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Study on the Emission Reduction Effect of Environmental Protection Tax—An Empirical Study Based on the Change of Pollution Charge Standard in China?

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Abstract

This paper reflects the actual effect of China's environmental protection tax by empirically analyzing the environmental effect of the emission fee, in order to provide reference for China's environmental tax reform. Based on the traditional environmental "Kuznets" model, the factor of environmental tax is added to verify the effect of environmental governance of environmental tax. The results show that: 1) the improvement of sulfur dioxide emission charge standard can effectively inhibit industrial sulfur dioxide emission, which verifies the existence of environmental effect of pollution levy policies. 2) The improvement of sewage charge standard has better inhibitory effect on sulfur dioxide emission per unit GDP than on sulfur dioxide emission. 3) There is regional heterogeneity in the "emission reduction" effect of sulfur dioxide emission charges in the eastern, central and western regions of China. Pollutants should be taxed differently according to regional differences. 4) Economic growth and sulfur dioxide emission show an inverted "U" shape, China is still in the stage before the inflection point of EKC. Economic growth still takes environmental damage as the cost, and the "emission reduction" effect of technological progress is not ideal, which reveals the urgency of increasing technological development in the field of green environmental protection under the current situation.

Keywords

Environmental Tax, Environmental Kuznets Model, Emissions Reduction, Pollution Levy Policies

1. Introduction

According to the World Health Organization (WHO), 137 million deaths per year in 2016 were due to environmental pollution, accounting for 24% of global deaths, meaning that a quarter of all global deaths are linked to environmental risks. A clean and healthy environment can reduce the global burden of disease by nearly a quarter (WHO). In particular, the COVID-19 pandemic is a further reminder of the delicate relationship between humans and the planet. China's economic development has shifted from a speed-based efficiency to a quality-based one, and our traditional "high energy consumption and high emission" economic development model will eventually bring about environmental problems that will not only cause huge socio-economic losses, but also endanger public health and may aggravate social inequality (Qi & Lu, 2015).

Theoretically environmental taxes can shift the tax burden from labor and capital elements to pollution emissions and natural resource use (Li & Xiong, 2017). Since China's environmental protection tax only started to be collected in 2018, it is not yet possible to directly use data from China's environmental protection tax to conduct empirical studies to verify the environmental effects of the environmental protection tax. Existing studies on the environmental effects of environmental protection tax mainly simulate and predict the effects of environmental tax reform on economy and environment by constructing general equilibrium analysis models and other methods (He & Li, 2009; Liu & Lv, 2009), for example, (Qin et al., 2015) used environmental economic general equilibrium analysis system to simulate the effects of environmental tax reform on macroeconomy, and pollution emission reduction, and found that environmental tax has a positive effect on pollution emission reduction. Most of the previous studies affirmed the environmental effects of environmental protection tax, but these simulations and prediction studies could only theoretically explain the environmental effects of environmental tax, but could not consider the influence of complex realistic factors on the effect of environmental protection tax, and could not accurately reflect the actual effect of environmental protection tax in China. Whether the environmental tax, as one of the important economic control tools in environmental regulation, can force enterprises to reduce their emissions through price means needs to be studied in depth. Considering that China's environmental protection tax is derived from the "tax burden shifting" of the sewage charge, and that the sewage charge system has been in place for more than ten years, this paper reflects the actual effect of the environmental protection tax in China by empirically analyzing the environmental effects of the sewage charge.

In addition, most of the existing literature discusses the environmental effects of the sewage charging system in China by using the total amount of inter-provincial sewage charges as the measurement index ignoring the endogenous problems that may be caused by the "quantity-based" characteristics of the sewage charges in China (Cui & Liu, 2010), and therefore, it is concluded that the inhibition effect of sewage charge on pollution emission is not obvious. The result is that the disincentive effect of sewage charges on environmental pollution is not obvious. In order to avoid the endogeneity problem between the total amount of sewage charges levied and the amount of pollution emissions, this paper takes the three times of national policies to increase the sewage charges (July 1, 2003 "Regulations on the Administration of Sewage Charges"; 2007 "Notice of the State Council on the Issuance of a Comprehensive Work Plan for Energy Conservation and Emission Reduction" and 2014 "Notice on the Adjustment of Sewage Charges Levy and Other Related Issues") and The differences in the timing of the implementation of the policy and the differences in the provincial emission fee charges in each province are used as a basis to verify the environmental effects of environmental protection tax in China from the perspective of exploring the study of the environmental effects of changes in the emission fee levy standards.

