

From Air to Water: Regulation-Induced Pollution Substitution Across Media

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Extended Abstract

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Abstract Summary

Environmental regulations frequently target specific emission media, such as air or water, in isolation. While effective in curbing targeted emissions, these single-medium policies can inadvertently incentivize firms to transfer hazardous pollutants to less-regulated media. This study empirically examines this phenomenon—cross-media pollution substitution—leveraging China's 2001 Key Cities for Air Pollution Prevention and Control (KCAPPC) policy as a quasi-exogenous regulatory shock. Utilizing a difference-in-differences (DID) strategy on a comprehensive panel dataset of heavily polluting manufacturing firms from 1998 to 2005, we investigate the impact of strict air quality mandates on water pollution.

Our findings reveal that while the KCAPPC policy successfully reduced targeted sulfur dioxide (SO₂) emissions by 15.9% among regulated firms, it simultaneously caused an 11.0% increase in absolute chemical oxygen demand (COD) emissions. Consequently, the water-to-air pollution ratio increased by a highly significant 11.4%, providing robust evidence of regulation-induced pollution leakage. Crucially, we unpack the "black box" of firm-level compliance mechanisms. By decomposing emission intensities into generation and removal components, we demonstrate that substitution is predominantly driven by the adoption of water-intensive, end-of-pipe treatments (e.g., wet scrubbers). In contrast, firms implementing in-process abatement technologies successfully reduced SO₂ without generating secondary water pollutants. Additionally, heterogeneity analyses indicate that this substitution is most prevalent in economically developed regions and among domestic firms.

This study highlights the inherent risks of unsynchronized environmental legislation, extending empirical evidence of cross-media substitution to the context of a transitional economy. The results underscore the critical need for integrated, cross-media regulatory frameworks and simultaneous monitoring. Furthermore, they emphasize that policymakers

must go beyond setting strict emission limits by actively incentivizing clean, in-process production technologies to prevent the unintended displacement of environmental harm.