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The Unintended Consequences of Coal-fired Power Plant Closure: Evidence from China

Fan, Gao, and Tang

Discussant: Xin Zou (Shirley), HKBU

A brief summary

- What
  - The impact of coal-fired power plant closure on air quality in China
  - Closure effect + displacement effect

- How
  - Identify the closure of coal-fired power plant with accurate coordinates at monthly frequency
  - Link the location of power plant with the air quality (proxied by SO2 level) nearby.
  - DID investigation with staggered treatment

- Who, When, and Where
  - More than 1,700 power plants
  - 2004.01-2014.06, China

- Why
  - Closure of the old power plant might transfer the burden to nearby power plants that are still operating, leading to higher SO2 emission around them

Main Findings

- Closure effect:
  - Compared with control areas in 35-50km radius of the retired coal-fire plants, monthly SO2 level in the vicinity of the plant (i.e., those within 35km radius) fall by 2.5% more after the plant closure
- Displacement effect:
  - Compared with control areas of the operating coal-fire plants, which is within 100km distance from the retired plant(s), monthly SO2 level in the vicinity of the operating plant increase by 1.9% more after the plant closure
  - Local (provincial) government may have internally shifted (some) electricity production burden to the plants that are still operating

Main Findings

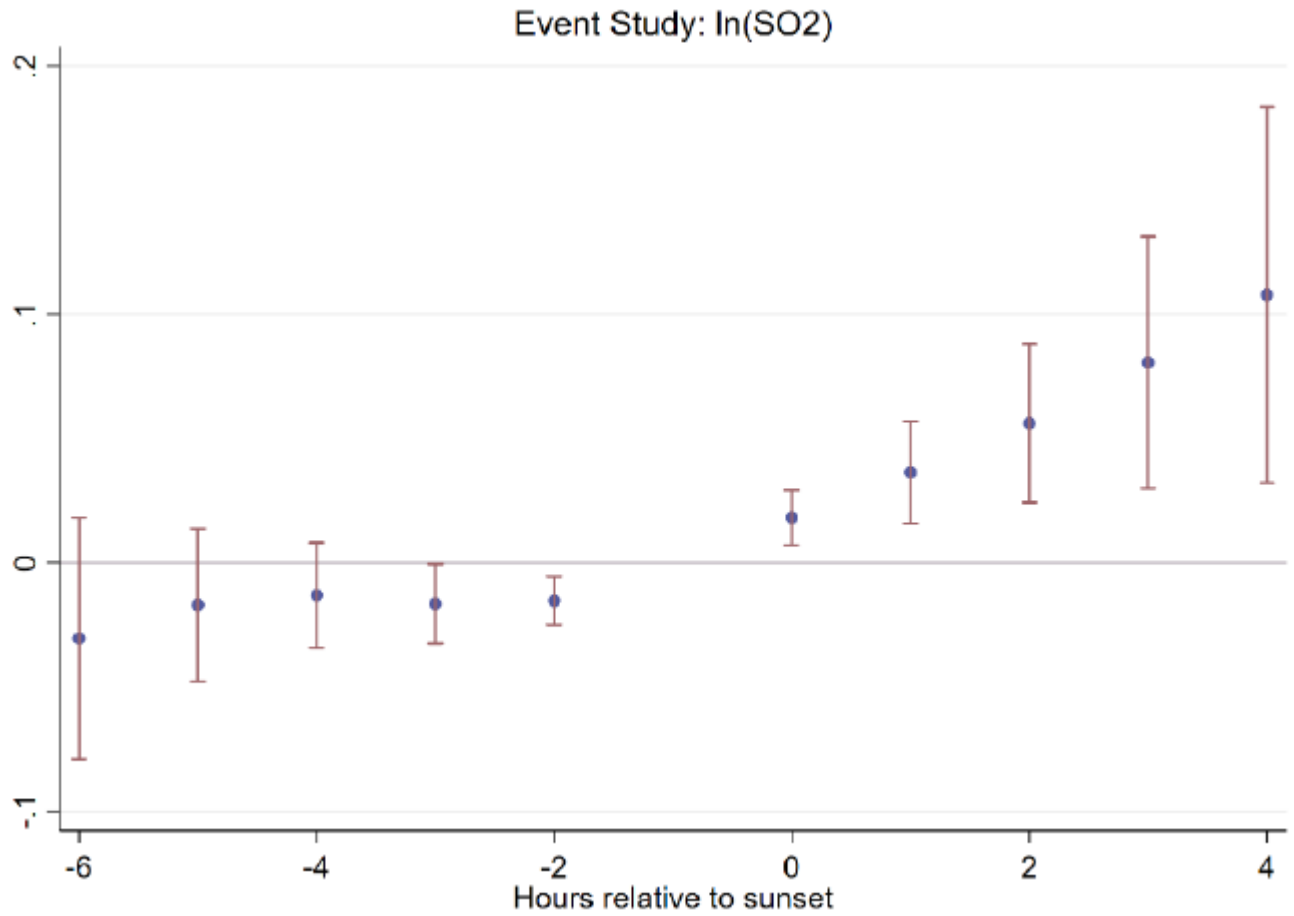
- Net exposure effect
  - Exposure = estimated effect * average SO2 level * total population size within 35 km radius
  - Net exposure = closure exposure + displacement exposure
  - Net exposure ~ 11.6% of the closure exposure
  - Power plant closures have negligible benefits unless planners have cleaner alternative energy sources
- Less displacement effect when more renewable energy power plants nearby
- No significant impact on local infant mortality

