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Transportation of U.S. Grains

A Modal Share Analysis

by

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Abstract

The analysis of movements of grain by mode of transport provides important information about changes in the competitiveness and relative efficiencies between the modes. The goal of this analysis was to estimate the tonnages of grain railed, barged, and trucked using secondary data sources. The types of grains identified were corn, wheat, soybeans, sorghum, barley and rye, and oats. The types of movements identified were those to domestic markets and those to ports for export.

Key words: **Grain transportation, grain movements, modal shares**

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Summary

The analysis of movements of grain by rail, barge, and truck provides important information about changes in the competitiveness and relative efficiencies between the modes. It can also provide a framework to assess public policies that affect the development and success of the Nation's transportation infrastructure.

The amount of grain moved in the United States increased significantly from 1978 to 1989. During this period, significant changes occurred among the types of grain moved and the volumes shipped to domestic and export markets.

Trends in movements and modal shares are strongly influenced by the corn, wheat, and soybean crops. These three crops accounted for 90 percent of all grain movement during the 1978-89 period. Movements reached a record total of 346.1 million tons by 1988, up 43 percent from 241.8 million tons in 1978. Nearly all of this growth resulted from a large increase in domestic grain movement, up 80 percent from 1978. Export movements peaked in 1981 at 144 million tons and bottomed in 1986 at just under 87 million tons.

Despite significant changes during the 1978-89 period, modal shares for all grain ended the period in 1989 very much the same as they began it in 1978. Railroads remain the predominant mode of grain transportation in the United States. While all modes increased tonnages, rail and barge shares decreased and truck share increased through 1988. The rail share of export grain movements remained relatively constant to slightly lower during the 1984-89 period. In the domestic market, rail share tended to decrease through 1988 then increased sharply in 1989. The barge share of export movements remained relatively flat during the 1984-89 period. The barge share of domestic grain traffic decreased slightly from 1984 to 1989. The truck share of export movements decreased from 1984 to 1988, and increased in 1989. The truck share of domestic movements increased from 1984 to 1988, and decreased in 1989.

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Introduction

Grains produced in the United States move to foreign and domestic markets through a well-developed transportation system. Rail, barge, and truck transportation facilitate a highly competitive market that bridges the gap between U.S. grain producers and foreign and domestic consumers.

Barges, railroads, and trucks often compete head-to-head as suppliers of transportation for grain movements. Despite a high degree of competition in some markets, these modes also complement each other. Before a bushel of grain reaches its final market, it has often been transported by two or more modes. This balance between competition and integration provides grain shippers with a highly efficient, low-cost system of transportation. The competitiveness of U.S. grains in the world market and the financial well-being of U.S. grain producers is very much dependent upon this competitive balance. A highly competitive and efficient transportation system translates into lower shipping costs, smaller marketing margins, and more competitive export prices. Such efficiencies also result in lower food costs for U.S. consumers and higher market prices for U.S. producers.

An analysis of the transportation of grain by mode provides important information about changes in competitiveness and relative efficiencies between the modes. Over a series of years, such work can help identify critical trends affecting the transportation of grain. It can also provide a framework to assess public policies that influence the development and success of the Nation's transportation infrastructure. Public policies that promote an efficient grain transportation system also promote strong U.S. agricultural and rural economies.

Methodology

Any effort to measure the tonnages of grain moved by mode of transport is confronted with the problem of data availability. Accurate data exist on rail and barge freight tonnages and commodities, but similar data are not available for truck movements. Other analyses of grain movements have relied extensively on survey data to overcome this obstacle.[1] The goal of this analysis was to estimate the tonnages of grain railed, barged, and trucked based on secondary data sources. Estimating these modal grain volumes and modal shares on an annual basis provides a data series that tracks changes in grain transportation over time.

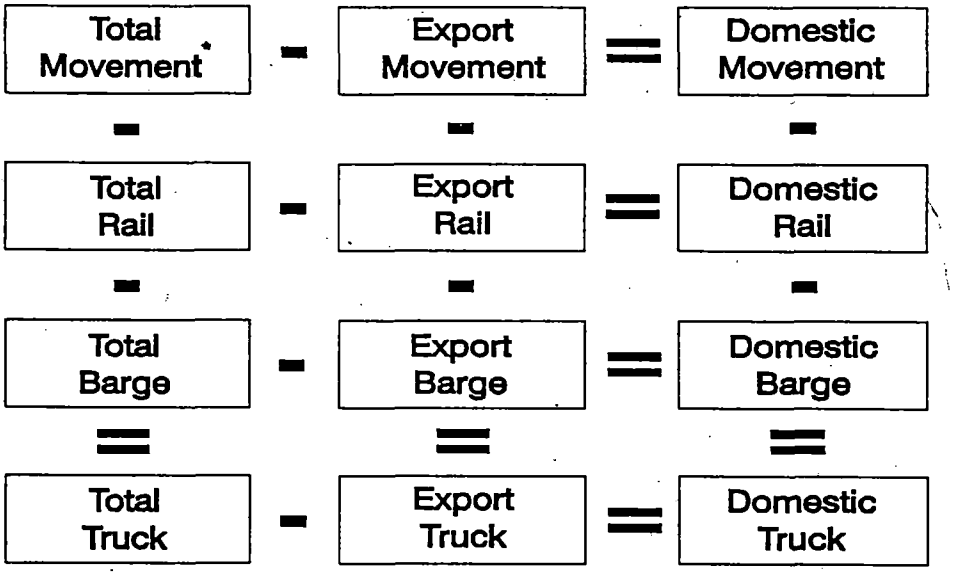
(The authors are economists with the Domestic Transportation Branch, Transportation and Marketing Division, Agricultural Marketing Service, U.S. Department of Agriculture.)

[1]For a listing of other modal share analyses of U.S. grain, see individual commodity flow and transportation requirement studies from 1977 and 1985 listed in the bibliography.

In this analysis, the term "modal share" describes that portion of the total tonnage of grain moved by a specific mode of transport -- rail, barge, or truck. These shares, expressed as percentages, were determined by mode for particular types of grains and types of movements. Grains identified for this analysis were corn, wheat, soybeans, sorghum, barley and rye, and oats. Transport movements were identified to domestic markets and to ports for export.

The estimates of modal tonnages and shares were based on the amount of grain moved to commercial markets. Rail and barge tonnages were taken from secondary sources.[2] Truck tonnages were estimated by subtracting rail and barge tonnages from the total tonnages transported. Estimates of truck tonnages are equivalent to the amount of grain moved but not transported by rail or barge. This procedure is illustrated in figure 1.

Figure 1--Model for estimating modal tonnages and share



*Total Movement equals total disappearance less the amont of grain grown and used on farm.

The method for estimating truck grain tonnages and modal share assumes that all rail and barge tonnages represent "long-haul" movements. "Short-haul" movements that originate on the farm are almost exclusively done by truck. Such farm-to-elevator movements are considered gathering movements. Unlike rail or

[2]Rail grain volumes were taken from the Association of American Railroads' *Commodity Freight Statistics*, 1978-89. Barge grain volumes were taken from the U.S. Army Corps of Engineers' *Waterborne Commerce of the United States*, 1978-89.

barge movements that typically end at the point of domestic consumption or export, these truck movements represent only the first and shortest segment of the entire shipping channel for grain. There are instances where rail and barge are used in combination to ship grain. One example is the rail movement of corn along the middle and upper Mississippi River and the Illinois River to barge loading facilities. The approach used in this analysis was unable to account for such rail and barge combinations. As a result, truck tonnages were underestimated by the amount of grain that was transported by both rail and barge. Such shipments are small, however, in relation to the total volume of grain transported in the United States.

Estimated Tonnages Transported

The approach used to estimate modal tonnages and shares required that the total tonnages of grain transported to market be determined. It was also necessary to determine the portions of total tonnage transported to domestic and export markets.

Total tonnage of grain transported was defined as the total U.S. grain disappearance less the amount of grain "grown and used on farm."[3] [4] Grain grown and used on farm must be deducted from total disappearance because it generates no commercial transportation demand. The export grain tonnages were defined as the amount of grain exported. Domestic grain tonnages were determined by subtracting export tonnages from total tonnages transported.

Estimated Modal Shares

Modal shares were calculated for all grains and for each type of grain based on the estimated modal tonnages. These modal shares were determined for total, export, and domestic movements.

Total Modal Shares. Modal shares for total movements were calculated for each selected grain.[5] Modal shares for total movements of all grains were calculated from the sums of the shipment tonnages for each of the selected grains.

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[3]Total disappearance is reported by the USDA Economic Research Service by crop based on marketing years which vary from crop to crop. These disappearance numbers were converted to calendar year equivalents by determining each quarter's monthly average and aggregating the appropriate monthly values by calendar year. For a more complete explanation of these movement estimates, see "Appendix B," Jerry D. Norton and Keith A. Klindworth, *Railcars for Grain: Future Need and Availability* (Washington, DC: U.S. Department of Agriculture, Office of Transportation, July 1989), p. 41.

[4]Disappearance data were provided by the USDA, Economic Research Service's *Situation and Outlook Reports*. "Grown and used on farm" data are those reported by the USDA Statistical Reporting Service prior to 1981 as "Used on farms where grown." Data from 1981 through 1989 were supplied by the USDA Economic Research Service and represent an estimated continuation of the earlier "Used on farms where grown" data series.

