Extreme Weather and Its Impact on Transportation, Infrastructure, and Farm Production

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Extreme Weather, Transportation, Infrastructure, and Production



Topic: WEATHER and BASIS SPREAD

Part 1: Recent findings

Weekly precipitation and temperature affect the gap between local and Gulf port crop prices

Part 2: New work

How extreme events disrupt the crop distribution system

Why New Orleans

RELEVANCE An important port

43% of ag exports through New Orleans

Local-to port price gaps matter Higher gap→ →higher buyer prices and costs →lower producer prices and receipts



Focus of analysis

U.S. Corn Belt

Corn and soybean collection points (elevators)

Basis spread

Local price less New Orleans price



Caution: NOT everything! Crop basis, infrastructure, and weather are BIG topics.



August 2020 : Derecho

Spring 2021 : I-40 bridge at Memphis



Recent work: Weather effects on basis

We started with certain expectations



Precipitation at a collection point

High precipitation could cause disruptions Basis highest with low precipitation

Growing season conditions

Good conditions cause large crop production and strains infrastructure *Extreme* conditions mean less crop production and less strain

Regional precipitation

Extreme precipitation means barges travel light or rivers flood

Basis highest with normal precipitation

Relationships (detailed)

SUMMARY

Estimation steps:

1. Effect of weather on

- (a) corn and soybean yields
- (b) river water level

 Effect of weather, yield, and river level on basis spread

3. Estimate future weather change affects on basis



Step 1a) Weather \rightarrow yield

Planting progress

- Warmer weather → earlier planting
- Dryer weather → earlier planting



Precipitation and temperature after planting → mixed effects

More precipitation or hotter temperature can be good or bad, depends on which week and starting point

Step 1a) Weather \rightarrow yield \rightarrow volume to ship

Example: Effects of weather <u>12 weeks after planting</u>

- Rising weekly precipitation → yield increases at decreasing rate
- Rising weekly temperature → yield decreases at increasing rate



Step 1b) Regional precipitation \rightarrow river level



River condition

Focus on four indicator points: 2 Mississippi, 1 Ohio, 1 Illinois

River level

Depends on regional precipitation

High-or-low trigger

Check if the levelfalls below low threshold ...rises above high threshold

Step 2) Estimate basis spread

Local price at collection point relative to the New Orleans price will be *higher if*

River level is NOT too low or too high

• Yields around collection point are low

 Local precipitation at collection point is normal, not extreme

o Other factors...

Example: higher local price if more local ethanol production

Implications of future weather patterns on basis spreads?

• NCAR: four scenarios for future US weather ...

Input: different weather scenarios

Implications of future weather Daterns on Low Medium L Climate change scenario, Low(week/inch) Climate change scenario, Low(week/inch) Climate change scenario, Medium L

• NCAR: four scena future US weather More precipitation



Source: National Center for Atmospheric Research

(https://gis.ucar.edu/inspector)

Implications of future weather Description Low Medium Low Climate change scenario, Low(Fahrenheit) Climate change scenario, Medium

• NCAR: four scena future US weather More precipitation Higher temperature



Source: National Center for Atmospheric Research (https://gis.ucar.edu/inspector)

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- NCAR: four scenarios for future US weather
 - More precipitation
 - Higher temperature
- Impose weather changes on data during our sample



Scenarios: adjust historical weather

Implications of future weather patterns on basis spreads?

- NCAR: four scenarios for future US weather
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- Impose weather changes on data during our sample
- Estimate impacts on basis spread



Scenarios: adjust historical weather

Output: estimated basis impacts

Implications of future weather patterns on basis spreads -- results

River level

High water a bit more frequent Low water a bit less frequent

Yields

Warmer→ plant a bit earlier Soybean yield lower, corn mixed

Basis spread

Slightly lower corn Increase for soybean (less volume) Wider ranges for both



New work: disaster disruptions

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 Do disasters (storms, floods, other) disrupt flow of grains, increase system costs, and reduce local prices?



New work: disaster disruptions

Data to measure

- local-to-port price gaps
- disaster type and location from USDA declarations

Estimate if disaster along the route affects the price gap

- Step 1: hypothetical least-cost routes to port without disasters
- Step 2: hypothetical least-cost routes to port with disasters
- Step 3: estimate basis spreads as functions of calculated route costs
- Step 4: calculate disaster impacts

Hypothetical least-cost routes to New Orleans



Road, rail, river routes

Notes:

Only to New Orleans Hypothetical least-cost route

Hypothetical least-cost routes to New Orleans



Road, rail, river routes

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Only to New Orleans Hypothetical least-cost route

Cost calculations

Use general indicators for road, rail, and river cost

Disaster - tornadoes

Weeks of Tornadoes 2012-2022; Max Weeks - 572



Disaster – winter storms

Weeks of Winter Storms, Ice Storms, Snow, and Blizzards 2012-2022; Max - 572 Weeks



Disaster – hurricanes

Weeks of Hurricanes, Typhoons, or Tropical Storms Max Weeks - 520



Disaster – mudslides, landslides

Weeks of Mudslides, Debris Flows, or Landslides 2012-2022; Max Weeks - 572



Disaster – floods

Weeks of Flooding and Flash Flooding Disaster Declaration 2012-2022; Max - 572 Weeks



Hypothetical least-cost routes to New Orleans



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Cost calculations

Use general indicators for road, rail, and river cost

Next: estimation and calculate disaster impacts

Floods, tornadoes, winter storms, mud slides, hurricanes

Weather variations and extremes affect the US crop distribution system

Estimated impacts

River level, crop volume (yield), local weather → basis

Disaster impacts

Hypothetical least-cost route, with disruptions

<u>Relevance</u>

- Distribution costs affect consumer and producer prices
- Indications of the resilience of the network

Weather variations and extremes affect the US crop distribution system

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River level, crop volume (yield), local weather → basis

Disaster impacts

Hypothetical least-cost route, with disruptions

Relevance

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Thank you for your attention!