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The Impact of Environmental Policy Regulation on the Competitiveness of High Energy-consuming Industries

Based on the Data Inspection of Four Industries of Steel, Thermal Power, Nonferrous Metals and Papermaking in Zhejiang Province

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***Abstract*—The output value of high energy-consuming industries is one of the main sources of local economic growth. Under the low-carbon economy, high energy-consuming industries are constrained by environmental policies and their economic growth is slowing down. Based on the panel data of four high energy-consuming industries of steel, thermal power, nonferrous metals and papermaking in Zhejiang Province from 2012 to 2016, this paper studies the relationship between environmental policy regulation in the context of low-carbon economy and the competitiveness of high energy-consuming industries in Zhejiang Province. The relationship between pollutant discharge and governance and economic growth in four industries was analyzed. The results of the analysis showed that environmental regulation can suppress pollution emissions, but the effects on emissions from different industries and different pollutants are different. And the discharge and treatment of pollutants are positively correlated with industrial output value. The purpose of this paper is to study how the government can improve the economic growth of high energy-consuming industries in the region through the regulation of environmental policies in the context of a low-carbon economy.**

Keywords—low-carbon economy; high energy-consuming industry; pollution heaven; regional competition; technological innovation

I. INTRODUCTION

Since 2018, the domestic and international economic development environment has undergone new profound changes, and economic development has entered a new normal. Under the strict conditions of comprehensive environmental regulation, the environmental protection target has initially achieved the expected results. The output value of high energy-consuming industries has always been the main source of local economic growth. Under the cadre promotion system, the competition among the governments is mainly to assess economic performance. The governments of various regions are under the pressure of economic and environmental competition to compete for economic growth in energy-consuming industries by relaxing environmental regulations. The pollution is a problem of one region. If the governance of a region is strict, it may not be obvious that the region is well governed. For the cyanobacteria in the Taihu Basin and smog from the north, the pollutants spread through the water and air to the surrounding area. The more stringent environmental regulations in a region is, the more obvious the inhibitory effect on economic growth will be, which not only increases the cost of pollution control in the region, but also increases the cost burden of enterprises, causing the economic benefits of some small and medium-sized enterprises that are unable to carry out technological innovation to decline. And they are facing with a situation of shutting down, being merged and bankruptcy.

In this context, this paper uses the panel data of the four high energy-consuming industries of steel, thermal power, nonferrous metals and papermaking in Zhejiang Province from 2012 to 2016, adopts the econometric method and uses the Spss12.0 software to analyze the relationship between environmental policy regulation and economic growth for different high energy-consuming industries under the conditions of environmental regulation. At the same time, this paper also makes further in-depth study of the relationship between pollutant discharge and economic growth in high energy-consuming industries in Zhejiang Province. According to the study, it has found that under the premise of environmental policy regulation, the two goals of "fish" and "bear's paw" that refer to protecting the ecological environment and promoting economic growth are the research objectives of this paper.

II. LITERATURE REVIEW

A. Research Status in China and Foreign Countries

Traditional economic theory holds that strict environmental policy regulation will lead to a decline in industrial competitiveness. Because the social benefits generated by environmental policy regulation will inevitably increase the private cost of enterprises and reduce their

competitiveness, that is, excessive economic costs will hinder the growth of business productivity and affects its competitiveness in the international market.

Porter (1995) proposed the "Pollution Heaven" Hypothesis. The government's environmental policy regulation will increase the regulation cost of enterprises in purchasing pollution treatment equipment and pollution control technology, selecting pollution treatment sites and treatment methods, and input of factors in the production of investment products, and the proportion of regulation cost in the total cost of high energy-consuming industries is relatively high. In order to maintain high competitive advantage in the market, high energy-consuming industries tend to avoid high-standard environmental regulatory areas (Cole, 2006), and they would shift to low-standard environmental policy control areas. Therefore, low environmental policy control areas are likely to become a "pollution heaven" for high energy-consuming industries. Porter also believed that environmental policy regulation would not increase the cost of the enterprise, but would lead to technological innovation, which would partially or completely offset the cost of environmental policy regulation (Porter and Linde, 1995), making the company more competitive. This opinion is Porter hypothesis.

