Economic impacts from PM2.5 pollution-related health effects in China: A provincial-level analysis
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Background

• China has faced with severe challenges relating to its environment, particularly air pollution in recent years.
• Bad air quality poses a significant threat to human health, increases health expenditure and decreases labor attendance and labor supply.
• Air pollution obviously has negative impact on the economy. We aim to use CGE model combined with health module to forecast and evaluate the long-term economic impacts caused by air pollution in 30 Chinese provinces.

Methods

1. Combining AIM/CGE, Health module and GAINS model
• GAINS-China model provided PM2.5 annual average concentration data in 30 provinces (Fig. 1).
• Health module quantifies the health impacts and converts to work time loss.

2. Scenario
• WAir scenario: without any intensive air-pollution-control technology. The bad air quality increases outpatient visits, hospital admissions and work loss day. Additional health expenditure and work time loss lead to adverse effects on the economy.
• WAir scenario assumes the existence of intensive air-pollution-control technologies are used to reduce PM2.5 concentration to levels much lower than those in reference and WAir scenario.

Results

PM2.5 concentration in 30 provinces

Health impact of air pollution in 2030

• Health endpoints: Respiratory symptoms are the most frequent health problem induced by PM2.5 pollution, followed by asthma attacks and chronic bronchitis.
• The WAir model/CGE scenarios, PM2.5 emissions in the WAir scenario could reduce the numbers of patients by about 75% (Fig. 4 upper).
• Total health expenditure: national total is 141 billion CNY in WAir scenario, Henan (18.0% CNY), Shandong (14.1.), and Jilin (13.2%) are the top five provinces.
• In the WAir scenario, the PM2.5 concentration for most provinces exceeded the national standard of 35 µg/m³.
• Even in the WAir scenario, the PM2.5 concentration is above the WHO standard of 10 µg/m³ (Fig. 5).

GDP loss and Welfare loss in 30 provinces

Net benefit of PM2.5 control technology in 2030

Net benefit in China

• The air pollution control cost reaches 833.6 billion Yuan, or about 0.79% of GDP. The net benefit (Fig. 4) from PM2.5 control technology is 0.86% in GDP: investment on such technologies is quite beneficial in China as a whole.

Net benefit at provincial level

• The net benefit (Fig. 4) is high in provinces with larger economies and higher PM2.5 concentrations, such as Tianjin (2.1%), Guangdong (1.49) and Shanghai (2.07%). By contrast, PM2.5 control technologies are less effective in less developed provinces and ultimately lead to negative net impacts, such as Fujian (-1.7%), Zhejiang (-0.69%), Guangxi (-0.68%), Henan (-0.54%), Qinghai (-0.53%) and Xinjiang (-0.51%).
• Policymakers should consider the differences and tailor suitable policies for different regions. The Chinese government should institute a suitable policy and provide necessary financial aid to these underdeveloped provinces. Developed regions can provide technology and financial aid to underdeveloped regions, since air pollution concentration depends not only on emissions in one region, but also on transboundary emissions from neighboring regions...

Summary & Conclusion

• PM2.5 pollution is very serious in China and leads to a large number of health, resulting in additional health expenditure, work loss time and premature death.
• The economic impact of PM2.5 pollution is significant in China. In 2030, GDP loss is 1.89% in the WAir scenario and 0.45% in the WAir scenario, while welfare loss is 2.67% in the WAir scenario and 0.63% in the WAir scenario.
• The economic impact differs markedly in different provinces. Beijing, Tianjin, Shanghai provinces have higher GDP loss and welfare loss in the WAir scenario.
• Air-pollution-control technology brings more net benefit in Tianjin, Beijing, Shanghai, compared to the rest of the country. Undeveloped provinces, such as Ningxia, Inner Mongolia, Guizhou have negative impact from air pollution control technology.

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