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The Effects of Rail Prices on U.S. Agricultural Exports

Joann Peterson and Justin Choe[1]

Abstract

In the past decade, rail tariffs (or rates) for the transport of U.S. wheat and soybeans have increased at a faster rate than rail tariffs for corn and other agricultural commodities. In the United States, wheat, corn, and soybeans are grown in regions that are not served by inland waterways and that may have access to only one or two rail freight lines. The absence of transportation substitutes, such as trucking and barge services in certain wheat and soybean producing states, and inadequate competition among existing railroads in these markets, may increase supply chain costs for U.S. agricultural exporters, especially during periods of market volatility. While the U.S. rail transportation industry is relatively efficient compared to that of other key agricultural markets, recent observed increases in U.S. rail tariffs for agricultural goods, should they persist, may affect the long-term competitiveness of U.S. wheat and soybean exports in global markets. After discussing the main factors influencing pricing and competition among freight railroads, including the deregulation on the U.S. rail freight industry, the paper analyzes changes in rail tariffs, and how they affect U.S. export prices of wheat, corn, and soybeans.

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U.S. International Trade Commission

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Introduction

This paper presents an evaluation of the potential impact of an increase in rail prices on U.S. exports of wheat, soybean, and corn. It takes into consideration the factors that affect competition in the U.S. rail freight market, including the presence of captive markets in grain- and oilseed-producing states. The paper seeks to build upon prior work by Wilson and Dahl (2011) and Woodard et al. (2016) concerning the critical relationship between rail transportation rates and grain prices. Using the latest available data on U.S. grain exports, prices, and associated rail tariffs (or rail freight rates),[2] the authors present a quantitative analysis that examines the relationship between U.S. rail transportation costs over time, as well as U.S. export pricing trends for wheat, corn, and soybeans. The paper aims to answer the following questions:

- How are increases in U.S. rail freight rates manifested in U.S. grain export prices?
- To what extent have high U.S. rail tariffs affected the volume and pricing of U.S. grain exports over time?
- How has the pricing structure of U.S. rail freight transport affected the recent export competitiveness of U.S. grains and oilseeds?

The first half of the paper provides a qualitative overview of the rail freight industry with a focus on U.S. agricultural markets. This section also describes the main factors influencing pricing and competition among freight railroads, including the historical impact of deregulation on the U.S. rail freight industry.[3] The second half of the paper presents an analysis of changes in rail tariffs, and how they relate to the prices of U.S. wheat, corn, and soybeans, and discusses the potential impact on export competitiveness. For this analysis, the authors use data from the U.S. Department of Agriculture (USDA) Foreign Agricultural Service (FAS) on U.S. agricultural export prices and volumes, and data from the USDA Agriculture Marketing Service (AMS) on U.S. rail tariffs for agricultural goods, among other sources. Overall, the analysis indicates that rail tariffs in markets with little competition are high and have increased at a steady rate even when commodity prices are volatile. Although U.S. grain and oilseed producers typically absorb the higher rail costs rather than pass them on to consumers, these high rail tariffs may have long-term implications for the ability of U.S. producers to compete in international markets.

The Rail Freight Industry: From Deregulation to Monopoly Power

The Early Years of Rail Freight Industry Regulation

Railroads are a key player in the transport of U.S. agricultural goods. Indeed, the two industries are inextricably linked and are a central feature of the U.S. economy. At times, they have been subject to

[2] Rail tariffs include the rules, terms, and charges for rail service and associated logistics services. In the context of this paper, rail tariffs refer to the charges levied by the service provider on the consumers of rail service.
[2] Although the term "railroad" can simply refer to the steel tracks on which a train runs, for the purposes of this paper, a railroad encompasses the infrastructure, organization, and personnel that provide rail service.

competing regulatory objectives.[4] Following its initial development in the 1830s, the U.S. rail freight system encompassed an extensive network of primary, secondary, and tertiary rail lines. These rail lines connected farms in remote, rural areas to commercial ports near large, urban centers.[5] The Interstate Commerce Act of 1887 provided a legislative framework for the industry and established the Interstate Commerce Commission (ICC) as the industry regulator.[6] In this role, the ICC had jurisdiction over rail tariffs, the routes railroads served, their entry and exit from the market, and railroad mergers.[7]

Importantly, the ICC was tasked with ensuring that freight railroads charged "reasonable" rates, although the economic criteria underlying the determination of such rates were unclear.[8] In general, regulations permitted railroads to establish rates below their variable costs of operation if they could prove that they did not have a monopoly in the market.[9] The ICC also required railroads to fulfill the regulatory obligation of common carriage, or the mandatory provision of transport service to geographic markets regardless of traffic density.[10] As a result of common carriage requirements placed on rail transport, certain segments of the U.S. railroad industry over time became unprofitable, burdened by excess capacity and the inability to set rates in response to changing economic conditions.[11]

[4] As discussed later, the primary modal substitutes for rail transportation are truck and water (barge) transport.
[5] The focus of this paper is on freight rather than passenger rail services. Friedlaender and Spady, *Freight Transport Regulation*, 1.
[6]The ICC remained as the industry regulator until 1980. As trucking became a viable substitute for rail transport, the ICC sought to regulate trucking to ensure that it did not pose as a significant competitive threat to rail freight service. In general, railroad regulation is defined by a set of policies on rates, routes, mergers and acquisitions, and abandonment of service. Friedlaender and Spady, *Freight Transport Regulation*, 5.
[7] Friedlaender and Spady, *Freight Transport Regulation*, 1.
[8] Under regulation, Congress did not define reasonable rates and instead tasked the ICC with determining a definition for such rates. U.S. Department of Agriculture, Testimony by Edward Avalos, Under Secretary of Agriculture, before the Surface Transportation Board, April 2011, 11.
[9] If competition from trucking existed, then the ICC concluded that a railroad did not have monopoly power. Boyer, "The Costs of Price Regulation," *The RAND Journal of Economics*, Autumn 1987, 409. The calculation of variable costs in a service industry is somewhat illusory. For a good, the variable cost is the cost of producing an extra unit; for rail freight service, it is more difficult to discern the incremental cost associated with an additional mile traveled or ton of cargo carried. Gallamore and Meyer, *American Railroads*, Chapter 2: The Ills of Government Regulation of Rail Rates and Services.
[10] In general, rail freight lines benefit from economies of traffic density. That is, the more freight a railroad carries on a fixed route or network, the lower the average costs to the railroad of providing that service. Harris, "Economies of Traffic Density in the Rail Freight Industry," *The Bell Journal of Economics*, Autumn 1977, 557. While U.S. freight railroads are almost exclusively under private ownership, U.S. passenger railroads are owned by the U.S. federal government. Both freight and passenger railroads are regulated by the Federal Railroad Administration, which oversees the safety of their operations. The economic regulation of freight rail lines is overseen by the Surface Transportation Board, as discussed later in the paper.
Wilson, "Market-Specific Effects of Rail Deregulation," *The Journal of Industrial Economics*, March 1994, 3.

Over the next few decades, the U.S. railroad industry underwent significant reorganization.[12] During this period, regulation corrected for overcapacity and the declining revenues of railroads, on the one hand, and protected a growing agricultural sector from monopoly rail rates, on the other.[13] By the early 1900s, the ICC had introduced a system for regulating rail tariffs known as the "value of service (VOS)" rate structure. Under VOS regulation, railroads were able to charge steeper freight rates for higher-value manufactured products than for lower-value agricultural goods.[14] Thus, VOS rules permitted rail lines to effectively discriminate, or differentiate, pricing based on the value of the commodity being carried, rather than on the volume of goods transported, the distance shipped, or the traffic density of the route served.[15] Although VOS rules permitted rail lines to earn higher revenues for the transport of certain goods, common carriage obligations remained. As such, some railroads continued to suffer from overcapacity, leading them to grow inefficient and unprofitable. Beginning in the 1930s, bankruptcies among certain rail lines ensued and, in 1970, a new era for the U.S. railroad industry began with a reassessment of regulatory practices and a move towards deregulation under the Staggers Rail Act of 1980.[16]

[12] In general, railroad regulation is defined by a set of policies on rates, routes, mergers and acquisitions, and abandonment of service. As competition among railroads increases and there is downward pressure on rates, firms may form cartels to retain profitability. Thus, railroad regulation protected against cartelization. Friedlaender and Spady, *Freight Transport Regulation*, 6; and Gallamore and Meyer, *American Railroads*, Chapter 2: The Ills of Government Regulation of Rail Rates and Services. The paper does not discuss the effect of the Sherman Antitrust Act of 1890 on railroad cartelization and monopoly power.

[13] However, such regulation also achieved a fragile balance among the major stakeholders for freight transport at the time—railroads, trucking firms, agricultural producers, and manufacturers. Agricultural producers accepted higher rates for the shipment of manufactured products in return for lower rail rates on the transport of agricultural commodities. Trucking firms accepted lower rates on low density routes in return for value of service rates. Friedlaender and Spady, *Freight Transport Regulation*, 1 and 5–6.

[14] Although VOS rate regulation meant that agricultural shippers paid lower rail tariffs than manufacturers, subsequent analysis showed that such regulation may have favored the latter. This is because, under VOS regulation, rail rates represented a higher proportion of marginal costs for producers of bulk commodities (e.g. grains) than for manufactured goods. Gallimore and Meyer, *American Railroads*, Chapter 2: The Ills of Government Regulation of Rail Rates and Services.

[15] Further, the Hoch-Smith resolution of 1925 required the ICC to consider agricultural incomes when determining freight rates. This resolution was followed by ICC rate regulation of trucking and barge shipping, as service through these modes grew to become viable substitutes for rail freight service. The objective was to ensure that railroads remained profitable (so as to avert higher rates for captive shippers), even in the face of increasing competition from transportation substitutes. Friedlaender and Spady, *Freight Transport Regulation*, 2–3. Price discrimination was explicitly prohibited under the Interstate Commerce Act of 1887—that is, railroads could not charge one customer a higher rate for a similar service than another customer. Gallamore and Meyer, *American Railroads*, Chapter 2: The Ills of Government Regulation of Rail Rates and Services.

[16]Other legislation in addition to the Staggers Act was also introduced to assist the industry, most notably, the Railroad Revitalization and Regulatory Reform Act (4-R) of 1976 (9 Pub. L. No. 94–210, 90 Stat. 31). Both laws permitted rail lines to abandon unprofitable routes. Wilson, "Market-Specific Effects of Rail Deregulation," *The Journal of Industrial Economics*, 7. The 4-R Act enabled railroads to exercise greater pricing flexibility and partially removed restrictions on railroad track rationalization and mergers. Bitzan, et. al, "The Differential Effects of Rail Rate Deregulation," June 2003, 10.

The Staggers Rail Act of 1980 and the Era of Deregulation

The Staggers Rail Act of 1980 (i.e., "the Staggers Act") (S.1946 — 96th Congress (1979–1980)) deregulated the U.S. railroad industry, granting rail lines the flexibility to set their own rates, determine the scope of their operations, and abandon service on unprofitable routes—all in the hope that they would become more productive.[17] Passage of the Act followed a period of increasing reliance on substitutes for rail transportation (resulting primarily from investment in the U.S. highway system, enabling the expansion of the trucking market), growing inefficiencies in the rail network, and ineffective industry regulation.[18] Among other things, the Staggers Act allowed railroads to customize their service offerings and enter into confidential contracts with shippers, terminating a requirement that railroads file tariffs with the ICC.[19]

Early outcomes of deregulation were positive for both shippers and railroads, including more efficient rail service, lower freight rates, and the elimination of costly routes associated with common carriage.[20] However, deregulation also led to significant industry consolidation, as railroads abandoned smaller branch lines and merged to take advantage of economies of scale and scope across a wider range of geographic and product markets. With consolidation, a new industry structure emerged, consisting of Class I railroads (i.e., those providing long-distance service), Class II railroads (i.e., those providing regional rail service) and Class III railroads (e.g., those providing short line service in local markets). [21] The rationalization of rail freight industry following deregulation led to the emergence of monopoly and duopoly rail markets, including in U.S. grain- and oilseed-producing states (figure 1).[22] Many states in the Great Plains, including the Dakotas, Montana, and, Wyoming, for example, are served by only one or two railroads. By contrast, in the central and eastern United States, grain markets have access to multiple railroads (and water transport by barge).

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[17] Wilson, "Market-Specific Effects of Rail Deregulation," March 1994, 3–4. Average annual productivity growth for railroads in the 1970s was one to two percent, compared to two to three percent for other industries (including non-transport industries) during the same period. Winston, "The Success of the Staggers Rail Act of 1980," October 2005, 4.

[18] Deregulation of the trucking industry under the Federal Motor Carrier Act of 1980 (S. 2245 (96th)) permitted the expansion of truckload (TL) carriers. In some markets, TL carriers could provide cheaper freight transport service than rail lines, and therefore were a competitive threat to railroads. Winston, "The Success of the Staggers Rail Act of 1980," October 2005, 6.

