

# NC STATE ECONOMIST

COLLEGE OF AGRICULTURE & LIFE SCIENCES

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## TRANSPORTATION INFRASTRUCTURE AND THE PRICE OF CORN

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### The Price of Corn

What distinguishes agricultural economics from ordinary economics? Arguably the following fact: agricultural commodities are not worth very much. Consider the price of corn, which has risen to unprecedented levels following this summer's Midwestern drought. As of early November, the price of corn was above \$7 per 56-pound bushel. At this lofty price, corn sells for  $\$7.00/56 = 13$  cents per pound. Corn is literally cheaper than dirt—at least cheaper than the planting soil advertised at the nearby hardware store.

Of course, what value corn lacks per unit of weight, it makes up for in volume. The total value of the corn crop in 2011 was more than \$75 billion. And huge swaths of the United States, especially the Midwestern Cornbelt states (Iowa, Illinois, Indiana, Nebraska and Minnesota), are dedicated to the cultivation of corn. More than half of the nation's nearly 100 million acres of corn land are planted in those five states; and nearly one-quarter of the land of the Cornbelt is planted in corn.

The economic problem posed by this tremendous mass of a relatively low-value commodity is how to get it to market at least cost. Every year, corn produced in the Midwest must be harvested, gathered, and moved to

where it is ultimately consumed: a feedlot or ethanol plant or export terminal. Significant portions of corn grown in the U.S. are sent to overseas markets—typically more than 20% of our production. Much of that corn is sent by truck or rail to the Mississippi River, where it is loaded onto barges and transported down the river to the Port of New Orleans. After a 12-day trip it is loaded onto transoceanic tankers.

Not all corn flows down the Mississippi river and out the Gulf of Mexico. Quite a bit of it travels over land, by truck and rail, to inland consumers in places like North Carolina. While North Carolina produces corn, it is more agriculturally diverse than the Cornbelt states, and produces much less corn than it consumes. Corn acreage in North Carolina accounts for only 3% of our state's land area, and so we import corn from the Midwest to feed to chickens, turkeys, and hogs. Much of the pork and poultry products are subsequently shipped back in the directions from which the feedgrain originated.

Since North Carolina, like New Orleans, is a destination market for corn, the logistical infrastructure that gets the corn to us is critical. Inefficiencies in the transportation network translate directly into higher prices that our poultry and hog industries pay for the grain fed to birds and pigs.

### Spatial Patterns in Corn Prices

All the effort devoted to grain transport adds significantly to the cost of corn. In fact, the costs of grain transportation reveal themselves when one looks at prices received by farmers (and paid by buyers) at different places at the same time. Corn is sold most cheaply where it is produced, and its price rises as it makes its way to final end users. Imagine a three-dimensional relief map of the United States, showing not altitude but corn price at each location. Such a map would have its low points in the Midwest—say, the middle of Iowa. As one moved east toward the Mississippi River, the price altitude would rise to reflect the costs of truck and train transport. Once one reached the river and headed south along it, the price surface would continue to rise until the Port of New Orleans. The price would be highest in New Orleans because at that point it reflects the full costs of transportation from mid-Iowa to the Gulf of Mexico. Like the river itself, the price of corn grows larger as one travels further south.

The price surface—a kind of map depicting prices across a broad geographic area—can be estimated if a sufficiently large number of corn price quotes are available over a wide area. The accompanying figures illustrate the Mississippi grainshed constructed for a particular post-harvest day: November 20, 2010. Figure 1 displays a three-dimensional image of the price surface for corn. (Figure 2 displays the same surface, but in the form of a contour map). The effects of grain transport can clearly be seen. The low-lying price regions are those in the Midwest grain-producing states, where bid prices for corn are as low as \$4.20 per bushel. A slightly higher plateau of still-low corn prices can be seen east of the Mississippi over Ohio. Price rises from each low plateau up toward the Mississippi, and rises again south toward New Orleans and the Gulf of Mexico. At the Port of New Orleans the price of grain is a full dollar higher than it is in the production regions that are upstream and inland.

### Understanding Changes in the Price Surface

Economists at NC State are now engaged in research to construct price forecast models based on the economic forces outlined above. Understanding what drives changes in the spatial patterns of grain prices is critical to those engaged in grain production, transport, and trade. Such understanding is also critical from a public policy perspective when considering the desirability of public investments in the infrastructure through which grain is transported.

