

What Makes Communities Resilient to Drought?

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Overview

1 Introduction

2 Model

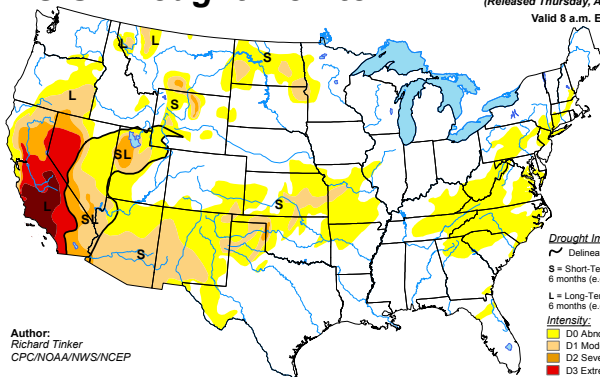
- First Stage
- Second Stage

3 Data

- In April 2016 in the United States:
 - 14% of land was in drought and 34% was abnormally dry.
 - 84.3 million people live in drought-affected areas, and 17.5 million live in areas experiencing exceptional drought
- In California:
 - 90% of the state is in drought and more than 50% is in severe to exceptional drought.
 - 84.3 million people live in drought-affected areas, and 17.5 million live in areas experiencing exceptional drought

U.S. Drought Monitor

April 19, 2016
(Released Thursday, Apr. 21, 2016)
Valid 8 a.m. EDT



Author:
Richard Tinker
CPC/NOAA/NWS/NCEP

Drought Impact Types:

~ Delineates dominant impacts

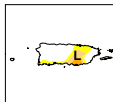
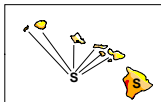
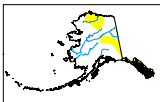
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



<http://droughtmonitor.unl.edu/>

- Climate change is likely to increase the length and severity
- Drought will effect all regions and populations at one time or another
- Resilience, not just risk of drought, will have far reaching implications for welfare changes from climate change.

First Stage Equation

$$y_{i,t} = \beta_i D_{i,t} + \alpha_i + \tau_i t + \gamma_{s,t} + \epsilon_{i,t} \quad (1)$$

Where:

- $D_{i,t}$ refers to the number of days in U.S. Drought Survey bins 2-4 in county i and year t
- α_i are county fixed effects controlling for time-invariant differences between counties
- τ_i is the coefficient on a county level linear time trend
- $\gamma_{s,t}$ are state-by-year fixed effects controlling for state level time trends common across all counties $i \in s$

First Stage Equation

- The state-by-year fixed effects will non-parametrically account for national trends in the outcome of interest as well as state-level trends
- The identifying variation in this model is within-county, annual deviations from the county time trend and from statewide annual average drought levels
- Standard errors will need to be corrected for serial correlation over space and time

Second Stage Equation

$$\beta_i = \rho_0 + \delta \mathbf{X}_i + \nu_i \quad (2)$$

Where:

- β_i come from Eq.(1) for a given outcome
- \mathbf{X}_i represents a vector of county characteristics such as urban/rural, proportion below age 5 or above age 65, home ownership, median cost of residential water bill
- δ is a vector of the associated coefficients for state level time trends common across all counties $i \in s$

Second Stage Equation

- This regression is cross-sectional and therefore not well identified from a causal perspective
- Model will illustrate how "drought resilience" (a low value of β_i) covaries with a set of common county socioeconomic characteristics
- We correct OLS standard errors by clustering over space

$$y_{i,t} = \beta_i D_{i,t} + \alpha_i + \tau_i t + \gamma_{s,t} + \epsilon_{i,t}$$

Left Hand Side

- **US Drought Monitor:**

- Scale from 0-4 updated weekly
- we create a 1-year, 3-year, and 5-year measure

Right Hand Side

- **Mortality:**

- Annual CDC WONDER database
- Over-65 and all-ages

- **Yields:**

- Annual USDA crop yield
- Corn, soybeans, and wheat

- **Employment:**

- United States Bureau of Labor Statistics

$$\beta_i = \rho_0 + \delta \mathbf{X}_i + \nu_i$$

Left Hand Side

- $\hat{\beta}$ from the first stage.

