# Assessing the Impact of PFAS Water Regulation

Laura Alcocer Quiñones

University of California, Davis

January 3, 2025

# The effects of PFAS regulation remain uncertain

**The EPA is trying to regulate 6 forever chemicals. Just 10,000 to go.**

We're going need a better way to tackle PFASs.

***Trump Promises Clean Water. Will He Clean Up 'Forever Chemicals'?***

Public health advocates worry that Donald Trump could unravel federal clean water efforts, including restrictions on lead pipes and chemicals known as PFAS.

**PFAS may be contaminating drinking water for up to 27% of Americans – study**

**Of 140 million people in the US who draw water from US aquifers via private or public wells, 70% at risk**

# Research Question

What is the effect of tightening regulatory standards for PFAS on water quality?

Intensive margin - Is water cleaned up over time for sources testing before and after the policy?

# Overview

What is the effect of tightening regulatory standards for PFAS on water quality?

**Challenge**: Reporting limits lead to large amounts of interval censoring

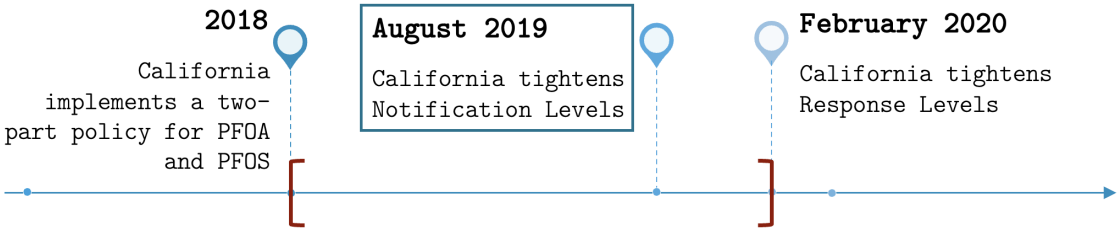
**Solution**: Parametric approximation to recover the distribution of PFAS concentration

**Empirical Approach**: Changes-in-changes

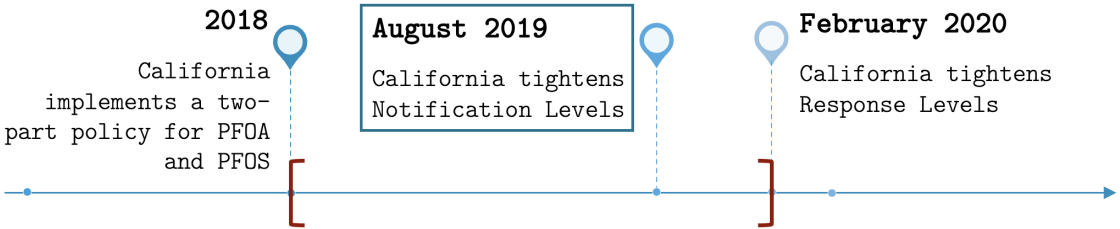
**Preview of Results**:

1. Ignoring censoring or replacing those observations with zeros or the reporting limit can lead to misleading results
2. Intensive Margin: Cannot detect an effect of the policy on water quality

# California Regulation



# California Regulation




**Notification levels**

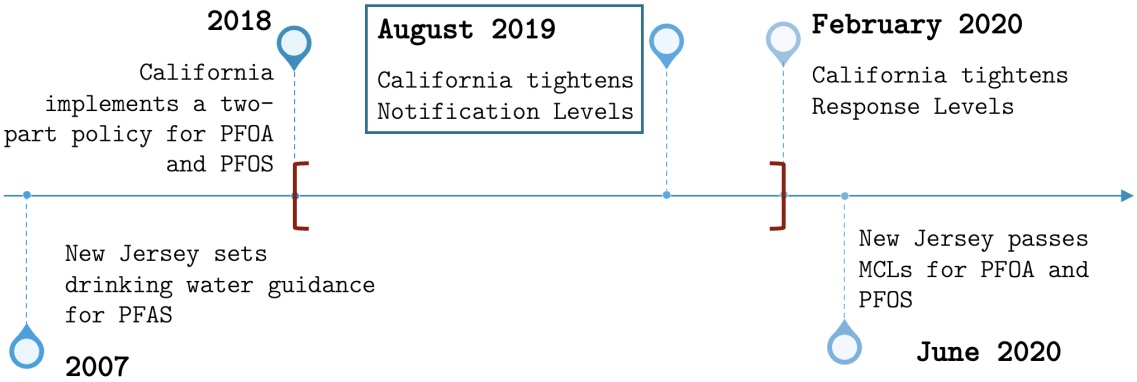
Requires notifying governing body of customers

