Market Concentration in the Wheat Merchandizing Industry

by

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Abstract: *Prices offered to farmers by grain handling facilities have been shown to be affected by the spatial competition structure of the market within which these facilities operate. However, little information exists about how elevators' technological and ownership type characteristics, differences in the demand for grain handling services, and volatility in railcar costs alter grain elevators' pricing behaviors within alternative spatially competitive market structures. This work combines several unique datasets—restricted-access rail waybill sample, daily basis bid information, and elevator-level technological and ownership structure characteristics—to provide an exploratory analysis of the specific factors that can help explain basis bid behaviors across 267 Kansas wheat handling facilities. We provide preliminary evidence that these factors could include variation in the final destination of shipped wheat, increased price variability and uncertainty in secondary railcar markets, differences in the capacity and loading speed, and the business structure (cooperative or investor-owned firm) of the elevator.*

Keywords: basis, competition, marketing, ownership structure, rail, transportation,

Introduction

The existence of imperfect competition in agricultural markets resulting from many sellers (farmers) and few buyers (processors, shippers) has been documented by several studies (Fackler and Goodwin 2001, Rogers and Sexton 1994). The extent to which market power affects prices received by farmers likely varies by the agricultural commodity considered and the existence of potential purchasers for those commodities. For wheat growers in the Great Plains, grain elevators are their primary market.

Over the past two decades, the domestic wheat market has seen increased entry of high-speed grain facilities that can accommodate loading shuttle-unit trains. The ability to load shuttle-unit trains within a designated amount of time enables elevators to preferentially reserve rail cars, secure lower rail rates, and, in many cases, more consistently meet the volume and timing needs of foreign buyers than conventional elevators. If shuttle-loading facilities can reduce the marginal cost of handling grain and potentially increase product throughput, then it seems plausible that some portion of those increased net returns will be passed on to grain producers in the form of stronger basis bids (i.e., higher cash prices). The impact of a shuttle-loader on the local market is likely a function of both their efficiency and the intensity of competition due to geographic proximity of other elevators.

Previous studies (Bekkerman et al., 2014) have found that shuttle-loading facilities command a smaller price premium in Kansas ($0.001/bu) than in Montana ($0.039/bu). This difference could be affected by the relative density of grain elevators in each state; Kansas has 5–6 times as many grain handling facilities as Montana. This suggests that the degree of elevator concentration and/or market power may affect the amount of cost savings that shuttle-loading facilities can pass on to farmers while remaining competitive.

A limitation of previous work has been the inability to measure pass-through without observing factors that actually affect transportation costs paid by shippers. Among others, these factors could include the distance between the originating elevator and the destination of a carload, the number of cars that an elevator acquires for shipment, elevators' loading capacity and speed, and the difference between tariff rates in the primary railcar market and the prices paid by an elevator in the secondary market. In Bekkerman et al. (2014), the authors did not have sufficient data to directly model these factors and, consequently, dealt empirically with the issue by including various fixed-effects in their model in order to control for these unobservable factors. However, this approach does not provide insights about which factors actually impact pass-through behavior and the magnitude of the pass-through.

We combine several unique datasets in order to develop an initial exploratory analysis of the grain handling market and how variation in this market can affect basis offers across grain elevators. We focus on the Kansas grain handling industry by combining restricted-use rail waybill data collected by the U.S. Surface Transportation Board with daily basis bids reported in the DTN historical database. The exploratory analysis helps identify several key insights about the Kansas transportation industry.

First, much of the interstate agricultural commodity rail movement is associated with wheat shipments, while corn—the predominantly produced crop in Kansas—is consumed largely in the state. Second, Kansas wheat is primarily shipped to export facilities across the United States, unlike in the northern Great Plains states where the vast majority of wheat is shipped to Portland. The majority of Kansas wheat headed for export flows to terminals on the U.S. Gulf Coast. Third, there have been significant increases in the price variability and uncertainty in the secondary rail market. Because increased risk has been shown to be passed on to farmers in the form of lower basis (Taylor, Tonsor, and Dhuyvetter, 2014), uncertainty in secondary rail markets could play a role in basis offers across elevators that are differentially exposed to this risk. Lastly, we find that elevators' actual shipping costs vary across the technology and type of elevator, with lower costs observed at elevators that are able to load shuttle trains and those owned by cooperatives.