[5]For this analysis, it is assumed that corn, wheat, soybeans, sorghum, barley and rye, and oats represent all grains. Although this is not strictly true, those U.S. crops not included represent relatively insignificant amounts of grain moved when viewed with respect to total U.S. grain movement.

Export Modal Shares. Export modal shares for barge were calculated from barge export tonnages which were based on internal grain and oilseed receipts reported on the Inland Waterway System. Export barge movements were defined as those to: 1) Kalama, Longview, and Vancouver, WA, and Portland, OR, on the Columbia-Snake River System; 2) Baton Rouge through New Orleans, LA, to the mouth of the passes on the Mississippi River System; 3) Lake Charles, LA, on the Calcasieu River; 4) Mobile, AL, on the Tennessee-Tombigbee River System; 5) Pascagoula, MS, on the Gulf Intercoastal Waterway; 6) Beaumont and Port Arthur, TX; 7) Galveston Bay (including Houston), TX; 8) Corpus Christi, TX, and the Gulf Intercoastal Waterway ports between Corpus Christi and the Mexican Border; and 9) Hampton Roads and Norfolk, VA, on the Chesapeake Bay.

Export modal shares for rail were determined from rail export tonnages to the Atlantic, Gulf of Mexico, and Pacific coasts. These tonnages were estimated from the Carload Waybill Sample (waybill) and data on grain car releases from ports.[6] [7] Rail tonnages by type of grain were estimated for the above three regions by applying the percentage of each type of grain railed to that region, as determined from the waybill, to the number of cars reported released from that region. The number of cars of each commodity for each port region was multiplied by the per-car tonnages for each type of grain at each region. The per-car tonnages were also determined from the waybill.

This approach could not be used to determine rail exports to Mexico or the Great Lakes ports because data on grain car releases are not available for these export rail movements. Rail exports to Mexico were determined from the waybill based on shipments of grain to U.S./Mexico border-crossing points. Rail exports to the Great Lakes were determined from grain delivery information at Duluth-Superior, MN, and Toledo, OH, and export data for these ports.[8] Total export rail tonnages were determined by aggregating across crops and ports.

Export modal shares for truck were determined from estimated truck export tonnages. Barge and rail export tonnages were subtracted from the total export tonnages to arrive at estimated truck export tonnages.

Domestic Modal Shares. Domestic rail and barge tonnages were estimated by subtracting export rail and barge tonnages from total rail and barge tonnages. Domestic truck tonnages were estimated by subtracting estimated export truck tonnages from estimated total truck tonnages. This is equivalent to subtracting domestic rail and barge tonnages from domestic movement tonnages.

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[6]Interstate Commerce Commission, *Carload Waybill Sample* (Washington, DC: ICC).

[7]Association of American Railroads, "PT Report No. 2" (Washington, DC: AAR, Transportation Division).

[8]Grain delivery information for Duluth-Superior was taken from data reported by the Minneapolis Grain Exchange, Minneapolis, MN. Grain delivery information for Toledo was taken from data reported by the Toledo Board of Trade, Toledo, OH. For a more complete explanation of the method use to estimate rail export tonnages for the Great Lakes ports, see Jerry D. Norton and Keith A. Klindworth, *Railcars for Grain: Future Need and Availability* (Washington, DC: U.S. Department of Agriculture, Office of Transportation, July 1989), pps. 46-47.

Grain Tonnages Moved and Modal Shares

The amount of grain moved into use in the United States increased significantly during the 1978-89 period. Significant changes also occurred among the types of grain moved and the volumes shipped to domestic and export markets.

All Selected Grains

Corn, wheat, soybeans, sorghum, barley and rye, and oats represent nearly all of the grain moved in the United States. Trends in movements and modal shares for all selected grains are influenced most strongly by the underlying trends in the corn, wheat, and soybean crops. Together these three grains accounted for 90 percent of all grain movement during the 1978-89 period.

Tonnages Moved. Total grain tonnages transported during the 1978-89 period displayed a strong upward trend. Movements reached a record total of 346.1 million tons in 1988, up 43 percent from 241.8 million tons in 1978. (See table 1.) Nearly all of this increase was the result of increased domestic grain movement, up 80 percent from 1978 to 1988. These increases are attributable to a large increase in the domestic movement of corn.

Grain export movements varied considerably during the 1978-89 period. Export movements peaked in 1981 at 144 million tons and bottomed in 1986 at just under 87 million tons. A stronger dollar and more competition from other grain producing countries left U.S. grain exports relatively flat during the 1978-89 period. Countries like those of the European Economic Community, which once imported sizeable volumes of U.S. grains, now compete with the United States in foreign markets. Larger production and surpluses in other grain producing countries like Argentina, Brazil, Canada, and Australia have also increased competitive pressure on U.S. grains in the world market.

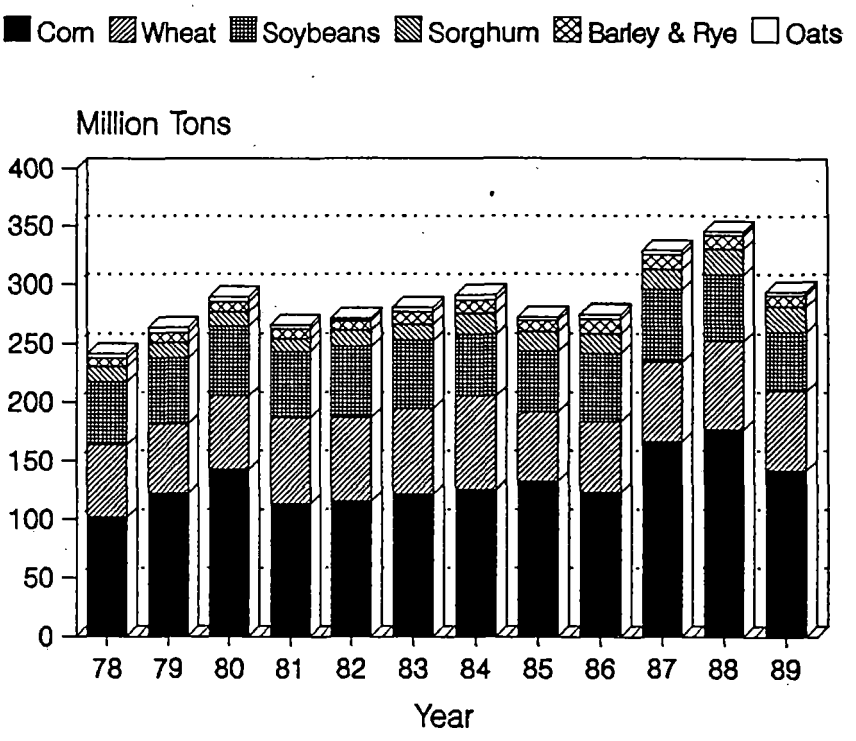
General trends developed between 1978 and 1989 for most grains, but the 1989 data either reversed or downplayed the magnitude of these trends. The one factor that explains this sudden change in grain transportation is the 1988 drought. Droughts present a number of problems for the grain transportation industry. As production decreases, less grain is available for transport during the following year. Another problem is that livestock feeders tend to increase grain feedings to compensate for the loss in forage production. Droughts also change transportation and storage patterns as processors move grains from different areas or liquidate on-hand stocks. All of these factors affect not only the total tonnages, but also the modal shares. Figure 2 illustrates changes in tonnages of grain moved by commodity for the 1978-89 period.

Modal Shares. Railroads remain the predominant mode of grain transportation in the United States. The rail share, as is true for barge and truck share, is highly dependent upon the mix of grains being transported. Wheat producers, as an example, are highly dependent upon rail transportation because most wheat is produced beyond the effective reach of water transportation. As a consequence, changes in the amount of wheat moved affect railroad tonnages much more significantly than barge or truck tonnages. Changes in corn exports, however, affect barge volumes much more significantly than other modes because of the proximity of corn production to the Inland Waterway System and the access it offers to port facilities at the mouth of the Mississippi River in Louisiana.

Table 1--Tonnages of U.S. grains transported by type of crop and type of movement, 1978-89

Year & type of movement	Corn	Wheat	Soybeans	Sorghum	Barley & rye	Oats	All Grains
				1,000 tons			
Total:							
1978	102,198	61,471	53,879	13,281	7,165	3,813	241,807
1979	122,470	59,213	56,408	13,391	7,878	4,419	263,779
1980	142,869	62,725	59,452	11,808	8,493	4,158	289,505
1981	114,028	72,829	56,889	10,611	8,314	3,479	266,150
1982	116,188	70,701	61,177	13,276	7,914	2,170	271,426
1983	122,200	72,655	58,767	13,037	10,461	3,605	280,725
1984	125,854	79,725	52,732	17,837	11,116	3,930	291,194
1985	133,187	58,697	52,050	18,908	10,245	3,893	276,981
1986	124,368	60,078	58,339	17,153	12,177	4,142	276,256
1987	165,230	67,694	61,503	16,715	12,406	3,946	327,494
1988	177,003	75,698	56,318	22,054	11,304	3,789	346,165
1989	142,112	67,977	50,212	21,448	9,427	2,950	294,125
Export:							
1978	55,162	37,584	22,822	2,680	716	206	119,170
1979	65,233	36,799	23,027	6,524	862	49	132,494
1980	69,492	39,407	24,006	8,813	1,798	107	143,623
1981	60,347	48,409	24,064	8,818	2,350	140	144,128
1982	53,780	44,954	28,081	6,630	1,522	42	135,009
1983	52,391	42,401	25,027	5,821	1,703	23	127,366
1984	53,947	46,566	21,476	7,487	2,187	16	131,679
1985	48,559	27,342	18,617	7,333	779	13	102,643
1986	29,795	27,152	23,566	4,558	1,803	34	86,909
1987	44,993	33,772	23,427	5,496	3,344	17	111,049
1988	51,211	44,640	19,674	7,140	2,405	14	125,084
1989	62,213	40,237	16,582	9,212	1,984	13	130,241
Domestic:							
1978	47,036	23,887	31,057	10,601	6,449	3,607	122,637
1979	57,237	22,414	33,381	6,867	7,016	4,370	131,285
1980	73,377	23,318	35,446	2,995	6,695	4,051	145,882
1981	53,681	24,420	32,825	1,793	5,964	3,339	122,022
1982	62,408	25,747	33,096	6,646	6,392	2,128	136,417
1983	69,809	30,254	33,740	7,216	8,758	3,582	153,359
1984	71,907	33,159	31,256	10,350	8,929	3,914	159,515
1985	84,628	31,356	33,433	11,575	9,466	3,880	174,338
1986	94,573	32,926	34,773	12,594	10,374	4,108	189,347
1987	120,237	33,923	38,076	11,219	9,062	3,929	216,446
1988	125,792	31,058	36,644	14,914	8,899	3,775	221,081
1989	79,899	27,740	33,630	12,236	7,443	2,936	163,884