Comments

- Very detailed and powerful data
  - Accurate location and timing of closure for coal-fired power plants all across China
  - Real-time satellite data on SO2 concentration
  - Enables causal identification
- Interesting research question
  - Focus on the displacement effect, which might be ignored by previous studies

Comments

- Agarwal, Han, Qin, and Zhu (2023): physical inspections by the Ministry of Environmental Protection may only temporarily reduce disguised pollution if firms can shift production activities to non-daylight hours

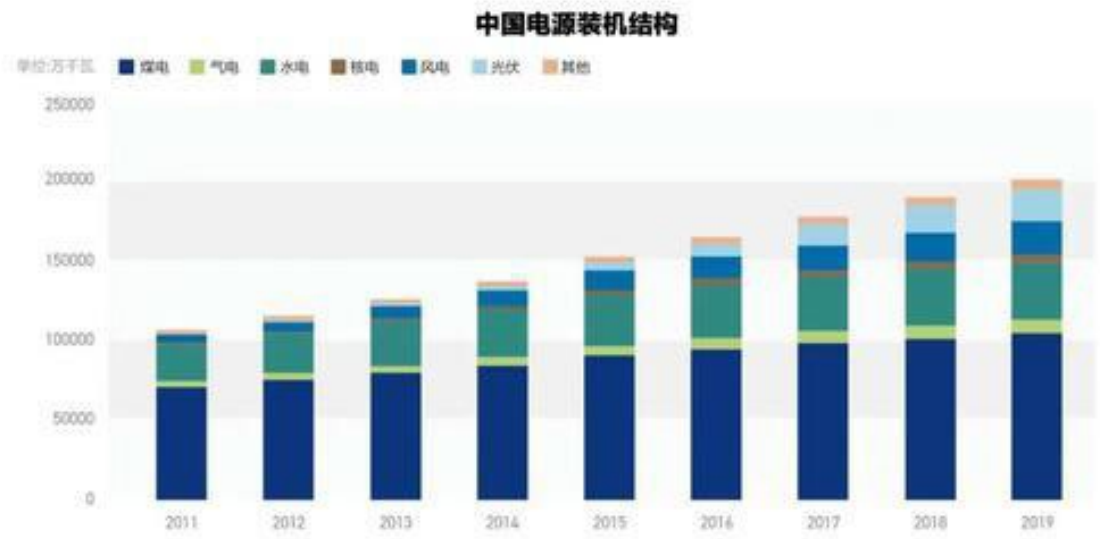


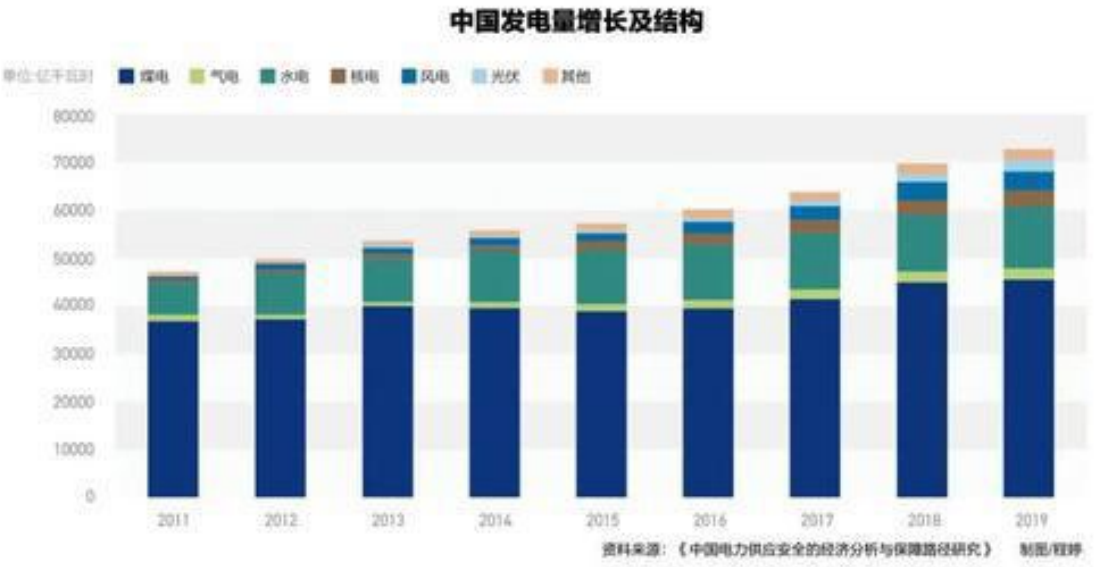
* Agarwal, Han, Qin, and Zhu. 2023. “Disguised pollution: industrial activities in the dark." *working paper*.

Comments

- 1. "**Unintended** consequence"?
  - Retirement of old plants, opening of new plants, and shifting production burden to nearby operating plants, etc., seem to be carefully planned
    - Government aim: "Great Pressure on Small" Scheme (2004) – replace inefficient small generator plants with large efficient ones while limiting the development of new small generator units
    - Local actions: shutdown pollution-inefficient plants located in industry-oriented and densely populated regions; new units are opened in less dense and less developed regions with higher production capacity; fully operating plants are youngest and located in least populated regions
    - ❖ The city still needs electricity, and cross-province transfer may have very large frictions → production burden of the closed plants is **intentionally** shifted to nearby operating plants, which are more pollution efficient

Comments





(Source: https://finance.sina.cn/chanjing/gdxw/2021-05-31/detail-ikmxzfmm5612432.d.html)

Comments

- 2. The net reduction effect
  - The major evidence supporting the claim that the displacement effect offsets most of the closure effect

Table 4: Net exposure effects from closed and operating coal-fired power plants

Panel A - Closure		**Panel B - Displacement**	
Estimated effects	-2.5%	Estimated effects	1.9%
