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Does government expenditure affect environmental quality? Empirical evidence using Chinese city-level data

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ABSTRACT

With rapid economic development, the Chinese government expenditures at various levels have increased sufficiently. At the same time, the environmental pollution in China has deteriorated significantly. In this study, the city-level panel data of 106 Chinese cities over the 2002–2014 period are utilized to investigate the impacts of government expenditure on the emissions of three typical pollutants. Specifically, the total effects are divided into two types: direct effects, through which government expenditure affects pollution directly; and indirect effects, which refer to the indirect influences of government expenditure on environmental pollution through its impacts on GDP per capita. To control for potential endogeneity and introduce dynamics, the generalized method of moments (GMM) method is utilized. The estimation results indicate that the total effects of government expenditure on these three pollutants are very different: for sulfur dioxide (SO_2), soot and chemical oxygen demand (COD), the total effects are decreasing, inverted-U and U-shaped, respectively. Furthermore, the indirect effects dominate the direct effects.

1. Introduction

With economic growth, the issues of environmental pollution and protection have become increasingly acute in many developing countries, particularly China. As the world's second largest economy, the Chinese government has devoted much effort to regulating and protecting the environmental quality. In the new millennium, air pollution has become one of the most urgent problems that affect the health of people and the economic development in China. The influential factors of the environmental quality, particularly the air quality, have been explored by several previous researchers. However, most studies focused on the social and economic factors, including GDP per capita (or other factors that measure the level of economic development), industrial structure, urbanization, and foreign business (e.g., Hao and Liu, 2016; Fan et al., 2017). Recently, certain researchers have focused more on the effects of government policies, including financial, fiscal, and monetary policies (e.g., He, 2015; Omri et al., 2015; Zhang et al., 2017). For instance, He (2015) investigated the impacts of fiscal decentralization on China's environmental quality in China. Omri et al. (2015) focused on the influences of financial development on the environment in Middle East and North Africa (MENA) countries. Recently, Zhang et al. (2017) examined the effects of China's environmental innovation on CO_2 emissions reduction. Recent studies found evidence that government expenditure is an important determinant of environmental quality (Halkos and Paizanos, 2013; Lopez et al., 2011). By choosing representative pollutants, Halkos and Paizanos (2013) analyzed the direct and indirect effect of the government expenditure on Sulfur Dioxide (SO_2) and Carbon Dioxide (CO_2) emissions. The researchers found that there is indeed a negative effect from the government expenditure on SO_2 emissions utilizing data from 77 countries.

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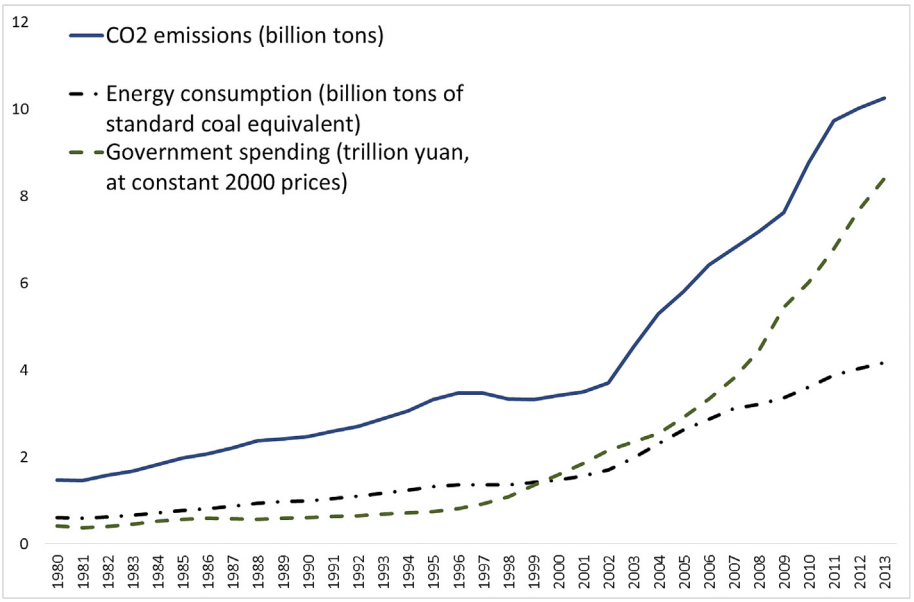

Fig. 1. China's energy consumption, government expenditure and CO_2 emissions, 1980–2013. Notes: The data of energy consumption are obtained from the China Energy Statistical Yearbooks, the data for government expenditure are obtained from the National Bureau of Statistics (NBS) of China, and CO_2 emissions are obtained from the Carbon Dioxide Information Analysis Center (CDIAC).

