Who Regulates the Regulators?

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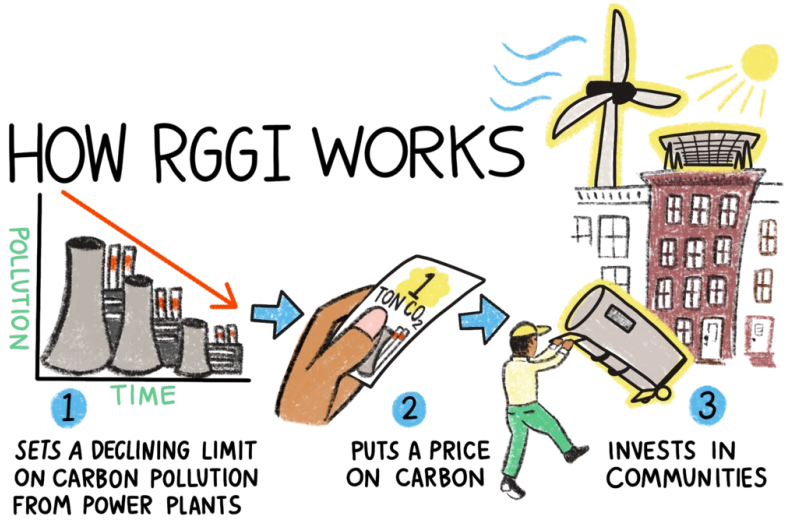
Background

Regional Greenhouse Gas Initiative



Mandatory market-based emissions reduction

Implementation

- Implement region-wide cap-and-trade on power plant CO2 emissions (northeastern states)
- 2009 - 2013: 188 mil ➪ 165 mil allowances
- 2014 - 2019: 91 mil ➪ 80 mil allowances

Our Goal

- Show effectiveness of RGGI in reducing CO2
- Predict emissions in a world where RGGI was never implemented

Show positive potential for stakeholders through further adoption by more states

Dataset

Source	Features
Clean Air Markets Program Data	CO_2 Emissions (1996-2024), Facility Info

Dataset

Source	Features
Clean Air Markets Program Data	CO_2 Emissions (1996-2024), Facility Info
US Energy Information Administration	CO_2 (1990-1995), Energy Flow, Fuel Types

