Will infrastructure construction cause environmental pollution in China?

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Abstract. Whether it is the historical experience of developed countries or the practice of most developing countries, it has been shown that in the stage of national industrialization and infrastructure construction, environmental pollution will accompany it. With the development of the country's industrialization and the improvement of people's awareness of environmental protection, the discharge of pollutants such as industrial wastewater and waste gas has caused people to pay more attention to environmental issues. This article comprehensively analyzes the impact of infrastructure construction on environmental pollution based on data from eastern China in 2009-2017. The research results show that infrastructure construction has a significant impact on environmental pollution in eastern China. Specifically, infrastructure construction has significantly increased the discharge of industrial wastewater and exhaust gas. Therefore, China needs to pay more attention to certain new pollution sources in the process of increasing infrastructure construction. All regions should strengthen cross-regional environmental protection cooperation and focus on green development.

Keywords: Infrastructure construction; environmental pollution; wastewater; waste gas.

1. Introduction
After nearly 70 years of development since the founding of the People's Republic of China, China's infrastructure construction has achieved many world-renowned achievements in the fields of transportation, energy, communications, and water conservancy. The rapid development of infrastructure has promoted social and economic development quickly and forcefully, and has made important contributions to improving people's living standards. In 1990, China's infrastructure stock assets ranked around 15th in the world, rose to 7th in 2000, and jumped to 3rd in 2010, behind the United States and Japan. By the end of 2017, the cumulative investment in China's urban infrastructure reached 113.68 trillion yuan, and the infrastructure stock has actually ranked first in the world. As of the end of 2018, the mileage of high-speed railways in China exceeded 29,000 kilometers, the number of highways was 142,500 kilometers, and the number of berths above 10,000 tons in coastal ports was nearly 1994. The mileage of urban subways reached 3882 kilometers, ranking first in the world. China's network penetration rate increases by 10% each year, and the amount of direct investment in telecommunications infrastructure construction each year is huge, which directly drives domestic demand of 100 billion yuan. However, with the acceleration of China's industrialization process and the continuous development of
infrastructure, the negative impact of China's infrastructure has gradually emerged. The main reason is that China's infrastructure construction has not fully understood and formed a development model that reflects the requirements of new development concepts such as innovation, coordination, greenness, openness, and sharing. China's infrastructure development model still prioritizes economic benefits, which has led to a series of problems in resources, the environment, and ecology. The weak development of green infrastructure has caused serious environmental pollution due to the discharge of waste water and waste gas. With the promulgation of the National Resource-based City Sustainable Development Plan and the formal implementation of the 2015 Environmental Protection Law, China's environmental protection work will enter a new stage.

Environmental protection, as an important measure to force the economy to "structure restructure", has also received widespread attention in today's society. Some scholars believe that the development of China's infrastructure and the acceleration of the industrialization process, a large number of foreign businessmen choose to develop in China in order to circumvent strict foreign environmental legal constraints, and the consumption of large amounts of resources will undoubtedly increase environmental problems. Y.F. Xia (1999) pointed out earlier that the development of foreign businessmen in China is mainly concentrated in pollution-intensive industries, which has a significant negative effect on China's ecological environment [1]. Other scholars believe that with the rapid construction of infrastructure and the rapid development of industrialization, the country's awareness of environmental protection is becoming stronger and stronger. Environmental regulations will promote the construction of environmental protection infrastructure and help China's environmental improvement. In addition, foreign companies have provided new equipment and new technologies to China [2]. Through technology spillovers, they have played a role as a model for host country enterprises, thereby improving China's environmental quality. In summary, the infrastructure construction has two impacts on the environment. At present, scholars have also studied from various aspects and have achieved fruitful results. Looking at the existing literature, there are still several issues worth exploring. For the eastern region with rapid economic development, how does infrastructure construction affect the environment? Is there a difference between water pollution and air pollution? In view of this, based on the existing literature, this article will use a more scientific spatial measurement research method to select the data analysis of the relationship between infrastructure construction and environmental pollution in the eastern region of 2009-2017, and develop an environmental protection plan for China. And modern urban economic development planning to provide scientific basis and policy recommendations.

