The Effectiveness of Network Administrative Organizations in Governing Inter-jurisdictional Natural Resources

Yixin Liu and Chao Tan

Online Supplemental Information

Contents

Appendix A Causal Identification

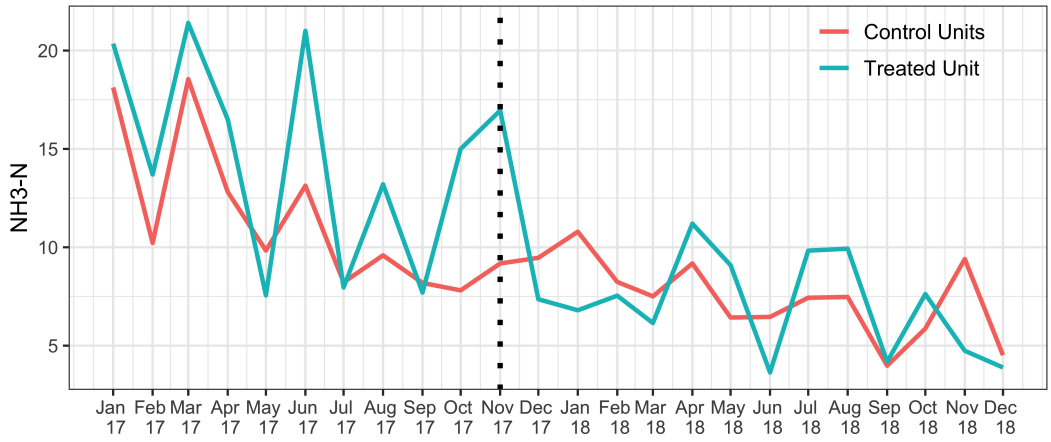
We follow Abadie et al.'s (2010; 2015) steps to demonstrate the synthetic control method's causal procedure. First, we have a sample of $J+1$ units. $J=1$ is the treated unit and $J=(2,...,J+1)$ is the donor pool of control units. All $J+1$ units have $T=T_0+T_1$ time points, T_0 and T_1 are the pre-intervention and post-intervention periods. To construct the synthetic control unit, we apply a weighting average of samples in the donor pool: $\mathbf{W}=(w_2,...,w_J+1)'$ with $(0 \leq w_j \leq 1)$. To select the best value of $\mathbf{W}$, we match the synthetic control unit's characteristics so they are similar to those of the treated unit. To obtain this, we include $\mathbf{X_1}$ $(k \times 1)$ vector of time-constant variables for the treated unit in the pre-intervention period, and $\mathbf{X_0}$ as the $k \times J$ matrix of the same time-constant variables for the control units. Then, we can construct the synthetic control unit by minimizing $\|\mathbf{X_1}-\mathbf{X_0W}\|$ to obtain the $\mathbf{W}^*$ (between 0 and 1), which minimizes the root mean square prediction error (RMSPE) in the pre-intervention period. The interpretation of RMSPE is the lack of fit between the treated unit and its synthetic control part in the pre-intervention period: $RMSPE=(\frac{1}{T_0}\sum_{t=1}^{T_0}(Y_{1t}-\sum_{J=2}^{J+1}w_j^*Y_{jt})^2)^{\frac{1}{2}}$. For more discussions of the RMSPE, please read (Abadie et al. 2015).

