Climate Policy Interactions + Energy Efficiency Paradox

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Section 11
ECON 1661 / API-135: Spring 2022

April 15, 2022

Announcements

- Office hours today from 3:00-5:00pm EDT
- Problem set #5 due Wednesday, April 27 at 12:00pm EDT
- Final exam: Saturday, May 7 from 9:00am - 12:00pm EDT in Science Center D
- Review session for final exam: Friday, April 29 from 1:30-2:30pm EDT in Belfer 200
  → Will start reviewing quantitative concepts from first half of the course next week

Outline

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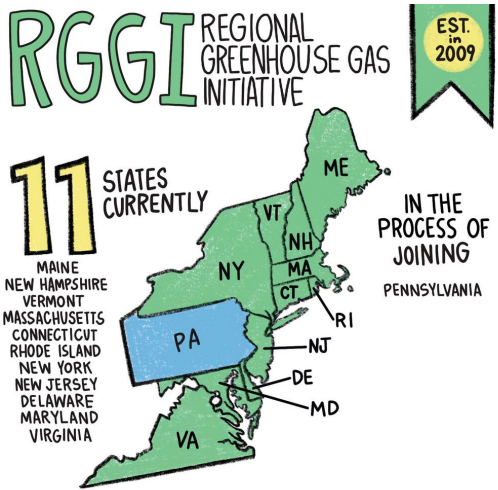
Why study sub-national climate policies?

- Reminder (from midterm!): CO_2 is a global, stock pollutant $\Longrightarrow$ global commons problem
  - For any jurisdiction, the benefits of its climate policy will be (much) less than costs incurred
  - Leakage likely to be greater for smaller jurisdictions

$\Rightarrow$ Why worry about sub-national policies?
  - National government not taking action
  - National policies insufficient

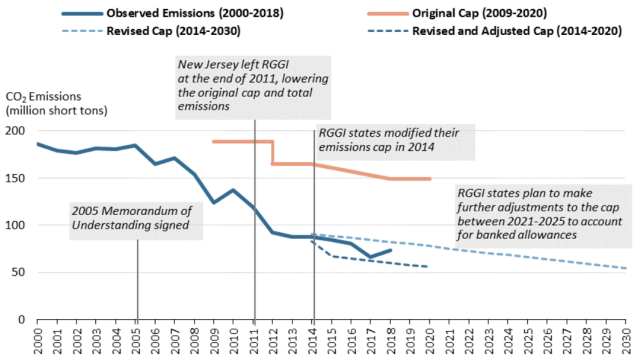
- 2 relevant examples of sub-national climate policies:
  - Regional Greenhouse Gas Initiative
  - California's AB-32

Regional Greenhouse Gas Initiative (RGGI)



- Launched in 2009 by CT, DE, ME, MD, MA, NH, NJ, NY, RI, and VT
- Downstream cap-and-trade program covering power sector emissions
- Initial permits allocated via auction $\rightarrow$ revenues used for consumer rebate programs
- Modest, but increasing stringency

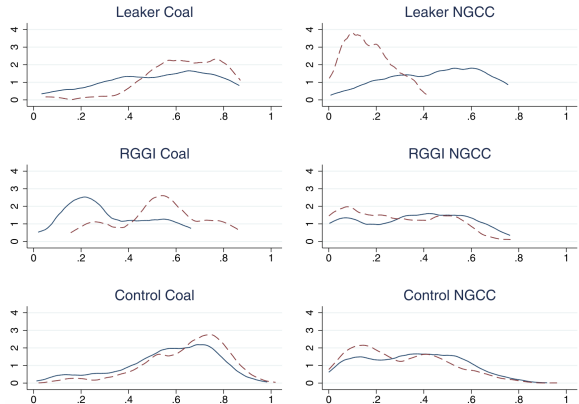
Regional Greenhouse Gas Initiative (RGGI): Modest success[1]



- 2019 CRS report:
  - Program covers 19% of emissions from RGGI states
  - RGGI states represent only 7% of US emissions
- Emissions are falling, but unclear how much RGGI contributed
  - Modest targets
  - Low natural gas prices
  - Great Recession
  - Energy conservation

[1] Ramseur, J.L. 2019. "The Regional Greenhouse Gas Initiative: Background, Impacts, and Selected Issues." Congressional Research Service R41836.

