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Extreme Weather Events Differentially Impact Retail Food Prices: Evidence from Early Warning Systems (OR03-01-22)

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Food Prices for Nutrition

Tufts UNIVERSITY | Gerald J. and Dorothy R. Friedman School of Nutrition Science and Policy

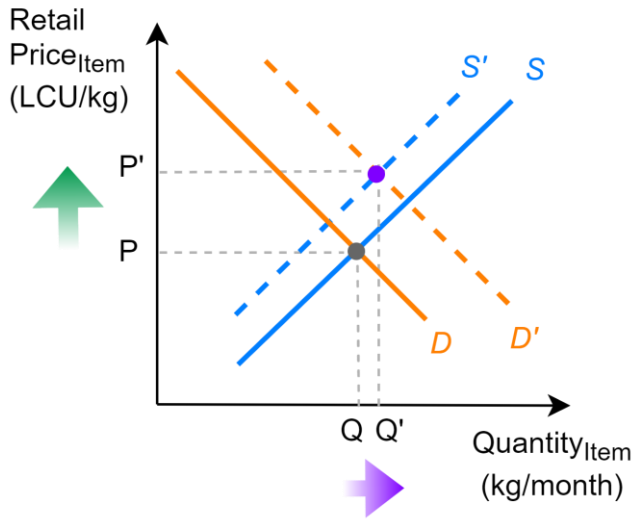
Disclosures

No conflicts to disclose

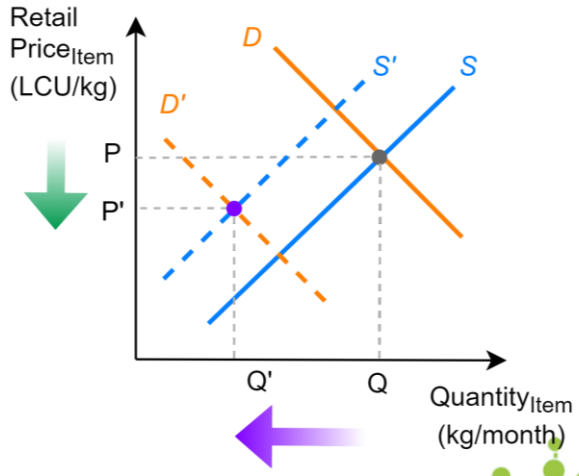
Motivation

- This paper addresses
  - resilience to extreme weather shocks
  - in retail food prices
    -- affecting real income and welfare
  - for all food groups
    -- with different nutritional attributes and market structures
- Shocks have an ambiguous effect:
  - lower supply and higher costs, but also
  - lower demand that would reduce price
- We only observe <u>net effect</u>

Case 1: Price rise due to higher supply costs compounded by higher demand



Case 2: Price decline due to lower demand offsetting higher supply costs



Background

- Increased climate variability and greater frequency of extreme weather events under climate change (IPCC, 2021)
- Majority (>73%) of research on climate shocks in the food system focus on production shocks (Davis et al, 2021; *n=325*)
  - Strong emphasis on staple grains and cereals (47%)
- Emerging evidence from global and national monitoring systems post Covid-19 (Bai et al., 2021; Narayanan & Saha, 2021)
- Early warning systems collect retail price data for food security monitoring; underutilized in price and climate analyses (Cedrez et al., 2020; Brown and Kshirsagar, 2015)

Data Processing

- Data compilation from three early warning systems (FAO GIEWS, USAID FEWSNET, WFP VAM)
- Inflation adjustment to June 2017 using IMF and FAO monthly consumer price indices for food items
- 2017 local currencies converted to 2017 USD using WB purchasing power parity for private consumption
  - Outcome 1: **2017 USD/kg**
- Each food item matched to USDA Standard Reference 28 or West Africa Food Composition Table
  - Outcome 2: **2017 USD/1000 kCal**