2. Study Design

2.1. Model Design

In order to provide a preliminary understanding of the relationship between economic growth, emission levy standards and sulfur dioxide emissions, the changes in emission levy standards and sulfur dioxide emissions, and GDP per capita and sulfur dioxide emissions are depicted as scatter plots respectively. The scatter plot shows that the higher the standard of sewage charges, the lower the sulfur dioxide emissions (**Figure 1**), and the relationship between sulfur dioxide emissions and China's GDP per capita is inverted "U" (**Figure 2**), which coincides with the shape of the Environmental Kuznets Curves (EKC). Environmental

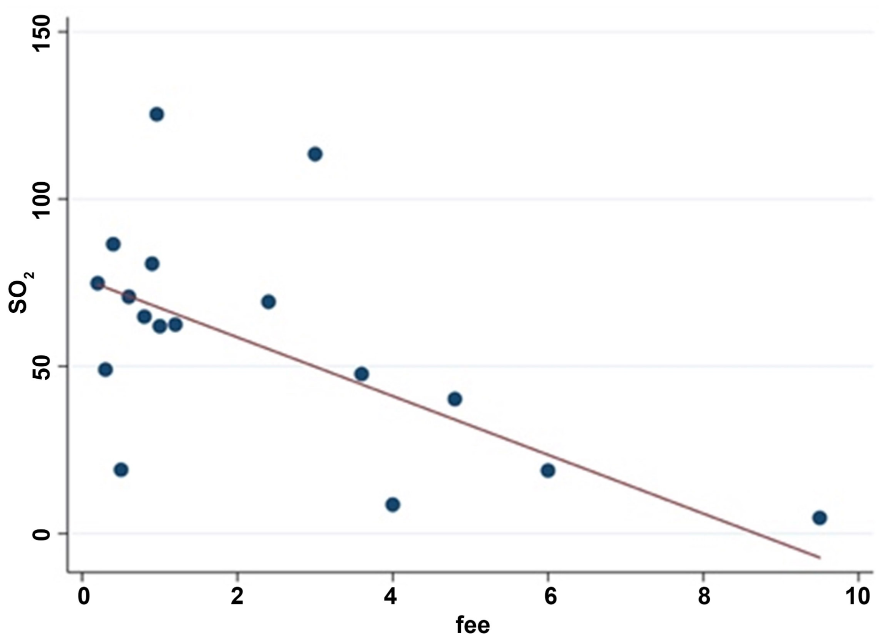

Figure 1. Relationship between emission fee collection standards and SO_2 emissions in China, 2004-2017.