What has allowed the work to proceed is a unique collaboration with an alumnus of NC State's Economics Graduate Program. Kevin McNew graduated with a Ph.D. in Economics in 1994, focusing on the economics of grain. After academic stints at the University of Maryland and Montana State University, he founded a firm—called GeoGrain—that collects real-time, daily data, on bid prices for grain at over 4,000 buying points across the country. Daily information from these markets is conveyed to grain traders and farmers to help them make informed marketing decisions. We have used a five-year history of these prices to statistically measure the variations in corn prices across the country that are due to transportation costs.

We have found that changes in the price of barge services along the Mississippi have strong influences on the price of corn at points distant from the river, as economic theory implies. When the price of barge services goes up, the price of corn inland goes down. Corn far from its ultimate destination is worth less if it costs more to get it to that final destination.

Further, there are strong and predictable seasonal changes in corn prices. Just after harvest in September and October, grain pools in the harvest regions, depressing the price relative to prices along the river and south. Buyers pay large premiums for grain that is ready to load onto ocean-going vessels in New Orleans relative to corn inland that still needs to

Figure 1. Corn Price Surface

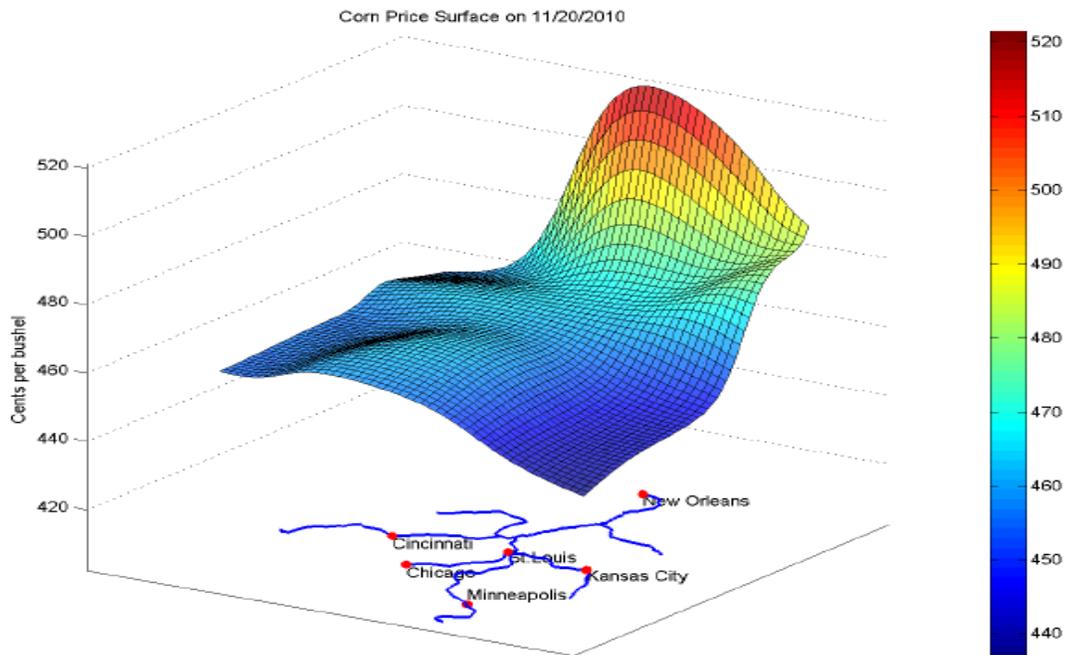
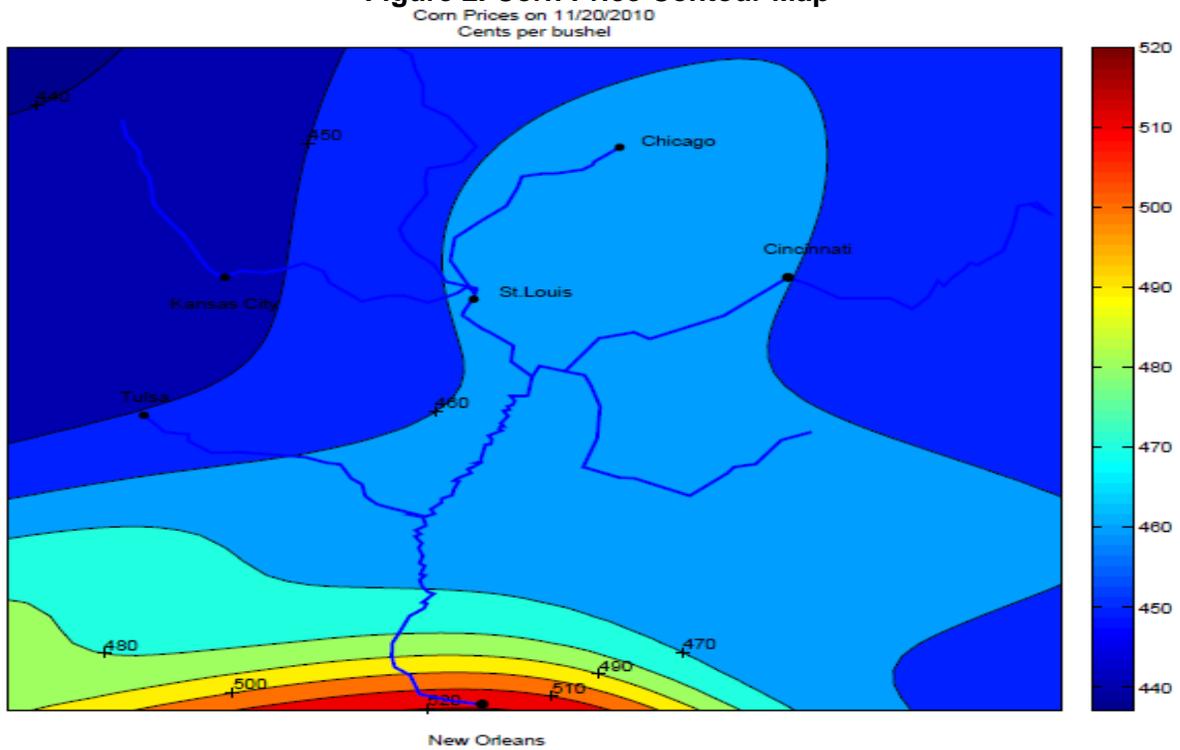