As Lopez et al. (2011) and Halkos and Paizanos (2013) theoretically argued, the reason that pollution may be affected by the level and composition of government spending is fourfold. First, economic growth may lead to higher environmental pressures, which requires more government spending to address. This requirement is also called the scale effect. Second, human activities caused by the accumulation of human capital rather than physical capital are more harmful to the environment, which is also known as the composition effect. Third, higher labor productivity may create more demand for government spending on the environment, which is also identified as the technique effect. Fourth, growing income makes it possible for residents to care more about the environmental quality and demand higher government spending, which is also considered the income effect. In sum, given that the possible effects of government spending on environmental quality are in different directions, and because these four effects may vary remarkably for different pollutants (Lopez et al., 2011; Lopez and Palacios, 2014), the net impacts of government expenditure on the environment may probably be ambiguous and be dependent on the specific pollutant and the country or region under investigation. Consequently, in this study, three typical environmental pollutants are utilized to investigate the impacts of government expenditure on the environmental quality in China.

As shown in Fig. 1, the increasing trends of China's CO_2 emissions, energy consumption and government fiscal spending are very similar in recent decades. Given that China is confronting critical crossroads to further improve its fiscal system and curb extravagant environmental pollution, it is interesting and necessary to investigate the relationship between government spending and environmental pollution in China. However, such investigation has been rare thus far. In this paper, the nexus of government spending and environmental pollution in China is explored for the first time explored, which is the main contribution of this study.

A notable characteristic of China's pollution situation is that significant differences in the severity of pollution across different regions and provinces exist. As shown in Fig. 2, during our sample period (2002–2014), the average levels of per capita soot emissions, which are important contributors to smog and haze pollution in China, exhibit a clear regional pattern: the northern region of China (including the northeastern provinces Jilin and Liaoning, northern provinces of Hebei, Shanxi and Shaanxi, Inner Mongolia autonomous region, and northwestern Xinjiang Uygur autonomous region) suffers from the highest level of pollution, which is followed by the eastern region (e.g., Jiangsu, Zhejiang and Shanghai), while southern China (e.g., Guangdong, Fujian, Hainan, and Guangxi Zhuang autonomous region) has the lowest level of pollution.[1] Given that the environmental pollution generally occurs in urban areas (Zheng et al., 2010) and that remarkable urban-rural differences in economic and social development exist, panel data of 106 Chinese cities over the period between 2002 and 2014 are utilized for the empirical study.

Compared with the conventionally utilized provincial panel data (e.g., Auffhammer and Carson, 2008; Hao and Wei, 2015), city-level panel data have more freedoms and reflect the essential characteristics of the situations of China's pollution and economic development. Therefore, the usage of city-level panel data is another contribution of this study. Furthermore, to ensure the comprehensiveness of the analysis and to explain the characteristics of various pollutants, three different pollutants, Sulfur dioxide (SO_2), Soot and Chemical Oxygen Demand (COD), are chosen as the indicators of environmental quality. These typical pollutants have different characteristics and display different trends and patterns over time. Thus, the investigation of these three different pollutants can depict a relatively comprehensive picture of environmental quality in China. For instance, SO_2 and soot are typical industrial air pollutants, which have been under the control of government for a long time due to the harm to human health, the environment and the ecosystem (Hao et al., 2015; Chen et al., 2016b). Moreover, the smog and haze pollution that shrouded China in recent years is also partly attributed to the transformation of SO_2 after certain chemical

[1] The spatial distributions of the other two pollutants investigated in this study (SO_2 and Chemical Oxygen Demand, COD) are similar to those of soot. Due to the length limit, the maps representing the distributions of per capita emissions of SO_2 and COD are not reported in this article but are available upon request.