Figure 2--U.S. grain shipments by commodity, 1978-89



While all modes have tended to increase grain tonnages during the 1978-89 period, the overall tendency for modal share has been less clear. (See table 2.) During the period from 1978 to 1988, rail tonnages increased by 34.5 percent. The rail share of all grain movement, however, decreased from 48.4 percent in 1978 to 45.5 percent in 1988. These trends were reversed in 1989 as rail tonnages decreased and rail share increased. During the 1978-88 period, barge tonnages increased by 23.5 percent, but barge share decreased from 21.0 percent in 1978 to 18.1 percent in 1988. In 1989, barge tonnages and share both increased. Truck tonnages increased by 70.3 percent from 1978 to 1988. During the same period, truck share increased from 30.6 to 36.4 percent. Truck tonnages and share both fell sharply in 1989. The overall changes in tonnages moved by mode for all selected grains are illustrated in figure 3.

The shifts reflected in the 1989 data are explained by the 1988 drought and a late surge in corn exports during 1989. The drought in 1988 substantially reduced the supply of corn that was available for transport the following year. This reduced the amount of total grain movement, particularly truck movement in 1989. A large increase in corn exports in late 1989 more than compensated for the impact of the drought on barge transportation demand. This is evident by the fact that only barge tonnages increased in 1989.

Modal shares vary greatly between export and domestic movements. The rail share of export grain movements showed no real trend. Rail share ranged from a low of 39.4 percent in 1985 and 1989 to a high of 44.9 percent in 1988. In the domestic market, rail share has tended to decrease from a high of 50.6 percent

Table 2--Tonnages and modal shares for all U.S. grains, 1978-89

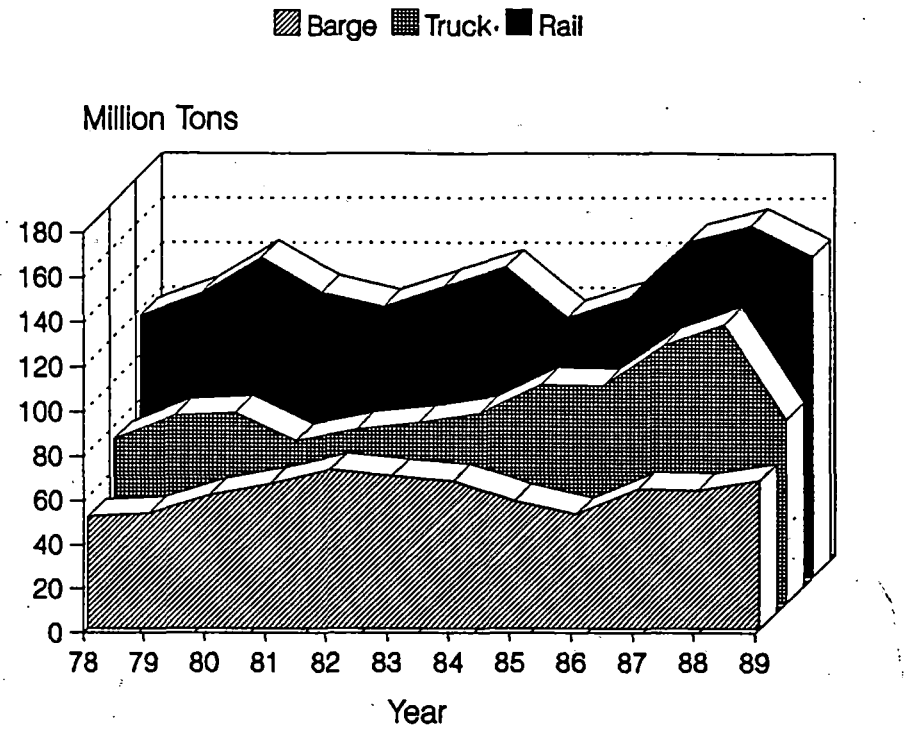
Year & type of movement	Mode of transport					
	Rail		Barge		Truck	
	1,000 tons	*Percent*	*1,000 tons*	*Percent*	*1,000 tons*	*Percent*
Total:						
1978	117,087	48.4	50,814	21.0	73,905	30.6
1979	127,177	48.2	52,207	19.8	84,396	32.0
1980	143,402	49.5	60,495	20.9	85,608	29.6
1981	127,581	47.9	65,504	24.6	73,065	27.5
1982	121,188	44.6	71,855	26.5	78,383	28.9
1983	130,457	46.5	69,078	24.6	81,191	28.9
1984	139,029	47.7	66,808	22.9	85,356	29.3
1985	116,443	42.0	57,806	20.9	102,732	37.1
1986	125,249	45.3	51,835	18.8	99,172	35.9
1987	150,405	45.9	62,447	19.1	114,642	35.0
1988	157,532	45.5	62,753	18.1	125,880	36.4
1989	143,622	48.8	67,313	22.9	83,191	28.3
Export:						
1984	58,247	44.2	60,194	45.7	13,238	10.1
1985	40,466	39.4	51,554	50.2	10,623	10.3
1986	34,892	40.1	45,108	51.9	6,908	7.9
1987	46,175	41.6	56,990	51.3	7,883	7.1
1988	56,204	44.9	58,480	46.8	10,400	8.3
1989	51,366	39.4	62,772	48.2	16,103	12.4
Domestic:						
1984	80,783	50.6	6,614	4.1	72,118	45.2
1985	75,977	43.6	6,252	3.6	92,109	52.8
1986	90,356	47.7	6,726	3.6	92,264	48.7
1987	104,230	48.2	5,457	2.5	106,759	49.3
1988	101,329	45.8	4,273	1.9	115,479	52.2
1989	92,255	56.3	4,541	2.8	67,088	40.9

in 1984 to 45.8 in 1988. Rail share, however, rebounded sharply in 1989, capturing 56.3 percent of the domestic market. Domestic rail tonnages increased from 80 million tons in 1984 to 92 million tons in 1989. The share of total rail tonnage that moved to domestic markets also increased from 58 percent in 1984 to 64 percent in 1989.

The barge share of export movements remained relatively flat during the 1984-89 period. Barge export share went from a low of 45.7 percent in 1984 to a high of 51.9 percent in 1986. It ended the period in 1989 with 48.2 percent of the export movement. The barge share of domestic grain traffic decreased slightly from 4.1

percent in 1984 to 2.8 percent in 1989. The share of total barge tonnages shipped for export remained around 90 percent, further demonstrating the importance of exports to barge tonnages.

Figure 3--Tonnages of all U.S. grains transported by mode, 1978-89



The relationship between export and domestic movements for trucks is opposite that for barges. From 1984 to 1988, trucks accounted for roughly 50 percent of all domestic movement and 10 percent or less of all export movement. Truck share of domestic movements increased from 45.2 percent in 1984 to 52.2 percent in 1988. However, domestic truck share fell to 40.9 percent in 1989. The truck share of export movements dropped to a low of 7.1 percent in 1987, but jumped to a high of 12.4 percent in 1989.

Corn

Of all U.S. grains, corn accounts for the greatest transportation demand. Corn represented 46.2 percent of all U.S. grain movement during the 1978-89 period. It accounted for 43.2 percent of all export grain movements and 47.8 percent of all domestic grain movements.

Corn dominates the U.S. grain transportation market by virtue of its large production volumes. It has the largest acreage of any grain crop, and per-acre yields in some areas average as much as four times that of wheat or soybeans. From 1985 to 1987, annual U.S. corn production averaged more than three times that

of wheat, the next largest grain crop.[9] The large volume makes it the dominant grain in demand for transportation. Structural changes in the livestock and poultry industries have also served to increase the demand for corn transportation.

Tonnages Moved. The tonnages of corn moved in the United States increased from 102 million tons in 1978 to 142 million tons in 1989. (See table 1.) The corn share of total movement increased, from 42.3 percent in 1978 to 48.3 percent in 1989. Domestic share of corn movement also increased from 46.0 percent to 56.2 percent. These trends in corn movements are most attributable to changes in the use of corn.