Portney (1994) and Jaffe et al. (1995) insisted that the new environmental policy regulation would bring some costs to the enterprise, and these costs would be offset by the social benefits of pollution reduction.

Some scholars have tested the relationship between environmental policy regulation and industrial competitiveness. A study by Brannlund et al. (1995) in the Swedish pulp and papermaking industry showed that strict environmental policy regulation might lead to a decline in corporate competitiveness. According to the research of Gray and Shadbegian (1995) on pulp and papermaking, petroleum refining and steelmaking in the United States, it finds that there is a negative correlation between regulated corporate pollution control costs and productivity, and that improving environmental performance does not bring enough benefits for enterprises to cover their costs.

Simpson & Bradford (1996) and Ulph (1996) theoretically proved that in two countries, where there was only one company in each country, the new regulation could not only improve the environmental quality, but also increased the profit of the enterprise, and its profit was mainly from exploring the market potential.

Local governments have competition in the field of environmental policy regulation (Fredriksson & Milimet, 2002; Levinson, 2003; Woods, 2006). These studies are based primarily on two assumptions. First, there is a spillover effect of pollution among the regions, that is, pollution has the characteristics of free flow across regions, such as cross-regional pollution of the atmosphere and water resources. This means that even if an area increases its investment in public products of environmental pollution control, the environmental quality of the region may not be improved due to the existence of pollutant spillover effects in adjacent areas (Anselin, 2001). Therefore, the optimal strategy of local governments is to compete to reduce their investment in environmental protection, and use limited resources to promote industrial economic development. The neighboring governments have to share the losses caused by environmental pollution. In recent years, Chinese scholars have also conducted tentative research on this issue.

Regarding the impact of environmental policy regulation on industrial development, Wang Yanli and Zhong Ao (2016) explored the relationship among local government competition, environmental policy regulation and high energy-consuming industry. Zhong Maochu et al. (2015) discussed the impact of environmental policy regulation on the evolution of industrial space. The research conclusions verified the “pollution paradise hypothesis”, and the effect of government environmental policy regulation is greater than that of non-government environmental policy regulation. Some studies have also shown that environmental policy regulation can promote inter-region industrial transfer in China, but the promotion of industrial upgrading is not obvious.

The inverted U-shaped relationship between economic development and environmental quality is the focus of scholars in China and foreign countries. Liu Huajun (2019) proposed collaborative treatment of smog pollution areas and pollutant standards, and an inverted U-shaped relationship between industrial development and environmental quality was derived.

B. Evaluation of Related Literature

An empirical study of whether Potter's hypothesis is validated begins in the United States. Whether the impact of environmental policy regulation on industrial competitiveness is positive or negative has become a hot topic in current academic circles. In recent years, Chinese scholars have also done some verification, but there is no conclusion. The conclusions of the study can be roughly divided into three situations. First, the traditional view has been partially confirmed, and environmental policy regulation has led to a certain degree of decline in industrial competitiveness. There are negative effects. Second, there is a positive correlation between "environmental policy regulation" and enterprise technology innovation, thus enhancing the competitiveness of the industry. Third, the impact of environmental policy regulation on industrial competitiveness is uncertain.

Chinese research mainly takes the national provincial panel data, the eastern, central or individual enterprises as the object to establish an econometric model for empirical research. There is no empirical analysis of single-column data in Zhejiang Province. In particular, the impact of high energy-consuming industry competitiveness under the pressure of low carbon has not been fully demonstrated. The output value of high energy-consuming industries is the main source of economic growth in Zhejiang Province. Against the background of low-carbon economy, Zhejiang Province is also facing the pressure of low-carbon requirements while maintaining economic growth. Therefore, the research of this topic is helpful to make the choice between the strategy of

appropriate relaxation or strict control considering the impact on economic growth in the implementation of environmental policy regulation and control.

