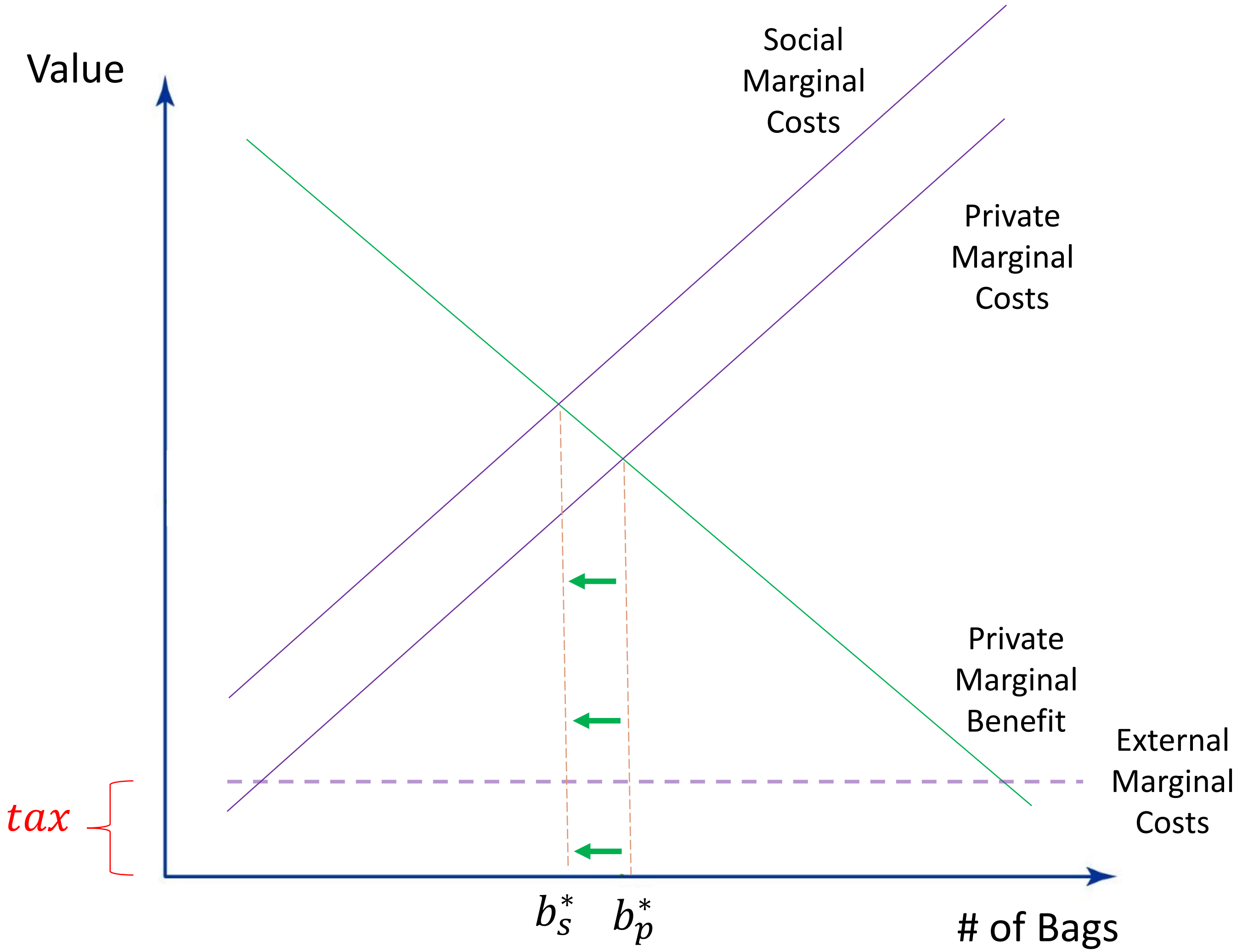
Lecture 3: Market Failures: Examples and in Practice

Prof. Theising
Environmental Economics
Econ 4075

First things first: who are our winners from last class?

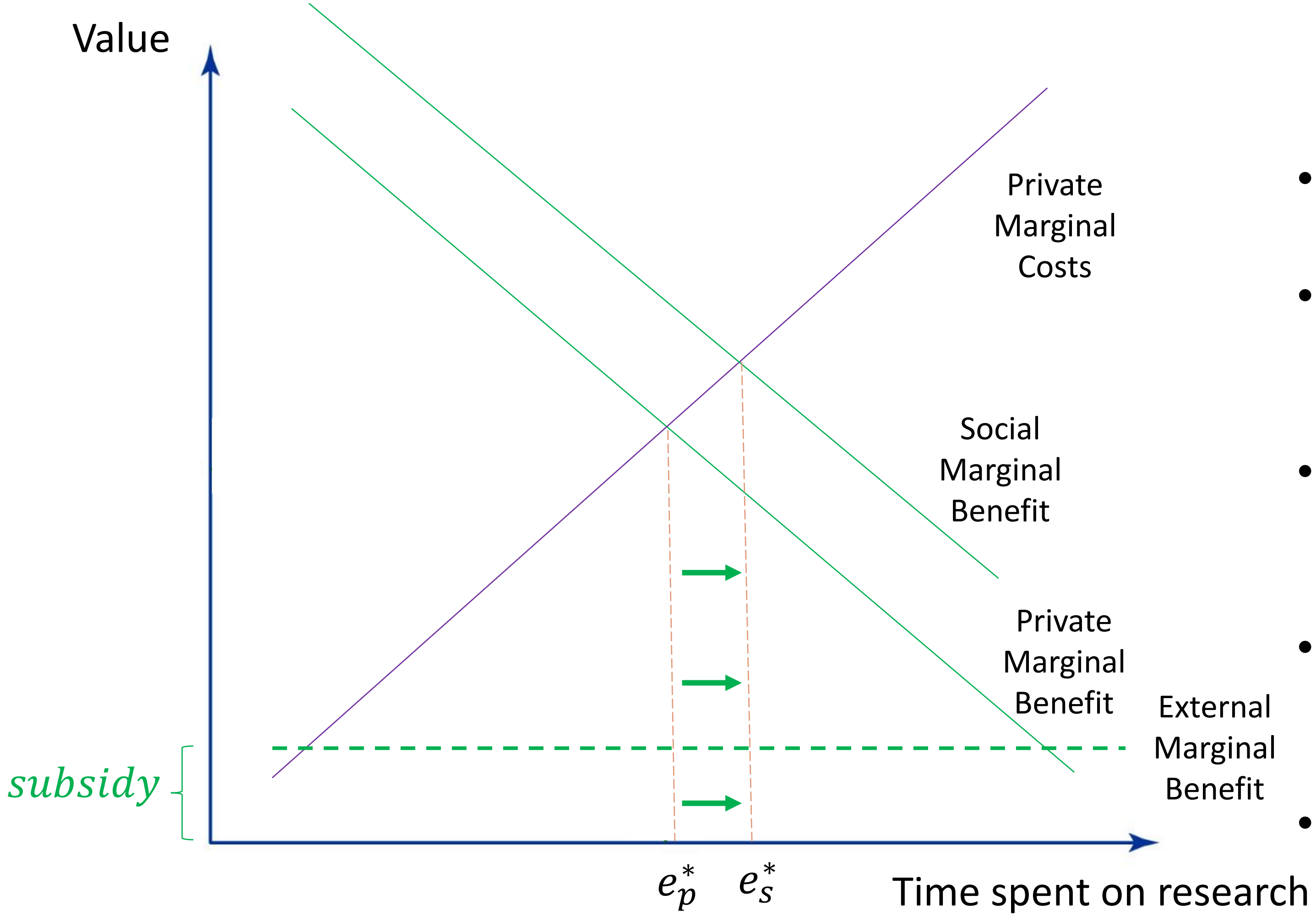
Recap of last lecture:

An Example:
The Market for Plastic Bags



- What's missing?
  - The external marginal cost
- Adding the external cost to the private recovers the (true) social marginal cost
- The socially optimal number of bags is *fewer* than the private. The private market *overprovides* bags
- What is a possible fix?
  - A *tax* equal to the external marginal cost

An Example:
The Market for Basic Research



- Basic research: scientific research largely driven by curiosity, without an immediate "real-world application" in mind.
- Here: the externality is a "good".
- The private market typically *underprovides* basic research.
- A government *subsidy* (often in the form of grants) can help correct this market failure
- In this context, is the external marginal benefit actually fixed (flat)?
- Try drawing an example of what you think external marginal benefits are

Market Failures

There are many different types or root causes of market failures. Think of some examples under each of these categories.

1. Information Asymmetries
    - One party in a transaction knows more than the other

2. Market Structure/Power
    - One party can influence the market equilibrium

3. Public Goods
    - Nonrival and nonexcludable

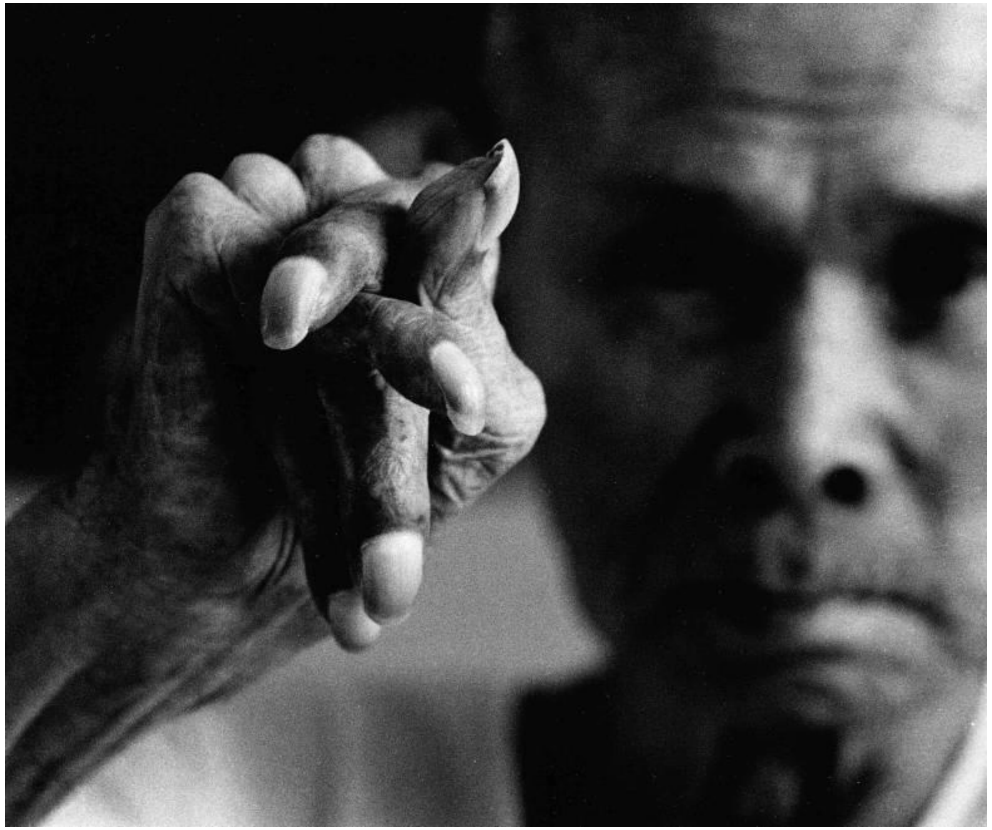
4. Externalities
    - Private actions have unintended effects

Spot the market failure(s) in these noteworthy environmental catastrophes of recent history:

The Cuyahoga River Caught Fire at Least a Dozen Times, but No One Cared Until 1969