**Response levels**

Requires source removal, treatment or public notification

Maximum Contaminant Level (MCL)

# Regulation Timeline and Research Design

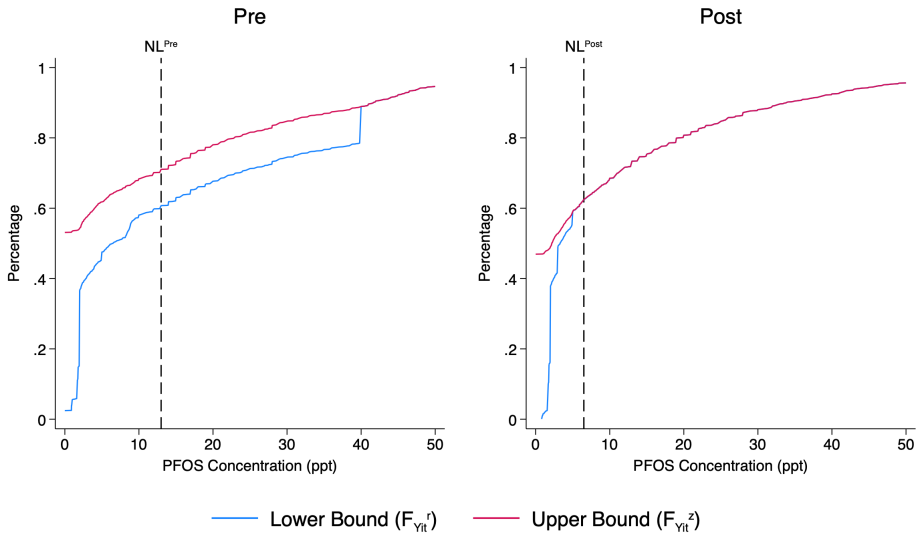



- Treatment: Tightening of Notification Levels for PFOA and PFOS in CA
- CA (Treated) & NJ (Control)

# Econometric challenges from interval-censored data

- Quarter-facility panel of PFOA and PFOS concentration in CA and NJ from 2018 through early 2020.
- **Reporting limits**: If a test detects concentration below the reporting limit, water systems are NOT required to report it.
- Approximately 60% of observations for both contaminants are censored.
- Under SDWA, 30% of observations would be in violation of the new federal standards.

# Econometric Implication I: Observed bounds, not the distribution of PFAS



# Econometric Implication II: Treatment effects are not point-identified in general

**Without further assumptions, we can only bound the ATT.**

$$ATT = E[Y(1)|D = 1] - E[Y(0)|D = 1]$$

If we can only bound $E[Y(1)|D = 1] \in [\mu_1^r, \mu_1^z]$ and $E[Y(0)|D = 1] \in [\mu_0^r, \mu_0^z]$

Then we can only bound the ATT,

$$ATT \in [\mu_1^r - \mu_0^z, \mu_1^z - \mu_0^r]$$

# Econometric Implication III: Naïve counterfactual analysis can lead to misleading results

Options to obtain point-estimates:

- $Y_{it}^{z}$: Censored observations replaced with zeros
- $Y_{it}^{r}$: Censored observations replaced with reporting limit
- $Y_{it}^{\star}|S_{it}=0$: Censored observations dropped

| | (1) $Y_{it}^{z}$ | (2) $Y_{it}^{r}$ | (3) $Y_{it}^{\star}\|S_{it}=0$ |
|---|---|---|---|
| ATT DID | -1.283 | -5.277** | -5.375* |
| | (1.047) | (1.801) | (2.362) |
| ATT CIC | 0.583 | -2.864 | -0.705 |
| | (1.735) | (2.206) | (3.415) |
| Observations | 10063 | 10063 | 3967 |

Standard errors clustered at the public water system level. CIC estimates bootstrapped with 1000 replications.

