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Effects of Automated Monitoring on Achieving Air Pollution Control Targets: Evidence from China

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Key Points

- Weak enforcement of environmental regulations remains a global issue, often due to inadequate monitoring and misaligned incentives.
- This study investigates the effect of the automated monitoring system on achieving air pollution control targets in China.
- Local governments strategically focus their efforts on areas adjacent to monitors, resulting in a 3.2% decrease in pollution in these areas compared to areas far away.
- Preexisting data manipulation, officials' political incentives, and public pressure are analyzed as sources of varying local government responses.

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Policy Focus

Air pollution is a critical issue affecting public health and the environment worldwide. In major countries around the world, local governments are responsible for the enforcement of national environmental regulations. However, inadequate monitoring and misaligned incentives often lead to strategic responses at the local level, resulting in localized cleanup rather than citywide reductions.

Advanced monitoring technology has been considered as a solution to this problem. In 2014, in response to increasing public concerns about air quality, the central government of China commenced an unprecedented "war on pollution". Air quality targets were allocated to provincial governments, and then to city governments. A nationwide, real-time, and automated monitoring system was introduced across three waves of cities (Figure 1), which left local governments with virtually no ability to manipulate data directly.

This policy bulletin introduces a study by Lin Yang, Yatang Lin, Jin Wang, and Fangyuan Peng (2024) that examines the impact of China's automated monitoring system on achieving air pollution control targets, investigating

whether technology-aided monitoring can lead to better enforcement or localized cleanup efforts.

Study Methodology

In China's practice, air pollution reduction performance is calculated by averaging the pollution readings across ground monitoring stations. To fill the spatial gaps in the ground monitoring network, the study measures air quality by utilizing satellite-derived PM2.5 concentration in grid cells covering the whole of China from 2008 to 2017. Combined with information about monitoring stations' locations, and city-level socioeconomic data to control for confounding factors, the study uses a spatial difference-in-differences (DiD) design to examine the difference between pollution reduction in monitored areas and unmonitored surrounding areas.

Furthermore, to explore variations in responses across cities, the analysis incorporates political-economy factors, including preexisting data manipulation, local officials' political incentives, and public pressure for cleaner air, by extracting data from multiple sources.