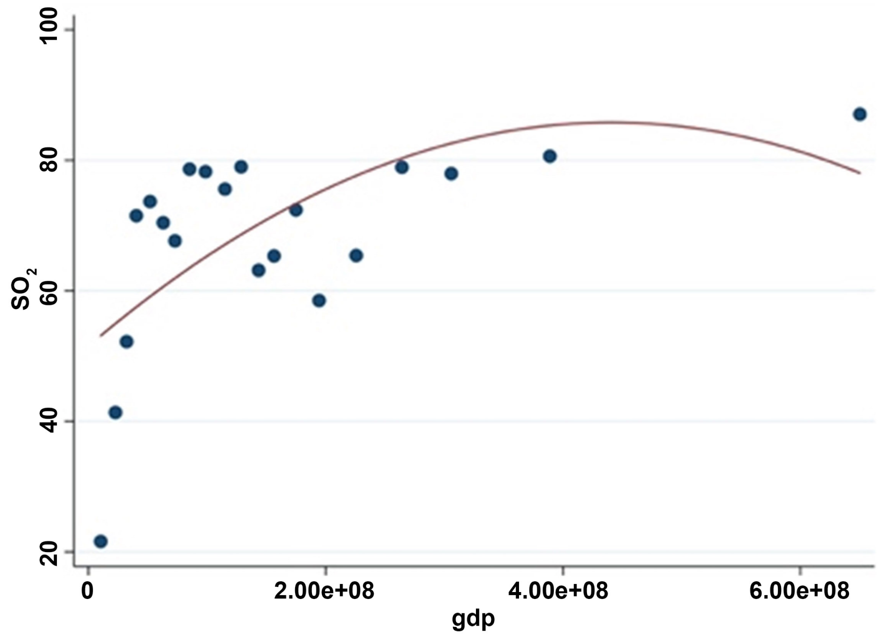

Figure 2. Relationship between GDP per capita and sulfur dioxide emissions in China, 1999-2017.

Kuznets theory considers that economic development inevitably destroys the environment ignoring the dynamics of technology, preferences and environmental investments, while over time, environmental degradation decouples from economic development (Panayotou, 1993). At higher levels of economic development, structural economic changes toward information and services industries, more efficient technologies and increased demand for environmental quality lead to a trend toward a steady decline in the extent and rate of environmental degradation (Stern, 2015).

Based on the above empirical facts, this paper adds the factor of environmental taxation to the traditional environmental "Kuznets" model to verify the effect of environmental taxation on environmental governance.

The form of the EKC model traditionally used for panel data analysis includes factors other than economic development that affect environmental quality.

$$\ln En_{it} = \beta_0 + \beta_1 \ln Ec_{it} + \beta_2 \left(\ln Ec_{it}\right)^2 + \beta_3 \left(\ln Ec_{it}\right)^3 + Y_{it} + \gamma_{it} \quad (1)$$

In the equation above, En_t is the environmental pollution situation of a region at time t, which is generally expressed by pollution emission or environmental quality index. β_0 is a specific parameter related to the region; Ec_t is the economic output of the region at time t, which is often measured by GDP or GDP per capita. β_1, β_2 is the parameter.

According to the relevant theoretical and empirical analysis, the model of environmental tax's environmental governance effect is as follows.

$$\begin{aligned} \ln enq_{it} = {} & \beta_0 + \beta_1 \ln ent_{it} + \beta_2 \ln gdp_{it} + \beta_3 \ln gdp_{it}^2 + \beta_4 \ln indu_{it} \\ & + \beta_5 \ln rd_{it} + \gamma_{it} + \alpha_i \end{aligned} \quad (2)$$

In which, *i*, *t* represents province and time, α_i, γ_{it} represent unobservable individual effects, random error terms, respectively. *enq* represents environmental pollution level; *ent* represents environmental tax intensity; *gdp*, *ind*, *rd* are control variables, which represent economic development level, industrial structure, and technological innovation level, respectively. *gdp* squared term is added to test whether the environmental Kuznets hypothesis holds.

2.2. Description of Data Sources and Variables

2.2.1. Data Sources

In this paper, panel data of 30 provinces, cities and autonomous regions (excluding Hong Kong, Macao and Taiwan; Tibet Autonomous Region is excluded due to some missing data) from 2004 to 2017 are selected for empirical testing, spanning a period of 14 years. All raw data were obtained from the China Statistical Yearbook of Industrial Economy, China Statistical Yearbook, China Statistical Yearbook of Environment, China Statistical Yearbook of Science and Technology, the website of China Statistics Bureau (http://data.stats.gov.cn/) and provincial government websites. The sample is representative and the data sources are reliable.