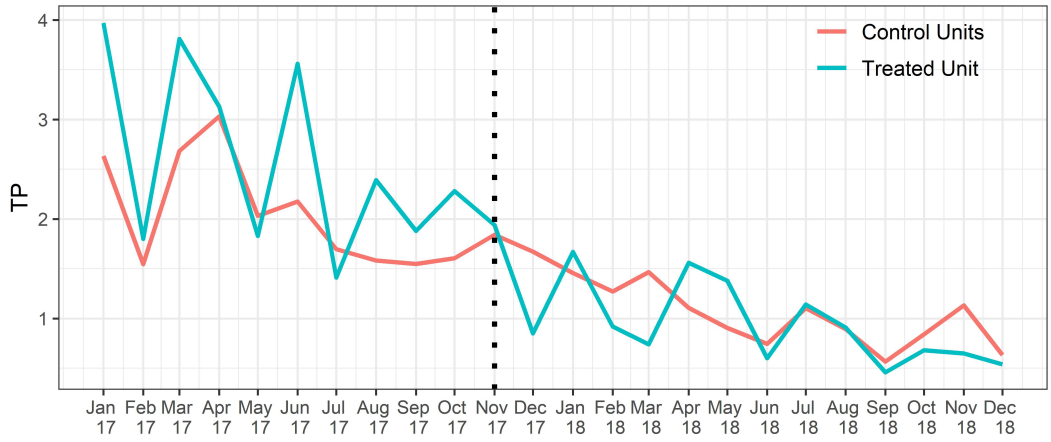
Let Y be the outcome variable, and we can identify:

$$\hat{\alpha}_{1t}=Y_{1t}-\sum_{i=2}^{J+1}\mathbf{W_j^*}Y_{jt}, t=T_1 \tag{1}$$

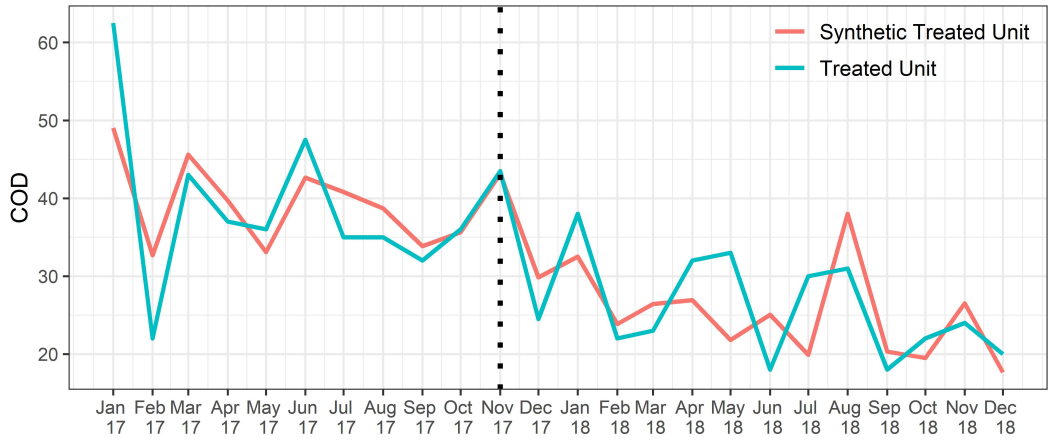
$\hat{\alpha}_{1t}$ estimates the average treatment effect on the treated unit $J=1$. Y_{1t} and $\sum_{i=2}^{J+1}\mathbf{W_j^*}Y_{jt}$ are the outcomes of the treated unit and its synthetic control counterfactual in the post-intervention period.