Source: history.com

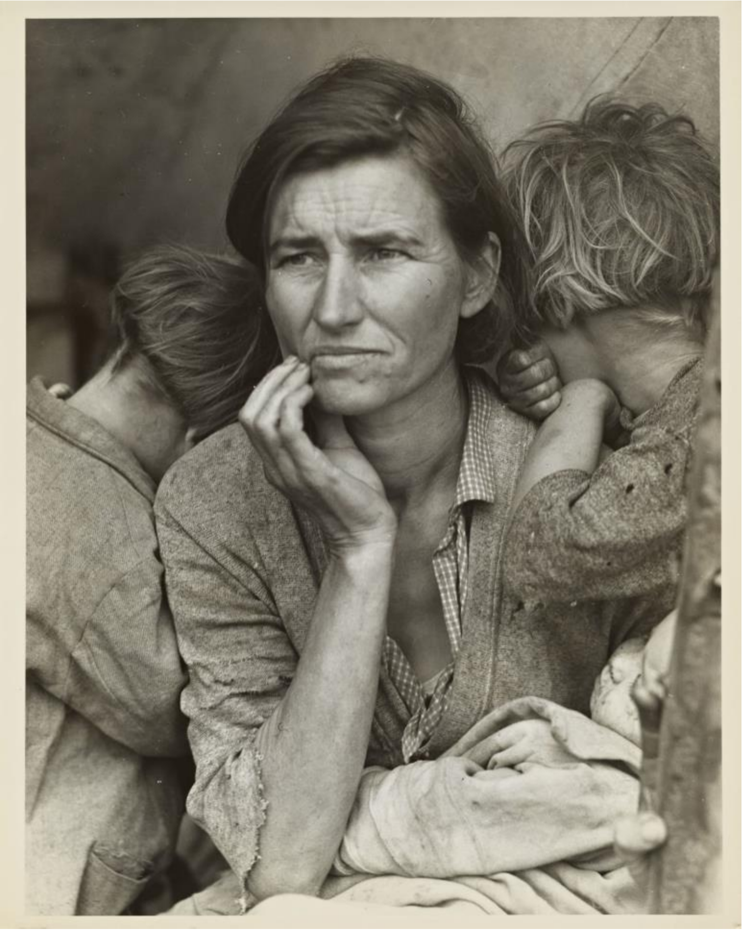
Minamata disease, 1956: the release of methylmercury in the industrial wastewater from a chemical factory owned by the Chisso Corporation



Source: [*Blind Magazine*]

The Dust Bowl

As one "black blizzard" hit after another, harmful dust particles accumulated in people's lungs, causing hundreds of deaths and sickening thousands.



Source: history.com

Groundwater aquifers: from the Ogallala to California to the DC suburbs… (*NYT*, 8/28/2023)

UNCHARTED WATERS

America Is Using Up Its Groundwater Like There's No Tomorrow

Overuse is draining and damaging aquifers nationwide, a New York Times data investigation revealed.

Share full article

1.6K

So what to do about market failures?

- In the presence of public goods or positive/negative externalities, action is needed if the goal is to increase social welfare… but what?

- Much of this course focuses on how governments should form policy in the presence of externalities.

- We'll come back to policy in Module 4 of this course, but let's preview some real-world examples of an attempts to deal with externalities.

Good intentions, but *unintended consequences*: examples from economic research illustrating that incentives matter when designing a response to environmental market failures.

Bag Leakage: The Effect of Disposable Carryout Bag Regulations on Unregulated Bags

By: Dr. Rebecca Taylor

Abstract: Leakage occurs when partial regulation of consumer products results in increased consumption of these products in unregulated domains. This article quantifies plastic leakage from the banning of plastic carryout bags. Using quasi-random policy variation in California, I find the elimination of 40 million pounds of plastic carryout bags is offset by a 12-million-pound increase in trash bag purchases—with small, medium, and tall trash bag sales increasing by 120%, 64%, and 6%, respectively. The results further reveal 12–22% of plastic carryout bags were reused as trash bags pre-regulation and show bag bans shift consumers towards fewer but heavier bags. With a substantial proportion of carryout bags already reused in a way that avoided the manufacture and purchase of another plastic bag, policy evaluations that ignore leakage effects overstate the regulation's welfare gains.

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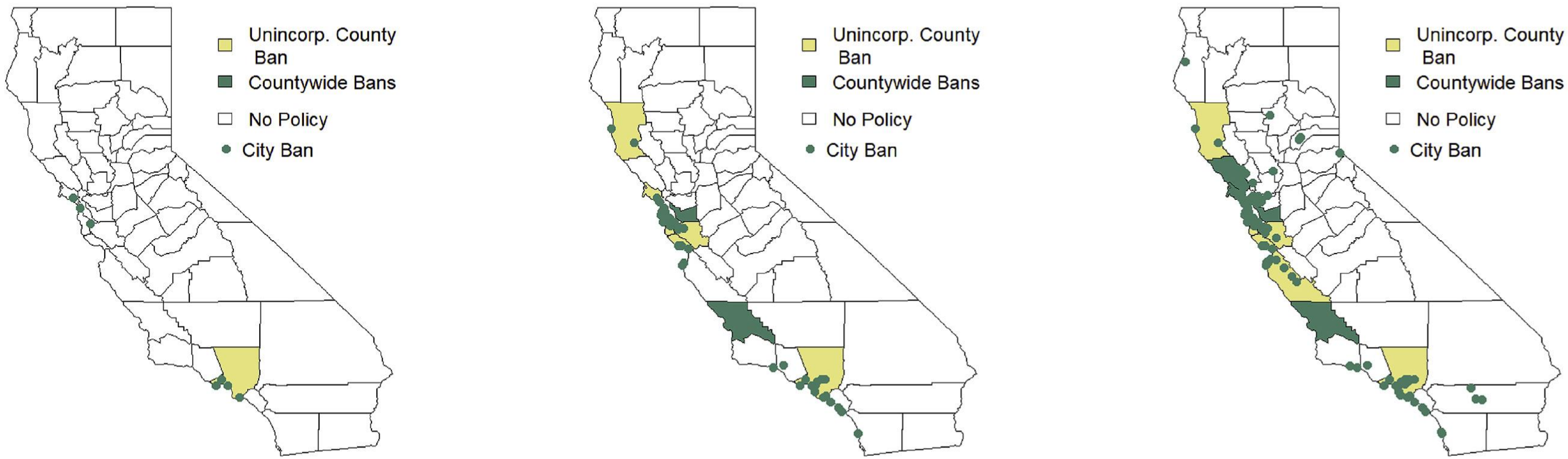
(a) 2011 (b) 2013 (c) 2015



Note: The local governments of unincorporated counties and incorporated cities can pass ordinances to regulate disposable carryout bags. City-level policies are depicted with dark green circles. Unincorporated county policies are shaded in light yellow. Countywide policies—where all unincorporated areas and all cities in a county implement DCB regulations—are shaded in dark green.

