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Evidence of Firm-level Pollution Leakage resulting from Clean Air Policy in China

EPRG Working Paper EPRG2511

Cambridge Working Paper in Economics CWPE2533

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Pollution leakage occurs when firms relocate polluting activities to less-regulated regions to reduce their compliance costs. Traditional metrics based on production or emissions may not always be feasible, especially in developing countries with limited data. Investment flows offer a valuable alternative, yet existing measures such as subsidiary counts lack precision. This study leverages manually collected investment data from annual reports of listed pollution-intensive firms to provide a more accurate assessment. Applying this dataset and the difference-in-differences (DID) method, we evaluate pollution leakage triggered by China's 2013 Clean Air Policy. The main findings are summarized as follows:

First, the policy significantly increased pollution leakage from key areas to less-regulated regions. Regulated parent firms in the key areas reduced output while simultaneously increasing pollution-related investments in their subsidiaries located in less-regulated areas after the policy, supporting the presence of pollution leakage. Second, the effects are more pronounced in the Three Regions than in the Ten City Clusters[1] leading to distinct relocation patterns. Firms in the Three Regions shift pollution-intensive investments to both nearby provinces and distant western China, while those in the Ten City Clusters mainly move to nearby, usually in central China. Spatially, firms in the Three Regions concentrated their investments in a bimodal manner with peaks at (0, 400] km and (1,600, 2,000] km, while firms in the Ten City Clusters mainly relocated within <400 km. These findings indicate that pollution leakage is not necessarily restricted to short distances. Finally, both city- and firm-level characteristics moderate the extent of pollution leakage. Cities with greater industrial agglomeration and better transportation infrastructure attract more pollution-intensive investments, reflecting firms' preference for locations with established supply chains and logistical efficiency. At the firm level,

[1] The "Three Regions" refer to the Beijing-Tianjin-Hebei region, the Yangtze River Delta (around Shanghai), and the Pearl River Delta (around Guangzhou), while the "Ten City Clusters" refer to ten other key city clusters located along major air pollution transmission corridors

investments are more likely to shift towards cities with existing subsidiaries, suggesting a role for coordination cost reduction. Firms with lower innovation capacity are more likely to relocate emissions, reflecting their limited ability to comply through technological upgrading.

These conclusions lead to several policy recommendations: First, regulators should strengthen environmental disclosure standards for listed firms' subsidiaries. Our findings show that intra-group investment shifts are a key channel for pollution leakage, especially within large corporate networks. Tougher subsidiary-level reporting requirements would improve transparency and enforcement.

Second, policymakers should proactively address pollution leakage driven by regionally differentiated environmental regulations by supporting mitigation efforts in less-regulated areas. Our findings confirm that pollution has shifted from eastern to central and western regions, closely following the relocation of investment. This pattern is largely shaped by regional economic disparities and differences in regulatory capacity. While central and western provinces may gain economically from this shift, they often lack the infrastructure and governance needed to manage the associated environmental pressures. Although transferring emissions from heavily polluted eastern regions to relatively cleaner areas may reduce marginal harm, it does not justify unchecked relocation. To prevent long-term environmental degradation and regional inequality, the central government should strengthen policy coordination and provide targeted funding to support emission reduction efforts in central and western China, with a particular focus on building early-stage pollution control infrastructure and strengthening institutional capacity.

Furthermore, as regions with strong industrial agglomeration and transport networks tend to attract more pollution-intensive investments, local governments should enhance environmental oversight to impede emission clustering. Encouraging innovation in pollution-intensive firms can also help curb investment-driven leakage. The central government should promote technological green upgrading by incentivizing pollution control technologies.

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Publication June 2025
Financial Support Chang Liu thanks the support by the Humanities and Social Sciences Fund of Ministry of Education of China (No. 23XJC790003) and the China Scholarship Council.