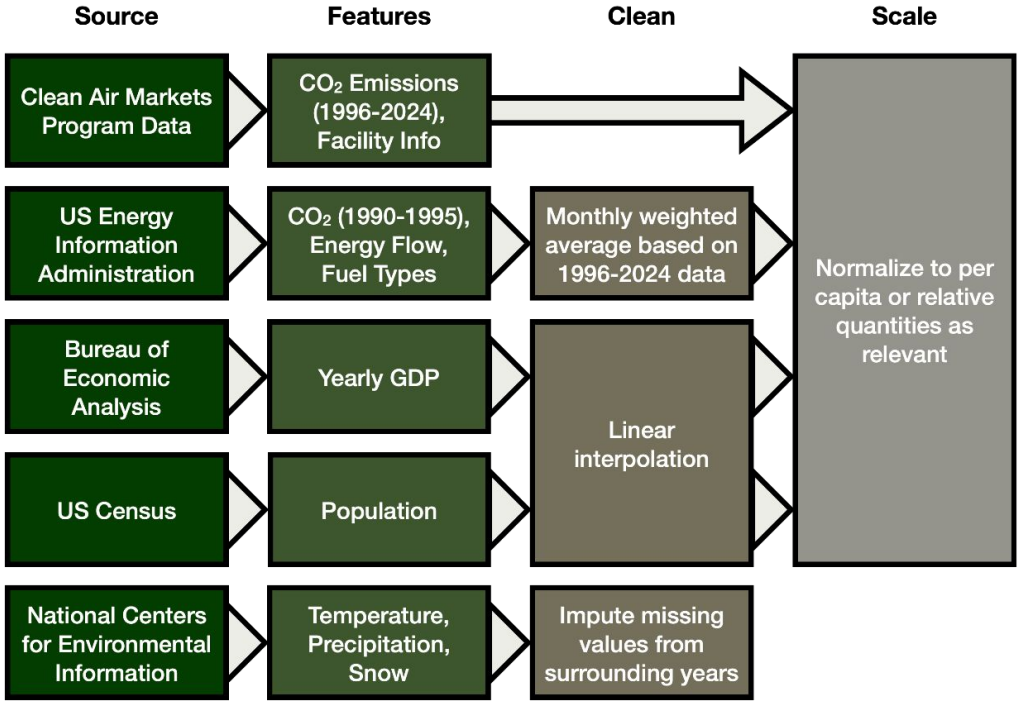
Dataset

Source	Features
Clean Air Markets Program Data	CO_2 Emissions (1996-2024), Facility Info
US Energy Information Administration	CO_2 (1990-1995), Energy Flow, Fuel Types
Bureau of Economic Analysis	Yearly GDP
US Census	Population
National Centers for Environmental Information	Temperature, Precipitation, Snow

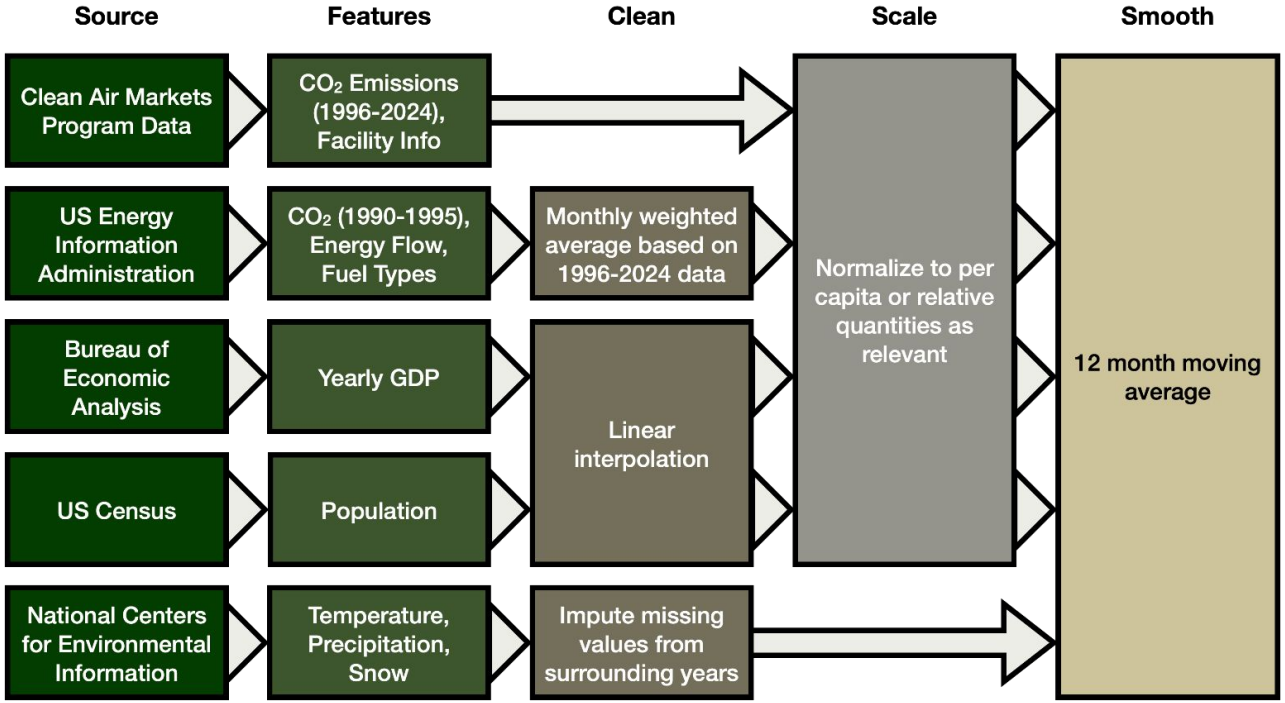
Dataset

Source	Features	Clean
Clean Air Markets Program Data	CO_2 Emissions (1996-2024), Facility Info	
US Energy Information Administration	CO_2 (1990-1995), Energy Flow, Fuel Types	Monthly weighted average based on 1996-2024 data
Bureau of Economic Analysis	Yearly GDP	Linear interpolation
US Census	Population	
National Centers for Environmental Information	Temperature, Precipitation, Snow	Impute missing values from surrounding years