▸ Bounding the ATT

# Identification Strategy: Applying CIC with interval-censored data

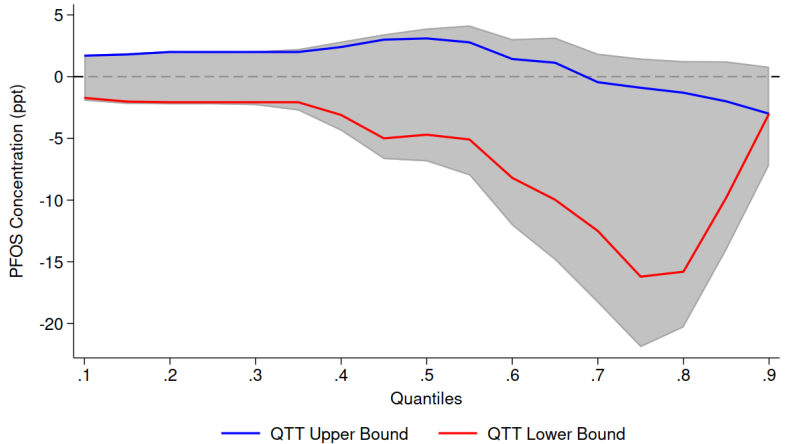
1. Parametric approximation to uncensored outcome (Ghanem, Shen, and Zhang, 2020)
2. Apply changes-in-changes (CIC) with its identifying assumptions (Athey and Imbens, 2006)

Advantages:

- Can bound the ATT
- Can bound the distributional treatment effects

▸ Censored MLE for NJ ▸ Identifying Assumptions

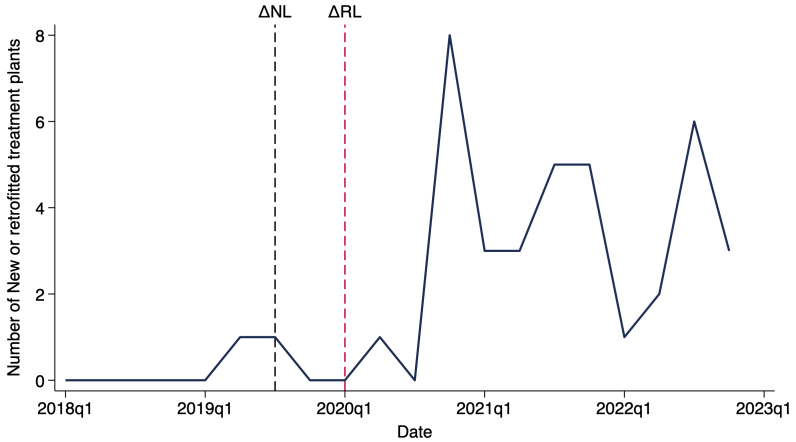
# Results: Cannot detect water quality changes following the policy




**Caveat**: Large reporting limits in the pre-period in CA make it difficult to detect effects.

# Work in progress

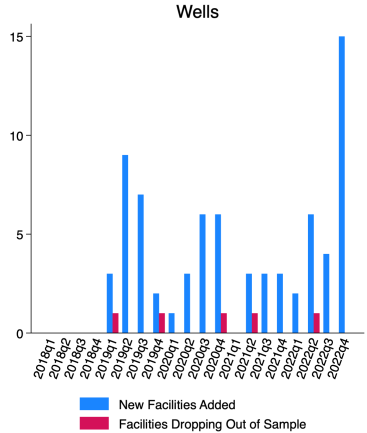
**Are public water systems retrofitting treatment plants to address PFAS?**

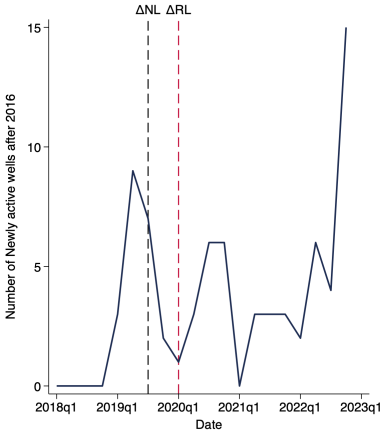



▸ Location of New TP

# Work in progress

## Are new wells entering or exiting the system?




▸ Location of Newly Active Wells ▸ Concentration for Newly Active Wells

# Conclusions

- Not dealing with partial interval censoring appropriately can lead to misleading policy conclusions.
- I pair a parametric approximation with changes-in-changes to overcome this issue.
- I cannot detect effects from a notification level change on water quality at the source.
- I find preliminary evidence of an increase in new or retrofitted treatment plants following the two-part policy.
- The methods shown can be applied to other settings with interval-censored data.