Regression Specification

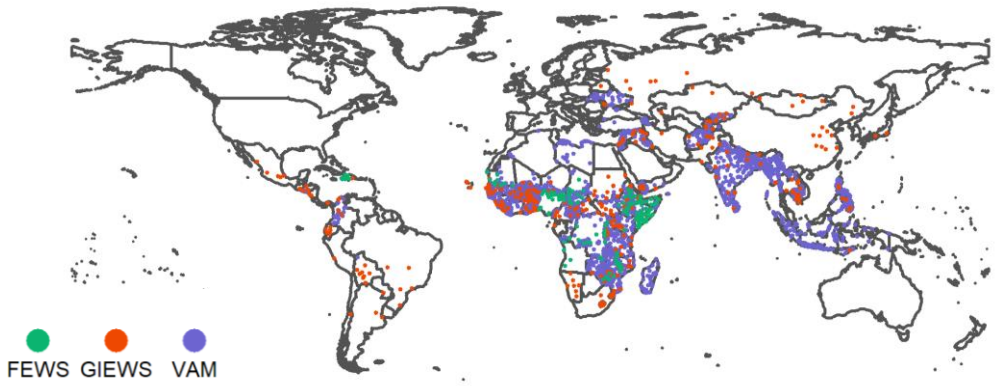
$$P_{ijmy} = \beta_0 + \beta_1 Extreme\ Event_{jmy} + \beta_2 FG_i + \boldsymbol{\beta_3}(FG_i * Extreme\ Event_{jmy}) + \beta_4 E_{jmy} + \beta_5 F_{imy} + \gamma_{jy} + \lambda_{my} + \theta_{jy} + \tau_i + \varepsilon$$

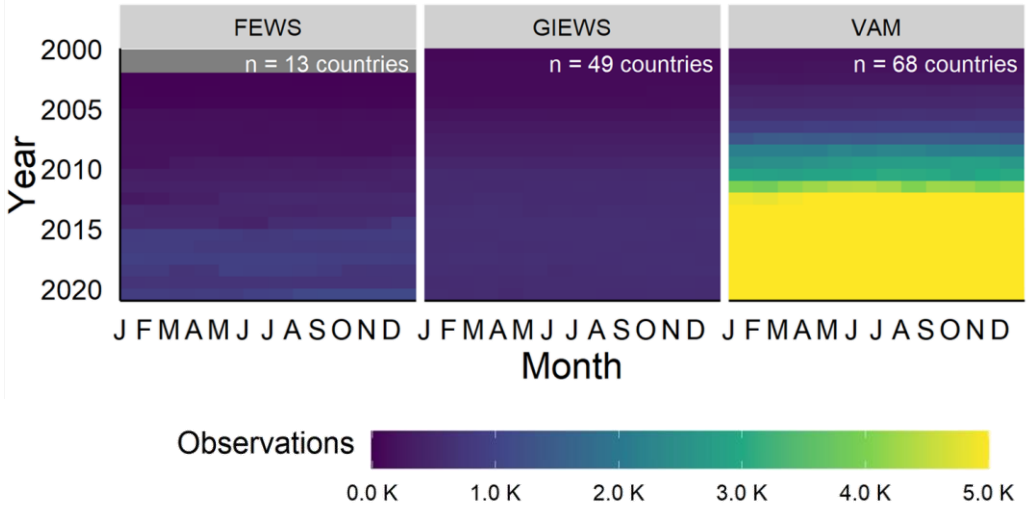
The subscript *i* refers to food item, *j* refers to market location, *m* refers to month, and *y* refers to year of price observation