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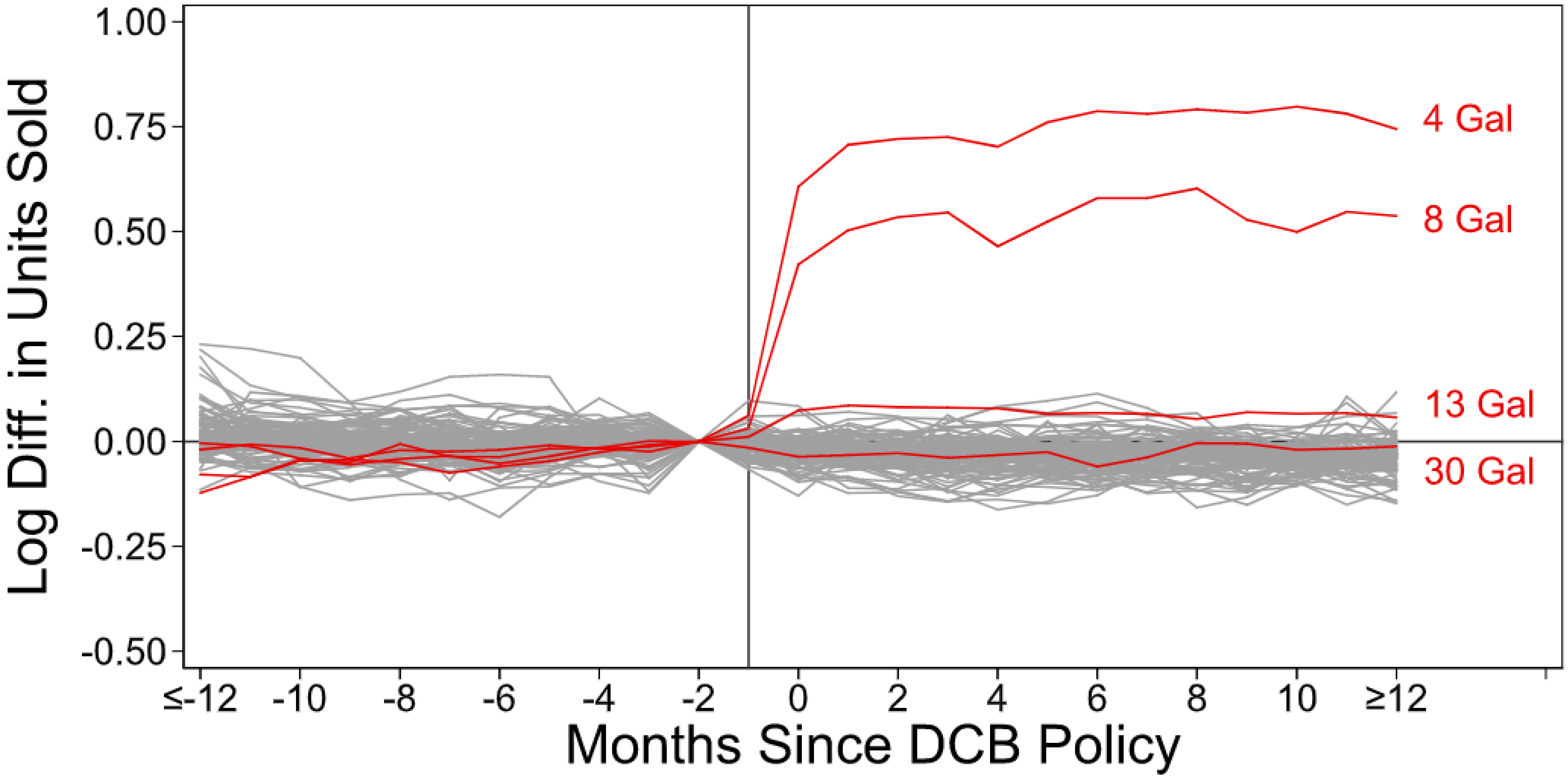
$$Y_{sjm}^{B} = \sum_{l=-12}^{12} \beta_l D_{l,jm} + \theta_{sj} + \delta_m + \epsilon_{sjm}$$

where Y_{sjm}^{B} is the outcome variable for store s in jurisdiction j and month-of-sample m with respect to bag product group B, θ_{sj} is a vector of store fixed effects, and δ_m is a vector of month-of-sample fixed effects. $D_{l,jm}$ is a dummy variable equaling one if jurisdiction j in month m implemented a DCB policy l months ago, with $l = 0$ denoting the month of implementation.

The β_l vector is the parameter of interest, as it traces out the differences in outcomes from before the DCB policies to after. I hypothesize that sales of trash bags deemed by customers to be substitutes for plastic carryout bags will increase. Thus, for any product group B that is a substitute for plastic carryout bags, I would expect the β_l coefficients in the post-policy period to be greater than zero.

$$Y^B_{sjm} = \sum_{l=-12}^{12} \beta_l D_{l,jm} + \theta_{sj} + \delta_m + \epsilon_{sjm}$$



The Effect of Driving Restrictions on Air Quality in Mexico City

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- In 1989, the government of Mexico City introduced the “Hoy No Circula” (“Today Don’t Drive”, or “Day Without A Car”) policy with the specific goal of reducing air pollution.
- Every vehicle, commercial and private, must stay off the roads one day of the work week (Mon-Fri, 5 AM-10PM).
- The last digit of the car’s license plate determines which day a vehicle is not allowed to be driven
  - Vehicles with last digits 5,6 are not allowed on the road on Mondays; 7,8 for Tuesdays, etc…

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What do you think was the result of this policy?