Figure 2. Corn Price Contour Map



be transported. As the crop year advances and grain is removed from the Cornbelt states, shipping conditions relax and the price premium paid for export-ready grain declines.

### **Water in the Mississippi is Critical to Grain Transport**

The usually invisible role that Mississippi barge traffic plays became quite visible recently, when the summer's drought throughout the Mississippi basin lowered water levels along the river's length. In early September, water levels fell so low that some ports became unusable by the barges, and certain stretches of the river slowed to a crawl. Grain couldn't travel down the Mississippi, nor could iron ore and other industrial materials travel upstream to smelters and factories that depend upon them. As of December 2012, river levees still were low and shipping companies had appealed to the U.S. Army Corps of Engineers to release more water from Missouri River dams to raise water levels on the Mississippi below St. Louis.

Extreme flows of the opposite kind—floods in 2011, 1993, and more dramatically in 1927—have led to massive public investments in levees, locks, and canals, as well as continual public expenditures on dredging. The most obvious individuals affected by extreme events along the river, and the public responses to them, are those who live near the river and in its flood plains. But the effects of changes in conditions on the great national waterway are felt far away from the river itself.

The possible effects of variability in flow and level of the Mississippi River that might result from changes in climatic conditions are the subjects of current research. Collaborative work between NC State economists and hydrologic engineers is addressing questions of the costs and benefits of different ways of

responding and adapting to variations in river flow. An important piece of such analysis will be the influence of water flows on the costs of grain transport and the ultimate effect on the price of corn.

### **Alternative Corn Routes: The Port of Wilmington**

Improvements and deterioration in transportation infrastructure have long-lasting impacts on the costs of transporting grain and, hence, on its price. As a coastal state, North Carolina has access to sea routes for grain, especially through the Port of Wilmington. But corn has not typically come into the state through Wilmington. That likely will change as Midwestern corn is increasingly diverted to ethanol plants in the Midwest. With less surplus corn leaving the Midwest as grain, Wilmington is likely to become a more important conduit for grain purchased by North Carolina livestock producers. A noteworthy development came this past September when the drought of 2012 in the Midwest prompted Prestage Farms and two other livestock producers to begin importing corn through Wilmington—from Brazil—to feed their hogs and poultry.

This rather remarkable and far-flung global route is likely to be used more frequently for a couple of reasons. The first is that in coming years increasing quantities of U.S. corn will be devoted to ethanol production because of the federal Renewable Fuel Standard. The second is the possible expansion of port facilities at Wilmington to take advantage of export opportunities to China through the soon-to-be expanded Panama Canal. If port facilities at Wilmington are improved, overseas Atlantic sources of grain will become cheaper. One factor that may inhibit that development, however, is inadequate railroad infrastructure to move the corn from Wilmington to feed mills in places like Wallace in Duplin County.