While still highly used as a primary feed ingredient in livestock rations, corn has increasingly been in demand for its processed products. Industrial use of corn more than doubled between the 1978/79 and 1988/89 marketing years. This category of consumption increased from 16.5 million tons to 34.5 million tons.[10] The increased use of corn fructose as a food sweetener and corn alcohol as an ingredient in ethanol gasoline blends has contributed largely to this increase.

The demand for corn as a feed crop has also increased. Total U.S. feed use of corn increased by 7.2 percent, from 104 million tons to 111.5 million tons, between the 1978/79 and 1988/89 marketing years. These increases have occurred in part because of increased poultry production. Broiler chicken production increased from 14 million live weight pounds in 1978 to 22.2 million live weight pounds in 1988.[11]

Shifts in the location of feeding have been equally important for corn transportation. In 1978, 79.4 million tons of corn were used on the same farm where it was grown. By 1989, this amount had dropped by 37.8 percent to 49.4 million tons. This decrease in on-farm use resulted almost entirely from the decrease in livestock feeding on corn producing farms. This fact is evident by shifts in the cattle industry. In 1970, the number of cattle marketed from feedlots with fewer than 1,000 head capacities accounted for over 40 percent of all marketings. In 1980, this proportion had dropped to 25 percent; by 1988, these smaller feedlots marketed only 16 percent of all cattle. While the number of cattle fed in small feedlots has decreased, the number of cattle fed in the largest commercial feedlots has increased.[12] These decreases in the on-farm use of corn have increased the need to move grain off the farm and into commercial markets.

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[9]U.S. Department of Agriculture, *Agricultural Statistics 1988* (Washington DC: U.S. Government Printing Office, 1988), p. 388.

[10]U.S. Department of Agriculture, *Feed Situation and Outlook Report* (Washington, DC: USDA, Economic Research Service), various issues.

[11]U.S. Department of Agriculture, *Livestock and Poultry Situation and Outlook Report* (Washington, DC: USDA, Economic Research Service, 1979 and 1989).

[12]Steve Reed, "An Analysis of Fed Cattle Marketings by Region and Feedlot," *Livestock and Feed Situation* (Washington, DC: U.S. Department of Agriculture, Economic Research Service, February 1989), pps. 39-40.

As indicated earlier, droughts strongly influence the transportation of grains, especially corn. The 1988 drought had pronounced impacts on the corn market. Total tonnages of corn available for movement decreased by nearly 35 million tons between 1988 and 1989. (See table 1.) The drought also depleted corn stocks. Total ending stocks, government and privately owned, fell from 119 million tons during 1987/88 marketing year to 54 million tons in 1988/89.[13]

Modal Shares. Trucks were the predominant mode of transport for corn with 44.8 percent of the total movement in 1988, up from 27.3 percent in 1978. (See table 3.) The truck share of the corn movement increased because truck corn tonnage increased nearly threefold between 1978 and 1988. While rail and barge corn tonnages increased considerably from 1978 to 1988, 35.3 and 23.9 percent respectively, both modes had decreased shares of the total corn movement. Rail share dropped from 47.4 percent in 1978 to 37.1 percent in 1988. Between these same years, barge share dropped from 25.3 to 18.1 percent. However, these trends do not hold for 1989 corn movements. Due to the drought-related changes in the market, both rail and barge share increased between 1988 and 1989 to 49.2 and 25.2 percent, respectively. Meanwhile, truck share decreased to 25.6 percent in 1989.

The increased truck share between 1978 and 1988 was driven almost entirely by increases in domestic corn transportation. Truck share of domestic corn movement increased from 50.7 percent in 1984 to 60.9 percent in 1988. At the same time, rail share of the domestic traffic dropped from 45.3 to 37.3 percent. Rail tonnages of domestic corn, however, actually increased by 44.3 percent from 1984 to 1988. Domestic barge share, already small, dropped from 4.1 percent to 1.8 percent from 1984 to 1988 with almost no change in the domestic barge tonnage. Domestic corn shipments in 1989 experienced two dramatic changes: Total domestic tonnages decreased by 36.5 percent from 1988; and modal shares for rail and truck experienced nearly identical reversals from 1988 levels.

Barge and truck both showed increases in share resulting from the export corn movement during the 1984-88 period. Barges continued to be the largest transporter of export corn, with more than half of this movement. Between 1984 and 1988, barges increased their export corn share from 52.7 to 58.3 percent. Truck share decreased during this period from 6.8 to 5.4 percent. Rail share decreased from 40.5 to 36.3 percent. Although corn exports increased by 21.5 percent in 1989, rail and barge shares of corn exports declined. In response to the increase in exports, truck export share increased to 10.6 percent in 1989. The modal shares for the domestic and export shipments of corn are shown in figure 4.

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[13]U.S. Department of Agriculture, *Feed Situation and Outlook Report* (Washington, DC: USDA, Economic Research Service), various issues.

Table 3--Tonnages and modal shares for U.S. corn, 1978-89

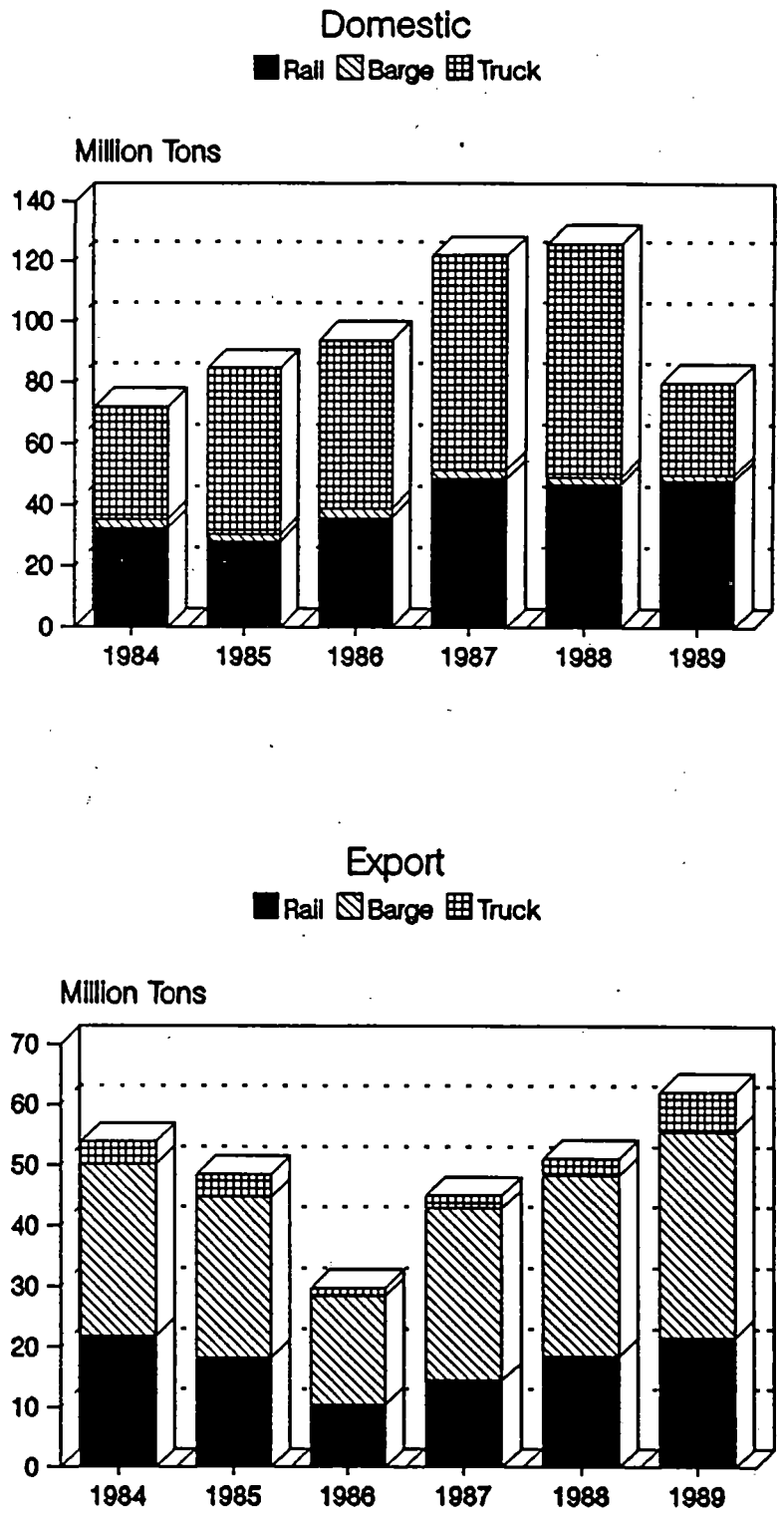
Year & type of movement	Mode of transport					
	Rail		Barge		Truck	
	1,000 tons	*Percent*	*1,000 tons*	*Percent*	*1,000 tons*	*Percent*
Total:						
1978	48,471	47.4	25,873	25.3	27,854	27.3
1979	56,467	46.1	28,366	23.2	37,636	30.7
1980	64,885	45.4	30,804	21.6	47,180	33.0
1981	51,979	45.6	31,628	27.7	30,420	26.7
1982	43,066	37.1	33,856	29.1	39,266	33.8
1983	52,196	42.7	34,174	28.0	35,830	29.3
1984	54,418	43.2	31,336	24.9	40,100	31.9
1985	46,262	34.7	28,906	21.7	58,019	43.6
1986	46,257	37.2	21,101	17.0	57,009	45.8
1987	63,214	38.3	31,343	19.0	70,673	42.8
1988	65,582	37.1	32,063	18.1	79,358	44.8
1989	69,870	49.2	35,804	25.2	36,438	25.6
Export:						
1984	21,863	40.5	28,421	52.7	3,663	6.8
1985	18,219	37.5	26,533	54.6	3,808	7.8
1986	10,405	34.9	18,019	60.5	1,372	4.6
1987	14,495	32.2	28,441	63.2	2,057	4.6
1988	18,606	36.3	29,834	58.3	2,770	5.4
1989	21,637	34.8	33,997	54.6	6,579	10.6
Domestic:						
1984	32,556	45.3	2,915	4.1	36,436	50.7
1985	28,042	33.1	2,374	2.8	54,212	64.1
1986	35,853	37.9	3,082	3.3	55,638	58.8
1987	48,719	40.5	2,902	2.4	68,616	57.1
1988	46,976	37.3	2,229	1.8	76,587	60.9
1989	48,233	60.4	1,808	2.3	29,858	37.4

Wheat

Wheat is the second largest crop transported in the United States. During the 1978-89 period, wheat accounted for 23.7 percent of all grain movement – 31.5 percent of all export movements and 17.6 percent of all domestic movements.