Right Hand Side

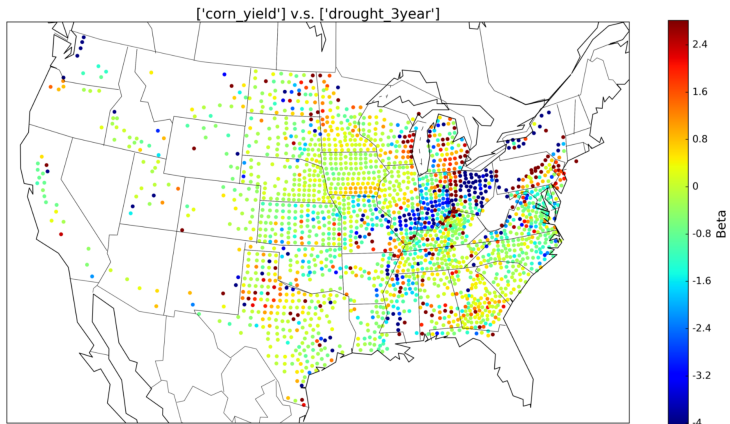
- **American Community Survey:**

- Annual (2005-2014) survey conducted by US Census
- Over 65, Under 5, Race, Ethnicity, Sex, Work in farming or ranching, Household Income, Household water bills

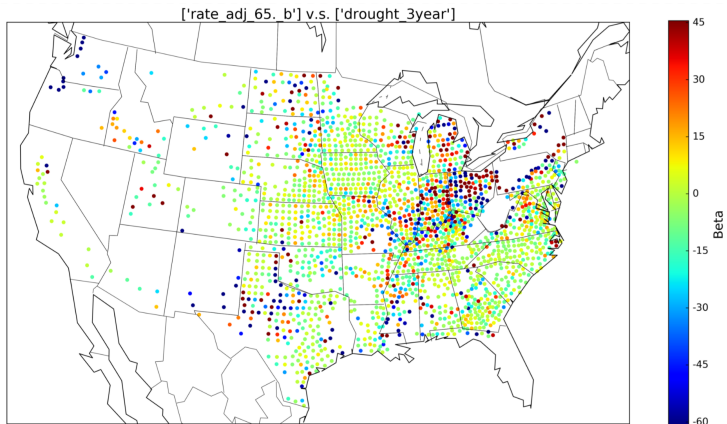
- **Water Usage:**

- EPA Facility Registry Service
- Count of facilities from high water use industries (agriculture, manufacturing and energy) per county

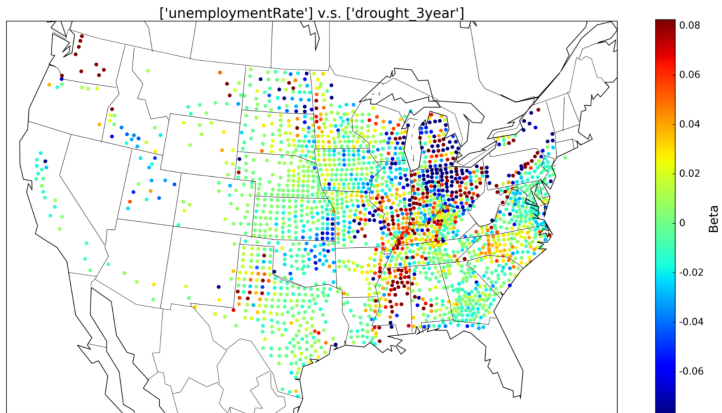
β of 3-yr Drought on Corn Yield



β of 3-yr Drought on Mortality



β of 3-yr Drought on Unemployment



Now, look at our Shiny!



The End