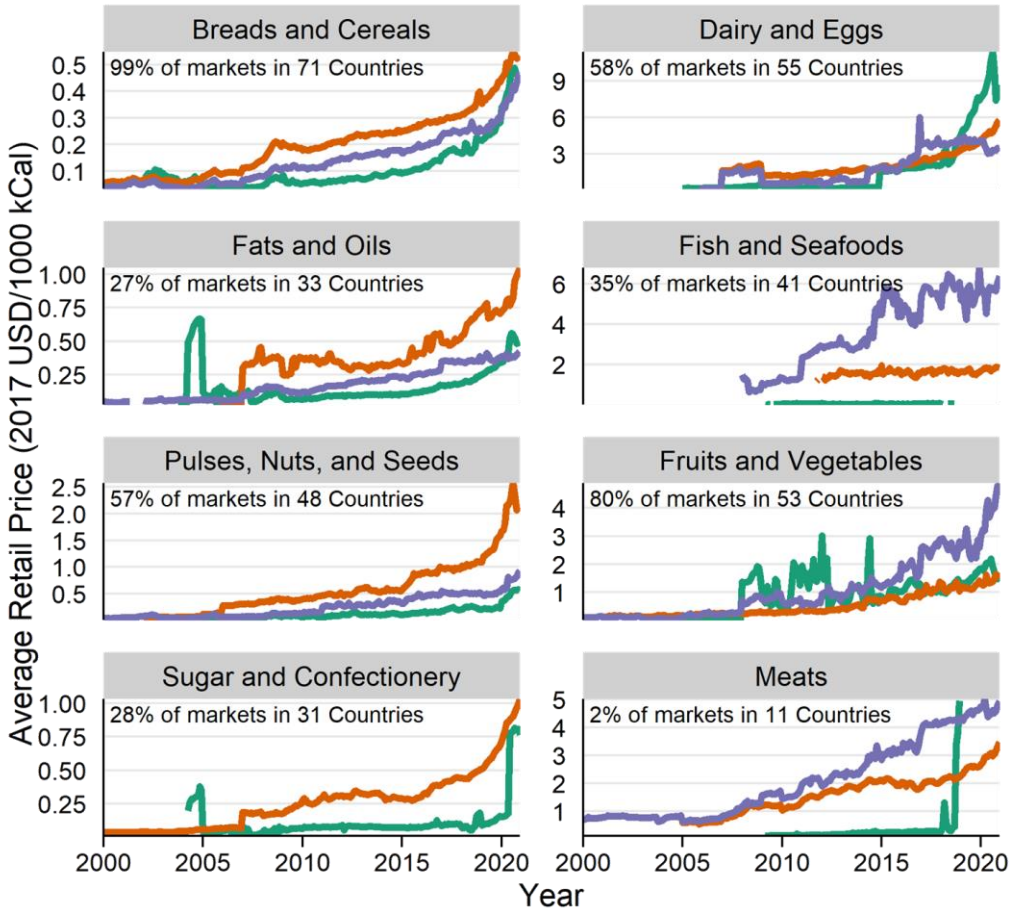
- P_{ijmy} : ln(Price per kg), ln(Price per 1000 kCal)
- *Extreme Event*: occurrence of flood, drought, heatwave, coldwave, or storm during month of observation
- FG_i : one of eight food groups with breads and cereals as reference category
- E_{jmy} : vector of time-varying factors including mean temperature (deg C), precipitation (mm), and interaction of temperature and precipitation
- F_{imy} : FAO commodity group price index for food group corresponding to *i*
- Fixed Effects: market location (γ_j), market-month (δ_{jm}), market-year (θ_{jy}), item (τ_i)

