Innovations in Environmental Regulation: The Case of Third Party Auditing

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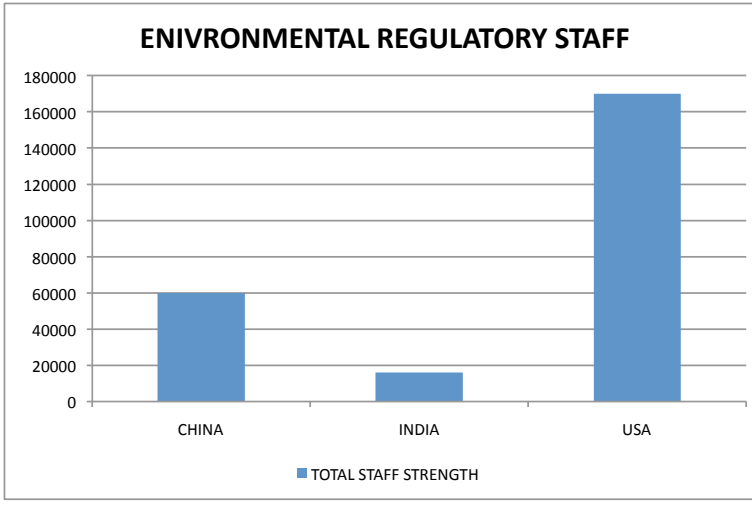
Outline

Environmental Regulation: The Need

- Ensuring clean air and water are classic public good problems
- If polluting allows for least cost growth, industries will have no incentive to control pollution
- Yet, unregulated industrialization and urbanization are likely to have a high health cost
  - Nearly 1/3 of India's urban population lives in cities where ambient concentration of particulates exceeds the national standard
  - Ministry of Environment and Forests estimated air pollution contributed to 40,351 premature deaths in only 36 cities of India in 1995
  - Economic loss caused by air pollution in same cities that year was US 1.31 billion
- Key question: How can we design regulations that still allows for sustainable growth?

Staff Strength

Figure: Who regulates



- Domestic Regulation has increased across the board and in line with International Standards
- However compliance remains poor
- Staff Shortage and Technical Competence relatively low
- Can outsourcing /private-public partnerships help? How should they be designed?
- Consider the example of third party auditing

Outline

The promise of third-party auditing

- Third party audits are the norm in financial regulation
  - Public companies typically required to provide audited financial statements
- And gaining importance in other sectors, such as environmental regulation.
  - Check compliance with domestic regulatory standards: either voluntary (US and UK) or mandated (India, Chile)
  - Enforcing international environmental standards like ISO 14001 and carbon offsets (Potoski and Prakash, 2005; Bhattacharyya, 2011).
- In all cases, the audited company hires and pays the auditor. There is a perception that this creates a conflict of interest for auditors needing to maintain their business.

Experimentally remove the conflict of interest

- Work within environmental audit system in Gujarat, India (with Duflo, Greenstone, Ryan)
  - Introduced by High Court in 1996 to reduce water pollution.
  - At baseline in 2009, perception that pollution was high but audit reports low and untrustworthy.
  - Sample all audit-eligible plants in the state's two largest cities.

- Audit treatment reforms three aspects of existing system
  1. Random assignment of auditors (prevents shopping) and fixed payment from central pool (financial independence).
  2. Backcheck auditors on performance (monitoring).

  In year 2 of the experiment, additionally,

  3. Auditors paid for accuracy relative to backchecks (accuracy incentives).

Results show a huge impact on auditor reporting

1. Baseline
   - Auditors working in control systematically underreport, especially just beneath the regulatory standard.

2. Auditor response
   - Treatment reduces false compliance readings in audit reports by 23%.
   - Effects present within-auditor.
   - Backchecks and accuracy incentives have independent effects.

3. Plant response
   - Plants reduce pollution. Reductions for targeted water pollutants as large as the change in reporting by auditors.

Background on environmental regulations: Enforcement of regulations up to states

- Gujarat Pollution Control Board regulates about 20,000 firms.
- Strict regulatory standards set by Water and Air Acts may be tightened but not relaxed by states.
- Two main tools for monitoring compliance with regulations.
  - Regulatory inspections.
  - Third-party audits.
- Regulator powerful: Plants need regulatory consent for product, quantity, investment to expand capacity, etc. Penalties include fines (forfeit of guarantees) and closure enforced by disconnecting electricity or water (10% disconnection rate in 2008).
- Primary tool is command and control regulation.

