Research on Kuznets Curve in Hubei and Gansu Provinces

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Abstract. Due to the differences in geographical location, industrial structure and economic development in China, the level of economic development and pollution emission levels in different regions vary widely. Using the environmental Kuznets curve theory, this paper conducts an empirical study with Hubei and Gansu provinces as examples, and analyzes the relationship between wastewater, carbon dioxide and sulfur dioxide emissions and per capita GDP in the two provinces during 2005-2015. The research shows that the total amount of carbon dioxide emissions and per capita GDP in Hubei presents a classic Kuznets curve "n" curve, while the three indicators in Gansu cannot form a reasonable Kuznets curve relationship with per capita GDP. Combining the two provinces According to the specific conditions of different industrial development stages, relevant policy suggestions are put forward to promote energy conservation and emission reduction in the two provinces while promoting economic development, so as to achieve a reasonable development trend of the Kuznets curve and usher in a decline in pollutant emissions.

Keywords: environment and economy; Kuznets curve; environmental quality and economic growth.

1. Introduction

In the past development stage, which means focusing on economic development, it did not coordinate development with environmental protection. Facts have proved that governance after development would not be beneficial to the current development situation. At present, low carbon, environmental protection, and ecology have become the themes of urban civilization. The "Ecological Civilization" proposed in the "12th Five-Year Plan" and the "Beautiful China" requirements proposed by the 18th National Congress of the Communist Party of China indicate that our country has begun to discover the importance of environmental protection. China has a vast territory, and the economic level varies greatly between regions. In order to study the relationship between economic growth and environmental pollution in different regions, a quantitative analysis of the geographical economy based on the Heihe-Tengchong Line can be carried out by referring to the vastly different GDP of different regions on both sides of the line. That is, the northwest side contributes about 4.3% of China's GDP and the southeast side contributes 95.7%. Therefore, using the empirical research method to choose and analyze Gansu on the northwest side of this line and Hubei on the southeast side can provide a horizontal comparison and reference for studying the relationship between economic growth and environmental quality.

2. Literature review

2.1 Literature review of domestic studies on the impact of economic development on the environment

In China, based on the theoretical basis of the Kuznets curve, Wang Rong used the entropy weight method to determine the weight of each index by constructing the ecological environment evaluation index system. This sub-equation is used to fit and analyze Lanzhou's industrial structure; constructed an ecological environment evaluation index system, and used the entropy weight method to determine the weight of each index. A sub-equation was used to fit and analyze Lanzhou's industrial structure [1]; Cao Feng used domestic macro-statistical data from 1995 to 2013 to perform econometric regression, and believed that the Kuznets curve in the stage of economic development showed an obvious inverted U curve relationship and an inflection point occurs in the advanced stage of industrialization[2]. Wu Chuanqing and Chen Wenyan (2016) established a significant U curve relationship between economic growth and environmental quality by constructing an environmental

quality evaluation system for the Yangtze River Economic Belt and conducting empirical analysis based on the panel data of the Yangtze River Economic Belt [3]. Song Malin and Wang Shuhong used Copeland's model to analyze the economic indicators and pollutant emissions of 20 provinces and cities in China, and concluded that the emission levels in different provinces will show different forms due to the local economic development status. [4]

2.2 Literature review of foreign studies on the impact of economic development on the environment

The environmental Kuznets curve is a product of Grossman and Krueger analyzing the possible impact of a specific institutional change - NAFTA on the environment. Grossman and Krueger used a reduced regression model to conduct the first empirical analysis of the relationship between per capita income and environmental quality, and they found an inverted U curve relationship between per capita income and environmental degradation [5]. Shafik & Bandyopadhyay conducted further empirical research, including panel data of 149 countries from 1986 to 1990. Pollution measures include SPM concentration, Unit GDP the carbon emissions, dissolved oxygen in river water, etc. The indicator still uses per capita GDP, and the model includes Linear equation, Quadratic equation and Cubic equation [6]. Bhagwati also studied this curve, and his research results show that when the income reaches a certain level, the positive effects of structural effects and technology effects will eventually exceed the negative effects of scale effects, and the relationship between some pollutants and per capita income, It has an inverted U curve[7]. However, some scholars object to the environmental Kuznets curve. Holtz-Eakin and Selden used quadratic function and logarithmic equationto conduct regression analysis on the relationship between carbon monoxide emissions and per capita income, and found carbon monoxide emissions and per capita income showed a monotonically increasing trend, and there was no relationship between economic development and environmental quality. There is always a clear inverted U- curve relationship [8]. Cropper et al. studied the relationship between the reduction of forest area in Africa and economic development, and found that there is no inverted U curve relationship. [9]

