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To Dry or Not To Dry: The Pass-Through of LCFS Subsidies to Distillers Grain Prices

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# To Dry or Not to Dry: The Pass-through Of LCFS Subsidies to Distillers Grain Prices

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## Introduction

- California's Low Carbon Fuel Standard uses tradable compliance credits to incentivize substitution away from fossil fuels towards lower-emission fuels in the transportation sector.
- Ethanol is the second largest biofuel by volume in California.
- LCFS credits provide an additional \$0.40 to \$0.60 of value per bushel of corn.
- Ethanol plants earn more credits if they co-produce wet distillers grain instead of dry distillers grain because plants use natural gas to dry distillers grains.
- Weekly changes in LCFS credit prices could pass-through to the spreads between different types of distillers grains.
- I find complete pass-through of changes in LCFS credit values to weekly differences in distillers grain price spreads for dry and wet distillers grain in Iowa.
- Nebraska has little evidence of pass-through of credit value changes to distillers grain price spreads.

## Objectives

- Use exogenous shocks in LCFS credit prices to estimate the pass-through to distillers grain price spreads.
- Test for heterogeneity in pass-through across the different types of distillers grain and states.

## Biofuel Research

- Pass-through of RIN prices is a key performance measure of RFS (Lade and Bushnell, 2019).
- Pass-through research on LCFS credit prices is just beginning (Mazzone, Smith, and Witcover, 2022; Swanson, 2023).
- Ethanol plants have been shown to have local market power in corn market (Jung, Sesmero, and Siebert, 2021; Saitone, Sexton, and Sexton, 2008; McNew and Griffith, 2005).
- Distillers grain market is largely ignored.

## LCFS

- California subsidizes alternative fuel suppliers base on how the supplier's fuel compares to an intensity standard.
- Fuels below standard earn credits while fuels above the standard generate deficits.
- Net suppliers of credits can sell their credits to firms with net deficits.
- Largest credit generating fuel types are biomass-based diesel, biogas, electricity, and ethanol (CARB, 2024).
- Ethanol is the second largest biofuel by volume in California, but volumes are largely set by Renewable Fuel Standard (CARB, 2024).
- Individual ethanol plants can increase their credits per gallon by reducing their life-cycle emissions.
- Changing distillers grain type is a short-term means of reducing emissions by 5 to 10% per gallon.