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Abstract: In 1989, the government of Mexico City introduced a program, *Hoy No Circula*, that bans most drivers from using their vehicles one weekday per week on the basis of the last digit of the vehicle's license plate. This article measures the effect of the driving restrictions on air quality using high-frequency measures from monitoring stations. Across pollutants and specifications there is no evidence that the restrictions have improved air quality. Evidence from additional sources indicates that the restrictions led to an increase in the total number of vehicles in circulation as well as a change in composition toward high-emissions vehicles.

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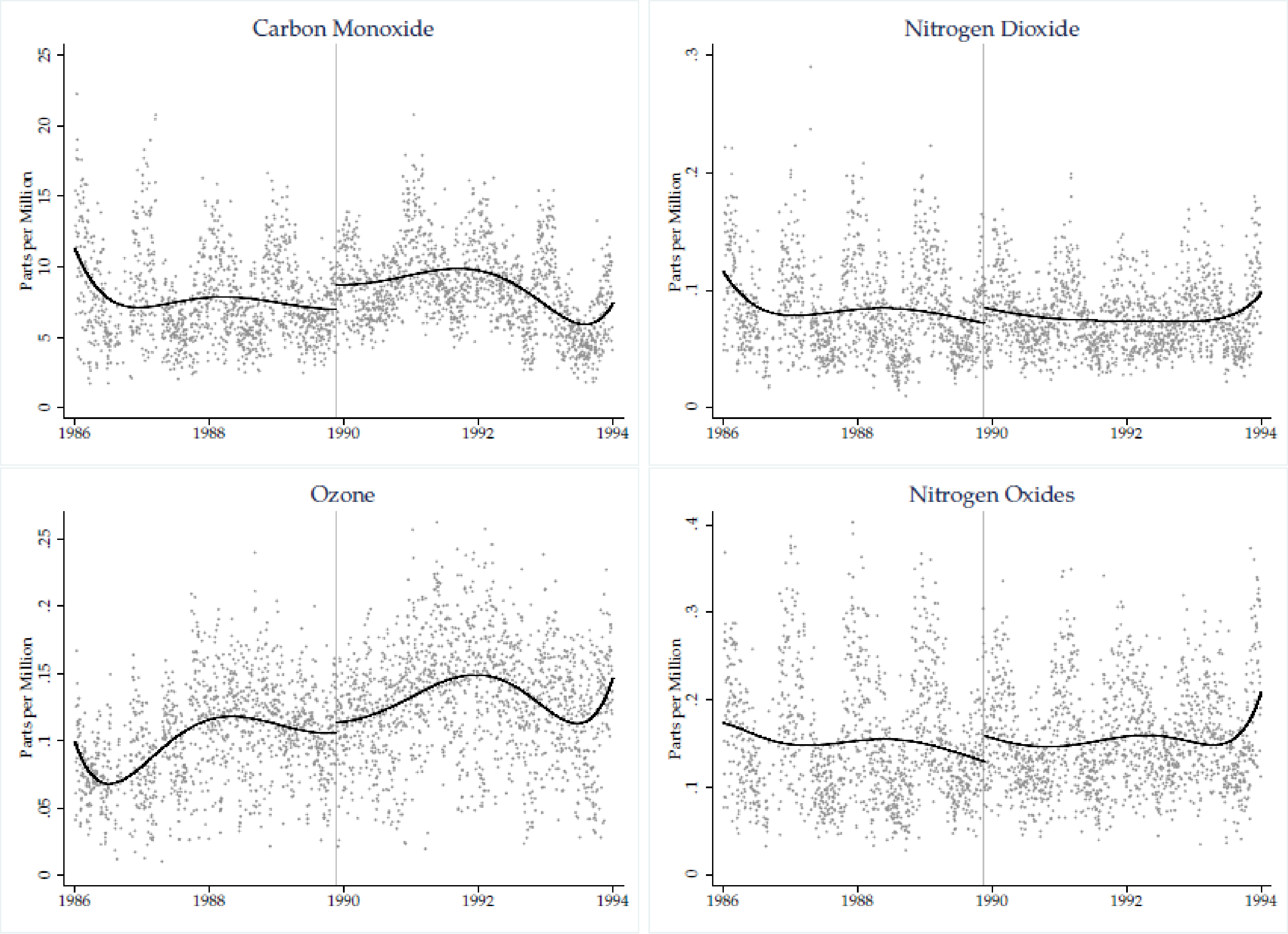
Table 3. *Supporting Data for the Household Car Ownership, Mexico City, 1983–93*
(annual average)

Indicator	*Before regulation, 1983–89*	*Under regulation, 1990–93*
Sales of new vehicles (thousands)		
Mexico City (federal district)	80	154
Rest of Mexico	127	237
Increase in vehicles registered (thousands)		
Mexico City (federal district)	7	239
Rest of Mexico	174	250
Net import of vehicles (thousands)		
Mexico City (federal district)	–74	85
Rest of Mexico	47	13
International phone calls (percentage growth)		
Mexico City	27.2	24.1
Whole country	19.5	29.7
Local phone calls (percentage growth)		
Mexico City	12.9	12.9
Whole country	19.5	29.6
Electricity consumption (percentage growth)		
Mexico City	7.0	7.0
Whole country	5.0	3.0
Metro ridership (percentage growth)		
Mexico City	5.7	–2.4

Figure 4: Maximum Daily Pollution Level, 1986-1993



Downwind and out: The strategic dispersion of power plants and their pollution

By: Dr. John Morehouse and Dr. Ed Rubin

Abstract: In federalist systems, local governments can maximize local welfare by exporting locally produced negative externalities. We empirically substantiate this externality-export strategy for air pollution using historical power-plant siting, administrative borders, and prevailing wind directions. Using a simple, non-parametric test, we show that decision-makers disproportionately sited coal-fueled plants to reduce counties'/states' downwind pollution exposure. Natural-gas-fueled plants—lower polluters—did not follow this strategy. We then illustrate the extreme exportability of coal plants' pollution: within 6 hours, 50% of coal plants' emissions leave their source states—and 99% depart source counties. These results highlight how local strategic responses challenge federalist systems.

