Policy Interactions, Local Impacts, & Distributional Equity

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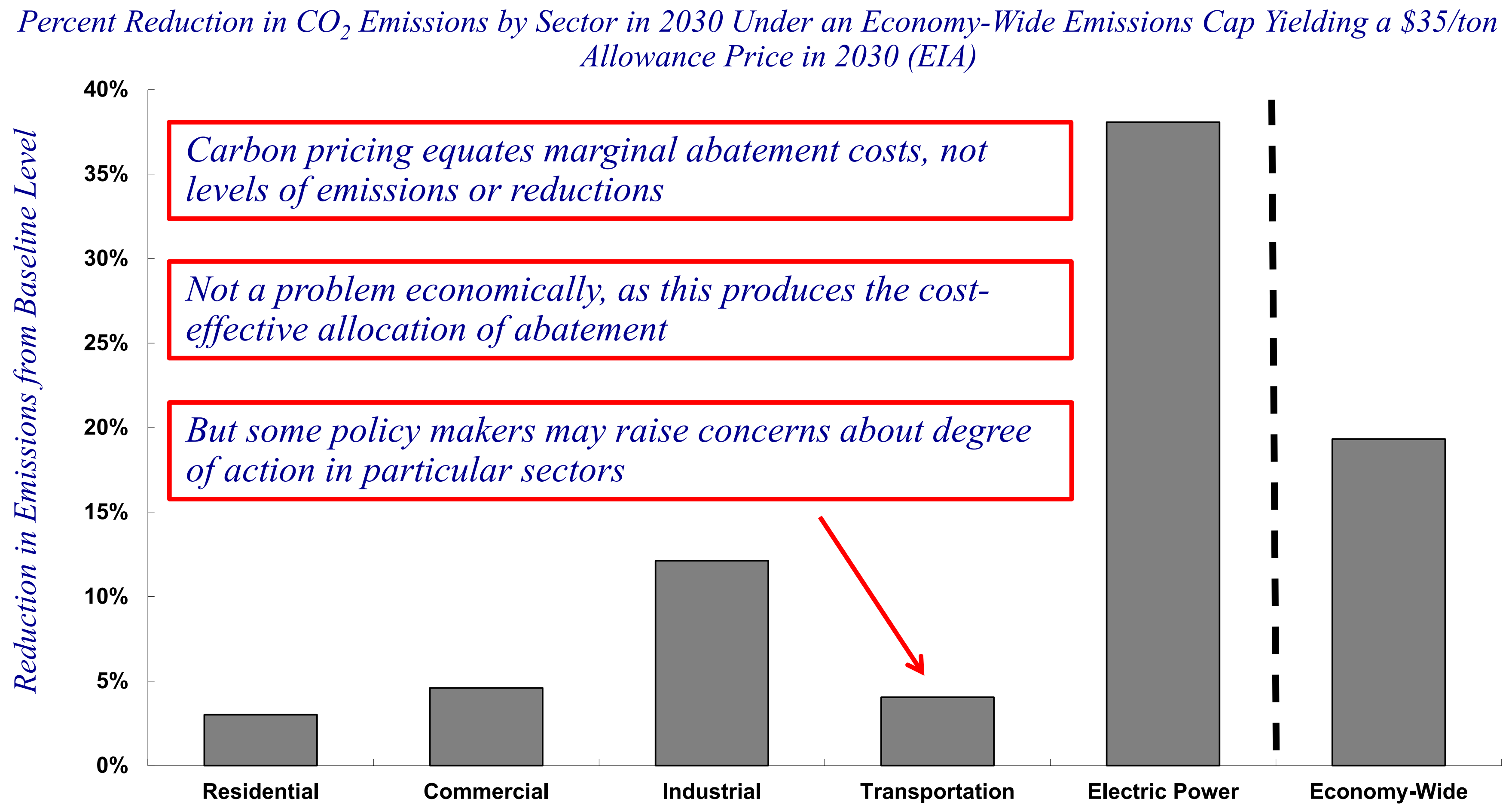
Interactions among Climate-Change Policies