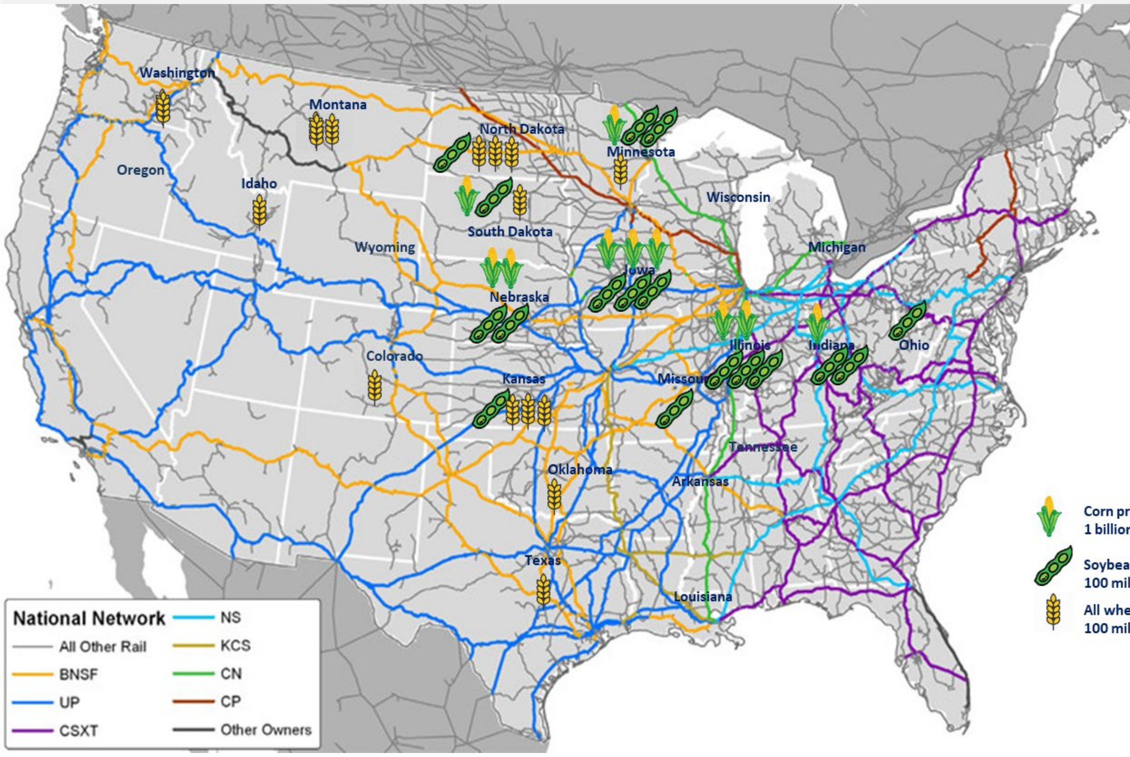
[19] Federal Railroad Administration, "Impact of the Staggers Rail Act of 1980," March 2011, 2.

[20] Although this paper does not provide a detailed analysis of the financial and operational outcomes of U.S. railroad deregulation, such an analysis has been undertaken by the Transportation Research Board (TRB), a division of the National Academy of Sciences, Engineering, and Medicine, for example. See "Table 1-1 Selected Statistics for Class I Freight Railroads, 1970–2013." TRB, *Modernizing Freight Rail Regulation*, 2015, 18.

[21] American Shortline and Regional Railroad Association, "Railroad Definitions," 2019; and USDOT, FRA, "Freight Rail Overview," July 8, 2020.

[22] Babcock and Atems, "Intrarailroad and Intermodal Competition Impacts on Railroad Wheat Rates," Fall 2015, 78.

Figure 1 The U.S. rail freight network post-Staggers Act



Source: Republished by Quora at https://www.quora.com/Why-did-USA-not-build-a-good-rail-connectivity, n.d. (accessed October 1, 2020) and compiled by USITC staff.

To offset the growing monopoly power of railroads, the Staggers Act included provisions to protect shippers in captive markets. Captive markets are those served primarily by a monopoly rail line and where shippers do not have access to alternatives such as truck or barge transport.[23] However, these provisions competed with the regulatory objective of ensuring that railroads maintained enough revenues to cover operating costs. In order to address these conflicting goals, the Staggers Act permitted railroads to engage in differential pricing, allowing them to cross-subsidize cheaper service to shippers in non-captive markets (i.e., those with access to truck and barge transport, and whose demand for rail service was more price elastic) from revenues earned in higher-margin captive markets (where shippers did not have access to transportation substitutes, and therefore had more inelastic demand for rail freight service).[24]

Although the practice of rate differentiation under the Staggers Act had a negative impact on the profit margins of many agricultural producers,[25] these negative price effects were mitigated by certain efficiency improvements in the rail transport of bulk commodities, like grains and oilseeds, through the

[23] GAO, "Freight Rail Pricing," December 2016, 18.
[24] Friedlaender and Spady, *Freight Transport Regulation*, 2–3.
[25] Producers of grains and oilseeds are considered as "price takers." Such commodities are homogenous and thus highly price elastic. Any increase in the cost of producing these commodities, including that associated with transport, are absorbed by farmers rather than passed on in the form of higher prices to consumers. USDA, "Comments of the U.S. Department of Agriculture before the Surface Transportation Board," April 12, 2011, 9; and USDA and USDOT, "Study of Rural Transportation Issues," April 2010, 204.

introduction of multi-car and unit train grain shipments (where all rail cars carry the same commodity).[26] Such improvements led to cost savings for railroads, which were then passed on to shippers.[27] The Staggers Act also allowed shippers and railroads to negotiate large-volume contracts for the transport of coal, grain, and other commodities at rates below the per-carload equivalent. The establishment of long-term contracts with shippers was an effective way for railroads to match the more competitive and flexible rates of trucking firms.[28] In some cases, railroads could adjust pricing in contracts to respond to market factors.[29]

In 1996, the Surface Transportation Board (STB) was established under the U.S. Department of Transportation as the economic regulator of the U.S. railroad industry, replacing functions of the ICC. Among other things, the STB limits the maximum value of rail tariffs that railroads can charge to captive shippers, and it oversees merger activity in the sector.[30] The STB also permits shippers to seek relief from excessively high freight rates.[31] The STB was established during a time when railroads were adjusting to a new competitive environment; in some cases, the early, positive outcomes of railroad deregulation under the Staggers Act were beginning to subside for rail lines and shippers. Railroads were faced with growing competition from trucks in certain geographic and niche product markets (e.g., refrigerated or just-in-time cargo), as well as rising costs from aging infrastructure and equipment. At the same time, shippers had less bargaining power vis-à-vis railroads due to mergers between large-scale rail lines, the abandonment of low-density routes, and the practice of rate differentiation.[32]

[26] USDA and USDOT, "Study of Rural Transportation Issues," April 2010, 289. Multiple car trains refer to trains that include between six and 49 rail cars and that transport freight from a single point of origin to one or more destinations. By contrast, unit trains consist of more than 50 rail cars and transport freight between a single origin and a single destination. Further, shuttle trains are composed of more than 75 rail cars, transport freight between two designated points, and are used in cases where the loading and unloading of freight is completed in a short time frame.

[27] See STB, "Study of Rail Rates: 1985–2007," January 16, 2009, 9, "Figure 3: Grain Rates and Train Type." The data in this figure show that between 1985 and 2007, railroad revenue per ton-mile decreased for single car (less than 6 cars), multi-car (6 to 49 cars), and unit train (more than 49 cars) grain shipments. The decrease was most pronounced for single car shipments. In addition, between 1985 and 2007, rates for single car grain shipments fell the most (3.3 cents per ton mile in 2007 compared to 5.7 cents in 1985) but still remained the costliest to shippers. By contrast, revenues per ton-mile for unit grain train shipments declined the least over the same period, and the earlier cost-savings to shippers from this service had diminished by 2007. Rates for unit train grain shipments were 2.4 cents per ton-mile in 1985, declining only to 2.3 cents per ton-mile in 2007.

[28] Approximately 20 percent of grain ton-miles in the United States are moved by contract rather than by common carriage. However, some common carriage movements enable grain shippers to reserve rail cars by auction, also a feature of contracts. Railroads prefer to provide service to grain shippers through common carriage because the volume and routing for grain shipments are often irregular. The rail transport of grains (and oilseeds) largely by common carriage means that these commodities are subject to rail tariff rates, which are similar to spot rates. TRB, *Modernizing Freight Rail Regulation*, 2015, 44 and 47.

[29] GAO, "Freight Rail Pricing," December 2016, 19.

[30] Under the STB, grains and oilseeds are considered as "non-exempt" commodities with respect to rules governing common carriage. More specifically, rail rates for the common carriage of these commodities are not exempt from and must adhere to STB ratemaking guidelines. "Exempt" commodities include those that are often conveyed in smaller volumes by truck (e.g., fresh fruits and vegetables) and, therefore, are more likely to benefit from intermodal competition. Commodities carried under contract with railroads are also exempt from STB rules on rail rates. TRB, *Modernizing Freight Rail Regulation*, 2015, 36–37.

[31] Ellig, "Railroad Deregulation and Consumer Welfare," 2002, 146.

[32] Bitzan, "The Differential Effects of Rail Rate Deregulation," June 2003, 17–18.

Industry Structure and Competition Following the Staggers Act

The most striking outcome of deregulation under the Staggers Act was the decrease in the number of Class I freight railroads in the United States—from 56 in 1975 to seven in 2005, the number that currently operates today. These railroads provide service over long distances and operate a combined total of 140,000 miles of track in the United States. The seven Class I freight railroads (i.e., those with annual operating revenues of $490 million or above) that serve the U.S. market are Burlington Northern Santa Fe (BNSF), CSX, Kansas City Southern (KCS) Railway, Norfolk Southern (NS), Union Pacific (UP), the Grand Trunk Corporation (a U.S. subsidiary of Canada National (CN) Railway), and Soo Railroad (a U.S. subsidiary of Canadian Pacific (CP) Railway). In addition, there are 22 regional rail freight lines that provide service over distances of at least 350 miles including, for example, the Belt Railway of Chicago, the Genesee and Wyoming, and the Indiana Belt Railway.[33] Moreover, there are nearly 600 local line haul carriers and switching and terminal carriers (that provide service to other railroads) in the U.S. market.[34]

In response to the Staggers Act, railroads began to reconfigure the supply chain for grains—shifting away from the point-to-point transport of goods from farm to consumer (or port) to a hub-and-spoke system. The hub-and-spoke system permits railroads to serve smaller customers by channeling traffic through centralized depots connecting large rail lines with smaller feeder (or short line rail) services.[35] The concentration of rail freight traffic in a single hub enables rail lines to achieve economies of traffic density, making service more cost efficient than point-to-point transport.

Other Factors Affecting the Demand for And Supply of Rail Freight Services

The demand for and supply of rail freight transport service for grains is currently affected by several factors. Among the most significant demand factors are the availability of transportation substitutes and the role played by grain elevators, whereas the supply of rail freight has been most influenced by innovations in rail service, including the development of intermodal hubs.

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[33] The regional freight railroads refer to line-haul railroads that operate a distance of at least 350 miles and earn $20 million in annual revenues or above, as well as line-haul railroads that earn between $40 and $490 million in annual revenues, regardless of mileage operated. USDOT, FRA, "Freight Rail Overview," July 8, 2020.

[34] CSX, "Short Line and Regional Railroads," 2016 (accessed September 25, 2020). The establishment of reciprocal switching agreements (in which one rail line agrees to carry the freight of another rail line), are one way to increase competition in a market, but high switching fees can also hinder competition. USDA, "Comments of the U.S. Department of Agriculture before the Surface Transportation Board," April 12, 2011, 5; and Hecker, Freight Railroads: Updated Information on Rates and Competition Issues," September 25, 2007, 17–18.

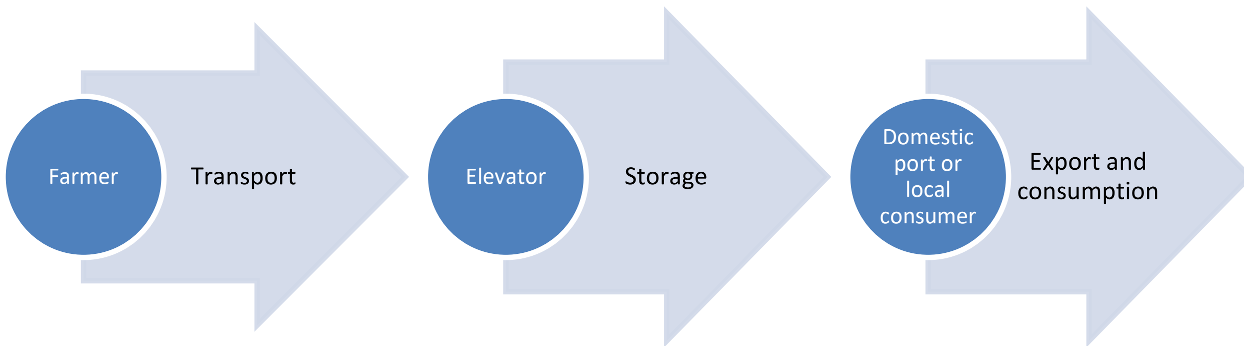
[35] See, for example, CSX, "Short Line and Regional Railroads," 2016 (accessed September 25, 2020). While hub-and-spoke systems are prevalent in the airline industry, the economic principles used to manage the marginal costs of airline passenger traffic may also apply to freight logistics, including transport by rail. Johnson, "How the Hub-and-Spoke Model Can Improve Distribution for Rail Networks," March 16, 2016.