Thank you!

lalcocer@ucdavis.edu

# Appendix

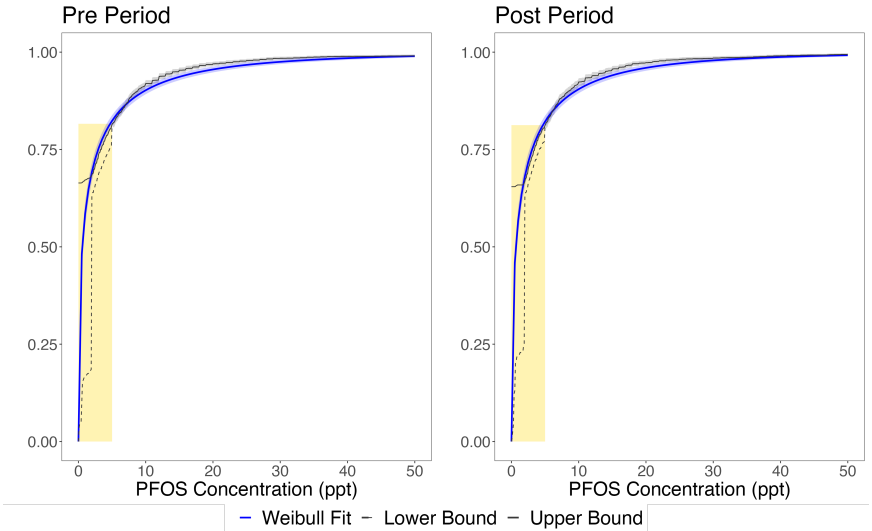
# Estimates using the upper and lower bound of the distribution do not bound the ATT

**The estimates obtained using the upper and lower bounds of the distribution are NOT the upper and lower bound of the ATT**.

- Take $F_{Y_{it}^z}(y)$ (upper bound) as the latent distribution then the treatment effect is
$$\mu_1^z - \mu_0^z$$
- Now take $F_{Y_{it}^r}(y)$ (lower bound) as the latent distribution then the treatment effect is
$$\mu_1^r - \mu_0^r$$
- These bounds fall within the interval $[\mu_1^r - \mu_0^z, \mu_1^z - \mu_0^r]$ (from implication II)

▸ Implication III

# Implementation: New Jersey PFOS Concentration




▸ Identification Strategy

# Identifying Assumptions

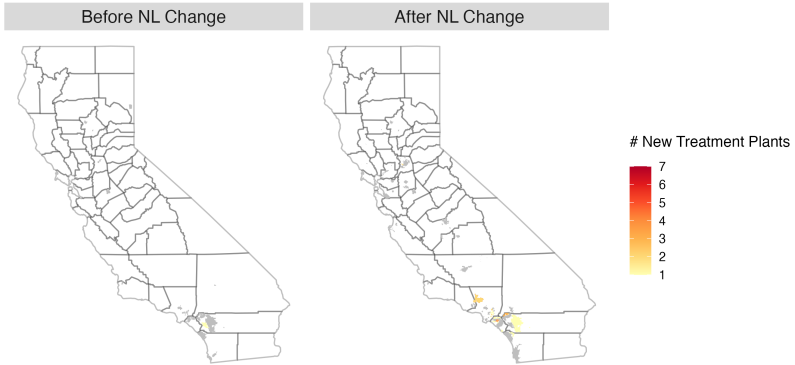
- CIC assumptions:
  1. Monotonicity
  2. Baseline water quality is the same for facilities with the same unobservables
  3. Distribution of unobservables conditional on treatment is time invariant
  4. Support condition
- The CDF of $Y_{it}^{\star}|G_i = g$ is a known function $H(y;\theta_{gt})$ with density $h(y;\theta_{gt})$.