III. Research Content Design

A. Data Source

This topic is based on the panel data of the high energy-consuming industry in Zhejiang Province from 2012 to 2016. The data comes from China Statistical Yearbook, China Industrial Statistical Yearbook, China Environmental Statistics Yearbook, Zhejiang Statistical Yearbook and "Zhejiang Natural Resources and Environment Statistical Yearbook". According to Wang Yanli's (2016) selection and grouping of high energy-consuming industries, the data of steel, thermal power, nonferrous metals and papermaking industry in Zhejiang Province were selected and studied in this paper. Econometric methods are used to empirically analyze the mechanism and possible impacts of environmental policy regulation on the competitiveness of high energy-consuming industries that are technologically innovative.

B. Establishment of Evaluation Index System of Environmental Policy Regulation

1) Studying the relationship between technological innovation of high energy-consuming industrial enterprises R&D and industrial output value: This paper selects enterprise R&D expenditure as an evaluation index of technological innovation. Capital input is the basis of technological innovation activities. To rapidly improve the level of technological innovation, it is necessary to have a strong capital input to guarantee it. Therefore, R&D expenditure is an important indicator of the level of technological innovation. The total industrial output value of high energy-consuming industries must be under the environmental policy regulation.

2) Studying the impact of environmental protection investment on the competitiveness of high energy-consuming industries in Zhejiang Province under the environmental policy regulation: This paper studies the relationship among environmental protection investment, environmental policy regulation intensity (E) and enterprise production output (T). Using the technological innovation output function T= f (E, G) to measure the impact of environmental policy regulation and industrial output value G on technological innovation output. For the evaluation of environmental regulation intensity, this paper uses the operating cost of pollution control facility, that is, the pollution control cost per thousand yuan of industrial output value as the evaluation indicator of the environmental policy regulation intensity. The environmental protection investment is I (investment) and the pollution discharge is D (discharge).

T= f (E, G) Formula (a)

Environmental Investment = Pollution Control Cost + Industrial Gross Output Formula (b)

Output (T)=Industrial Gross Output + pollution discharge Formula (c)

3) Studying the relationship between pollutant emissions and industrial output value: This paper selects pollutant emissions such as exhaust gas, sulfur dioxide, wastewater, and solid waste as representatives of environmental pollutants. The greater the proportion of pollution control costs is, the smaller the proportion of industrial output, and the smaller the emissions will be.

IV. Data Analysis and Empirical Results

A. Analyzing the Relationship Between Technological Innovation and Industrial Output Value

The data is the R&D expenditure of Zhejiang Province from 2012 to 2016, which represents the investment of technological innovation of enterprises. Based on the regression analysis of the contribution of R&D expenditure to the total industrial output value (Cheng Wenhong, 2019), the results show that the larger the R&D investment is, the larger the industrial output value will be.

B. Based on Environmental Protection Investment of Zhejiang Province (2012-2016), Analyzing the Relationship Between the Intensity of Environmental Protection Investment and Total Output Value

The greater the intensity of environmental policy regulation of high energy-consuming industries is, the greater the investment in environmental protection, and the greater the treatment rate or compliance rate of environmental pollutants will be. The greater the environmental cost payment rate is, the greater the intensity of environmental policy adjustments for high energy-consuming industries in the region, and the lower the total industrial output value will be.

The results of data analysis show that Zhejiang's technological innovation and increased investment in environmental protection are highly correlated with the growth of Zhejiang's industrial output value, which has a significant role in promoting (Cheng Wenhong, 2019).

C. Analysis of the Relationship Between Pollutant Discharge and Industrial Output Value of High Energy-consuming Industries

1) Environmental pollution index: Wastewater, waste gas and solid waste discharge are the main sources of environmental pollution in China, and are also commonly used indicators to measure environmental pollution (Liu Huajun, 2019). Therefore, the selection of environmental pollution indicators mainly includes wastewater discharge, exhaust discharge and solid waste discharge. Among them, the wastewater discharge is represented by the urban industrial wastewater discharge, and the exhaust gas discharge is represented by the emission of exhaust gas in addition to industrial sulfur dioxide, while the solid waste

discharge is represented by the emission of industrial smoke, and sulfur dioxide is listed separately.