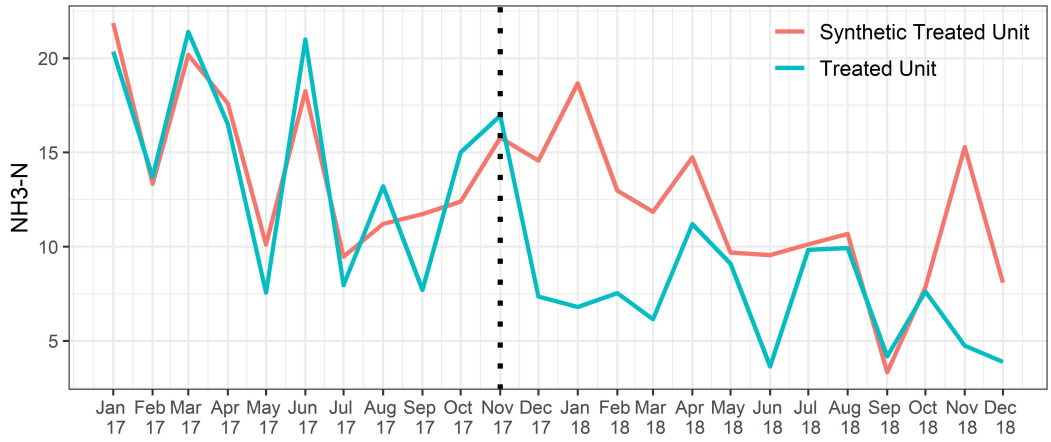
Appendix B Trends of Pollutants

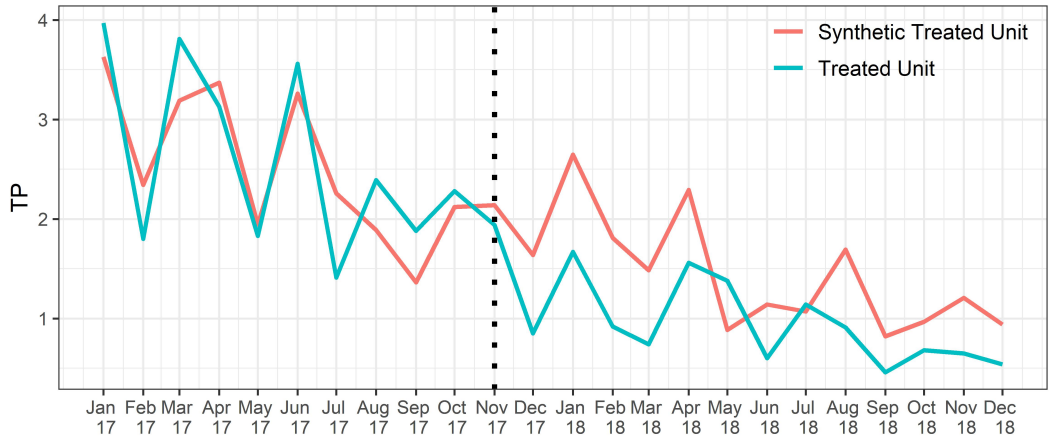


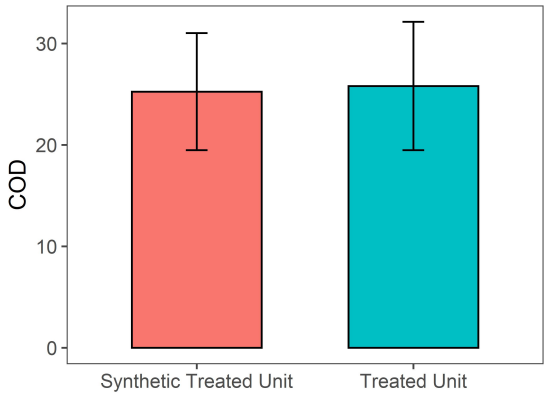


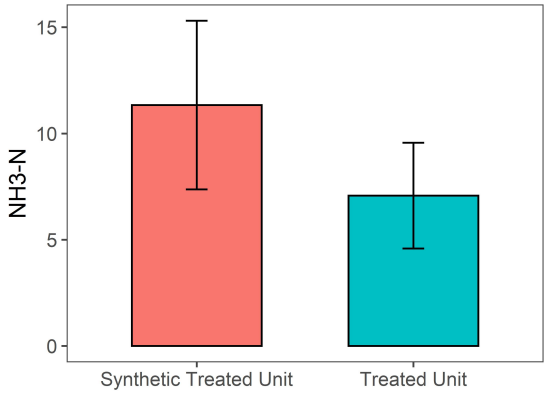
Appendix C Treatment Effect on Each Pollutant

