurring the high inventory costs of storing large amounts of flour. In addition, train shipments of flour require the use of specialized equipment with few alternative uses. Covered hopper cars, which move wheat, can alternatively move many raw unprocessed and some processed commodities (Wilson 1989).

Transportation rates also have played a role in the strategic locations of flour mill facilities. Mill locations are shifting from producer regions to consumer regions. Flour mills that were built in the 1980s located near population centers (Harwood et al. 1989). The expected costs of shipping flour relative to wheat helped to determine where the mills were built (Harwood et al. 1989). More mills were constructed in the western and eastern parts of the United States, i.e. California, Arizona, and Florida (Figure A.22).

The flour milling industry began to change structurally in the 1970s, moving toward fewer and larger firms. Since 1973, the industry decreased from 292 mills to 203 in 1993, yet the milling capacity has increased from 929,000 cwt per day (1.5 million bushels) to 1,265,200 cwt (2.1 million bushels) per day in 1993 (Figure A.23; Milling & Baking News 1994). Much of the increase in the concentration of milling capacity can be explained by economies of size, resulting from improved transportation technology. For example, the larger mill facilities can take advantage of unit train technology more easily, resulting in large cost savings.

The increase in milling capacity has been driven by the upward trend in the consumption of wheat flour products. In 1968, annual per capita consumption of wheat was 156.2 pounds, increasing to

183.6 pounds in 1990. Much of the increase can be attributed to the change in consumer preference for healthy foods and also time-saving mixes which have flour as an ingredient. Overall, the domestic use of wheat has increased, reaching 1.3 billion bushels in 1993 (Figure A.24).

Export Markets

A surplus of grain is found only in a handful of nations, and the United States has historically been one of them. The United States has exported wheat since modes of transportation have been available for transporting exports. In the 1970s, wheat exports peaked at more than 1.5 billion bushels, but have been volatile since this peak. During the 1990s exports have ranged between 1.0 and 1.4 billion bushels (Figure A.25). Typical U.S. wheat flow movements from the inland producing regions to the coastal consumption and export regions are illustrated in Figure A.26. U.S. wheat flows in all directions, both domestically and internationally. Different classes of wheat grown in different regions go all over the world for a number of uses.

Countries such as Russia and India once exported grain but have now become major importers. Developing countries of Asia, Africa, and Latin America have also been importing wheat on a major scale (Morgan 1979). Changes in imports from these countries can be attributed to a number of factors, including changes in consumption preference, increasing income levels, population growth rates, inefficient logistics, and government export programs. For example, in countries where rice was once the staple, people have acquired a taste for bread and other wheat products (Morgan 1979). Not only is wheat required for human consumption, but as livestock feed.