First, although U.S. freight railroads typically account for the majority of domestic transport of agricultural goods by volume, their share of transport in grain markets has decreased in recent years.[36] Trucking has emerged as a viable substitute for rail transport in some grain markets, outpacing growth in the share of such transport by rail freight. In other cases, truck transport serves as a complement to rail service by providing, for example, the last mile delivery of goods that travel by rail.[37] In general, trucks face fewer infrastructure constraints than railroads, and can accommodate both short- and long-haul distances, as well as truckload (TL) and less-than-truckload (LTL) volumes, without a significant impact on their overhead costs.[38] Although the transport of grains by barge is also a substitute in certain markets for rail transport, barge transport is limited by the availability of nearby waterways and therefore does not pose as an immediate threat to rail service in many U.S. markets.[39] In some cases, barge transport complements transport by truck and rail, especially in export markets in the eastern and southern United States.[40]

Second, grain elevators work in conjunction with railroads to transport and distribute grain in a cost-efficient manner (figure 2). As such, elevators serve as consolidation and storage points for grain and oilseeds, preventing spoilage of these goods, and facilitate the movement of grains to domestic consumers or export markets.[41]

[36] USDA, "Transportation of U.S. Grains: A Modal Share Analysis," updated April 2019. Figure 5: U.S. grain modal shares, 1978–2016, 5. For example, the share by tonnage of grain transported by truck in the U.S. market increased from approximately 30 percent to 60 percent between 1978 and 2016. During the same period, the share of grain transported by rail decreased from about 50 percent to 25 percent. Further, the share of grain transported by barge fell from about 20 percent to 15 percent. The data include the transport of barley, corn, sorghum, soybeans, and wheat.
[37] USDA and USDOT, "Study of Rural Transportation Issues," April 2010, 403–404. To illustrate further, trucks may transport goods between barge and rail providers, from rail stations to consumers, and within remote or rural areas not served by rail transport.
[38] The role of rail-to-rail competition in determining rail tariffs may be diminished in markets where grains and seeds are consumed by the local market, including for further processing, or as inputs into the feed and dairy industries, both of which are frequently served by truck transport. Bitzan, "The Differential Effects of Rail Rate Deregulation," June 2003, 33. Full TL operations refer to the transport volumes of more than 2,000 pounds; LTL refers to transport of small shipments ranging in size from 500 to 2,000 pounds. USDA and USDOT, "Study of Rural Transportation Issues," April 2010, 407.
[39] U.S. wheat-producing states are, on average, more than 150 miles away from barge transportation on the Mississippi River, a major waterway for inland barge traffic destined for the Gulf Coast.
[40] Export ports include those along the Atlantic and Pacific coasts, the Mississippi, Louisiana and Texas Gulf coasts, and the Great Lakes. Inland waterways include the Arkansas, Columbia, Illinois, Ohio, Missouri, and Mississippi rivers.
[41] See, for example, CSX, "Agriculture Location Maps," Accessed September 25, 2020.

Figure 2 The supply chain for grains in U.S. agricultural markets



Source: Compiled by USITC staff.
Note: In the supply chain for grains, the difference between the farm price of grains and their export price (i.e., the costs of transportation, storage, and other services) is referred to as a price spread.

At present, the majority of grain elevators in the United States are located near end-users or maritime ports, particularly in the Gulf Coast, the Midwest, the Pacific Northwest, and the West Coast.[42] At the same time, however, the reduction of branch rail lines after railroad deregulation—i.e., railroads providing grain transport service between farms and elevators—has led to the development and increasing use of shuttle train service. Shuttle trains permit the loading and unloading of grains directly from silos on farms, thereby bypassing the need for third-party storage.[43]

Finally, railroads have responded to an increase in competition from trucks with the deployment of larger capacity grain cars for economies of scale and, as noted, the use of unit train grain shipments.[44] Such innovations are facilitated by investment in rolling stock and power units that permit rail lines to carry more cargo over longer distances.[45] The cost savings from these scale economies may be passed on to shippers in the form of lower freight rates.[46] Rail lines have also taken advantage of economies scale by investing in intermodal hubs that consolidate freight from both small and large-scale customers, thereby dispersing the costs of such service over higher freight volumes. This has enabled railroads to

[42] USDA and USDOT, "Study of Rural Transportation Issues," April 2010, 32–33. See Figure 2-7: Location of elevator storage capacity, with rail and barge systems.
[43] USDA and USDOT, "Study of Rural Transportation Issues," April 2010, 254–255. In shuttle trains, the locomotive remains attached to the cars, unlike in unit train carriage. See, for example, "MaxYield Cooperative 100 Rail Car Loading Process, West Bend, IA," posted on August 20, 2012.
[44] USDA and USDOT, "Study of Rural Transportation Issues," April 2010, xi.
[45] Rolling stock refers to the vehicular equipment used by railroads, including train cars, wagons, and locomotives.
[46] Bitzan, "The Differential Effects of Rail Rate Deregulation," June 2003, 17.

maintain or acquire market share among small customers, some of whom had been served by branch lines, and whose primary alternative to rail freight service is trucking.[47]

Literature Review

This section reviews several studies on the impact of rail transport pricing on agricultural goods.[48] Overall, these studies find that rail tariffs are most influenced by the presence of transportation substitutes—specifically, the availability and proximity of grain shippers to barge transport. Intra-rail competition may also lead to lower rail tariffs, but the effects of such competition are less significant than the effects of transportation substitutes. Other factors that have a mitigating effect on rail tariffs are transport distance and shipment weight. Both factors lead to higher revenue-to-variable cost ratios for freight railroads.

First, in his paper, MacDonald (1987) estimated the impacts of intra- and intermodal competition (i.e., competition within the same transportation mode or competition between modes, like truck and rail) on U.S. rail tariffs for corn, wheat, and soybeans. The paper focuses on grain markets in Kansas, Oklahoma, and Texas in the Southern Plains; Nebraska, Minnesota, Montana, North Dakota, and South Dakota in the Northern Plains; and Idaho and Washington in the Northwest. The author used data from the Interstate Commerce Commission's (ICC) Annual Railway Waybill sample for 1983. The data contain individual observations of shipments for corn, soybeans, and wheat from designated points of origin. The author found that rail tariffs decrease in markets where grain shippers have access, and are closer in distance to, inland waterway transport by barge.[49] By contrast, shippers that are farther from barge traffic paid higher rail tariffs (see MacDonald 1989).[50] The author also found that intra-rail competition (i.e., competition between railroads) has a less significant effect on rail tariffs in markets where transportation substitutes exist.[51]

Second, Prater, et. al (2010) perform a two-part analysis on the impact of declining U.S. freight rail competition on rail tariffs for agricultural commodities. In the first part, the authors examine railroad concentration in U.S. crop reporting districts (CRDs) for six states during 1985–2007. The analysis included four commodity groups: grains and oilseeds; grain products; food products; and fertilizers.[52] Of the four groups, grains and oilseeds experienced decreases in competition across the largest number of CRDs, as measured by inverse Herfindahl-Hirschman Indices (HHIs), and the highest increase in the

[47] Johnson, "How the Hub-and-Spoke Model Can Improve Distribution for Rail Networks," *Inbound Logistics*, March 16, 2016; and Miklovic, "Expansion Continues at CSX Northwest Ohio Intermodal – Nov. 26," November 26, 2014. Intermodal hubs enable the efficient movement of twenty-foot-equivalent unit (TEU) containers among rail, trucks, and ships. For more information about intermodal operations and their relationship to rail freight transport see, for example, FreightRailWorks, "How Freight Railroads Transport Goods Through Intermodal," posted August 13, 2015.

[48] For further analysis of studies that track rail rate reductions on grains, oilseeds, and other commodities following the Staggers Act, see "Table 1-2 Rail Rates Studies, Early Post-Deregulation Period" in TRB, "Modernizing Freight Rail Regulation," 2015, 20.

[49] MacDonald, "Competition and Rail Rates for the Shipment of Corn, Soybeans, and Wheat," Spring 1987, 151–153.

[50] MacDonald, "Effects of Railroad Competition on Grain Transportation," USDA, June 1989, 10–18.

[51] MacDonald, "Competition and Rail Rates for the Shipment of Corn, Soybeans, and Wheat," Spring 1987, 152–153.

[52] Prater, et. al, "Rail Competition Changes Since the Staggers Act," Fall 2010, 111–115.

presence of railroad monopolies.[53] The authors conclude that because railroad deregulation led to mergers and acquisitions among major freight rail lines and the abandonment of rail service in some areas, it contributed to the near-monopoly power of rail providers in certain grain-producing states. In the absence of regulation, intra- and intermodal competition are the primary ways to prevent excessive tariffs, but in some U.S. grain markets, such competition is inadequate.[54]

In the second part of their study, Prater, et. al examine rail tariffs during 1988–2007 in six states with limited rail-to-rail competition and distant from barge transport: Colorado, Kansas, Montana, Nebraska, North Dakota, and South Dakota; and four states with higher intra-rail competition and closer to barge facilities: Illinois, Indiana, Iowa, and Missouri. The authors found that the lack of intra-rail or barge-to-rail competition in states such as Montana and North Dakota had a less significant effect on rail tariffs than length of transport. Railroads in Montana and North Dakota transported grain over longer distances, resulting in higher revenue-to-variable cost ratios for these railroads and lower tariffs for their customers.[55]

Third, Babcock and Atems (2015) examine the rail transport of wheat in nine U.S. states— Idaho, Kansas, Minnesota, Montana, North Dakota, Oklahoma, South Dakota, Texas, and Washington — using rail traffic data from 2012. The authors found that railroad costs, such as transport distance and shipment weight, were significant determinants of rail tariffs for wheat producers. The authors also found that intermodal competition (i.e., railroad versus a combination of truck-to-barge transport) was significant, even though most of the nine states were relatively far from internal waterways.[56] At the same time, intramodal competition among railroads, as measured by the HHI, was not significant, although such competition exists to varying degrees within the nine states included in the study.[57]

Other studies look at effects of deregulation across different agricultural commodities. For example, using data from 1981–2000, Bitzan, et. al (2003) examine how rail pricing for agricultural goods is affected by the characteristics of the commodity being shipped. Specifically, Bitzan, et. al look at the effects on rail tariffs of transport distance, transport substitutes, the availability of substitutes for certain commodities (like corn for soybeans used as domestic feed), and the geographic dispersion of production. The authors find that the availability of commodity substitutes, in particular, leads to high price elasticity for rail transport and a decrease in rail tariffs.[58] Moreover, commodities that are produced in multiple locations are subject to lower rail prices than commodities produced in only one or a few locations. Finally, the availability of transportation substitutes (e.g., truck and barge) and nearby access to domestic feed and export markets, may mitigate the negative price effects of near-monopoly

[53] The HHI index ranges from 0 to 1, with 0 representing a perfectly competitive market, and 1, a monopoly market. Bitzan, "The Differential Effects of Rail Rate Deregulation," June 2003, 17.
[54] Prater, et. al, "Rail Competition Changes Since the Staggers Act," Fall 2010, 126–127.
[55] Prater, et. al, "Rail Competition Changes Since the Staggers Act," Fall 2010, 124–126.
[56] U.S. wheat-producing states are, on average, more than 150 miles away from barge transportation on the Mississippi River, a major waterway for inland barge traffic destined for the Gulf Coast. Babcock and Atems, "Intrarailroad and Intermodal Competition Impacts on Railroad Wheat Rates," JTRF Volume, Fall 2015, 61–62.
[57] Babcock, Michael W. and Bebonchu Atems, "Intrarailroad and Intermodal Competition Impacts on Railroad Wheat Rates," Fall 2015, 79–81.
[58] Bitzan, "The Differential Effects of Rail Rate Deregulation," June 2003, 25.

railroad status in some markets, as producers benefit from both intermodal competition and proximity to consumers.[59]

Other recent studies employ econometric analysis to examine the interaction between grain prices and rail tariffs. For example, Wilson and Dahl (2011) use an econometric model to find that the basis values of grains becomes more volatile during periods of increasing global demand.[60] Using weekly data for soybeans and corn, the authors also examine the basis values and futures prices and link them to the concentration of firms in the rail industry. The authors find that rail concentration varies greatly by region, and that the price margins associated with handling and trading, excluding shipping costs of all modes, have been growing over time. Ultimately, the authors show that there is an inverse relationship between the price that the farmer receives for grains and their shipping costs.

At the same time, Woodard et al. (2016) examine commodity price behavior and grain flows. The authors find that rail network costs have “frictional” impacts on the basis value of grains.[61] Using several model specifications, the authors show that spatial factors lead to arbitrage relationships in grain basis prices. Furthermore, the authors find that rail tariffs apply a downward pressure on local spot market prices relative to exchange-traded futures prices. The findings of both the Wilson and Woodard studies imply that increasing volatility in price behavior increases the overall risk for farmers, and that higher rail tariffs are likely to result in higher spot market prices for grains.[62]

Quantitative Analysis of Rail Tariffs and Grain Exports

Overview

This section is divided into three parts. Following a review of the data and methodology used in the paper, the first part of the section discusses the relative importance of agricultural goods to the U.S. rail freight sector and examines the geographic concentration of U.S. grain production. The second part describes growth in U.S. export markets for grains, particularly in Asia. It also examines the differences in rail tariffs for grains destined for export markets compared to grains for domestic consumption. The final part of the section discusses the effects of rail freight prices and the likely impact on profits of U.S. grain producers, and the extent to which such prices may have an impact on the competitiveness of U.S. grain exports.