SO2 levels (DU)	0.528	SO2 levels (DU)	0.384
Total Population size (<=35km)	1,250,000,000	Total Population size (<=35km)	2,000,000,000
Net Closure exposure [A]	- 16,500,000	Net Displacement exposure [B]	14,592,000
Panel C - Overall			
Net exposure [A + B]	≈-1,908,000		
Net exposure/Net closure [A]	≈ 11.6%		

  - Heavily dependent on the local population size
    - Table 1 shows the retired plants are located in places with much higher population density → inconsistency?
  - If compute based on changes in total SO2 emitted:
    - Closure effect=-2.5%*0.528=-0.0132 DU
    - Displacement effect=1.9%*0.384=0.007296 DU
    - Net reduction in total SO2 = (-0.0132+0.007296)/0.0132=-44.7%, a sizable effect

Comments

- 3. Economic channel & further investigations
  - Directly check the operation of the nearby operating plants?
  - Heterogeneity tests that help to enhance the channel
    - Is the displacement effect more severe in earlier time period, when cleaner alternatives are less available?
    - Is the displacement effect more severe in provinces where inter-province electricity transfer have larger friction?
  - Is the within-province transfer pollution efficient?
  - Economic magnitude
    - What is a “healthy” level of SO2? Do the changes of the SO2 level economically significantly affect the local air quality? Eg., before the closure, most local air quality is unhealthy but they become healthy after the closure
    - If the air quality are both healthy or unhealthy before and after the closure, this could explain why infant mortality is not significantly affected

Comments

- 4. Others
  - The CSDID vs. DID
    - Most tables use DID, but Figure 5 uses CSDID. Better to be consistent
  - Staggered treatment → effect can be identified using the treatment group alone
    - Don’t need to worry about the overlapping control problem

Summary

- Very nice paper with important implications based on cool dataset
- Lucky to discuss and enjoyed reading it
- Looking forward to future versions/publication

Thank You

Discussant:
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