Data Description

We combine several datasets that link information about Kansas wheat elevators' price bidding behavior (i.e., prices that are reported to have been offered by elevators to farmers), elevator technological and business structure characteristics, and information about shipment origins, volume, costs, and destination. The price data for winter wheat is a panel dataset of weekly cash and futures prices for 267 locations in Kansas over the 2004 to 2013 period. Cash prices were obtained from a historical database of posted bids reported to DTN. Futures prices for the nearby (closest contract to expiration at a given point in time) and harvest (July) hard red winter wheat contracts traded on the Kansas City Board of Trade (KCBT), as well as implied volatilities for

the nearby contracts, were collected from Bloomberg.[1] Using the cash and futures prices, the nearby basis levels are calculated by subtracting the futures price from the cash price.[2]

Additional information about the elevators in the panel dataset was gathered from a variety of sources. The ability of an elevator to load shuttle trains was determined by directly contacting individual elevators and from state and federal elevator licensing records, railroad websites, news releases, and the Kansas Grain and Feed Association's Annual Directory. For each elevator reported to be a shuttle-loader, the year in which they began loading shuttle trains was also recorded. Other elevator characteristics were similarly collected and include information about rail line access, business structure (cooperative or investor-owned firm), and licensed grain holding capacity.

Information about shipment activity is from the 2004–2013 Carload Waybill Sample datasets, maintained by the U.S. Department of Transportation's Surface Transportation Board (STB). A rail waybill is a required document filed by an elevator or railway line that transports some cargo. This document typically includes information about the originating shipper, the contents of a shipment and its volume, the destination and any rail switching points, payments obtained by the owner of a railway line for the shipment, and many other informational items. Data provided by the STB is a stratified sample of these waybills. A sample is available for each state and includes information for any railcar that passes through the state (regardless of whether it originates or terminates in that state). There are two types of carload waybill sample data available: public use and restricted-access. The public use data aggregates waybills into a few regions within each state. However, the restricted-access data provides full information about each specific waybill that appears in an annual sample.

In order to appropriately match elevator-level basis and facility characteristics data with specific shipment information, we use the restricted-level carload waybill sample data for Kansas. The original data contain information about all products shipped through Kansas during the sample period. Consequently, we limit the sample to only field crops using the Standard Transportation Commodity Codes (STCCs) that range between 01100 and 01200. Specifically, to identify shipping trends, we focus on the four most produced and shipped crops in Kansas: corn (1132), sorghum grains (1136), wheat (1137), grain screenings (1139), and soybeans (1144).[3]

We then limit the data to only those carloads that originated at Kansas elevators, regardless of the final destination. The STB waybill sample only provides the ZIP code of the originating

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[1] The rollover date for the nearby contract was defined as the first day of the month that the nearby contract was due to expire.

[2] It should be noted that cash bids collected in this manner represent offer prices to buy grain and do not necessarily imply that grain was transacted at these prices for every elevator on every day. While a significant proportion of winter wheat produced in Kansas and Montana is shipped west to export terminals in the Pacific Northwest, KCBT hard red winter wheat futures contracts—for which delivery locations are not on the west coast—represent the only consistently reported instrument for evaluating future price expectations. Furthermore, significant convergence problems that occurred in KCBT winter wheat futures markets (for example, see Garcia, Irwin, and Smith, 2015) would similarly affect basis values in all winter wheat production locations.

[3] Grain screenings are a byproduct of the grain handling and cleaning process of grain. These can include whole, broken, ground, or fractured kernels and must consist of at least 70% of whole, light, and broken kernels of wheat, barley, oats, corn, rye, flaxseed, sorghum, triticale, soybeans, wild oat, or a combination of these crops. Up to 30% of other foreign material is permitted.

elevator. Therefore, to appropriately match these elevators to those in the basis bid dataset, we use the freight station accounting code (FSAC), which can be geocoded to a city name. This provides sufficient geographic specificity to merge all of the elevator-level data.

Exploratory Empirical Insights

The combined data are used to examine the grain handling industry in Kansas, the characteristics of shipments of Kansas grain, and the supply-side dynamics for grain elevators. Each aspect provides insights into the potential underlying factors that could influence elevators' pricing behaviors, both independently and vis-à-vis the spatial competition structure of the grain marketing landscape.