- **Carbon pricing may be necessary, but it will *not* be sufficient, due in part to other market failures**
    - Principal-agent problem (renter-occupied properties) → Building Codes
    - R&D spillovers → Government funding for R&D
- **So, specific non-pricing policies *can be* complementary**
- **However, frequent motivation for "complementary policies" is apparently "insufficient" action from some sectors …**

Motivation for Asking if Carbon-Pricing is Sufficient: Cost-Effective Carbon Pricing Achieves Different Reduction Levels in Different Sectors



Interaction of Complementary Policies with Cap-and-Trade Can Be Particularly Problematic

- **Some "complementary policies" can *conflict* rather than complement – Important Issue in Europe, USA, and many other parts of the world (Example: LCFS in CA)**
  - *Consequences* of policy for sources *under the cap* of a cap-and-trade system
    - *Achieves no incremental CO_2 emission reductions* – relocates emissions, i.e., 100% leakage (*unless* allowance price floor or ceiling is binding; acts as carbon tax)
    - *Drives up abatement costs* (marginal costs not equated)
    - *Suppresses allowance price* (by reducing overall demand for allowances)
  - So, some "complementary policies" can have perverse effects
- **Motivation may also be policy makers wanting to keep allowance price low by having other policies do "heavy lifting"**
- **Policy interactions can also arise in case of sub-national policies …**

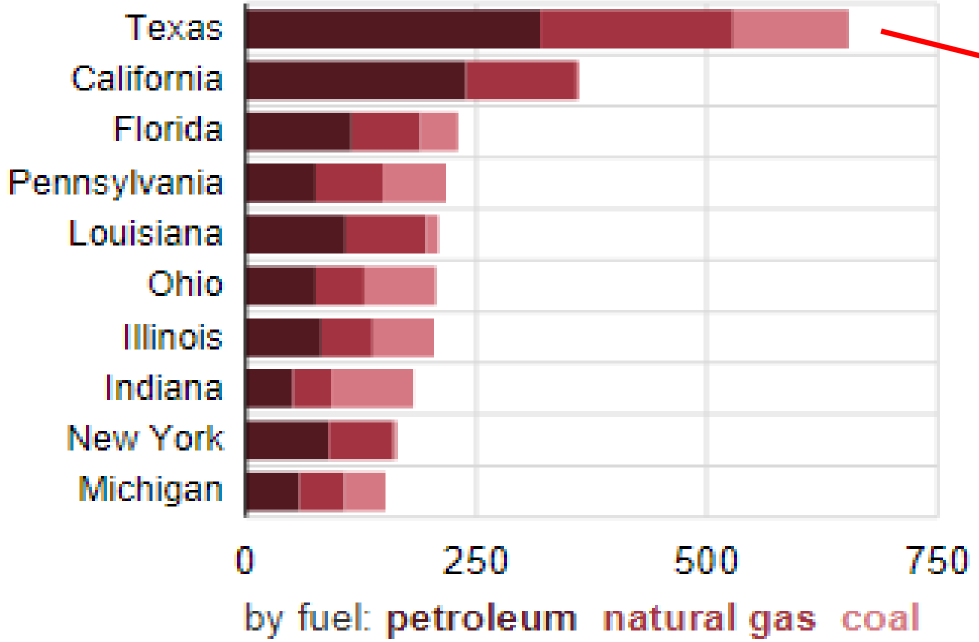
Why Think about Sub-National Climate Policies?

- **Reminder: climate change is a global commons problem**
  - For virtually any jurisdiction, the benefits it reaps from its actions will be *less* than the costs it incurs.
  - Also, leakage generally greater for smaller jurisdictions.

- **So, why think about sub-national policies?**
  - National government does not take action, or pursues insufficient action
  - States as "policy laboratories" for policy design
  - State policy can generate innovation and policy spillovers to other states and/or national government?

