When The River Runs Low: Heterogeneous Impacts of Transportation Disruptions on Local Grain Basis

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Abstract

A substantial share of U.S. soybean and corn exports from the Midwest move by barge along the Mississippi River System to export terminals in the Louisiana Gulf. Transportation costs between Midwestern grain elevators and export terminals create a wedge between prices at these locations, and shocks to these costs are partially passed on to farmers through lower cash bids and weaker basis. We estimate the pass-through rate of river transportation cost shocks to farmers using elevator-level cash bids and barge freight rates in a fixed-effects instrumental variables model, with river levels serving as an instrument. We also examine interaction effects for distance to a river port, distance to a processing plant, and the density of nearby elevators. Results indicate that higher river transportation costs weaken soybean and corn basis. The negative effect is smaller for elevators located farther from a river port or in areas with more nearby elevators, while distance to a processing plant has little or no moderating impact. Pass-through for corn is more strongly moderated by local elevator density, whereas pass-through for soybeans is more sensitive to distance from a river port. These findings help farmers assess their exposure to basis risk from river transportation disruptions. Our results also provide policymakers with an empirical measure of the cost of such disruptions on farmers, informing the valuation of infrastructure investments that mitigate them.

Keywords: Grain transportation; Basis risk; Infrastructure investment; Mississippi River System.

JEL Codes: Q13, R41, L92.

1. Introduction

A substantial share of U.S. soybean and corn exports from the Midwest move by barge along the Mississippi River System to export terminals in the Louisiana Gulf, where they are loaded onto ocean-going vessels for shipment to global markets. In 2022, barges carried 44 percent of all U.S. grain exports—over 66.7 million metric tons—while rail accounted for 45 percent and trucks just 11 percent (Henderson, Gastelle, and Caffarelli, 2024). This share has been relatively consistent over time, with barges moving between 42 and 48 percent of U.S. grain exports in most years since 2010. The Mississippi River barge network provides a substantial cost advantage in moving grain from the Midwest to Gulf export terminals. Per-ton-mile transportation costs for barges are markedly lower than for rail or truck, enabling U.S. soybeans and corn to reach deep-water ports at competitive delivered prices despite the long distances from interior production regions. This cost efficiency is a key factor in maintaining U.S. competitiveness in global grain markets, helping offset higher domestic production costs relative to some exporting countries(Friend and Lima, 2011).

While barge transportation is generally cost-efficient, freight rates can be highly volatile when the system faces constraints. As shown in Figure 1, barge rates vary seasonally, but also experience sharp, short-lived spikes in response to disruptions. The record peak in late 2022, for example, coincided with historically low water levels on the Mississippi River that restricted barge drafts and traffic capacity (Yoder, 2025). Because transportation costs form a wedge between farm-level and export prices, disruptions that raise barge freight rates—such as low (or high) river levels, lock closures, or extreme weather—can weaken cash bids at country elevators (Wilson and Dahl, 2011). While futures prices may react to some extent, the impacts are primarily localized and therefore reflected in basis impacts, making hedging using futures and

options impossible. Therefore, disruptions to river transportation represent a significant risk to farmers, who have fewer tools to manage this source of risk.

While river disruptions affect farmers across the Midwest, the impacts are not likely uniform. Many factors could alter the impact of river disruptions on local basis. At the local level, basis declines when river disruptions reduce local grain demand relative to the national market. The magnitude of this local demand shift depends partly on proximity to the river, since areas closer to it rely more heavily on barge transportation and barge rates make up a larger share of total farm-to-market transportation costs. Given a decrease in relative demand, the extent of basis movement also depends on the relative elasticity of local supply and demand. On balance, more elastic local supply reduces the basis change, while less elastic supply amplifies it. Supply side factors could include the amount of unused storage capacity available to farmers and alternative marketing opportunities. Demand side factors could include the relative market power of grain buyers and their access to storage capacity. The result is potential for significant heterogeneity in basis impacts of river disruptions.

These patterns are consistent with, and partially documented in prior research on transportation costs and basis. Transportation costs have been consistently identified as a primary determinant of grain basis (Hart and Olson, 2017). Haigh and Bryant (2001) found that barge rates significantly influence spot prices, with much of the marketing margin driven by barge rate risk. In Arkansas, McKenzie (2005) showed that rising barge rates weaken soybean basis as higher transportation costs are partially passed on to farmers. Similarly, Adjemian et al. (2016) found that higher rail tariffs contribute to wider basis, characterizing this as an unhedgeable source of risk. Others have directly linked river levels to basis and documented measurable impacts (Mobarok, Thompson, and Skevas, 2024; Mitchell and Biram, 2025). Beyond

transportation rates themselves, several studies emphasize the role of risk premiums arising from barge rate volatility (Mckenzie, Isbell, and Brorsen, 2019; Isbell, McKenzie, and Brorsen, 2020). A separate strand of literature has examined spatial heterogeneity in basis, linking its behavior to storage capacity, transportation infrastructure, and market structure (McKenzie, 2005; Riley, 2010; Kim and Brorsen, 2012; Beeler et al., 2025).

Despite previous research on transportation costs and the local behavior of basis, important gaps remain in the literature. First, many studies are geographically limited, focusing on single states or narrow regions, which constrains the generalizability of their findings. Second, most use either barge rates or river levels directly as predictors of basis. While barge rates are the economically relevant measure, they may be endogenous with grain prices; river levels, by contrast, are plausibly exogenous but affect basis only indirectly through their impact on barge rates. Previous research has not explicitly modeled this relationship, and a structural approach would more accurately represent the underlying market dynamics. Third, the literature offers limited explanation for heterogeneity in barge rate pass-through, which limits the applicability of existing findings.

The objective of this research is to determine the extent to which increases in barge transportation costs are transmitted to local basis values across the Midwest, and the degree of heterogeneity due to distance from a river port, distance to a processing plant, and local density of grain elevators. By estimating both the average effect and the heterogeneity of responses, we seek to identify which regions are most vulnerable to basis deterioration during river disruptions, and what drives these responses. This analysis will not only estimate the magnitude of farmer exposure to river transportation-related basis risk but also shed light on the market mechanisms—such as competition in local grain buying and access to alternative marketing

opportunities—that drive variation in impacts. Understanding these dynamics is critical for producers and policymakers, as it informs decisions on marketing strategies, infrastructure investments, and policies aimed at improving the resilience of the grain marketing system.

The dataset for this study was constructed by merging elevator-level cash price data with information on transportation infrastructure, environmental conditions, and local market characteristics from multiple sources. The resulting panel is at the elevator–week level and spans 2016–2024 for both corn and soybeans. To address potential endogeneity between barge freight rates and basis, we employ an instrumental variable (IV) approach, using deviations in river gage height as an instrument for barge rates. Interaction terms capture how the effect of transportation costs varies with an elevator's proximity to river ports, distance to a processing plant, and the intensity of local grain buying competition. Separate models are estimated for corn and soybeans to account for differences in crop-specific marketing dynamics. The results show that higher barge freight rates significantly weaken local basis. Pass-through is greater for elevators located close to river ports or in less competitive markets, with corn basis more influenced by local competition and soybean basis more influenced by distance to ports.

The remainder of the paper is organized as follows. Section 2 describes the data sources, variable construction, and summary statistics. Section 3 outlines the empirical strategy, including the identification approach and estimation procedures. Section 4 presents the results and discusses implications for grain marketing and transportation policy. Section 5 concludes.