Background on environmental regulations: Environmental audit system

High Court of Gujarat mandated regulator to introduce audits in 1996 in response to severe urban water pollution.

> *The contral mechanism through the system of internal and external audit is very much known in the fields of company law and income tax. We see no reason why such audit should not be made obligatory in respect of capital provided by nature.*

Built with several common safeguards

- Auditors cannot consult for the same plant.
- Rotation mandated every three years.
- Reports for other plants disallowed if auditor decertified.
- Audit teams can perform at most 15 audits per year.
- Audit teams must be comprised of four people with particular degrees and experiences.

Background on environmental regulations: What is an audit and what are its consequences?

- Auditors visit three times per year for one day at a time, take pollution readings and observe the plant's environmental management.
- Auditors submit report with pollution readings and suggested improvements in operations by subsequent February 15.
- Consequences of Audit.
  - Non-submission is punishable, in principle, by closure and disconnection of water and electricity.
  - Non-compliance can lead to closure and payment of fines.
  - False audits can lead to decertification of auditor and void of other reports.

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Audit-eligible plants randomly assigned to audit treatment

- Sample of 473 audit eligible plants from the GPCB regions in and around Gujarat's two most populous cities.

- 233 of 473 plants assigned to modified audit treatment
  1. Random assignment of auditors (prevents shopping) and fixed payment from central pool, to create financial incentives for independence.
  2. Auditors backchecked on performance by Schedule I auditors (20% for T throughout, and $\approx$ 50% for T and C end-2010).
  3. Auditors paid for relative accuracy (year 2 only).

- Plants assigned to audit treatment once but auditors randomly assigned to treatment plants at the beginning of each year.

Outline

Data from three sources

- Sample largely consists of small and medium sized textile firms.
- Audit reports (with pollutant readings) for all firms.
- Backcheck reports (conducted by independent engineering colleges) submitted to researchers during experiment.
  - Conducted for 20% of treatments in 2009 and 2010. Also conducted for total of 130 treatment and control plants at end of third season of audit visits in 2010
  - Measure the same pollutants at the same place within several weeks. Median lag 17 days.
  - Auditors knew they faced a 20% likelihood of being back-checked. Use of backchecks not specified in first year.
- Endline survey for final pollution outcomes. About 6 months after end of treatment (April-July 2011).

Reporting outcomes for important pollutants

Pollutants are important general measure of air and water quality

- Water pollutants measure oxygen demand required to stabilize samples and solid content, ammonia nitrogen content. $Water =$ {BOD, COD, TDS, TSS, NH_3-N }.
- Air pollutants principle byproducts of combustion and all EPA criteria pollutants. $Air = \{SO_2, NO_x, SPM\}$
- $All = Water \cup Air$.