Sub-National Emissions can be *Meaningful*

Energy-related carbon dioxide emissions by state (top ten, 2016)
million metric tons of carbon dioxide



#	Country	CO2 Emissions (tons, 2016)	1 Year Change	Population (2016)	Per capita	Share of world
1	China	10,432,751,400	-0.28%	1,414,049,351	7.38	29.18%
2	United States	5,011,686,600	-2.01%	323,015,995	15.52	14.02%
3	India	2,533,638,100	4.71%	1,324,517,249	1.91	7.09%
4	Russia	1,661,899,300	-2.13%	145,275,383	11.44	4.65%
5	Japan	1,239,592,060	-1.21%	127,763,265	9.70	3.47%
6	Germany	775,752,190	1.28%	82,193,768	9.44	2.17%
7	Canada	675,918,610	-1.00%	36,382,944	18.58	1.89%
8	Iran	642,560,030	2.22%	79,563,989	8.08	1.80%
9	South Korea	604,043,830	0.45%	50,983,457	11.85	1.69%
10	Indonesia	530,035,650	6.41%	261,556,381	2.03	1.48%
11	Saudi Arabia	517,079,407	0.92%	32,443,447	15.94	1.45%
12	Brazil	462,994,920	-6.08%	206,163,053	2.25	1.29%
13	Mexico	441,412,750	-2.13%	123,333,376	3.58	1.23%
14	Australia	414,988,700	-0.98%	24,262,712	17.10	1.16%
15	South Africa	390,557,850	-0.49%	56,207,646	6.95	1.09%
16	Turkey	368,122,740	5.25%	79,827,871	4.61	1.03%
17	United Kingdom	367,860,350	-6.38%	66,297,944	5.55	1.03%
18	Italy	358,139,550	0.84%	60,663,060	5.90	1.00%
19	France	331,533,320	2.11%	64,667,596	5.13	0.93%
20	Poland	296,659,670	2.67%	37,989,220	7.81	0.83%

Source: *U.S. Energy Information Administration - EIA - Independent Statistics and Analysis*

Example in U.S. – State-Level “Clean Energy” Policies

- **With U.S. federal policy lacking, sub-national policies have grown**
- **State climate policies have been strengthened, particularly in “progressive states”**
  - Renewable mandates
  - Zero Emission Vehicle (ZEV) requirements
  - Appliance efficiency standards
  - Building codes
  - Zoning laws
  - Subsidies
  - Carbon-pricing initiatives

Interactions when a Jurisdiction within a Cap-and-Trade System Takes Additional Actions

- **Examples:**
  - EU ETS member country puts in place a more ambitious CO_2 policy
  - Province/state in country with a national cap-and-trade system puts in place a more ambitious CO_2 policy
- **Can yield same perverse outcome as with "complementary policies"**
  - *Achieves no incremental CO_2 emission reductions* – relocates emissions to other jurisdictions
  - *Drives up* abatement costs
  - *Suppresses* allowance price
- **But, will these perverse outcomes necessarily arise?**
  - Answer: interactions can be *problematic*, *benign*, or *positive*…

Problematic Interactions

- **If national policy limits emissions *quantities* or uses nationwide *averaging* of performance, …**
- **Then, emission *reductions* accomplished by "green" state/province (more stringent policy than national) reduce pressure on other states,**
  - thereby freeriding – indeed, *encouraging* (such as through lower allowance price) – emission *increases* in other states
- **Result: 100% leakage, and loss of cost-effectiveness nationally**
- **Potential examples**
  - State limits on GHGs/mile *and* Federal CAFE standards
  - State renewable fuels standard *and* Federal RFS; or state renewable portfolio standard *and* Federal RPS
  - British CO_2 policies if under umbrella of EU ETS
- **Partial solution: carve-out from broader policy (eliminates 100% leakage, but still not cost-effective!)**

Benign Interactions

- **Example #1: Regional Greenhouse Gas Initiative (RGGI)**
  - RGGI (state) policies are less stringent than future Federal policy
  - Result: state policies become non-binding and largely irrelevant

- **Example #2: Federal policy sets price (not quantity)**
  - A carbon tax, or a binding safety-valve/price collar in cap-and-trade
  - More stringent actions in green states *do not lead* to offsetting emissions in other states induced by a changing carbon price.
  - *However*, there will be *different* marginal abatement costs across states, and so aggregate reductions are *not* achieved *cost-effectively*.