2. Data

2.1 Elevator-Level Cash Price Data

This study used elevator-level cash bid data for corn and soybeans obtained from DTN. The raw file contained daily spot bids at individual elevators together with elevator identifiers and geographic coordinates. The sample was restricted to elevators located within the Mississippi River and its tributary basins. Covered states included North Dakota, South Dakota, Minnesota, Wisconsin, Nebraska, Iowa, Illinois, Indiana, Ohio, Michigan, West Virginia, Kentucky, Missouri, Kansas, Oklahoma, Arkansas, Tennessee, Louisiana, Mississippi, and Alabama. Major waterways in this region included the Mississippi, Ohio, Arkansas, Missouri, Illinois, and Tennessee Rivers. The analysis period spanned 2016 through 2024.

2.2 Supplementary Data Sources

Several external datasets were integrated to enrich the elevator-level price data. Future price data for corn and soybeans were obtained from cmdtyView by Barchart. The dataset included daily closing prices for nearby futures contracts. To construct a consistent price series, the contracts were rolled over 15 days prior to expiration. The daily prices were then aggregated to the weekly level using arithmetic averages for each ISO week, aligning with the frequency of the cash price data. Basis values were then calculated as the difference between the weekly average futures price and the corresponding elevator-level cash price.

River port locations were obtained from the U.S. Army Corps of Engineers (USACE) institute for Water Resources (USACE, 2025). From the full inventory of over 23,000 ports, a subset was retained based on operational status, location on the Mississippi River or a major tributary, and relevance to corn or soybean handling. Each elevator was geospatially linked to its

nearest qualifying port, and each river port connected with an elevator was matched to the nearest U.S. Geological Survey (USGS) gate site on the same river system. Hourly gage height values were retrieved using dataRetrieval R package (Decicoo et al., 2025) and aggregated to the weekly level. Weekly values were then demeaned by subtracting the long-term site average to obtain weekly deviations. To address missing data issues, ports were matched only to gage sites with no more than ten missing weekly observations over the study period.

Weekly barge freight rates were obtained from the USDA Agricultural Marketing Service (USDA AMS, 2025). Rates were expressed as a percentage of the 1976 base tariff (in dollars per ton), which declines with proximity to the New Orleans Gulf port (Isbell, McKenzie, and Brorsen, 2020). To express freight costs in units consistent with commodity pricing, rates were converted to dollars per bushel using standard weight conversions of 56 pounds per bushel for corn and 60 pounds for soybeans (USDA ERS 2025a, 2025b).

Each elevator was also linked to the nearest processing facility. For corn, these included corn refiners, ethanol plants, and feed mills; for soybeans, the processing facility was soybean crush plant. Facility locations were obtained from the U.S. Energy Atlas (EIA 2024), Corn Refiners Association (CRA, 2025), Soybean Meal Info center (Soybean Meal Info center 2025), and the U.S. Food & Drug Administration (FDA, 2024). Environmental conditions were incorporated using county-level drought data from the U.S. Drought Monitor (2024). A composite drought severity index was constructed as a weighted average of the share of county area in each drought classification[1].

[1] The drought severity index was computed as:

$$Drought\ Index = 0 * \%None + 1 * \%D_0 + 2 * \%D_1 + 3 * \%D_2 + 4 * \%D_3 + 5 * \%D_4$$

where $D_0 - D_4$ represent increasing drought intensity: Abnormally Dry, Moderate Drought, Severe Drought, Extreme Drought, and Exceptional Drought, respectively. None indicates areas with no drought.

2.3 Data Integration and Summary Statistics

The final dataset was constructed by integrating elevator-level cash price data with spatial infrastructure, environmental, and market-level information. Each observation corresponds to a unique elevator-week combination. After merging and filtering for missing values in key variables such as basis, barge rate, and gage height, the resulting dataset included 544,240 observations for corn and 881,477 observations for soybeans, spanning the period from 2016 through 2024. The corn data covered 414 counties, while the soybean data included 533 counties. Figure 2 and Figure 3 illustrate the spatial distribution of corn and soybean elevators, ports, gage sites, and processing plants across the Mississippi River Basin. A notable limitation of the dataset is the absence of reliable gage height data along the Tennessee River and lower Mississippi River. While several USGS gage sites exist in these regions, most do not have gage height data or have been deactivated. For example, only the Perryville site on the Tennessee River reported gage height data, and the record ended prematurely on December 7, 2016. To address this limitation, Tennessee River ports were connected to gage sites on Ohio River, and ports along lower Mississippi River were linked to the nearest active gage sites on Mississippi River.

Descriptive statistics for the main variables are reported separately for corn and soybeans in Table 1. The average basis was −19.68 cents per bushel for corn and −45.92 cents per bushel for soybeans, and the standard deviations were 41.87 and 53.60, respectively. The average barge freight rate was $0.65 per bushel for corn and $0.58 for soybeans. Barge rates ranged from a minimum of $0.11 to a maximum of $3.42 per bushel for corn, and from $0.11 to $3.66 for soybeans. Gage height deviation ranged from −24.20 to 34.78 feet for corn with a mean of −0.05, and −24.20 to 30.21 feet with a mean of 0 for soybean. The average distance from a corn elevator to the nearest river port was 141 miles, and 106 miles for soybeans. The average

distance to the nearest processing plant was 17 miles for corn and 61 miles for soybeans. Elevators also faced substantial local competition, with an average of 36 nearby elevators (within 50 miles) for corn, and 45 for soybeans.

3. Methods

This study used a two-stage fixed effects regression framework to estimate the effect of river level on local grain basis. Weekly elevator-level data were used to separately estimate models for corn and soybeans. The analysis proceeded in two steps: first, instrumenting for barge freight rates using exogenous variation in river conditions, second, estimating the effect of the instrumented barge rates on basis.

3.1 First-Stage Estimation of Barge Freight Rates

Barge freight rates were potentially endogenous in the basis function due to unobserved factors that simultaneously influenced both transportation costs and local cash prices. For instance, local supply shocks, regional storage constraints, or temporary surges in demand may have driven up barge rates and also widened the basis. In such cases, OLS estimations would have produced biased estimates of the true effect of transportation costs on basis.

To address endogeneity, a two-stage least square approach was employed. In the first stage, barge freight rates per bushel were instrumented using river gage height and its square, which was plausibly exogenous to local grain market. River gage height directly affected navigation conditions on inland waterways and thereby influenced barge availability and cost. At the same time, gage height was unlikely to affect local basis through any channel other than transportation cost. Both unusually low and high water levels have been shown to disrupt river navigation. Low stages reduce navigable depth and led to barge light-loading or channel

closures, while high stages increase current velocity and reduce maneuverability, leading to operational restrictions and lock closures (Amorim et al., 2023). The squared term was therefore included to allow for a non-monotonic relationship between gage height and barge rates. Drought severity index, river port fixed effect, year, and month fixed effects were also included in the first-stage regression as control variables.

Accordingly, the first stage was estimated at the river port level to generate the instrumented barge rate:

$$x_{it} = \alpha_0 + \alpha_1 z_{it} + \alpha_2 z_{it}^2 + \alpha_3 d_{it} + \gamma_i + \delta_t + \theta_t + \varepsilon_{it} \quad (1)$$

where x_{it} is barge rate at port i, week t, z_{it} is river gage height deviation of the gage site connected with port i in week t, d_{it} is the drought severity index for the county containing port i in week t, γ_i, δ_t, and θ_t are port, year, and month fixed effects, and ε_{it} is an error term.