2) Classification of four different types of steel, thermal power, chemical fiber and papermaking: According to the study of Wang Yanli and Zhong Ao (2015), comparing with the energy consumption intensity, the energy consumption intensity of steel is 2.952; the energy consumption intensity of thermal power is 1.564; the energy consumption intensity of nonferrous metals is 2.032; and the energy consumption intensity of papermaking industry is 1.467. All these are high energy-consuming industries.

- Steel

TABLE I. DATA OF VARIOUS POLLUTANT DISCHARGE AND TOTAL OUTPUT VALUE OF ZHEJIANG PROVINCE'S STEEL MANUFACTURING INDUSTRY IN 2012-2016

	Output Value (100 Million Yuan)	Wastewater (10 Thousand Yuan)	Exhaust Gas (100 Million Cubic Metres)	Solid Waste (10,000 Tons)	SO_2(T)
2012	1305.23	22735.3	3035.54	596.02	40084.7
2013	1733.15	30427.5	3323.53	591.79	31131.53
2014	1748.3	30376.24	3364.77	849.84	31569.7
2015	1594.92	25495.1	3330.36	677.22	26759.68
2016	1299.59	19571.2	2322.85	599.97	10246.62

[a.] Note: The data comes from the 2013-2017 Zhejiang Statistical Yearbook and Zhejiang Natural Resources and Environment Statistical Yearbook.

TABLE II. REGRESSION ANALYSIS OF TOTAL OUTPUT VALUE AND THREE WASTES DISCHARGE IN THE STEEL INDUSTRY

	Multiple R	R^2	Correlation	Trends in future environmental policy regulation
Wastewater discharge	Discharge amount of wastewater	0.982255133375393	High-positive correlation	↓
Exhaust gas discharge (non-SO_2)	0.947993603969892	0.898691873167824	High-positive correlation	↓
Solid waste discharge	0.501506464326947	0.251508733761715	Positive correlation	—
SO_2 discharge	0.992834676130999	0.985720694128145	High-positive correlation	↓

The analysis results of "Table I" and "Table II" show that the higher the discharge of wastewater, exhaust gas and SO_2 in the steel industry is, the higher the total output value will be. The environmental protection regulation standards can be appropriately relaxed, and technological innovation is needed. The discharge of solid waste is moderately related to the total industrial output value, and the environmental protection control standards are moderate, which has a general impact on economic growth.

The data analysis results in "Table III" and "Table IV" show that the higher the cost of wastewater and exhaust gas pollution control in the steel industry is, the greater the pollution discharge will be. The higher the total output value is, the better the treatment effect, and the more effective environmental protection regulation will be.

TABLE III. POLLUTION CONTROL COSTS AND TOTAL OUTPUT VALUE OF ZHEJIANG STEEL INDUSTRY IN 2012-2016

	Output value (100 million yuan)	Wastewater (10 thousand yuan)	Exhaust gas (10 thousand yuan)
2012	1305.23	22735.3	58988.9
2013	1733.15	30427.5	70851.8
2014	1748.3	30376.24	67305.3
2015	1594.92	25495.1	56960.5
2016	1299.59	19571.2	44038.57

[a.] Note: The data comes from the 2013-2017 Zhejiang Statistical Yearbook and Zhejiang Natural Resources and Environment Statistical Yearbook.

TABLE IV. REGRESSION ANALYSIS OF POLLUTION CONTROL COSTS AND TOTAL OUTPUT VALUE OF ZHEJIANG STEEL INDUSTRY IN 2012-2016

	Multiple R	R2	Correlation	The effect of pollution control on economic growth
Wastewater	0.958684613	0.919076188	High-positive correlation	good
Exhaust Gas	0.812660058	0.660416369	High-positive correlation	good

- Thermal power

TABLE V. VARIOUS POLLUTANT DISCHARGE AND TOTAL OUTPUT VALUE OF ZHEJIANG THERMAL POWER MANUFACTURING INDUSTRY IN 2012-2016

	Output value (100 million yuan)	Wastewater (10 thousand yuan)	Exhaust gas (100 million cubic metres)	Solid waste (10,000 tons)	SO_2(t)
2012	4017.48	9034.5	10296.53	2160.21	250716. 93
2013	4243.39	16651	10298.79	2047.52	225614. 05
2014	4291.48	11443.1	12795.19	1924.38	186365. 42