3. Empirical Analysis

3.1 Basic Theory - Environmental Kuznets Curve

In 1991, American economists Grossman and Krueger aimed at the North American Free Trade Area negotiation, Americans worried that free trade would worsen the Mexican environment and affect the domestic environment of the United States. They first empirically studied the relationship between environmental quality and per capita income, and pointed out that the relationship between pollution with per capita income is that "pollution increases with per capita GDP at low income levels, and decreases with GDP growth at high income levels". The World Bank's World Development Report in 1992 expanded the impact of research on the relationship between environmental quality and income with the theme of "Development and the Environment". In 1993, Panayotou borrowed the inverted U curve between per capita income and income inequality defined by Kuznets in 1955, and called the relationship between environmental quality and per capita income as the Environmental Kuznets Curve (EKC). EKC revealed that environmental quality begins to degrade with the increase of income, and the income level rises to a certain level and then improves with the increase of income, that is, the relationship between environmental quality and income is an inverted U curve relationship.

The factors affecting the environmental Kuznets curve include: economic development (scale effect, technology effect and structural effect), international trade, market mechanism, etc.

3.1.1 Economies of scale, technology effect and structure effect.

(1) Economies of scale: In Western economic theory, scale effect refers to the phenomenon of decreasing long-term average cost due to the expansion of production scale under a given

technological level. When economic growth increases investment in order to reduce costs, the consumption of resources will also increase, and pollution emissions will also increase.

(2) Technology effect: Higher income levels represent better and more efficient production technology. When R&D expenditure rises, technological progress will increase productivity, improve the efficiency of resource use, reduce the factor input per unit of output, and weaken the impact of production on the natural environment; in addition, the development and application of clean technologies will recycle resources and reduce unit output. pollution emissions.

(3) Structural effect: With the development of the economy, the output structure and input structure will change. In the early stage of economic development, the industrial structure changed from agriculture to energy-intensive heavy industry, which increased pollution emissions, and then turned to low-polluting service industries and knowledge-intensive industries. The input structure changed, the emission level per unit of output decreased, and the environmental quality improved.

3.1.2 International trade

With the development of technology, even developing countries are in the high pollution development stage that developed countries have experienced in the past, they can adopt new technologies to reduce energy consumption and pollution and achieve cleaner production. In addition, exporting industrial products will increase environmental pollution, while importing industrial products will reduce environmental pollution. But some studies have also found that international trade can exacerbate environmental pollution. Scholars such as Copeland-Tayloy (1994), Chichilnisky (1994), Wheeler (1995) believe that the pressure of international competition causes or exacerbates policy failures in the environmental field. In order to maintain a competitive advantage, underdeveloped regions compete to lower environmental standards, which leads to pollution in developed regions. The transfer of large-scale industries or enterprises to less developed areas with lower environmental standards will lead to environmental deterioration in the latter.

3.1.3 Market mechanism

Due to the negative externality of environmental pollution, a company creates profits at the expense of polluting the environment, which will bring external costs to another company, so the company's private marginal cost of production will be greater than the social marginal cost. When making production decisions, enterprises will produce according to the principle that the marginal cost of the enterprise equals the marginal profit, but according to the social welfare maximization standard, the production quantity of the enterprise should be determined by the constraint that the marginal cost of the society equals the marginal benefit of the society. Rational enterprises will transfer these external marginal costs to the society, which will lead to the consumption of more resources than the optimal allocation of social resources, resulting in agglomeration of pollution.

3.2 Indicator selection

The environmental quality indicators select the total wastewater discharge, Carbon dioxide emissions and sulfur dioxide emissions from 2005 to 2015 in Hubei and Gansu, and the economic development indicators select the per capita GDP from 2005 to 2015. The data source is the National Bureau of Statistics.

3.3 Model Construction

EKC is to discuss the relationship between economic development level and environmental pollution degree by simulating the change trend between economic level and environmental quality related indicators. The EKC analysis process mainly uses quadratic functions and cubic functions to verify the EKC relationship between economic growth and environmental pollution. Taking the per capita GDP of Hubei and Gansu from 2005 to 2015 as the representative economic growth variable in the EKC model, the analysis model is set as follows:

$$Y = b_0+b_1X \quad (1)$$
$$Y = b_0+b_1X+b_2X^2 \quad (2)$$
$$Y = b_0+b_1X+b_2X^2+b_3X^3 \quad (3)$$

In the above formula, Y represents the environmental quality index, which are: total wastewater discharge (10,000 tons), sulfur dioxide emissions (10,000 tons) and carbon dioxide emissions (tons). X represents the economic growth index, which is GDP per capita (100 million yuan); b0, b1, and b2 represent the model coefficients. This paper will build a model to fit and analyze the relationship between the per capita GDP of Gansu and Hubei and the total amount of wastewater discharge (10,000 tons), sulfur dioxide emissions (10,000 tons), and carbon dioxide emissions (tons) in Gansu and Hubei from 2005 to 2015. Through comparative analysis, the best fitting model is finally obtained.