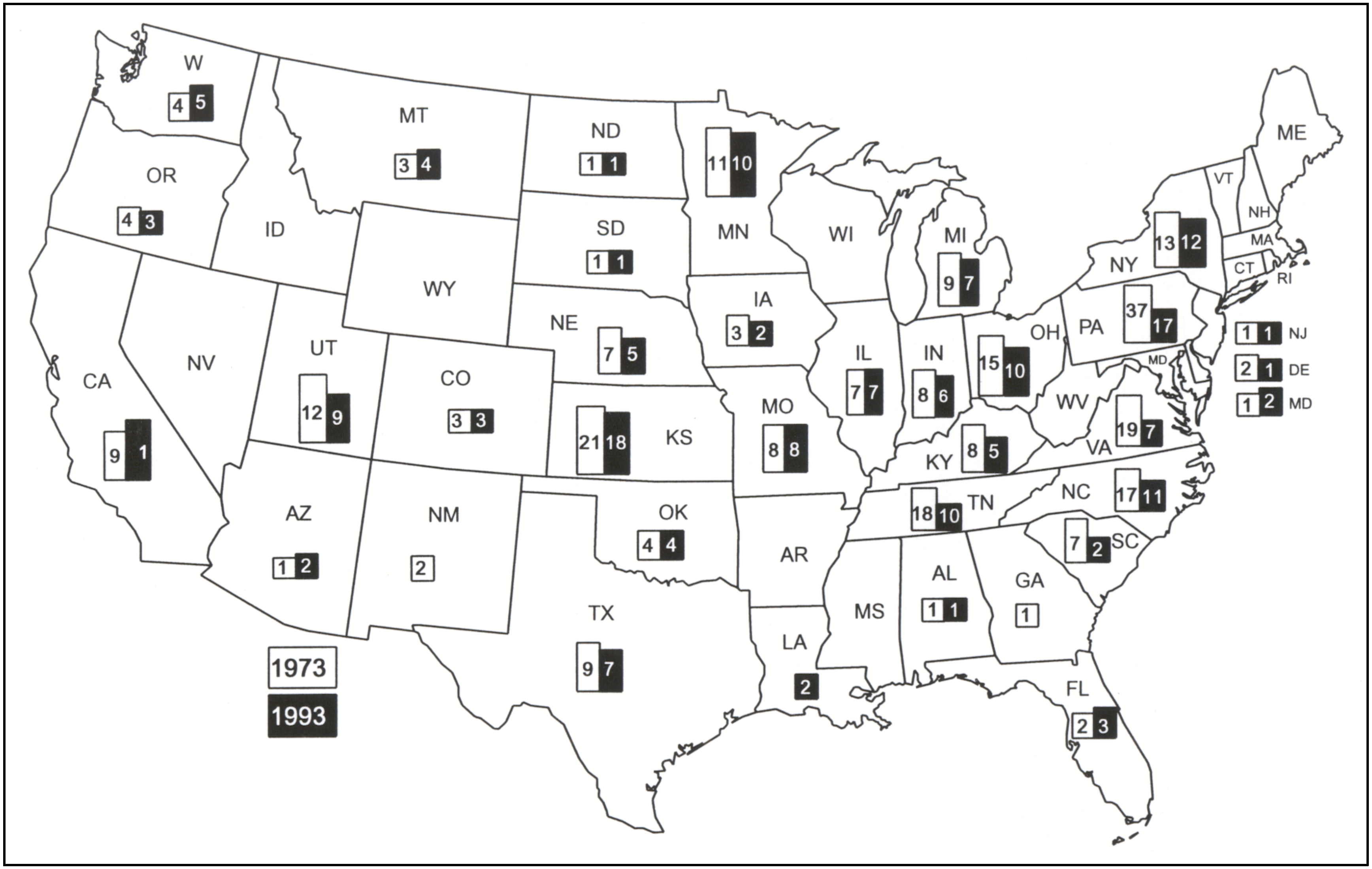

Figure A.22. U.S. Wheat Flour Mills by State, 1973 and 1993

SOURCES: Milling & Baking News. *1973 Milling Directory & Buyer's Guide.* Kansas City, MO: Sosland Publishing Co., 1973; and Milling & Baking News. *1994 North American Grain & Milling Annual.* Kansas City, MO: Sosland Publishing Co., 1994.