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$$p\text{-Value}(n_s) = \mathbf{P}(X \geq n_s;\, n = N_T,\, p = 0.5) = \sum_{x=n_s}^{N_T} \binom{N_T}{x} 0.5^{N_T}$$

We operationalize this test as an implementation of Fisher's Exact Test (Fisher, 1934; Fisher, 1935; Conover, 1971; Imbens and Rubin, 2015). Under a sharp (one-sided) null hypothesis of *no strategic siting to reduce downwind area*, the test statistic n_s (the number of plants for whom downwind area is less than upwind area) is distributed as a binomial distribution with size equal to the number of plants in the sample (N_T) and probability $p = 0.5$. Under this null, the expected share of plants whose downwind area is less than its upwind area is 50%. Consequently the p-value for a given test statistic is

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Figure 6: HYSPLIT trajectory and dispersion: Two example plants, January and July 2005

(a) Plant 1378, January 2005 **(b)** Plant 1378, July 2005

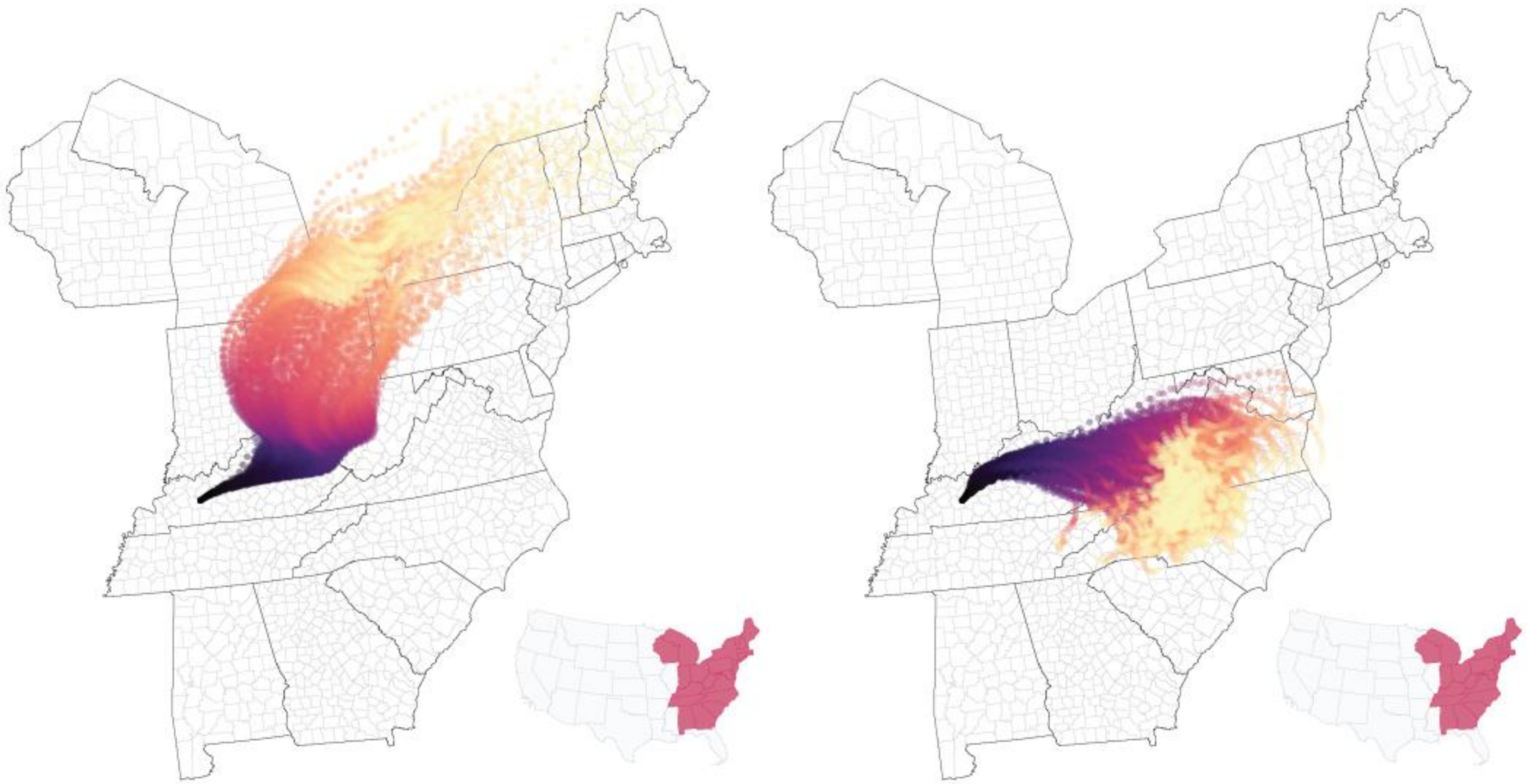

Table 1: Testing strategic siting: Upwind *vs.* downwind areas for coal and natural gas plants