The Grain Industry in Kansas

Kansas has the largest wheat production and handling industry in the United States. As such, the grain handling infrastructure is well-developed for large grain throughput and shipping. Furthermore, because of the high production capacity of Kansas producers, most of the grain holding and storage occurs at grain elevators rather than in on-farm storage. These conditions have led to a grain marketing landscape that is characterized by a high spatial density of grain elevators that varies significantly in its loading technologies, storage and handling capacity, and ownership structure.

Figure 1 shows the Kansas grain handling infrastructure and Table 1 provides summary statistics of the Kansas wheat marketing industry. The figure shows that the high density of elevators, is strongly related to the overall crop production capacity across the state. The table and figure also make evident that the majority of elevators are structured as farmer cooperatives (blue circles). However, the majority of elevators that have shuttle train loading capabilities (red circles) and have the largest storage and handling capacity (larger circles) are owned by private firms. Only three of the elevators in the sample are both cooperatively owned and are shuttle-loaders. The ownership structures (and potentially the related marketing strategies) are likely to impact elevators' basis bid behavior.

Figure and table 1 also provide insights about the potential effects that spatial competition may have on basis bidding and how price shocks are likely to transfer geographically. The figure and table show that while many of the elevators are located on main rail lines, a substantial number of facilities are either located on a rail line spur or do not have access to rail transportation services. Additionally, there are discernible differences in elevator density across the state, with higher concentration in the central and southwestern portion of Kansas and lower concentration in the northwest. These factors have been shown to impact basis bidding behavior and the spatio-temporal transference speed of price shocks (Bekkerman et al., 2014; McNew and Griffith, 2005).

In addition to the spatial competition and ownership structure of Kansas elevators, it is also important to capture the production and consumption demand of the state's grain output. Figure 2

shows that during 2004–2013, corn constituted 40–50% of Kansas' overall crop production. Wheat is the second most produced crop, representing approximately 20–30% of total output. Figure 2 also shows that annual wheat production has remained relatively stable over the period, while sorghum and soybeans tend to be more readily traded off for corn during periods of higher corn demand.

Despite the fact that corn is the largest produced crop in Kansas, wheat is the most exported crop from the state. The data indicate that throughout the sample period, wheat rail shipments were 4–8 times larger than any of the other crop-related commodities. In addition, most of the wheat shipments (97.8%) were delivered to locations outside of Kansas. This provides suggestive evidence about the demand dynamics for each of the major crops. That is, while the demand for wheat is largely driven by economic factors outside of the state, demand for corn, soybeans, and sorghum is sufficiently characterized by in-state consumers (primarily feedlots). These demand differences imply that elevators' bidding behaviors for wheat are much more likely to be influenced by more macroeconomic factors (i.e., markets outside of Kansas).

Where Does Kansas Wheat Go?

The large volume of Kansas wheat exports requires a more in-depth assessment of the shipments' destination, which can help provide insights about factors that are likely to affect elevators' pricing behaviors. Table 2 makes evident that the overwhelming majority of Kansas wheat heads south to Texas. Over the sample period, over 58% of all shipments (nearly 41 million tons) were transported by rail to Texas. In comparison, the next largest receiver of Kansas wheat was Illinois, representing just under 10% of the total shipments during 2004–2013.

Figure 4 provides a more detailed characterization of the locations to which Kansas wheat is delivered by rail. The figure shows the counties of the delivery locations and the average annual percentile of the overall shipment volume. For example, counties in red are those that received wheat volumes that were above the 90th percentile of the total shipped volume. Not surprisingly, four counties in Texas receive, on average, the largest volume of Kansas wheat. Other counties to which large volumes of Kansas wheat are delivered are in southwestern California and southern Louisiana. As shown in Figure 3, these counties have one aspect in common: each county has a large international export facility that handles agricultural commodities. This indicates that the majority of Kansas wheat is exported to the world market and its price is largely affected by global conditions.

However, in Kansas there are also important domestic dynamics. Figure 3 shows (marked by squares) counties in which there are large flour milling facilities. Not surprisingly, many of these counties fall into the upper percentiles of Kansas wheat delivery volume distribution. Most of the mills (and many of those that receive a large volume of Kansas wheat) are located in the central United States. The delivery location in Alabama represents the furthest eastward delivery point for Kansas wheat in the time period analyzed.

