

# Air Pollution and Firm-Level Human Capital, Knowledge and Innovation

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## Abstract

This paper investigates the long-run effects of prolonged air pollution on firm-level human capital, knowledge and innovation composition. Using a novel firm-level dataset covering almost all industrial firms engaged in science and technology activities in China, and employing a regression discontinuity design, we show that prolonged pollution significantly diminishes both the quantity and the quality of human capital at the firm level. More specifically, we show that air pollution affects firm-level human capital composition by reducing the share of employees with a PhD degree and master's degree, but instead increasing the share of employees with bachelor's degree. Moreover, the difference in the composition of human capital materially change the knowledge and innovation structure of the firms, with our estimates showing that pollution decreases innovations that demand a high level of creativity, such as publications and inventions, while increasing innovations with a relatively low level of creativity, such as design patents. Quantitatively, on the intensive margin, one  $\mu\text{g}/\text{m}^3$  increase in the annual average PM2.5 concentration leads to a 0.188 loss in the number of innovations per R&D employee. Overall, we show that air pollution (due historical use of coal in the north vs. electricity in the south) has created a gap in human capital, knowledge, and innovation between firms in the north and south of China, highlighting the importance of environmental quality as a significant factor for productivity and welfare.

**Keywords** Pollution, human capital, knowledge, innovation, China

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