2.2.2. Variable Description

Explanatory variables. Environmental pollution level (*enq*): industrial sulfur dioxide emissions and sulfur dioxide emissions per unit of GDP were selected as the explanatory variables to make an empirical test of the environmental effects of environmental taxes in China. The reason for choosing industrial SO_2 emissions as an indicator of environmental quality is that SO_2 emissions are mainly from industrial production, and China's environmental regulatory system has only just been completed, which has a limited role in regulating polluting consumption behavior. The inclusion of sulfur dioxide per unit of GDP is to explore the impact of the levy rate on the green efficiency of production activities.

Main explanatory variables. Environmental tax (*ent*): At present, there are different definitions of environmental tax in a broad sense and in a narrow sense. The environmental tax in a narrow sense is mainly based on the theory of environmental externality and the theory of Pigou tax, which refers to the tax levied specifically on certain environmental pollution behaviors; the environmental tax in a broad sense also includes other taxes related to the environment other than those levied on specific pollution behaviors. China's environmental tax is based on the policy of "sewage charge" and the principle of "tax burden shifting", so before the Environmental Protection Tax Law, the sewage charge actually played the role of environmental tax in China. Therefore, the environmental effect of environmental tax is investigated by using the emission fee rate as the main explanatory variable.

Control variables. Level of economic development (*gdp*): higher levels of economic activity (production and consumption) require more energy and material inputs and produce more waste by-products. Environmental quality is influenced by economic activities, and economic development affects environmental quality mainly through scale, technological and structural effects (Grossman & Krueger, 1992). Therefore, this chapter uses the level of economic development as one of the control variables and the real GDP after price deflating as a measure of the level of economic development.

Industrial structure (industry): As the economic level increases, the industrial structure will also change. There is a strong dependency between the environment and industry in China (Si & Cao, 2021) and the impact on environmental quality in the process of industrial structure change is the structural effect of economic growth on environmental quality. In general, the greater the share of industrial output in the economy, the more serious the pollution caused to the environment (Cai & Li, 2009). Therefore, in this paper, the ratio of the output value of secondary industry divided by GDP is used as an indicator of industrial structure.

Level of technological innovation (*rd*): the speed and direction of technological change is one of the important factors affecting environmental problems (Jaffe, Newell, & Stavins, 2000), and the number of patents for technological R&D reflects the level of technological innovation, but since it is difficult to obtain data on patent grants in the field of energy conservation and emission reduction, this paper measures the level of technological innovation by the number of granted patent applications per capita (Yu & Li, 2018; Xue & Wu, 2014).

3. Analysis of Empirical Results

3.1. Descriptive Statistics

This paper studies the relationship between environmental taxes and environmental pollution. Since the panel data have corresponding cross-sectional data at the time series level at the same time, problems such as non-linearity and non-smoothness are likely to exist, so this paper uses the natural logarithm method to process the data, ln denotes the previous scale of the data variables, and the descriptive statistics of the processed variables are shown in **Table 1**, and the data show that there are large differences between the relevant indicators in various provinces and cities across the country.

3.2. Analysis of Regression Results

According to existing studies, the environmental protection tax effect may have

Table 1. Results of descriptive statistics of variables.

Variables	Mean	Median	Minimum	Maximum	Standard deviation	Skewness	Kurtosis	Sample size
ln*enq*	3.899	4.045	−0.755	5.299	0.975	−1.530	5.949	420
ln*gdp*	10.302	10.402	8.366	11.767	0.673	−0.224	2.481	420
ln*ent*	−0.312	−0.511	−1.609	2.251	0.609	1.021	6.731	420
ln*rd*	0.568	0.583	−2.358	3.748	1.315	0.138	2.343	420
ln*indu*	−0.789	−0.740	−1.660	−0.527	0.206	−1.954	7.100	420

regional heterogeneity (Ciaschini et al., 2012; Zheng, 2019). Therefore, in order to investigate whether there is regional heterogeneity in the environmental effects of sewage charges, after regressing 30 provinces and cities across China, this paper will follow the classification criteria of the National Bureau of Statistics for the three major economic zones in China, and divide 30 provinces and cities (excluding Hong Kong, Macao and Taiwan; Tibet Autonomous Region is excluded due to some missing data) into After regressing the 30 provinces and cities (excluding Hong Kong, Macau and Taiwan; Tibet Autonomous Region is excluded due to some missing data), this paper will divide them into East, Central and West regions to further investigate the heterogeneity of the environmental effects of environmental taxes in the three major economic zones in China.