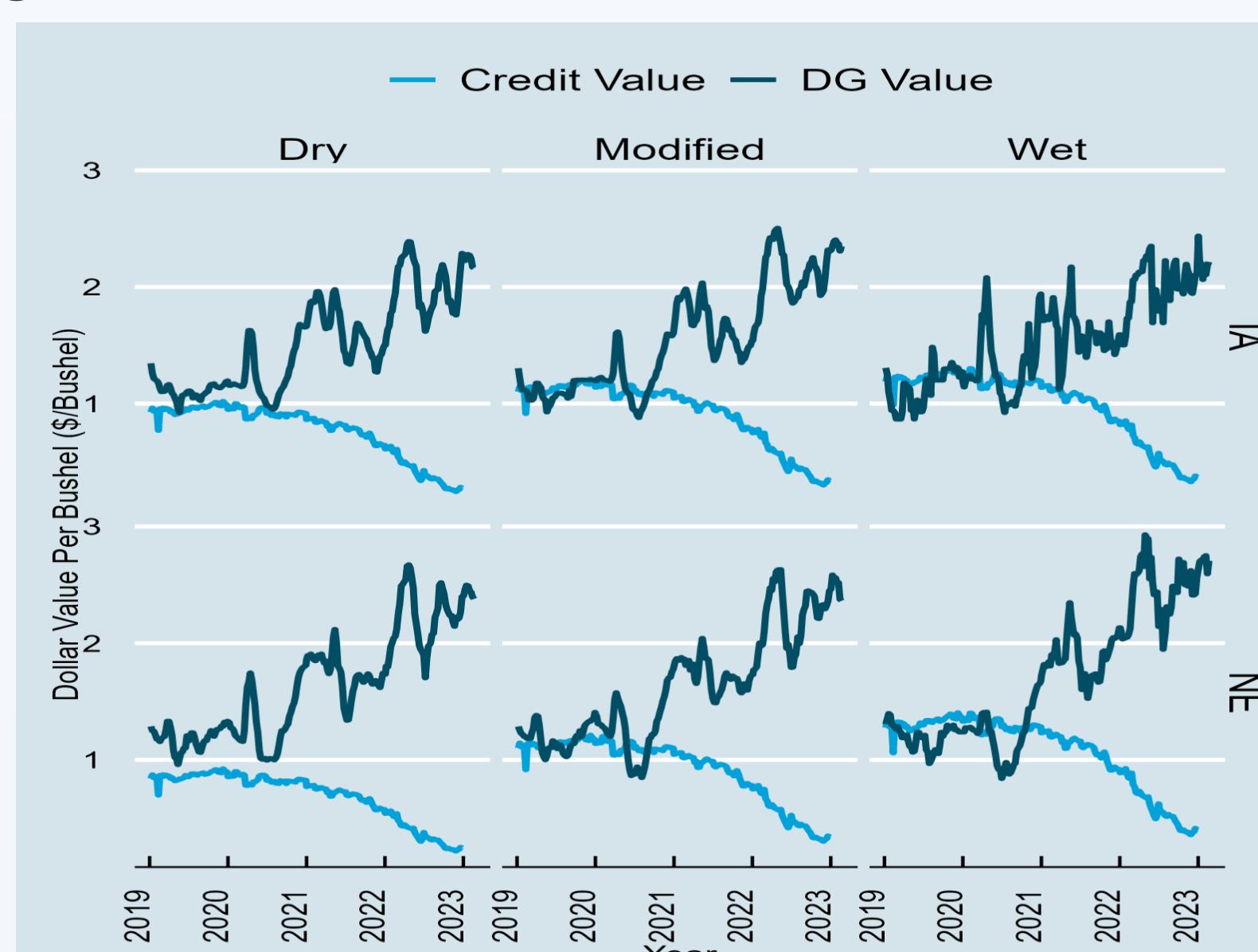
## Distillers Grains

- Distillers grains are a high protein cattle feed.
- Second largest source of revenue for ethanol plants.
- Distillers grains come in three types: dry (10% moisture), modified (55 to 60% moisture), and wet (65 to 70% moisture).
- Drying wet into modified or dry uses natural gas and increases the emissions of ethanol co-produced with lower moisture distillers grain.

