

Research on Pollution Control Effect of Environmental Protection Tax in China

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Abstract

Based on the panel data of 30 provinces in the country from 2010 to 2020, this paper uses the fixed effect model to study the impact of environmental protection tax on the emissions and production of industrial three wastes on the basis of pollution charges. The results show that the income of environmental protection tax has a significant inhibitory effect on the emission of industrial waste gas and industrial solid waste, while the inhibitory effect on the emission of industrial waste water is not significant. In this regard, based on the current situation of China's environmental protection tax development, suggestions are put forward to gradually expand the scope of collection, improve the tax standard, improve the installation rate of automatic monitoring equipment and develop energy conservation and environmental protection industry.

Keywords

Environmental protection tax; Three industrial wastes; Pollution control.

1. Introduction

In recent years, with the continuous acceleration of China's industrialization and urbanization process, serious environmental pollution problems have been caused, especially the massive discharge of industrial waste water, industrial exhaust gas and industrial solid waste, which endangers people's health and safety and is not conducive to the sound development of economic society. In the face of such a severe environmental situation, China has issued a series of policies and began to levy environmental protection tax in 2018, which also means that no pollution charges will be imposed. The report of the 20th CPC National Congress also pointed out that we should promote green development and promote the harmonious coexistence of human and nature. It put forward the requirement to further promote the prevention and control of environmental pollution, and continue to fight well in the defense of blue sky, blue water and pure land. Nevertheless, it is still difficult to effectively control the discharge of industrial wastes from the source. Therefore, studying the pollution control effect of China's environmental protection tax on industrial wastes has certain practical significance for the further development of environmental protection tax in the future and even for the realization of China's ecological civilization strategy.

With the introduction of environmental protection tax in 2018, many domestic scholars introduced models to empirically analyze the pollution control effect of environmental protection tax, and put forward a series of improvement suggestions on this basis. Zhou Bo et al. Sun Xinyue (2022) studied the national and regional data respectively, but found that the pollutant emissions were not significantly affected by environmental protection tax and were

positively correlated with tax revenue. Xue Gang et al. (2020) introduced the linear regression model and the "inverted U" curve model respectively, and found that it is difficult to fully realize the emission reduction effect of air pollutants and water pollutants according to the current collection standards. Xu Yingzhi et al. (2019) constructed a panel threshold regression model and found that there was an obvious threshold effect between environmental protection tax and haze pollution, and the impact of different environmental protection tax indexes on haze pollution was also different. Yu Jiayi and Li Xin (2018), in order to solve the endogenous problem, chose to delay the emission fee by one period, and forecast the policy effect of environmental protection tax with the emission fee. Liu Ye and Zhang Xunchang (2018), from the perspective of the emission fee collection standard, found that raising the sulfur dioxide collection standard has a significant inhibitory effect on sulfur dioxide emissions, but there are regional differences. Li Xuhong and Zheng Zhen (2015) studied the relationship between the actual tax rate of pollutant discharge fee and pollutants, and found that the increase of the actual tax rate would help reduce the emission of pollutants. Tian Yulin and Ma Juhua (2022) proposed to optimize the tax rate and expand the scope of taxation in view of some problems existing in the current environmental protection tax. Huang Hong and Zhang Shijing (2020) put forward suggestions on the improvement of environmental protection tax from the aspects of tax system and tax collection and management. They should adjust the scope of tax collection and increase the cooperation between ecological and environmental departments and tax authorities.

2. Theoretical Analysis and Research Assumptions

2.1. Negative externalities of environmental pollution

The externality theory was first proposed by Marshall, which was mainly used to study the impact of external factors on the development of enterprises. Later, it was improved through further research and analysis by Pigou. Externalities are also called externalities and spillovers, including positive externalities and negative externalities. Positive externality means that one's behavior brings benefits to the society, but does not obtain the cost that others need to bear. Negative externality means that a person's behavior has caused certain losses to the society, but does not have to pay corresponding costs for this part of losses. With the advancement of industrialization and urbanization, many manufacturing enterprises directly discharge a large number of industrial pollutants without treatment, causing serious environmental pollution. Environmental pollution is characterized by negative externalities. Pollutant enterprises only need to pay the cost of production, while the consequences of environmental pollution are borne by the society. Therefore, imposing environmental protection tax on pollution discharging enterprises can realize internalization of external costs, standardize the production and pollution discharging behavior of enterprises, and reduce environmental pollution.