Table 2 shows the regression results of the fixed effects model, where columns (1)-(4) show the regression results for the national level and the east, central and western regions respectively under the explanatory variable of sulfur dioxide emissions. It can be found that the estimated results of the variable ln*ent* are significantly negative, indicating that the increase in the sulfur dioxide emission fee levy effectively suppresses the sulfur dioxide emissions. At the national level, the estimated coefficient of the variable ln*ent* is −0.192 and passes the 1% significance test, indicating that for each percentage point increase in sulfur dioxide emission fee, sulfur dioxide emissions will be reduced by 0.192 percentage points. Columns (2)-(4) show the regression results for the East, Central and West regions, respectively, and it is found that the regression results of the variable ln*ent* are significantly negative in the East, Central and West regions, but not in the West region. The increase of emission fee standard in the western region fails to

Table 2. Regression results.

Explanatory variables	Sulfur Dioxide				sulfur dioxide per unit of GDP			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln*ent*	−0.210*** (−4.30)	−0.186*** (−2.95)	−0.464*** (−5.20)	−0.048 (−0.51)	−0.218*** (−4.94)	−0.208*** (−3.35)	−0.455*** (−5.01)	−0.075 (−0.81)
(ln*gdp*)^2	−0.195*** (−4.72)	−0.428*** (−4.37)	−0.659*** (−6.31)	−0.130 (−1.94)	−0.243*** (−5.93)	−0.488*** (−5.08)	−0.669*** (−6.30)	−0.162** (−2.49)
ln*gdp*	3.855*** (4.71)	8.442*** (4.23)	13.437*** (6.28)	2.751** (2.09)	3.794*** (4.69)	8.667*** (4.42)	12.605*** (5.79)	2.38* (1.87)
ln*rd*	−0.087 (−1.22)	0.250* (1.74)	−0.198** (−2.31)	−0.303** (−2.33)	−0.096 (−1.36)	0.235* (1.67)	−0.195*** (−2.24)	−0.313* (−2.48)
ln*industry*	1.282*** (6.03)	2.464*** (5.09)	0.121 (0.51)	1.186*** (2.94)	1.308*** (6.23)	2.533*** (5.32)	0.144** (0.59)	1.227*** (3.13)
Prob > F:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F-test:	49.94	39.65	33.23	58.02	31.17	19.29	23.81	32.92
R-squared:	0.5151	0.6753	0.6226	0.4176	0.8709	0.8897	0.9178	0.8809

significantly reduce SO_2 emissions, which indicates that regional differences should be taken into account when setting environmental tax standards in order to achieve the expected "green effect".

4. Further Discussion

In order to further investigate the environmental effects of environmental taxes, the regression results are shown in columns (5)-(8) of Table 2, with the "green efficiency" of production activities as the explanatory variable again for the whole country and the East, Central and West regions. The regression results, it can be found that the estimation of the variable ln*ent* is significantly negative, indicating that the increase of sulfur dioxide emission fee levy standard has effectively suppressed the sulfur dioxide emission. At the national level, the estimated coefficient of the variable ln*ent* is −0.218 and passes the 1% significance test, indicating that for each percentage point increase in sulfur dioxide emission charges, sulfur dioxide emissions per unit of GDP will be reduced by 0.218 percentage points. Comparing the results in columns (1) and (5), it can be found that the effect of the increase in the emission fee standard on reducing sulfur dioxide per unit of GDP is better than the effect of reducing total sulfur dioxide emissions, which indicates that the increase in the emission fee levy standard is conducive to improving the green efficiency of China's economic growth, but because China's economy is still in a period of rapid growth, the emission reduction effect of the increase in the emission fee standard on total sulfur dioxide emissions However, since China's economy is still in a period of rapid growth, the emission reduction effect of the increase in emission charges on total SO_2 emissions is partly offset by the expansion of economic production scale, resulting in the emission reduction effect of emission charges on total SO_2 emissions is slightly weaker than that on SO_2 emissions per unit of GDP.