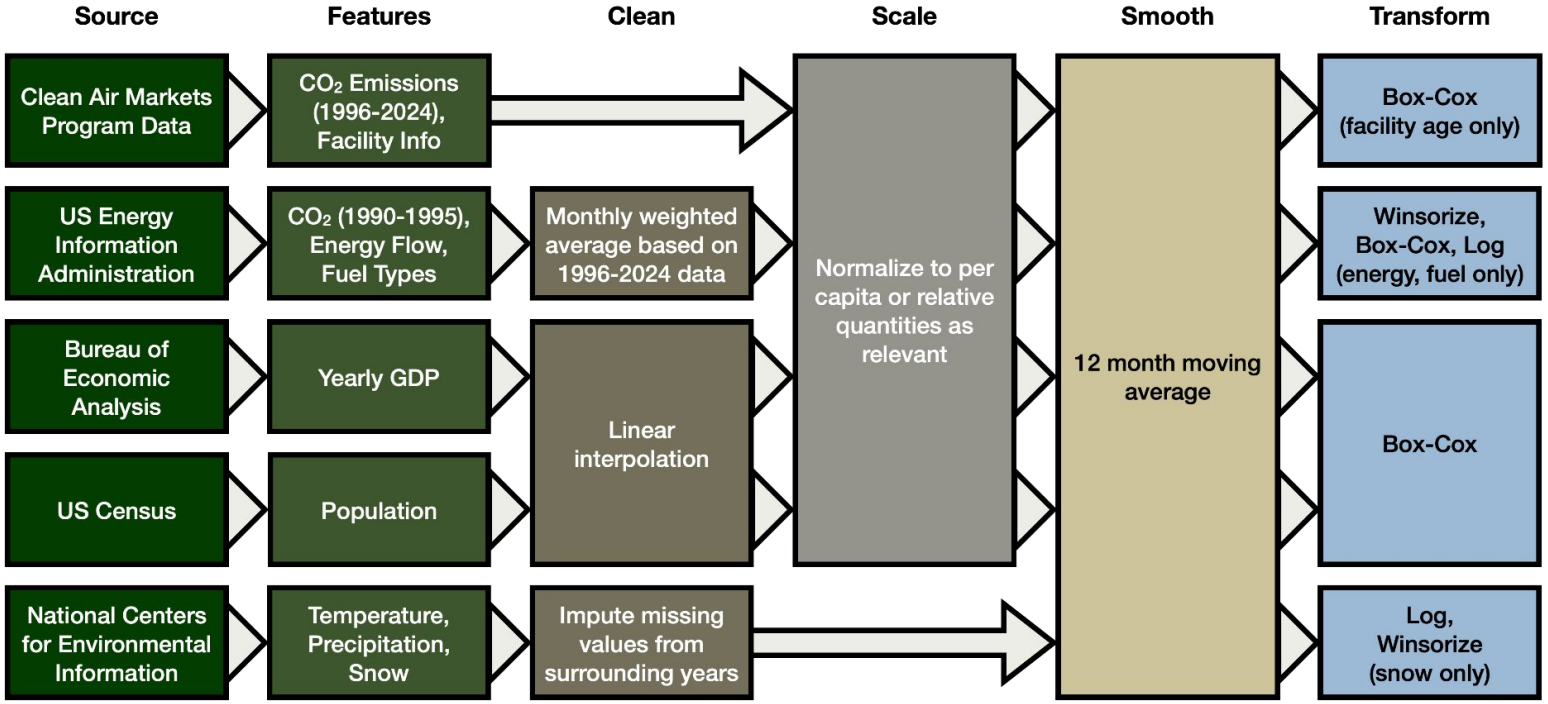
Dataset


Source
Features
Clean
Scale
Clean Air Markets Program Data
CO_2 Emissions (1996-2024), Facility Info
US Energy Information Administration
CO_2 (1990-1995), Energy Flow, Fuel Types
Monthly weighted average based on 1996-2024 data
Bureau of Economic Analysis
Yearly GDP
US Census
Population
Linear interpolation
National Centers for Environmental Information
Temperature, Precipitation, Snow
Impute missing values from surrounding years
Normalize to per capita or relative quantities as relevant

Dataset


Source
Features
Clean
Scale
Smooth
Clean Air Markets Program Data
CO_2 Emissions (1996-2024), Facility Info
US Energy Information Administration
CO_2 (1990-1995), Energy Flow, Fuel Types
Monthly weighted average based on 1996-2024 data
Bureau of Economic Analysis
Yearly GDP
US Census
Population
Linear interpolation
National Centers for Environmental Information
Temperature, Precipitation, Snow
Impute missing values from surrounding years
Normalize to per capita or relative quantities as relevant
12 month moving average

Dataset


Source
Features
Clean
Scale