2.2. Dual dividend characteristics of environmental protection tax

Pierce formally put forward the concept of "double dividend" in 1991. The theory of "double dividend" is one of the theoretical prerequisites for the levy of environmental protection tax, which means to effectively curb pollution, improve environmental quality and realize the effect of "green dividend" by imposing environmental protection tax on pollutant discharging enterprises; It also uses tax revenue to slow down the distortion of the current tax system on capital and labor, improve social employment rate and people's living standards, and realize the "blue dividend" effect. It is of great significance for the continuation of human ecological civilization to increase the tax cost of enterprises by taxing polluting enterprises, and to give full play to the economic leverage of taxation to regulate the pollution behavior of enterprises. On the other hand, the environmental protection tax collected should be earmarked, and a special environmental protection fund should be established to strengthen the treatment of

environmental pollution. Based on practical factors, whether the environmental protection tax can really play a "green dividend" effect and achieve pollution reduction requires further data collation and empirical analysis to conduct in-depth research.

To sum up, this paper puts forward the research hypothesis: China's environmental protection tax levied on pollutant discharging enterprises can effectively curb the emission of industrial pollutants, achieve the goal of green dividend, and play its pollution control effect.

3. Analysis of Pollution Control Effect of Environmental Protection Tax

3.1. Research design

3.1.1. Variable selection and data source

On January 1, 2018, China's environmental protection tax law was formally implemented, which also means that the collection of pollution charges has become history. When studying the pollution control effect of environmental protection tax, the academia mostly uses the "three industrial wastes" to reflect the emission of pollutants, while the taxable pollutants specified in the environmental protection tax law include air pollutants, water pollutants and solid waste, so it is more reasonable to choose the "three industrial wastes" indicator. From the perspective of China's industrialization process, the economic and social development cannot be separated from the development of the secondary industry. In addition, the per capita GDP, total foreign investment and total energy consumption of each region will affect the emission of industrial pollutants. Based on the availability of data and the convenience of data processing, this paper will take logarithms of data and conduct empirical research.

Explained variable: Most of the pollutants come from industrial pollution, so this paper selects three indicators of industrial wastewater discharge (Water), industrial waste gas discharge (SO₂) and industrial solid waste generation (Waste) as the explained variable. Among them, industrial sulfur dioxide emission is selected as the indicator of industrial waste gas emission. Considering that the data of industrial solid waste emissions is difficult to obtain, the indicator of industrial solid waste emissions is selected.

Explanatory variable: This paper studies the pollution control effect of environmental protection tax, so the environmental protection tax income (Tax) is used as the explanatory variable. Most of the tax objects, tax items and tax standards of environmental protection tax take the pollution charge as the reference standard, so the data before 2018 corresponds to the pollution charge income, while the data after 2018 corresponds to the environmental protection tax income.

Control variables: First, per capita gross regional product (PGDP). The environmental Kuznets curve reflects the relationship between per capita income and environmental pollution, so the per capita GDP is used to reflect the income change of residents in each province. Second, the proportion of the secondary industry. The rapid development of industrialization will lead to environmental pollution problems. The secondary industry is mostly dominated by traditional industries, so the indicator of the proportion of the secondary industry is adopted. Third, total foreign investment. The "Pollution Paradise Hypothesis" indicates that enterprises engaged in pollution-intensive industries tend to build in countries or regions with low environmental threshold requirements, so the total amount of foreign investment will affect the environmental quality. Fourth, total energy consumption. Referring to the research method of Zhang Xin (2020), the total energy consumption index is selected as one of the control variables.

