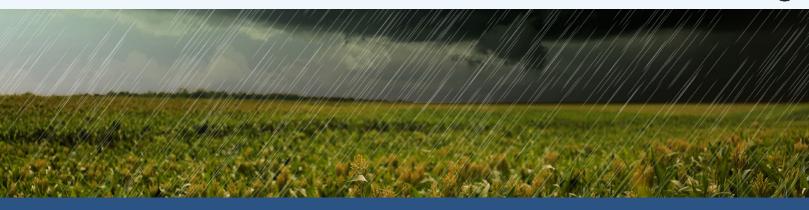# Weather Extremes, Infrastructure, and Its Impacts on U.S. Corn and Soybean Basis Levels (Summary)

Delmy Salin

The findings and conclusions in this publication are those of the author(s) and should not be construed to represent any official USDA or U.S. Government determination or policy.

WHAT IS THE ISSUE?

The margin between corn and soybean prices at collection points in the Midwest and the Gulf price reflect the costs of moving these bulk commodities from farming regions to export facilities. These margins, or crop basis, depend on many factors, including the transportation network, network disruptions, storage costs, and volume of material being moved. The margins also depend on the costs—often associated with barge availability—of moving goods along the transportation network. Weather also plays a role. Weather can affect yield in the region and around each collection point. Weather factors can also damage grain quality, impair barge traffic by making river levels too high or too low for normal volumes, and sever routes for other modes (e.g., by flooding). With the climate changing rapidly, these factors must be better understood so that analysts can estimate the influence of climate change effects on crop basis and commodity prices in general.

HOW WAS THE STUDY CONDUCTED?

The effect of weekly variations in temperature and precipitation on crop basis of each collection point in the central region[1] was estimated in a multistep process. First, an econometric panel data model was developed for the period 2008-2020 that explains changes in basis as a function of local precipitation, flooding and low

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1 A 13-State region congregated around the headwaters of the Mississippi River in the Upper Midwest.

water level proxies, crop yields, and control variables (e.g., diesel price, ethanol intensity). Local precipitation captures the immediate effect of a normal or abnormal weekly rainfall on the local cash price. As explained above, river flooding and low water levels affect basis by disrupting grain transportation. Yield captures the local crop supply effect on basis. Nonlinear or disproportionate effects were included in the analysis (in the case of local precipitation and yield) to capture the effect of extreme rainfall events and very high crop supply on basis.

Next, econometric models were developed that link weather conditions to yield (to gauge the demand for transportation services) and link precipitation to river water level (to test if low or high water conditions reduce barge travel). The first connection was examined from the perspective that weather conditions affect both the planting dates and progress of a crop. These factors can, in turn, impact crop yields. The planting progress and water level estimates accounted for the potential non-linear effects of weather variables on planting progress and river water level.

Finally, the analysis made use of econometric results of the basis, planting progress (and inferred yield), and water-level models, along with data on climate change scientists' projections of temperature and precipitation. Using all of this data, the analysis simulated the effect on basis of projected climate-change scenarios of temperature and precipitation.

WHAT DID THE STUDY FIND?

Impact of Weather on Planting Progress, Yield, and River-Water Levels

Results suggest that warming weather can accelerate planting, while precipitation slows planting progress. The researchers found rising precipitation often improved crop yield, depending on when the crops were planted. However, levels of precipitation that were far above average negatively impacted crop yields.

The effect of temperature on crop yields was more mixed. In early weeks of the corn growing season, higher than average temperatures positively affected yields, while in later weeks, high temperatures negatively affected yields. For soybeans, the opposite pattern was observed—i.e., early high temperatures negatively affected yields, while late high temperatures positively affected yields. Lastly, and as expected, results showed that rising precipitation levels correlated to higher river water levels.

Determinants of Crop Basis

The main results of the analysis of corn and soybean basis determinants are as follows:

- Corn and soybean basis is significantly affected by local precipitation, yield shocks, river water variables, and other external factors such as ethanol intensity and diesel price.

- High local precipitation leads to lower corn basis.

- High local precipitation causes soybean basis to rise initially and then fall.

- Low corn yield (less volume) leads to higher corn basis.

- High corn yield (more volume) leads to lower corn basis.

- Low soybean yield (less volume) leads to higher soybean basis.

- Regarding the effects of river traffic disruption, both high and low water reduce basis for upriver points.

Climate-Change Simulation Results

Climate change implies changes in local precipitation; crop yield (through changes in planting progress, and growing season weather); and river levels (i.e., more or fewer days with high or low water levels). Climate change scientists' projections of temperature and precipitation were used to simulate the effects of climate change on planting, yield, river levels, and basis. The simulations helped connect climate-change-related infrastructure strain with the gap between farm and buyer prices. The main results of the simulation-based analysis are as follows:

- Climate change—mainly, in the form of rising temperatures—shifted planting progress (of both corn and soybeans) earlier.

- Changes in weather variables increased average corn yield slightly and reduced average soybean yield. At the same time, yield distributions narrowed (especially for corn).

- Climate change scenarios showed small increases in the number of floods and reductions of the number of low-water days along the Mississippi and Illinois Rivers.

- Corn basis decreased (by 0.05 cents, on average)—mainly driven by precipitation change—in the high-change climate scenario.

- Soybean basis was found to increase (by 2.6 cents, on average) as a result of climate change. Temperature change was the main driver of this increase.

- Calculating the impacts of local precipitation, yield, and river water conditions showed yield to be the main driver of changes in both corn and soybean basis.

- The ranges of corn and soybean basis widen in all four climate change scenarios.

Author Contact
Theodoros Skevas
skevast@umsystem.edu
573-882-8496

USDA Contact
Delmy Salin
Delmy.Salin@usda.gov

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