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Economic costs of motor vehicle emissions in China: A case study

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Abstract

The last decade has witnessed a dramatic increase in the number of motor vehicles in China. Motor vehicles have become an increasingly important contributor to air pollution in major Chinese cities. While research interest in vehicular pollution in China has increased in recent years, there is little research on evaluating monetary costs of this pollution. This paper uses Beijing as a case study to evaluate the magnitudes of air pollution concerning motor vehicles. A monetary estimation of air pollution in regard to motor vehicles is presented on the basis of data for Beijing in 2000. Two methods—willingness-to-pay and human capital methods—are used to analyse the high and low points of estimation.

Keywords: Monetary evaluation; Air pollution; Road transport; China

1. Introduction

The last decade has witnessed a dramatic increase in the number of motor vehicles in China, vehicles have risen four-fold in 25 years, China is now the fourth largest motor vehicle producer and the world's third largest consumer. In 2003, the number of motor vehicles and motorcycles was 24.21 million and 59.29 million respectively, and forecast to rise 90 million and 192 million by 2020 (Li, 2004). This growth in the number of motor vehicle has serious economic and social implications for Chinese society and the economy. It will affect significantly urban lifestyle, and generate huge economic opportunities for various industries. On the other hand, the vehicle fleet's rapid growth presents a challenge to urban authorities in that air quality may seriously deteriorate and traffic congestion will increase. Various measures, including new regulations and standards, have been introduced to address these issues. However, it is hard to know how effective these measures are without information regarding the magnitude of the economic damage caused by motor vehicles.

Ironically, motor vehicle-related externalities are the result of the Chinese government's efforts to raise the standard of living. Indeed, the most affluent super large cities suffer these external costs more than elsewhere in China. Several factors account for this. First, the vast majority of vehicles used in China are driven in major

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Table 1
Vehicle emissions in Beijing

Vehicle category	Units	Average emission factors			US model year of similar emission level
		CO	HC	NO_x	
Car	g/km	43.6	4.3	1.3	69–71
Mini van	g/km	25.3	5.7	2.1	74–78
Jeep	g/km	33.5	6.2	3.2	74–78
LDGT	g/km	51.7	9.5	4.6	71–74
HDGE	g/kmh	164.6	29.6	17.3	70
MC	g/km	14.4	2.0	0.1	85–88

Note: LDGE—light duty gasoline truck, HDGE—heavy duty gasoline engine, MC—Motorcycle.
Source: (Hao et al., 2000).

cities, and most private motor vehicles are registered there. Beijing, for example, accounted for 8.8% of the number of privately-owned vehicles in China in 2003, while its population accounted for only 1.1% of the population (National Bureau of Statistics of China, 2004). This is not only because residents in large cities are more affluent than rural residents, but also because the road infrastructure is much better developed.

Second, less efficient technology makes the pollution level per vehicle much higher in China than in developed countries. Walsh (1996) estimates that the carbon monoxide (CO) and hydrocarbon (HC) emission levels of some domestically designed and manufactured engines are about 10–20 times the levels emitted from controlled vehicles in the US or Japan. He and Cheng (2000) also point out that the average emission factor per vehicle in China is several times higher than vehicle emissions in industrialized countries. Hao et al. (2000) show that the average emission levels of motor vehicles in Beijing in the late 1990s were equivalent to those in the US in the late 1970s (Table 1). Additionally, the fuel consumption of some vehicles is between 50% and 100% greater that the same type of vehicle manufactured in Western countries (He and Cheng, 2000). A survey of 3187 car owners shows that 46.3% of owners of medium to low class cars[1] were unhappy with the noise level, and 39.2% complained about their car's anti-shake function (Chen and Duan, 2001). While new standards for cars have been introduced in many large cities, and various measures, including installing catalytic converters, have been used to improve older vehicles' environmental performance, emission levels are still substantially higher than international standards.

Third, there is the high population density. The environment's ability to 'clean' itself is much weaker in situations of high population density and many tall buildings; thus the interactions among different external factors are more likely to create a vicious circle. For example, a high accident rate worsens congestion, and low driving speed due to congestion results in higher levels of pollution. Tests conducted in China show that the emission level of carbon monoxide (CO) and hydrocarbon (HC) at speeds of 24 km/h are 60.5% and 73.8% higher than at the speed of 45 km/h (Fu et al., 2001).

2. The environmental problem

2.1. Urban air quality

Air pollution is one of China's most pressing environmental problems. This is mainly due to the rapidly deteriorating air quality in many large Chinese cities. The World Health Organisation (WHO) issues a list of the 10 most polluted cities in the world every year. In 1995, three Chinese cities—Beijing, Lanzhou and Taiyuan—were on this list (He and Cheng, 2000). In 2000, 9 out of the 10 cities with the worst air pollution in the world were from China (Sun, 2001).

The World Health Organization (1999) annual mean guidelines for air quality standards are 90 μgm per cubic meter for total suspended particulates (TSP), and 50 μgm per cubic meter for sulphur dioxide (SO_2) and nitrogen oxides (NO_x). Table 2 shows that almost all major Chinese cities listed have exceeded the

[1] Medium to lower class cars in this survey cover 10 models of five domestically made cars: Santana, Red Flag, Jetta, Citroen and Lingyang (Chen and Duan, 2001).