



## RESEARCH HIGHLIGHTS

# International Spillover Effects of Air Pollution: Evidence from Mortality and Health Data

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What is the impact of cross-boundary air pollution on human health in neighboring countries and what benefits can pollution rules have across borders?

### Context

Air pollution poses a significant threat to human health. One challenge countries encounter in reducing air pollution is that some of it may be caused by sources in neighboring countries and be carried over borders. This is the case in South Korea, where westerly winds carry pollution from China during the fall and winter months. In this way, countries like South Korea may not have full control over the pollution hurting their citizens.

### Methods

The authors employ recent advances in atmospheric science to collect data on the hourly particulate matter (PM<sub>2.5</sub>) pollution trajectories from China to South Korea. They combine these trajectory data with hourly particulate pollution in China and South Korea and estimate how the transboundary pollution from China effects particulate pollution in South Korea. They then connect these data with mortality and emergency room visit data in South Korea to quantify the health impacts of transboundary air pollution.

### Key Findings

**Transboundary air pollution from China plays a significant role in the level of particulate pollution in South Korea.** In fall and winter, the authors find that particulate pollution is substantially higher in the northwest regions of South Korea closest to China than in the southeast regions, while the two regions have similar pollution levels in the spring and summer when there is far less westerly wind. A one microgram per cubic meter increase in transboundary pollution from China results in a 0.122 microgram per cubic meter increase in pollution in South Korean cities on average.

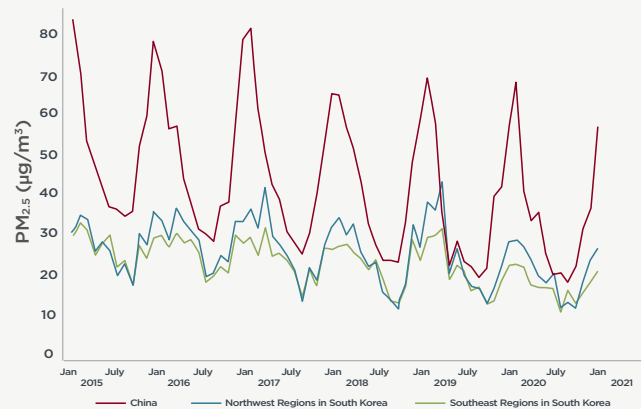
**Particulate Pollution coming from China increases mortality in South Korea, with babies impacted the most.** A one microgram per cubic meter increase in transboundary pollution from China increased mortality by 0.6 percent in South Korea,

or 31.2 deaths for every million people annually and 3.56 deaths for every billion people every hour. Overall, a one microgram per cubic meter increase in local pollution—not just that coming from China—increased mortality by 1.5 percent, or 79.7 deaths for every million people annually and 9.09 deaths for every billion people

every hour. Babies who were a year old or younger suffered the most from pollution, with their mortality increasing by 2.1 percent from pollution from China alone and 5.5 percent from all particulate pollution.

**Particulate Pollution coming from China increases ER visits for asthma and rhinitis, or nasal inflammation.** In collecting data on emergency room visits in South Korea between 2013 and 2017 for the patients admitted due to rhinitis or asthma, the authors find that a one microgram per cubic meter increase in pollution from China leads to 50 additional ER visits for every billion people daily for asthma and 482.6 additional ER visits for every billion people daily for rhinitis. Annually, that's an increase of 18.3 people for every million for asthma and 176.1 for every million people for rhinitis, or a 0.5 percent and 3.4 percent increase, respectively.

Figure 1 • PM<sub>2.5</sub> in China and South Korea



Note: This figure illustrates the evolution of monthly average hourly PM<sub>2.5</sub>. The Northwest region in South Korea is defined as cities in South Korea that have more than or equal to 35% of frequency of trajectories coming from China.

**Strong environmental policies in China reduce pollution and its impact on mortality in both countries.** After China began its “war on pollution” in 2014, which came with a series of strong clean air rules, pollution significantly declined nationwide. The authors find that China had a 14.07 microgram per cubic meter drop in pollution during the sample period and that South Korea saw a 9.63 microgram per cubic meter drop in pollution from China from 2015 to 2019. Based on the authors’ estimates, this drop led to fewer deaths (a reduction in annual mortality by 300.4 people for every million) from transboundary air pollution, which the authors calculate saved South Korea \$2.62 billion per year. However, the authors did find evidence that China may have strategically reduced more air pollution in Chinese cities where most air pollution stays inside the country borders and reduced less in cities where most air pollution blows outside of the country. This implies the benefits of clean air rules could be larger for neighboring countries if applied equally.

“We discovered that countries are vastly impacted by the pollution caused by their neighbors. The good news is the benefits of strong policies to reduce pollution also extend to neighboring states. This underscores the importance of treating air pollution as a regional and even global challenge that requires cooperation, and not just a problem to confront at a local level.”

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### **CLOSING TAKE-AWAY**

Air pollution can have a significant impact on the health of citizens in neighboring countries, but the benefits of strong pollution policies also extend to neighbors especially when applied equally. This suggests that there is a benefit to considering air pollution policy at the global scale and not just at the local and/or national level.

The Energy Policy Institute at the University of Chicago (EPIC) is confronting the global energy challenge by working to ensure that energy markets provide access to reliable, affordable energy, while limiting environmental and social damages. We do this using a unique interdisciplinary approach that translates robust, data-driven research into realworld impacts through strategic outreach and training for the next generation of global energy leaders.