Railcar Cost Dynamics

A common challenge in many industrial organization and production economics studies is the limited information about firms' variable costs. Overcoming this challenge requires making assumptions about the cost structure, empirically estimating variable costs using observed variation in pricing and/or production behaviors, or both. The STB carload waybill data helps to directly overcome this challenge by providing information about payments that an elevator made to railcar owners to ship a carload of wheat.

Table 3 presents summary statistics of the average payments made by Kansas elevators for shipping wheat. In order to account for differences in the shipping volume and distance that a carload travels, we standardize each carload's total cost to a cost per mile traveled of a bushel of wheat (bushel mile). On average, the data indicate that elevators paid $0.30 per bushel mile. The table also provides cost comparisons by loading technology (conventional or shuttle-loading) and by ownership structure.

As expected, there is suggestive unconditional evidence that shuttle-loading elevators experience a cost advantage over the conventional elevators, because railway companies provide discounts for faster loading of large shuttle unit trains. There are also interesting insights about the potential differences in the shipments costs across elevators with different ownership structures. The data indicate that, on average, cooperatively owned elevators have a large (nearly 50%) discount relative to their privately-owned counterparts. This advantage appears to be larger across conventional elevators with different ownership types. While the reasons for these large differences are not immediately evident, it is clear that ownership type likely plays a role in variable shipping costs and could impact elevators' bidding behaviors.

In addition to accounting for variable costs of shipping, it is also important to acknowledge the historical shift in the uncertainty of costs associated with acquiring railcars. For Kansas wheat, which is primarily shipped out of the state by rail, this uncertainty can lead to important implications for elevators' bidding behavior. Figure 4 provides suggestive evidence that railcar cost uncertainty has increased significantly during the sample period, 2004–2013. The figure shows bids for railcars in secondary rail markets, in which elevators can acquire railcars from other grain handling facilities (which purchase the railcars directly from railway companies in the primary market). The secondary market is important because many elevators (especially smaller ones that do not have the capacity or technology to load large unit trains) must make on-demand railcar purchases and, thus, acquire railcars primarily in the secondary market.

The horizontal line at $0.00 in Figure 4 is used as a reference and represents that a railcar is acquired in the secondary market at exactly the same price as was paid in the primary market. Prices above the zero reference line imply that cars were purchased for a premium and values below indicate that costs were below the initial railcar price. Figure 4 makes evident that after approximately 2007, the volatility in the secondary market significantly increased. During our sample period, some elevators had to pay in excess of $1,000 per railcar (in addition to the original purchase price) in order to ship their crop. More strikingly (but outside of our sample period), secondary market premiums were as high as $4,000 per railcar. These price fluctuations

and resulting uncertainty about shipping costs are likely to affect elevators' bidding behavior. Taylor, Tonsor, and Dhuyvetter (2014) show that when faced with greater risk, elevators pass on these risks to farmers in the form of weaker basis bids.

Lastly, although the summary statistics indicate that there are some differences in costs, it is necessary to note that table 3 represents unconditional means. In addition, existing research has shown that in more spatially dense markets (such as Kansas), elevators are not likely to pass-through these cost-saving advantages to farmers (Bekkerman et al., 2014). While additional research that incorporates variable cost information and ownership types will help further the research on pass-through behavior, the insights from the unconditional statistics presented in table 3 should be interpreted with care.

Conclusions

The ability to combine several unique datasets that provide highly detailed information about both rail shipment and price bidding behaviors of Kansas grain elevators provides an opportunity to develop a better understanding of the economic structure of the wheat marketing landscape. Additionally, these data offer a chance to examine the impacts of important market structure changes, such as increased entry of shuttle-loading grain handling facilities, greater presence of privately owned facilities, and changes in the flow of wheat from its traditional destination (export facilities in Texas) to new western U.S. locations that serve the increasing demand from Asia.

Continued empirical work is also necessary to identify the financial management and optimal investment opportunities in the largest wheat production and marketing state. Do financial incentives still exist for building or expanding existing facilities to have shuttle train loading capabilities? Do cooperatively owned facilities really have a significant cost advantage and what are the factors that drive this advantage? Are cost-savings passed through to farmers and does the ownership structure influence the decision to pass through those savings in the form of higher basis bids?