3.2 Second-Stage Estimation of Grain Basis

In the second stage, instrumented barge rates were used to estimate the causal effect of transportation costs on elevator-level basis. The second-stage estimating equation was:

$$y_{it} = \beta_0 + \beta_1 \hat{x}_{it} + \beta_2 d_{it} + \beta_3 m_i^P + \beta_4 m_i^A + \beta_5 n_i + \beta_6 \hat{x}_{it} m_i^P + \beta_7 \hat{x}_{it} m_i^A + \beta_8 \hat{x}_{it} n_i + c_i + \delta_t + \theta_t + u_{it} \quad (2)$$

where y_{it} is the basis for elevator i in week t, $\hat{x}_{it}$ is the predicted barge rate, d_{it} is the drought severity index in the elevator's county, m_i^P is the distance of the elevator to the nearest river port, m_i^A is the distance to the nearest processing plant, n_i is the number of competing elevators within a 50-mile radius. c_i, δ_t, and θ_t are county, year, and month fixed effects, and u_{it} is an error term. Interaction terms between the predicted barge rate and the concentration variables were included to allow the marginal effect of transportation costs on basis to vary across different operating

environments. These interaction terms captured whether the impact of barge rates depended on factors such as the elevator's distance to the nearest river port or processing facility, and the number of competing elevators nearby.

3.3 Model Estimation

All models were estimated using the feols() function from the fixest package in R (Bergé, 2018). It applied the within transformation to remove fixed effects by demeaning the dependent and independent variables within each fixed effects group. As a result, parameter estimates were identified from variation within ports or counties over time, and constant terms (α_0 and β_0) were absorbed into the fixed effects structure.

The 2SLS estimation was conducted separately for corn and soybeans. For each crop, models were estimated using both linear and log-transformed versions of the interaction terms in Equation (2). The log-transformed interactions were constructed by taking the natural logarithm of one plus the relevant variable (e.g., $\log(1 + m_i^P)$) to accommodate zeros and account for diminishing marginal effects. Models with state-level or elevator level fixed effects were also estimated to assess the robustness of the results (see Appendix).

4. Results

4.1 First-Stage Regressions

Table 2 presents the results from the first-stage regressions. The regressions were conducted at the port-week level, rather than the elevator-week level, to avoid issues related to multiple elevators being linked to the same port. Since fixed effects absorbed the constant terms, intercept estimates were not reported in Table 2. The coefficient of gage height difference (α_1) was negative and statistically significant in both models, consistent with the hypothesis that lower

river levels raised transportation costs. A one-foot decline in gage height was associated with an increase in barge rate of approximately 0.3 cents per bushel. The squared term was positive and significant, suggesting that both unusually low and high river levels increased barge freight rates. In both models, the coefficient of the drought severity index was positive and significant, suggesting that drought conditions were associated with barge rates. While river gage height captured localized, short-term fluctuations in water level, the drought index reflected broader regional water scarcity.

The joint Wald F statistics for the excluded instruments (gage height difference and its squared term) were 54.9 for corn and 114.3 for soybeans. These results indicated that the instruments were strongly correlated with barge freight rates and served as valid instruments for the second-stage regressions.

4.2 Second-Stage Regressions

Table 3 and Table 4 reports the second-stage IV regressions for corn and soybeans. Five specifications were estimated for each crop: a baseline model without interaction terms, and models with interaction terms between barge rate and (1) distance to port, (2) distance to processing plant, and (3) number of elevators within a 50-mile radius, and a model with all three interaction terms.

For corn, the coefficient on barge rate was negative and statistically significant across all model specifications, indicating that higher barge transportation costs would weaken the corn basis. In the baseline model without interactions, a one dollar increase in barge rate would cause a 34.32 cent decrease in corn basis. The model including an interaction between barge rate and distance to port showed that this pass-through effect varied across space. The barge rate

coefficient became larger (-54.55), while the interaction term was positive and significant (0.13), indicating elevators located closer to river ports were more sensitive to barge rate changes. The model with the number of elevators interaction showed a similar pattern. The coefficient on barge rate was -48.45, and the interaction term with the number of elevators was positive and significant (0.56), suggesting that local competition mitigated the impact of barge rate increases. In contrast, the interaction between barge rate and distance to processing plant was insignificant ($\alpha = 0.05$) in both single-interaction model and the full model, but the negative sign is consistent with the expectation that elevators farther from processors face greater exposure to transportation costs. The model that included all three interaction terms exhibited the best overall fit for corn. It had the highest within R^2 (0.09) and the lowest RMSE (27.60). In the full model, the coefficient on barge rate was -74.24, meaning that a one dollar increase in barge rate would cause the corn basis decrease by 74.24 cents, conditional on the spatial moderators being 0. The interactions with port distance (0.16) and number of elevators (0.64) remained positive and statistically significant. These results suggest that the pass-through of barge rates to corn basis was strongest near river ports and in areas with fewer competing elevators.

For soybeans, the results showed a similar pattern. In the baseline model, a one dollar increase in barge rate reduced soybean basis by 11.54 cents. As in the corn models, the magnitude of pass-through increased once interaction terms were introduced. The model with port distance interaction showed a significant and positive coefficient (0.14), indicating that soybean elevators located closer to ports were more exposed to barge rate fluctuations. Notably, the interaction with processing plant distance was positive and statistically significant in both the single-interaction (0.05) and full (0.01) models. This finding contrasts with the corn results. The interaction between barge rate and number of elevators was also positive and significant in the

full model, consistent with the interpretation that local competition reduced the ability of elevators to pass transportation costs onto farmers. The coefficient on barge rate in the full model was -41.31, meaning that a one dollar increase in barge rate would cause the soybean basis to decrease by 41.31 cents. The full model also achieved the best overall fit among the soybean specifications, with the highest within R^2 (0.12) and lowest RMSE (32.47).

In model with linear interaction terms, some marginal effects of barge freight rates on local cash prices were positive, implying that higher transportation costs would raise local prices, which is economically implausible. To address this, we used the log-transformed interaction model to capture negative and diminishing marginal effects. Figure 4 and Figure 5 present elevator-level heat maps of the average marginal effects from log-transformed interaction models, corresponding to the regression results in Table 5 and Table 6. For corn (Figure 4), the smallest pass-through effects were concentrated in central Iowa and southern Minnesota, areas with dense clusters of elevators where strong local competition may limit the ability to pass higher transportation costs to farmers. More negative effects appeared along the Mississippi River corridor and in more isolated areas, where dependence on river terminals is greater and competition is weaker. For soybeans (Figure 5), the smallest effects were also in the upper Midwest, particularly Minnesota, Iowa, and Illinois, consistent with regions of high elevator density. Larger negative effects were in Indiana, Ohio, and the Lower Mississippi River regions.

To further illustrate where pass-through effects are most and least severe, the top 10 and bottom 10 counties based on the average marginal effects from the log-transformed interaction models were identified. Table 7 and Table 8 present the results for corn and soybean, respectively. For corn, the least negative effects are concentrated in central Iowa. These counties have very high elevator density and are located far from river ports, which limits transportation

cost increases are transmitted to corn basis. The most negative effects for corn were concentrated along the lower Mississippi River and its tributaries, including counties in Arkansas, Louisiana, Mississippi, and Kentucky. These locations generally have very few elevators, low local competition, and close to river ports. For soybeans, the least negative effects were found in western Kansas, where counties are located far from river ports but have moderate elevator density. The most negative effects were concentrated along the river and lie very close to river ports and often have few nearby elevators, leaving them highly susceptible to pass-through effects. Overall, the results suggest that local competition plays a larger role in basis change for corn. For soybeans, distance to river ports emerged as the dominant factor, indicating greater reliance on barge transportation.