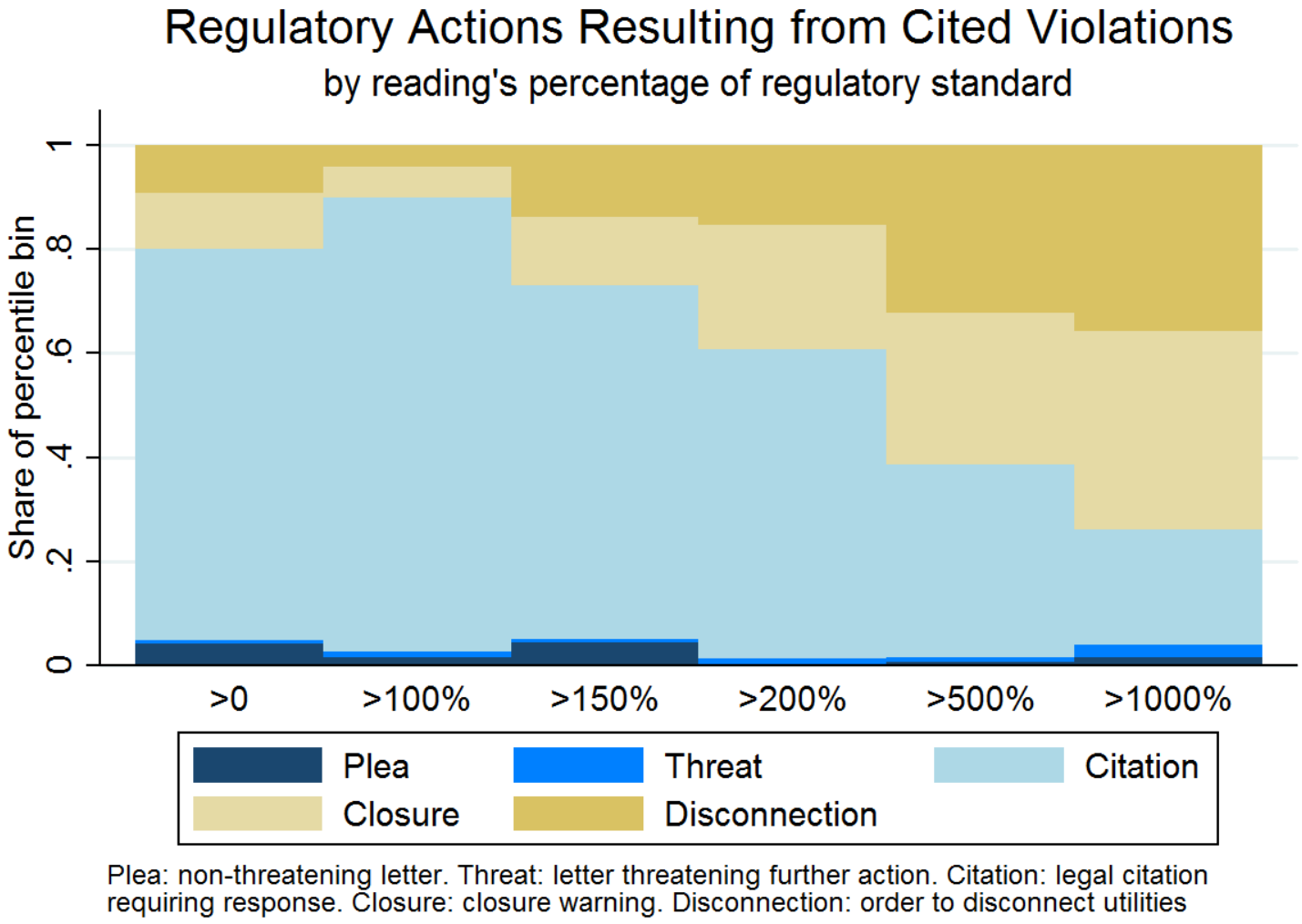
Most pollutant readings standardized throughout by subtracting pollutant mean *in backchecks* and dividing by pollutant standard deviations *in backchecks*.

Final-outlet water and boiler-stack air samples

Figure: Water sampling

Figure: Stack sampling

More severe violations provoke more severe penalties



Plea: non-threatening letter. Threat: letter threatening further action. Citation: legal citation requiring response. Closure: closure warning. Disconnection: order to disconnect utilities