Positive Interactions

- **States can address *market failures* not addressed by a Federal "carbon-pricing" policy**
  - Example: principal-agent problem re. energy-efficiency investments in renter-occupied properties → state or local building codes
- **States can be *"laboratories"* for policy design**
  - Can provide useful information for development of national policy
  - But will state authorities allow their "laboratory" to be closed after the experiment has been completed and the information delivered?
- **States can create *pressure* for more stringent Federal policy**
  - Example: CA standards and subsequent change in Federal CAFE
  - Desirable if previous national policy is insufficient, but an empirical question
- ***Cities* can also be engaged** (Brookings survey, 2020)
  - 45 of 100 largest U.S. cities have made *serious climate pledges,* but most are aspirational, *not* realistic
  - 30 of the 45 cities with pledges are *behind* their targeted emission cuts
  - The 45 city pledges *if executed* would reduce U.S. total annual emissions by 6%

Localized Climate Change & Policy Impacts

- **Importance of Local Air Pollutants Correlated with CO_2 Emissions**

- **Distribution of Benefits and Costs of Climate Policy: Environmental Justice and Just Transition**

The Importance of Correlated Pollutants: Example: The Clean Power Plan (2014)

- **Rule for existing power plants proposed June 2, 2014:** 30% reduction of CO_2 emissions below 2005 level by 2030
  - ➢ Rule facilitated (through flexibility) but did not guarantee cost effectiveness
  - ➢ Intended to facilitate cap-and-trade
- EPA assigned states CO_2 standards, based on existing mix of generating units in the state
- Let's look at Obama administration's economic analysis of this proposal …

Economic Analysis of “Clean Power Plan” Rule

- **Fundamental economic arithmetic of a global commons problem**

  - Benefits spread globally, cost incurred locally (and damages worse in other parts of the world)

  - It would be surprising – to say the least – if EPA were to find that the expected benefits of the proposed rule would exceed its expected costs

  - But this is what EPA found.

  - Its central estimate is positive net benefits (benefits minus costs) …
    - of **$67 billion annually in the year 2030**!
    - *How can this be?*

Estimated Benefits and Costs of Proposed Clean Power Plan in 2030

EPA's Regulatory Impact Analysis, Mid-Point Estimates, Billions of Dollars

94% of estimated domestic benefits are health impacts of correlated local air pollutants	Climate Change Impacts	
	Domestic	Global
Benefits		
Climate Change	$3	$ 31
Total Benefits	$3	$ 31
Total Compliance Costs	$9	$ 9
Net Benefits (Benefits – Costs)	**- $6**	$ 22

Non-Uniformly Mixed Pollution & "Hot Spots"

- **Market-based instruments reduce costs by allowing low (abatement) cost polluters to reduce emissions by more than high-cost polluters**
  - Generates **differences** in emissions reductions across firms
  - This is fine when **benefits** of pollution reduction are the same everywhere
  - But when benefits (pollution damages) vary (e.g., due to differences in population exposed), this can create pollution *"hot spots"*
  - So, when high-damage sources have high abatement costs, with *increasing marginal damages*, efficiency is reduced
- **If pollution is non-uniformly mixed (local pollutants), benefits (avoided damages) will not be the same everywhere**
- **Key Issue: Some local pollutants (PM 2.5) are produced along with global pollutants (CO_2)**

Distribution of Local Benefits and Costs of Climate Policy: Environmental Justice (EJ) and Just Transition

- **Damages of climate change (and correlated pollutants)– and therefore benefits of climate policy – are *not equally distributed within jurisdictions* (or globally)**