3.4 Model Fit Test

This paper uses SPSS to carry out the fitting regression analysis of the above models on per capita GDP and wastewater discharge, per capita GDP and sulfur dioxide emissions, and per capita GDP and carbon dioxide emissions respectively.

3.4.1 Hubei Environmental Kuznets Curve Fitting Test

(1) The fitting results of per capita GDP and total wastewater discharge in Hubei (as shown in Table 1):

Table 1. The fitting results of per capita GDP and total wastewater discharge in Hubei

y: Total wastewater discharge

Equation	The model summary					Parameter estimates			
	R^2	F	df1	df2	Sig.	Constant term	b1	b2	b3
Linear model	.955	189.829	1	9	.000	216998.997	1.862		
Quadratic model	.971	132.684	2	8	.000	199005.237	3.289	-2.278E-005	
cubic model	.974	86.078	3	7	.000	179874.647	5.635	.000	8.765E-010

X: Per capita GDP

Among them, R^2 is the correlation coefficient, and when the quadratic equation is constructed, R^2 is 0.974. The maximum value of R^2 indicates that the fitting effect is the best. Therefore, the quadratic equation of per capita GDP and wastewater discharge can be obtained: $Y = 199005.237+3.289X+(-2.278\times10^{-5})X^2$. The fitting curve is shown in Figure 1.

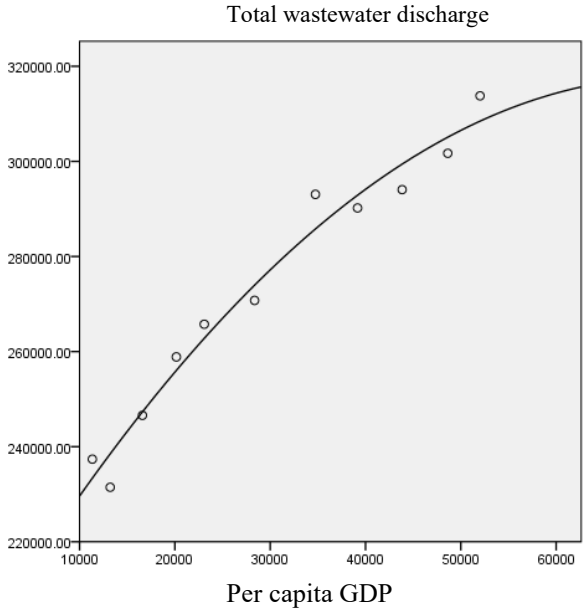


Figure 1. Quadratic equation diagram of per capita GDP and total wastewater discharge in Hubei Province

(2) The fitting results of per capita GDP and sulfur dioxide emissions in Hubei (As shown in Table 2):

Table 2. The fitting results of per capita GDP and sulfur dioxide emissions in Hubei

Y: Sulfur dioxide emissions

Equation	The model summary					Parameter estimates			
	R^2	F	df1	df2	Sig.	Constant term	b1	b2	b3
Linear model	.858	54.349	1	9	.000	77.010	.000		
Quadratic model	.861	24.784	2	8	.000	78.796	-.001	2.261E-009	
cubic model	.905	22.251	3	7	.001	95.669	-.003	7.535E-008	-8.730E-013

X: Per capita GDP

Among them, R^2 is the correlation coefficient, and when the cubic equation is constructed, R^2 is the largest, which is 0.905, indicating that the fitting effect is the best. Therefore, the equations of per capita GDP and sulfur dioxide emissions are: $Y = 95.669-0.003X+(7.535\times10^{-8})X^2+(-8.73\times10^{-13})X^3$.The fitting curve is shown in Figure 2:

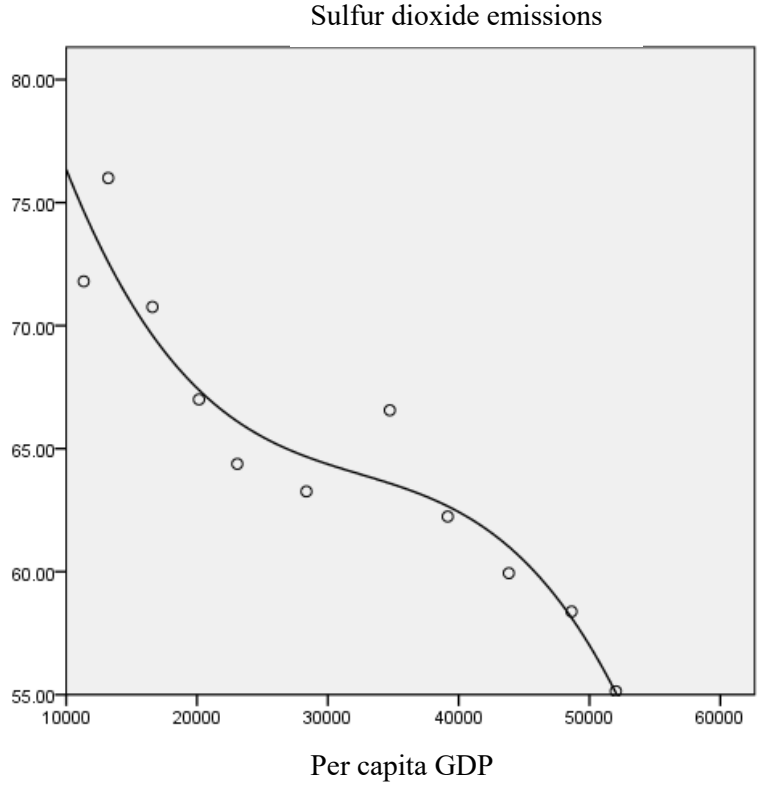


Figure 2. Fitting curve of per capita GDP and sulfur dioxide emissions in Hubei Province

(3) The fitting results of per capita GDP and total carbon dioxide emissions in Hubei (As shown in Table 3):

Table 3. The fitting results of per capita GDP and total carbon dioxide emissions in Hubei

Y: Total carbon dioxide

equation	The model summary					Parameter estimates			
	R^2	F	df1	df2	Sig.	Constant term	b1	b2	b3
Linear model	.537	10.420	1	9	.010	202.321	.003		
Quadratic model	.891	32.826	2	8	.000	26.146	.017	-2.230E-007	
cubic model	.900	20.944	3	7	.001	94.064	.009	7.115E-008	-3.211E-012

X: Per capita GDP

Among them, r2 is the correlation coefficient, and when the cubic equation is constructed, r2 is the largest, which is 0.900, indicating that the fitting effect is the best. Therefore, the relationship between per capita GDP and carbon dioxide emissions can be obtained as: $Y = 94.064+0.009X+(7.115\times10^{-8})X^2+(-3.211\times10^{-12})X^3$.The fitting curve is shown in Figure 3:

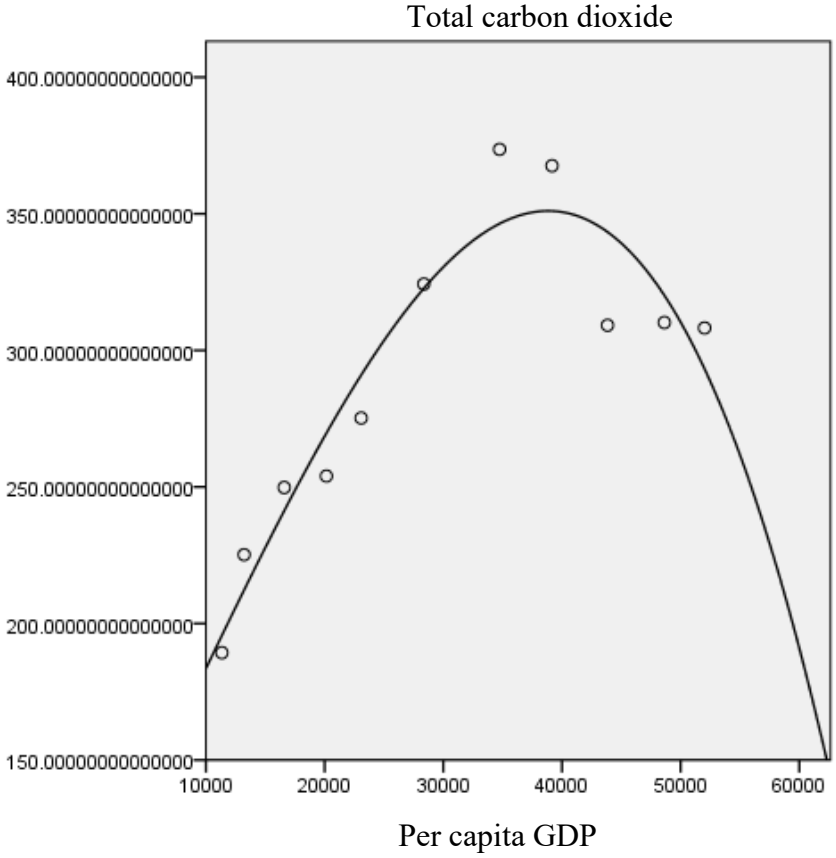


Figure 3. Fitting graph of per capita GDP and total carbon dioxide emissions in Hubei Province