The demand for wheat transportation is substantially different than that for corn. Most wheat production is concentrated in the Plains States, which have virtually no direct access to waterway transportation. Although barge transportation on the Columbia-Snake River System is available for white wheat grown in the Pacific Northwest and the Mississippi River System provides barge transportation for soft red winter wheat grown in the eastern Corn Belt and Mississippi River Valley, the

Figure 4--U.S. corn shipments by mode, 1984-89



bulk of wheat production still occurs in those regions where rail is the dominant mode of transport. Demand for wheat transportation is also driven much more extensively by the export market. During the 11-year period beginning with the 1978/79 marketing year and ending with the 1988/89 marketing year, 59.9 percent of all U.S. wheat produced was exported.[14] This is significantly higher than the 25.6 percent of corn production exported during the same period.[15]

Tonnages Moved. Total tonnages of wheat moved in the United States varied considerably. Wheat tonnages, which averaged 61.1 million tons during the first 3 years of the 1978-89 period, reached a high of 79.7 million tons in 1984. (See table 1.) In 1985, tonnages reached the second lowest level at 58.7 million tons and then climbed back to 68 million tons by 1989.

Domestic wheat tonnages increased from 23.9 million tons in 1978 to 27.7 million tons in 1989. Export tonnages during this period varied even more than total tonnages. Export tonnages reached a high of 48.4 million tons in 1981 and then fell to a low of 27.2 million tons in 1986.

Modal Shares. Rail dominated the movement of wheat, accounting for 73.6 percent of all wheat moved during the 1978-89 period. Rail wheat tonnages and modal share showed little trend, but did peak in 1988 at 58.8 million tons and 77.7 percent. (See table 4.) Barge and truck also showed this same lack of trend in tonnages and modal shares.

During the 1978-89 period, barge accounted for 19.1 percent of all wheat movement, peaking in tonnage in 1981 at 16.9 million tons with 23.2 percent of the wheat movement. During this same period, trucks moved only 9 percent of all wheat.

The majority of barge and truck wheat movements are to export. For the 1984-88 period, 88.8 percent of barge and 63.6 percent of all truck tonnages were export movements. By contrast, only 43.1 percent of all rail tonnages were export. Rail increased its share of wheat export movements from 61.1 percent in 1984 to 64.1 percent in 1988. Barge export share decreased from 30.4 percent in 1984 to 28.9 percent in 1988. Truck export share dropped from 8.5 percent in 1984 to 7.1 percent in 1988. In 1989, modal share for wheat exports showed a striking reversal with an increase in both barge and truck share at the expense of rail share. This shift is explained by the significant increase in the exports of soft red winter wheat during 1989. These exports accounted for 29.9 percent of wheat exports in 1989 as compared to 14.2 percent in 1988.[16]

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[14]U.S. Department of Agriculture, *Wheat Situation and Outlook Report* (Washington, DC: USDA, Economic Research Service), various issues.

[15]U.S. Department of Agriculture, *Feed Situation and Outlook Report* (Washington, DC: USDA, Economic Research Service), various issues.

[16]U.S. Department of Agriculture, *Grain and Feed Market News* (Washington, DC: USDA, Agricultural Marketing Service), various issues.

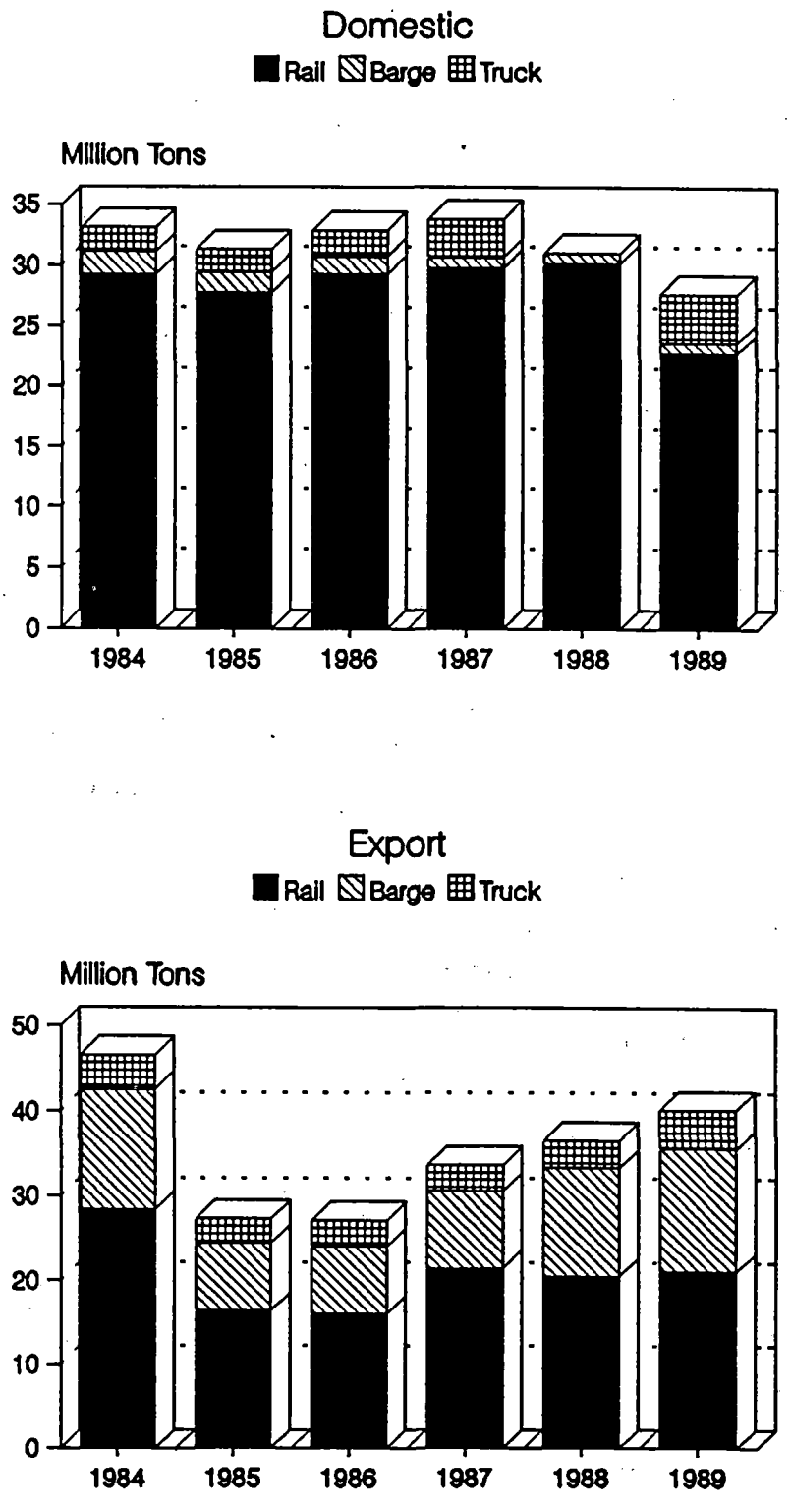
Table 4--Tonnages and modal shares for U.S. wheat, 1978-89

Year & type of movement	Mode of transport					
	Rail		Barge		Truck	
	1,000 tons	*Percent*	*1,000 tons*	*Percent*	*1,000 tons*	*Percent*
Total:						
1978	44,449	72.3	10,248	16.7	6,773	11.0
1979	45,661	77.1	10,222	17.3	3,331	5.6
1980	49,631	79.1	12,876	20.5	218	.3
1981	50,432	69.2	16,889	23.2	5,508	7.6
1982	52,590	74.4	16,330	23.1	1,781	2.5
1983	51,500	70.9	13,867	19.1	7,289	10.0
1984	57,738	72.4	15,992	20.1	5,995	7.5
1985	44,220	75.3	9,796	16.7	4,681	8.0
1986	45,372	75.5	9,465	15.8	5,240	8.7
1987	51,333	75.8	10,081	14.9	6,281	9.3
1988	58,840	77.7	13,706	18.1	3,151	4.2
1989	43,915	64.6	15,434	22.7	8,628	12.7
Export:						
1984	28,429	61.1	14,168	30.4	3,969	8.5
1985	16,402	60.0	8,081	29.6	2,859	10.5
1986	16,050	59.1	8,043	29.6	3,059	11.3
1987	21,472	63.6	9,218	27.3	3,082	9.1
1988	28,600	64.1	12,888	28.9	3,151	7.1
1989	21,135	52.5	14,553	36.2	4,548	11.3
Domestic:						
1984	29,309	88.4	1,824	5.5	2,026	6.1
1985	27,818	88.7	1,715	5.5	1,822	5.8
1986	29,322	89.1	1,423	4.3	2,181	6.6
1987	29,861	88.0	863	2.5	3,199	9.4
1988	30,240	97.4	818	2.6	0	.0
1989	22,780	82.1	880	3.2	4,080	14.7

Rail was the dominant carrier for domestic wheat shipments. During the 1984-89 period, rail accounted for 89 percent of all domestic movements as compared to 4 percent for barge and 7 percent for truck.[17] The trends in domestic and export wheat shipments are depicted in figure 5.

