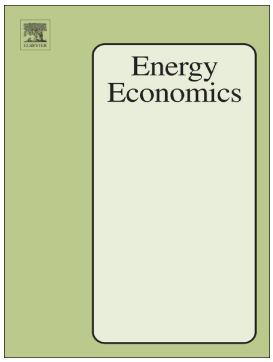

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Socioeconomic burden of air pollution in China: province-level analysis based on energy economic model

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Abstract

In this study, we apply to China the China Regional Energy Model, developed as part of the Regional Emissions Air-Quality Climate Health (REACH) assessment framework, and estimate $PM_{2.5}$-associated health costs. We estimate that, in 2015, exposure to $PM_{2.5}$ caused a nationwide welfare loss of US$248 billion, 3.6% of the baseline level. Over half the cost is from mortalities associated with chronic exposure, followed by indirect loss (38%) and short-term exposure (9%). The cost varies among provinces (0.45%–5.78% of welfare), due to subnational heterogeneity in air quality, population density, and income levels. The cost in absolute terms is large in populous, coastal provinces, such as Shandong, Jiangsu, Zhejiang, and Guangdong, but when the local economy size is controlled for, the Greater Beijing area and central inland provinces also suffer large welfare losses in relative terms.

Keywords: Air pollution; Socioeconomic burden; China; Computable general equilibrium

1. Introduction

China's excess air pollution is widely known. In 2014, for example, annual fine particulate ($PM_{2.5}$) levels in 31 Chinese major cities (4 province-level cities and 27 provincial capitals) were 23-124 μg/m^3, with a mean of 65 μg/m^3, exceeding the World Health Organization (WHO) guideline level of 10 μg/m^3 by a factor of >6 (Nam, forthcoming). As demonstrated by a substantial body of the epidemiological literature, conventional air pollutants, such as $PM_{2.5}$, increase health risks substantially (Dockery et al., 1989, 1992, 1994). Given its excessiveness, air pollution in China has posed enormous and imminent threats to the public health of urban residents.

Many impact studies motivated to increase public awareness of the threats have used such epidemiological evidence to estimate pollution-induced socioeconomic burdens. A conventional approach first keeps track of the morbidity and mortality cases that occur due to exposure to excess pollution, applying concentration-response functions, drawn from the epidemiological literature, to given pollution levels. Each case is then valuated in monetary terms, using market or surveyed data for each health endpoint. A substantial number of China-focused studies have adopted this approach, and their estimated pollution-health costs range from 3.5 to 5.9% of China's historic gross domestic product (GDP) (see **Section 4.2**).

One potential problem in the literature is a lack of dynamic thinking in economic valuation. Many available estimates for China are based on a static application of the conventional approach mentioned

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