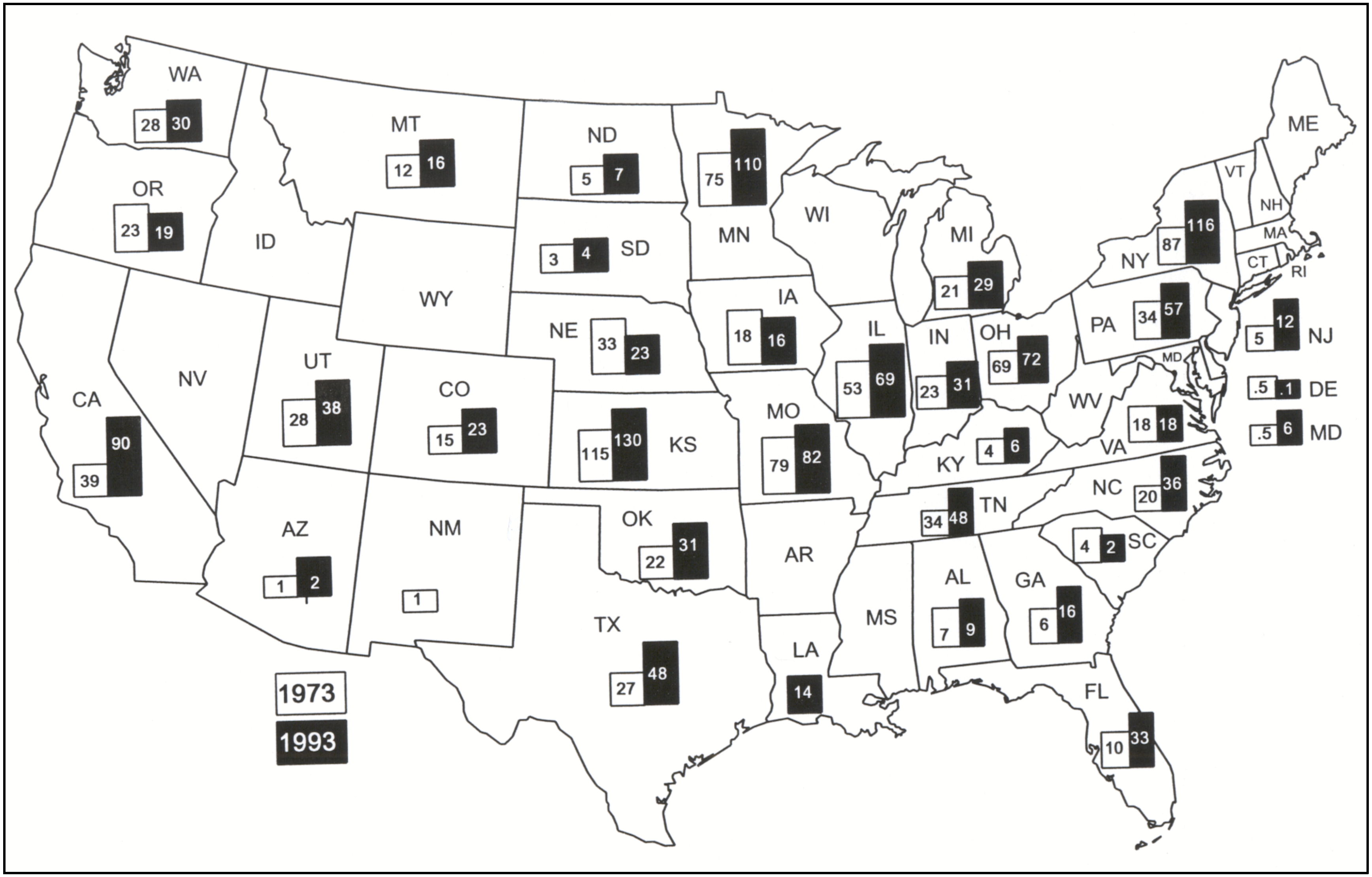

Figure A.23. U.S. Wheat Flour Mill Capacity by State, 1973 and 1993, in Thousand CWT per day.

SOURCES: Milling & Baking News. *1973 Milling Directory & Buyer's Guide.* Kansas City, MO: Sosland Publishing Co., 1973; and Milling & Baking News. *1994 North American Grain & Milling Annual.* Kansas City, MO: Sosland Publishing Co., 1994.

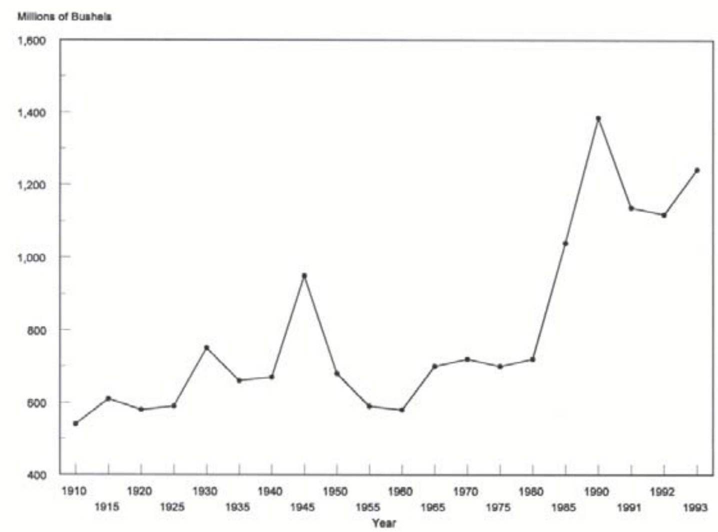

Figure A.24. Domestic Use of Wheat, 1910 to 1993

SOURCE: U.S. Department of Agriculture. *Agricultural Statistics.* Washington, DC: United States Government Printing Office, various years.