	Output value (100 million yuan)	Wastewater (10 thousand yuan)	Exhaust gas (100 million cubic metres)	Solid waste (10,000 tons)	SO_2(t)
2015	4329.5	12564.9	12379.63	1929.89	174564. 66
2016	4446.2	16240	10199.81	1977.09	77341. 98

[a.] Note: The data comes from the 2013-2017 Zhejiang Statistical Yearbook (CD) and Zhejiang Natural Resources and Environment Statistical Yearbook.

TABLE VI. REGRESSION ANALYSIS OF TOTAL OUTPUT VALUE AND THREE WASTES DISCHARGE IN THERMAL POWER INDUSTRY

	Multiple R	R^2	Correlation	Trends in future environmental policy regulation
Wastewater discharge	0.694892	0.482875	positive correlation	—
Exhaust gas discharge (not SO_2)	0.223061	0.049756	Low-positive correlation	↑
Solid waste discharge	0.827491	0.684741	high-positive correlation	↓
SO_2 discharge	0.890036	0.792164	high-positive correlation	↓

The analysis results in "Table V" and "Table VI" show that the higher the solid waste discharge and SO_2 pollution discharge in the thermal power industry is, the higher the total output value will be. The environmental protection regulation standards can be appropriately relaxed, and on the other hand, technological innovation is needed. The discharge of wastewater is moderately related to the total industrial output value, and the environmental protection control standards are moderate, which has a general impact on economic growth. There is low-positive correlation between the discharge of exhaust gas (non-SO_2) and industrial output values, raising environmental standards and having little impact on economic growth.

TABLE VII. POLLUTION CONTROL COSTS AND TOTAL OUTPUT VALUE OF ZHEJIANG THERMAL POWER INDUSTRY IN 2012-2016

	Output value (100 million yuan)	Wastewater (10 thousand yuan)	Exhaust gas (10 thousand yuan)
2012	4017.48	9034.5	555452
2013	4243.39	16651	623625.7
2014	4291.48	11443.1	607697.1
2015	4329.5	12564.9	658476.7
2016	4446.2	16240	2879767.92

[a.] Note: The data comes from the 2013-2017 Zhejiang Statistical Yearbook and Zhejiang Natural Resources and Environment Statistical Yearbook.

TABLE VIII. REGRESSION ANALYSIS OF POLLUTION CONTROL COSTS AND TOTAL OUTPUT VALUE OF ZHEJIANG THERMAL POWER INDUSTRY IN 2012-2016

	Multiple R	R^2	Correlation	The effect of pollution control on economic growth
Wastewater	0.694892087595352	0.482875013402626	positive correlation	general
Exhaust gas	0.665677858563658	0.443127011381897	positive correlation	general

According to the data analysis in "Tables VII" and "Table VIII", the wastewater and exhaust gas pollution control costs of the thermal power industry are moderately related to the total industrial output value; the treatment effect is general; and a moderate environmental protection policy can be adopted.

- Nonferrous metals

The data analysis results in "Table IX" and "Table X" below show that the higher the SO_2 pollution discharge in the nonferrous industry is, the higher the total output value will be. And the environmental protection standards can be appropriately relaxed, at the same time, it is necessary to make technological innovation. The discharge of wastewater and exhaust gas is moderately related to the total industrial output value. There is low-positive correlation between the discharge of solid waste and total industrial output value. Environmental protection standards can be appropriately increased, and there is no significant impact on economic growth.

TABLE IX. VARIOUS POLLUTANT DISCHARGE AND TOTAL OUTPUT VALUE OF ZHEJIANG NONFERROUS METALS MANUFACTURING INDUSTRY IN 2012-2016

	Output value (100 million yuan)	Wastewater (10 thousand yuan)	Exhaust gas (100 million cubic metres)	Solid waste (10,000 tons)	SO_2(t)
2012	48.23	3422.1	128.09	53.52	4325.97
2013	38.52	3207.1	115.58	43.84	3419.91
2014	35.61	4190.9	167.53	68.18	2919.73
2015	42.08	5282.8	204.59	72.77	2464.52
2016	42.62	4908.7	225.2	56.94	1587.79

[a.] Note: The data comes from the 2013-2017 Zhejiang Statistical Yearbook (CD) and Zhejiang Natural Resources and Environment Statistical Yearbook.