Among them, the data of the explanatory variables and the explained variables are from the China Environmental Statistics Yearbook, the China Environmental Statistics Yearbook, the China Tax Yearbook and the statistical yearbooks of each province, and the data of the control

variables are from the China Statistical Yearbook, the China Energy Statistics Yearbook and the China Trade and Foreign Economic Statistics Yearbook.

The following table shows the specific explanation of each indicator of the model:

Table 1. Specific indicators in the model

Variable type	Variable name	Index	Unit
Interpreted variable	<i>lnWater</i>	Industrial wastewater discharge	10000 tons
	<i>lnSO₂</i>	Industrial exhaust emissions	10000 tons
	<i>lnWaste</i>	Industrial solid waste output	10000 tons
Explanatory variable	<i>lnTax</i>	Environmental protection tax	10000 yuan
Control variable	<i>lnGDP</i>	Per capita GDP	RMB100mn
	<i>lnSecond</i>	Proportion of secondary industry	%
	<i>lnInvest</i>	Total foreign investment	USD100mn
	<i>lnEnergy</i>	Total energy consumption	10000 tons

3.1.2. Model setting

Based on the panel data of 30 provinces (cities, autonomous regions) in the country from 2010 to 2020, this paper selects the fixed effect model, and constructs three models with three types of industrial pollutant emissions as the explanatory variables to verify the pollution control effect of environmental protection tax. The model built in this paper is as follows:

Model 1: Analyze the impact of environmental protection tax (Tax_{it}) on industrial wastewater discharge ($Water_{it}$).

$$lnWater_{it} = \beta_0 + \beta_1 lnTax_{it} + \beta_2 lnPGDP_{it} + \beta_3 lnSecond_{it} + \beta_4 lnInvest_{it} + \beta_5 lnEnergy_{it} + \varepsilon_{it} \tag{1}$$

Model 2: Analyze the impact of environmental protection tax (Tax_{it}) on industrial exhaust emissions (SO_{2it}).

$$lnSO_{2it} = \beta_0 + \beta_1 lnTax_{it} + \beta_2 lnPGDP_{it} + \beta_3 lnSecond_{it} + \beta_4 lnInvest_{it} + \beta_5 lnEnergy_{it} + \varepsilon_{it} \tag{2}$$

Model 3: Analyze the impact of environmental protection tax (Tax_{it}) on the amount of industrial solid waste ($Waste_{it}$).

$$lnWaste_{it} = \beta_0 + \beta_1 lnTax_{it} + \beta_2 lnPGDP_{it} + \beta_3 lnSecond_{it} + \beta_4 lnInvest_{it} + \beta_5 lnEnergy_{it} + \varepsilon_{it} \tag{3}$$

Where, i represents the sectional unit of each province (city, autonomous region), i=1,2,3, 30; T is the year, t=2010, 2011,....., 2020; $lnWater_{it}$ is the logarithm of industrial wastewater

discharge, $\ln SO_{2it}$ is the logarithm of industrial exhaust emissions, $\ln Waste_{it}$ is the logarithm of industrial solid waste production; $\ln Tax_{it}$ represents the logarithm of environmental protection tax revenue, $\ln PGDP_{it}$ represents the logarithm of GDP per capita, $\ln Second_{it}$ represents the logarithm of the secondary industry, $\ln Invest_{it}$ represents the logarithm of total foreign investment, $\ln Energy_{it}$ represents the logarithm of total energy consumption; ε_{it} represents random perturbation term.

3.2. Empirical analysis

3.2.1. Stability test

In order to check the stability of the panel data and prevent the possibility of false regression when using the panel data modeling, the unit root test should be carried out on the panel data. In this paper, the LLC test method is used. According to the test results, the P value of all variables is significant at the 5% significance level, and the original hypothesis is rejected. Therefore, all variables can be considered to be stable.

