

The Effects of Decentralized Environmental Regulation on Air Quality

Evidence from the U.S. Clean Air Act

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Motivation

Policy design issue:

- ▶ How should environmental regulatory systems be structured?
 - ▶ Should environmental regulation be locally or centrally determined?
 - ▶ Main issue: air quality is a public good, subject to spillovers
 - ▶ Can local regulation internalize spillovers?
 - ▶ Can central regulation reflect local tastes adequately?
 - ▶ Another externality:
 - ▶ Will local regulators 'compete' for industry?

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 - ▶ Can central regulation reflect local tastes adequately?
 - ▶ Another externality:
 - ▶ Will local regulators 'compete' for industry?
- ▶ Questions:
 - ▶ What is the effect on air quality within a jurisdiction if the air pollution regulator changes from the central government to that jurisdiction?
 - ▶ What is the effect on air quality elsewhere as regulation changes hands?

The Clean Air Act and NSPS

- ▶ New Source Performance Standards
 - ▶ Nationally-uniform industry-specific emissions standards affecting the emissions of 'criteria' pollutants or their precursors
 - ▶ The standards are enacted in order to “level the playing field for states competing for new industrial growth”
 - ▶ Each industry chosen on the basis of how much plants in that industry contribute to pollution and how large is the industry
 - ▶ 65 standards promulgated during 1970–1990

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 - ▶ Each industry chosen on the basis of how much plants in that industry contribute to pollution and how large is the industry
 - ▶ 65 standards promulgated during 1970–1990
- ▶ 'Delegation':
 - ▶ The EPA is the enforcer of these standards
 - ▶ EPA can delegate enforcement authority to any state or local government that requests it
 - ▶ State/local government must have sufficient legal and financial resources
 - ▶ EPA can reject or revoke with reason
 - ▶ Delegated jurisdiction can withdraw at any time without reasons

NSPS and 'Delegation'

- ▶ Delegation data was collected from the *Federal Register*
 - ▶ Each time a delegation is made, it is published in the *FR*
 - ▶ Information on: who received delegation, what for, and when

NSPS and 'Delegation'

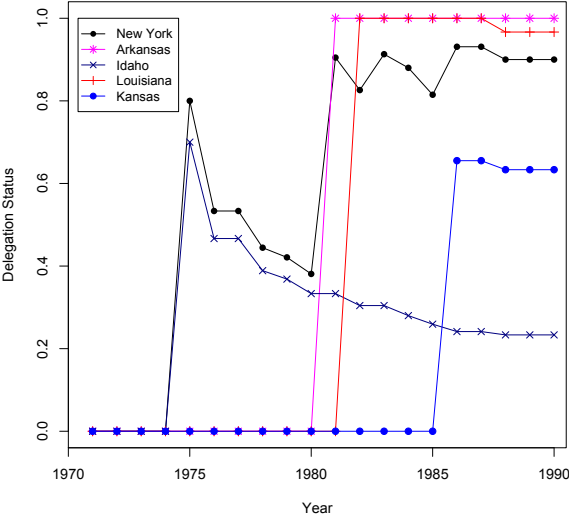
- ▶ Delegation data was collected from the *Federal Register*
 - ▶ Each time a delegation is made, it is published in the *FR*
 - ▶ Information on: who received delegation, what for, and when
- ▶ For some pollutants, there are multiple standards
- ▶ I use a summary measure of delegation for each pollutant, for a jurisdiction i at time t :
 - ▶ Delegation status of standard k to i at t : $a_{kit} \in \{0, 1\}$
 - ▶ K_t standards available for delegation at time t

$$d_{it} = \frac{1}{K_t} \sum_{k=1}^{K_t} a_{kit}$$

- ▶ E.g., in 1975 there are 2 standards for PM
- ▶ NC has been delegated 1 standard
- ▶ $d_{NC,1975} = 0.5$

Delegation of PM Standards

Delegation of Particulate Matter Standards



Delegation and Ambient Air Concentration

- ▶ No (or little) regional emissions data during this time period
- ▶ Pollutant concentrations data from EPA's Air Quality System
 - ▶ Monitors measure the amount of a pollutant in a given volume of air at a fixed location
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- ▶ Other variables:
 - ▶ State-level variables: GDP, Population, Share of employed in manufacturing
 - ▶ County-level variables: Population, Share of employed in manufacturing, Number of manufacturing firms, Nonattainment status

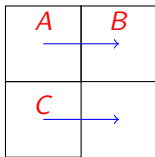
Data

Table: Northeast Region and Particulate Matter

Variable	Mean	Standard Deviation
Annual Concentration ($\mu\text{g}/\text{m}^3$)	57.69	22.75
Annual Delegation	0.67	0.35
Distance to Eastern Border (km)	179.92	127.42
Distance to Western Border (km)	165.58	118.07
Annual Upper Windspeed (km/h)	32.11	4.73
Number of States	10	
Number of Monitors	1968	
Number of Observations	14025	

Basic Estimating Approach for a Given Pollutant

- ▶ The policy affects emissions, which affect ambient air concentrations
- ▶ Emissions may cross political boundaries



- ▶ State i , county j , monitor m , time t :

$$\begin{aligned} \log(c_{ijmt}) = & \beta_0 + \beta_1 d_{it} + \beta_2 d_{ht} \cdot \mathbf{1}\{h \text{ upwind of } m\} \\ & + \mathbf{X}_{ict} \beta_3 + \lambda_m + \lambda_t + \varepsilon_{icmt} \end{aligned}$$

Results: The Northeast U.S.