Columns (6)-(8) show the regression results for the east, central and western regions, respectively, and it can be found that similar results are presented when the explanatory variable is sulfur dioxide emissions per unit of GDP, i.e., the increase in emission charges in the east and central regions significantly reduces sulfur dioxide emissions per unit of GDP, while this effect is not obvious in the western region, which once again verifies that the environmental effect of emission charges " regional heterogeneity" of the environmental effects of emission charges. The analysis of the control variables shows that the squared GDP of each region is correlated with the level of environmental pollution at the 1% significance level, both with sulfur dioxide emissions as the explanatory variable and with sulfur dioxide emissions per unit of GDP as the explanatory variable, and the correlation coefficient is negative, this result indicates that the relationship between economic growth and the level of environmental pollution in China is This result indicates that the relationship between economic growth and environmental pollution levels in China is of "inverted U" shape, and this result is consistent with the hypothesis of environmental Kuznets hypothesis. This result indicates that China is still in the stage before the inflection point of the environmental Kuznets curve, and the economic growth is still at the cost of environmental damage. The regression results for the east, central and west regions also confirm this conclusion.

Industrial structure is correlated with environmental pollution level at 1% significance level and shows a positive correlation. The same results were obtained for sulfur dioxide emissions per unit of GDP as the explanatory variable. The regression results for the level of technological innovation and environmental pollution level at the national level are negative but not significant, indicating that the emission reduction effect brought by technological progress is not significant at present, while in the regression results for the central and western regions, technological progress and environmental pollution level are both significantly negatively correlated, i.e., technological progress is conducive to green economic development and helps to reduce the pollution level in the central and western regions. In the regression results for the eastern region, the explanatory variable of technological progress is positive and significantly correlated at the 10% significance level, which means that technological progress in China also completes the transformation from pollution-based to technology-based (Xie, 2021). According to the Annual Report on Environmental Statistics 2016-2019, "China's sulfur dioxide emissions decreased by 46.5% from 8.549 million tons in 2016 to 4.573 million tons in 2019. While sulfur dioxide emissions in the eastern region have increased with technological progress, the impact of technological progress on sulfur dioxide emissions in the eastern region has increased rather than decreased, probably due to the diminishing marginal utility of technological progress on the effect of sulfur dioxide emission reduction, and the current technological progress in the field of environmental protection is close to the peak in terms of sulfur dioxide emission reduction in the eastern polluting enterprises, so at this time the eastern polluting industries may experience an increase in pollution emissions of the increase, which urgently requires the East to continue to accelerate the pace of technological innovation, higher technology to further reduce the emissions of polluting industries.

5. Research Conclusion and Implications

This paper analyzes the impact of the sewage charge levy standard on the emission of environmental pollution pollutants based on the three national policies to raise the sewage charge standard and the differences in the time of implementing the policy and the provincial sewage charge standard in each province, so as to verify the environmental effects of environmental protection tax in China. The results found that:

First, the increase of the emission fee standard can effectively reduce the level of sulfur dioxide emissions and sulfur dioxide emissions per unit of GDP in China, which indicates that the increase of the emission fee standard not only helps to reduce the level of pollution in China, but also helps to improve the "green efficiency" per unit of GDP, and the effect of the increase of the sulfur dioxide emission fee standard on improving the "green efficiency" per unit of GDP is better than the effect of reducing sulfur dioxide emissions.

Secondly, the regressions on the east, middle and west regions of China show that there is "regional heterogeneity" in the effect of sulfur dioxide emission reduction, both in terms of sulfur dioxide emissions as the explanatory variable and sulfur dioxide emissions per unit of GDP as the explanatory variable, suggesting that the environmental tax reform needs to be "tailored to local conditions", in other words, the tax standards for pollutant emissions should be set differently according to the environmental carrying capacity, industrial structure and economic development level.