While previous studies have examined the impact of shipping on grain prices, we conduct a parsimonious analysis using historical trends to determine the relationship between rail transport and grain exports, including, but not limited to, an examination of rail tariffs, agricultural export volumes,

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[59] Bitzan, “The Differential Effects of Rail Rate Deregulation,” June 2003, 14–18.
[60] Wilson and Dahl, “Grain Pricing and Transportation,” Autumn 2011, 420–434.
[61] Woodard, Dutta, and Xue, “Impacts of Futures Markets Speculation and Rail Transportation Networks on Commodity Basis Behavior.” Conference paper presented at the Agricultural and Applied Economics Association, 2016 Annual Meeting, July 31–August 2, Boston, Massachusetts. Grain basis refers to the difference between the cash market price for a grain and its future price, which is an indicator of nearby supply sufficiency.
[62] Woodard, Dutta, and Xue. Conference paper presented at the Agricultural and Applied Economics Association, 2016 Annual Meeting, July 31–August 2, Boston, Massachusetts.

and commodity prices.[63] In light of recent trade policy changes around the world, especially regarding key grain exports markets such as China, it is worthwhile to conduct the analysis with recent data. Further analysis is conducted using the spatial characteristics of rail transportation and the destination of exports, as well as other transportation modes

Data and Methodology

This paper uses a wide range of data sources, largely from the U.S. Department of Agriculture (USDA), to analyze the rail industry and its impact on the grain sector. For U.S. rail tariff rates, data from USDA Agricultural Marketing Service (AMS) is used.[64] The online database collects price data from the websites of Class I railroad companies, and provides monthly average rail tariffs for corn, soybeans, and wheat. The dataset also includes the origin city and state, as well as the destination city and state for each rail shipment. The distance between the end points, as well as the per-car, per-ton, and per-domestic unit tariffs are included as well.

The authors also use data from AMS' rail car-loadings database,[65] and weekly carloads data from the Surface Transportation Board's (STB) Rail Service Metrics. The STB data are divided into 23 major commodity groups. These groups follow the Standard Transportation Commodity Code (STCC), a seven-digit number that identifies cargo that is loaded onto rail cars (i.e., loaded cargo). The database also shows which of the seven Class I railroads is responsible for the shipment. Concurrently, the Grain Rail Cars Loaded and Billed database[66] is used, for state-level information and further detail on the type of railroad (i.e., shuttle vs. dedicated). This database only includes railcars that fall under specific STCCs.[67]

At the commodity level, the authors use several sources of agricultural pricing data. For example, USDA's "Commodity Price Spreads" database provides grain prices at select inland origin points and key export points, thereby revealing the price spread between the origin and destination for these commodities.[68] Origin points differ slightly by commodity based on key production regions.[69] Separately, for export pricing, the authors rely on data from the Foreign Agricultural Service (FAS). The first dataset is the "Production, Supply, and Distribution" database, which lists USDA's latest estimates for

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[63] Parsimonious analysis uses a streamlined model that has few assumptions and variables but nonetheless is effective in explaining observed trends.
[64] USDA, "U.S. Rail Tariff Rates for Grain and Soybeans." Accessed November 2, 2020.
[65] USDA, "Rail Carloadings." Accessed November 2, 2020.
[66] USDA, "Grain Rail Cars Loaded and Billed.", Accessed November 2, 2020.
[67] The STCCs that are used are as follows: 01131 (barley), 01132 (corn), 01133 (oats), 01135 (rye), 01136 (sorghum grains), 01137 (wheat), 01139 (grain, not elsewhere classified), 01144 (soybeans), 01341 (beans, dry), 01342 (peas, dry), and 01343 (cowpeas, lentils, or lupines). To ascertain the volume of grains transported by barge, the authors use the down-bound barge grain movements database. These data are provided by the U.S. Army Corps of Engineers and maintained by the USDA. The commodities that are tracked include corn, soybeans, wheat, and other grains (i.e., oats, barley, sorghum, and rye). Similarly, another database entitled "Barge Volumes by Commodity Category in Tons" contains data on annual volumes of major commodities that are transported by barge on the Mississippi River. This dataset also uses information from the U.S. Army Corps of Engineers, and provides a comparison of the volume coal, petroleum, and grains transported by barge. USDA, "Downbound Barge Grain Movements (Tons)." Accessed November 2, 2020.
[68] USDA, "Commodity Price Spreads." Accessed November 2, 2020.
[69] Origin and destination points that are tracked include: Illinois and Nebraska with the Gulf for corn; Iowa and Gulf for soybean; Kansas and Gulf for hard red winter wheat; and North Dakota and Portland for hard red spring wheat.

production, trade, consumption, and storage.[70] The data are stored by marketing year, following the natural crop production cycles of a given crop by country. The second FAS database is the "Global Agricultural Trade System Online," which provides monthly trade statistics by U.S. trade partners for key exports such as corn, wheat, and soybeans.[71] In addition, agricultural commodity prices are also derived from the International Grains Council (IGC). IGC provides market data and daily free on board (f.o.b.) prices for key grain exporters in nominal U.S. dollars.[72] Data include export prices from U.S. exporters, as well as other competitors such as Argentina, Brazil, and Ukraine.[73]

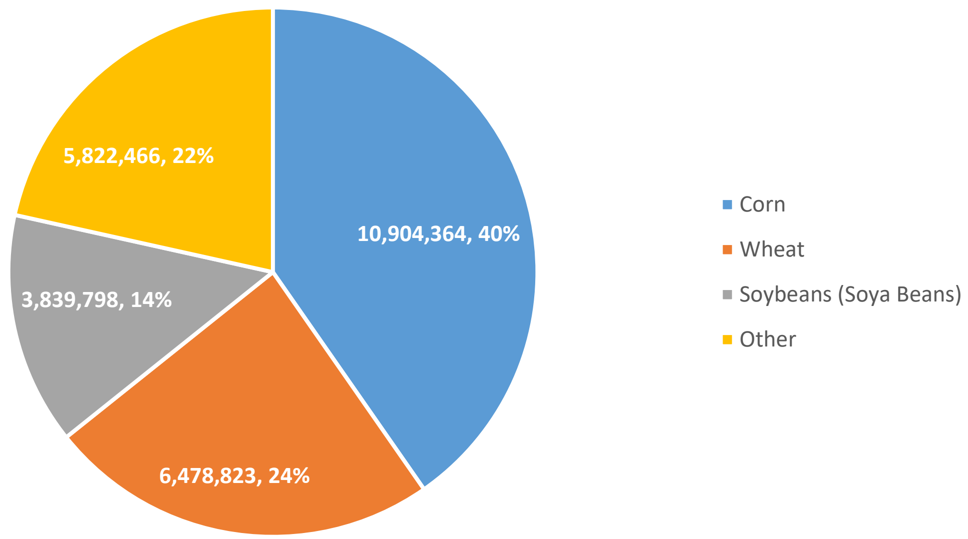
While the results of regression analyses were not sufficiently robust to include in the current version of this paper, and data limitations precluded other quantitative analyses, the constructed framework provides a potential avenue of future research with increased data availability or a narrower scope of research.[74]

The Importance of Agriculture to Railroad Systems

Agricultural goods account for a significant proportion of U.S. rail freight transport. Measured by volume and tonnage, farm products (identified under STCC 01, which includes grains and oilseeds) is the fourth-largest commodity that is shipped on the rail system (figure 3).[75] When measured by carloads, farm products still remain one of the key commodity groups as the eighth-largest, indicating that shipments of farm products by rail are relatively heavy per car compared to other commodity groups (figure 4). Regardless of measurement, shipments of agricultural goods account for a large portion of rail freight, in both relative and absolute terms.

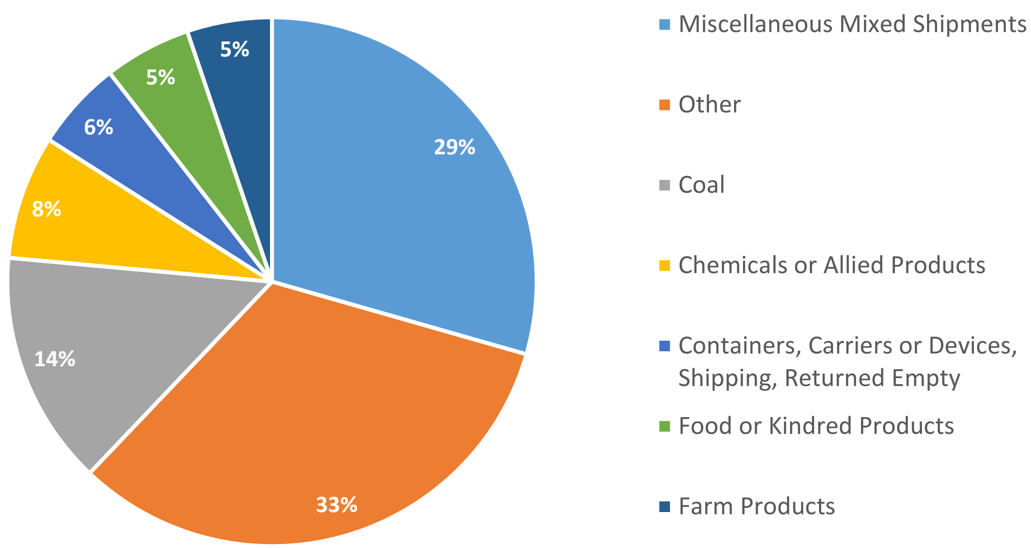
[70] USDA, "PSD Online." Accessed November 2, 2020.
[71] USDA, Foreign Agricultural Service, "Global Agricultural Trade System Online." Accessed November 2, 2020.
[72] Free on board is a term that denotes the price of the goods at the point of uniform valuation. United Nations et al., *System of National Accounts 2008*.
[73] Data on export prices use free-on-board (fob). FOB contracts relieve the seller of responsibility once the goods are shipped. After the goods have been loaded onto a ship—technically, "passed the ship's rail"—their control is transferred to the importer.
[74] Largely two factors are thought to have impacted this outcome. First, data availability prevents of capturing the frequent changes in grain prices and the corresponding demand changes, as well as region-specific effects. Second, the specific details of each shipping contract are unobservable, and may contain specific clauses that may alter the decision-making process of the farmer.
[75] STCC 01 "Farm Products", includes Field Crops (011), Fresh fruits and tree nuts (012), Fresh vegetables (013), Livestock and livestock products (014), Poultry and poultry products (015), and miscellaneous farm products (019).

Figure 3 Top agricultural commodity groups by tonnage, 2015



Source: USDA, AMS, Agricultural Transportation Open Data Platform. Portal. Accessed November 2, 2020.

Figure 4 Key rail commodity groups by carloads, 2015



Source: USDA, AMS, Agricultural Transportation Open Data Platform. Portal. Accessed November 2, 2020.

Within farm products, corn, wheat, and soybeans are the three largest commodity groups and account for 87 percent of all shipments, measured by volume. Farm products outside of these three commodities include other grains such as sorghum, barley, and oats, but their overall volume is much smaller. The large share of rail freight volume represented by corn, soybeans, and wheat underlines the importance of these grain products and their close relationship to the railroad industry.[76]

U.S. Grain Production and Domestic Transport

U.S. production of grains and oilseeds is geographically concentrated, leading to an inherent challenge in transporting agricultural goods for export.[77] A substantial share of U.S. crop production is in midwestern states that do not have direct access to maritime ports.[78] Therefore, when U.S. grains from these areas are destined for export, total transportation costs may be higher compared to other states that have direct access to waterways. This is due to geographic distance from ports and a lack intra- or intermodal competition in associated transport markets, as found in prior studies.[79]

The maps below depict the production, rail transport, and export of wheat and soybeans, using three datasets from 2015: the Surface Transportation Board's (STB) confidential Carload Waybill Sample; county-level production data from USDA's National Agricultural Statistics Service; and export volume data from USDA's Federal Grain Inspection Service (figure 5).[80] Darkly shaded areas on the maps represent areas of high agricultural production, measured in bushels. Thick lines represent large volumes of rail freight, in metric tons. Large circles represent high levels of inspections at each port, indicating greater exports emanating from these locations.

[76] Association of American Railroads, "Grain: How Freight Rail Moves Wheat, Soy & Corn.", Accessed November 18, 2020.

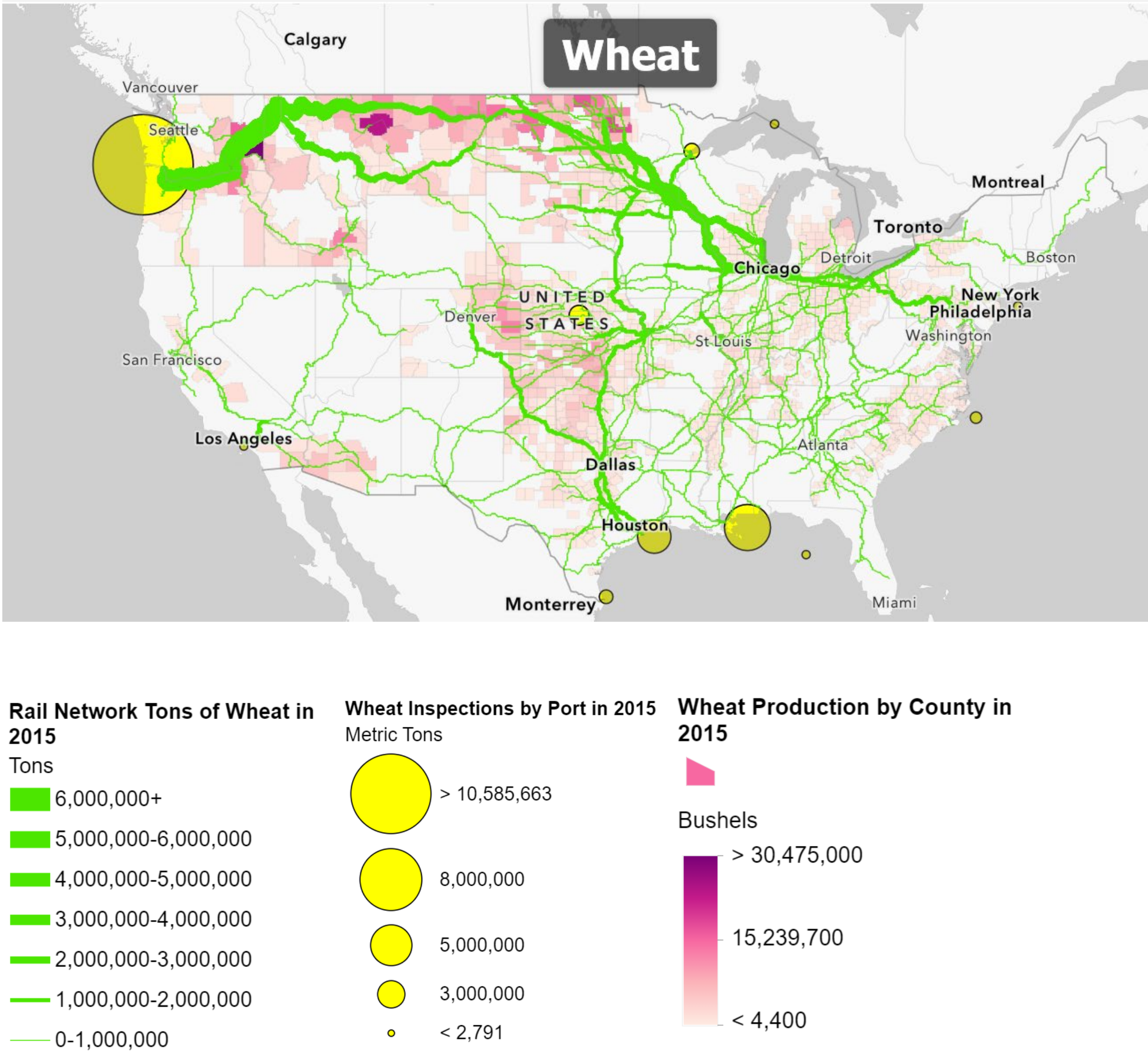
[77] For more information on the geographic characteristics of U.S. grain production, see appendix A.