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Table 1. Summary Statistics of Selected Variables

Variable	Mean	Standard Deviation
Proportion shuttle-loaders	0.087	—
Proportion with rail access	0.693	—
Proportion owned by co-operative	0.640	—
Storage capacity (thousand bushels)	1,817.124	3,529.250
Ratio of on-farm to off-farm stored wheat	0.084	0.039
Nearby basis (dollars per bushel)	-0.594	0.359
Total elevator locations		267

Notes: Standard errors are presented only for continuous variables.

Table 2. Total wheat shipment destinations, 2004–2013

Termination state	Tons Shipped	Percentage of total shipped
Texas	40,987,193	58.07%
Illinois	6,889,522	9.76%
Missouri	5,065,646	7.18%
5 states	1.2–4.5 mil.	1–6.5% each
13 states	< 0.5 mil.	< 1 % each

Notes: Grouped states did not receive sufficient shipments or did not at least three railroads used for shipments. Consequently, these states cannot be shown as per restricted-access data agreements.

**Table 3. Elevators' Payments to Railroad Company per Mile per Bushel Transported**

Elevator type	Mean
Overall	$0.30
Cooperative ownership	$0.18
Private ownership	$0.33
Conventional	$0.32
Conventional, cooperative ownership	$0.18
Conventional, private ownership	$0.36
Shuttle-loading facility	$0.28
Shuttle-loading, cooperative ownership	$0.19
Shuttle-loading, private ownership	$0.29

*Notes:* Data represent the average payment between 2004 and 2013.
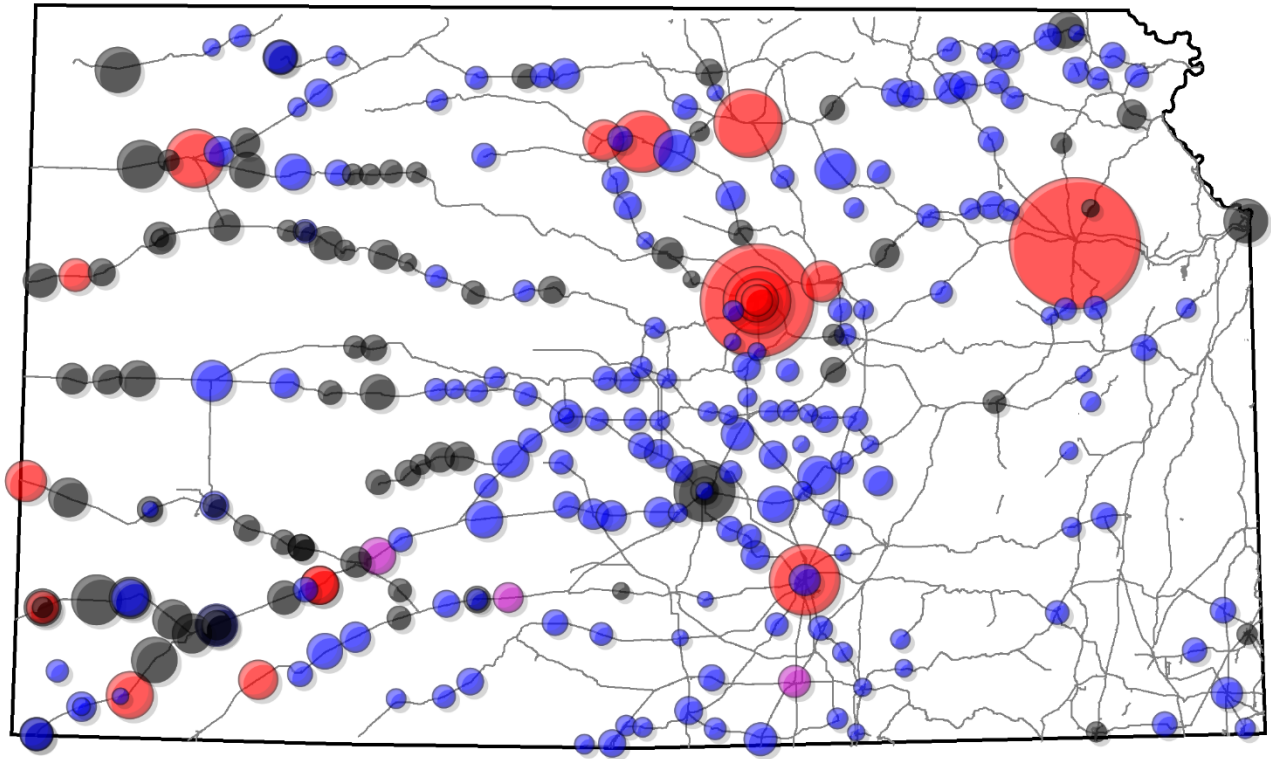
Figure 1. Location, Ownership Type, and Relative Capacity of Kansas Grain Elevators