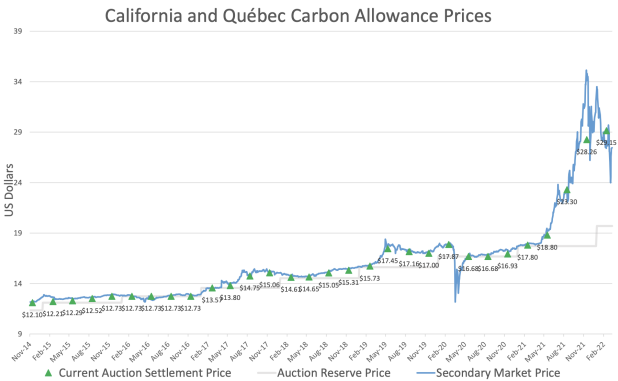
Leakage under RGGI: Fell and Maniloff (2018)[2]



- Use electricity market data for U.S. to examine impact of RGGI on generation
- Do attribute some reductions in RGGI states coal-fired generation to the program
  - $\downarrow$ CO_2 emissions in RGGI states by 8.8 million tons/year
  - $\uparrow$ CO_2 emissions in RGGI-surrounding areas by 4.5 million tons/year
- Leakage to Ohio and Pennsylvania led to nearly 50% leakage rate

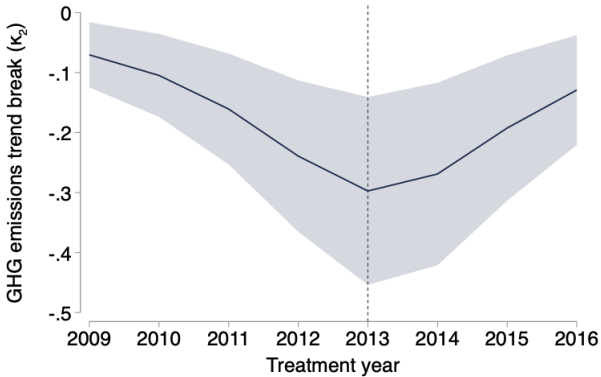
[2]Fell, H. and P. Maniloff. 2018. "Leakage in regional environmental policy: The case of the regional greenhouse gas initiative." *Journal of Environmental Economics and Management*, 87: 1-23.

California Global Warming Solutions Act (AB-32 & AB-398)



- AB-32 (2006): requires CA to reduce GHG emissions to return to 1990 levels by 2020
  - Cap-and-trade system covering $\sim$ 85% of state economy
  - Includes energy efficiency standards, RPS, low carbon fuel standard
- Linked with Quebec's CAT program since 2014
- AB-398 (2017): Extends program with steeper allowance cap to 2030
  - Reduction of 40% of 1990 levels
  - Institutes price ceiling, other price containment mechanisms

Effect of AB-32 CAT: Hernandez-Cortes and Meng (2021)[3]



- Statewide emissions declined 5.3% from 2013 to 2017
- Hernandez-Cortes and Meng (2021): estimate that CAT program reduced regulated facilities' emissions by 9% annually from 2012 to 2017

[3]Hernandez-Cortes, D. and K.C. Meng. 2021. "Do Environmental Markets Cause Environmental Injustice? Evidence from California's Carbon Market." NBER Working Paper No. 27205.

Outline

Interaction between overlapping climate policies

- Observe major climate policies in sub-national jurisdictions
- Have also learned why carbon pricing is necessary, but not sufficient $\Longrightarrow$ other market failures
  - Principal-agent problems (e.g., renter-occupied properties $\rightarrow$ building codes)
  - Public good nature of information (e.g., R&D spillovers $\rightarrow$ government funding for R&D)

  $\Rightarrow$ Need for complementary policies
- But often justification for "complementary" policies not rooted in separate market failures
- In practice, high likelihood of overlapping policies, giving rise to natural question of how the policies interact?
- We focused on cases of nesting climate policies (e.g., national and sub-national policies)

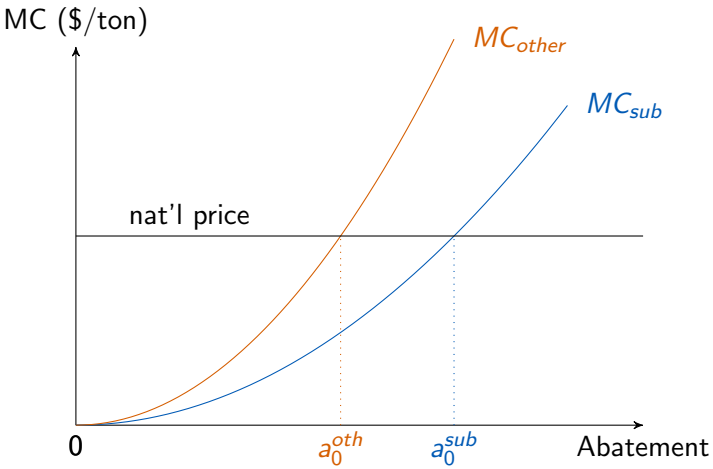
Problematic interactions

- If a national policy limits emissions quantities or uses nationwide averaging of performance...