Using censored MLE, I can estimate the counterfactual distribution:

$$H_{11}^{CF}(y) = H_{10}(H_{00}^{-1}(H_{01}(y)))$$

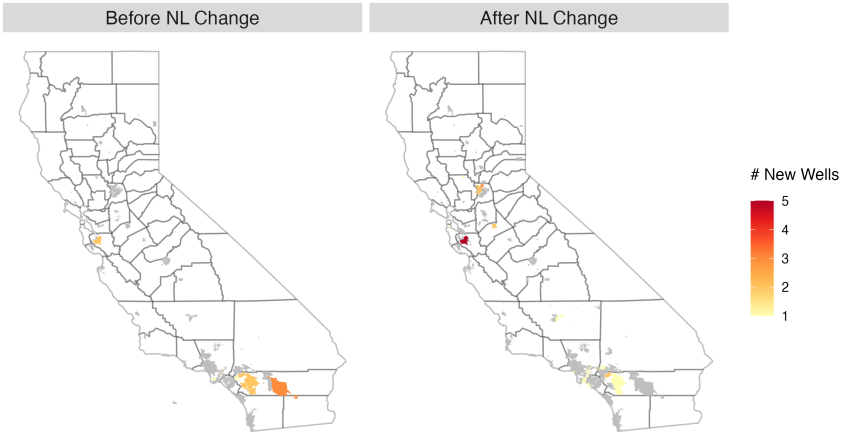
▸ Identification Strategy

# Number of new treatment plants before and after notification level change



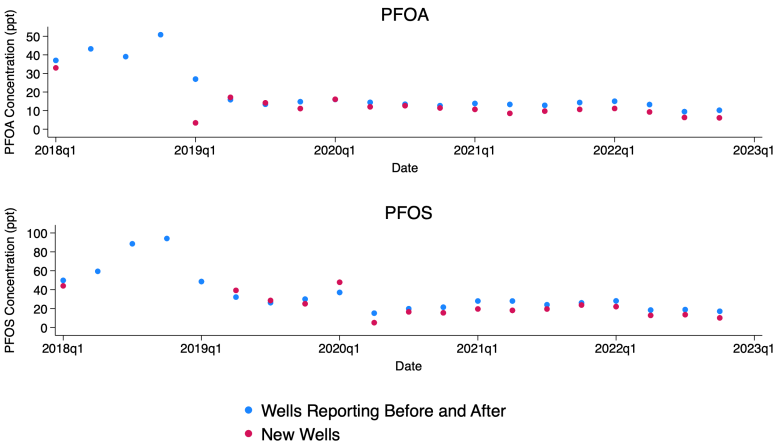

▸ Work in progress

# Number of newly active wells before and after notification level change



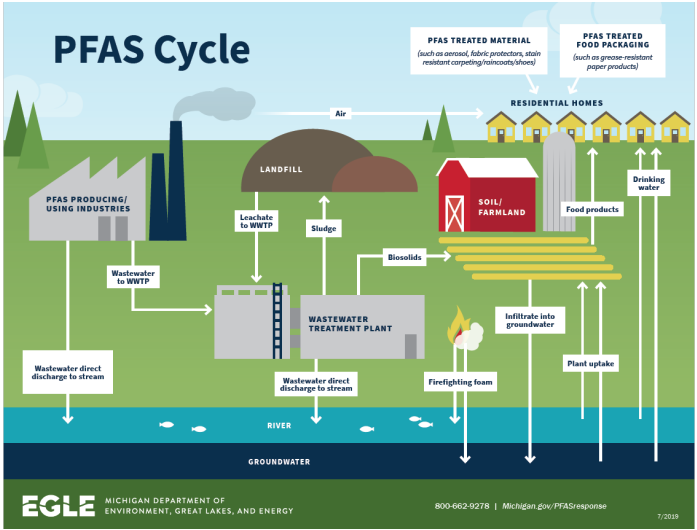

▸ Work in progress

# Newly active wells are not that much cleaner than those testing before and after




▸ Work in progress

# How does PFAS enter water?



# Public water system flow