5. Discussion & Conclusion

This study estimated the extent to which increases in barge freight rates were transmitted to local basis values across the Midwest and the degree of heterogeneity in these effects due to distance from a river port, distance to a processing plant, and local density of grain elevators. Using a two-stage least squares framework and incorporating measures of market concentration, we estimated both the average pass-through effect and the variation in responses across locations. The results showed that barge freight rates had a significant negative effect on grain basis, with the largest basis reductions occurring for farmers located closer to river ports or in less competitive local markets. These results have implications for risk management for farmers, for infrastructure investments, and grain market competition.

River disruptions that increase transportation costs are a significant and potentially growing source of risk for farmers. Because basis changes are not directly hedgeable using futures or options, farmers have limited tools to protect against these losses. Our results provide

location-specific insight into this risk. In the most affected corn counties, pass-through effects approach full cost transmission from the river to the farm gate, while more insulated areas experience minimal effects. Farmers in high-risk areas could mitigate exposure by diversifying marketing channels, selling to processing plants when possible, investing in on-farm or leased storage to improve flexibility is marketing timing to avoid transportation constraints.

The results also highlight the importance of competitive local grain buying markets. Areas with lower competition—in terms of fewer elevators—experienced more pass-through of barge cost increases. Local or regional policies that help small country elevators remain viable, support farmer cooperatives, or facilitate entry of new buyers could reduce the degree of cost transmission. The findings suggest that in merger review, regulators should consider not just national market concentration, but also how consolidation affects local competition. In the case of a merger between grain companies with overlapping territories, the number of effective competitors could be reduced when nearby elevators come under common management. As a result, farmers may face greater basis reductions when transportation costs rise. Expanding alternative marketing channels—such as biofuel or feed processing plants—could also reduce exposure to river-related risk while potentially increasing local demand and supporting stronger spot prices.

From an infrastructure perspective, these results underscore the economic value to farmers of maintaining and improving Mississippi River System navigation. Investments that reduce the likelihood or severity of disruptions can preserve farm revenues in the most affected regions, while deterioration would disproportionately harm producers near ports. In several counties in Arkansas, Louisiana, and Mississippi, the observed pass-through rates indicate that disruptions could be transmitted almost entirely to farm-level prices. Infrastructure evaluations

could explicitly consider farm-level benefits when prioritizing projects. The estimates here may help provide some help in determining losses avoided through improved navigation reliability.

Although this study focused on barge transportation, future research could extend the framework to examine rail cost pass-through, or jointly model multiple transportation modes to capture substitution effects and network-level resilience.

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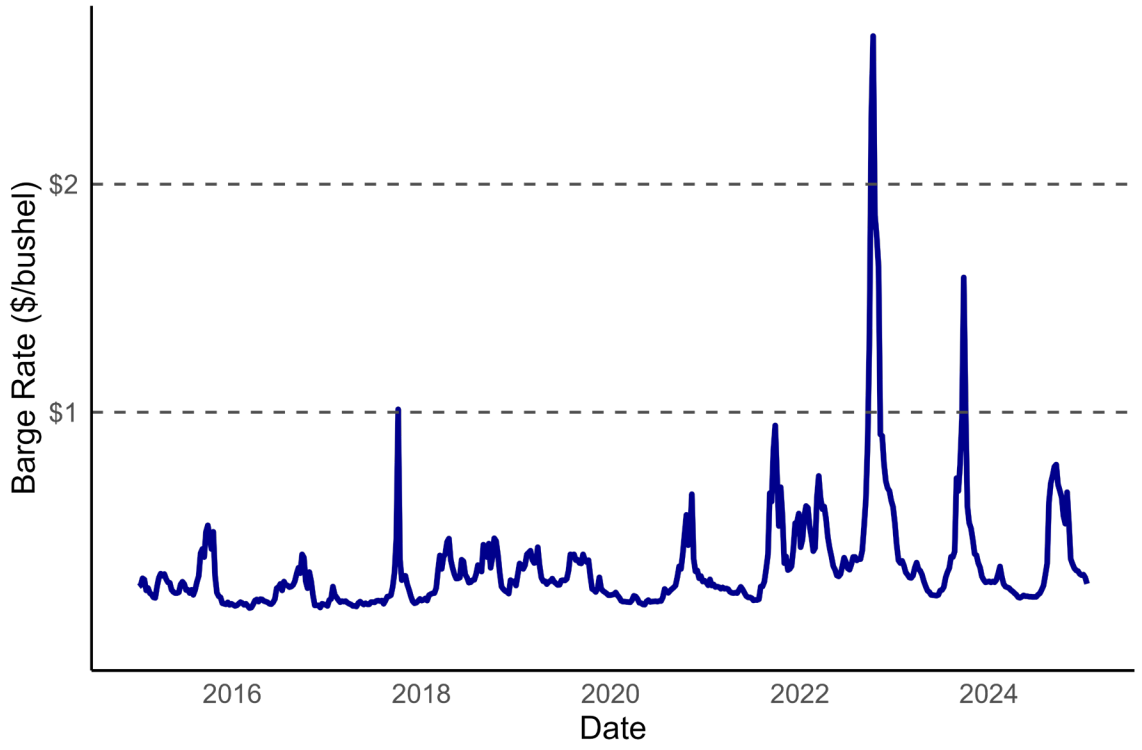


Figure 1. Barge Freight Rates Measured in USD Per Bushel of Soybeans from Memphis, Tennessee.

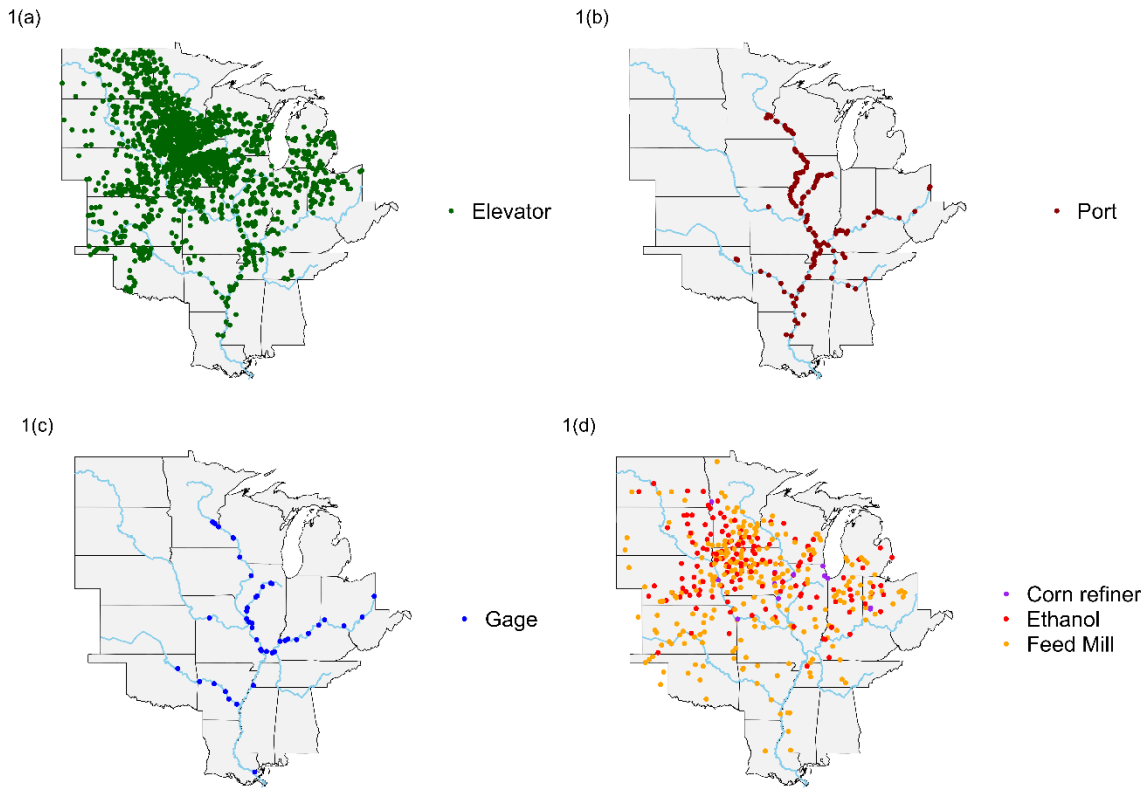


Figure 2. Geographic Distribution of Corn Elevators, River Ports, Gage Sites, and Processing Plants with the Mississippi River Basin.