Dataset Summary

Total *n* = 1,346,513 in 2,321 markets in 71 countries



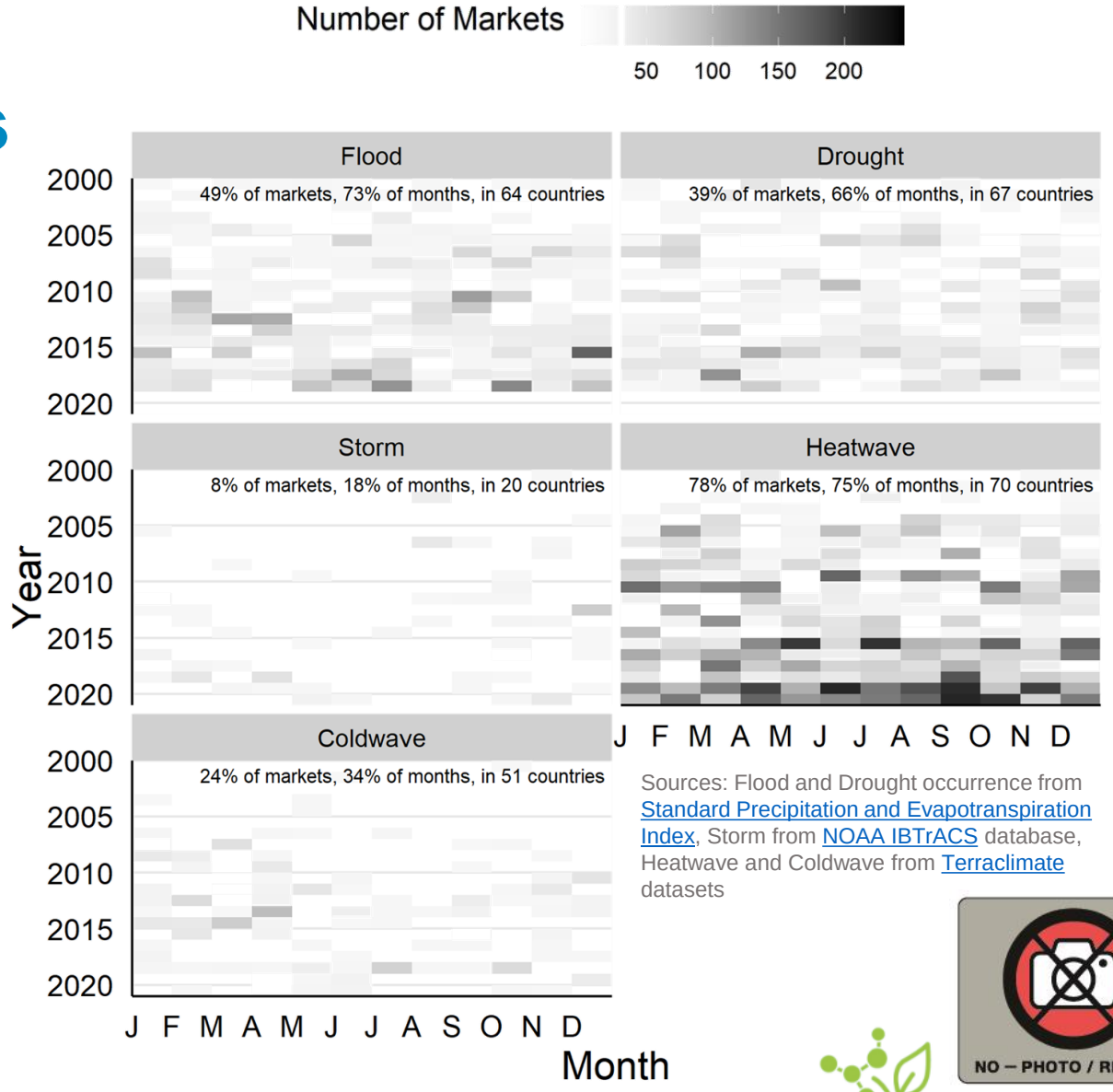




Sources: Retail prices are reported by FAO GIEWS, USAID FEWS, and WFP VAM

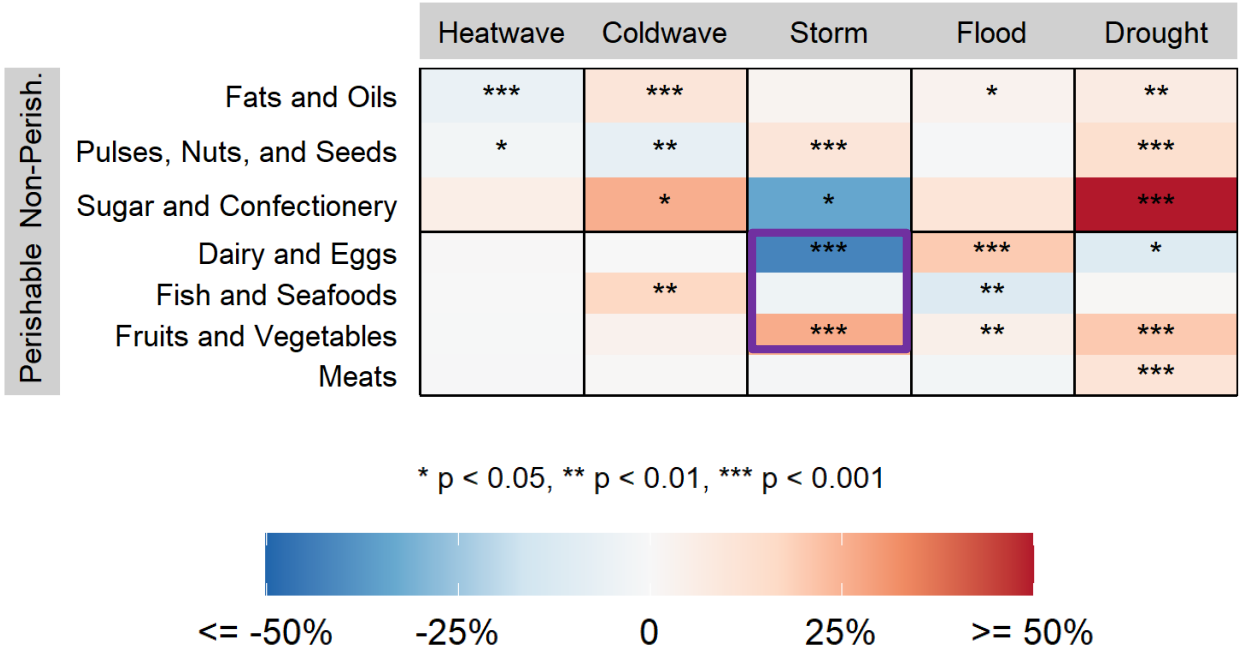
Extreme weather events

- Data Sources
  - Floods and Droughts: Standardized Precipitation and Evapotranspiration Index
  - Heatwaves and Coldwaves: Terraclimate
  - Storms (windspeeds): NOAA IBTraCS database
- Event definitions
  - Flood = 1 if 1-month SPEI > 1.5
  - Drought = 1 if 6-month SPEI <= -1.5
  - Heatwave if Tmax anomaly >= 2
  - Coldwave if Tmin anomaly <= -2
  - Storm = 1 if at least Category 2 (windspeeds of 43 m/s) was observed within 200 km vicinity of market
- Climate shocks are spatially and temporally heterogenous



