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Research on the Relationship between Pollutant Discharge Sources and Economic Development——Take the Provinces of the Country as Examples

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Abstract: *Under the background that the issue of environmental protection has become the focus of attention of all countries, China has also put forward a series of policies for the construction of green ecology. In order to facilitate the national or central government's macro analysis and propose macro adjustment strategies, this paper uses a multiple linear regression model to empirically analyze the relationship between industrial pollutant emissions, agricultural pollutant emissions, domestic pollutant emissions and a province's economic development relationship. The results show that: First, industrial pollution emissions account for a large proportion of the emissions from all sources in each province, and at the same time it has a significant positive impact on the economic development of each province; Second, agricultural pollution emissions are relative to industrial pollutants In terms of emissions and domestic pollution emissions, they account for a relatively small proportion of the emissions from various sources in each province, and their positive impact on the economic development of the provinces is less than that of industrial pollutants and domestic pollution emissions; Third, Domestic pollution emissions account for the largest proportion of emissions from all sources in each province, and at the same time it has the largest positive impact on the economic development of each province. Based on the above results, this article puts forward the following recommendations: Relevant departments should resolutely eliminate outdated production capacity, resolve excess production capacity, completely close small scattered and polluting enterprises, optimize the layout of the agricultural industry, and provide institutional and financial support for agricultural equipment and related technologies. Finally, by popularizing the knowledge of energy conservation and environmental protection to the residents to cultivate their awareness of environmental protection, promote the reuse of resources, and achieve the goal of a balance between a beautiful ecological environment and a high level of economic development.*

Keywords: *Environmental pollution, Economic development, Pollutant discharge, Multiple linear regression analysis*

1. Introduction

In recent years, the issue of environment and development has become the focus of attention of countries all over the world. With the further construction of human civilization and society, the improvement of the ecological environment has become the responsibility and pursuit of the international community. As one of the fastest growing countries in the world in recent years, China's average annual economic growth rate of 9.8% over the past 30 years reflects the "Chinese miracle" everywhere. However, the high economic growth rate is based on the ecological environment to a certain extent. As the price of destruction, the "Top Ten Environmental Issues in China" have been valued by researchers and leaders from all walks of life. The balance between environment and development has been one of the issues that my country has paid attention to in recent years.

In 2020, General Secretary Xi Jinping pointed out at the 75th United Nations General Assembly that China will increase its nationally determined contributions, adopt more powerful policies and measures, strive to reach the peak of carbon dioxide emissions by 2030, and strive to achieve carbon neutrality by 2060. Therefore, at this stage, we need to look for the potential relationship between environmental pollution and economic development, solve the problem of environmental pollution from the root cause, and at the same time ensure stable economic growth to a certain extent. In this context, this article focuses on exploring the relationship between industrial pollutant discharge, agricultural pollutant discharge, domestic pollutant discharge and the economic development of a province, and accurately analyzes the

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source of pollutant discharge and the economy from the perspective of pollutant discharge sources. The relationship between developments, which has strong practical significance for proposing relevant measures for a certain pollutant emission source.