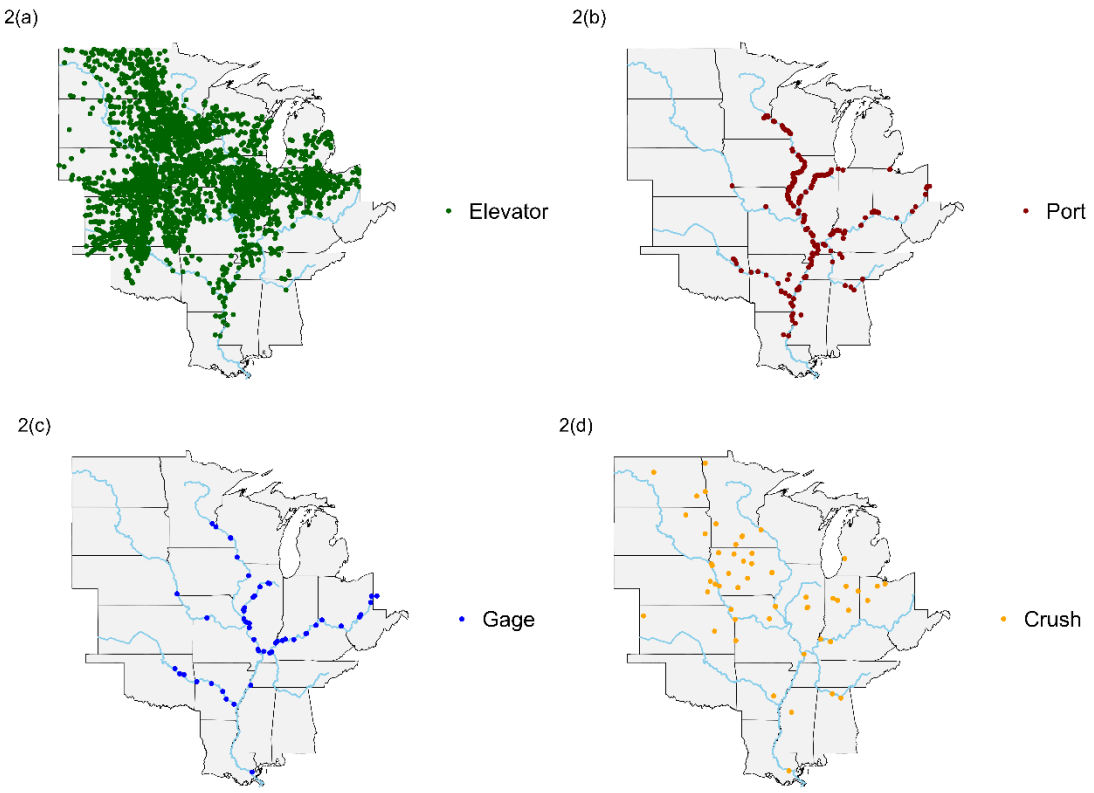


Figure 3. Geographic Distribution of Soybean Elevators, River Ports, Gage Sites, and Processing Plants with the Mississippi River Basin.

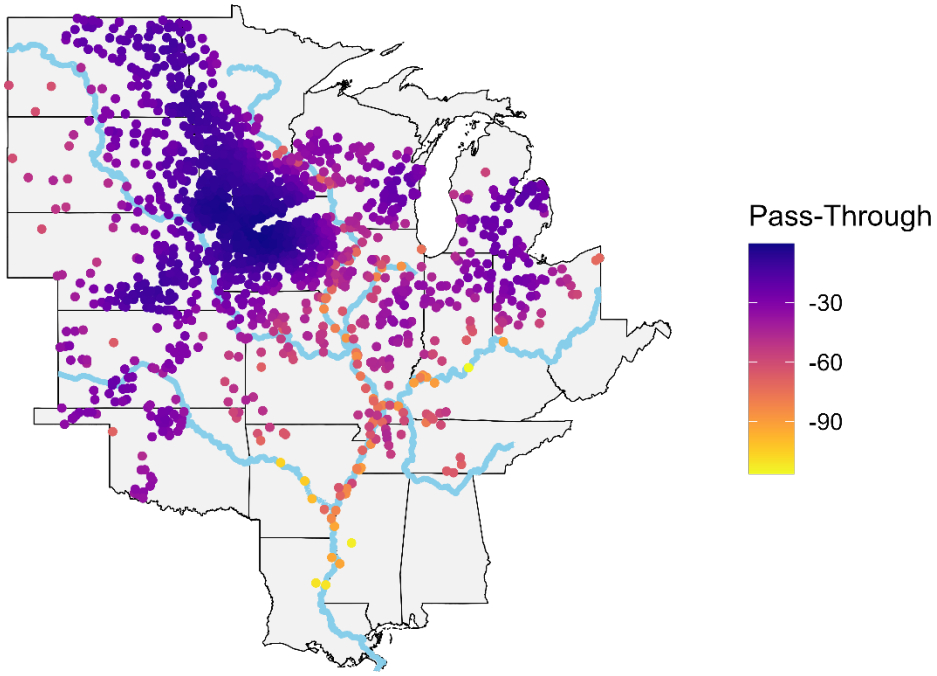


Figure 4. Spatial Distribution of Marginal Effects of Barge Freight Rates on Corn Basis.

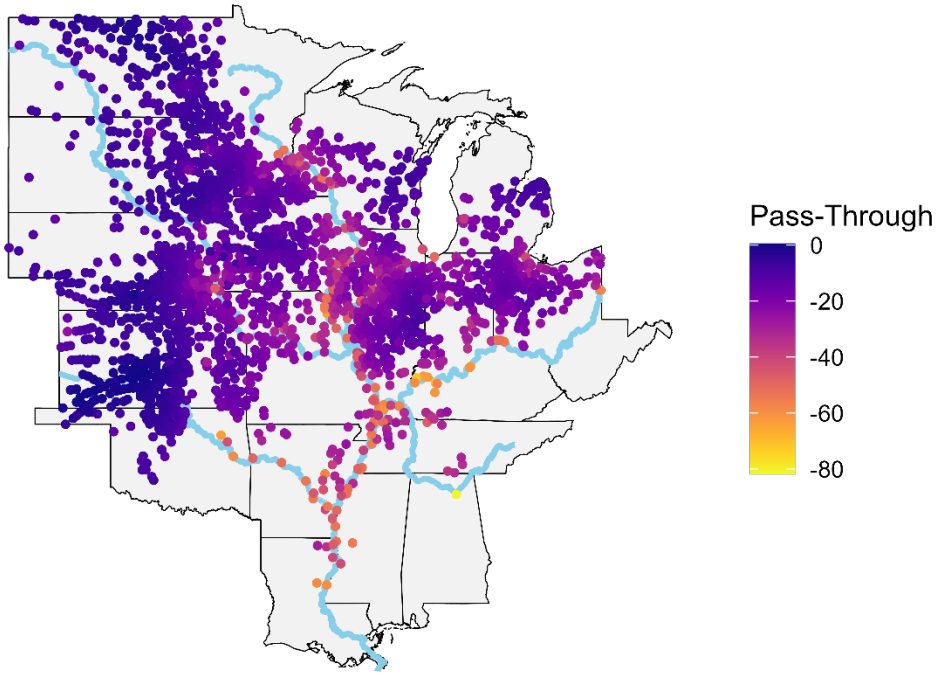


Figure 5. Spatial Distribution of Marginal Effects of Barge Freight Rates on Soybean Basis.