[17]Table 4 indicates that domestic truck movements of wheat dropped to zero in 1988. This anomaly is the result of a larger than usual amount of wheat being shipped by rail. The high level of demand for wheat in 1988 resulted in multiple rail shipments of wheat and, in turn, an over counting of railed wheat. Because the methodology used in this analysis delegates domestic truck movements as a residual to the other shipments, an over counting of rail reduced the volume of wheat shown as transported by truck.

Figure 5--U.S. wheat shipments by mode, 1984-89



Soybeans

Soybeans accounted for 19.8 percent of all grain movement during the 1978-89 period. With the exception of seed use, virtually all soybeans grown in the United States are moved to domestic processors or to the export market. The location of processing plants throughout the Midwest and the concentration of soybean production along the Mississippi River System have lead to truck domination of the domestic soybean market and barge domination of the export soybean market.

Tonnages Moved. Soybean movements were relatively flat, ranging from a high of 61.5 million tons in 1987 to a low of 50.2 million tons in 1989. (See table 1.) The proportion of soybean movements for export dropped. In 1978, export movements accounted for 42.4 percent of all soybean movements. In 1989, this percentage dropped to 33 percent. The domestic tonnages of soybeans increased 8.3 percent, from 31 million tons to 33.6 million tons, during the 1978-89 period.

Modal Shares. Truck was the dominant transporter for soybeans, accounting for 49.3 percent of all movements. (See table 5.) During the 1978-89 period, barge and rail accounted for 28.2 and 22.5 percent, respectively. Overall, barge share decreased from 26.4 percent in 1978 to 25.5 percent in 1989. Barge share did, however, increase through 1986. Rail share increased from 18.2 percent in 1978 to 24.3 percent in 1989. These increases occurred as truck tonnages decreased from 29.8 million tons to 25.2 million tons. Truck share of soybean movements also decreased from 55.4 percent in 1978 to 50.2 percent in 1989.

Despite a general decrease, barge remained the predominant carrier for soybean exports. Although barge export tonnages remained relatively flat, the barge share increased from 66.1 percent in 1984 to 68.7 percent in 1989. Similarly, rail tonnages remained relatively flat while rail share increased from 18.8 to 21.2 percent. These increases came at the expense of truck tonnages and share, which both dropped. During the 1984-89 period, export truck tonnages decreased by 48.4 percent and truck export share decreased from 15.1 to 10.1 percent.

Trucks remained the dominant carrier in the domestic soybean market. Truck tonnages of domestic soybeans remained fairly constant. Truck share, however, dropped from 70.0 percent in 1984 to a low of 62.1 percent in 1987. It rebounded to 70.0 percent in 1989. Domestic rail tonnages of soybeans increased 46.5 percent from 1984 to 1988, but fell sharply in 1989. Rail share of domestic movements increased from 25.6 to 32.0 percent before dropping to 25.8 percent in 1989. Barge tonnages remained flat during the period, accounting for roughly 4 percent of all domestic soybean traffic. These modal share trends for domestic and export soybean movements are illustrated in figure 6.

Sorghum

Sorghum accounted for only 5.5 percent of all grain movement in the United States during the 1987-89 period. Still, as a feed grain, sorghum remains an important crop. The majority of sorghum grown in this country is used for livestock feed. During the 11-year period beginning with the 1978/79 marketing year and ending with the 1988/89 marketing year, 61.2 percent of all sorghum produced was used domestically as feed. As a comparison, 59.5 percent of all

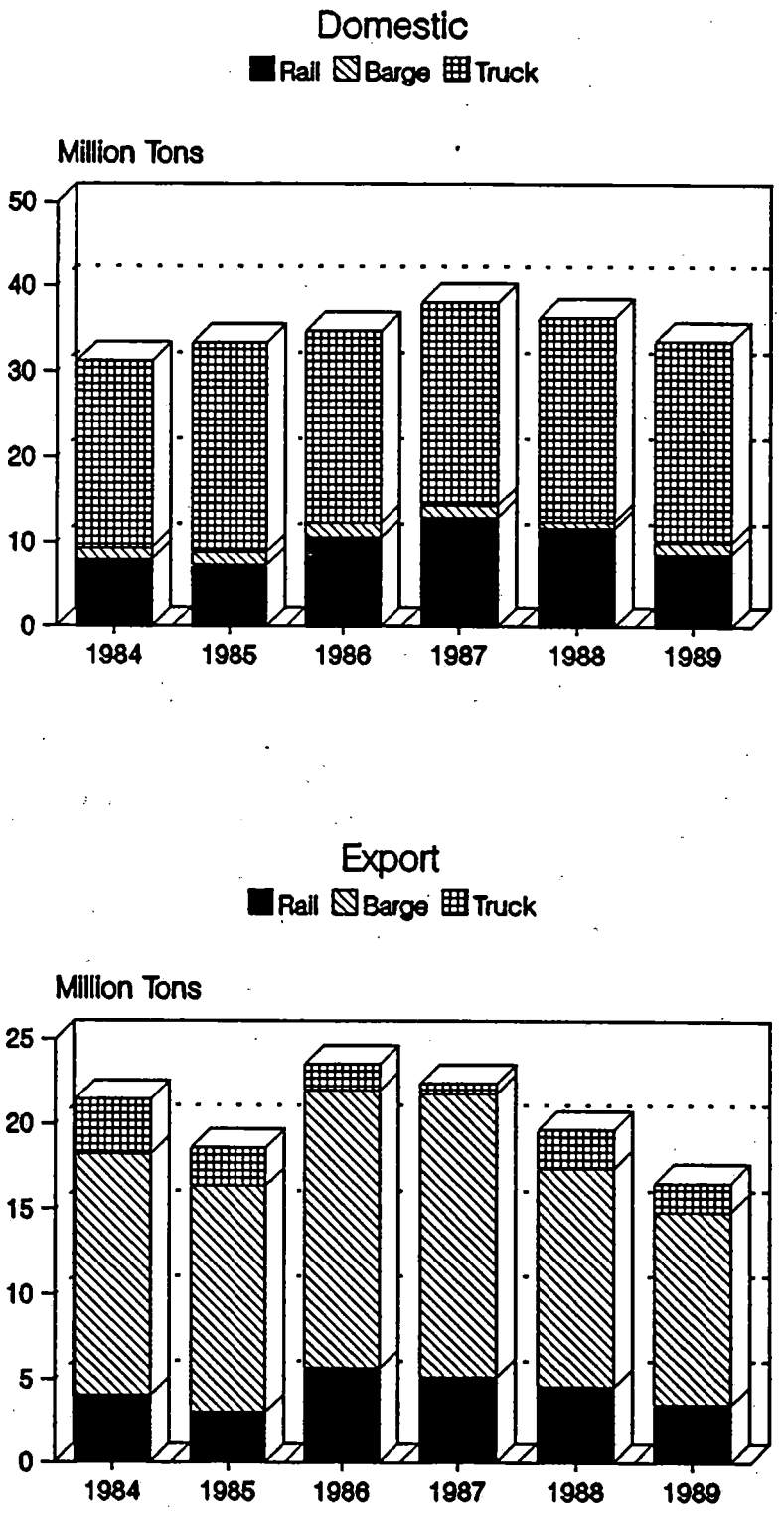
Table 5--Tonnages and modal shares for U.S. soybeans, 1978-89

Year & type of movement	Mode of transport					
	Rail		Barge		Truck	
	1,000 tons	*Percent*	*1,000 tons*	*Percent*	*1,000 tons*	*Percent*
Total:						
1978	9,804	18.2	14,235	26.4	29,840	55.4
1979	10,102	17.9	13,242	23.5	33,064	58.6
1980	11,420	19.2	16,089	27.1	31,943	53.7
1981	10,173	17.9	15,341	27.0	31,374	55.1
1982	12,411	20.3	19,803	32.4	28,964	47.3
1983	13,117	22.3	19,300	32.8	26,351	44.8
1984	12,060	22.9	15,544	29.5	25,128	47.7
1985	10,364	19.9	14,881	28.6	26,805	51.5
1986	16,277	27.9	18,054	30.9	24,008	41.2
1987	18,131	29.5	18,081	29.4	25,291	41.1
1988	16,302	28.9	13,706	24.3	26,310	46.7
1989	12,192	24.3	12,806	25.5	25,215	50.2
Export:						
1984	4,048	18.8	14,186	66.1	3,242	15.1
1985	3,033	16.3	13,340	71.7	2,244	12.1
1986	5,654	24.0	16,329	69.3	1,583	6.7
1987	5,155	22.0	16,640	71.0	1,632	7.0
1988	4,561	23.2	12,888	65.5	2,225	11.3
1989	3,517	21.2	11,393	68.7	1,672	10.1
Domestic:						
1984	8,012	25.6	1,358	4.3	21,886	70.0
1985	7,332	21.9	1,541	4.6	24,561	73.5
1986	10,623	30.5	1,725	5.0	22,425	64.5
1987	12,976	34.1	1,441	3.8	23,659	62.1
1988	11,741	32.0	818	2.2	24,085	65.7
1989	8,675	25.8	1,413	4.2	23,543	70.0

corn produced was used domestically as feed. The adaptability of sorghum to the hotter and drier regions of the country, which are unsuitable for corn production, and its use as a main ingredient in livestock rations, especially cattle feed, have made sorghum movements much more reliant upon truck and rail transportation.

