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Research on optimal environmental tax, sub-optimal selection and influencing factors in China

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Abstract

Considering the definition of the optimal environment tax, according to the sub-optimal choice under real conditions, Marginal cost of emission reduction is regarded as environmental tax payable and listed as a dependent variable. Through setting the independent variables, selecting samples and making empirical analysis, the conclusions of the paper are as follows: The actual environmental tax charged is positively correlated with government supervision and public participation, and negatively correlated with enterprise environmental investment, government environmental expenditure, upgrading of industrial structure and size of enterprise. At last, the paper puts forward some suggestions: strictly enforce the environmental tax, encourage public participation and increase the investment on environmental protection.

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1. Introduction

With the implementation of China's environmental protection tax law, a series of issues such as whether the construction of China's environmental tax system has clear goals and principles, whether the implementation path is clear, and whether the tax scope, the tax items, the tax rate are appropriate have been concerned by all parties. This paper intends to make a preliminary discussion on the meaning of the optimal environmental tax, the sub-optimal choice under realistic conditions and the influencing factors.

2. Literature review

The research on environmental tax is generally believed to be originated from the discussion on environment and taxation in <The Economics Of Welfare>published by Arthur Cecil Pigou, This book points out that the optimal pigou tax should be equal to the difference between marginal social cost and marginal private cost[1].

However, the assumption of the optimal Pigou tax is based on the idealized state. Bovenberg and Goulder [2] point out that, in fact, the government often relies on distorted tax system to increase fiscal revenue. When determining environmental tax in this sub-optimal situation, the actual environmental tax is generally smaller than the optimal environmental tax.

So, what are the factors that affect the actual collection of environmental taxes?

The government plays an extremely important role in environmental governance. Halkos and Paizanos [3] examined the data of 77 countries from year1980 to 2000. They concluded that the expansion of the government's financial expenditure on the environment can improve the quality of the environment. Based on the provincial panel data from 1998 to 2000, Guan Hailing and Zhang Peng [4] found that the increase of government expenditure can reduce the emission of environmental pollution to a certain extent. Dong Liying and Sun Yongjun[5] believed that industry associations can play a supporting role by supervising the operation of enterprises in reality. The public will also participate in pollution control activities in the form of direct communication with polluting enterprises or put pressure on polluting enterprises through the government. Li bin et al. [6] decomposed technological progress and structural change into 8 effects, demonstrating that technological effects play a leading role in the process of pollution reduction, while changes in industrial structure are not very obvious.

3. Research hypothesis

Although the actual tax is generally less than the optimal environmental tax, it can still stimulate enterprises to save energy and reduce emissions by increasing the pollution cost of enterprises. Therefore, this paper makes the following hypothesis based on the actual environmental tax.

H1: The actual amount of environmental tax is positively related to the government supervision.

In the course of China's rapid economic development, Environmental pollution and ecological destruction are becoming more and more serious. The intensity of government supervision is reflected in the levy and intensity of environmental taxes.

H2: The actual amount of environmental tax is negatively related to the investment in environmental protection.

With the development of economy, the environmental problem is getting more and more serious, more and more enterprises realize that taking the environmental responsibility initiatively can not only protect the environment, but also enhance competitiveness and create brand advantages of green production. When social responsibility is strengthened, the enterprise will invest more funds and manpower to reduce pollution.

H3: The actual amount of environmental tax is negatively related to the government's environmental expenditure.

The increase in environmental governance spending indicates that the government attaches more importance to pollution caused by the production process. Enterprises can use this funds to research technologies or directly add sewage treatment equipment, so that enterprises can reduce the emissions of pollutants.

H4: The actual amount of environmental tax levied is negatively correlated with the upgrading of industrial structure.

The industrial structure layout of a country has an inseparable relationship with the quality of its environment. After the upgrading of industrial structure, especially after the reduction of the number of secondary industry and the increase of the number of tertiary industry, the emission of pollutants will be reduced, and the actual amount of environmental tax levied will also be reduced.

H5: The actual amount of environmental tax is positively correlated with the degree of public participation.

The participation of the public reflects people's awareness of environmental protection. It can monitor the illegal discharge of pollutants by various means at anytime and anywhere, so as to urge enterprises to discharge pollutants according to legal channels and pay the environmental tax according to the amount of pollutants discharged.

H6: The actual environmental tax is negatively correlated with the size of the enterprise.

Compared with small-scale enterprises, large and medium-sized enterprises pay more attention to corporate image, they pay more attention to environmental protection. Therefore, as far as enterprise size is concerned, the larger the enterprise, the smaller the actual environmental tax, vice versa.

4. Variable setting and sample selection

(1) Y: The actual amount of environmental tax levied. This paper selected 30 provinces, municipalities and autonomous regions as the object of study (Tibet is not included). Since China began to implement the environmental protection tax law on January 1, 2018, the current environmental protection tax law came from the previous implementation of the "sewage discharge fee" system. This paper selected the 2007-2015 sewage discharge fee data to replace the actual environmental tax levied.

(2) G: The intensity of government regulation. This paper takes the number of environmental regulators as the indicator to measure government supervision intensity.

(3)R: Enterprise's environmental investment. In this paper, enterprises' investment in environmental protection is the embodiment of corporate environmental awareness.

(4) P: Government environmental expenditure. This paper uses the provincial and municipal governments' environmental financial expenditure data.

(5)F: Level of upgrading industrial structure. This paper describes the upgrading level of industrial structure by using the regional added value of the second and third industries/GDP.

(6)Pu: The degree of public participation. This paper uses the number of network/telephone complaints, the total number of letters and visitors in 30 regions to measure the degree of public participation.