Table 1. Summary Statistics of the Final Data.

	Basis (cents/bu)	Cash Price (cents/bu)	Futures Price (cents/bu)	Barge Rate ($/bu)	Gage Height Diff (feet)	Drought Index	Dist. to Port (mi)	Dist. to Plant (mi)	Num of Elevators Within 50mi
Corn									
Mean	-19.68	439.59	459.26	0.65	-0.05	0.73	141.46	17.10	35.91
Std. Dev.	41.87	146.77	121.85	0.35	3.64	1.04	100.17	17.18	28.24
Min	-180.85	207.40	317.10	0.11	-24.20	0.00	0.03	0.00	0.00
Max	537.05	1,337.25	807.75	3.42	34.78	5.00	532.85	124.58	107.00
Soybean									
Mean	-45.92	1,088.89	1,135.24	0.58	0.00	0.72	105.91	61.27	45.27
Std. Dev.	53.60	264.92	236.35	0.36	3.79	1.07	85.71	43.29	24.93
Min	-1,011.71	286.00	816.50	0.11	-24.20	0.00	0.02	0.00	0.00
Max	633.30	1,909.35	1,703.95	3.66	30.21	5.00	558.14	276.92	122.00

Table 2. First-Stage Regression Results for Barge Freight Rate.

	Corn	Soybean
Gage height deviation	-0.003***	-0.003***
	(0.0004)	(0.0004)
Squared gage height deviation	0.0003***	0.0003***
	(0.00003)	(0.00002)
Drought index	0.017***	0.022***
	(0.002)	(0.002)
Adj. R^2	0.67	0.65
Year fixed effect	Yes	Yes
Month fixed effect	Yes	Yes
County fixed effect	Yes	Yes
Wald F stat	54.90	114.30

Note: Numbers in parentheses are standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3. Second-Stage Regression Results for Corn Basis.

	No Interaction	Port Distance Interaction	Plant Distance Interaction	Neighbor Interaction	All Interactions
Barge rate	-34.32***	-54.55***	-32.10***	-48.45***	-74.24***
	(6.15)	(6.90)	(6.33)	(6.16)	(7.03)
Drought index	5.21***	5.10***	5.20***	5.04***	4.88***
	(0.32)	(0.31)	(0.32)	(0.32)	(0.31)
Port distance	-0.07***	-0.14***	-0.06***	-0.06***	-0.15***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Plant distance	-0.35***	-0.39***	-0.26**	-0.35***	-0.38***
	(0.05)	(0.05)	(0.08)	(0.05)	(0.08)
Number of neighbors	0.00	0.02	-0.00	-0.43***	-0.46***
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)
Barge rate × Port distance		0.13***			0.16***
		(0.01)			(0.01)
Barge rate × Plant distance			-0.13		-0.04
			(0.08)		(0.07)
Barge rate × Number of neighbors				0.56***	0.64***
				(0.05)	(0.05)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes	Yes
County fixed effect	Yes	Yes	Yes	Yes	Yes
Within R^2	0.05	0.07	0.05	0.07	0.09
RMSE	28.13	27.94	28.12	27.86	27.60
Num. Obs.	544,240	544,240	544,240	544,240	544,240

Note: Numbers in parentheses are standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 4. Second-Stage Regression Results for Soybeans Basis (Linear Interaction).

	No Interaction	Port Distance Interaction	Plant Distance Interaction	Neighbor Interaction	All Interactions
Barge rate	-11.54*	-27.67***	-14.59**	-13.91**	-41.31***
	(4.59)	(4.84)	(4.80)	(5.27)	(5.55)
Drought index	3.02***	2.90***	2.97***	3.02***	2.89***
	(0.28)	(0.28)	(0.28)	(0.28)	(0.28)
Port distance	-0.26***	-0.36***	-0.26***	-0.26***	-0.37***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Plant distance	-0.15***	-0.13***	-0.18***	-0.15***	-0.13***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Number of neighbors	-0.09.	-0.07	-0.09	-0.12*	-0.22***
	(0.05)	(0.05)	(0.05)	(0.06)	(0.06)
Barge rate × Port distance		0.14***			0.16***
		(0.01)			(0.01)
Barge rate × Plant distance			0.05*		0.01
			(0.02)		(0.02)
Barge rate × Number of neighbors				0.06	0.25***
				(0.04)	(0.04)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes	Yes
County fixed effect	Yes	Yes	Yes	Yes	Yes
Within R^2	0.11	0.12	0.11	0.11	0.12
RMSE	32.67	32.51	32.67	32.67	32.47
Num. Obs.	881,477	881,477	881,477	881,477	881,477

Note: Numbers in parentheses are standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 5. Second-Stage Regression Results for Corn Basis (Log Interaction).

	No Interaction	Port Distance Interaction	Plant Distance Interaction	Neighbor Interaction	All Interactions
Barge rate	-26.66***	-80.89***	-19.45**	-79.94***	-126.31***
	(5.78)	(6.96)	(6.45)	(7.70)	(8.68)
Drought index	5.10***	5.02***	5.08***	5.01***	4.94***
	(0.32)	(0.32)	(0.32)	(0.32)	(0.32)
Port distance	-4.79***	-11.55***	-4.72***	-4.44***	-10.68***
	(0.75)	(0.94)	(0.76)	(0.67)	(0.86)
Plant distance	-4.14***	-4.28***	-2.09*	-4.11***	-4.22***
	(0.50)	(0.51)	(0.99)	(0.47)	(0.97)
Number of neighbors	-2.08	-1.43	-2.10	-12.85***	-11.55***
	(1.56)	(1.59)	(1.56)	(2.07)	(2.12)
Barge rate × Port distance		11.41***			10.49***
		(0.91)			(0.89)
Barge rate × Plant distance			-2.95**		-0.03
			(1.10)		(1.05)
Barge rate × Number of neighbors				16.94***	15.84***
				(1.75)	(1.70)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes	Yes
County fixed effect	Yes	Yes	Yes	Yes	Yes
Within R^2	0.05	0.07	0.05	0.07	0.08
RMSE	28.11	27.91	28.10	27.86	27.69
Num. Obs.	544,240	544,240	544,240	544,240	544,240

Note: Numbers in parentheses are standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 6. Second-Stage Regression Results for Soybean Basis (Log Interaction).