Table: Particulate Matter: Northeast Region

Variable	(1)
Delegation	0.0329*** (0.0079)
log(GDP)	0.8631*** (0.0679)
log(State Pop)	-1.5293*** (0.2511)
State Manufacturing Share	1.2002*** (0.2105)
log(County Pop)	0.7334*** (0.0862)
County Manufacturing Share	-0.0258 (0.0600)
Nonattainment	-0.0210** (0.0097)
Surface Windspeed	-.1236*** (.0191)
Monitor FE	Y
Year FE	Y
Obs.	14024
R^2	0.8930

Notes: Standard errors clustered at the monitor-level.

Own Effect Robust to Different Specifications

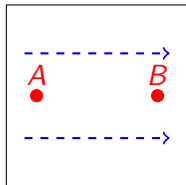
Table: Particulate Matter: Northeast Region

Variable	(1)	(2)	(3)	(4)
Delegation	0.0329*** (0.0079)	0.0326*** (0.0079)	0.0324*** (0.0078)	0.0319*** (0.0077)
Upwind Delegation		0.0232*** (0.0090)		0.0236*** (0.0088)
Non-Upwind Delegation			-0.0114 (0.0223)	-0.0153 (0.0221)
Obs.	14024	14024	14024	14024

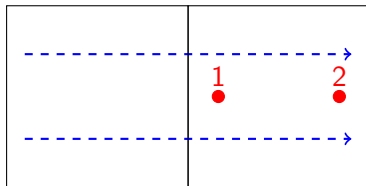
Notes: All specifications contain full controls. Standard errors clustered at the monitor-level.

Spatial Heterogeneity

- ▶ If the wind is blowing W to E, a jurisdiction may treat plants at *A* and *B* differently:



- ▶ If the wind is blowing W to E and there pollution spillovers, then monitor 1 will be affected differently relative to monitor 2:



Border Distance Matters

Table: The Effect of Delegation on Particulate Matter Concentrations

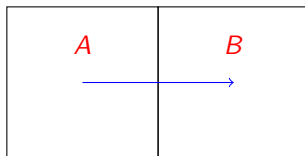
Variable	(1)	(2)
Delegation	0.0326*** (0.0079)	0.1348*** (0.0353)
Delegation \times Distance to Downwind Border		-0.0203*** (0.0073)
Upwind Delegation	0.0232*** (0.0090)	0.2175*** (0.0379)
Upwind Delegation \times Distance to Upwind Border		-0.0386*** (0.0075)
Obs.	14024	14024

Notes: Both specifications contain full controls. Standard errors are clustered at the monitor-level.

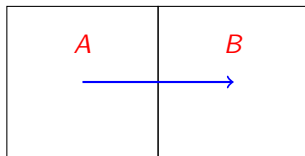
- ▶ Average distance from downwind border at which point the net own effect is zero: 765km
- ▶ Average distance from upwind border at which point the net upwind effect is zero: 280km
 - ▶ Note: Pennsylvania is 455km wide

Using Windspeed

- ▶ The strength of the wind may affect pollutant transport



vs.



Windspeed Matters

Table: The Effect of Delegation on Particulate Matter Concentrations

Variable	(1)	(2)
Delegation	0.1357*** (0.0354)	0.1247 (0.0916)
Delegation \times Distance to the Downwind Border	-0.0206*** (0.0073)	-0.0199** (0.0077)
Delegation \times Windspeed		-0.0004 (0.0023)
Upwind Delegation	0.2175*** (0.0379)	0.0077 (0.0887)
Upwind Delegation \times Distance to the Upwind Border	-0.0387*** (0.0076)	-0.0354*** (0.0075)
Upwind Delegation \times Windspeed		0.0067*** (0.0025)
Obs.	14024	14024

Notes: Both specifications contain full controls. Standard errors are clustered at the monitor-level.

- ▶ A 10 km/h increase in windspeed between a jurisdiction and its upwind neighbour increases PM concentration by 6.7%

Summary

- ▶ Compared to central regulation, local regulation is different
 - ▶ Pollution concentrations increase at home
 - ▶ Pollution concentrations increase downwind
- ▶ The effects depend on how the pollutants are transported
 - ▶ Greatest effects around borders
 - ▶ Windspeed matters for spillovers
- ▶ Further issues:
 - ▶ Delegation is endogenous
 - ▶ Do firms relocate within- or across local governments in response to delegation?
 - ▶ Why would states seek delegation?