(7)S: The size of the enterprise. This paper uses the number of employees in enterprises to represent the scale of the enterprise.

5. Model construction and empirical analysis

5.1 Model construction

In this paper, the linear model is adopted to study the influence of related factors on the environmental tax actually levied. In order to alleviate the fluctuation of data and the correlation of data series, and ensure the accuracy of the model, this paper take the actual amount of environmental tax and corporate environmental investment and government environmental expenditure as logarithms. The model established in this paper is as follows:

$Log(Y_{i,t})=c+\beta_1 G_{i\,t} +\beta_2 Log(R_{i,t}) +\beta_3 Log(P_{i,t})+ \ldots\ldots+\beta_5 Pu_{i,t} +\beta_6 S_{i,t} +\varepsilon$

c: Horizontal intercept β: Coefficient

ε: Random Error i: Region i t: time

5.2 Unit root test

LLC was used to test the sequences, and the results were shown in Table 1.

Table 1 LLC results

Variable	Single Order	Statistic	Prob.
Log(*Y*)	0	-3.8289	0.0001
Log(*P*)	0	-3.0300	0.0045
G	0	-4.4967	0.0008
Log(*R*)	0	-2.2306	0.0000
F	0	-0.9304	0.0047
Pu	0	-1.2482	0.0007
S	0	-5.7645	0.0000

After LLC test, it is found that the single integer order of all variables is zero, which shows that the sequence after scoring is stable.

5.3 Co-integration test

This paper adopts Pedroni co-integration test method, and the results are shown in table 2.

Table 2 Co-integration test results

	Statistic	Prob.	Weightde Sta.	Prob.
Panel v- Statistic	2.1127	0.0419	1.2118	0.0297
Panel rho- Statistic	-2.4538	0.0037	-3.0039	0.0021
Panel PP- Statistic	1.6679	0.0006	2.4936	0.0000
Panel ADF- Statistic	-3.3316	0.0000	-5.2155	0.0000

By observing the probability of the test results, they were all less than 0.05, indicating that there was a long-term stable relationship between the variables.

5.4 Regression analysis

After passing the co-integration test in the previous step, it is shown that the variables set in this paper have a long-term and stable relationship, and the residual error of the equation to be established is stable.

First, the mixed estimation model is established, and the analysis results are shown in table 3.

Table 3 The results of mixed model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
G	-0.7097	0.0980	-1.4133	0.0015
Log(*R*)	-0.4128	0.0387	-1.6594	0.0019
Log(*P*)	-0.1240	0.3317	-0.7328	0.0000
F	-0.0735	0.02273	-0.1774	0.0312

Pu	-0.7012	0.1199	0.8998	0.0000
S	-0.0018	0.0770	-0.2017	0.0268
C	5.8831	0.6413	6.5677	0.0207
R-squared	0.6130	Mean dependent var		3.3680
Adjusted-R-squared	0.6372	S.D. dependent var		0.1570
S.E. of regression	0.0959	Akaike info criterion		1.8325
Sum squared reside	2.3533	Schwarz criterion		1.7642
Log likelihood	244.1412	F-statistic		10.3801
Durbin-Watson stat	1.9375	Prob(F-statistic)		0.0000

Secondly, a fixed effect model is established, and the Redunent Fixed Effected test is performed to determine whether to abandon the mixed estimation model. The test results are shown in Table 4.

Table 4 The results of Redunent Fixed Effected test

Effect Test	Statistic	Prob.
Cross-section F	10.3086	0.0209
Cross-secrion Chi-square	25.5507	0.0187

The probability of the test result is less than 0.05, and the result indicates that the original hypothesis should be rejected, the fixed effect model should be abandoned, and the mixed estimation model should be retained.

Finally, the random effect model is established and the Hausman test is conducted to determine whether the random effect model should be selected. The test results are shown in table 5.

Table 5 The results of Hausman test

Test Summary	Chi-Sq.Statistic	Prob.
Cross-section random	23.5003	0.0018

The probability of the test result is less than 0.05, and the result indicates that the original hypothesis should be rejected and the random effect model should be abandoned, but the mixed estimation model is still retained because the fixed effect model is negated in the last step.

After the above steps, the final hybrid estimation model is determined. According to the results of the regression of table 3, the constructed model of determination coefficient is 0.6130, which shows that the actual environmental tax collected can be explained by 61.3% under the combined effect of the six independent variables. The F-test value of the model is 10.3801 and the corresponding probability is 0, which shows that the model has passed the overall significance test. In the mixed estimation regression model, the probability of t-test of six explanatory variables are small, it indicates that the model can be established at a significance level of 5%.

6. Research conclusions and suggestions

Based on the above analysis, the following conclusions and suggestions are drawn:

(1) The actual environmental tax collected is positively correlated with the intensity of government supervision and the degree of public participation, H1 and H5 are both established. This shows that strengthening government supervision and encouraging public participation are important to implement China's environmental protection tax law.

(2) The actual environmental tax levied is negatively correlated with enterprises' environmental investment and government environmental expenditure, H2 and H3 are both established. This shows that the environmental expenditure of enterprises and governments is conducive to promoting energy conservation and emission reduction. Therefore, we should take a series of measures, such as financial subsidies, tax relief and so on, to encourage and force enterprises to reduce pollutant emissions.

(3) The actual environmental tax levied is negatively correlated with the upgrading level of industrial structure and the scale of enterprises, H4and H6 are both established. This shows that accelerating the upgrading of industrial structure and promoting the development of large and medium-sized enterprises are conducive to promoting clean-low carbon production, reducing pollutant emissions.

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