	No Interaction	Port Distance Interaction	Plant Distance Interaction	Neighbor Interaction	All Interactions
Barge rate	-15.75***	-53.58***	-30.55***	-25.73***	-86.68***
	(4.24)	(5.14)	(5.43)	(6.07)	(7.58)
Drought index	2.68***	2.55***	2.64***	2.68***	2.51***
	(0.28)	(0.28)	(0.28)	(0.28)	(0.28)
Port distance	-15.35***	-20.57***	-15.29***	-15.28***	-20.31***
	(0.77)	(1.00)	(0.76)	(0.76)	(0.98)
Plant distance	-8.47***	-8.13***	-10.74***	-8.45***	-10.41***
	(1.05)	(1.07)	(1.21)	(1.05)	(1.22)
Number of neighbors	1.61	2.39	1.68	0.01	-0.49
	(1.60)	(1.66)	(1.59)	(1.81)	(1.76)
Barge rate × Port distance		8.57***			8.47***
		(0.84)			(0.82)
Barge rate × Plant distance			3.96***		4.05***
			(0.97)		(0.99)
Barge rate × Number of neighbors				2.77*	5.11***
				(1.37)	(1.28)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes	Yes
County fixed effect	Yes	Yes	Yes	Yes	Yes
Within R^2	0.11	0.11	0.11	0.11	0.11
RMSE	32.65	32.54	32.64	32.64	32.52
Num. Obs.	881,477	881,477	881,477	881,477	881,477

Note: Numbers in parentheses are standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 7. Counties with the Largest and Smallest Pass-Through Effects of Barge Freight Rates on Corn Basis.

State	County	Pass-Through Effect	Elevators in County	Mean Neighbors in 50 miles	Mean Distance to River Port	Mean Distance to Plant
Largest (Most Negative)						
MS	Warren	-92.70	1	1.00	7.71	17.12
MS	Washington	-93.31	1	4.00	1.06	8.76
LA	Madison	-93.35	1	1.00	7.21	34.29
AR	Jefferson	-99.45	1	2.00	1.47	2.70
AR	Pulaski	-103.81	1	1.00	2.03	39.32
AR	Pope	-106.27	1	0.00	5.80	10.44
LA	Catahoula	-110.64	1	1.00	0.58	48.63
LA	Concordia	-110.75	1	1.00	0.57	63.98
MS	Yazoo	-113.59	1	0.00	2.40	38.16
KY	Jefferson	-116.25	1	0.00	1.62	2.10
Smallest (Least Negative)						
IA	Webster	-0.89	3	93.48	161.48	5.57
IA	Boone	-1.44	5	93.95	152.54	8.53
IA	Hamilton	-1.48	12	101.16	135.47	5.58
IA	Humboldt	-1.96	10	93.94	145.22	8.39
IA	Story	-1.98	11	100.18	131.34	6.96
IA	Greene	-2.00	6	84.16	170.26	5.61
IA	Calhoun	-2.20	6	81.52	176.53	9.21
IA	O'Brien	-2.20	7	85.97	161.54	2.91
IA	Clay	-2.60	3	86.00	155.65	9.43
IA	Pocahontas	-2.78	6	85.68	154.15	10.61

Table 8. Counties with the Largest and Smallest Pass-Through Effects of Barge Freight Rates on Soybean Basis.

State	County	Pass-Through Effect	Elevators in County	Mean Neighbors in 50 miles	Mean Distance to River Port	Mean Distance to Plant
Largest (Most Negative)						
IL	Pulaski	-59.88	2	23.00	0.49	5.29
IN	Vanderburgh	-60.15	3	15.96	0.09	15.56
KY	Jefferson	-60.74	1	0.00	1.62	79.93
IN	Warrick	-61.41	1	9.00	0.12	21.25
KY	McLean	-61.42	1	7.00	0.30	20.51
KY	Daviess	-63.02	2	9.46	1.85	2.15
OK	Rogers	-63.15	1	1.00	0.02	131.02
IN	Clark	-64.26	1	1.00	0.12	82.88
IN	Posey	-71.50	1	11.00	0.28	0.10
AL	Marshall	-81.62	1	1.00	0.11	0.17
Smallest (Least Negative)						
KS	Stevens	-0.10	3	31.61	310.76	150.80
KS	Edwards	-0.13	5	49.40	226.60	161.93
KS	Haskell	-0.22	4	34.22	299.12	137.31
KS	Stafford	-0.24	6	63.53	206.11	139.40
KS	Gray	-0.47	5	36.37	280.54	137.24
KS	Pawnee	-0.62	5	42.13	239.89	153.38
KS	Kiowa	-0.81	4	42.93	218.02	174.43
KS	Meade	-0.85	5	31.53	271.93	158.47
KS	Grant	-0.87	4	28.39	325.10	123.50
KS	Seward	-0.98	3	27.11	289.36	162.46

Appendix.

Appendix Table A1-A8 report robustness checks using alternative functional forms or the interaction terms (log transformations) and different fixed-effects (elevator or state level). For the models with elevator level fixed effects, coefficients for β_3, β_4, and β_5 were not estimated due to multicollinearity. Across most specifications, higher barge freight rates reduce both corn and soybean basis. The exceptions are corn elevator fixed effect models, where β_1 is positive in these two models.

Table A1. Second-Stage Regression Results for Corn Basis (Elevator Fixed Effect, Linear Interaction).

	No Interaction	Port Distance Interaction	Plant Distance Interaction	Neighbor Interaction	All Interactions
Barge rate	55.59***	43.47***	62.72***	52.99***	41.90***
	(11.71)	(10.83)	(11.12)	(11.03)	(9.48)
Drought index	4.09***	3.89***	4.03***	3.83***	3.48***
	(0.19)	(0.17)	(0.19)	(0.19)	(0.17)
Barge rate × Port distance		0.12***			0.16***
		(0.01)			(0.01)
Barge rate × Plant distance			-0.23***		-0.18***
			(0.05)		(0.04)
Barge rate × Number of neighbors				0.50***	0.57***
				(0.03)	(0.03)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes	Yes
County fixed effect	Yes	Yes	Yes	Yes	Yes
Within R^2	0.02	0.03	0.03	0.04	0.05
RMSE	26.81	26.67	26.80	26.62	26.39
Num. Obs.	544,240	544,240	544,240	544,240	544,240

Note: Numbers in parentheses are standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A2. Second-Stage Regression Results for Soybean Basis (Elevator Fixed Effect, Linear Interaction).

	No Interaction	Port Distance Interaction	Plant Distance Interaction	Neighbor Interaction	All Interactions
Barge rate	-24.25***	-39.58***	-26.56***	-23.32***	-41.55***
	(5.80)	(5.17)	(5.81)	(5.95)	(5.04)
Drought index	3.98***	3.76***	3.95***	3.99***	3.75***
	(0.14)	(0.13)	(0.14)	(0.14)	(0.13)
Barge rate × Port distance		0.15***			0.17***
		(0.00)			(0.00)
Barge rate × Plant distance			0.04***		-0.05***
			(0.01)		(0.01)
Barge rate × Number of neighbors				-0.04*	0.13***
				(0.02)	(0.02)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes	Yes
County fixed effect	Yes	Yes	Yes	Yes	Yes
Within R^2	0.01	0.02	0.01	0.01	0.02
RMSE	30.86	30.69	30.85	30.86	30.67
Num. Obs.	881,477	881,477	881,477	881,477	881,477

Note: Numbers in parentheses are standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A3. Second-Stage Regression Results for Corn Basis (Elevator Fixed Effect, Log Interaction).

	No Interaction	Port Distance Interaction	Plant Distance Interaction	Neighbor Interaction	All Interactions
Barge rate	55.59***	14.45	70.85***	23.94*	-4.92
	(11.71)	(10.32)	(11.28)	(11.80)	(10.08)
Drought index	4.09***	3.81***	4.03***	3.90***	3.62***
	(0.19)	(0.17)	(0.19)	(0.19)	(0.17)
Barge rate × Port distance		12.04***			11.57***
		(0.54)			(0.57)
Barge rate × Plant distance			-5.00***		-2.32**
			(0.83)		(0.74)
Barge rate × Number of neighbors				13.55***	12.01***
				(1.21)	(1.11)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes	Yes
County fixed effect	Yes	Yes	Yes	Yes	Yes
Within R^2	0.02	0.04	0.03	0.03	0.05
RMSE	26.81	26.62	26.79	26.68	26.50
Num. Obs.	544,240	544,240	544,240	544,240	544,240

Note: Numbers in parentheses are standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A4. Second-Stage Regression Results for Soybean Basis (Elevator Fixed Effect, Log Interaction).