- ...then a binding (more stringent) sub-national policy will lead to:
  1. 100% leakage
  2. Loss of national cost-effectiveness

- Why?
  - Emissions reductions accomplished by "green" sub-national jurisdiction reduce pressure on other sub-national jurisdictions
  - This encourages (e.g., through lower allowance price) emission increases in other states

Problematic interaction: National CAT + stringent sub-national CAT



- National CAT program with two representative firms:
  1. Firms in sub-national jurisdiction with MC_{sub}
  2. All other firms with MC_{other}
- Sub-national jurisdiction puts in place more stringent CAT policy $\Rightarrow$ their abatement $\uparrow$
- These firms still subject to national CAT $\Rightarrow$ demand for national permits $\downarrow$, other firms abatement, $\downarrow$
- Overall abatement costs increase!

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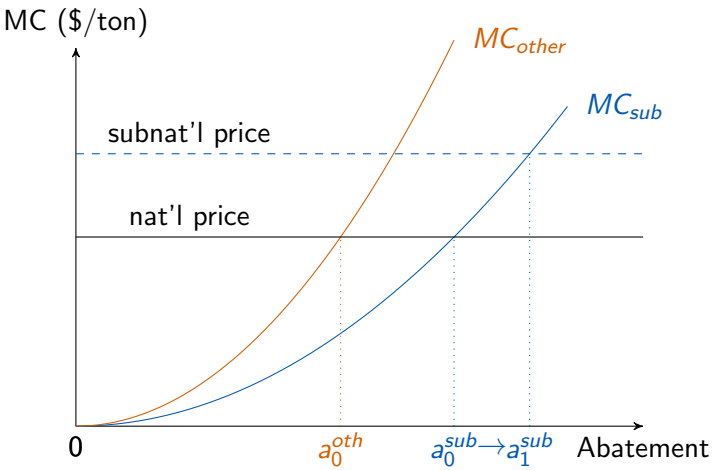

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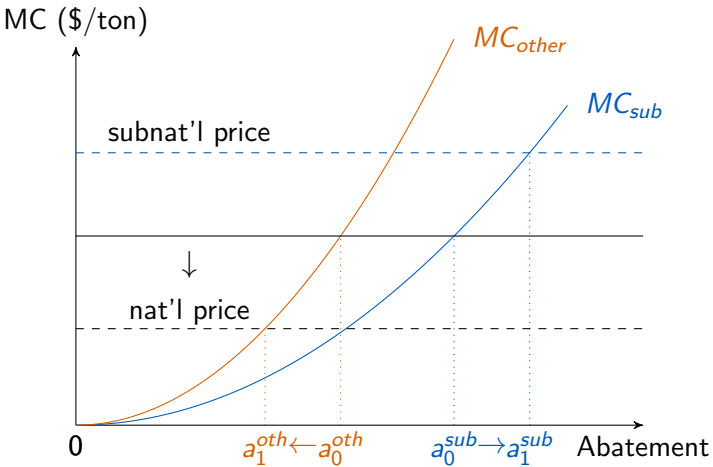

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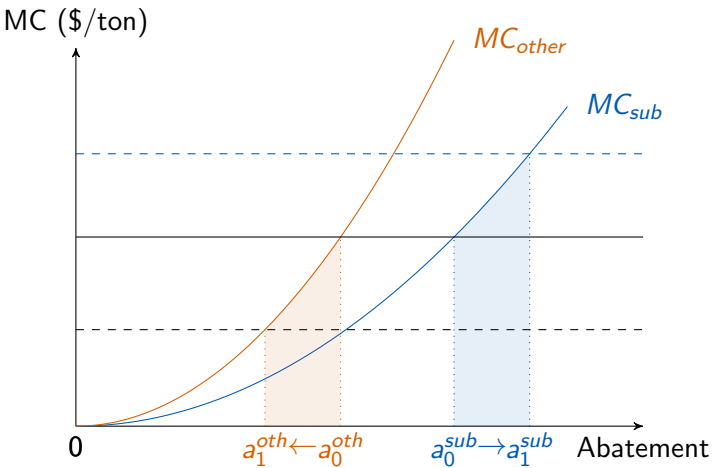