## Data

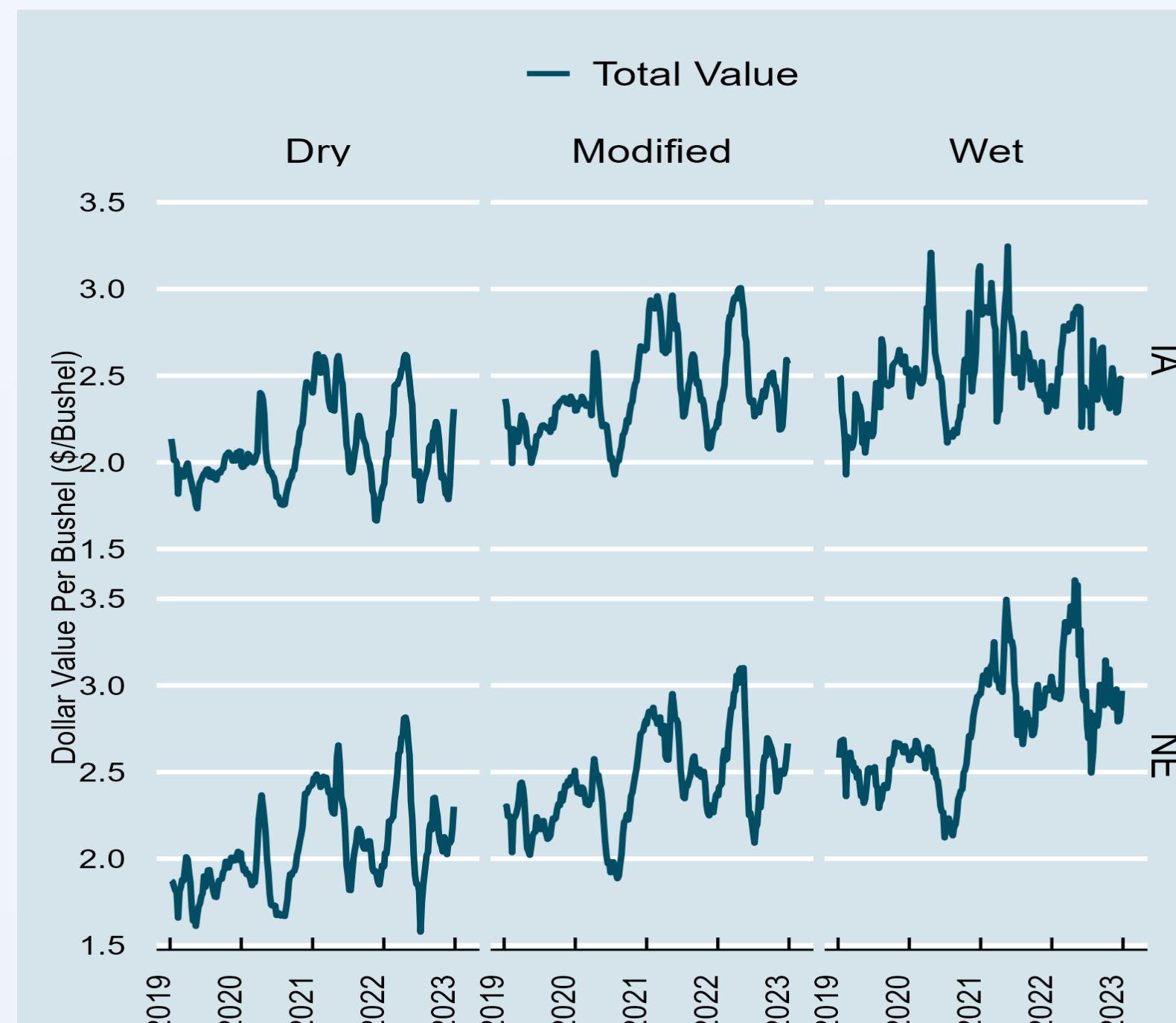
- California Air Resources Board (CARB) provides data to compute the number of credits per distillers grain type.
- CARB provides weekly updates on credit prices.
- USDA Agricultural Marketing Service (AMS) provides weekly distillers grain price data.
- AMS also provides fixed-proportions on their bioenergy reports.

Figure 1: Per Bushel Value of Credits and Distillers Grain



Note: Dry is dry distillers grains, Modified is modified distillers grains, and Wet is wet distillers grains. Credit value is the per bushel value of LCFS credits for each type. DG value is the per bushel value of distillers grain production. "IA" indicates Iowa. "NE" indicates Nebraska.

Figure 2: Per Bushel Value of Credits and Distillers Grain



Note: Dry is dry distillers grains, Modified is modified distillers grains, and Wet is wet distillers grains. Total value is the sum of the per bushel value of LCFS credits and distillers grains. "IA" indicates Iowa. "NE" indicates Nebraska.

## Empirical Model

- I use a distributed lag model of weekly changes in state-level distillers grain price spreads regressed on weekly changes in the spreads of credit values between distillers grain types.