TABLE X. REGRESSION ANALYSIS OF TOTAL OUTPUT VALUE AND THREE WASTES DISCHARGE IN NONFERROUS METAL INDUSTRY

	Multiple R	R^2	Correlation	Future environmental policy regulation intensity
Wastewater discharge	0.650199588	0.422759505	Positive correlation	—
Exhaust gas discharge (not SO_2)	0.670625141	0.449738079	Positive correlation	—
Solid waste discharge	0.055535562	0.003084199	Low-positive correlation	↑
SO_2 discharge	0.724679188	0.525159926	high-positive correlation	↓

TABLE XI. POLLUTION CONTROL COSTS AND TOTAL OUTPUT VALUE OF ZHEJIANG NONFERROUS METAL INDUSTRY IN 2012-2016

	Output value (100 million yuan)	Wastewater (10 thousand yuan)	Exhaust gas (10 thousand yuan)
2012	48.23	3422.1	8091.6
2013	38.52	3207.1	17045.5
2014	35.61	4190.9	7343
2015	42.08	5282.8	12041.7
2016	42.62	4908.7	13085.78

[a.] Note: The data comes from the 2013-2017 Zhejiang Statistical Yearbook and Zhejiang Natural Resources and Environment Statistical Yearbook.

TABLE XII. REGRESSION ANALYSIS OF POLLUTION CONTROL COSTS AND TOTAL OUTPUT VALUE OF ZHEJIANG NONFERROUS METAL INDUSTRY IN 2012-2016

	Multiple R	R^2	Correlation	The effect of pollution control on economic growth
Wastewater	0.046557834	0.002167632	Low-positive correlation	Bad
Exhaust gas	0.171391977	0.171391977	Low-positive correlation	Bad

According to the data analysis results of "Table XI" and "Table XII", the higher the cost of wastewater and waste gas pollution control in the nonferrous industry is, the lower the total output value will be. It will have the poor treatment effect, and appropriately relax the environmental protection standards.

- Papermaking

TABLE XIII. VARIOUS POLLUTANT DISCHARGE AND TOTAL OUTPUT VALUE OF PAPERMAKING INDUSTRY IN ZHEJIANG PROVINCE IN 2012-2016

	Output value (100 million yuan)	Wastewater (10 thousand yuan)	Exhaust gas (100 million cubic metres)	Solid waste (10,000 tons)	SO_2(t)
2012	1627.95	75333.8	356.58	215.33	24845.98
2013	1660.52	78816.4	334.38	196.57	22588.44
2014	1693.7	77002.7	338.02	308.19	20355.7
2015	1739.59	73177.8	341.14	304.7	17655.5
2016	1889.76	67297.4	278.92	259.9	7771.69

TABLE XIV. REGRESSION ANALYSIS OF TOTAL OUTPUT VALUE AND THREE WASTES DISCHARGE IN PAPERMAKING INDUSTRY

	Multiple R	R^2	Correlation	Future environmental policy regulation intensity
Wastewater discharge	0.987298039	0.974757419	High-positive correlation	↓
Exhaust gas discharge (non-SO_2)	0.913597569	0.834660518	High-positive correlation	↓
Solid waste discharge	0.164704292	0.027127504	Low-positive correlation	↑
SO_2 discharge	0.999855705	0.999711431	High-positive correlation	↓

The data analysis results in "Table XIII" and "Table XIV" show that the higher the discharge of wastewater, exhaust gas (non-SO_2) and SO_2 in the papermaking industry is, the higher the total output value will be. The environmental protection regulation standards can be appropriately relaxed, and on the other hand, technological innovation is needed. Solid waste discharge is associated with low industrial output values, raising environmental standards and having little impact on economic growth.