	No Interaction	Port Distance Interaction	Plant Distance Interaction	Neighbor Interaction	All Interactions
Barge rate	-24.25***	-58.11***	-27.01***	-25.93***	-61.07***
	(5.80)	(5.20)	(6.06)	(6.77)	(6.43)
Drought index	3.98***	3.67***	3.97***	3.98***	3.66***
	(0.14)	(0.13)	(0.14)	(0.14)	(0.13)
Barge rate × Port distance		9.75***			9.87***
		(0.42)			(0.43)
Barge rate × Plant distance			0.70		-0.57
			(0.56)		(0.56)
Barge rate × Number of neighbors				0.56	1.59*
				(0.77)	(0.75)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes	Yes
County fixed effect	Yes	Yes	Yes	Yes	Yes
Within R^2	0.01	0.02	0.01	0.01	0.02
RMSE	30.86	30.74	30.86	30.86	30.74
Num. Obs.	881,477	881,477	881,477	881,477	881,477

Note: Numbers in parentheses are standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A5. Second-Stage Regression Results for Corn Basis (State Fixed Effect, Linear Interaction).

	No Interaction	Port Distance Interaction	Plant Distance Interaction	Neighbor Interaction	All Interactions
Barge rate	-3.99	-14.05	-1.89	-23.71*	-40.70**
	(9.94)	(12.04)	(10.22)	(10.47)	(11.79)
Drought index	4.94***	4.89***	4.93***	4.86***	4.77***
	(1.12)	(1.11)	(1.13)	(1.16)	(1.15)
Port distance	-0.00	-0.04	-0.00	-0.00	-0.06.
	(0.02)	(0.04)	(0.02)	(0.02)	(0.03)
Plant distance	-0.31***	-0.32***	-0.22*	-0.31***	-0.32***
	(0.04)	(0.04)	(0.08)	(0.04)	(0.07)
Number of neighbors	0.08	0.08	0.07	-0.38*	-0.42**
	(0.11)	(0.11)	(0.11)	(0.14)	(0.13)
Barge rate × Port distance		0.06			0.09**
		(0.04)			(0.03)
Barge rate × Plant distance			-0.14		-0.01
			(0.13)		(0.10)
Barge rate × Number of neighbors				0.55**	0.61**
				(0.16)	(0.17)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes	Yes
County fixed effect	Yes	Yes	Yes	Yes	Yes
Within R^2	0.05	0.05	0.05	0.06	0.07
RMSE	29.10	29.05	29.09	28.84	28.74
Num. Obs.	544,240	544,240	544,240	544,240	544,240

Note: Numbers in parentheses are standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A6. Second-Stage Regression Results for Soybean Basis (State Fixed Effect, Linear Interaction).

	No Interaction	Port Distance Interaction	Plant Distance Interaction	Neighbor Interaction	All Interactions
Barge rate	-14.77	-28.48**	-15.85	-17.19	-39.04***
	(9.55)	(9.88)	(9.84)	(10.07)	(9.73)
Drought index	3.75***	3.65***	3.72***	3.76***	3.72***
	(0.84)	(0.77)	(0.84)	(0.83)	(0.79)
Port distance	-0.14***	-0.22***	-0.14***	-0.14***	-0.24***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Plant distance	-0.09**	-0.08**	-0.10*	-0.09**	-0.06.
	(0.02)	(0.02)	(0.04)	(0.02)	(0.03)
Number of neighbors	-0.03	-0.02	-0.02	-0.06	-0.14*
	(0.04)	(0.05)	(0.05)	(0.07)	(0.07)
Barge rate × Port distance		0.12***			0.14***
		(0.02)			(0.02)
Barge rate × Plant distance			0.02		-0.03
			(0.05)		(0.04)
Barge rate × Number of neighbors				0.05	0.20.
				(0.12)	(0.10)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes	Yes
County fixed effect	Yes	Yes	Yes	Yes	Yes
Within R^2	0.07	0.08	0.07	0.07	0.08
RMSE	32.79	32.66	32.79	32.79	32.62
Num. Obs.	881,477	881,477	881,477	881,477	881,477

Note: Numbers in parentheses are standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A7. Second-Stage Regression Results for Corn Basis (State Fixed Effect, Log Interaction).

	No Interaction	Port Distance Interaction	Plant Distance Interaction	Neighbor Interaction	All Interactions
Barge rate	-1.20	-42.10**	3.62	-59.16**	-100.01***
	(6.21)	(14.11)	(6.81)	(18.59)	(14.67)
Drought index	4.89***	4.82***	4.88***	4.90***	4.84***
	(1.10)	(1.09)	(1.11)	(1.14)	(1.13)
Port distance	-1.44	-7.06***	-1.42	-1.47.	-6.90***
	(0.87)	(1.78)	(0.86)	(0.81)	(1.72)
Plant distance	-4.70***	-4.82***	-3.29*	-4.57***	-5.17***
	(0.55)	(0.56)	(1.31)	(0.54)	(1.18)
Number of neighbors	0.77	0.78	0.72	-10.34*	-10.26**
	(2.87)	(2.95)	(2.87)	(3.64)	(3.42)
Barge rate × Port distance		8.59**			8.29**
		(2.32)			(2.19)
Barge rate × Plant distance			-2.07		0.72
			(1.39)		(1.45)
Barge rate × Number of neighbors				16.38**	16.30**
				(4.95)	(4.77)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes	Yes
County fixed effect	Yes	Yes	Yes	Yes	Yes
Within R^2	0.05	0.05	0.05	0.06	0.07
RMSE	29.09	28.96	29.08	28.82	28.70
Num. Obs.	544,240	544,240	544,240	544,240	544,240

Note: Numbers in parentheses are standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A8. Second-Stage Regression Results for Soybean Basis (State Fixed Effect, Log Interaction).

	No Interaction	Port Distance Interaction	Plant Distance Interaction	Neighbor Interaction	All Interactions
Barge rate	-16.07	-55.04**	-23.20	-24.82	-75.92***
	(9.36)	(14.95)	(14.40)	(14.80)	(19.00)
Drought index	3.32***	3.21***	3.29***	3.33***	3.21***
	(0.68)	(0.62)	(0.68)	(0.68)	(0.63)
Port distance	-8.75***	-14.19***	-8.72***	-8.74***	-14.18***
	(1.51)	(2.16)	(1.48)	(1.51)	(1.96)
Plant distance	-5.93***	-5.64***	-7.07*	-5.92***	-6.55**
	(1.40)	(1.35)	(2.79)	(1.39)	(2.14)
Number of neighbors	3.51*	3.72*	3.56.	2.14	1.43
	(1.65)	(1.64)	(1.70)	(2.09)	(1.63)
Barge rate × Port distance		8.82***			8.87***
		(2.00)			(1.93)
Barge rate × Plant distance			1.97		1.60
			(2.79)		(1.97)
Barge rate × Number of neighbors				2.34	3.99
				(3.93)	(3.05)
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes	Yes
County fixed effect	Yes	Yes	Yes	Yes	Yes
Within R^2	0.08	0.08	0.08	0.08	0.08
RMSE	32.76	32.63	32.76	32.76	32.62
Num. Obs.	881,477	881,477	881,477	881,477	881,477

Note: Numbers in parentheses are standard errors.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.