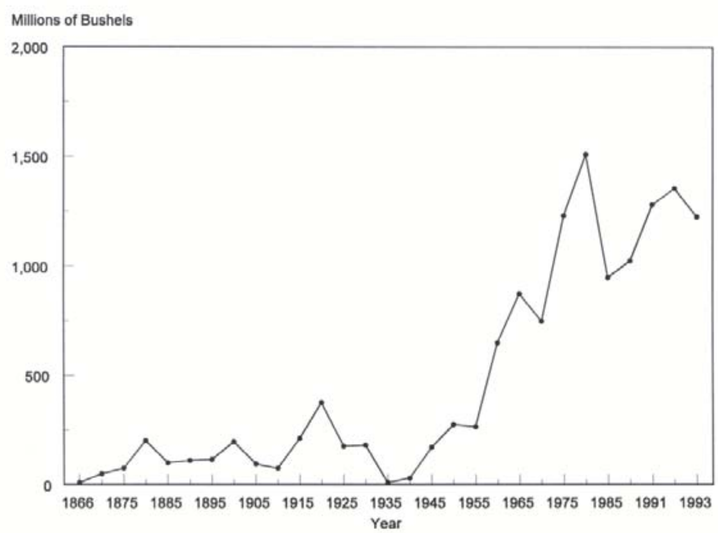

Figure A.25. Exports of U.S. Wheat, 1866 to 1993

SOURCE: U.S. Department of Agriculture. *Agricultural Statistics.* Washington, DC: United States Government Printing Office, various years.

