Discussion of

Opening the Brown Box: Production Responses to Environmental Regulation

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Contributions

- Comprehensive study of **within-firm** production responses to stringent environmental regulation
- Granular data on **firm-product-level** inputs and outputs, combined with **quasi experimental** variation from **India**'s CEPI regulation of 88 industrial clusters

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  1. Shift from coal to electricity use (?)
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- The authors document effective emissions reduction through:
  1. Shift from coal to electricity use (?)
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- Possible trade-off between emissions reduction and local economic dynamism: reduced firm entry and product variety

Four suggestions

1. Estimator and identification
2. Data quibble
3. Emission shifting
4. External validity

Estimator: DiRD vs. DiD

- Difference-in-discontinuities design (DiRD) vs standard DiD
- What's the difference?
- DiRD: LATE narrowly around threshold (local parallel trends near the threshold), DiD: ATT/ATE (global parallel trends)
- But you do not use a bandwidth around the threshold(s): DiRD converges to a traditional DiD estimator ("loss of local nature")

Estimator: DiRD vs. DiD

$$
\begin{aligned}
Y_{kijcst} = {} & \beta_1 \text{Post}_t \times \text{CEPI}^{[60,70)}{}_c + \beta_2 \text{Post}_t \times \text{CEPI}^{[70,100]}{}_c \\
& + \beta_3 \text{CEPI}_c + \beta_4 \text{Post}_t + \gamma_i + \kappa_{jst} + \epsilon_{kijcst}
\end{aligned} \tag{1}
$$

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& + \delta_3 \text{Post}_t + \gamma_i + \kappa_{jst} + \epsilon_{kijcst}
\end{aligned} \tag{2}
$$

where k, i, j, c, s, and t represent a product, firm, industry, city, state, and year, respectively

Identification: small C

- N=88; T= 75 (43+32); C=13
- Very small control group: check sensitivity to single anomalous control units
- Use wild cluster bootstrap or randomization inference?
- Why not (also) go beyond N=88 by picking additional (matched) control clusters?

Data

- Firms voluntarily self-report energy inputs at the product level
- Treated firms reduced energy inputs into the average product by 63% on an annual basis and product-level CO_2 emissions by approximately 66%
- Realistic?

Emission shifting inside and outside clusters?

- No evidence for increased M&A activity or new plant establishments (**extensive margin**)
- Evidence on emission shifting at the **intensive margin** by buying emission-intensive inputs and intermediates from outside of the treated cluster?
- Note: You already observe that, *within* clusters, less-polluting industries start to reallocate production towards higher-margin and coal-intensive products

Which *generalizable* lessons can we draw about firm behavior?

- “Environmental regulation” (title)
- “Emission capping regulation” (abstract)
- “Mandated pollution reduction” (abstract) and “Mandated abatement investments” (>70) (p. 26)
- “Heightened emissions monitoring” (p. 15)
- “Remedial action plans mandated by the regulator clearly identified specific actions and provided time frames for completion" (p. 9)
- “SMEs within the targeted clusters were offered grants and subsidies to undertake investments" (p. 9).

To conclude

- Impressive paper that pushes the boundary of studying firm responses to tightening environmental regulation
- Internal validity: clarify estimator and 'deal' with small number of control clusters
- External validity: discuss implications (e.g. for trade-off between emissions reduction and local economic dynamism)