Empirical strategy uses experimental variation

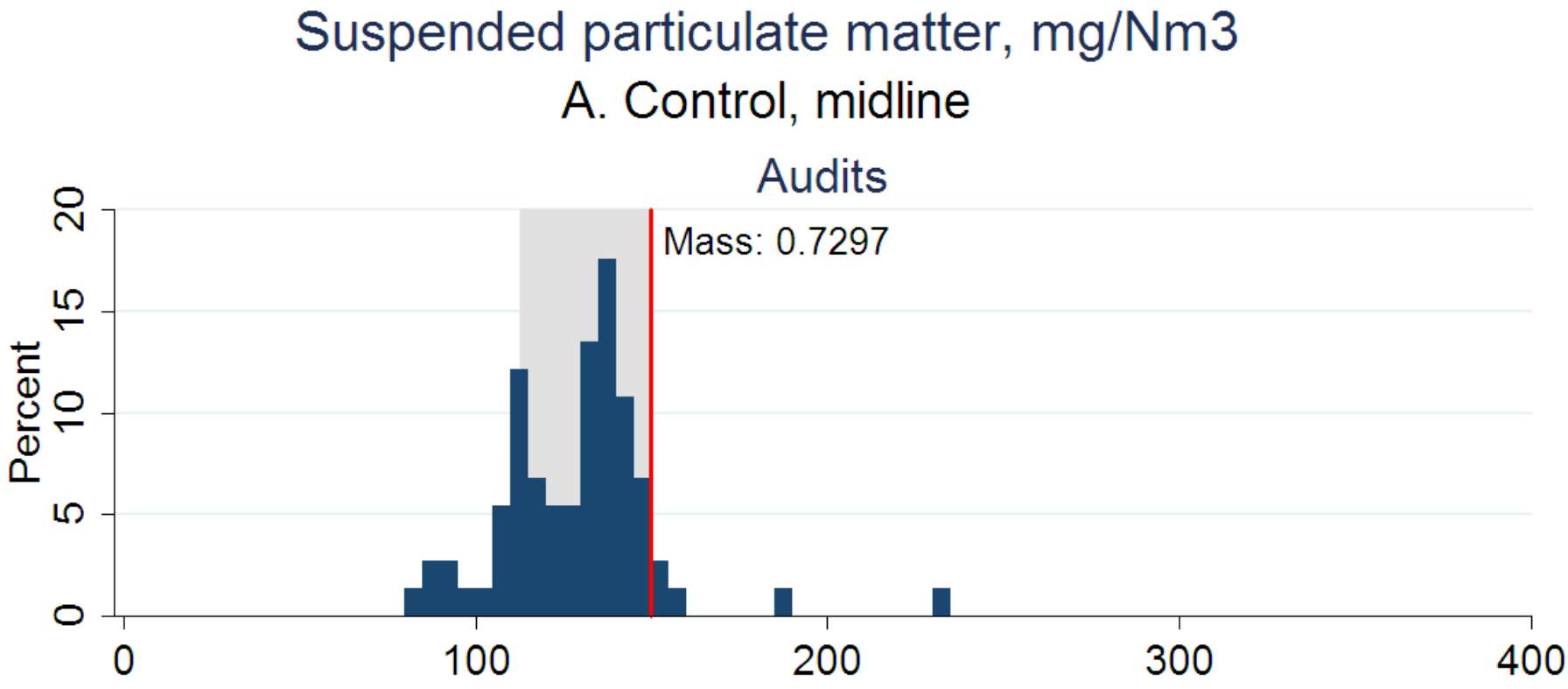
We estimate ordinary least-squares regressions of the form:

$$y_{ij} = \beta T_j + \alpha_r + \alpha_y + \alpha_a + \epsilon_{ij},$$

where y_{ij} is an outcome variable of interest i at plant j, α_r are fixed effects for the region r, α_y are fixed effects for the year $y \in \{2009, 2010\}$ and α_a are auditor fixed effects.

Outline

Figure: Audit Readings for Suspended Particulate Matter (SPM)