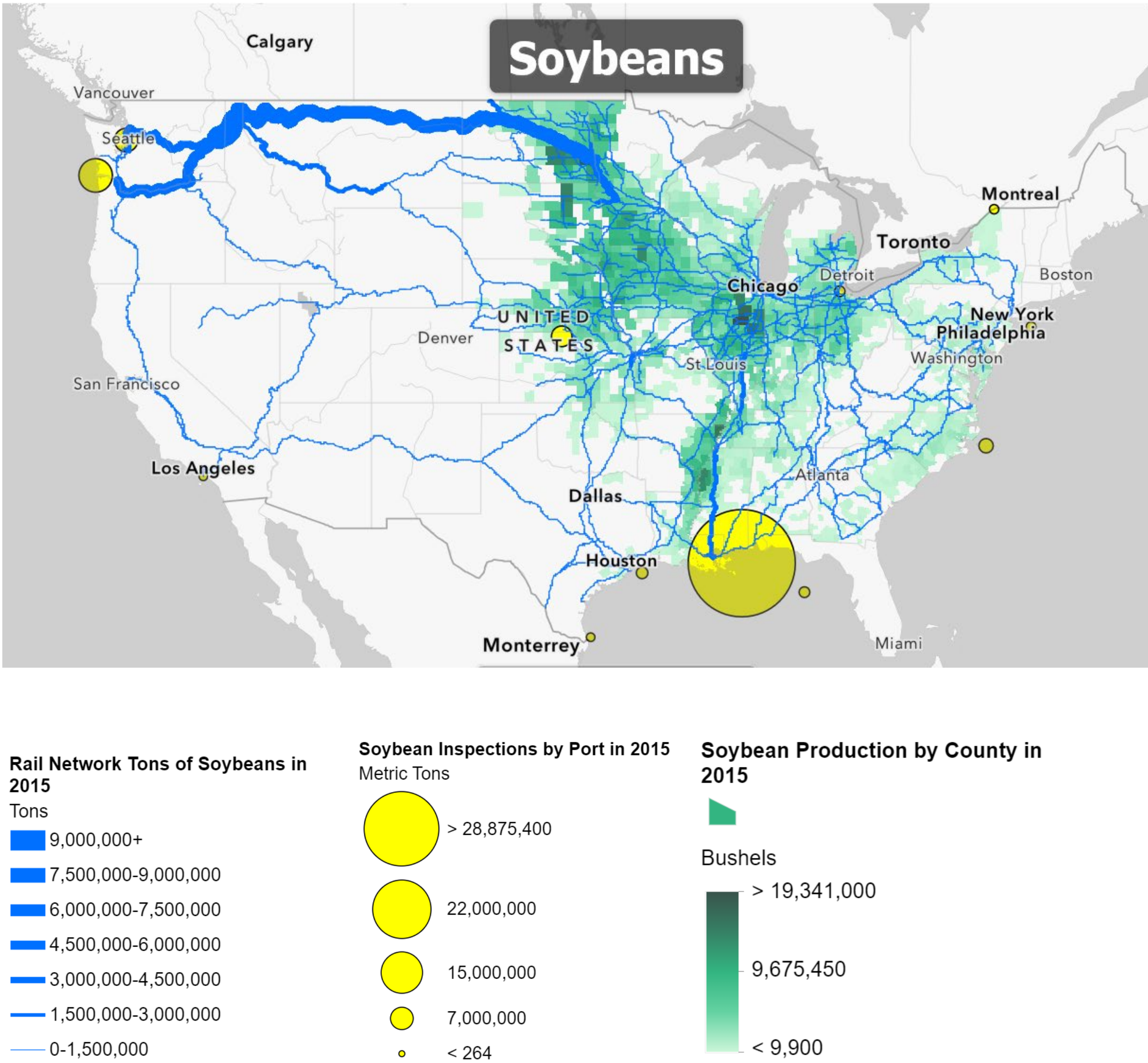
[78] Table A.1 in Appendix A, which shows the production share by state, for wheat, corn, and soybeans illustrates this dispersion. For corn, the top five producing account for roughly 60 percent of national production. The same applies for soybeans, where the top five producing states account for 52 percent of total production. The top three producing states of wheat produce 46 percent of national production for the 2019 season. Most, if not all, of these states are clustered in the Midwest.

[79] MacDonald, "Competition and Rail Rates for the Shipment of Corn, Soybeans, and Wheat," *Rand Journal of Economics* Spring 1987, 151–153.

[80] USDA, "The Role of Rail in Agricultural Transportation." Accessed November 2, 2020.

Figure 5 U.S. production, transportation, and export locations for wheat and soybeans, 2015





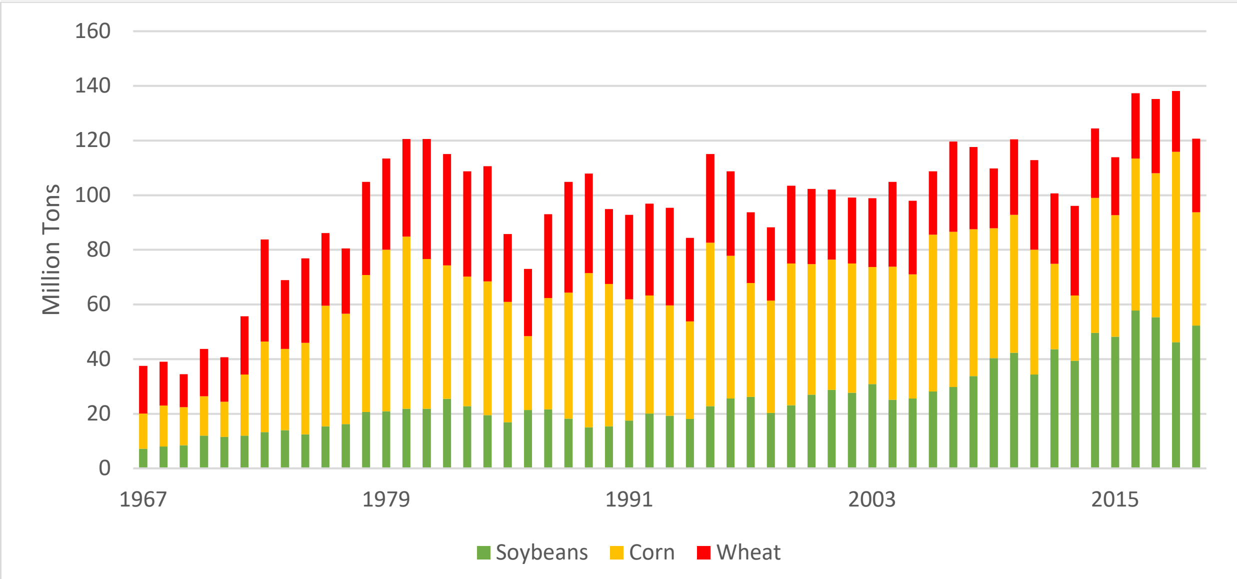
Source: STB and USDA. Agricultural Transportation Open Data Platform. Accessed November 2, 2020.

The maps illustrate the spatial challenge of U.S. agricultural exports, or the difficulty of transporting these commodities from inland locations to key ports. U.S. soybean production is concentrated in the Midwest, in states such as Illinois, Iowa, and Minnesota. Exports of soybeans from these markets flow primarily through New Orleans and are largely destined for China. By contrast, a large portion of U.S. wheat exports from the Midwest are conveyed by rail to the Pacific Northwest (PNW), and then transported by ship from Portland or Seattle to Asian markets. The strong dependence on railroad lines in the Pacific Northwest, especially for high producing wheat states, is shown by the thick green lines in the first map. The example underscores the findings of prior research: landlocked states are subject to higher rail prices than non-landlocked states because the former have no close barge access and limited rail-to-rail competition.[81]

U.S. Exports of Agricultural Commodities

U.S. exports of key agricultural commodities—corn, soybeans, and wheat— have grown rapidly in the past couple of decades due to an increasing demand for grains and oilseeds in Asian markets. In 2015, exports of soybeans exceeded 52 million tons, which is more than seven times the amount of U.S. exports in 1967 (figure 6). The same applies for wheat and corn: corn exports at 41.5 million tons is three times that in 1967, and wheat exports have also grown 50 percent to roughly 27 million tons.

Figure 6 Annual U.S. exports of agricultural commodities, 1967–2015, million tons

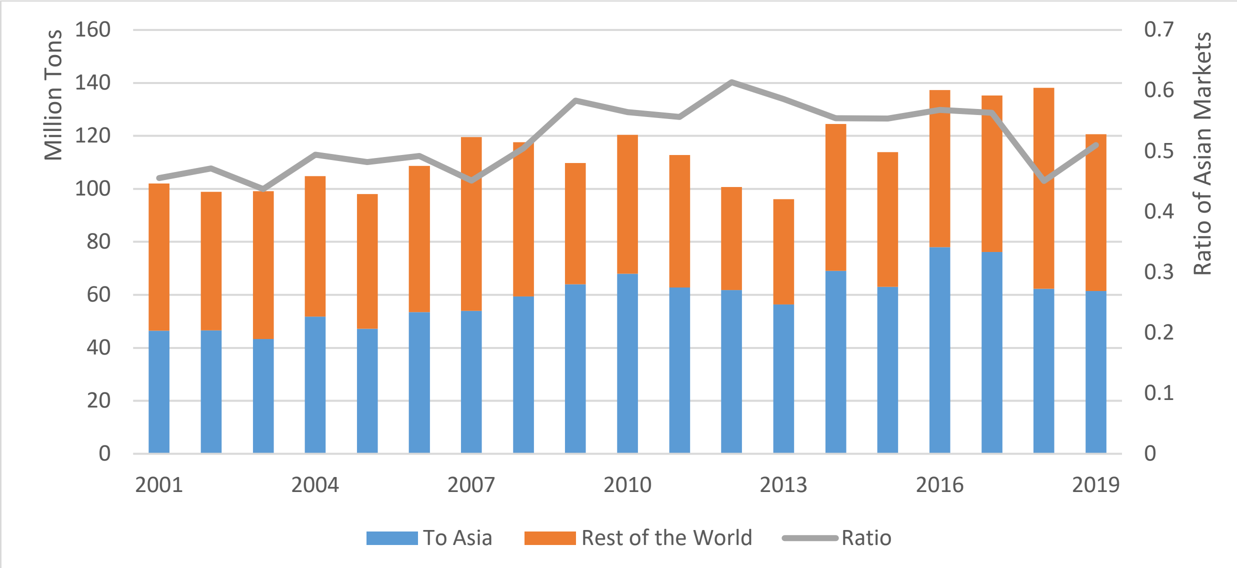


Source: USDA Foreign Agricultural Service, Global Agricultural Trade System. Accessed March 15, 2021.