- **Distribution of climate-change (and correlated pollutant) *damages* (policy *benefits*) within jurisdictions vary in terms of:**
  - Economic sector (extreme case, for example: agriculture vs high tech)
  - Job category (for example, top management vs unskilled labor)
  - Geographic location (for example, highlands vs lowlands)
  - Income groups
  - Racial and ethnic groups

- **Distribution of *costs of climate-change policies* likewise vary –both for abatement (mitigation) costs ("Just Transition") and adaptation costs**

Why worry about distributional equity in design of (efficient or cost-effective) policy?

- **Definition of Efficient Policy: Maximize Net Benefits, i.e., difference between benefits & costs**
- **But all policies create winners and losers**
  - Tax on gasoline reduces air pollution, but makes it more costly to get to work
  - Closing down coal mines
- **Some efficient/cost-effective policies are regressive**
  - Improving Los Angeles visibility by increasing electricity rates
    - Low-income households pay higher share, but rich living up in the hills get the benefits.
- **Other policies are progressive**
  - Superfund cleaned up abandoned hazardous waste sites
    - Rich pay more in taxes and don’t live near these sites

An Example that Caused Concern

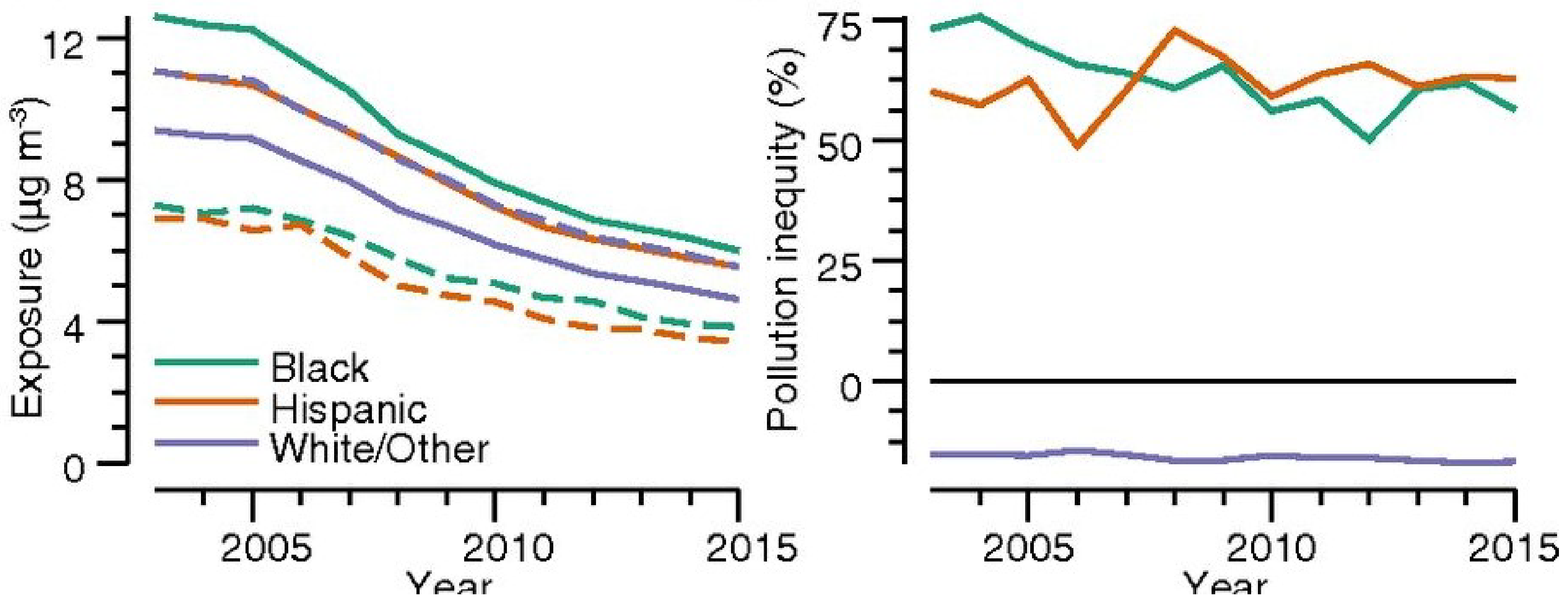
- **In 1978, Ward Transformer Company illegally dumped** 31,000 gallons of PCBs (carcinogenic & other health effects)
- **North Carolina identified two potential sites to dispose of the soil:**
  1. **Warren County**: 60% black & 25% of population below poverty line
     - ➢ Shallow water table, *not* well suited for a landfill.
  2. **Chatham County**: 27% black & 6% of population below poverty
     - ➢ *Suitable* private site *available*
- **Result: Warren was selected.** In 1993, the disposal site was found to be leaking PCBs
- **This incident has been credited with starting the Environmental Justice Movement in the USA**