2. Literature review

At present, many studies have confirmed the relationship between environmental pollution and economic development. Wildner [1] introduced environmental quality into the utility function, and incorporated environmental and sustainable development issues into the basic framework of the new growth theory; researchers [2] pointed out that for many developed countries, pollution is the cause of health expenditures, while in some developing countries, health expenditure is the cause of pollution. Muhammad Awais Anwar [3] revealed a positive and significant relationship between CO2 emissions and per capita health expenditure in samples of all countries in the study. Grossman and Kreuger (1995)[4] studied environmental pollutant emissions data in multiple countries, It is concluded that there is an "inverted U-shaped" relationship between the discharge of environmental pollutants in most countries and the country's per capita national income; Zhang Shengling [5] et al. studied economic growth and PM2.5 concentration in China and different geographic regions. It is concluded that there is an inverted U-shaped relationship between economic growth and haze pollution, and that haze pollution in turn inhibits economic growth; Zhonghua Cheng [6] and other researchers used dynamic spatial panel models to analyze the effects of economic growth The impact of haze pollution, it is concluded that economic growth has no significant impact on haze pollution, but the growth has aggravated the haze pollution in cities in the middle of industrialization; Yin Fan [7] used the relevant data of Hunan Province as a research and used organic compounds VOCs emission efficiency represents the degree of environmental pollution, and it is concluded that environmental pollution will continue to be serious with economic growth. Zhang Haijun [8] used industrial wastewater, waste gas, and solid emissions as the explanatory variables, and ln(GDP) and ln(GDP)2 as the explanatory variables, and explored the relationship between the variables. Based on the VAR model, Zheng Huimin [9] used industrial waste gas, industrial waste, and industrial wastewater as the environmental pollution indicators of Shaanxi Province, and took the annual data of Shaanxi's per capita GDP as the representative of economic growth, and investigated the relationship between economic growth and environmental pollution in Shaanxi Province. Dynamic relationship. Liu Jinyu [10] used population, GDP, and urbanization as explanatory variables, and sulfur dioxide, smoke and dust, industrial wastewater, and industrial solid waste as the explanatory variables, and studied the relationship between environmental quality and economic development in Shandong Province. Some pollutant emissions in Shandong Province have crossed the inflection point, but there is still the possibility of a rebound if environmental protection is not continued in the future. Zhou Zehui [11] based on panel data from 29 inter-provincial regions in China, using per capita GDP and industrial sulfur dioxide emissions as the measurement indicators of economic development level and environmental pollution degree, based on the environmental Kuznets (EKC) curve to study the relationship between the two The relationship between environmental pollution and economic development in China generally follows the characteristics of the EKC curve. Based on the simultaneous equation estimation of panel data, Bao Qun [12] draws a conclusion that economic growth and pollution discharge have a two-way effect, and based on this conclusion, he proposed a policy combination that simultaneously improves pollution control capabilities and promotes sustained economic growth. Liang Kunli [13] calculated the growth of the green economy and compared it with the total output, and concluded that the increase in energy consumption has a positive effect on the growth of the green economy, and environmental pollution is an important factor in restraining the growth of the green economy. .

In summary, the existing research mainly explores the relationship between industrial pollutants or single pollutants and economic development, ignoring the discharge of agricultural pollutants, domestic pollutants, and other various pollutants and economic development. The relationship between the results is more one-sided and lacks comprehensive consideration. At the same time, most of the existing researches are based on a certain province and city, and are highly targeted. In view of this, this article uses the national provinces as sample data to comprehensively analyze the effects of industrial pollutants, agricultural pollutants and domestic pollutants on the economic development of a province. The impact has better universal applicability, which is conducive to the country or the central government's macro analysis and the proposal of macro adjustment strategies, which is of practical significance.

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3. Sample data and variable analysis

3.1 Data source

The pollutant emission data used in this article comes from the 2012 China Research Data Service Platform (CNRDS), including the industrial, agricultural and domestic pollutant emissions of 31 provinces across the country; the GDP data of each province and city comes from the 2013 China Statistical Yearbook. Empirical analysis based on the above sample data.

3.2 Variable description

This article uses industrial pollutant discharge, agricultural pollutant discharge and domestic pollutant discharge as explanatory variables. Among them, industrial pollutants are the sum of industrial wastewater emissions, industrial chemical oxygen demand emissions, industrial ammonia nitrogen emissions, industrial sulfur dioxide emissions, industrial nitrogen oxides emissions, and industrial smoke (dust) emissions; agricultural pollutants It is the sum of agricultural chemical oxygen demand emissions and agricultural ammonia nitrogen emissions; domestic pollutants are domestic wastewater emissions, domestic chemical oxygen demand emissions, domestic ammonia nitrogen emissions, domestic sulfur dioxide emissions, domestic nitrogen oxides emissions, and The sum of domestic smoke (powder) and dust emissions. All explanatory variables are in 10,000 tons, and the explained variable GDP is also in 10,000 yuan. The name and composition of each variable are shown in Table 1.

Table 1: Variable definition

	Variable name	Variable definitions	Variable composition
Explained variable	GDP	Gross Domestic Product	
Explanatory variables	IPD	Industrial pollutant discharge	Industrial wastewater emissions, Industrial chemical oxygen demand emissions, Industrial ammonia nitrogen emissions, Industrial sulfur dioxide emissions, Industrial nitrogen oxides emissions, Industrial smoke (dust) emissions
	APD	Agricultural pollutant discharge	Agricultural chemical oxygen demand emissions, Agricultural ammonia nitrogen emissions
	DPD	Domestic pollutant discharge	Domestic wastewater emissions, Domestic chemical oxygen demand emissions, Domestic ammonia nitrogen emissions, Domestic sulfur dioxide emissions, Domestic nitrogen oxides emissions, Domestic smoke (dust) emissions

3.3 Descriptive statistics

First, perform a descriptive statistical analysis of the data, as shown in Table 2.