3.4.2 Gansu Environmental Kuznets Curve Fitting Test

(1) The fitting results of per capita GDP and total wastewater discharge in Gansu (as shown in Table 4):

Table 4. The fitting results of per capita GDP and total wastewater discharge in Gansu

Y: Total wastewater discharge

Equation	The model summary					Parameter estimates			
	R^2	F	df1	df2	Sig.	Constant term	b1	b2	b3
Linear model	.980	430.836	1	9	.000	30602.188	1.452		
Quadratic model	.980	193.721	2	8	.000	31768.899	1.288	4.878E-006	
Quadratic model	.993	323.181	3	7	.000	56990.194	-4.208	.000	-7.408E-009

X: per capita GDP

Among them, R^2 is the correlation coefficient, and when the quadratic equation is constructed, R^2 is the largest, which is 0.98, indicating that the fitting effect is the best. Therefore, the equations of per capita GDP and wastewater discharge can be obtained as follows: $Y =31768.899+ 1.288X+(4.878\times10^{-6}) X^2$. The fitting curve is shown in Figure 4:

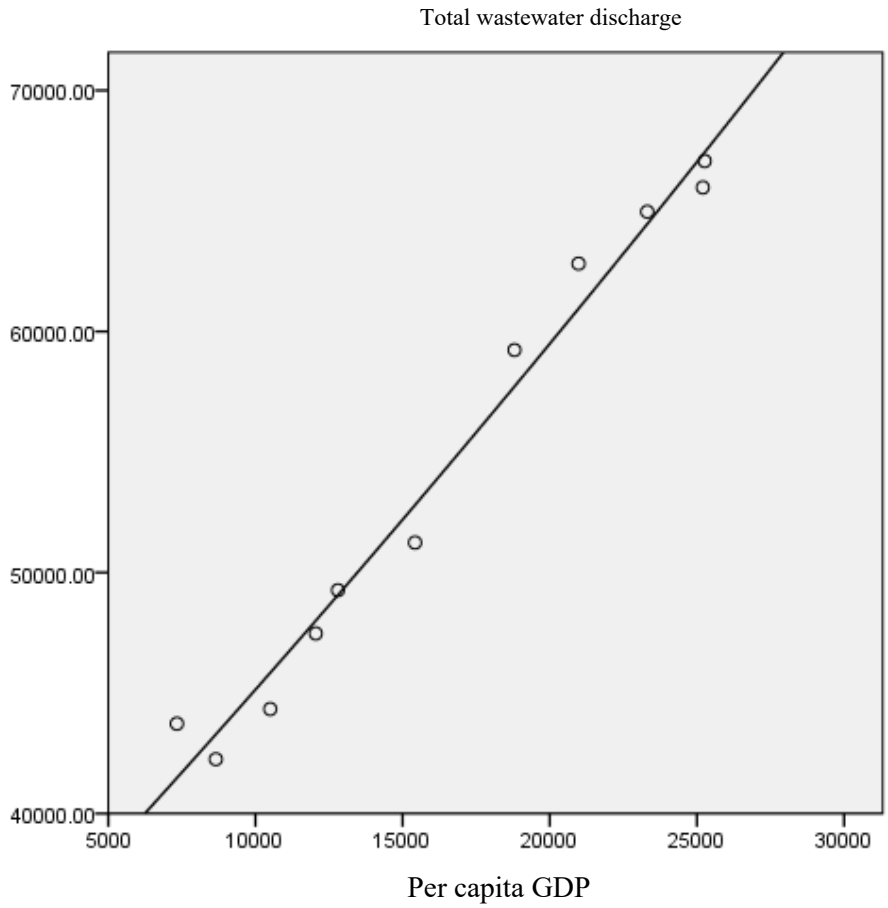


Figure 4. Fitted graph of per capita GDP and total wastewater discharge in Gansu Province

(2) The fitting results of per capita GDP and Sulfur dioxide emissions in Gansu

(As shown in Table 5)

Table 5. The fitting results of per capita GDP and Sulfur dioxide emissions in Gansu