Source: The History of Environmental Justice in Five Minutes (nrdc.org)

Correlation between Race/Income & Pollution

- **Studies have found spatial correlation between pollution levels and race and/or income.**
- **Potential mechanisms:**
    - *Pollution levels depress real estate values → cheaper homes, lower rents → low income and minority populations move into area*
    - Lax enforcement of environmental regulations in poorer neighborhoods
    - Imperfect information regarding environmental harms

Exposure to PM 2.5 in the United States (2003-2015)



- Exposure (solid lines) & Contributions (dashed lines)
- Black & Hispanic have *higher exposure*, and *lower contributions*
- All are trending down over time
- "Pollution inequity" (measured as Exp/Cont – 1) trending slowly downward?

Sources: Tessum, *et al.* 2019. PNAS. Inequity in consumption of goods and services adds to racial–ethnic disparities in air pollution exposure. See also: Currie *et al.* 2023. AER. "What Caused Racial Disparities in Particulate Exposure to Fall? New Evidence from the Clean Air Act and Satellite-Based Measures of Air Quality."

Do Market-Based Environmental Policies Increase EJ Impacts?

- **Question**: Has California's Cap & Trade program *widened* pollution concentration gaps?
- **Hypothesis**: California's 2013 CO_2 *cap-and-trade* program could alter *local air pollution* disparities by changing which sources are emitting
- **Evidence** from recent study: Hernandez-Cortes & Meng. *Journal of Political Economy (*2023), "Do environmental markets cause environmental injustice? Evidence from California's carbon market"
- *Environmental justice gap* = difference in pollution experienced in disadvantaged communities relative to other communities
  - Disadvantaged communities formally defined by the State with a scoring system based on multiple socioeconomic indicators:
  - Poverty levels, educational attainment, unemployment rate, are correlated with racial and/or ethnic composition

Do Market-Based Environmental Policies Increase EJ Impacts? (continued)

Findings:

- In **2008**, significant EJ **gaps existed** and **grew through 2012**
- **Since 2013** (start of **C&T** program), the EJ **gaps have fallen**
- **But** while EJ gaps have narrowed, they have **not** been **eliminated**