Tonnages Moved. The tonnages of sorghum moved in the United States has increased significantly. Total sorghum movements increased 61.5 percent from 13.3 million tons in 1978 to 21.4 million tons in 1989. (See table 1.) Domestic tonnages accounted for 56.9 percent of all sorghum moved. The domestic share of sorghum movements decreased from 79.8 percent in 1978 to 16.9 percent in

Figure 6--U.S. soybean shipments by mode, 1984-89



1981, then increased to 57 percent by 1989. Domestic tonnages increased from 10.6 million tons to 12.2 million tons. Export tonnages increased from 2.7 million tons to 9.2 million tons.

Modal Shares. Rail accounted for the largest share of sorghum traffic with 51.4 percent of the total movement, as compared to truck with 38 percent and barge with 10.7 percent. (See table 6.) Major shifts occurred between the modes. While the rail tonnages of sorghum increased 22.8 percent, from 8 million tons in 1978 to 9.8 million tons in 1989, the rail share decreased from 60.0 to 45.6 percent. During the same period, truck tonnages nearly doubled from 5.1 million

Table 6--Tonnages and modal shares for U.S. sorghum, 1978-89

Year & type of movement	Mode of transport					
	Rail		Barge		Truck	
	1,000 tons	*Percent*	*1,000 tons*	*Percent*	*1,000 tons*	*Percent*
Total:						
1978	7,967	60.0	172	1.3	5,142	38.7
1979	8,296	62.0	165	1.2	4,930	36.8
1980	9,876	83.6	419	3.6	1,512	12.8
1981	8,138	76.7	1,187	11.2	1,286	12.1
1982	6,619	49.9	1,474	11.1	5,184	39.0
1983	4,980	38.2	1,205	9.2	6,853	52.6
1984	6,976	39.1	3,056	17.1	7,806	43.8
1985	8,839	46.7	3,534	18.7	6,535	34.6
1986	8,711	50.8	2,429	14.2	6,013	35.1
1987	8,750	52.3	1,964	11.8	6,001	35.9
1988	8,419	38.2	2,200	10.0	11,435	51.8
1989	9,786	45.6	2,409	11.2	9,252	43.1
Export:						
1984	2,542	34.0	2,850	38.1	2,095	28.0
1985	2,399	32.7	3,302	45.0	1,633	22.3
1986	1,453	31.9	2,318	50.9	787	17.3
1987	3,044	55.4	1,924	35.0	527	9.6
1988	2,812	39.4	2,164	30.3	2,163	30.3
1989	4,695	51.0	2,345	25.5	2,173	23.6
Domestic:						
1984	4,433	42.8	206	.0	5,711	55.2
1985	6,440	55.6	232	2.0	4,903	42.4
1986	7,257	57.6	111	.9	5,226	41.5
1987	5,706	50.9	40	.4	5,473	48.8
1988	5,607	37.6	36	.2	9,271	62.2
1989	5,091	41.6	65	.5	7,080	57.9

tons in 1978 to 9.3 million tons in 1989. Truck share increased from 38.7 to 43.1 percent. More sorghum was moved by truck than by rail in 1988, the only time during the entire 12-year period. Barges also increased their tonnage and share of the sorghum traffic. Barge tonnages increased from 172,000 tons in 1978 to 2.4 million tons in 1989. Barge share increased from 1.3 to 11.2 percent.

Domestic movements accounted for the predominant share of rail and truck sorghum tonnages during the 1984-89 period. Of all railed sorghum, 67.1 percent was shipped to domestic markets. For trucks, 80.1 percent was shipped for domestic consumption. Barges were used primarily for export movements. Export shipments accounted for 95.6 percent of all barged movements. During the 1984-89 period, rail, barge, and truck accounted for 41, 36.1, and 22.7 percent, respectively, of export movements of sorghum. In the domestic market, rail, barge, and truck accounted for 47.4, 0.9, and 51.7 percent, respectively, of the traffic. Figure 7 illustrates these changes in the modal shares for both the domestic and export markets.

Barley and Rye

Barley and rye accounted for only 3.4 percent of all U.S. grain movement.[18] (See table 1.) Consumed primarily in the domestic market, these two commodities generated only 4.9 percent of all domestic grain traffic and 1.4 percent of the export traffic. The majority of all barley and rye is used for livestock feed. For the marketing years beginning with 1978/88 and ending with 1988/89, 50.2 percent of all barley and 48.7 percent of all rye were consumed as animal feed. During these years, food, alcohol, and industrial use consumed more than 32 percent of all barley and 26 percent of all rye.[19]

Tonnages Moved. Barley and rye movements increased by 30.3 percent from 7.2 million tons in 1978 to 9.4 million tons in 1989. Much of this increase resulted from domestic movements of these grains. Domestic movements accounted for 81.4 percent of all barley and rye traffic. Domestic tonnages increased by 14 percent, starting at 6.4 million tons in 1978 and ending in 1989 at 7.4 million tons. Export movements, small by comparison, varied widely.

Modal Shares. Rail was the dominant carrier for barley and rye, accounting for 68.2 percent of all such traffic. Trucks and barges moved 27.8 and 4.2 percent, respectively, of these two grains. All three modes increased their tonnages over the 12-year period. Rail increased its barley and rye tonnages 36.4 percent from 4.9 million tons in 1978 to 6.7 million tons in 1989. (See table 7.) Trucks increased their tonnage slightly from 2.1 million tons in 1978 to 2.2 million tons in 1989. Barge tonnages, for the same years, increased fourfold from 99,000 to 486,000 tons.

While rail share showed little discernible trend, barge share increased slightly from 1.4 percent in 1978 to 5.2 percent in 1989. Truck share decreased from 30.1 to 23.8 percent. During the 1984-89 period, barge transported 25.6 percent of all exported barley and rye. Rail and truck transported 56.8 and 17.6 percent,

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[18]Barley and rye were aggregated in this analysis for consistency with secondary barge data. Barley accounts for more than 95 percent of the total in this aggregation.

[19]U.S. Department of Agriculture, *Feed Situation and Outlook Report* (Washington, DC: USDA, Economic Research Service), various issues.