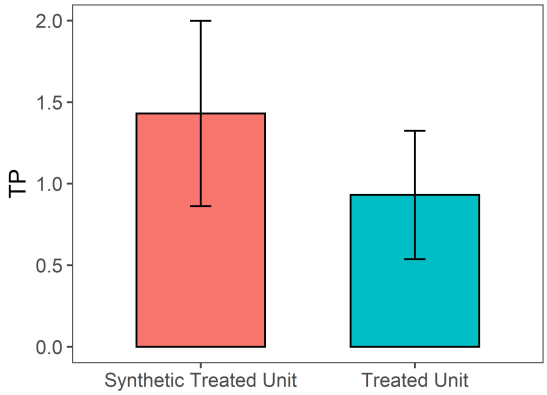






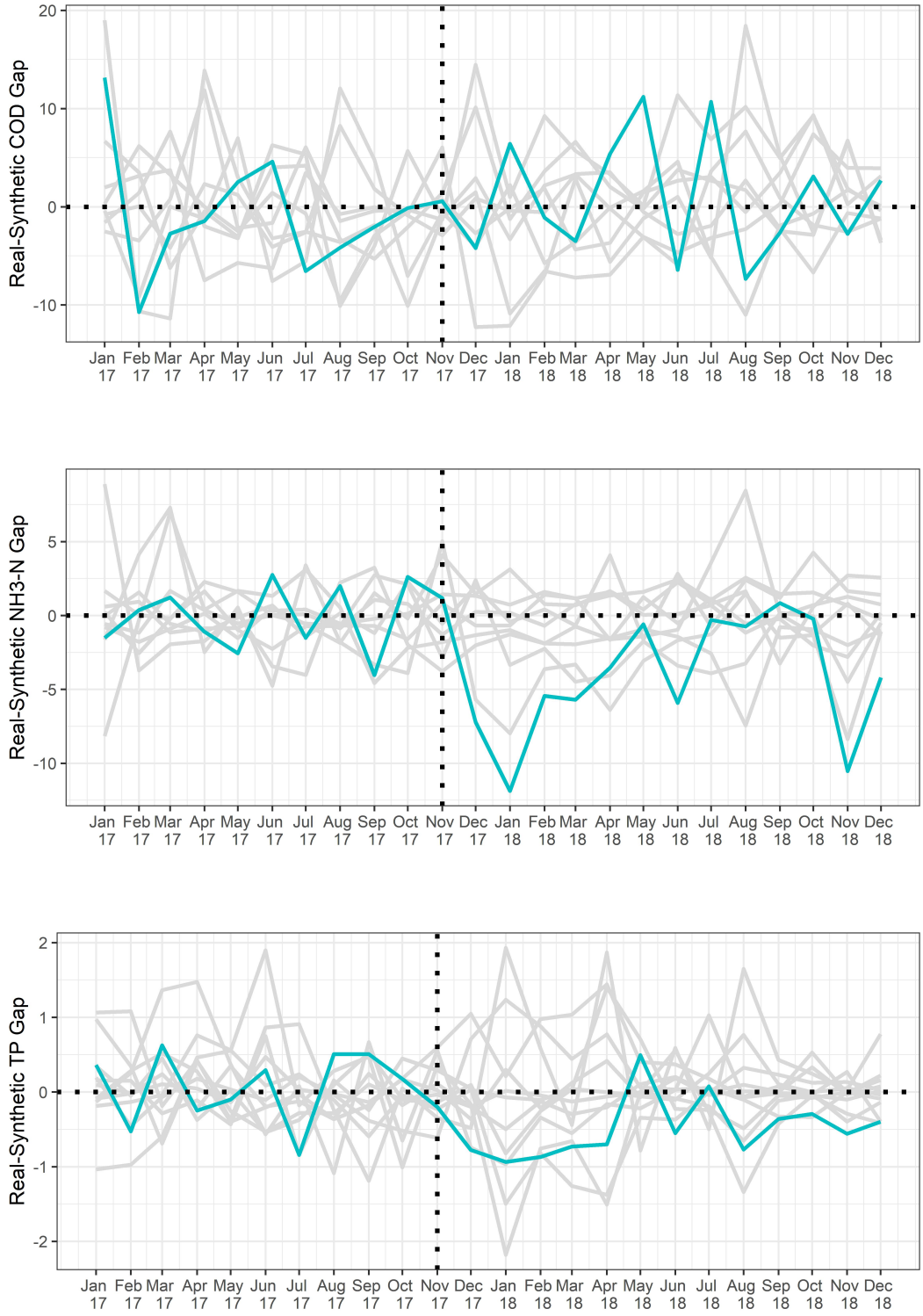






Note:
COD: ATT = 0.55 (1%) (S.E. = 2.38, p-value = 0.82)
NH3-N: ATT = 4.26 (38%) (S.E. = 1.30, p-value = 0.00)
Total Phosphorus: ATT = 0.50 (35%) (S.E. = 0.19, p-value = 0.02)