TABLE XV. POLLUTION CONTROL COSTS AND TOTAL OUTPUT VALUE OF ZHEJIANG PAPERMAKING INDUSTRY IN 2012-2016

	Output value (10,000 tons)	Wastewater (10 thousand yuan)	Exhaust gas (10 thousand yuan)
2012	1627.95	75333.8	14001
2013	1660.52	78816.4	11023.6
2014	1693.7	77002.7	12307.8
2015	1739.59	73177.8	15324.2
2016	1889.76	67297.4	13364.85

[a.] Note: The data comes from the 2013-2017 Zhejiang Statistical Yearbook and Zhejiang Natural Resources and Environment Statistical Yearbook.

TABLE XVI. REGRESSION ANALYSIS OF POLLUTION CONTROL COSTS AND TOTAL OUTPUT VALUE OF ZHEJIANG PAPERMAKING INDUSTRY IN 2012-2016

	Multiple R	**R^2**	**Correlation**	**The effect of pollution control on economic growth**
Wastewater	0.904533208	0.818180324	High-positive correlation	Good
Exhaust gas	0.222047221	0.049304968	Low-positive correlation	Bad

According to the data analysis results of "Tables XV" and "Table XVI", the higher the cost of wastewater pollution control in the papermaking industry is, the higher the total output value, and the better the pollution control effect will be. The larger input of waste gas is, and the lower total industrial output value will be. And the effect of pollution control is not obvious. It can appropriately reduce the pollution control costs, and relax the environmental protection regulations.

V. CONCLUSION

This research project uses the panel data of four high energy-consuming industries such as steel, thermal power, nonferrous metals and papermaking of Zhejiang Province from 2002 to 2016, and adopts econometric methods to empirically analyze the role of Zhejiang's environmental policy regulation on the competitiveness of technological innovation industry and possible impacts of the force. In the current economic new normal environment, it is necessary to maintain growth, and to consider low-carbon ecology. This paper has a certain reference role in the formulation of environmental protection policies in the "13th Five-Year Plan".

The output value of high energy-consuming industries is one of the main sources of economic growth in Zhejiang. Against the background of low-carbon economy, the pressure of low-carbon demand in Zhejiang Province is huge, and the impact of environmental policy regulation on the competitiveness of high energy-consuming industries in Zhejiang Province is deeply studied. Adopting a one-size-fits-all environmental policy regulation will not necessarily achieve significant results, but will also reduce economic growth.

The high energy-consuming industries such as steel, thermal power, nonferrous metals, and papermaking of Zhejiang Province should be treated differently according to data research and analysis.

For the steel industry, it is necessary to properly loose environmental regulation standards of wastewater, exhaust gas and SO_2, and technological innovation is needed. Moderate environmental control standards are adopted for solid waste discharge. The higher the cost of wastewater and exhaust gas pollution control in the steel industry is, the greater the pollution discharge, the higher the total output value, and the better the treatment effect will be. The environmental protection regulation policy achieves good results.

For the thermal power industry, it is appropriate to loosen the discharge of solid waste and environmental protection standards for SO_2 pollution discharge, and on the other hand, technological innovation is needed. Increasing environmental standards for discharge of non-SO_2 has little impact on economic growth. The environmental protection control standards for wastewater discharges are moderate and have a general impact on economic growth.

For the nonferrous metal industry, it is convenient to appropriately loosen the environmental protection standards for SO_2 pollution discharge. The discharge of solid waste is related to the low total industrial output value, and the environmental protection regulation standards can be appropriately increased, which has no major impact on economic growth. The higher the cost of pollution control of wastewater and exhaust emissions is, the lower the total output value will be. The burden of corporate pollution control costs should be reduced.

Environmental protection regulations for the discharge of wastewater, exhaust gas (non-SO_2) and SO_2 in the paper industry may be appropriately relaxed and technical innovation is required on the other hand. It can raise environmental standards for the discharge of solid waste, which has little impact on economic growth. The effect of wastewater treatment is obvious, and the effect of environmental policy regulation of exhaust gas is not obvious. The cost of pollution control should be reduced.

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