2. Model Construction

This article takes the eastern regions of China with higher levels of economic development, including Beijing, Guangdong, Hainan, Jiangsu, and Shanghai as research samples, measures the degree of air pollution by sulfur dioxide (SO2) emissions in various regions, and waste water by region Total emissions indicate the degree of water pollution. In the use of estimation methods, according to empirical research, when the research sample is limited to some specific individuals, the fixed effect model is more suitable [3]. However, this article focuses on environmental issues in eastern China. Therefore, it is reasonable to use the fixed effect model at the same time. Controls year and region effects. The explanatory variable is the level of transportation infrastructure. The interpreted variable includes the level of environmental pollution, and other factors that bring environmental pollution are used as control variables. This article selects the urbanization rate, the ability to deal with harmless domestic waste, the level of economic development, and the industrial structure Control variables, logarithmic processing for variables with larger values, and finally set the following measurement models.

\[
\begin{align*}
\text{Ln(so2)}_i &= \alpha_i + \beta_1 \text{Lnjcs}_i + \beta_2 \text{city}_i + \beta_3 \text{er}_i + \beta_4 \text{Lngdp}_i + \beta_5 \text{str}_i + \varepsilon_i \\
\text{Lnwat}_i &= \alpha_i + \beta_1 \text{Lnjcs}_i + \beta_2 \text{city}_i + \beta_3 \text{er}_i + \beta_4 \text{Lngdp}_i + \beta_5 \text{str}_i + \varepsilon_i 
\end{align*}
\]  

(1) (2)

3. Data source and indicators

The data of infrastructure construction and environmental pollution in the eastern part of this paper mainly come from the statistical yearbooks of provinces (cities). The sample time is from 2009 to 2017.
Environmental pollution level ($so_2, wat$): Select the representative pollutant emission level of sulfur dioxide ($so_2$) as the main indicator to measure air pollution; select the total wastewater discharge ($wat$) to indicate the level of water pollution. Water and air resources are part of our survival and can be used to measure the level of environmental pollution.

Infrastructure construction ($jcs$): Select the total investment in fixed assets (unit: 100 million yuan) to indicate the level of infrastructure construction, and take the logarithm.

Urbanization rate ($city$): The ratio of urban population to total population is used as a measure of urbanization rate.

Harmless treatment capacity of domestic garbage ($er$): Select the harmless treatment rate of domestic garbage as a measure.

Economic development level ($gdp$): Choose per capita GDP as a measure of the level of economic development in a region.

Industrial structure ($str$): Most studies use the output value of the secondary or tertiary industry as a percentage of GDP, but this paper considers the extensiveness of pollutants and uses the research results of Xu Deyun (2008) to refer to the industrial structure index. The calculation method is: where: represents the proportion of the j-th industry's GDP in GDP [4].

Descriptive statistics after processing of each variable are shown in Table 1.

| Variable | Obs | Mean  | Std.  | Min   | Max   |
|----------|-----|-------|-------|-------|-------|
| lnso2    | 95  | 12.7656 | 1.2691 | 9.5660 | 14.4184 |
| lnwat    | 95  | 12.3944 | 0.8652 | 10.4836 | 13.7518 |
| lnjcs    | 99  | 9.4773  | 0.8777 | 6.8960  | 10.9188 |
| er       | 99  | 92.0838 | 10.6760 | 59     | 100   |
| lngdp    | 99  | 11.0192 | 0.4101 | 9.8655  | 11.7675 |
| city     | 99  | 0.6662  | 0.1319 | 0.4374  | 0.8961 |
| str      | 99  | 2.4235  | 0.1563 | 2.1731  | 2.8013 |

It can be seen from Table 1 that the standard deviation of most variables after taking the logarithm of the main variables is relatively small, indicating that the degree of dispersion is small and the data is stable [5]. However, the maximum and minimum values of domestic garbage innocuous treatment capacity are quite different, mainly because the domestic garbage innocuous treatment capacity is weak in Hebei, Liaoning and other places. Compared with Beijing, Jiangsu, Fujian and other places, gap. However, further analysis is generally possible.

4. Results and analysis
The benchmark model (1) is used to perform fixed-effect and random-effect regressions to explore the impact of transportation infrastructure construction on air pollution. It was found that, as a whole, the regression coefficients of the equations were significant at the level of 1%, and the regression results were better, as shown in Table 2.
Table 2. Impact of infrastructure construction on air pollution.

| VARIABLES | (1)          | (2)          | (3)          |
|-----------|--------------|--------------|--------------|
| jcs       | 1.2496***    | 1.7830***    | 1.6646***    |
|           | (0.077)      | (0.111)      | (0.102)      |
| city      | 11.7125***   | 7.9240***    |
|           | (1.766)      | (1.727)      |
| er        | -0.0009      | -0.0003      |
|           | (0.008)      | (0.007)      |
| gdp       | -3.4604***   | -2.7233***   |
|           | (0.518)      | (0.538)      |
| str       | -2.8219***   | -1.9718***   |
|           | (0.858)      | (0.783)      |
| Constant  | 0.9213       | 33.1214***   | 21.5589***   |
|           | (0.735)      | (3.783)      | (4.176)      |
| Observations | 95         | 95           | 95           |
| R-squared | 0.9213       | 0.875        |
| Number of year | 9          | 9            | 9            |
| i         | NO           | NO           | Yes          |
| t         | NO           | NO           | Yes          |

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

It can be seen from Table 2 that when the control variable is not added to column (1), the development of infrastructure construction significantly increases the emissions of SO2, that is, the development of infrastructure significantly increases the degree of air pollution; Controlling variables, the infrastructure construction coefficient is significantly positive, the same conclusion can be reached; column (3) controls the time and industry effects, and the conclusion is still sound. It can be seen from the regression results that the level of urbanization has a significant promotion effect on air pollution, that is, the higher the level of urbanization, the higher the degree of air pollution. Such as the "haze" in Beijing [6].