	(1) Coal-fueled plants	(2) Natural-gas-fueled plants
Panel A: Siting strategically within **county**		
Count	514	1,254
Count *strategic*	292	620
Percent *strategic*	56.81%	49.44%
Fisher's exact test of H_0: In-**county** downwind area ≤ upwind area		
Under H_o: *E[Percent strategic: County] = 50%*		
P-value	0.0012	0.6641
Panel B: Siting strategically within **state**		
Count	514	1,254
Count *strategic*	277	574
Percent *strategic*	53.89%	45.77%
Fisher's exact test of H_0: In-**state** downwind area ≤ upwind area		
Under H_o: *E[Percent strategic: State] = 50%*		
P-value	0.0426	0.9987
Panel C: Siting strategically within **both county *and* state**		
Count	514	1,254
Count *strategic*	179	314
Percent *strategic*	34.82%	25.04%
Fisher's exact test of H_0: Downwind area ≤ upwind area in **county and state**		
Under H_o: *E[Percent strategic: County* $\wedge$ *State] = 25%*		
P-value	<0.0001	0.4978

We define a plant's location as "strategic" if the downwind area *within its home county (or state)* is less than its upwind area *within its home county (or state)*. We calculate *downwind* and *upwind* areas based upon 90-degree right triangles with a vertex at the plant pointing up- or down-wind based upon the locally prevailing wind direction. Figure 2 illustrates this calculation. *Sources:* eGRID (2018) and authors' calculations.

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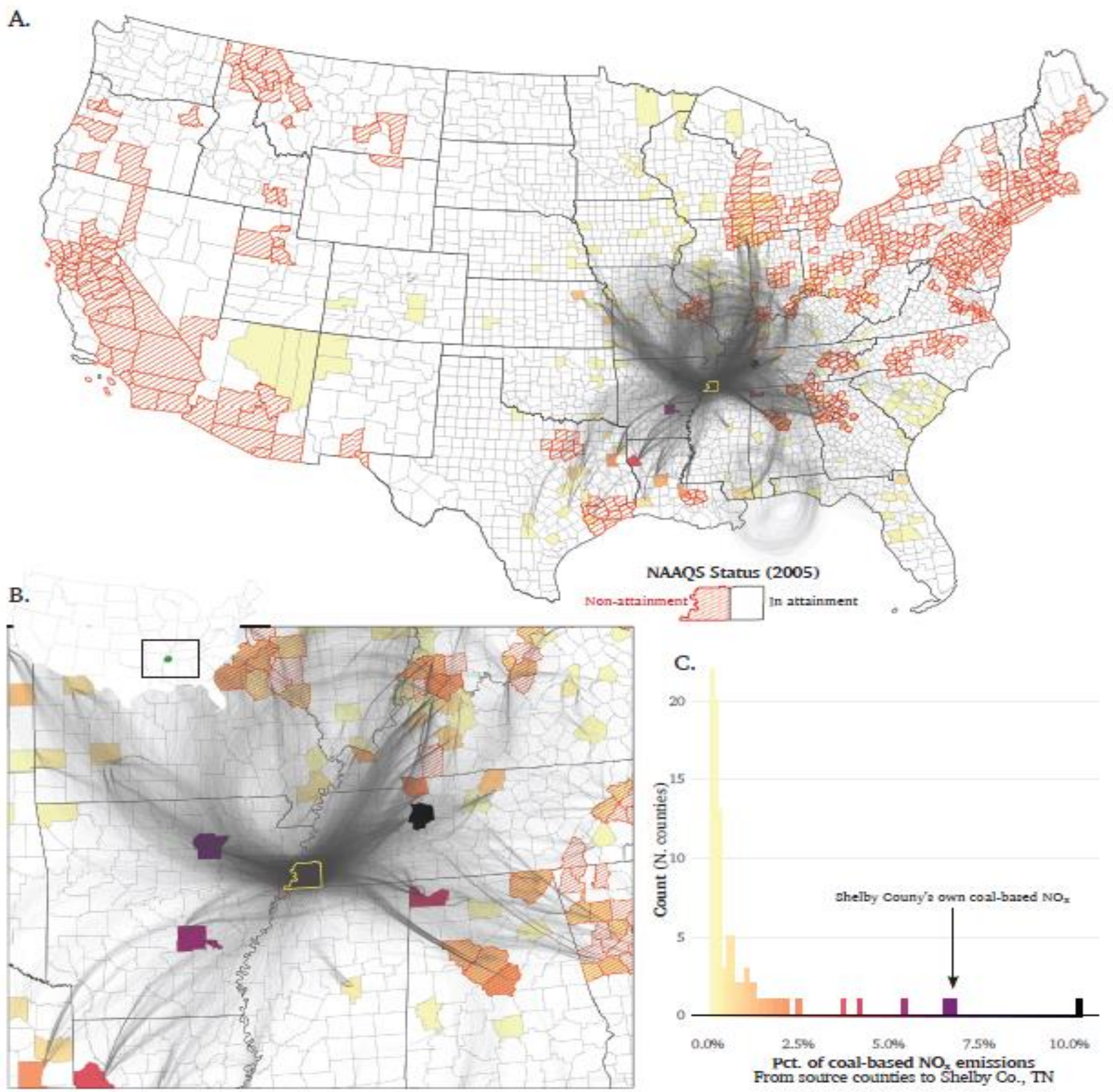
A.
NAAQS Status (2005)
Non-attainment
In attainment
B.
C.
Shelby Couny's own coal-based NO_x
Count (N. counties)
Pct. of coal-based NO_x emissions
From source counties to Shelby Co., TN

Learning by Viewing? Social Learning, Regulatory Disclosure, and Firm Productivity in Shale Gas

By: T. Robert Fetter, Andrew Steck, Chris Timmins, Douglas Wrenn

- “Sunlight is said to be the best of disinfectants.” – US Supreme Court Justice L. Brandeis, 1914
  - Environmental regulators often mandate information disclosure to reduce externalities or socially undesirable behavior
- In the last 10-15 years, hydraulic fracturing for shale gas has become common in the US
  - Each of the 18 states with active fracking passed chemical information disclosure laws by 2015
  - Public concern about potential use of toxic chemicals in proximity to residential and commercial land uses
- **Public access to more information is generally a good thing, but this paper asks: does it come with an unintended cost?**

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Abstract: In many industries firms can learn about new technologies from other adopters; mandatory disclosure regulations represent an understudied channel for this type of social learning. We study an environmentally-focused law in the shale gas industry to examine firm claims that disclosure requirements expose valuable trade secrets. Our research design takes advantage of a unique regulatory history that allows us to observe complete information on chemical inputs prior to disclosure, along with the timing of information availability for thousands of wells after disclosure takes effect. We find that firms' chemical choices following disclosure converge in a manner consistent with inter-firm imitation and that this leads to more productive wells for firms that carefully choose whom to copy — but also a decline in innovation among the most productive firms, whose innovations are those most often copied by other firms. Our results suggest there is a long-run welfare trade-off between the potential benefits of information diffusion and transparency, and the potential costs of reduced innovation.