3.2.2. Analysis of regression results

According to the regression results in Table 2, the impact coefficient of environmental protection tax revenue on the emissions of industrial waste gas and industrial solid waste is negative, indicating that the environmental protection tax has played an inhibiting role on the emissions and production of these two types of pollutants. For every 10000 yuan increase in environmental protection tax, the discharge of industrial wastewater will increase by 10.57 million tons. It can be seen that environmental protection tax has no emission reduction effect on industrial wastewater emissions. The reason may be that some water pollutants are not included in the scope of taxation at present, and the tax rate of environmental protection tax is low, resulting in the phenomenon that the tax cost of enterprises is lower than the cost of pollution reduction, and the pollution control effect of environmental bond is not played.

In the control variables, the per capita GDP is negatively correlated with the discharge of industrial wastewater and industrial exhaust gas. According to the environmental Kuznets curve, when the economic development reaches a certain level, with the further increase of per capita income, the discharge of industrial pollutants will gradually decrease and the degree of environmental pollution will gradually slow down. With the continuous improvement of regional GDP, part of the funds can be used to develop energy-saving technologies and further reduce pollutant emissions. For every 1% increase in the proportion of the secondary industry, the discharge of industrial waste water will increase by 121.88 million tons, the discharge of industrial waste gas will increase by 331.8 million tons, and the output of industrial solid waste will increase by 119.9 million tons. The secondary industry is dominated by traditional manufacturing industry, so the higher the proportion of the secondary industry, the more industrial pollutant emissions. The impact coefficient of total foreign investment on industrial wastewater emissions, industrial exhaust emissions and industrial solid waste emissions is negative, which is not consistent with the "pollution paradise hypothesis". China attracts foreign investment by virtue of cheap labor force and broad consumer market. Foreign investment projects are not only high pollution and high energy consumption projects, but also a large number of foreign investment introduction has brought advanced energy-saving technology and experience to Chinese enterprises (Xu Yingzhi et al., 2019), reducing the impact of pollutants on the environment to a certain extent. The coefficients of the total energy consumption are all positive, indicating that with the increase of the total energy consumption, the emissions and production of the three types of pollutants have an obvious increasing trend. This also shows that enterprises need to further improve the energy utilization rate in the industrial production process.

Table 2. Model regression results

Variable	Model 1	Model 2	Model 3
<i>lnTax</i>	0.1057** (4.0597)	-0.2915** (-4.5745)	-0.1015** (-3.6384)
<i>lnGDP</i>	-0.4160** (-3.8948)	-1.4712** (-7.3897)	0.1574*** (1.8052)
<i>lnSecond</i>	1.2188** (5.8735)	3.3180** (8.5502)	0.1199 (0.7055)
<i>lnInvest</i>	-0.0676 (-1.5886)	-0.330641** (-4.1578)	-0.0166 (-0.4769)
<i>lnEnergy</i>	0.2926*** (1.7411)	1.5039** (4.7858)	1.2448* (9.0475)
R^2	0.9459	0.9056	0.9702
F-test	151.1745	83.2355	289.7639

Note: ***, ** and * indicate that they have passed the significance level test of 10%, 5% and 1% respectively.

4. Conclusions and Suggestions

4.1. Conclusions

Based on the provincial panel data from 2010 to 2020, this paper constructs the measurement models of industrial wastewater emissions, industrial exhaust emissions and industrial solid waste emissions, and empirically studies the pollution control effect of environmental protection tax. The research results show that the environmental protection tax revenue has a significant inhibitory effect on the emission of industrial waste gas and the production of industrial solid waste, while the inhibitory effect on the emission of industrial waste water is not significant.

Since the fee was changed to tax in 2018, China has made great achievements in the practice of environmental protection tax. The report of the 20th National Congress of the Communist Party of China once again mentioned the goal of carbon peak and carbon neutrality. In order to better realize this goal and give full play to the pollution control effect of environmental protection tax, we can improve the tax scope, tax rate setting, industrial structure and other aspects.