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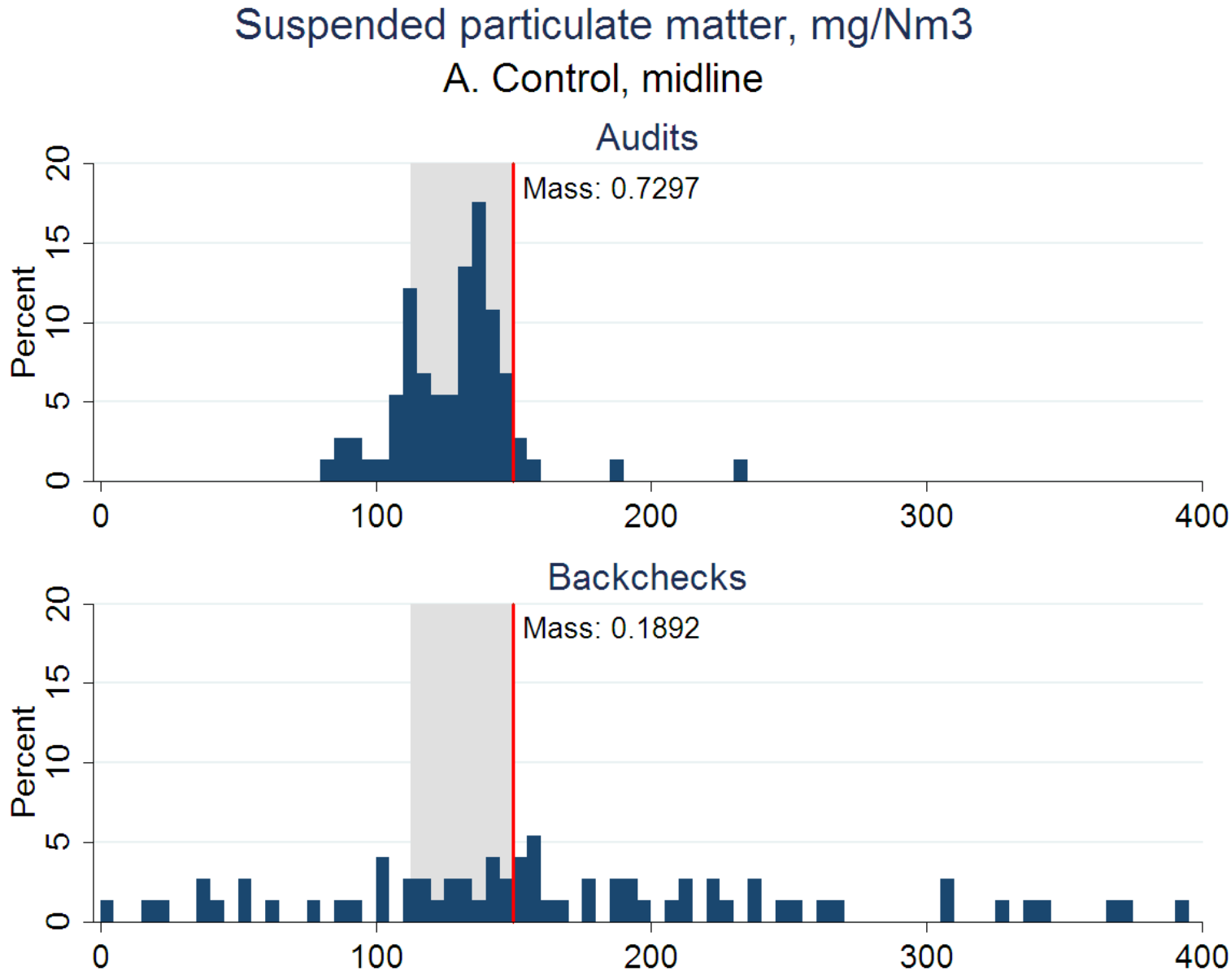