Smooth
Transform
Clean Air Markets Program Data
CO_2 Emissions (1996-2024), Facility Info
US Energy Information Administration
CO_2 (1990-1995), Energy Flow, Fuel Types
Monthly weighted average based on 1996-2024 data
Bureau of Economic Analysis
Yearly GDP
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Impute missing values from surrounding years
Normalize to per capita or relative quantities as relevant
12 month moving average
Box-Cox (facility age only)
Winsorize, Box-Cox, Log (energy, fuel only)
Box-Cox
Log, Winsorize (snow only)

Dataset

Source	Features	Clean	Scale	Smooth	Transform	Combine
Clean Air Markets Program Data	CO_2 Emissions (1996-2024), Facility Info					
US Energy Information Administration	CO_2 (1990-1995), Energy Flow, Fuel Types	Monthly weighted average based on 1996-2024 data				
Bureau of Economic Analysis	Yearly GDP	Linear interpolation				
US Census	Population					
National Centers for Environmental Information	Temperature, Precipitation, Snow	Impute missing values from surrounding years				

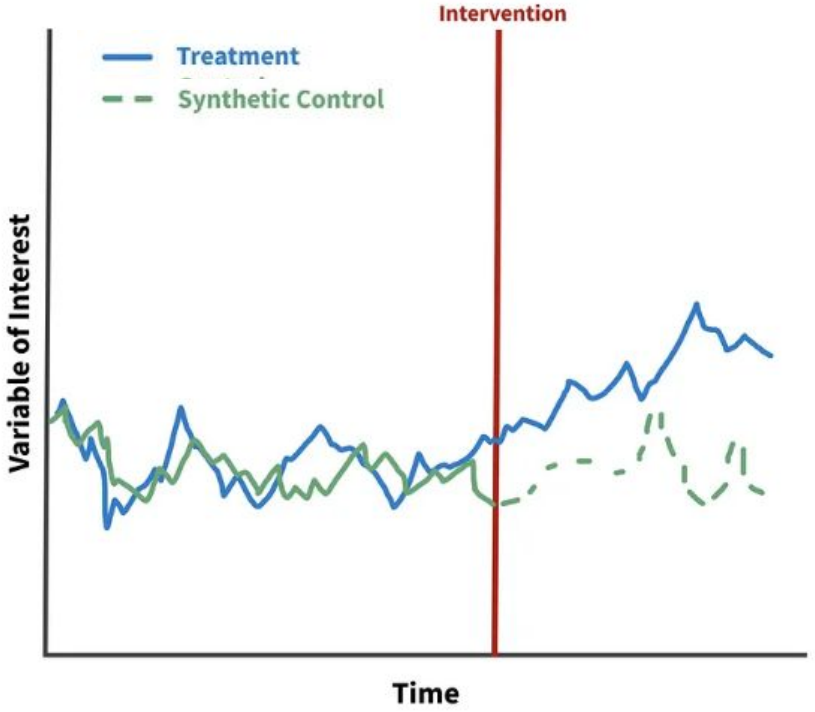
Final Dataset *(with Transformations)*:

CO_2 per Capita *(Log)*
Average Facility Age (Box-Cox)
Energy Production per Capita (Box-Cox)
Energy Use per Capita (Winsorized)
% Fossil Fuel Usage
% Renewables Usage (Winsorized, Log)
GDP per Capita (Box-Cox)
Population Density (Box-Cox)
Snowfall (Winsorized, Log)

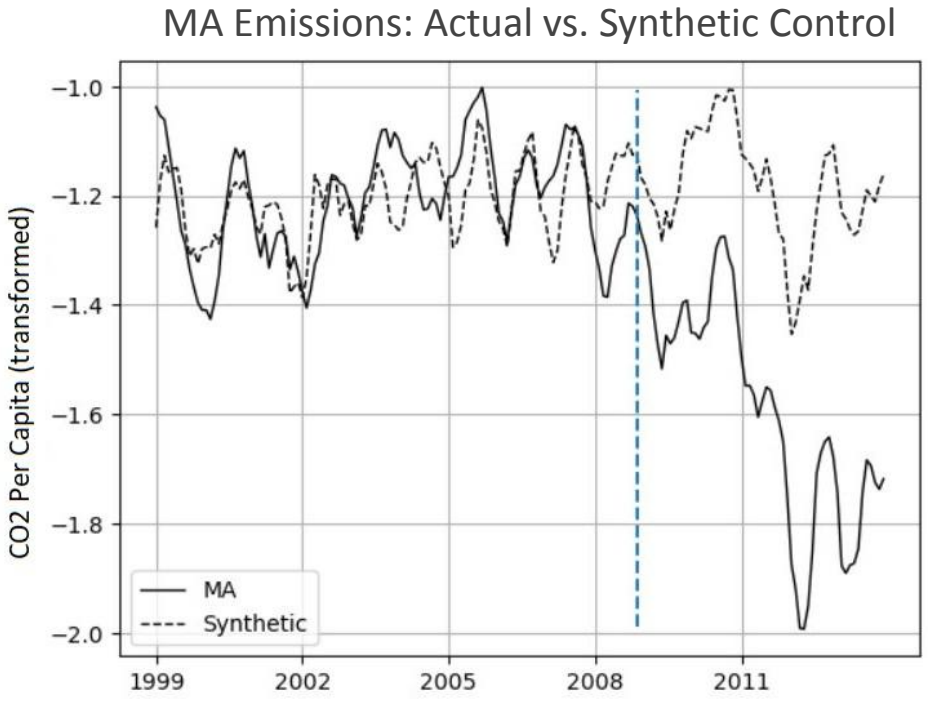
Model

Synthetic Control Method:

- Goal: create synthetic control state from weighted combination of control states
- Weights chosen to minimize
  Gap = Synthetic - Treated
  during pre-intervention period
- Gaps in post-intervention period then used to evaluate intervention effect



Model



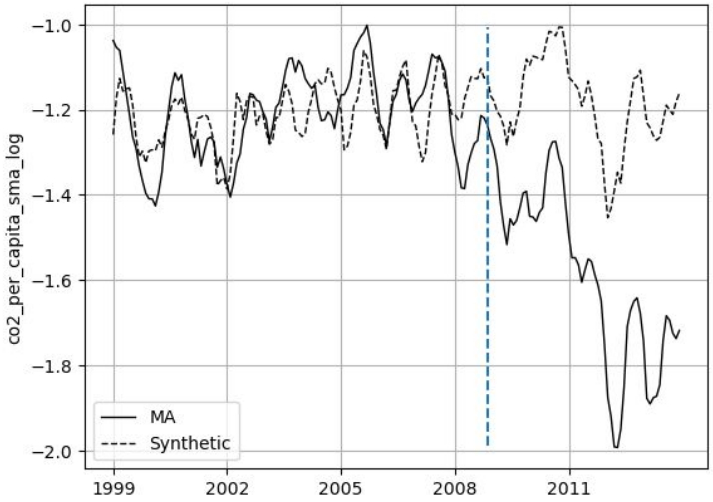
Final Model:

- Model: Augmented Synthetic Control
- Variable of Interest: CO2 emissions per capita
- Intervention date: 2009-01-01
- Donor Pool: 33 (non-RGGI) states

Variables	Real MA	Synthetic MA
Snow	1.035	0.973
% of Energy Produced from Coal	0.258	0.339
CO2 per capita	-1.213	-1.239

Results

Initial Hypothesis Test

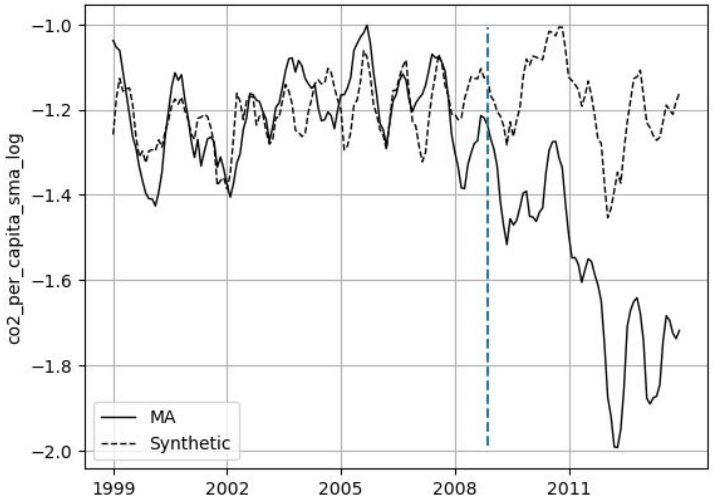


- r^2 = .26
- p = .03
- 79% CO2 Reduction

Placebo Test

Results

Initial Hypothesis Test



- r^2 = .26
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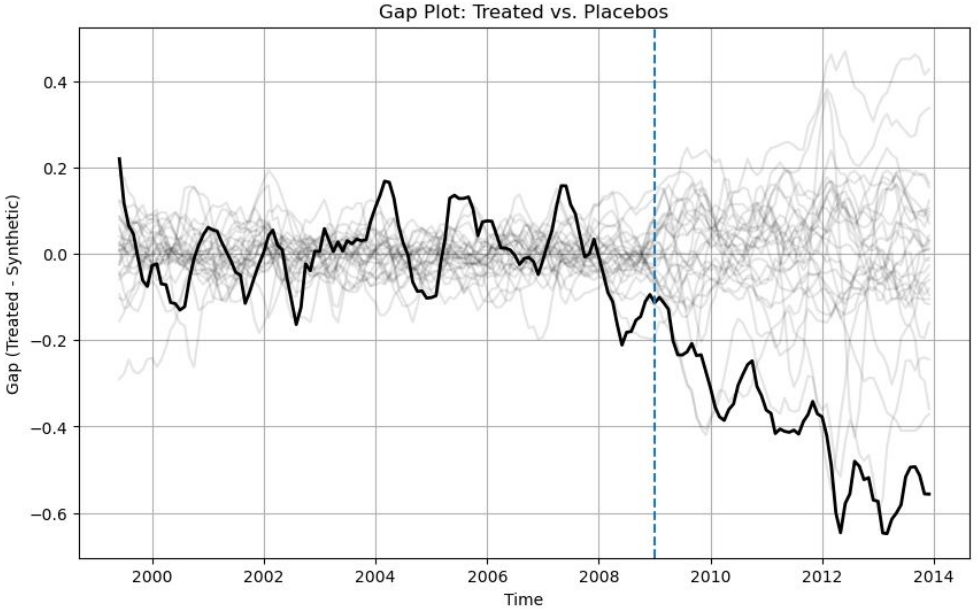
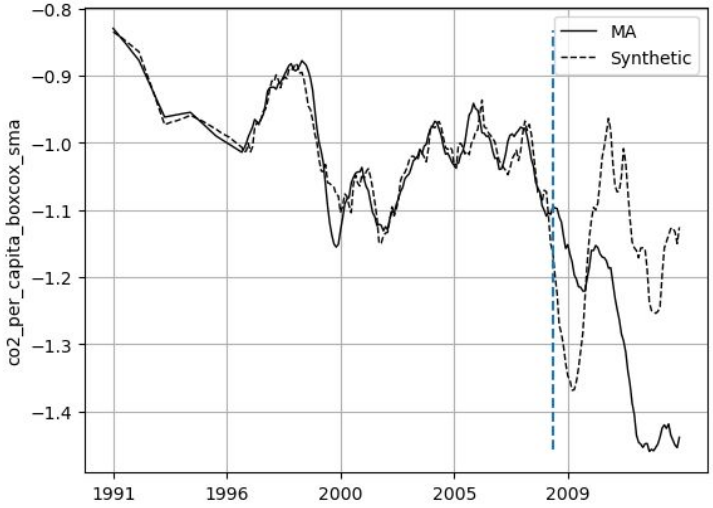
Placebo Test