During this rapid growth, Asia has emerged as a primary destination for agricultural goods.[82] Since 2001, exports of corn, soybeans, and wheat have grown from an aggregated 46 million tons to over 78 million tons in 2016 (figures 7 and 8, and table B.2). The share of Asian markets, measured as a portion of total exports, has also grown from 46 percent in 2001 to a high of 61 percent in 2012, falling to 51 percent in 2019. While exports to China headline such growth, constant growth in East Asian markets such as Japan and South Korea, and emerging markets in Southeast Asia, are also key demand drivers.[83]

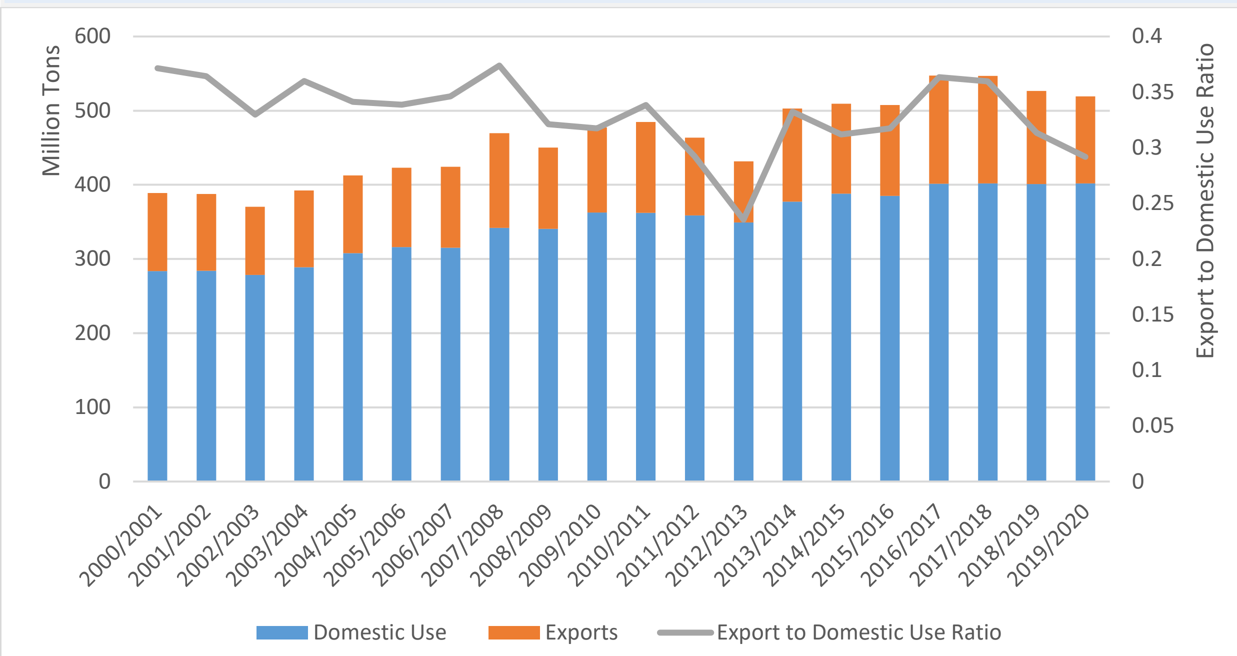
[81] Prater, et. al, “Rail Competition Changes Since the Staggers Act,” *Journal of the Transportation Research Forum*, Fall 2010, 126–127.
[82] Asia includes East Asia (China, Japan, South Korea, Taiwan, Hong Kong, Mongolia, Macau, and North Korea), Southeast Asia (Vietnam, Philippines, Indonesia, Thailand, Malaysia, Singapore, Burma, Cambodia, Brunei, Laos, and Timor-Leste), and South Asia (India, Pakistan, Bangladesh, Sri Lanka, Nepal, Maldives, Bhutan, and Afghanistan).
[83] Levin Flake, “Southeast Asia: A Fast-Growing Market for U.S. Agricultural Products.” USDA, FAS, 2014.

Figure 7 U.S. grain exports to Asia compared to non-Asian countries, 2001–2019, million tons



Source: USDA Foreign Agricultural Service, Global Agricultural Trade System. Accessed November 2, 2020.

Figure 8 Changes in Domestic Use and Exports of U.S. grains, 2000–2019, million tons



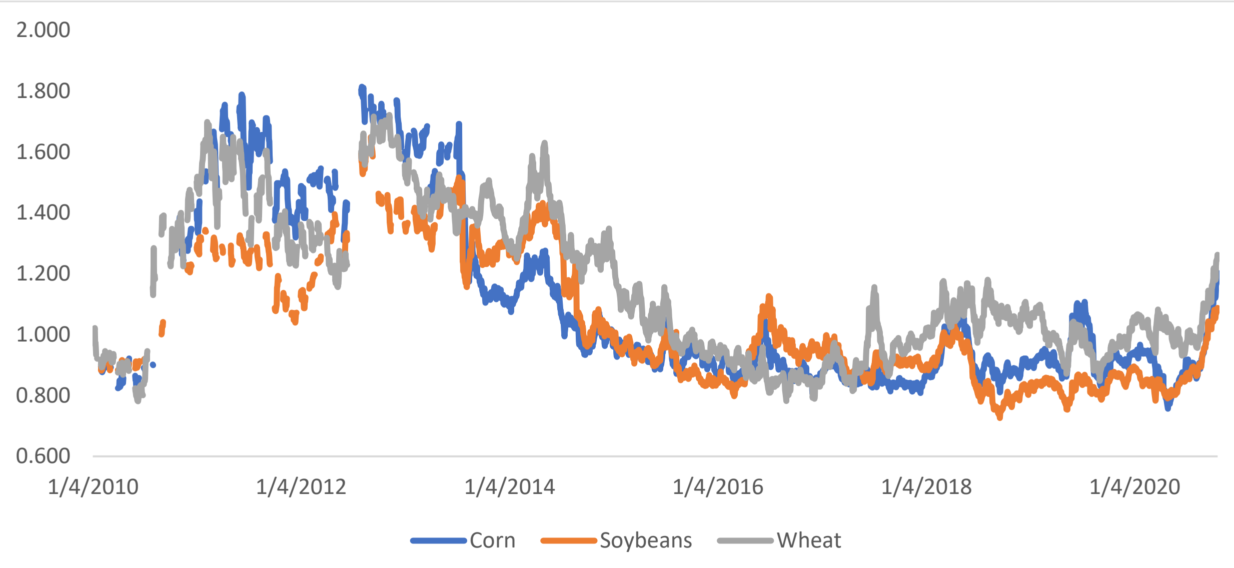
Source: USDA Foreign Agricultural Service, PSD Database. Accessed November 2, 2020.

With strong demand coming from Asian markets, rail shipments of agricultural commodities have shifted away from domestic markets and towards maritime ports. Key ports used for U.S. export shipments are New Orleans, Louisiana in the South, and Portland, Oregon and Seattle, Washington in the Pacific Northwest.[84] Notwithstanding growth in the demand for U.S. grain exports, 2010–2020 data

[84] USDA, “Profiles of Top U.S. Agricultural Ports.”, 2013

indicate a downward trend in U.S. grain export prices (figure 9). This decrease may be partly due to higher global production and rising yields for certain grains and oilseeds. Overall, the increasing reliance of U.S. grain exporters on rail transport, coupled with a decade-long decline in grain export prices, have made rail tariffs more important to the farm economy.[85]

Figure 9 Export prices of U.S. grains, indexed (January 1, 2020 = 1)



Source: USDA, AMS. Grain Transportation Report Datasets. Accessed November 2, 2020

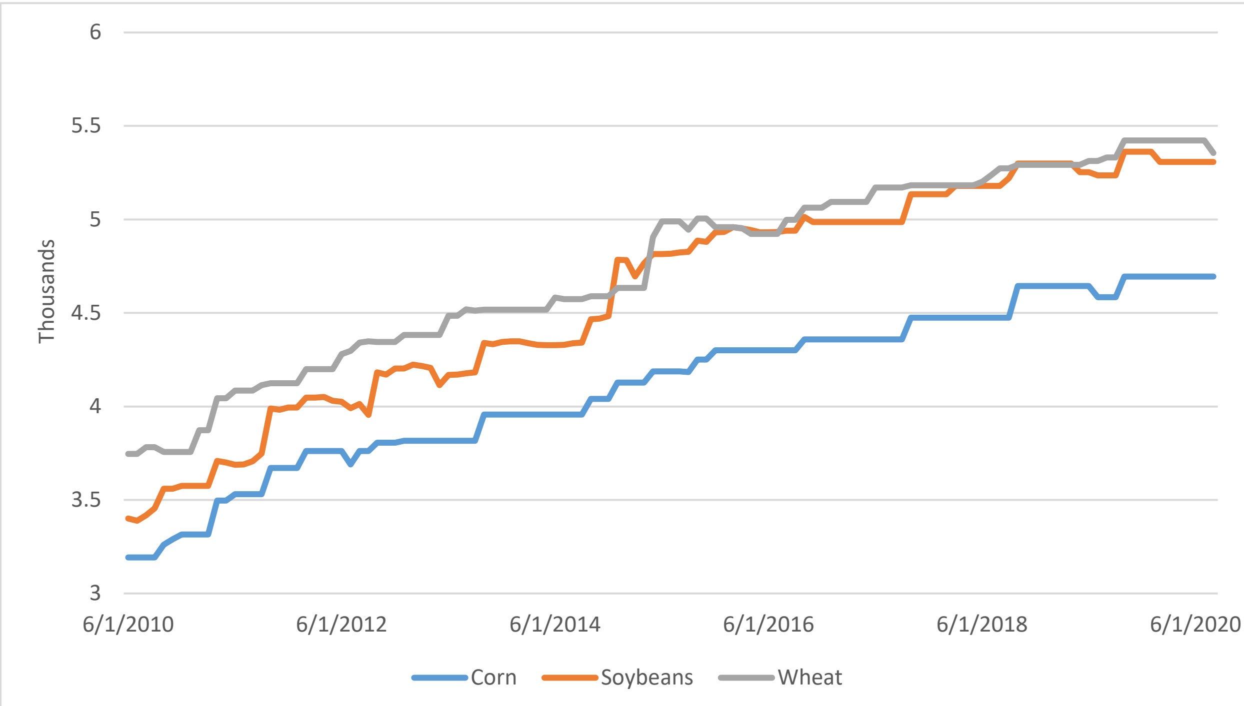
Changes in Rail Tariffs for U.S. Grain Producers and Price Spreads

With expanding global demand for U.S. grains and oilseeds, rail tariffs have risen, in turn increasing the transportation price burden on agricultural shippers.[86], The average rail tariffs for grains have risen steadily in the last decade according to USDA AMS, and, as mentioned earlier, many studies have demonstrated that rail tariffs have a clear economic impact on commodity prices, especially on prices that farmers receive.[87] In some cases, the transportation prices are simply added to the origin prices to cover costs. In other cases, transportation costs are borne by agents in the value chain, such as grain elevators and processors, in the form of time and risk.[88] For farmers that produce grain for export, high rail tariffs may lead to higher price spreads and lower profitability.[89]

[85] Funk, "Slowing Economy, Trade Wars, Drag on US Rail Companies.", 2019.
[86] For a comparison of barge, rail, and truck transport of U.S. grains and oilseeds, see appendix B.
[87] Wilson and Dahl, "Grain Pricing and Transportation", 2011; Woodard, Dutta, and Xue, "Impacts of Futures Markets Speculation and Rail Transportation Networks on Commodity Basis Behavior.", 2016.
[88] Steadman and Kruse, "Identifying Transportation Costs Associated with Soybeans, Corn, and Related Agricultural Products.", 2019.
[89] Steadman and Kruse, "Identifying Transportation Costs Associated with Soybeans, Corn, and Related Agricultural Products.", 2019.

To illustrate, rail tariffs per carload for U.S. corn shipments have risen from roughly $3,200 in June 2010 to nearly $4,700 in August 2020, representing a 47-percent increase (figure 10). Rail tariffs for wheat have jumped from $3,746 to $5,355 in the same time frame and, for soybeans, from $3,400 to over $5,300, representing 43 percent and 56 percent growth, respectively.

Figure 10 Rail tariffs per carload, by commodity, U.S. dollars, 2010–2016



Source: USDA, AMS. Grain Transportation Report Datasets. Accessed November 2, 2020.

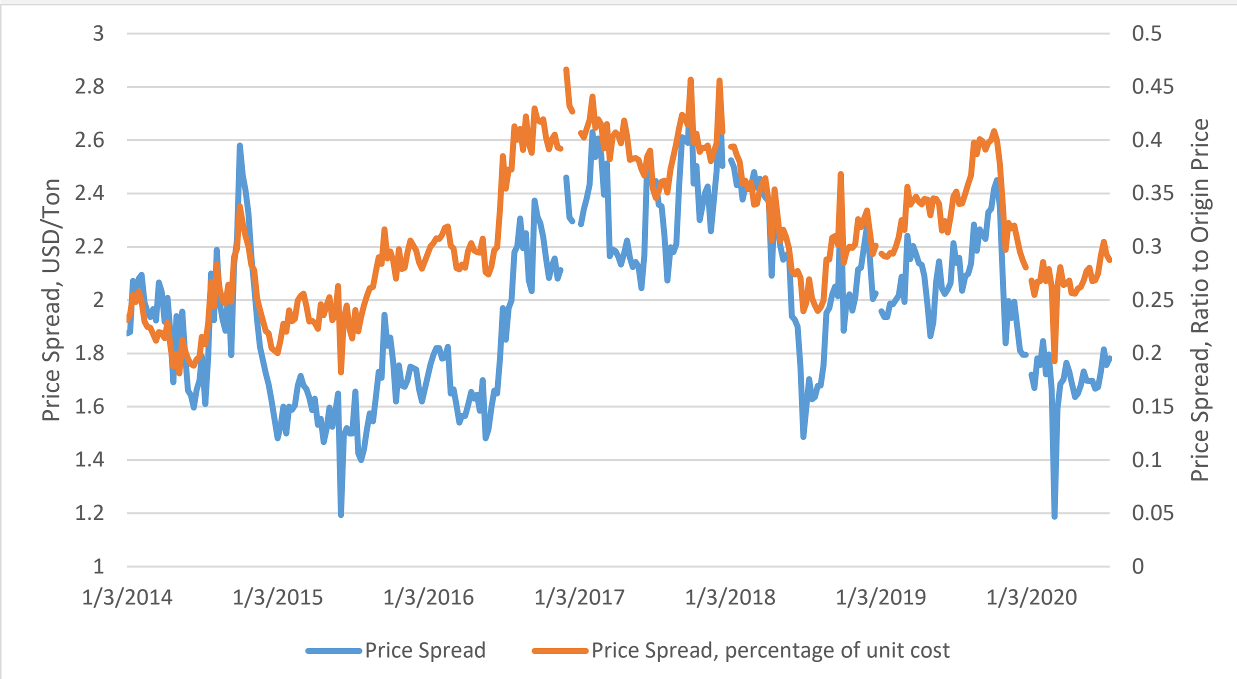
Rail tariffs are heavily regulated, and the rail industry structure has not changed much since the Staggers Rail Act of 1980. However, the grain markets have changed significantly, and the levels of demand and supply for both agricultural commodities and shipping services have risen sharply. This is illustrated in figure 10, which shows that during 2010–2016 when international grain demand increased sharply, rail prices for corn and soybeans increased at a higher rate than wheat. This suggests, among other things, that changes in both domestic and international demand for U.S. agricultural goods may place pressure on the capacity of the rail transportation system, thus leading to price implications.[90]