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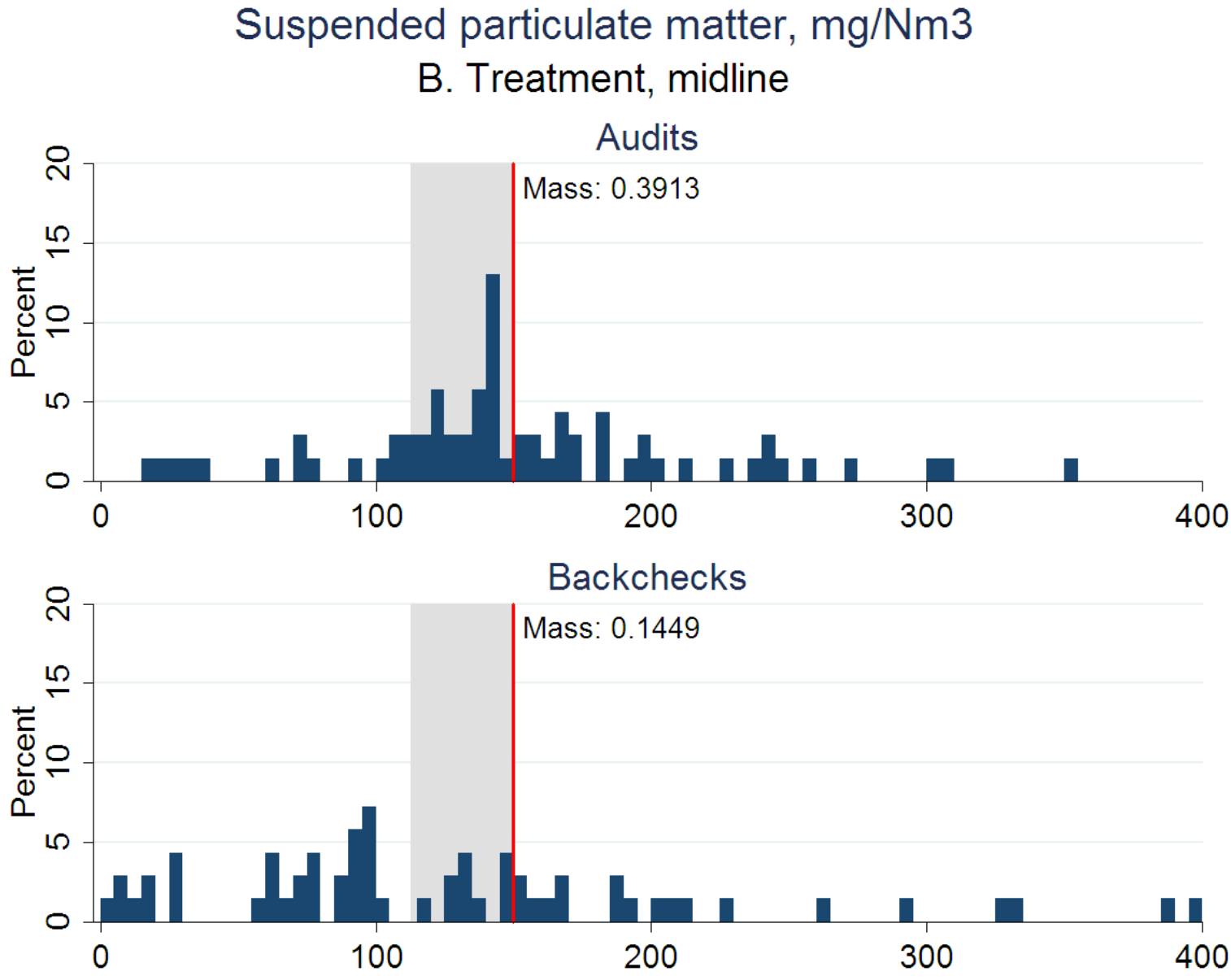