Notes: Circles represent the location of a grain handling facility. Gray circles represent conventional, privately owned elevators. Red circles represent privately owned facilities with shuttle train-loading capabilities. Blue circles represent conventional elevators that are cooperatively owned. Purple circles represent cooperatively owned facilities with shuttle train loading capabilities. The size of each circle represents the total storage capacity at the location relative to other elevators across the two states. Black lines characterize rail lines.
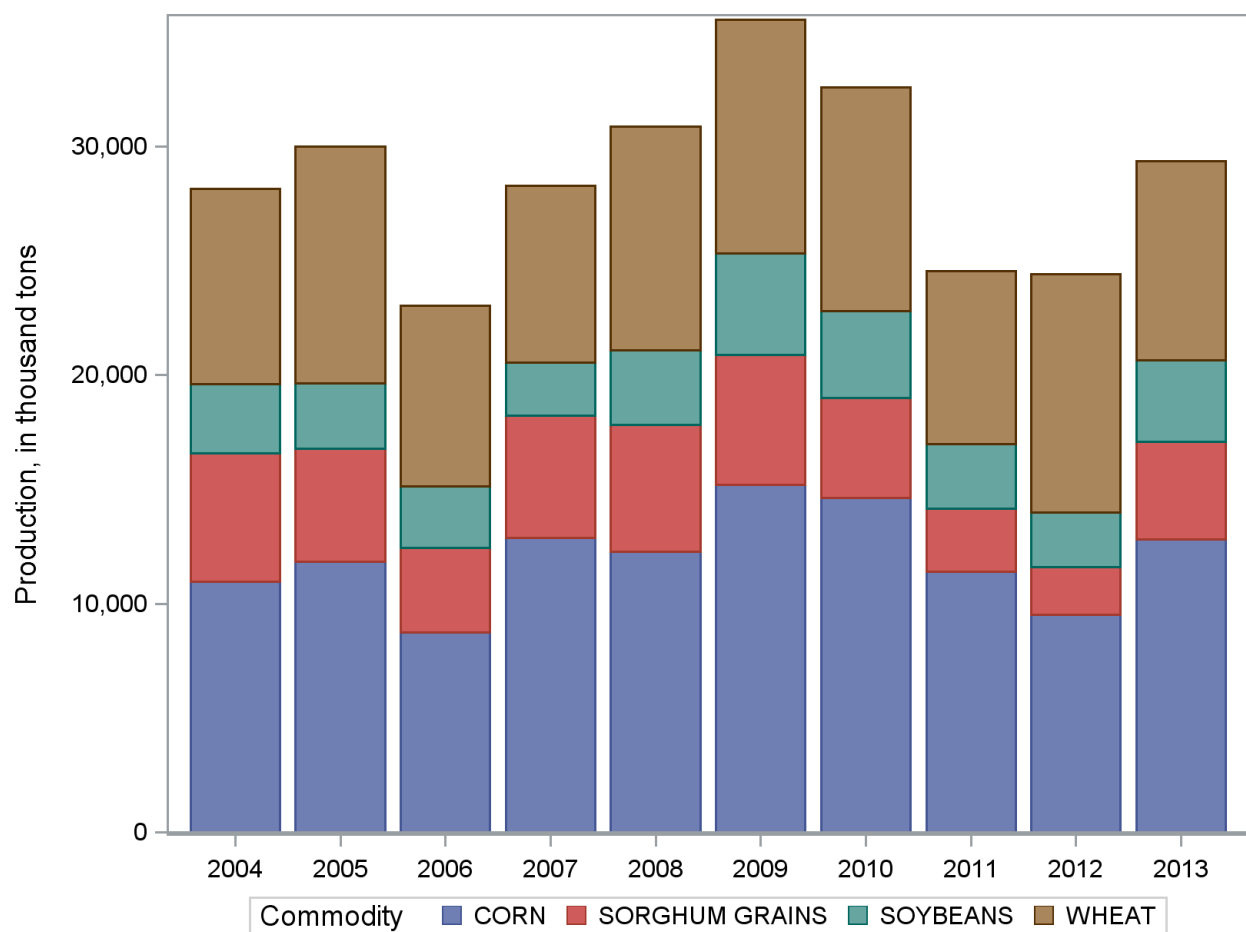
Figure 2. Annual Crop Production in Kansas by Year

