CO2 Levels as a Result of AB32 Bill in California

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Abstract

- The AB32 Bill in California was the first law in the country to set sharp state standards on carbon emissions reduction.
- The bill set the standard to get to 1990 levels of GHG emissions by 2020.
- I use a Difference-in-Difference Method to examine whether the bill was significantly effective at reducing emissions relative to other nearby, quasi-politically similar states, holding unemployment constant.
- I find inconclusive evidence that California's AB32 bill was successful in reducing emissions relative to controlled states, with the "Treat" variable positively correlated with CO2 levels at a statistically significant level and the DiD estimator negatively correlated though statistically insignificant at any confidence level.

Current Knowledge on the AB32 Bill/Gap in Research

- The general understanding with the AB32 Bill:
  1. The bill was signed into law in 2006, and the target of hitting its goal of reaching 1990 levels was met in 2016.
  2. This was the second state-ratified bill regarding CO2/GHG emission reductions, but the first with such large-scale impacts.
- However, there is little understanding in how much the Bill itself was involved in lowering the bill, or if it was more signed into law during a time where GHG emissions steadily declined country-wide.

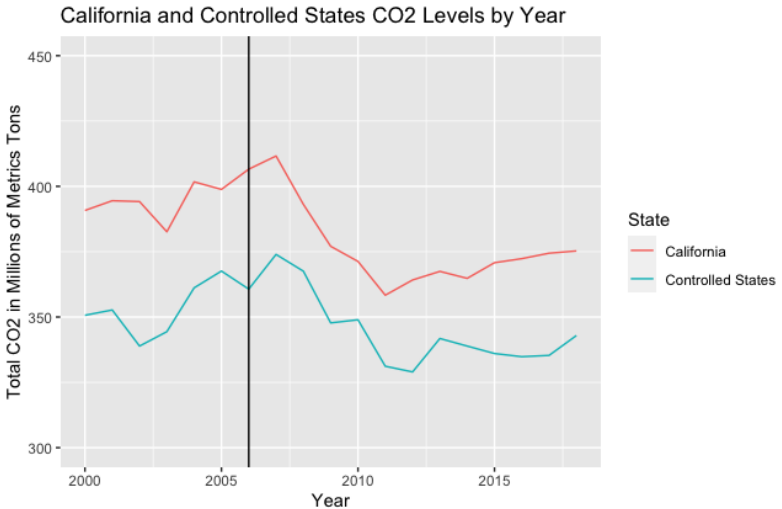
GHG Emissions and Unemployment Data Selection

- I used data collected from Climate Watch through the US Bureau Department of Commerce, and the U.S. EPA.
- I chose a collection of Arizona, Washington, Nevada, Colorado, and Oregon to be a conglomerate of a control group based on geographical position, a decent counterpart of political ideals/policies enacted to the treatment group, and a combined similar population, and thus similar CO2 levels to the treatment group.
- This data set includes information by state from years 2000-2018 on:
  1. GHG emissions (Total and by each individual greenhouse gas, including CO2)
  2. CO2 emissions by sector (industrial, agriculture, etc)
  3. Population and GDP
- I then used data through the U.S. Bureau Labor of Statistics for Unemployment Rates by state from 1990-2018. (I used weighted average annual unemployment rates for the control group).

Difference-in-Difference

- I used a Difference-in-Difference (will be shortened to DiD) approach to find an causal effect of the policy on CO2 levels.
- For DiD to be unbiased, 2 main assumptions are necessary, which I believe I have successfully managed in this study:
  1. This is the only policy of its kind to be signed into law during this time (it would not be for over 12+ months for another GHG emissions reductions bill to be introduced in another state in the U.S.).
  2. Parallel Trends Theory: The CO2 levels were shown to be on similar levels before the treatment policy, assuming they would continue to be the same if no policy were enacted (Which I have provided visual evidence of in Figure 1 Later).

Figure 1


California and Controlled States CO2 Levels by Year
Total CO2 in Millions of Metrics Tons
450
400
350
300
2000
2005
2010
2015
Year
State
California
Controlled States

Differences-in-Differences

Using Time and State Dummy Variables, I estimate

$$CO2Levels = \beta_0 + \gamma_1 Treat + \gamma_2 Post + \delta_{DiD} PostTreat + \gamma_3 Unemployment + \varepsilon_i$$

Where *Treat* is a binary dummy variable of being in a controlled state or in the treatment state, *Post* is a binary time dummy variable of being before or after 2006(The policy starting year), and *PostTreat* is an interaction term between two binary variables where 1 is being in California post-2006 and 0 otherwise. The δ_{DiD} coefficient on the interaction term is thus the estimator of the treatment effect on the control group after the policy was enacted.

Figure 2

	Dependent variable:
	TotalCO2
Treat	42.035***
	(6.397)
Post	-6.539
	(5.883)
PostTreat	-9.615
	(8.069)
Unemployment	-2.009**
	(0.941)
Constant	365.126***
	(7.000)
Observations	38
R^2	0.755
Adjusted R^2	0.726
Residual Std. Error	11.967 (df = 33)
F Statistic	25.482*** (df = 4; 33)
Note:	*p<0.1; **p<0.05; ***p<0.01

Results

- The DiD method of OLS estimation shows a negative but statistically insignificant treatment effect of the 2006 AB32 Bill.
- The model shows statistical significance of Treat at the 99% confidence level, and significance of Unemployment at the 95% confidence level.
- We can reject the hypothesis that the means of the two sample populations are the same at the 99% confidence level.

Discussion

- An unideal use of Control States and way around Parallel Trends
- Effect of the 2008 Housing Crisis on data and overall CO2 levels notable.
- A potential reason for the inconclusive evidence could be that these emission reduction target bills with very little to zero changes in actual laws targeting CO2 predominant-sectors/emitters hinders the overall effectiveness of the bill.

Final Remarks

- I planned to find the effect of the AB32 bill on CO2 levels through a very basic differences-in-differences model.
- I found a statistically insignificant, though negative effect of the policy on CO2 levels, presumably due to reasons explained above.
- However, I do believe the AB32 Bill not only technically succeeded in its goal of helping reduce California emissions by its target date, but that it also was effective in starting a widespread change in emissions reductions bills and an evolution into more technical reductions policy field focused on eliminating GHG with new measures other than target dates.
- Still much more is needed to help get the U.S. and the world into a renewable environment with drastically reduced CO2 levels, including reduced deforestation, increased afforestation, and a change in the transportation/manufacturing industry to cleaner energy sources.

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