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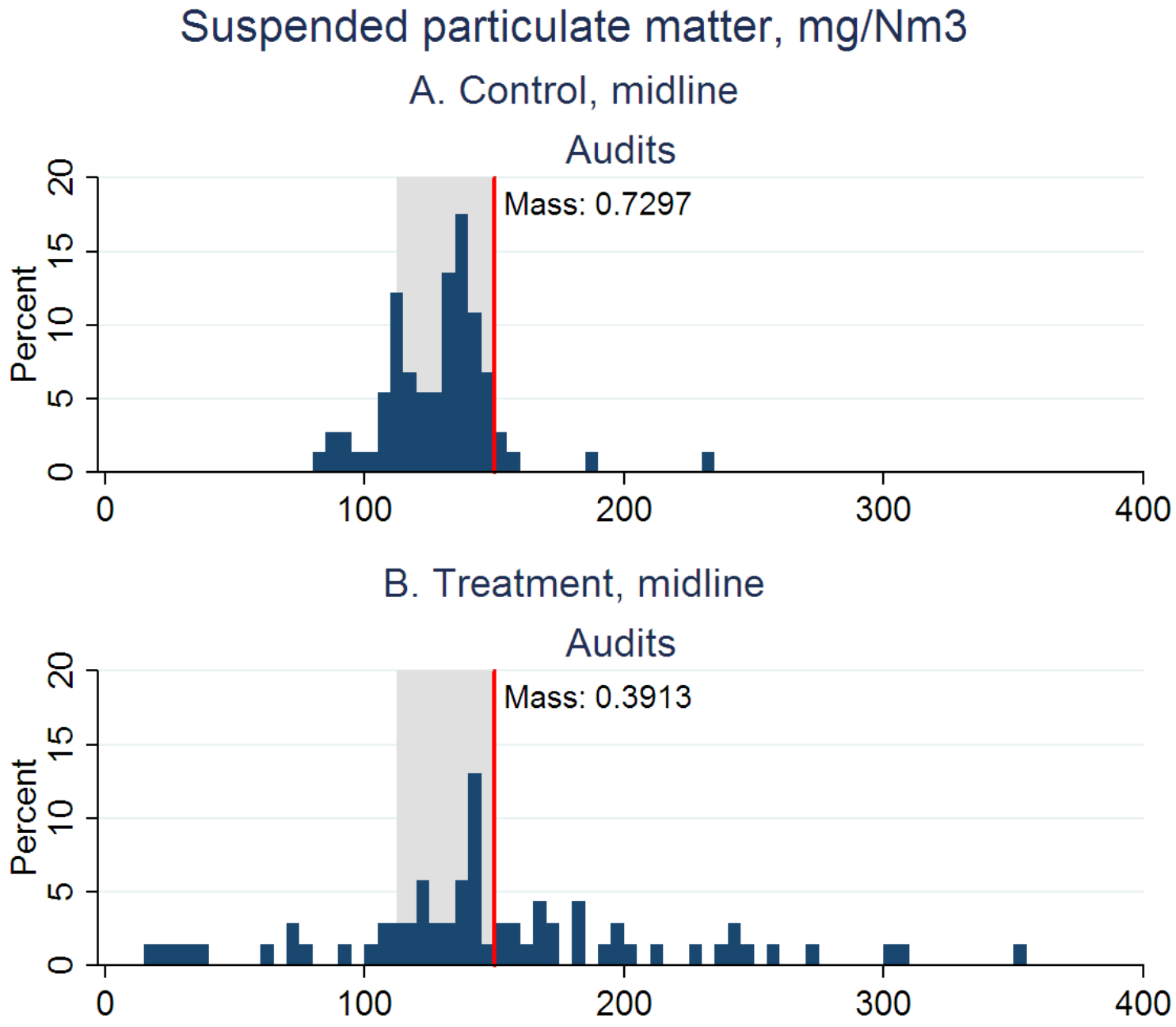


Excess mass below pollutant standards sharply reduced

Table: Likelihood of Pollution Report Between 75% and 100% of Regulatory Standard, Across All Pollutants

	(1) Control	(2) Treatment	(3) Ctl + Trt
Audit report (=1)	0.270***	0.0851***	0.270***
	(0.0253)	(0.0228)	(0.0252)
Audit report X Audit treatment			-0.185***
			(0.0339)
Constant (Backcheck)	Yes	Yes	Yes
Audit treatment	No	No	Yes
Observations	1132	1104	2236