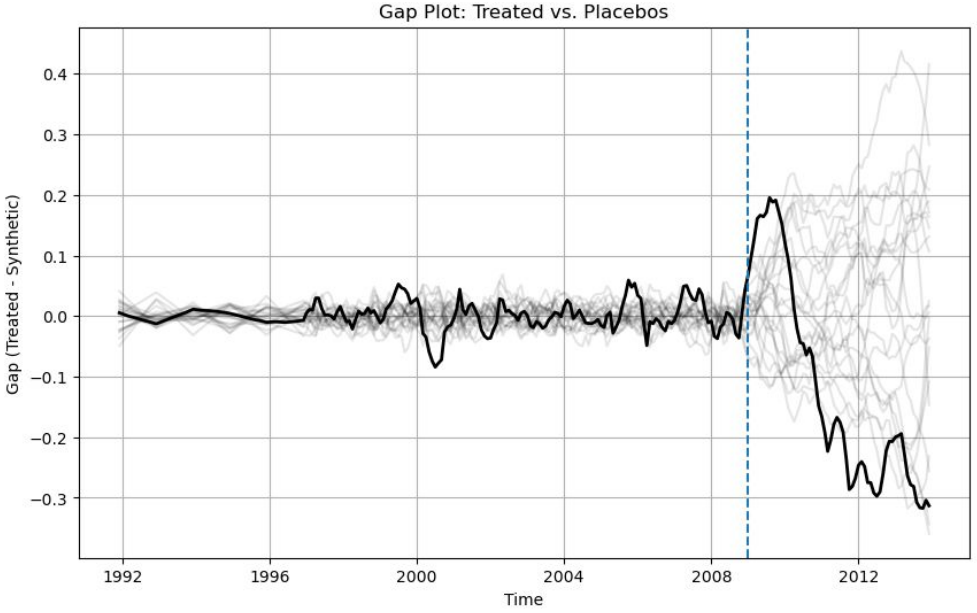
Results

Second Hypothesis Test



- r^2 = .91
- p = .18
- 0.4% CO2 Reduction

Placebo Test



Future Work

- Robustness checks
- Explore bias from anticipation and interference effects
- Benefit-cost analysis