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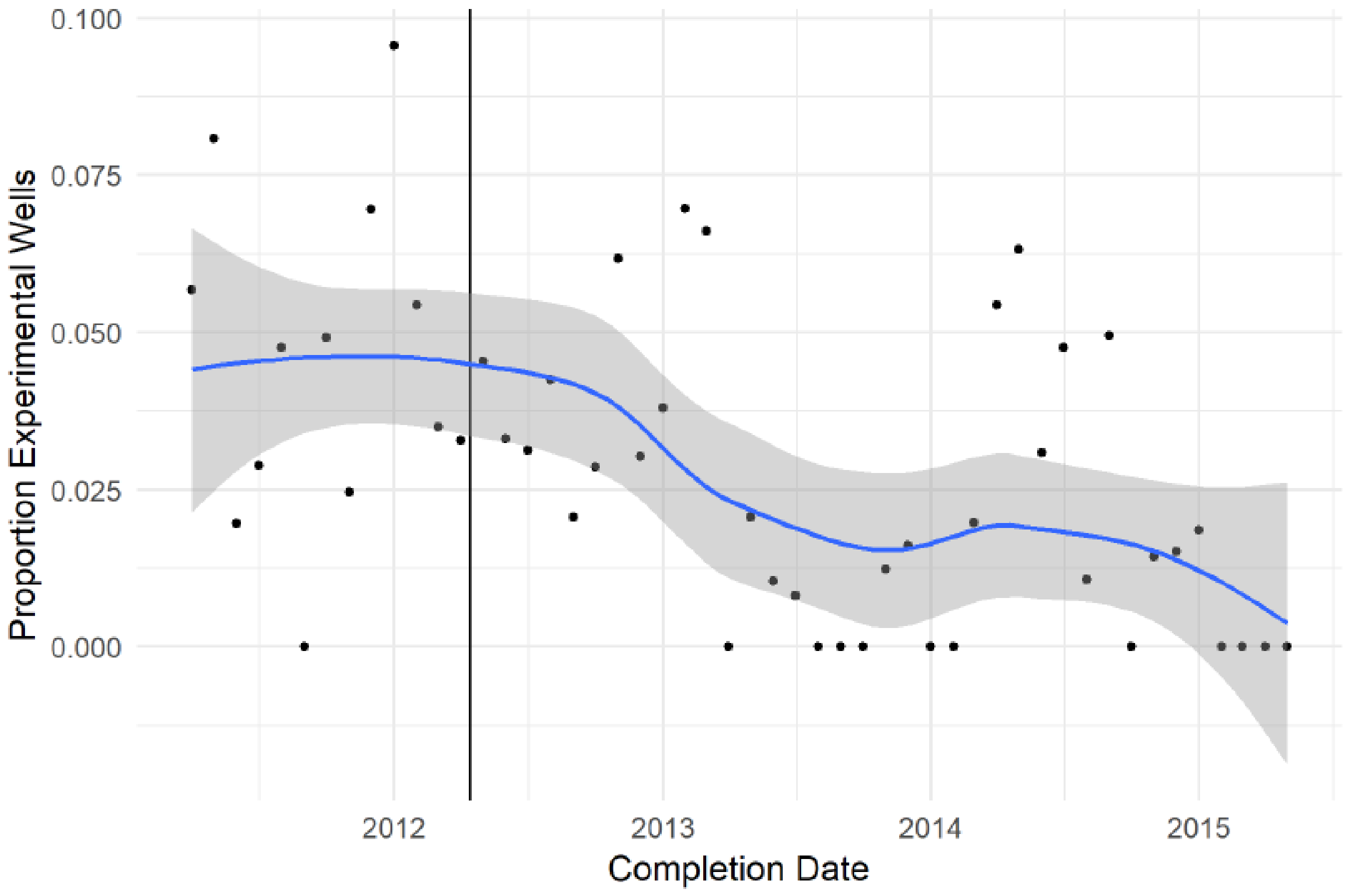
FIGURE 5: PROPORTION OF EXPERIMENTS OVER TIME



Notes: Each point represents one calendar month. The vertical axis indicates the proportion of wells hydraulically fractured in that month for which operators used an experimental combination of chemicals, compared to the most recent 1,000 wells fractured in Pennsylvania. The vertical black line marks April 2012, the month in which full public disclosure became mandatory. The best-fit line is a locally weighted linear (loess) regression.

Learning by Viewing? Social Learning, Regulatory Disclosure, and Firm Productivity in Shale Gas

By: T. Robert Fetter, Andrew Steck, Chris Timmins, Douglas Wrenn

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Big-picture takeaways:

- Correcting externality-driven market failures requires governmental or institutional entities to take action
- But some actions may worsen the problem. **Incentives and trade-offs across policy goals matter!**
- Effective policy considers behavioral responses and takes advantage of incentive structures.
- Keep these ideas in the back of your mind as we discuss benefit and cost estimation over the next modules.

Next Week

- Tuesday, Sept 5th is on a "Monday" Schedule
  - Beginning Module 2 with a lecture on econometrics and treatment effects in environmental economics

- Wednesday, Sept 6th is a regularly scheduled class

- Sunday, Sept 10th (@11:59pm): first reflection post is due
  - Reflection prompts on Github
  - Submission on Canvas