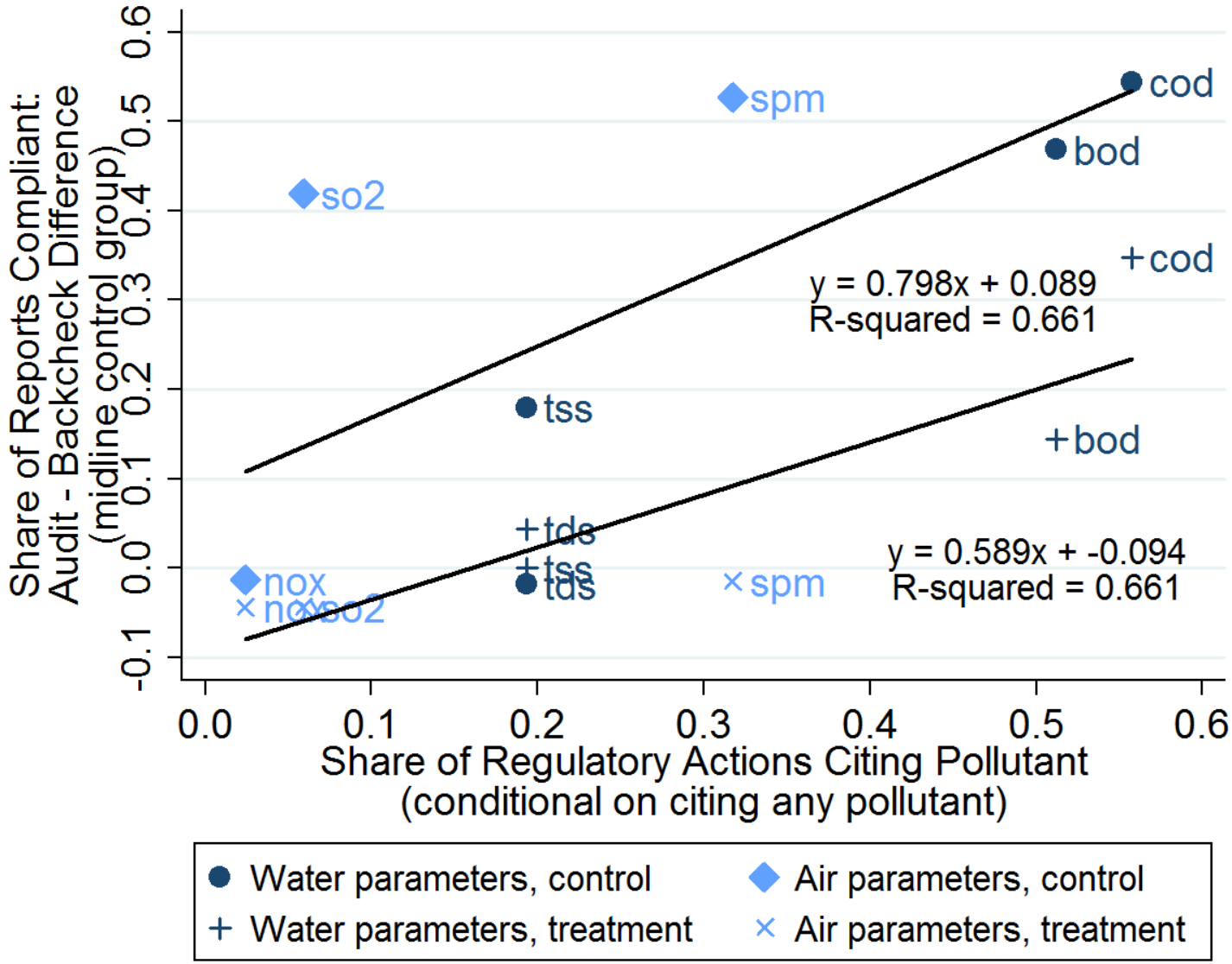
Pooled, standardized final-stage effluent and boiler-stack air samples.
Midline audit reports that reached GPCB and midline backchecks.

Level effects economically large

- Effect size for BOD, an important water pollutant, implies that a report at the standard would move to 89% above the standard in treatment.
- Effect size for SO_2, an air pollutant, implies that a report at the standard would move to 35% above the standard in treatment.
- Change in reports shifts many plants from compliance to non-compliance and is economically significant.

Linking misreporting with penalty structure

Figure: Compliance Against Regulatory Citations



Effect on Pollution Emissions

Firms reduce pollution

Table: Pooled Pollutant Concentrations on Treatment Status

	(1) all	(2) all	(3) water	(4) water	(5) air	(6) air
Audit treatment assigned (=1)	-0.211**	-0.456*	-0.300*	-0.982*	-0.0528	0.0237
	(0.0993)	(0.266)	(0.159)	(0.528)	(0.0566)	(0.101)
Auditor fixed effects	No	Yes	No	Yes	No	Yes
Control mean	0.077	0.077	0.114	0.114	0.022	0.022
N	1439	1439	860	860	579	579

Final-stage effluent and boiler-stack air samples; endline survey; inspection control group. Standard errors clustered at the plant level in parentheses.

Firms reduce pollution

- Response in water pollutants under regulatory scrutiny
- No change in effluent volume–real reductions in pollutant load.
- Not shown today: abatement appears to have come cheap. Little difference in costs by treatment status.

Outline

Broader Implications

- Staffing shortage and need for technical expertise are likely to increase private sector participation in monitoring activities
- Designing how PSP occurs need to be sensitive to regulatory and legal environments. Conflict of interest problems are likely severe whenever reputation incentives are weak
  - Little regulatory follow-up may be equivalent to lack of investor skepticism in financial markets
- Basic insights of this paper likely to hold across several setting:
  - Reducing conflict of interest has large, fast and nearly complete effect on auditor reporting.
  - Clearly driven by incentives: present within auditors.