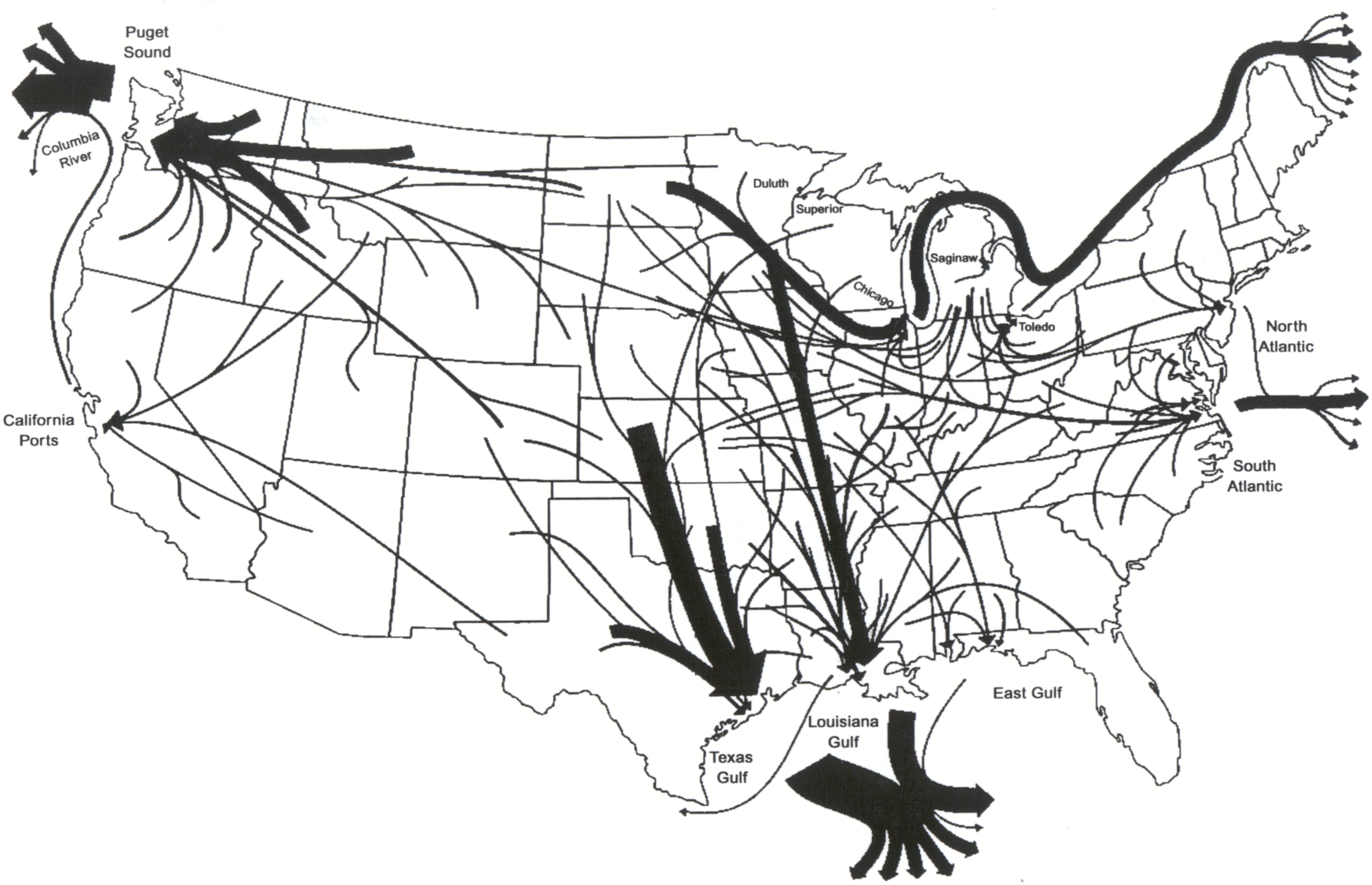

Figure A.26. U.S. Typical Wheat Flows

SOURCE: Lowell Hill and David Timmerman. *Grain Movements to Points of Export in 1985*. Special Publication 76, Agricultural Experiment Station, College of Agriculture, University of Illinois at Urbana-Champaign, 1986.

Summary

The evolution of the transportation network played a fundamental role in the development of the United States. Large cities flourished near areas with waterway access and by coastal lines in the United States because products were easily moved by water transportation. As the railway system evolved in the late 1800s and early 1900s, rail tracks crossed the United States and opened each region to regional and international trade. Furthermore, the truck and highway development of the early 1900s made it easier for farmers to move their grain to markets.

Scientific advances in production and harvesting technologies increased wheat yields and supply significantly since the 1950s. Advances within the transportation industry have enabled larger more efficient wheat movements to flow through the marketing channels. The advent of covered hopper rail cars and unit train technology of the 1980s greatly increased the efficiency of the rail industry.

In 1992 nearly 70 million tons, more than 2 billion bushels, of wheat were transported through the United States. Each mode of transportation played an important role in these movements. Trucks make the initial haul from farm to elevator. However, truck movements of wheat are limited after they reach the elevator. In 1992, commercial trucks hauled nearly 9 percent of wheat to domestic processors and to export markets. Wheat movements by barge have been higher than commercial truck movements because of the large amount of wheat that flows through the waterway system to port facilities for export. Rail plays a predominant role in wheat shipments as nearly 70 percent of all wheat moves by rail to U.S. consumers and export markets.

Each mode of transportation has experienced regulatory reform at some point in time. The reforms that have impacted producers most are changes in truck weight restrictions that currently require farmers to limit their gross vehicle weight to 80,000 pounds on the highways. Waterway regulations did not significantly impact wheat until the Inland Waterways Revenue Act of 1978 imposed an excise tax on fuel. The tax was further increased by the Water Resources Development Act of 1986 which scheduled fuel taxes to increase to 20 cents per gallon by 1995. Additional acts have been proposed to further increase waterway fuel taxes. The railroad industry was highly regulated until the Staggers Act of 1980 allowed more freedom in rate setting, rail line abandonments, and mergers. The Association of American Railroads indicated that five years after Staggers, real grain rates declined by 26 percent.

Several changes have occurred in the transportation industry which have impacted and enhanced the movement of wheat throughout the United States. The United States has built a tremendous logistical system which serves the U.S. agriculture industry, which in turn supplies world demand. The United States has been a major exporter of grain for centuries, and this would not have been possible without an efficient logistical system.