Table 2: Sample descriptive statistics

Variable name	Observations	Mean (10,000 yuan/ 10,000 tons)	Standard deviation (10,000 yuan/ 10,000 tons)	Minimum (10,000 yuan/ 10,000 tons)	Max (10,000 yuan/ 10,000 tons)
GDP	31	186224146.7	143253663.6	7010300	570679200
IPD	31	71637.55	59966.96	400.73	236373.7
APD	31	39.81968	35.12093	0.44	141.82
DPD	31	149301.5	124868.6	4302.76	652015.1

4. Empirical analysis

4.1 Measurement model

This article focuses on exploring the relationship between industrial pollutant discharge, agricultural pollutant discharge, and domestic pollutant discharge and the economic development of a province, using multiple regression to conduct empirical analysis. The analysis model contains the regression coefficients of IPD, APD, and DPD respectively.

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4.2 Model checking

4.2.1 Regression equation

Using a multiple linear regression model to perform regression analysis on the above parameters, the multiple linear regression equations of industrial pollutant emissions, agricultural pollutant emissions, and domestic pollutant emissions and the economic development of a province are as follows:

4.2.2 Goodness of fit test

The regression equation was tested for goodness of fit, and the results are shown in Table 3.

Table 3: Model summary

Model	R	R^2	Adjusted R^2	Estimated standard error
1	0.965[a]	0.932	0.924	39499853.17

Note: a. Predictor variables: (constant), life, agriculture, industry

According to the above table, the following conclusions are drawn: the regression equation should adopt the adjusted correlation coefficient, and the adjusted correlation coefficient R^2 is 0.924, indicating that the regression equation has a high degree of fitting.

4.2.3 Significant F test

The significance F test was performed on the regression equation, and the results are shown in Table 4.

Table 4: Analysis of variance

	Sum of square	Degree of freedom	Mean square	F	Significance
Return	5.736E+17	3	1.912E+17	122.540	0.000
Residual	4.213E+16	27	1.560E+15		
Total	6.157E+17	30			

From Table 4, it can be drawn: F=122.540, indicating that the linear relationship between industrial pollutant emissions, agricultural pollutant emissions, and domestic pollutant emissions and the economic development of a province is significant; sigF = 0.000<0.05, indicating that it is believed When the interval is 95%, the overall regression equation reaches a significant level, and the regression equation is reasonable.

4.2.4 Significance t test

The significance t test was performed on the regression coefficient, and the results are shown in Table 5.

Table 5: Regression analysis

	B	Standard error	Standard coefficient	t	Significance
Constant	9905651.046	3508909.333		2.823	0.
IPD	1018.730	230.306	0.433	4.423	0.000
APD	429497.652	90192.703	0.107	4.762	0.000
DPD	575.966	103.307	0.510	5.576	0.000

It can be obtained from Table 5 that the standard error of the regression coefficient is small and the t value is large, indicating that the discharge of industrial pollutants, agricultural pollutants, and domestic pollutants have a strong ability to vary linearly with the economic development of a province: sigt = 0.000<0.05, which indicates that when the confidence interval is 95%, the regression coefficient overall reaches a significant level, and the regression coefficient is effective.

4.2.5 Collinearity test

The regression coefficients were tested for collinearity, and the results are shown in Table 6 and Table 7.

It can be seen from Table 6 and Table 7 that the tolerance of the regression coefficient is greater than 0.1, the variance expansion factor is less than 10, the characteristic value is greater than 0.001, and the condition index is less than 30, indicating the discharge of industrial pollutants, agricultural pollutants and domestic pollutants. There is no obvious collinearity problem between emissions and the economic development of a province.

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After testing the regression equations and regression coefficients, the regression equations and regression coefficients overall reached a significant level, which was reasonable and effective.