Y: Sulfur dioxide emissions

Equation	The model summary					Parameter estimates			
	R^2	F	df1	df2	Sig.	Constant term	b1	b2	b3
Linear model	.270	3.321	1	9	.102	50.799	.000		
Quadratic model	.278	1.542	2	8	.271	53.419	-8.715E-005	1.095E-008	
cubic model	.668	4.701	3	7	.042	103.919	-.011	7.392E-007	-1.493E-011

X: Per capita GDP

Among them, R^2 is the correlation coefficient, and when the cubic equation is constructed, R^2 is the largest, which is 0.668, indicating that the fitting effect is the best. Therefore, the relationship between per capita GDP and sulfur dioxide emissions is: $Y = 103.919 - 0.011X + (7.392 \times 10^{-7})X^2 + (-1.493 \times 10^{-11})X^3$

The fitting curve is shown in Figure 5:

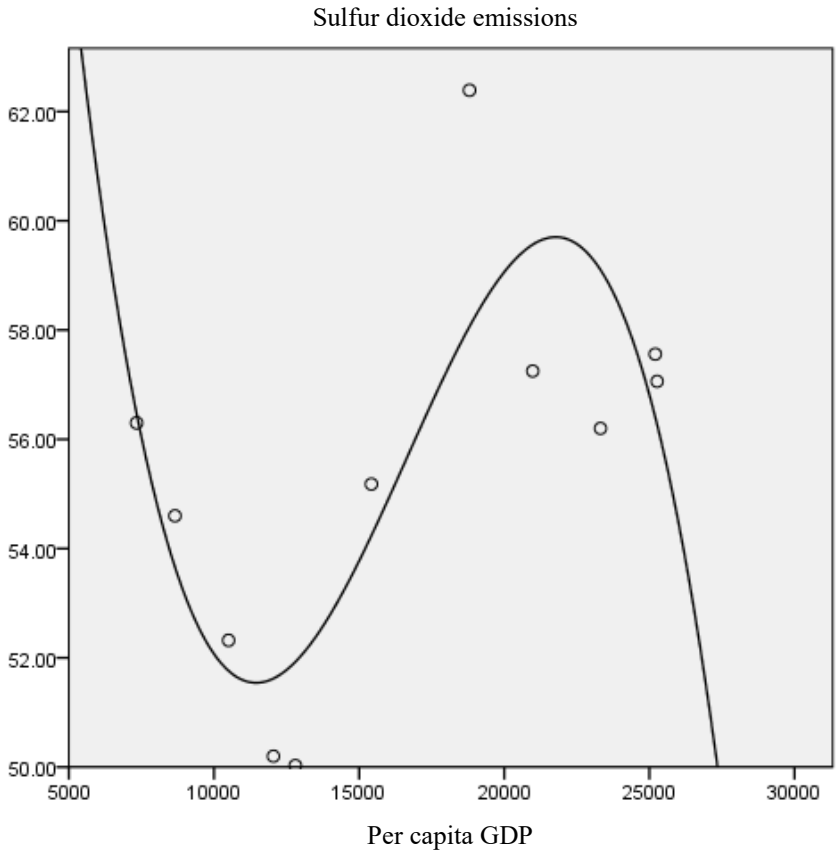


Figure 5. Fitted graph of per capita GDP and SO_2 emissions in Gansu Province

(3) The fitting results of per capita GDP and carbon dioxide emissions in Gansu are shown in Table 6:

Table 6. The fitting results of per capita GDP and carbon dioxide emissions in Gansu

Y: carbon dioxide emissions

Equation	The model summary					Parameter estimates			
	R^2	F	df1	df2	Sig.	Constant term	b1	b2	b3
Linear model	.977	388.523	1	9	.000	49.782	.005		
Quadratic model	.980	198.959	2	8	.000	36.643	.006	-5.493E-008	
cubic model	.991	258.579	3	7	.000	109.124	-.009	9.903E-007	-2.139E-011

X: Per capita GDP

Among them, r2 is the correlation coefficient, and when the cubic equation is constructed, r2 is the largest, which is 0.991, indicating that the fitting effect is the best. Therefore, the relationship between per capita GDP and carbon dioxide emissions can be obtained as: $Y = 109.124-0.009X+(9.903\times10^{-7})X^2+(-2.139\times10^{-11})X^3$

The fitting curve is shown in Figure 6:

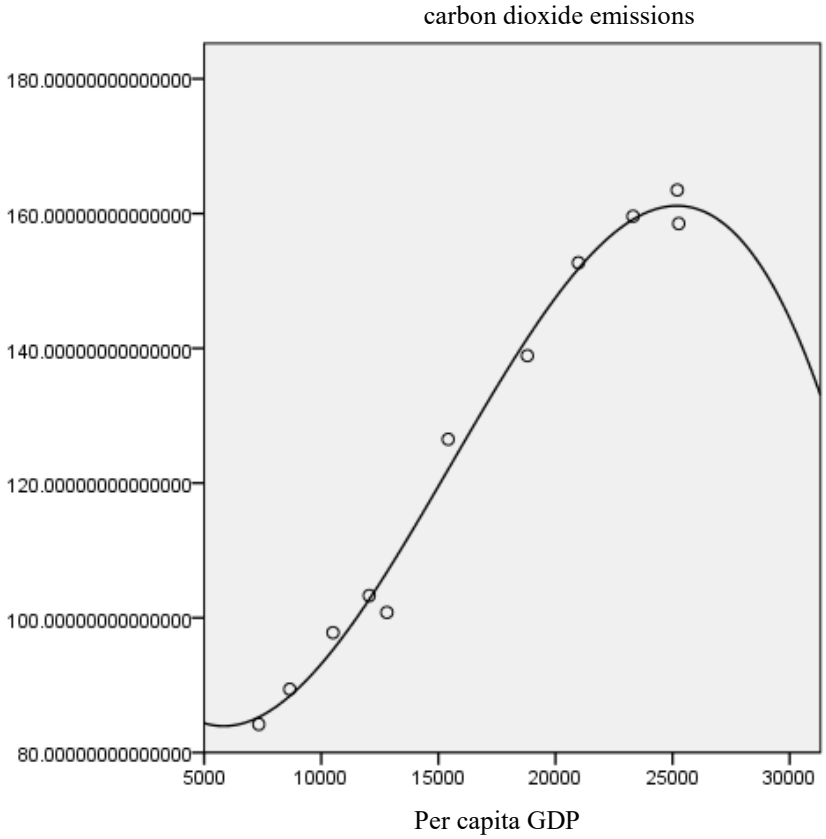


Figure 6. Fitted graph of per capita GDP and carbon dioxide emissions in Gansu

To sum up, when the data is taken from Hubei Province, only the total carbon dioxide emissions and per capita GDP show the Kuznets curve shape; when the data are taken from Gansu Province, there are two total emissions of wastewater and total carbon dioxide emissions. The indicator and GDP per capita conform to the "n" curve of the Kuznets curve.

The relationship between per capita GDP and total wastewater discharge in Hubei presents a quadratic function. Its coefficient b2=-2.278×10^{-5}, indicating that the total amount of wastewater discharge in this region will show a trend of rising first and then falling with the development of economy. Looking at the combined curve, the total amount of wastewater discharge in Hubei is still increasing with the rise of per capita GDP, and there is still some distance from the inflection point of the pollutant discharge of the Kuznets curve. In addition, the per capita GDP of Hubei also has a quadratic function relationship with carbon dioxide emissions, and its coefficient b2=-3.211×10^{-12}, indicating that the relationship between carbon dioxide emissions and the economy presents an inverted "U" curve relationship, which is A typical environmental Kuznets curve represents that when the economy continues to grow, the carbon dioxide emissions in the region will experience a process of first increasing and then gradually decreasing. The total amount of sulfur dioxide emissions in Hubei has a cubic function relationship with per capita GDP, and the Kuznets curve cannot be fitted;

The per capita GDP, sulfur dioxide emissions and carbon dioxide emissions of Gansu are all cubic function models, indicating that these two pollutant emissions do not conform to the Kuznets curve. The total amount of wastewater discharge and GDP per capita in Gansu are in the form of a quadratic function, and the coefficient b2=4.878×10-6, that is, the quadratic function graph is a “U” curve with an upward opening. The fitting of GDP per capita and wastewater discharge curve is the second half of the curve, and the discharge of wastewater increases with the increase of GDP per capita.

4. Discussion

The above data analysis shows that there are certain differences in the relationship between the economy and pollutant emissions in Hubei and Gansu provinces. The reason is not only affected by objective factors such as the inherent geographical environment, resource endowment and development foundation of the two provinces, but also by differences in policies, economic structure and regional industrial structure types.