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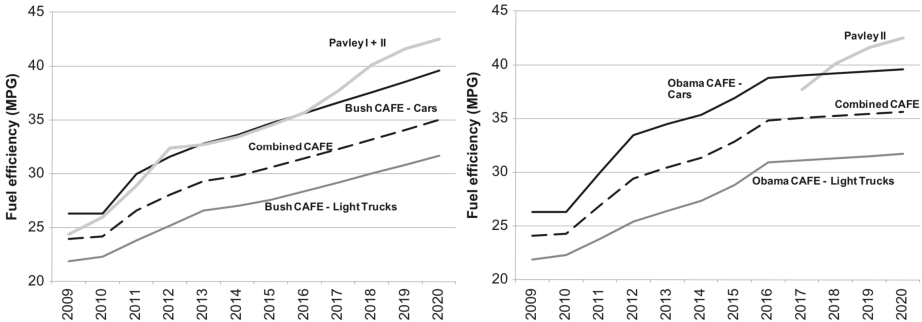
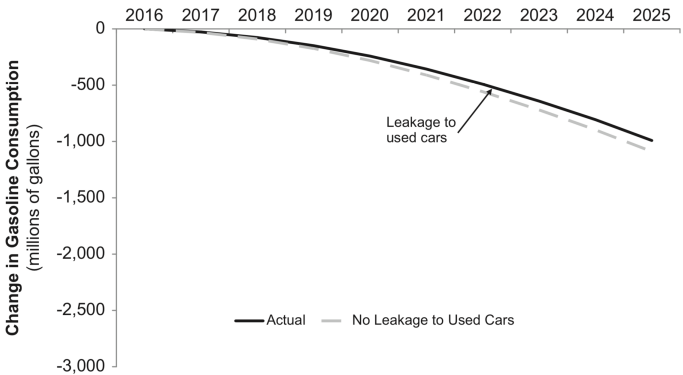
Example of problematic interaction: US CAFE and CA Pavley Standards



- "Pavley" standards: Coalition of 14 states led by CA established limits on GHG emissions per mile from light-duty autos starting in 2009
  - Two phases: Pavley I (2009-2016) and Pavley II (2017-onward)
- Direct interaction with federal Corporate Average Fuel Economy (CAFE) standards
  - Both (effectively) require manufacturers to meet average fuel economy targets for new sales
- 2009: Obama Admin agrees to tighten Bush CAFE standards through 2016 (right above)

CAFE-Pavley interactions: Goulder et al. (2012)[4]



- Two main leakage issues:
  1. Leakage to non-Pavley states ($\sim$58.5% of sales)
  2. Leakage to used car market
- Calibrate a model of supply and demand in US used/new car markets
- State-federal cooperation avoids 74% leakage in first phase, potentially 65% in second phase

[4] Goulder, L.H., M.R. Jacobsen and A.A. van Benthem. 2012. "Unintended consquences from nested state and federal regulations: The case of the Pavley greenhouse-gase-per-mile limits." *Journal of Environmental Economics and Management*, 63: 187-207.

Benign interactions

- Two main cases of benign interactions:
  1. National policy limits emissions quantities or uses nationwide averaging of performance and the sub-national policy is not binding
     - Example: RGGI and potential Federal climate policy
  2. National policy sets prices rather than limiting emissions quantities
     - A carbon tax, or a binding price collar in cap-and-trade
     - More stringent actions in green states do not lead to offsetting emissions since there is no change in carbon price
     - Importantly, still lose cost-effectiveness

Positive interactions

- Sub-national jurisdictions can address market failures not addressed by a national carbon-pricing policy
  - E.g., state/local building codes for energy-efficiency principal-agent problems
- Sub-national jurisdictions as laboratories for policy design
- Sub-national jurisdictions can create pressure for more stringent national policy
  - E.g., Pavley-CAFE standards? Example of both a negative interaction and—as a result—a positive interaction since it led to more stringent Obama CAFE standards

Outline

Energy efficiency market failures

- Once again: carbon pricing is necessary, but might not be sufficient $\Longrightarrow$ other market failures warrant additional policy interventions

- Why might a carbon price not yield the socially optimal investment in energy efficient technologies?
  - Supply-side explanations: knowledge spillovers (positive externalities from R&D) $\longrightarrow$ underinvestment
  - Demand-side explanations: frictions associated with diffusion of technologies

Energy efficiency gap/paradox

- Private gap / "energy paradox:" some energy efficient technologies that would pay off for adopters are not adopted
- Social gap / "energy efficiency gap:" some energy efficient technologies that would be socially efficient (i.e., pay off for society) are not adopted
- These concepts are focused on the diffusion/deployment component of RD&D: why are certain technologies not adopted?