Some studies have shown that higher rail tariffs are transferred to the producer, as observed through the price spreads of grains. Our analysis shows that increasing rail tariffs have not been reflected in price spreads.[91] For example, figure 11 shows the price spread of hard red winter (HRW) wheat destined for the Gulf region in Louisiana or Portland, Oregon. During 2014–20, the price spreads have been volatile in both absolute and relative terms.[92] The blue line represents the actual price wedge between the origin

[90] Marsh, "Grain Shippers Brace for Tight Rail Market.", 2020.
[91] The spread equals the difference between the farm price of grains and their export price, and covers the costs of transportation, storage, and other services.
[92] Hard red winter wheat is the most common variation of wheat grown in the United States and is produced in the midwestern plain states. It is also a popular class of wheat for U.S. export.

and destination points, whereas the orange line illustrates the ratio of the price wedge to the origin price. This price spread reflects additional economic factors such as storage costs and price hedging. In comparison to the upward trend of railroad tariffs shown above, the price spread shows volatility, reflective of changing economic factors in agricultural commodity markets. [93] The price spread represents the difference between the origin and destination, regardless of export orientation. The price spread is assumed to cover all logistics costs, including rail freight. Thus, while the price spread is volatile, due to a strong influence from commodity markets, the freight rates continue to steadily rise, squeezing farmers and other stakeholders along the value chain.

Figure 11 Price spreads for wheat, 2014–2020, in U.S. dollars per metric ton



Source: USDA, AMS. Grain Transportation Report Datasets. Accessed November 2, 2020

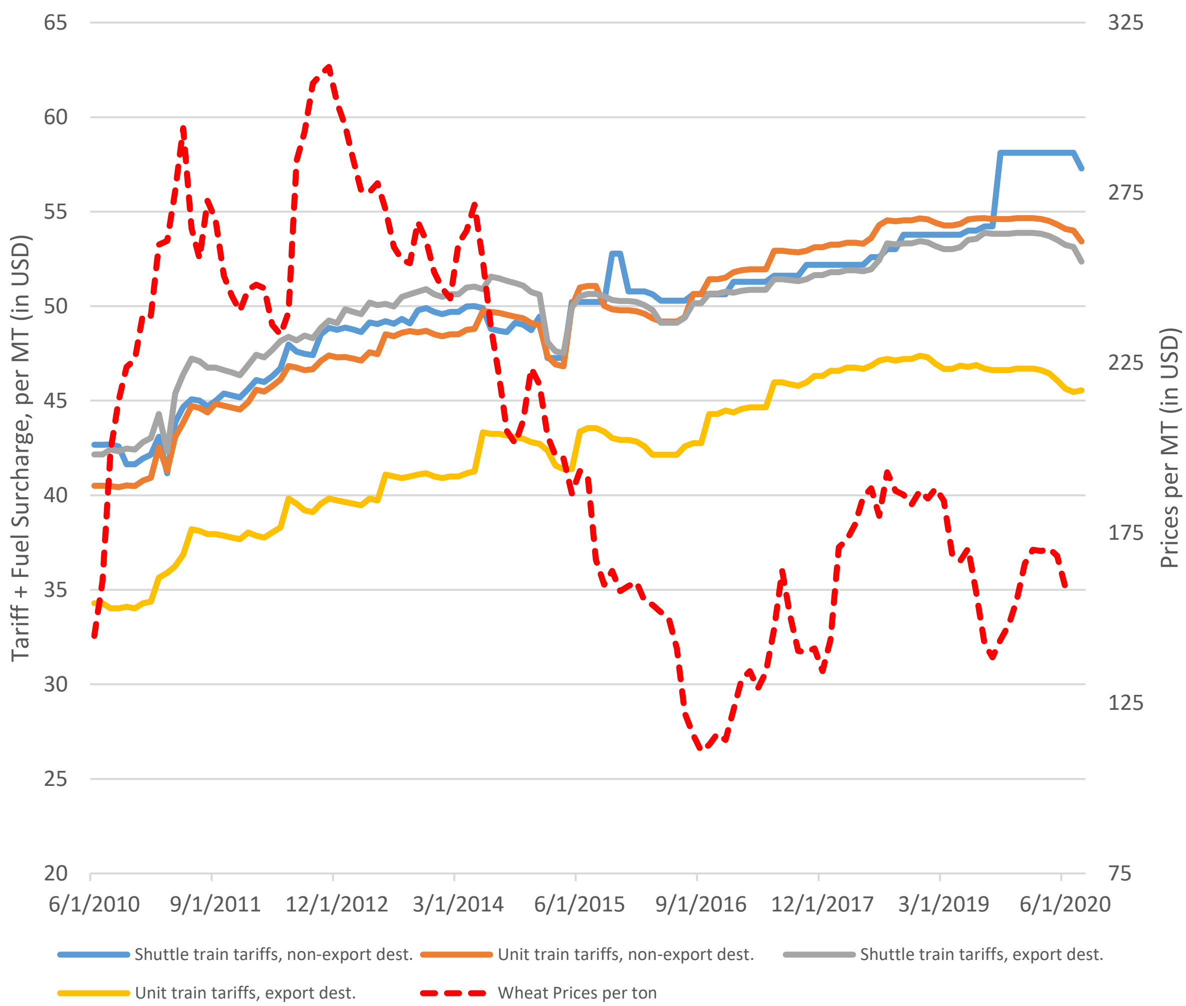
Effects of Higher Rail Tariffs on U.S. Grain Exporters

With rising transportation costs, U.S. grain export competitiveness is likely to be affected, especially for grains with high demand in East Asian markets. Higher rail transportation costs may be transferred to the producer, reducing the incomes and profit margins of producers and negatively affecting the competitiveness of U.S. grain exports. As seen in figure 12, U.S. wheat prices have fluctuated rapidly

[93] For soybeans and corn, price variance is also observed, although not as pronounced as that of HRW. Unlike the case with HRW, corn and soybean price spreads are relatively stationary, reflecting the overall size of exports and trade volume in the futures market. For corn and soybeans, price spreads for destinations apart from Louisiana and Oregon (i.e., price spreads for non-export markets) have been added to the AMS database, starting in 2020. Historical observations are unavailable, but the price spreads for export-oriented destinations are higher than that of non-export destinations.

over the last 10 years, ranging from over $300 per ton to as low as below $125 per ton. However, rail tariffs have steadily increased from roughly $40 per ton to near $55 per ton. Thus, the cost of rail transportation may account for more than 40 percent of the price of U.S. wheat, with long-term revenue implications for U.S. grain exporters.

Figure 12 U.S. wheat prices and rail tariffs, 2010–15



Source: USDA, AMS. Grain Transportation Report Datasets. Accessed November 2, 2020

Conclusion

The Staggers Act of 1980 changed the regulatory landscape of U.S. railroads with a view toward decreasing the cost of rail freight service through increased efficiencies and the removal of common carriage requirements. This objective was partly achieved through the merger of large U.S. rail lines, which also diminished rail competition in many grain-producing states. At present, despite the original intent of U.S. railroad deregulation, most large U.S. railroads still retain monopoly or near-monopoly status, providing a disincentive for them to decrease freight rates. At the same time, the availability of truck and, particularly, barge service as substitutes for rail transportation remain limited in certain agricultural markets, including those in the Midwest and the Pacific Northwest. As a result, where domestic or export demand for U.S. grains and oilseeds from these markets has increased, rail rates have also increased.

Data on rail tariffs examined in this paper indicate an increasing trend in rail prices for the transport of corn, soybeans, and wheat over the past decade. While the key drivers of such price increases are unobservable from aggregate data, it is evident that rail tariffs do not always respond to macroeconomic factors affecting the demand for other types of transportation. Where farmers are unable to absorb the additional costs of rail transport, and these higher costs are instead incorporated further along the value chain, they may have an adverse effect on the competitiveness of U.S. grain exports. New investments in U.S. rail infrastructure, equipment, and technology could bring further productivity gains to railroads and, hence, pricing benefits to U.S. grain and oilseed producers and exporters.[94] Future research should work to examine the impact of productivity gains in the rail freight industry on U.S. grain and oilseed producers, as well as draw comparisons between the impact of rail tariffs on the export competitiveness of the U.S. grain and oilseed industry and that of other key grain markets, such as Argentina, Brazil, and Ukraine.

[94] Leonard, “6 Charts Show How PSR Changed Rail,” April 22, 2020.

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Appendix A

Table A.1 U.S. production of key crops by state, 2019, percentage share

State	Corn	Soybeans	Wheat	Corn	Soybeans	Wheat
	In million bushels			Share (%)		
ALABAMA	237	54	6	0	0	0
ARIZONA	9	0	3	0	0	0
ARKANSAS	654	656	3	1	4	0
CALIFORNIA	62	0	7	0	0	0
COLORADO	881	0	98	1	0	5
DELAWARE	141	33	4	0	0	0
FLORIDA	9	0	0	0	0	0
GEORGIA	284	15	3	0	0	0
IDAHO	132	0	99	0	0	5
ILLINOIS	9288	2620	37	14	15	2
INDIANA	4019	1326	16	6	7	1
IOWA	12657	2465	0	18	14	0
KANSAS	4041	973	338	6	5	18
KENTUCKY	1297	424	25	2	2	1
LOUISIANA	462	211	0	1	1	0
MARYLAND	363	110	12	1	1	1
MICHIGAN	1284	367	34	2	2	2
MINNESOTA	6307	1525	80	9	8	4
MISSISSIPPI	542	419	1	1	2	0
MISSOURI	2388	1151	25	3	6	1
MONTANA	6	0	219	0	0	11
NEBRASKA	8963	1417	55	13	8	3
NEW JERSEY	11	19	1	0	0	0
NEW MEXICO	6	0	3	0	0	0
NEW YORK	403	54	4	1	0	0
NORTH CAROLINA	497	281	13	1	2	1
NORTH DAKOTA	2315	943	321	3	5	17
OHIO	2082	1019	22	3	6	1
OKLAHOMA	227	59	110	0	0	6
OREGON	11	0	50	0	0	3
OTHER STATES	294	0	0	0	0	0
PENNSYLVANIA	761	151	10	1	1	1
SOUTH CAROLINA	189	50	2	0	0	0
SOUTH DAKOTA	3008	760	66	4	4	3
TENNESSEE	803	341	14	1	2	1
TEXAS	1442	12	70	2	0	4
UTAH	4	0	6	0	0	0
WASHINGTON	90	0	143	0	0	7
WEST VIRGINIA	6	0	0	0	0	0
WISCONSIN	2301	406	10	3	2	0
WYOMING	8	0	5	0	0	0

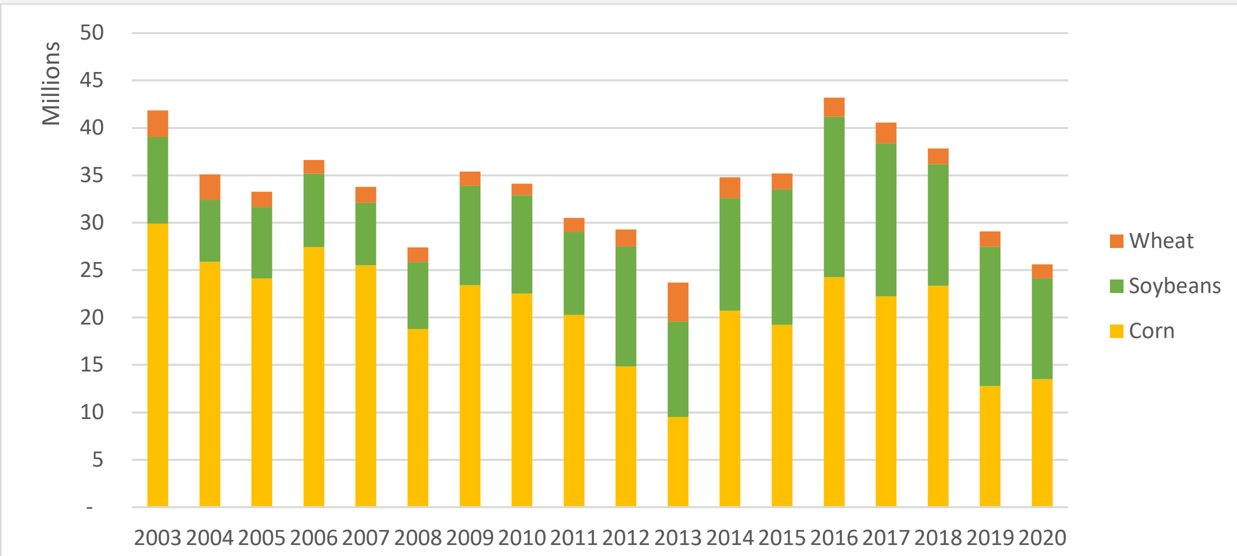
Source: National Agricultural Statistical Agency, Crop Production, 2019

Appendix B

Other Modes of Transport for Agricultural Goods

An important consideration for an agricultural shipper is the selection of transportation mode. As discussed in the first section of this paper, an agricultural shipper may choose between rail, truck, or barge to transport goods to the next step in the value chain. Especially for large amounts of grain, the choice between barge and rail becomes an important decision point for the shipper. Both modes of transportation can move large amounts at a competitive price, but each have their own challenges.[95] For instance, barge use depends highly on the weather, as weather patterns affect water levels in major waterways (figure B.1). Demand for these transportation services also reflect macroeconomic and industry specific factors, as seen in the sharp drops during a global recession in 2008 and a massive drought in 2013 when exports were halved.