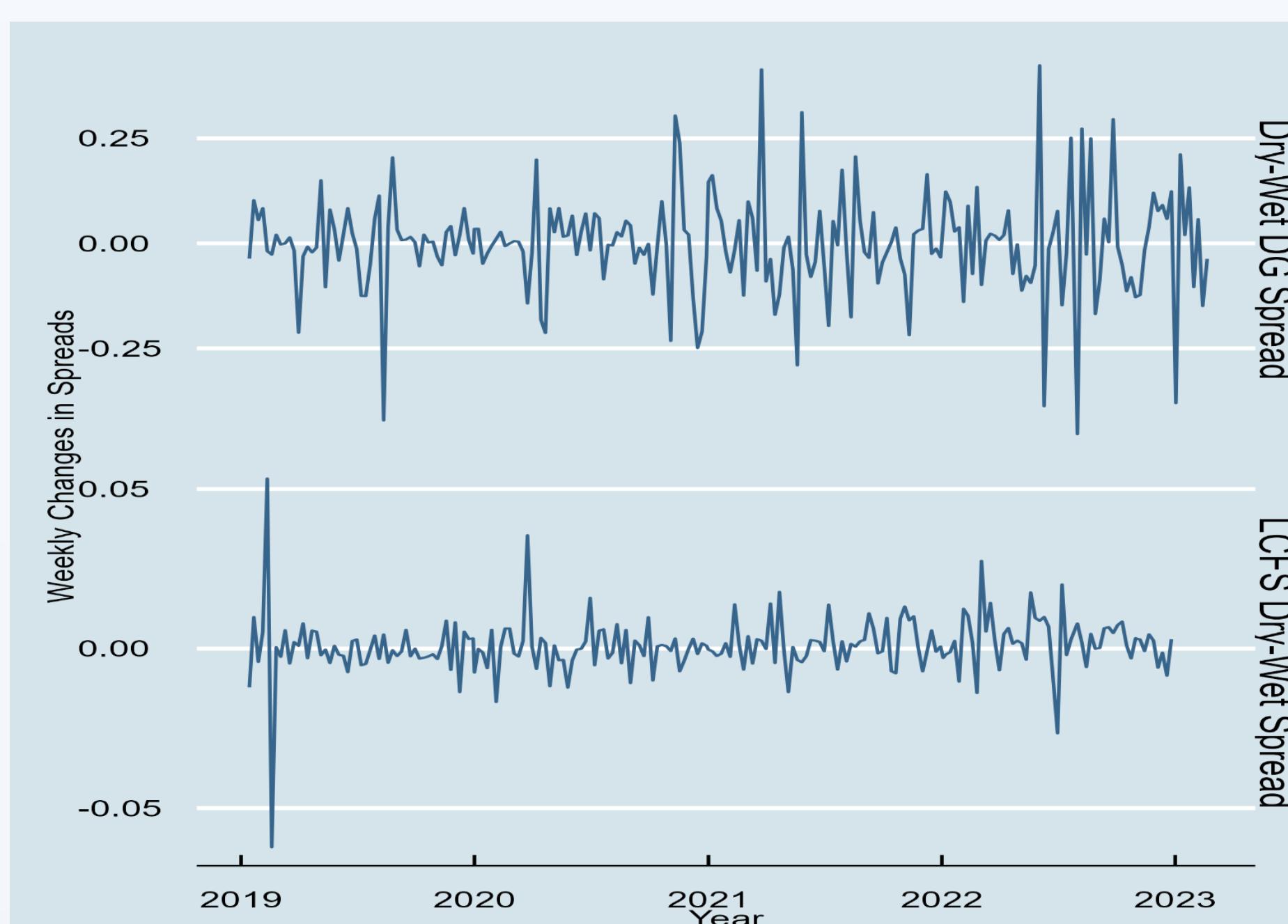
$$\Delta DG_{spread, s,t,j} = \sum_{p=0}^d \beta_p \Delta credit_{spread, s,t,j} + \alpha_m + \gamma_y + \psi_{m,y} + \epsilon_{s,t,j}$$

- $\Delta$  indicates first-order difference operator,  $DG_{spread}$  is the per bushel spread between distillers grain pair  $j$ ,  $credit_{spread}$  is the spread in the per bushel value of LCFS credits for distillers grain pair  $j$ .
- $\beta_p$  estimates the additional pass-through of weekly LCFS credit spread changes to weekly differences in distillers grain price spreads.
- $\beta_p = 1$  indicates full pass-through.