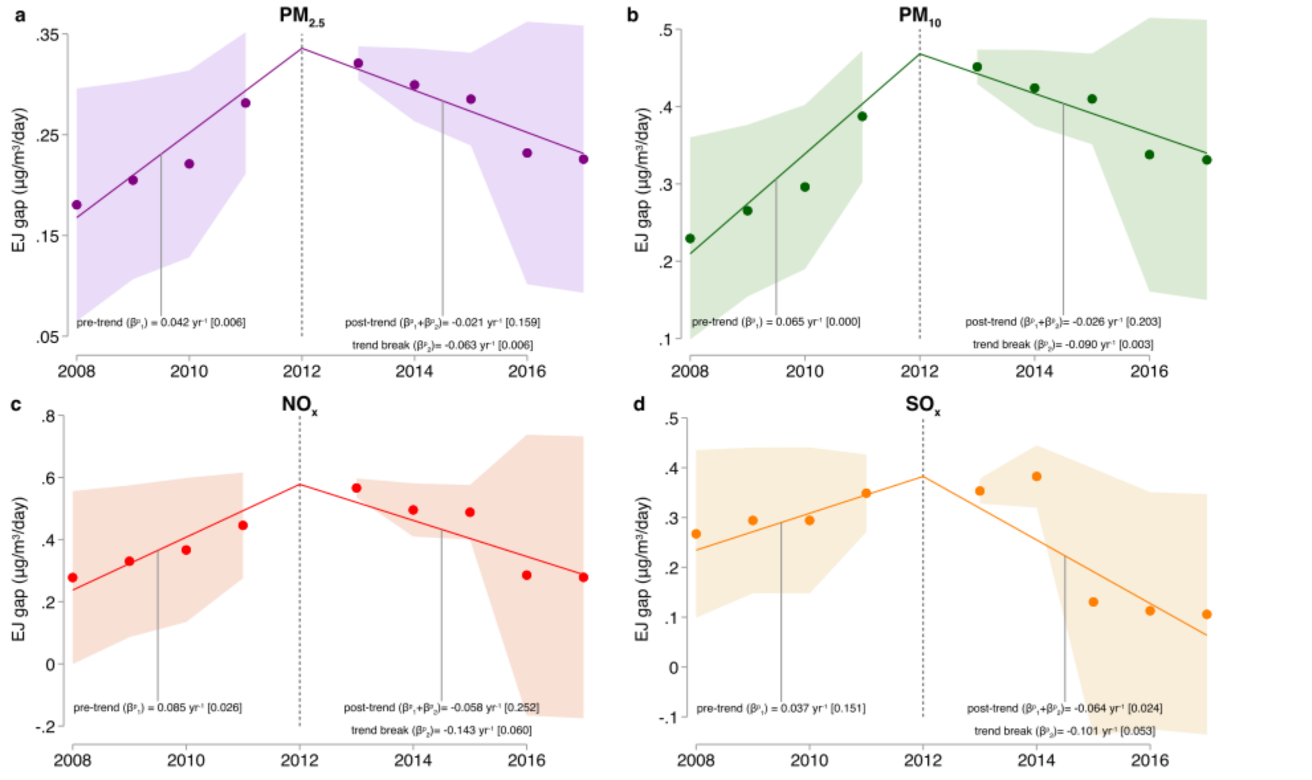


Fig. 4. Environmental justice gap effect of the cap-and-trade program. NOTES: Panels show the estimated average pollution concentration gap (in $\mu g/m^3$/day) between disadvantaged and other zip codes (i.e., "EJ gap") during 2008–2017 for (a) $PM_{2.5}$, (b) PM_{10}, (c) NO_x, and (d) SO_x, respectively. Dots show year-specific EJ gap with 95% confidence interval. Solid lines show linear fits from Eq. (2). Associated text indicates point estimates and p-values (in brackets) for the pre-C&T linear trend (β_1^p), post-C&T trend break (β_2^p), and post-C&T linear trend ($\beta_1^p + \beta_2^p$), as reported in Table 2. Estimates centered at the 2008 EJ gap shown in Table S6. Confidence intervals and p-values

Key Take-Aways

1. Even if carbon-pricing is necessary, it will *not* be sufficient
2. *Complementary policies* can interact with cap-and-trade in perverse ways:
   - No incremental emissions reduction
   - Increased costs
   - Suppressed allowance price
3. Sub-national policies can interact with a national policy in ways that are problematic, benign, or positive
4. *Correlated localized air pollutants* can be important
5. *Impacts* of climate change – *and adaptation* – are highly *specific to localities*
6. *Unequal distribution of climate-change (& correlated pollutant) damages* (& policy benefits) by sector, profession, geography, income, race, and ethnicity
7. Distribution of *mitigation and adaptation costs likewise not uniform*