Figure 7--U.S. sorghum shipments by mode, 1984-89

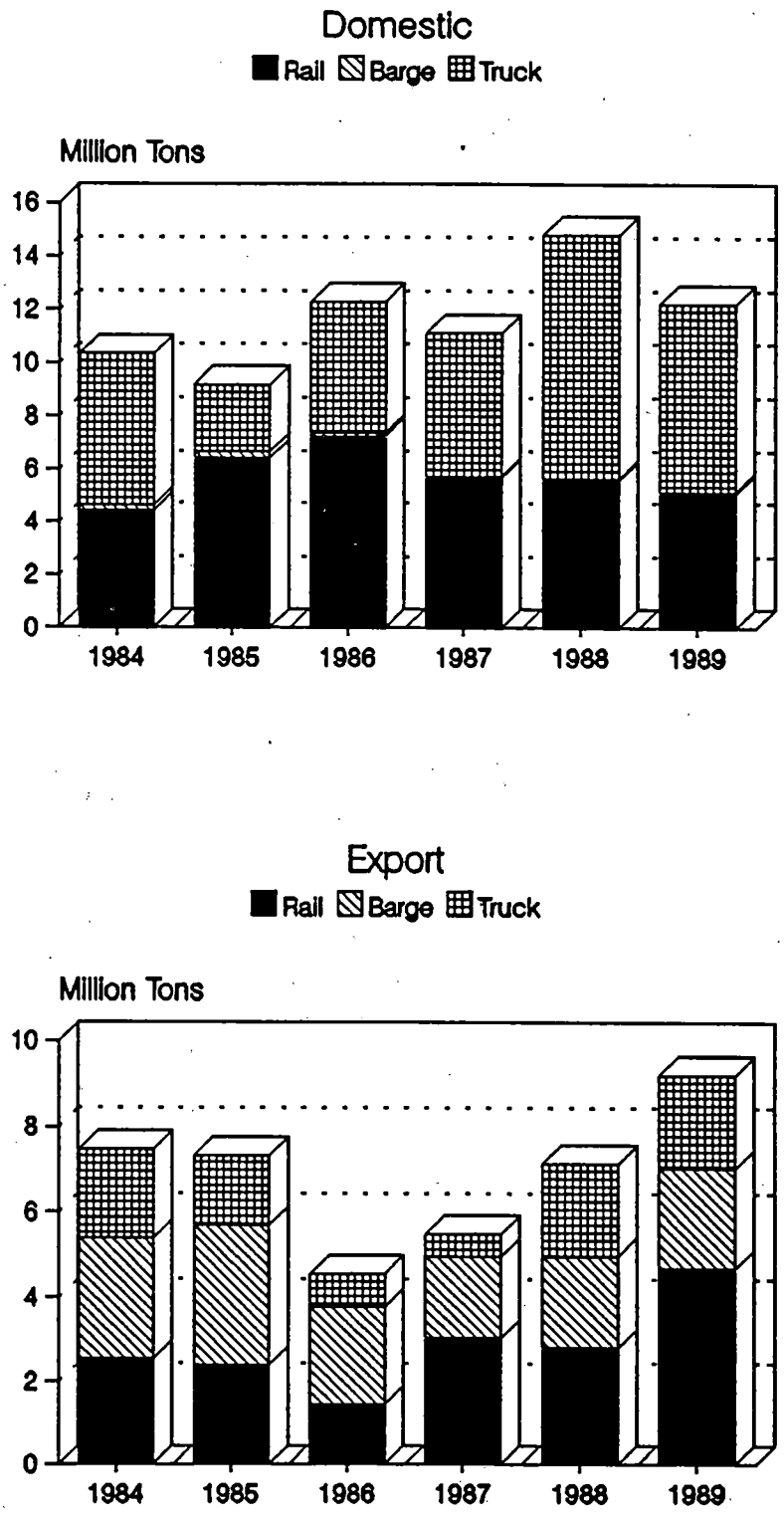

Table 7--Tonnages and modal shares for U.S. barley and rye, 1978-89

Year & type of movement	Mode of transport					
	Rail		Barge		Truck	
	1,000 tons	*Percent*	*1,000 tons*	*Percent*	*1,000 tons*	*Percent*
Total:						
1978	4,910	68.5	99	1.4	2,157	30.1
1979	5,469	69.4	89	1.1	2,321	29.5
1980	6,495	76.5	133	1.6	1,865	22.0
1981	5,969	71.8	342	4.1	2,003	24.1
1982	5,663	71.6	289	3.6	1,962	24.8
1983	7,666	73.3	403	3.9	2,392	22.9
1984	7,002	63.0	589	5.3	3,524	31.7
1985	6,118	59.7	324	3.2	3,803	37.1
1986	8,013	65.8	407	3.3	3,757	30.9
1987	8,170	65.9	765	6.2	3,471	28.0
1988	7,587	67.1	703	6.2	3,014	26.7
1989	6,695	71.0	486	5.2	2,246	23.8
Export:						
1984	1,362	62.3	562	25.7	262	12.0
1985	414	53.1	298	38.2	68	8.7
1986	1,325	73.5	388	21.5	90	5.0
1987	2,009	60.1	763	22.8	571	17.1
1988	1,621	67.4	703	29.2	81	3.4
1989	376	19.0	483	24.3	1,125	56.7
Domestic:						
1984	5,640	63.2	27	.3	3,262	36.5
1985	5,704	60.3	26	.3	3,736	39.5
1986	6,688	64.5	19	.2	3,667	35.3
1987	6,160	68.0	2	.0	2,900	32.0
1988	5,966	67.0	0	.0	2,933	33.0
1989	6,319	84.9	3	.0	1,121	15.1

respectively, of this export traffic. Rail and truck dominated domestic transport. The rail share of domestic barley and rye tended to increase from 63.2 percent in 1984 to 84.9 percent in 1989. For the same years, truck share of the domestic movement decreased from 36.5 to 15.1 percent.

Oats

Movements of oats in the United States accounted for only 1.3 percent of all grain movement during the 1978-89 period. Virtually all of the oats shipped were for the domestic market. With the exception of a small amount of oats used in milling for food consumption, most oats are consumed as animal feed. During the period, 90.8 percent of all oats were consumed as feed.[20]

Tonnages Moved. Despite a 62.6 percent reduction in U.S. oat production, the tonnage of oats moved in the United States experienced only a modest drop from 3.8 million tons in 1978 to 3 million tons in 1989. (See table 1.) During this period, total oat use actually decreased 4.9 million tons, or 51.3 percent, while imports increased from 11,000 tons to over 1 million tons annually.[21] Oat movement tonnages remained stable, however, because the amount of oats that were grown and used on farm decreased by 60.7 percent from 9 million tons in 1978 to 3.5 million tons in 1989.[22]

Modal Shares. Oats predominantly move by truck, which accounted for 68 percent of all oat movement. Rail and barge movements accounted for 25.6 and 6.4 percent, respectively. (See table 8.) Rail tonnages decreased 46.1 percent from 1978 to 1988, before rebounding sharply in 1989. Rail share decreased from 39.0 to 21.2 percent from 1978 to 1988, but regained lost share in 1989 when it returned to 39.5 percent. Barge traffic picked up much of the loss of rail traffic, doubling its tonnage from 187,000 tons to 374,000 tons and its share from 4.9 to 12.7 percent between 1978 and 1989. This increase is primarily due to the increase in oat imports moved upstream by barge. During the 1984-89 period, export movements accounted for less than one half of 1 percent of all oat traffic. In the domestic market, truck, rail, and barge movements accounted for 69.3, 21.5, and 8.7 percent, respectively, of the oat movement.

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[20]U.S. Department of Agriculture, *Feed Situation and Outlook Report* (Washington, DC: USDA, Economic Research Service), various issues.

[21]U.S. Department of Agriculture, *Feed Situation and Outlook Report* (Washington, DC: USDA, Economic Research Service), various issues.

[22]Based on "Used on farms where grown" data reported by the USDA Statistical Reporting Service prior to 1981 and data supplied by the USDA Economic Research Service for 1981 through 1989.

Table 8--Tonnages and modal shares for U.S. oats, 1978-89

Year & type of movement	Mode of transport					
	Rail		Barge		Truck	
	1,000 tons	*Percent*	*1,000 tons*	*Percent*	*1,000 tons*	*Percent*
Total:						
1978	1,486	39.0	187	4.9	2,139	56.1
1979	1,182	26.7	123	2.8	3,114	70.5
1980	1,095	26.3	173	4.2	2,890	69.5
1981	889	25.6	117	3.4	2,473	71.1
1982	841	38.7	104	4.8	1,225	56.5
1983	999	27.7	130	3.6	2,476	68.7
1984	835	21.2	292	7.4	2,804	71.3
1985	640	16.4	365	9.4	2,888	74.2
1986	619	14.9	379	9.1	3,144	75.9
1987	808	20.5	213	5.4	2,925	74.1
1988	801	21.2	375	9.9	2,612	68.9
1989	1,164	39.5	374	12.7	1,412	47.9
Export:						
1984	3	16.6	7	44.1	6	39.3
1985	0	.0	0	1.2	12	98.8
1986	6	16.9	12	34.2	17	49.0
1987	0	.0	4	22.5	13	77.5
1988	2	17.8	2	14.2	9	68.0
1989	6	48.5	1	7.5	6	44.1
Domestic:						
1984	832	21.3	285	7.3	2,797	71.5
1985	640	16.5	365	9.4	2,876	74.1
1986	613	14.9	367	8.9	3,128	76.1
1987	808	20.6	209	5.3	2,912	74.1
1988	799	21.2	373	9.9	2,602	68.9
1989	1,158	39.4	373	12.7	1,406	47.9

Conclusion

The single most significant trend during the 1978-89 period was the upward growth in tonnages of all grains moved. This trend was driven almost entirely by the increase in domestic off-farm grain use, particularly that for corn. Off-farm feeding increased as the livestock industry, in general, expanded through a variety of structural changes that have meant fewer, but larger, feeders located outside of traditionally surplus grain production regions. Off-farm demand for grain also increased as industrial uses, especially those for corn and its processed products, expanded. The tonnages of grain moved to export showed a high degree of variability during the 12-year period. After falling from record high levels during the early 1980's, exports again expanded in the late 1980's.

The tonnages of all grain transported increased 21.6 percent, from 242 million tons in 1978 to 294 million tons in 1989. The tonnages transported by each mode also increased. Between 1978 and 1989, rail tonnages increased 22.7 percent, from 117 million tons to 144 million tons; barge tonnages increased 32.5 percent, from 51 million tons to 67 million tons; and truck tonnages increased 12.6 percent, from 74 million tons to 83 million tons.

The modal share analysis for all grains indicates that, despite significant changes in share during the period, modal shares remained very much the same in 1989 as in 1978. Rail share, which began in 1978 at 48.4 percent, ended the period in 1989 at 48.8 percent. Rail share gains in corn and soybeans were negated by a loss in the share of wheat movement. Barge share showed some increase in 1989 after several years of decline. Barge share, 21.0 percent in 1978, ended the period in 1989 at 22.9 percent. The increase in barge share is, in part, attributable to an increase in wheat share from 16.7 to 22.7 percent. Truck share, which showed a general trend upward from 30.6 percent in 1978 to a high of 36.4 percent in 1988, fell to a period low of 28.3 percent in 1989. Trucks increased their share of the wheat and sorghum movements, but lost share in the movements of all the other grains. Increased barge and truck shares of the wheat movement are the direct result of the increased production and marketing of soft red winter wheat.

As this study indicates, modal share is highly dependent upon the type of grains being transported and the shipment origination and destination markets. High levels of grain exports increase demand for rail and barge transportation. Increased domestic off-farm feed use and increased domestic demand for processed grain products drive up demand for truck transportation. Adequate rail, barge, and truck transportation are essential to a grain transportation infrastructure that supports the export and domestic marketing of U.S. grain. Public and private policymakers must consider these real-market implications as they address future agricultural and transportation policy questions.

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