## Results

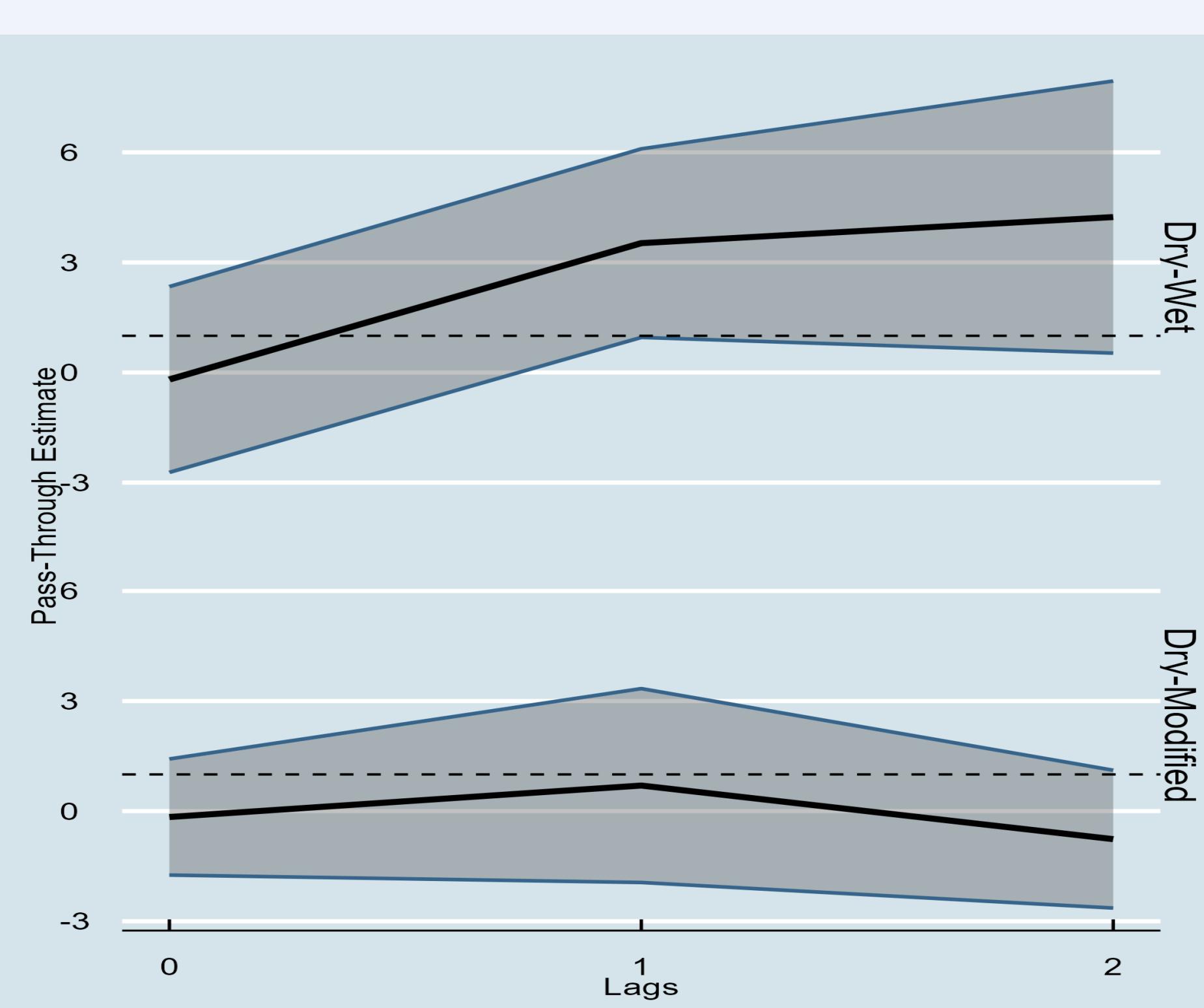
- I find full pass-through of weekly changes in LCFS credit value spreads to distillers grain price spreads for dry and wet distillers grain in Iowa during the steep credit price fall starting in 2021.
- Evidence for pass-through in Nebraska and for other price spreads is weak.
- The smaller, local feeder cattle market and larger number of ethanol plants could be driving result in Iowa.