Third, the square of GDP is negatively correlated with the level of environmental pollution. The level of economic development is positively correlated with the level of environmental pollution. This result indicates that the relationship between economic growth and environmental pollution level in China is in the shape of "inverted U", which is consistent with the hypothesis of environmental Kuznets hypothesis. China is still at the stage before the inflection point of the environmental "Kuznets" curve, and the technological progress is not ideal for reducing sulfur dioxide emissions, and the growth of economic scale still brings a lot of pollutions, which indicates that the current technology level of green environmental protection is not effective in reducing pollutant emissions. In order to realize the "double dividend" of environmental protection tax, we should increase the support for "green" technology to reduce the pollution emission level by technological progress.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Cai, H., & Li, H. (2009). Per Capita Income, Industrial Structure and Environmental Quality—An Analysis Based on EKC Curve. *Economy and Management, 23,* 15-17+34.

Ciaschini, M., Pretaroli, R., Severini, F. et al. (2012). Regional Double Dividend from Environmental Tax Reform: An Application for the Italian Economy. *Research in Economics, 66,* 273-283.

Cui, Y., & Liu, X. (2010). Provincial Tax Competition and Environmental Pollution in China—An Analysis Based on Panel Data from 1998-2006. *Financial Research, 36,* 46-55.

Grossman, G. M., & Krueger, A. B. (1992). *Environmental Impacts of a North American Free Trade Agreement* (Discussion Papers No. 8, pp. 223-250). Centre for Economic Policy Research.

He, J., & Li, S. (2009). Analysis of the Impact of Environmental Tax Policy on Energy Conservation and Emission Reduction. *Quantitative and Technical Economic research, 26,* 31-44.

Jaffe, A. B., Newell, R. G., & Stavins, R. N. (2000). Technological Change and the Environment. *Environmental Resource & Economics, 22,* 461-516.

Li, H., & Xiong, Z. (2017). Ecological Occupation, Green Development and Environmental tax reform. *Economic Research, 52,* 124-138.

Liu, F., & Lv, Z. (2009). Optimal Environmental Taxation and Its Supporting Policies in the Framework of Economic Growth—A Simulation Based on Chinese Data. *Management World, 6,* 40-51.

Panayotou, T. (1993). Empirical Tests and Policy Analysis of Environmental Degradation at Different Stages of Economic Development. *Pacific and Asian Journal of Energy, 4,* 23-42.

Qi, Y., & Lu, H. (2015). Pollution, Health and Inequality—Beyond the "Environmental Health Poverty" Trap. *Management World, 9,* 32-51.

Qin, C., Wang, J., Ge, C., Gao, S., & Liu, Q. (2015). The Impact of Environmental Taxation on Economy and Pollution Emissions. *China Population-Resources and Environment, 25,* 17-23.

Si, L., & Cao, H. Y. (2021). A Study on the Measurement of Pollution Reduction and Industrial Development under the Emissions Trading System. *Quantitative Economic and Technical Economics Research, 38,* 107-128.

Stern, D. I. (2015). The Environmental Kuznets Curve after 25 Years. *CCEP Working Papers, 19,* 1-22.

Xie, R. (2021). Green Technology Progress, Positive Externalities and Environmental pollution Management in China. *Management Review, 33,* 111-121.

Xue, J. N., & Wu, P. E. L. (2014). Technological Progress, Technology Industrialization and Carbon Emission Efficiency-Analysis Based on Inter-Provincial Panel Data in China. *Shanghai Economic Research,* 11-119.

Yu, J. X., & Li, X. (2018). An Empirical Study on the Effect of Environmental Protection Tax on Emission Reduction in China. *Tax Economic Research, 23,* 76-82.

Zheng, S.-M. (2019). How Do Environmental Policies Affect Environmental Quality?—Evidence Based on Provincial Panel Data. *China Soft Science, No. 2,* 49-61+92.