4.2. Suggestions

(1) Gradually expand the scope of taxation. The above empirical results show that the levy of environmental protection tax has not significantly inhibited the emission of industrial waste water, and the pollution control effect on the emission of industrial waste gas and industrial solid waste needs to be strengthened. Environmental protection tax is levied on the first three items of air pollutants, the first five items of water pollutants of the first category, and the first three items of other water pollutants. Therefore, each province (city, autonomous region) can add corresponding taxable pollutant projects for the same pollution outlet according to the local actual situation and the need of pollutant emission reduction. In particular, the tax items of industrial wastewater can be changed to the first five or eight items of water pollutants. So that enterprises can pay more attention to the emission of pollutants and achieve the pollution control goal of environmental protection tax. With the proposal of the goal of carbon peak and carbon neutralization, carbon dioxide can be gradually included in the tax scope, and the tax basis is determined according to the amount of pollution equivalent converted from carbon dioxide emissions. The key emission units included in China's carbon emission market are mainly high-emission enterprises, and there are not many medium-low emission enterprises.

Therefore, tax on carbon dioxide can play a role of fair regulation and better achieve the goal of carbon peak and carbon neutrality.

(2) Increase the tax standard. From the empirical results, it can be seen that environmental protection tax has not effectively inhibited the discharge of water pollutants, which may be caused by lower tax standards. On the basis of empirical analysis in this paper, we can further analyze the pollutant emission status in different regions and the inhibition effect of environmental protection tax on them. Higher tax rate standards can be set in regions with relatively developed heavy industry, such as the western and northeastern regions, while lower tax rate standards can be set in the central and eastern regions with relatively developed light industry. The implementation of differentiated tax rates among regions will force heavy industry enterprises to develop clean energy and reduce the emission of taxable pollutants. According to the tax table of tax items specified in China's environmental protection tax law, the tax amount of air pollutants is 1.2 to 12 yuan per pollution equivalent, the tax amount of water pollutants is 1.4 to 14 yuan per pollution equivalent, and the tax amount of solid waste is different per ton according to different sub-tax items. The industrial wastewater discharge has the reason of low tax, so the tax on water pollutants can be increased to 2.4 yuan to 24 yuan per pollution equivalent. The tax amount of air pollutants can also be increased to 2.2 to 22 yuan per pollution equivalent.

(3) Improve the installation rate of automatic monitoring equipment. The Bulletin of the Second National Pollution Survey issued in 2020 investigated the units and self-employed households with pollution sources. The scope of the survey was mainly industrial pollution sources, agricultural pollution sources, domestic pollution sources, centralized pollution control facilities and mobile sources. Based on the survey results, key pollutant discharge enterprises that meet the installation conditions should be included in the scope, and the installation rate of automatic monitoring equipment should be improved. At the same time, medium and low emission enterprises should be encouraged to install automatic monitoring equipment within their own capabilities. Governments at all levels should use the collected environmental protection tax revenue to carry out environmental governance and ecological maintenance, provide financial support to enterprises that take the initiative to install automatic monitoring equipment, and give certain tax returns and corporate income tax preferences. The amount of corporate income tax payable can be deducted by reference to the policy on the addition and deduction of corporate income tax and the relevant provisions on the purchase of professional equipment for environmental protection. At the same time, the ecological environment department should establish a perfect inspection system and maintenance mechanism, improve the operation speed and monitoring accuracy of automatic monitoring equipment, and avoid inaccurate monitoring of pollutant emission data.

(4) Develop energy conservation and environmental protection industries. The environmental protection industry is an emerging industry that China is vigorously supporting at present, and is in an important position of energy conservation and innovation. Therefore, it is necessary to support enterprises to improve their innovation ability and develop energy conservation and environmental protection industry from tax incentives and special funds. In terms of tax preference, enterprises engaged in qualified environmental protection, energy conservation and water conservation projects will enjoy a preferential policy of "three exemptions and three reductions in half" to encourage production enterprises to introduce green production technologies and improve resource utilization efficiency. In terms of special funds, local governments can use part of the income as special funds for environmental protection according to the collection of environmental protection tax, so as to achieve special use. Give environmental protection enterprises certain financial subsidies, encourage them to increase investment in technology and equipment research and development, and improve the overall level of innovation.

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