Future Work

- Robustness Checks:
  - Placebo date test

Future Work

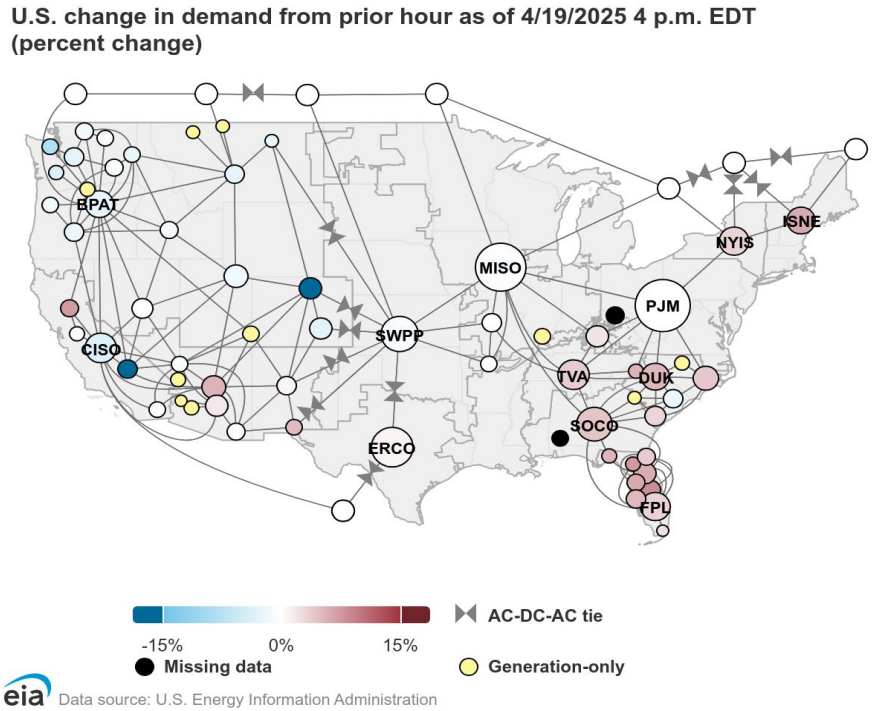
- Robustness Checks:
  - Placebo date test
  - Leave-one-out test

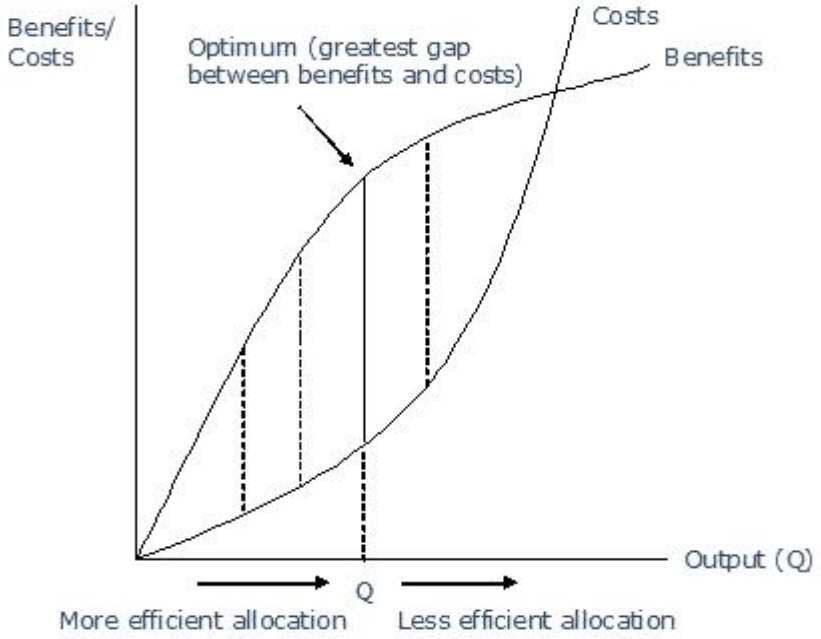
Future Work

- Potential biases:
    - Anticipation effects by power plants before RGGI auctions began.

Future Work

- Potential biases:
  - Anticipation effects by power plants before RGGI auctions began.
  - Interaction effects between electricity markets inside and outside of RGGI



Future Work

- Benefit-cost analysis:
  - How cost-effective has RGGI been compared to alternatives?