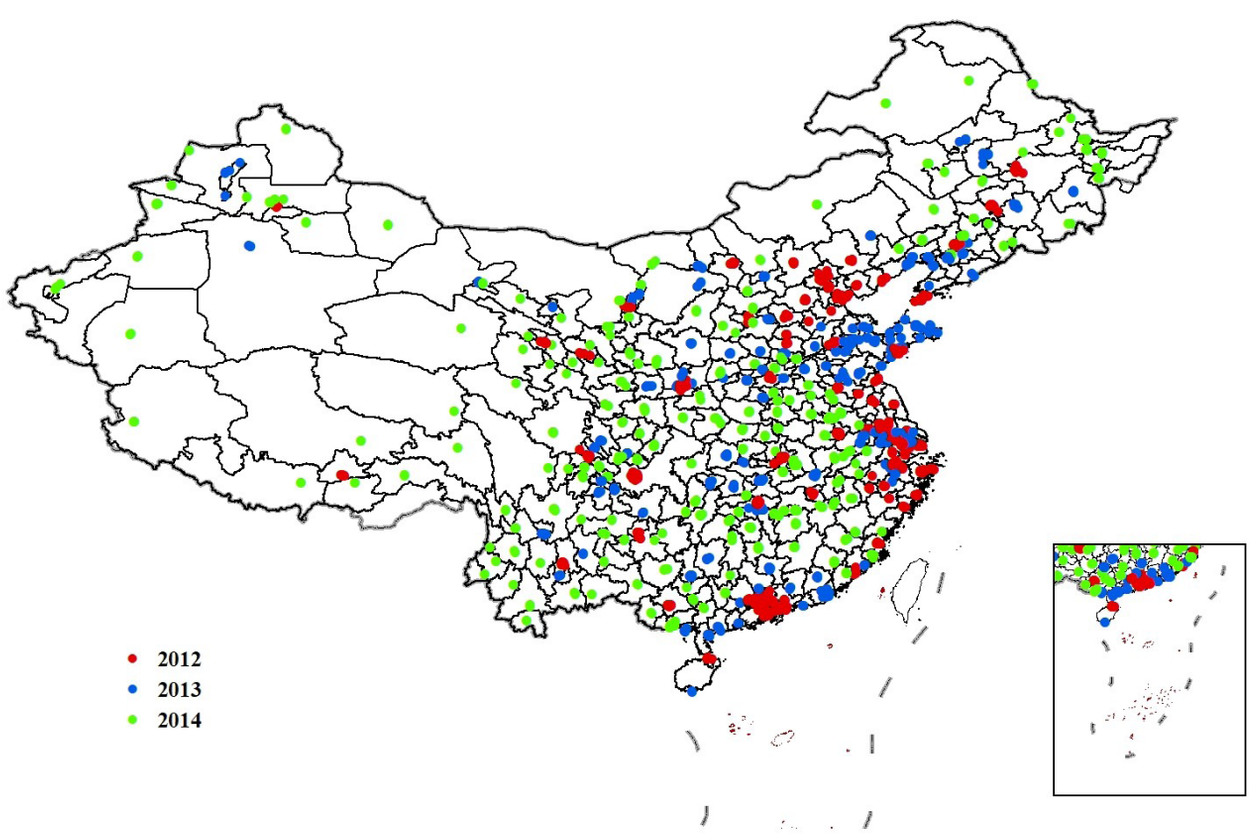
Findings and Analysis

Uneven Pollution Controls across Space

The empirical analysis reveals that air pollution in areas within a 3 km radius of monitors is 3.2 percent lower than that in the unmonitored areas after the automation rollout, while pollution levels in monitored and unmonitored areas exhibited similar trends before automation, suggesting that local governments strategically focused their pollution control efforts on areas adjacent to monitors.

Meanwhile, the impact of monitor automation on city-level pollution is negative but small and statistically insignificant. To further explore the spatial pattern of possible pollution relocation inside the city, the study analyzes the impact at different distances from monitors, from 3 km to 150 km. The results show that the effect of automation on pollution reduction decreases monotonically with distance to the monitor, slowly approaching zero at the distance beyond 120 km, suggesting uneven pollution control across space.

Figure 1 The Timeline of Monitoring Station Automation



Note: This figure displays the spatial distribution of monitoring stations that were automated in three waves, which took place in 2012, 2013, and 2014, respectively.

Mechanisms of Localized Cleanup

By reviewing numerous government policy documents, the researchers found that local governments often explicitly mentioned strategic cleaning measures in their official documents. They identified 121 documents from 72 cities that mentioned specific targeted measures near the monitors, such as coal use regulations, dust suppression, traffic restrictions, etc.

For empirical tests of these mechanisms, the study examines how monitor automation affects the spatial patterns of industrial activities. Using satellite-based data on thermal anomalies, the results show a 10.1 percent reduction in the probability of observing industrial activities within a 3 km radius of monitors relative to unmonitored areas. Also, the analysis of satellite-based relative humidity clearly reveals that automation increases the relative humidity near monitors.

Factors behind Differentiated Responses across Cities

Data Manipulation before Automation: Cities with a history of data manipulation under previous monitoring systems show larger pollution gaps between monitored and unmonitored areas following the rollout of automated monitors.

Local Officials' Political Incentives: As the nationwide antipollution campaign strengthens the tie between monitored pollution levels and local officials' performance evaluation, city leaders with a higher likelihood of promotion than the provincial median have a greater inclination toward strategic cleaning. Also, greater strategic responses are observed among cities with pollution reduction targets.

Public Pressure: Stronger strategically targeted responses take place in provinces with low levels of civic engagement in environmental issues, which suggests complementarity between top-down and bottom-up approaches in achieving environmental targets.

Additional Costs of Uneven Pollution Controls

Reexamination of Environmental Performance: As the comparison of pollution control results between satellite and ground-based measures shows, the strategic response at the local level worsened the monitors' representativeness in measuring citywide air quality. It could lead to biased policy evaluations and subsequent actions since higher-level regulators often rely on monitor readings to reward or punish local officials.

Implications for Environmental Justice: As more developed and urbanized areas tend to contain more monitors, strategic cleaning tends to bring about greater health and amenity benefits from pollution reduction for high-income and urban residents. These consequences could be further amplified by large disparities in the utilization of health services, awareness of pollution-related risks, and prevention measures between rural and urban areas.

Recommendations

Integrate Multiple Data Sources

The study reveals that the current coverage of the monitoring network in China is insufficient to preclude local officials' strategic responses. In this case, satellite-based pollution measures, which can fill the gap in the spatial coverage of ground monitors, can help evaluators better interpret the monitored data.

Also, advanced monitoring technologies, such as mobile monitors and micro-monitors, can be leveraged to broaden network coverage and further supplement data sources. The evaluators should integrate information from the ground monitoring system, satellite-based data, mobile monitors, observations by the public, and third-party auditors, for evaluation accuracy and better regulatory outcomes.

Enhance Public Participation

Regarding the growing public awareness about environmental issues and the increasing complexity of pollution monitoring, the country's environmental authority should engage local citizens in pollution monitoring and management more actively.

Using e-governance has become a highly cost-effective approach for authorities at different levels to promote public engagement. For example, some local governments have launched real-time disclosure of monitoring data or provided speedy follow-up to public claims on social media platforms.

Main Reference

Yang, Lin, Yatang Lin, Jin Wang, and Fangyuan Peng. "Achieving Air Pollution Control Targets with Technology-Aided Monitoring: Better Enforcement or Localized Efforts?." *American Economic Journal: Economic Policy* 16, no. 4 (2024): 280-315.

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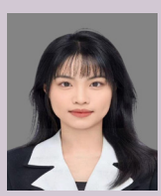

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