Notes: Data are from the USDA National Agricultural Statistical Service. Production represents the product of quantity and harvested acres.
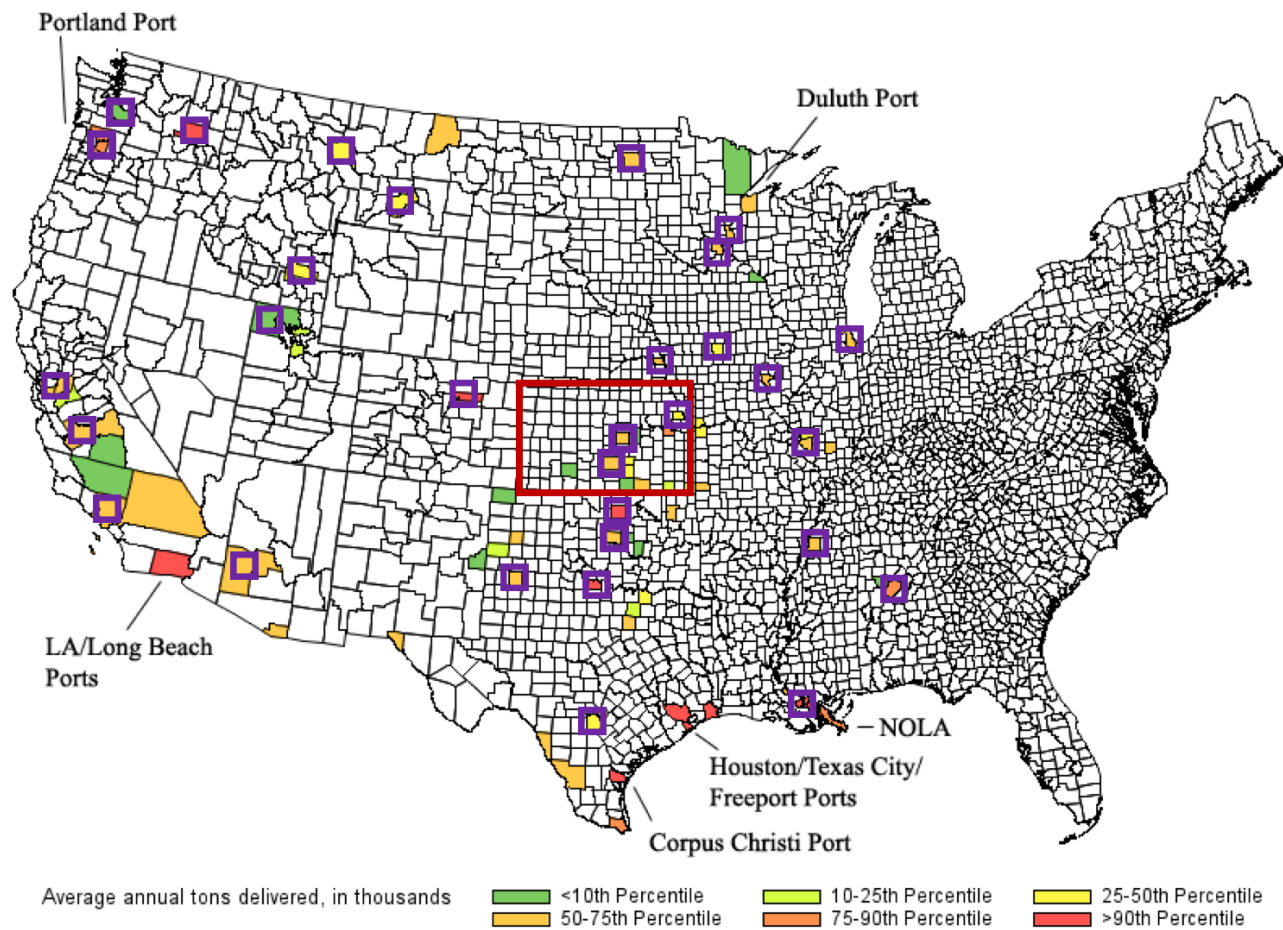
Figure 3. Delivery Locations of Kansas-Originated Wheat, by County