Figure 3: Weekly Changes in Dry-Wet Spreads in Iowa



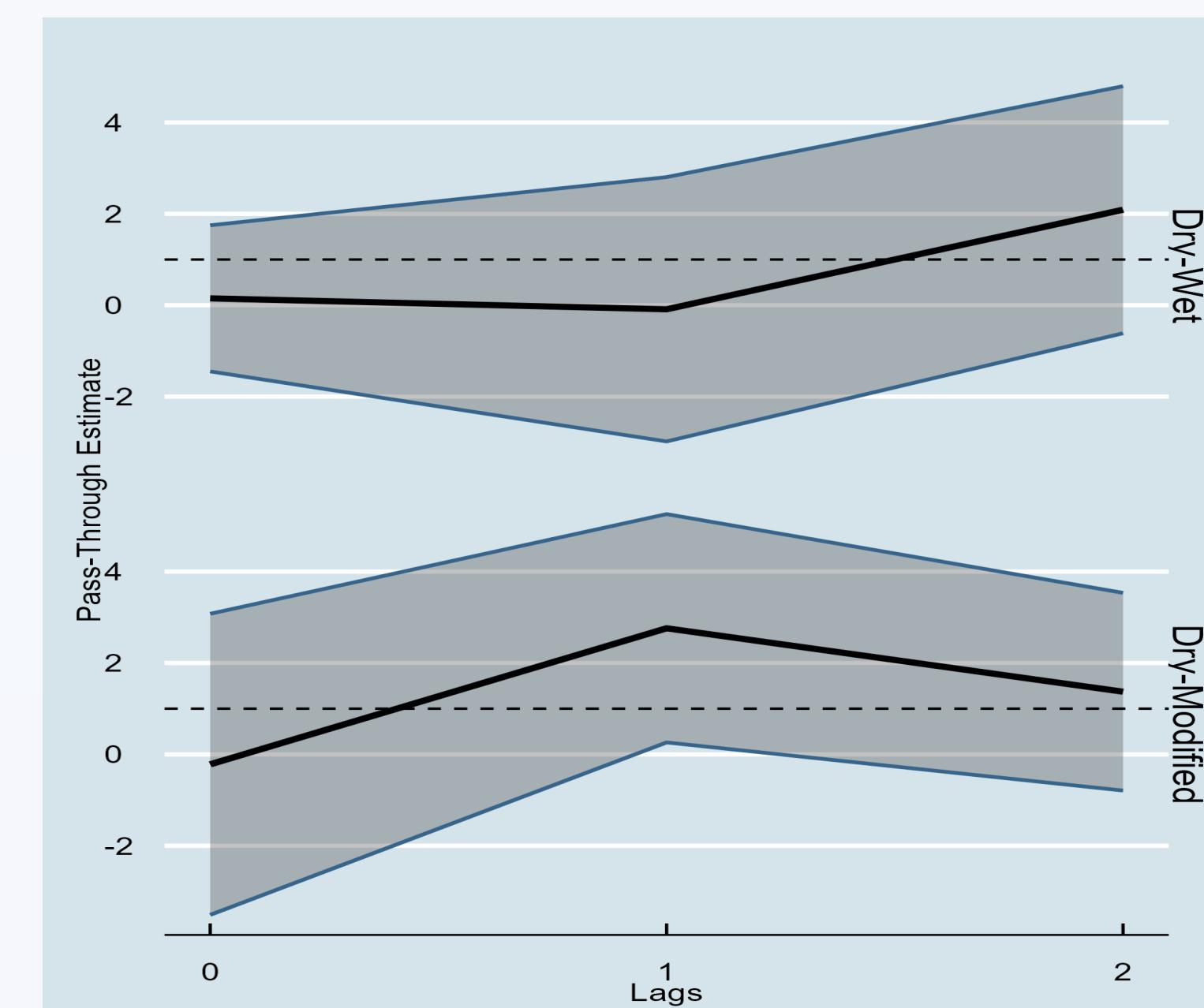
Note: Dry-Wet DG spread are weekly changes in the spread between the per bushel value of dry and wet distillers grains. LCFS Dry-Wet spread are weekly changes in the spread between the per bushel value of LCFS credit spreads.

Figure 4: Pass-through to Iowa Distillers Grain Prices Post-Covid



Note: Dry-Wet is the pass-through of changes in the LCFS credit value spread between dry and wet distillers grains. Dry-Modified is the pass-through of changes in the LCFS credit value spread between dry and wet distillers grains. Solid black line represents the point estimate for the pass-through. Solid blue lines and gray shading represent 10% confidence intervals. Standard errors are Newey-West with lag equal to 3. Lag 0 is immediate change in distillers grain price spread during week of change. Other lags represent the additional pass-through in each week after the change occurred.

Figure 5: Pass-through to Nebraska Distillers Grain Prices Post-Covid



Note: Dry-Wet is the pass-through of changes in the LCFS credit value spread between dry and wet distillers grains. Dry-Modified is the pass-through of changes in the LCFS credit value spread between dry and wet distillers grains. Solid black line represents the point estimate for the pass-through. Solid blue lines and gray shading represent 10% confidence intervals. Standard errors are Newey-West with lag equal to 3. Lag 0 is immediate change in distillers grain price spread during week of change. Other lags represent the additional pass-through in each week after the change occurred.

## Conclusions

- The pass-through of LCFS credit value changes indicates that the LCFS could be impacting agricultural by-product and feed grain markets.
- In particular, local cattle feeders in Iowa could benefit from increases in LCFS credit values by growing in the spread between dry and wet distillers grains.

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