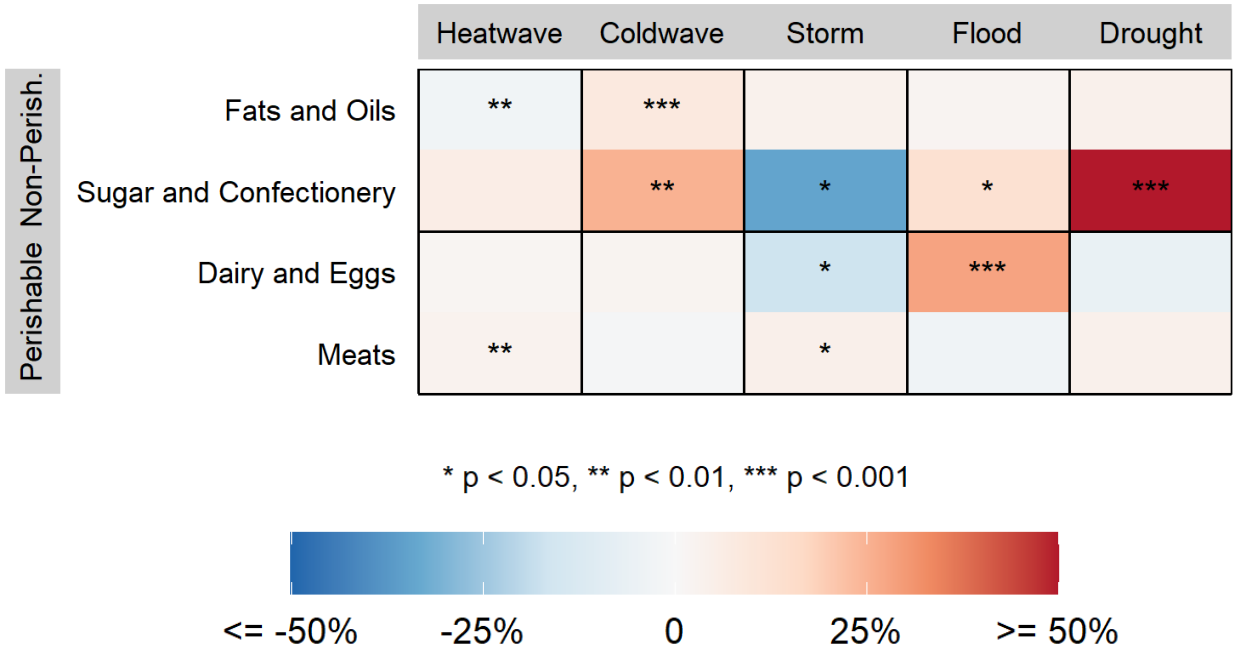
Sources: Flood and Drought occurrence from Standard Precipitation and Evapotranspiration Index, Storm from NOAA IBTrACS database, Heatwave and Coldwave from Terraclimate datasets