Notes: Major ocean export facilities are indicated on the map. Counties with large flour mills are outlined by squares. Kansas is outlined by the large rectangle.
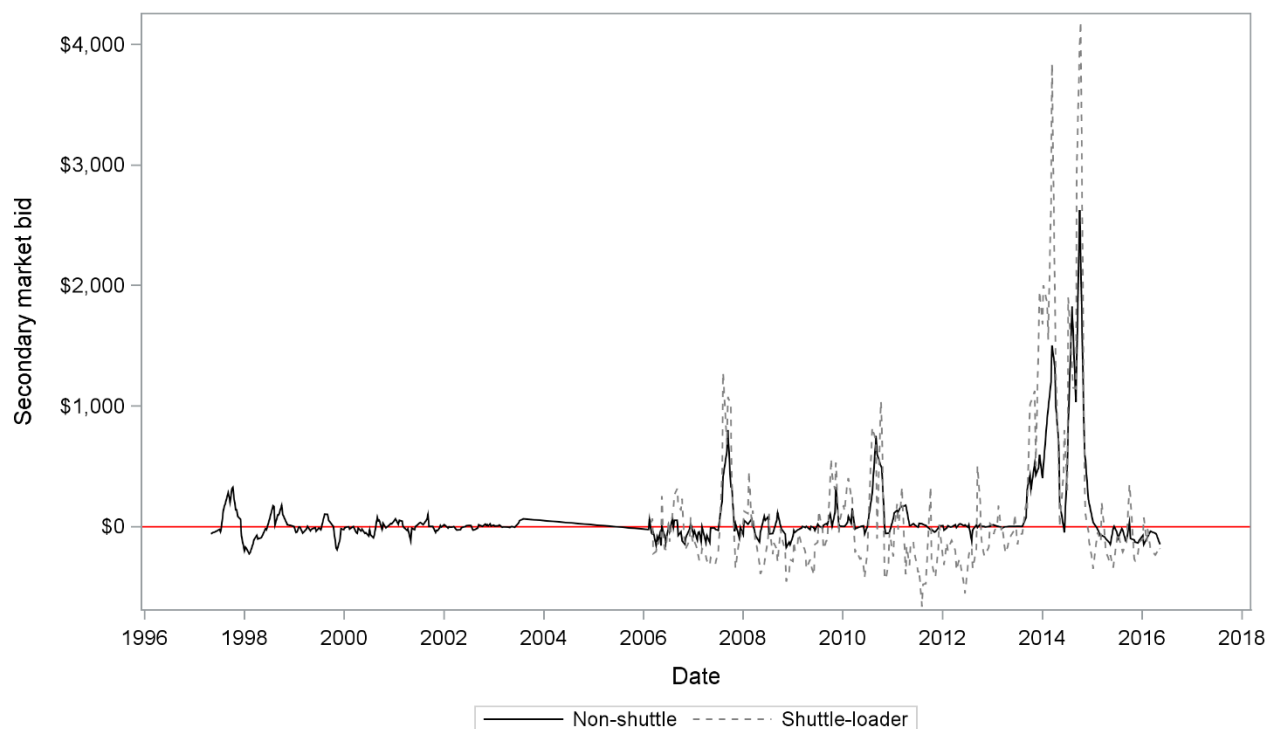
Figure 4. Average Weekly Secondary Rail Market Bids for the Nearby Month, 1997–2016

Notes: Data are from the USDA Agricultural Marketing Service Grain Transportation Report Datasets ("Bids/Offers for Railcars to be Delivered in the Secondary Market"). Linear interpolation is used for weeks when no secondary bid information is available.