Appendix D In-place Placebo Test of Pollutants



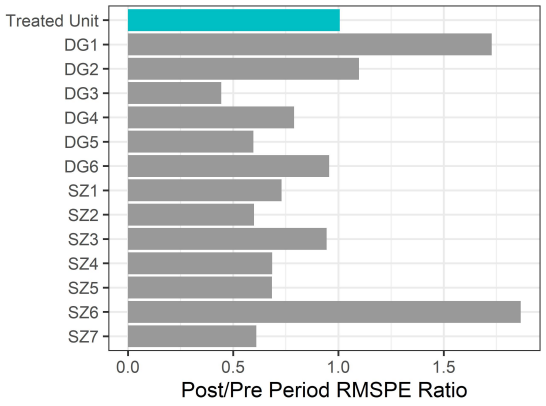


Figure D1: COD

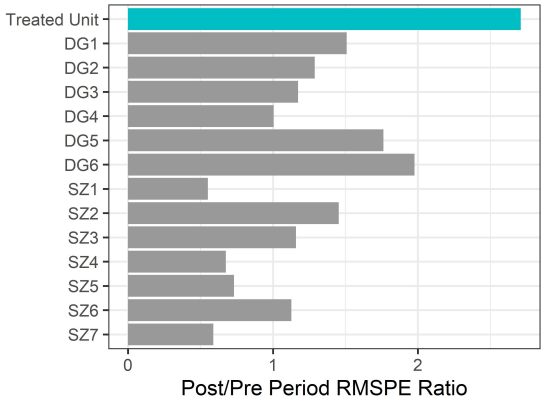


Figure D2: NH3-N

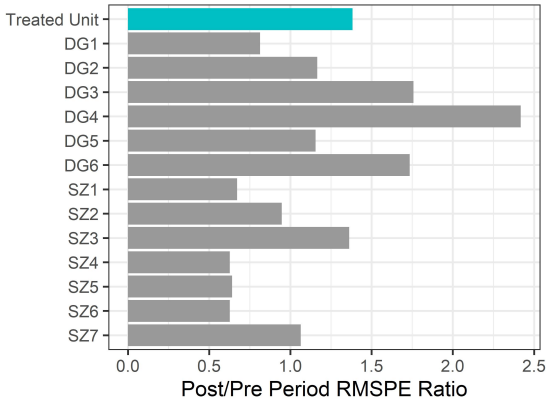
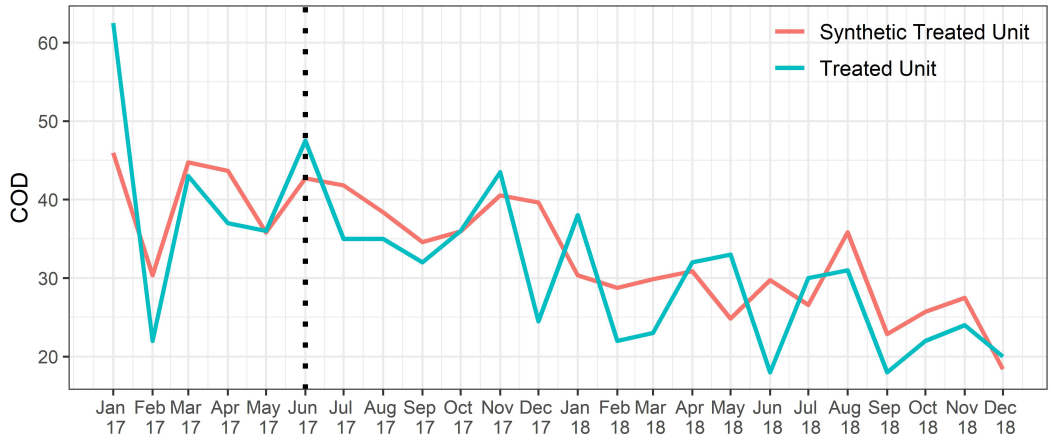
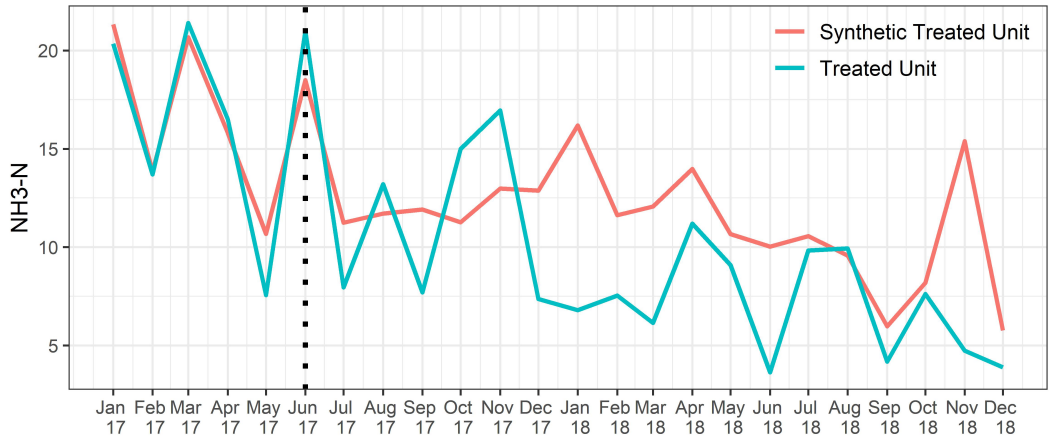
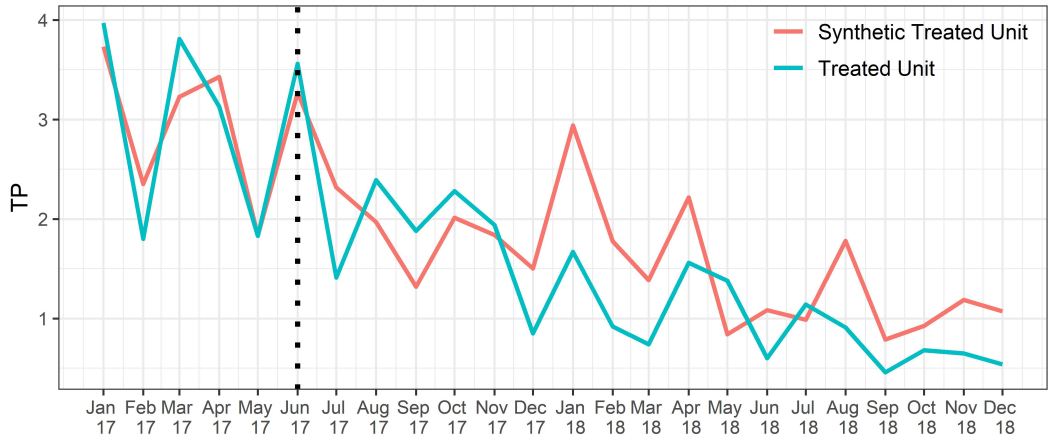


Figure D3: TP

Appendix E In-time Placebo Test of Pollutants







References

Abadie, Alberto, Alexis Diamond, and Jens Hainmueller. 2010. Synthetic control methods for comparative case studies: Estimating the effect of california's tobacco control program. *Journal of the American statistical Association* **105** (490):493–505.

——. 2015. Comparative politics and the synthetic control method. *American Journal of Political Science* **59** (2):495–510.