Table 6: Collinearity analysis table 1

	TOL	VIF
Constant		
IPD	0.264	3.790
APD	0.687	1.456
DPD	0.302	3.306

Table 7: Collinearity analysis table 2

Dimension	Eigenvalues	Condition Index
1	3.403	1.000
2	0.288	3.440
3	0.246	3.721
4	0.064	7.285

5. Conclusions and policy recommendations

This article uses the 2012 China Research Data Service Platform (CNRDS) data, based on multiple linear regression models, analyzes from different sources of pollutants, and analyzes the emissions of industrial pollutants, agricultural pollutants, and domestic pollutants and the economy of a province. Research on the relationship of development, the results and recommendations are as follows:

First, industrial pollutant emissions account for a large proportion of the emissions from various sources in each province. At the same time, it has a significant positive impact on the economic development of each province. Therefore, industry occupies an extremely important position in the Environmental pollution has also caused a very large impact. Relevant departments should increase the control of industrial pollution emissions, conduct scientific and efficient treatment of pollutants, increase waste utilization, and implement corresponding penalties and supervisions for certain enterprises that do not meet relevant standards for emissions, and resolutely eliminate outdated production capacity and resolve Excess production capacity and the complete closure of small scattered and polluting enterprises can as far as possible improve the level of economic development while ensuring the ecological environment.

Second, compared with industrial pollutant emissions and domestic pollution emissions, agricultural pollutant emissions account for a relatively small proportion of emissions from various sources in each province, although it also has a significant positive impact on the economic development of each province. , But the degree of impact is less than that of industrial pollutant emissions and domestic pollution emissions. However, it is undeniable that agriculture is the foundation for maintaining the people's livelihood. Even so, relevant departments should optimize the layout of the agricultural industry, provide institutional and financial support for agricultural equipment and related technologies, and increase crop productivity while controlling pollutant emissions. The amount.

Third, domestic pollution emissions account for the largest proportion of emissions from all sources in each province, and at the same time it has the largest positive impact on the economic development of each province. Therefore, relevant departments should promote the awareness of environmental protection by popularizing the knowledge of energy conservation and environmental protection to residents, promote the reuse of resources, and achieve the goal of a balance between a beautiful ecological environment and a high level of economic development.

References

[1] Pablos I, Wildner S, Assam C, et al. Pollen Allergens for Molecular Diagnosis [J]. Current Allergy & Asthma Reports, 2016, 16(4):31

[2] Das Ramesh Chandra and Ivaldi Enrico. Is Pollution a Cost to Health? Theoretical and Empirical Inquiry for the World's Leading Polluting Economies [J]. International Journal of Environmental Research and Public Health, 2021, 18(12): 6624-6624.

[3] Muhammad Awais Anwar and Ghulam Rasool Madni and Iftikhar Yasin. Environmental quality, forestation, and health expenditure: a cross-country evidence [J]. Environment, Development and

ISSN 2616-5872 Vol.3, Issue 2: 29-34, DOI: 10.25236/AJEE.2021.030206

Sustainability, 2021: 1-27.
[4] Economic Growth and the Environment. Grossman G.M, Krueger A.B. National Bureau of Economic Research, No.w4634. 1994
[5] Zhang Shengling et al. The spatial dynamic relationship between haze pollution and economic growth: new evidence from 285 prefecture-level cities in China [J]. Journal of Environmental Planning and Management, 2021, 64(11): 1985-2020.
[6] Zhonghua Cheng and Qingfei Xu and Ian Fraser Sanderson. China's economic growth and haze pollution control [J]. Natural Hazards, 2021: 1-17.
[7] Yin Fan, Liu Zhitong, Nie Yanqing, Liu Ming. Analysis of the relationship between air pollutants and economic growth and measurement of coordinated development [J]. Journal of Hebei Academy of Sciences, 2020, 37(03): 95-100.
[8] Zhang Haijun. Research on the relationship between industrial pollutant discharge and economic growth: Taking Ningxia Hui Autonomous Region as an example [J]. Qinghai Finance, 2020, {4}(08): 12-16.
[9] Zheng Huimin. Research on the relationship between economic growth and environmental pollution in Shaanxi based on the VAR model——from the perspective of the classification of pollutant emissions [J]. China Price, 2018, {4}(08): 20-22.
[10] Liu Jinyu. Research on the relationship between pollutant emission and economic development in Shandong Province [J]. Shanxi Agricultural Economics, 2019, {4}(17): 116-117.
[11] Zhou Zehui, Zhao Na. Research on the relationship between China's environmental pollution and the level of economic development [J]. China Urban Economy, 2010, {4}(06): 88-90.
[12] Bao Qun, Peng Shuijun. Economic Growth and Environmental Pollution: Simultaneous Equation Estimation Based on Panel Data [J]. World Economy, 2006, {4}(11): 48-58.
[13] Zhang Li. Environmental Pollution and Economic Growth in China [J]. Modern Economic Information. 2019(10)