Figure B.1 U.S. down-bound grain movements via barge, 2003–2020, million tons



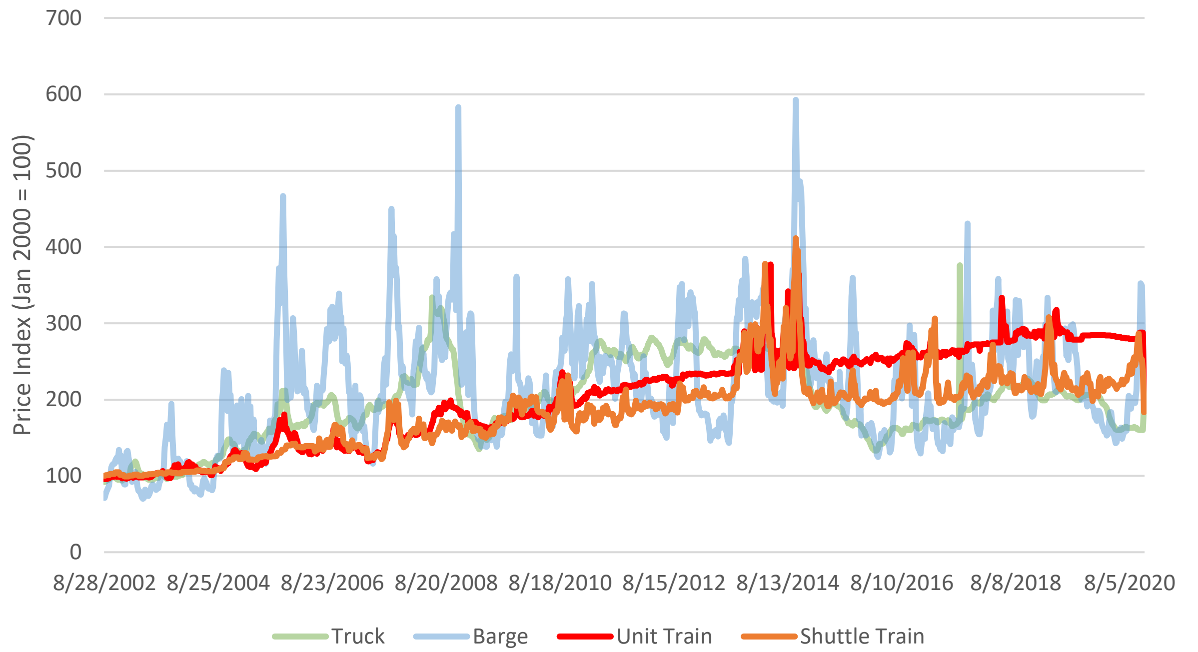
Source: USDA. Agricultural Transportation Open Data Platform. Accessed November 2, 2020

At the same time, the transportation of grains by truck is relatively expensive but has the flexibility and accessibility that rail and barge lack. Figure B.2 and table B.1 include data from USDA's "Grain Transportation Costs Indicators" database.[96] This database compares the costs of barge, truck, rail, and ocean vessels indexed at the start of the year 2000. The data permit analysis of the relative cost of each transportation mode, and the share of transportation costs in the value chain. As seen in table B.1, most grains that are transported by truck in the United States are destined for domestic use rather than for

[95] For both barge and rail, loading and unloading must occur at docks or stations, which restricts accessibility. For barge, rainfall and the water levels of the Mississippi River are limiting factors.
[96] USDA, "Grain Transportation Cost Indicators."

export.[97] In particular, trucks are used to ship grains from producers to mills, and for transport to farms when used as feed for livestock, among other purposes. However, because U.S. grains that are destined for export enjoy a distinct price advantage when shipped via barge or rail (compared to grains for domestic use), such benefits outweigh the flexibility of transporting freight by truck.

Figure B.2 U.S. transportation by mode, indexed (January 2000 = 100)



Source: USDA. Agricultural Transportation Open Data Platform. Accessed November 2, 2020
Note: The index for each series is as follows: For truck, the base rate is $1.49 per gallon. For unit train, the base rate is $1,815.15 per railcar, including the tariff and fuel surcharges. For shuttle train, the base rate is $2,338.28 per railcar, including the tariff and fuel surcharges. For barge, the base rate is $180 and is based on Illinois River barge rates. For the Gulf-to-Japan ocean route, the base rate is $22.36/metric ton. For the Pacific Northwest-to-Japan ocean route, the base rate is $14.10/metric ton.

[97] The authors define the residual use of total domestic transport (the portion not accounted for by rail transport) as trucking. For more information, see Chang et al, Transportation of U.S. Grains: *A Modal Share Analysis 1978-2016 Update*, USDA (2017).

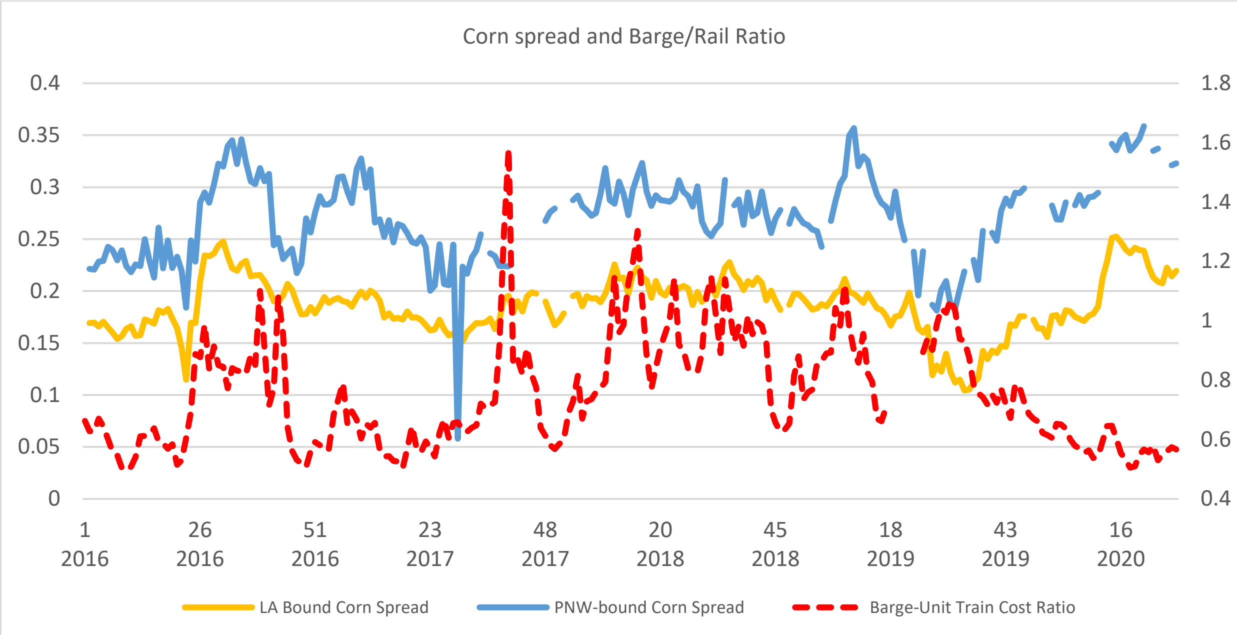
Table B.1. Modal share of grain transportation in the United States, 2000–2016, cost basis

	Total			Export			Domestic		
Year	**Rail**	**Barge**	**Truck**	**Rail**	**Barge**	**Truck**	**Rail**	**Barge**	**Truck**
2000	129.82	72.2	200.69	46.07	67.56	9.16	83.76	4.64	191.53
2001	133.23	71.81	202.29	46.95	67.19	7.88	86.28	4.62	194.41
2002	129.92	74.27	188.11	43.57	68.51	5.8	86.35	5.76	182.31
2003	130.36	68.4	191.86	41.78	62.78	5.28	88.57	5.62	186.57
2004	136.32	67.27	206.33	48.02	61.73	16.73	88.3	5.54	189.6
2005	141.13	57.67	221.29	53.8	52.98	8.36	87.33	4.69	212.93
2006	158.29	60.48	227.55	59.67	56.62	13.06	98.61	3.87	214.49
2007	152.42	65.75	245.53	61.37	61.61	19.44	91.06	4.14	226.09
2008	149.06	56.12	270.34	67.3	51.77	18.41	81.76	4.35	251.92
2009	142.66	62.69	267.81	59.08	59.1	9	83.59	3.59	258.81
2010	151.25	65.43	291.75	67.41	61.37	6.69	83.84	4.06	285.06
2011	138.16	59.79	297.04	53.09	55.88	22.85	85.07	3.91	274.2
2012	125.99	60.43	290.46	41.47	55.6	9.8	84.52	4.82	280.66
2013	115.11	56.76	308	39.98	51.85	22.66	75.12	4.91	285.34
2014	132.23	74.97	338.19	52.5	71.05	23.95	79.73	3.92	314.24
2015	135.73	72.06	338.97	49.18	68.16	24.72	86.55	3.91	314.25
2016	141.14	81.24	348.69	63.01	77.25	21.71	78.13	3.98	326.98

Source: Chang, Kuo-Liang “Matt”, Peter Caffarelli, Jesse Gastelle, and Adam Sparger. Transportation of U.S. Grains: A Modal Share Analysis, April 2019. U.S. Dept. of Agriculture, Agricultural Marketing Service.
Note: Grains include corn, wheat, soybeans, sorghum, and barley.

Lastly, figure B.3 shows a comparison between the weekly price spread for Louisiana (LA)-bound corn shipments and Pacific Northwest (PNW)-bound corn shipments during 2016–2020. The blue line in figure B.3 shows the difference between the PNW and origin corn prices; the yellow line shows the spread between LA prices and origin prices. The transportation costs for PNW-bound corn shipments are higher than for LA-bound shipments, and these higher costs are mostly borne by corn producers. The red line denotes the relative cost of rail and barge during 2016–20 and indicates that the price gap does not move in tandem with barge prices. In other words, the relative price gap between barge and rail does not trickle down to the producer.

Figure B.3 Corn spread and barge-to-rail ratio, 2016–2020, in USD/bushel (left) and ratio



Source: USDA. Agricultural Transportation Open Data Platform. Accessed November 2, 2020.

Table B.2 Estimates of domestic use and exports, by commodity, by marketing year, in 1,000 tons

Commodity	Corn		Soybeans		Wheat		Combined		
MarketingYear	Domestic Use	Exports	Domestic Consumption	Exports	Domestic Consumption	Exports	Domestic Use	Exports	Export/Dom. Use Ratio
2000/2001	198,102	49,313	49,203	27,103	36,184	28,904	283,489	105,320	37%
2001/2002	200,941	48,383	50,867	28,948	32,434	26,190	284,242	103,521	36%
2002/2003	200,748	40,334	47,524	28,423	30,448	23,139	278,720	91,896	33%
2003/2004	211,595	48,258	44,600	24,128	32,498	31,524	288,693	103,910	36%
2004/2005	224,610	46,181	51,407	29,860	31,783	29,009	307,800	105,050	34%
2005/2006	232,015	54,201	52,751	25,579	31,320	27,291	316,086	107,071	34%
2006/2007	230,674	53,987	53,473	30,386	30,940	24,725	315,087	109,098	35%
2007/2008	261,632	61,913	51,627	31,538	28,614	34,363	341,873	127,814	37%
2008/2009	258,041	46,965	48,112	34,817	34,640	27,635	340,793	109,417	32%
2009/2010	280,987	50,270	50,724	40,798	30,728	23,931	362,439	114,999	32%
2010/2011	284,549	46,508	48,351	40,959	29,424	35,147	362,324	122,614	34%
2011/2012	277,961	39,096	48,786	37,186	31,993	28,606	358,740	104,888	29%
2012/2013	262,973	18,545	48,550	36,129	37,810	27,544	349,333	82,218	24%
2013/2014	293,002	48,790	50,043	44,594	34,260	32,012	377,305	125,396	33%
2014/2015	301,837	47,421	54,989	50,136	31,328	23,523	388,154	121,080	31%
2015/2016	298,845	48,228	54,475	52,869	31,943	21,168	385,263	122,265	32%
2016/2017	313,785	58,313	55,719	58,964	31,865	28,600	401,369	145,877	36%
2017/2018	313,981	61,916	58,873	58,071	29,246	24,658	402,100	144,645	36%
2018/2019	310,446	52,483	60,405	47,676	29,989	25,502	400,840	125,661	31%
2019/2020	309,506	45,173	61,773	45,777	30,564	26,276	401,843	117,226	29%

Source: USDA, FAS, PSD Online. Accessed November 2, 2020. https://apps.fas.usda.gov/psdonline/app/index.html.