Fixed effect and random effect regressions were performed on the benchmark model (2) to explore the impact of transportation infrastructure construction on water resource pollution. It is found that the regression coefficients of the equation are significant at the level of 1% as a whole, and the regression results are better.

Table 3. Impact of infrastructure construction on water pollution.

| VARIABLES | (1)          | (2)          | (3)          |
|-----------|--------------|--------------|--------------|
| jcs       | 0.8007***    | 1.1383***    | 1.1244***    |
|           | (0.058)      | (0.084)      | (0.090)      |
| city      | 2.9465**     | 2.2196       |
|           | (1.338)      | (1.529)      |
| er        | -0.0062      | -0.0055      |
|           | (0.006)      | (0.006)      |
| gdp       | -1.6075***   | -1.4022***   |
|           | (0.392)      | (0.476)      |
| str       | 2.2217***    | 2.4530***    |
|           | (0.650)      | (0.693)      |
| Constant  | 4.7906***    | 12.5372***   | 10.2669***   |
|           | (0.558)      | (2.866)      | (3.696)      |
| Observations | 95         | 95           | 95           |
| R-squared | 0.803        | 0.803        |
| Number of year | 9          | 9            | 9            |
| i         | NO           | NO           | Yes          |
| t         | NO           | NO           | Yes          |

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
It can be seen from Table 3 that when the control variable is not added in column (1), the development of infrastructure construction significantly increases the discharge of wastewater, that is, the development of infrastructure significantly increases the level of water pollution; Related control variables, the infrastructure construction coefficient is significantly positive, and the same conclusion can be reached; column (3) controls the time and industry effects, and the conclusion is still sound.

5. Conclusions and countermeasures

Based on the above empirical results, it is found that the construction of infrastructure has significantly increased the level of environmental pollution in China, and it needs to be given full attention. Controlling environmental pollution is related to the physical and mental health of residents and affects economic and social development. It is one of the three major battles to build a well-off society in an all-round way. This article comprehensively analyzes the impact of infrastructure construction on environmental pollution based on data from the eastern region of 2009-2017, and finds that infrastructure construction significantly increased industrial wastewater and exhaust emissions. The research results are of great significance to China's infrastructure construction. China needs to pay more attention to certain new pollution sources in time to increase infrastructure construction and pay attention to green development.

Based on the above conclusions, we give the following policy recommendations:

1) Fully integrate new technologies into infrastructure construction
   Infrastructure has the characteristics of large scale, high investment, long cycle, etc., but the continuous updating of new technologies and processes, and the closer and deeper connection and impact of new technologies and infrastructure, the “advanced” layout of infrastructure Higher requirements are put forward. Intelligent water supply, intelligent power supply, face recognition, vehicle information collection, intelligent manhole covers, intelligent elevators and other intelligent technology application scenarios can help rationally plan and lay out infrastructure and protect various industrial areas, especially municipal, environmental protection, energy, public safety and other infrastructure construction, reduce waste of resources, and incorporate environmental indicators into construction planning can effectively reduce environmental pollution.

2) Strengthening the construction of environmental protection infrastructure
   In order to reduce energy consumption and reduce the level of environmental pollution, China's urban infrastructure construction needs to be transformed and upgraded. In the practical work, it is necessary to adopt the most advanced and applicable technology in conjunction with the situation in China to reconstruct and improve the centralized energy system, and on the basis of meeting the requirements of residents, further improve the environmental quality. At the same time, it is also necessary to vigorously develop clean energy and renewable energy such as solar energy and geothermal energy, which has an irreplaceable role and significance for energy conservation and consumption reduction. In addition, it is necessary to establish a scientific and perfect market mechanism for urban sewage and garbage treatment, create basic conditions for the marketization of urban sewage and garbage treatment, and promote the market-oriented development of urban sewage and garbage treatment. The implementation of urban sewage treatment and waste treatment construction can effectively and quickly improve China's urban environmental pollution problems.

3) Increase the construction of ecological gardens and attach importance to comprehensive and sustainable development
   Ecological garden construction can create a comfortable living environment for residents and promote the green and healthy development of the city. Firstly, the green vegetation in the green ecological garden system can effectively improve the air quality of the city; secondly, it can increase the artistic effect and aesthetics of the urban buildings as a whole. Therefore, in the construction of urban gardens, they should complement each other, make full use of resources, and form beautiful landscapes. The construction of ecological garden is related to the image of the city and the ecological protection of the city, so we must pay attention to it.
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