Main Effect



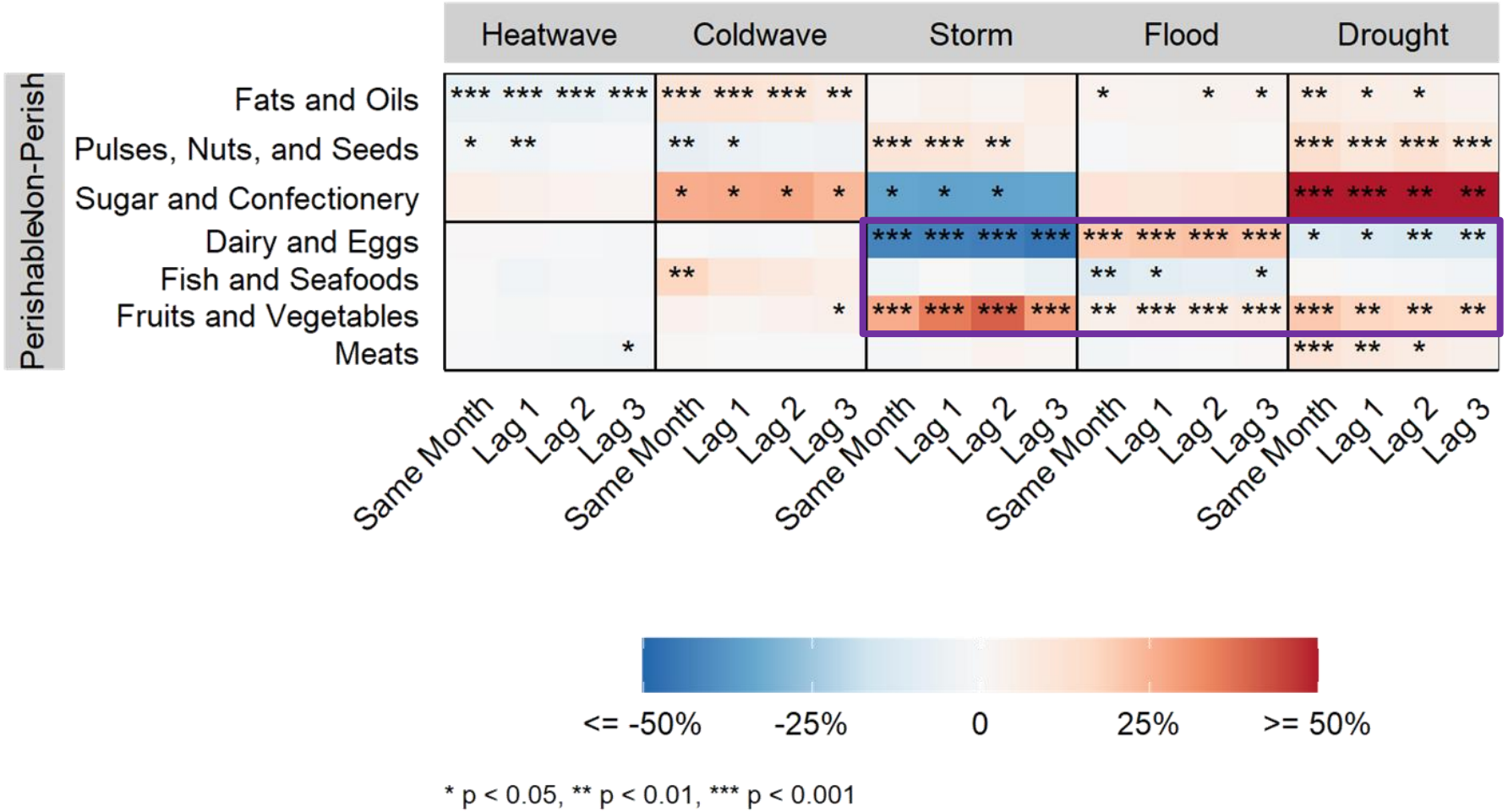
- Fruits and Vegetables
  - Relative 26%↑ during Storm
  - Relative 20%↑ during Drought
- Meat
  - Relative 11%↑ during Drought
- Dairy and Eggs
  - Relative 42%↓ during Storm
  - Relative 20%↑ during Flood
- Oils and Fats
  - Relative 11%↑ during Coldwave
- Pulses, Nuts, and Seeds
  - Relative 14%↑ during Drought
- Sugars and Confectionery
  - Relative 50%↑ during Drought
  - Relative 26%↑ during Coldwave
  - Relative 34%↓ during Storms

Main Effect: Controlling for World Prices



- FAO Commodity Price Index not available for Fruits and Vegetables and Pulses, Nuts, and Seeds
- Inclusion sharpens observed effect
- Dairy and Eggs
  - Relative 17%↓ during Storms (previously 42%)
  - Relative 28%↑ during Floods (previously 20%)
- Fats and Oils
  - Relative 8%↑ following Coldwaves (previously 11%)
- Sugars and Confectionery
  - Relative 52%↑ after Drought
  - Relative 25%↑ after Flood
  - Relative 34%↓ after Storm

Persistence Effect



Conclusions

- Food groups respond differently to different extreme events
- Type and mechanism of extreme event affects supply and demand for food groups
- Results can inform interventions to make certain food groups more affordable and accessible to facilitate healthy diets
- Results can inform climate adaptation and mitigation policies and programs

Limitations & Future Directions

- Market characteristics: rural/urban, distance, travel time, nighttime lights
- Temporal domain of compound/complex events
  - Droughts unfold over years, floods unfold over weeks
- Spatial scale of impact—GPS point vs. area
- Role of violence

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Thank you! Questions?

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