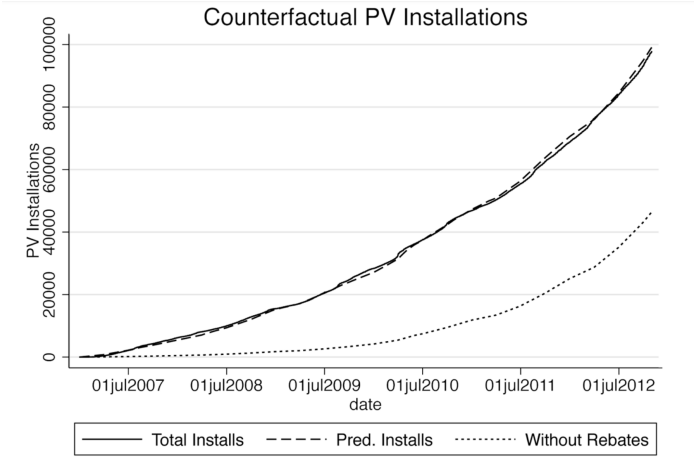
Energy efficiency gap/paradox: Explanations

- We discussed three categories of explanations:
  - Market failure explanations (e.g., information asymmetries, externalities, liquidity constraints)
  - Behavioral explanations (e.g., salience, heuristics)
  - Model/measurement explanations (e.g., unobserved costs, unmeasured product attributes)

- If the EE gap is not a measurement problem, policy *might* improve social welfare

- Potential policies:
  - Subsidies for energy efficient technologies
  - Information provision
  - Regulations over/bans of non-efficient technologies
  - R&D investment

Subsidies for solar PV adoption: Hughes and Podolefsky (2015)[5]



- Can potentially address liquidity constraints through subsidies/loans
- Solar PV adoption heavily subsidized in US
- CA Solar Initiative: $3.3 billion subsidy program for PV adoption
- Hughes and Podolefsky (2015) find that CSI rebates ↑ adoption by 53% from 2007-2012

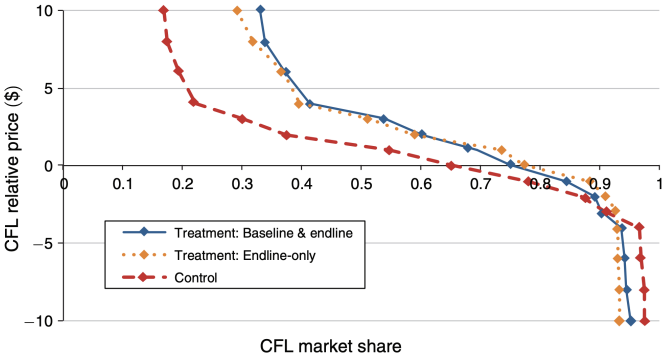
[5] Hughes, J.E. and M. Podolefsky. 2015. "Getting Green with Solar Subsidies: Evidence from the California Solar Initiative." *Journal of the Association of Environmental and Resource Economists*, 2(2): 235-275.

Behavioral explanations: The case of energy efficient lightbulbs

- Would subsidizing or mandating the use of energy efficient lightbulbs be social-welfare-enhancing?

- Allcott and Taubinsky (2015): consider the market for compact flourescent (CFL) light bulbs
  - CFLs: more energy efficient, cheaper (in the long run) than traditional incandescent bulbs $\Longrightarrow$ but uptake is low!
  - Now: LEDs more efficent than CFLs, but at the time of analysis, CFLs were main energy-efficient alternative
  - Ask: should the government offer a CFL subsidy or ban incandescents?

Energy efficient lightbulbs: Allcott and Taubinsky (2015)[6]



- Does the demand curve for CFLs reflect consumers true preferences?
- Recover true WTP when agents are debiased
- Use "true" WTP to estimate welfare effects from subsidy and ban
  - Optimal CFL subsidy: $3
  - Ban reduces welfare by $0.44/package
  - Losses from ban are 65% larger than gains from optimal subsidy

[6] Allcott, H. and D. Taubinsky. 2015. "Evaluating Behaviorally Motivated Policy: Experimental Evidence from the Lightbulb Market." *American Economic Review*, 105(8): 2501-2538.

Concluding thoughts

- Policy interactions important in-practice: for many reasons, see overlapping, nesting, and complementary policies

- We have provided a framework for understanding the reasons for such policies and evaluating the potential interactions between them

- But importantly, there are likely to be context-specific factors affecting our overall assessment of these interactions
  - → E.g., the Pavley-CAFE standards can be seen as having positive and negative interactions

- Multiple market failures likely necessitate multiple policies: both pricing and technology policies may be necessary, but neither is sufficient!
  - → Careful assessment of the drivers of the energy paradox in a given setting will help identify policy solutions