4.1 Analysis of the causes of environmental Kuznets curve in Hubei Province

The total carbon dioxide emissions in Hubei reaching 373.6 tons in 2011, and then dropped to 308.22 tons, forming an inverted U curve trend. In contrast, the sulfur dioxide emissions and wastewater emissions in Hubei showed a single downward and upward trend, respectively. From the perspective of economic development level, from 2005 to 2015, the per capita GDP of Hubei increased from 11,342 yuan to 52,015 yuan. GDP per capita increased by 21.4%; From the perspective of industrial structure, the largest carbon emission sectors in Hubei are the transportation and storage industry of the tertiary industry, followed by the agriculture, forestry, animal husbandry and fishery of the primary industry. The carbon dioxide emissions of the two industries relative to the total carbon dioxide emissions account for than half. The extensive economic model with high input and low output still dominates the local industrial development. The oil processing, coking and nuclear fuel processing industries are growing rapidly, and the consumption of raw coal has always been in the dominant position in the energy consumption of industrial enterprises above designated size. In addition, iron and steel, non-ferrous metals, petrochemicals, and other traditional pillar industries in Hubei are mostly energy-intensive and high-emission industries, which are the main components of pollutant emissions in Hubei Province; From a policy perspective, in order to promote the transformation and upgrading of the high-carbon emission industrial structure, the state adjusts the industrial structure through policy means such as guidance and restrictions, and the carbon emission trading system is one of them. In 2011, the "five cities and two provinces" including Hubei carried out carbon trading pilot work. Since the launch of the Hubei carbon trading pilot on April 2, 2014, with its complete institutional design and comprehensive compliance risk control system, It has formed the second largest carbon market in the world and the largest carbon market in China, accounting for 48% of the national carbon market, with excellent energy saving and emission reduction effects.

4.2 Analysis of the causes of the environmental Kuznets curve in Gansu

In general, from 2005 to 2015, Gansu Province's carbon emissions and economy were in a continuous growth trend. In general, the growth rate has been on the rise, except for the slow decline in 2009 and 2014. Before 2009, the average annual growth rate of carbon emissions was more than 5%, and the growth rate was relatively fast. In 2009, there was a negative growth. It entered a slow growth period from 2009 to 2014, and reached 163.5 tons in 2014, and then dropped to 158.1 tons, forming an inverted U curve. In contrast, the discharge of wastewater in Gansu showed a single downward trend, while the discharge of sulfur dioxide dropped from 56.3 tons in 2005 to 50.0 tons in 2009, then rose to 62.39 tons in 2011, and then fell again to 2015. 57.1 tons, showing an unstable fluctuation trend in general.

Gansu has a long sunshine time and a large amount of evaporation, and because Gansu is located in the inland, it is difficult to contact the warm and humid air flow, so the spatial and temporal distribution of rainwater is uneven, and the population, resources, environment, and development of different regions are seriously imbalanced, resulting in ecological environment. Fragile, resource load pressure is too high. At the same time, Gansu has experienced rapid population growth, rapid development of industrial and agricultural water use, and more and more frequent droughts, especially in the 1990s. In addition, the construction of urban water resources infrastructure in Gansu is seriously lagging behind, and the construction density is lower than the national average level of cities. As a

result, many sewages in the city have not formed a reasonable sewerage and discharge system, and the sewage treatment rate and urban water cycle reuse rate are low. Therefore, the total sewage discharge in Gansu remains high.

From the perspective of economic development, the economic growth rate of Gansu has exceeded the growth rate of carbon emissions in the past ten years, but the future industrialization and urbanization process will still have a certain impact on the scale of carbon emissions. Gansu is currently at a low level of economic and social development, facing the development status quo of the transition from the early stage of industrialization to the middle stage. The demand for energy is growing rapidly, and both industrialization and urbanization require a large number of energy-intensive products, so carbon emissions are still rising year by year.

From the perspective of industrial structure, Gansu's agriculture, forestry, animal husbandry and fishery, wholesale and retail trade and catering industry are low-energy-consuming industries, but their role in reducing carbon emissions is limited. The main influencing factors are the three sectors of industry, transportation, warehousing, post and telecommunications, and living consumption. The main growth sector of total carbon emissions in Gansu is the secondary industry, which is highly consistent with the composition of carbon emissions in Gansu Province. dominate the total emissions. Coal is the main energy consumption species in Gansu Province. About 80% of the annual primary energy consumption is coal, and the resulting carbon emissions also account for more than 80% of the total carbon emissions in Gansu Province.

5. Summary

Using the environmental Kuznets curve theory, this paper conducts an empirical study with Hubei and Gansu provinces as examples, and constructs the relationship between wastewater, carbon dioxide and sulfur dioxide emissions and economic growth during 2005-2015. The research shows that there are certain differences in the relationship between the economy and pollutant emissions in Hubei and Gansu provinces. Hubei Province's total carbon dioxide emissions and per capita GDP show the "n" curve of the Kuznets curve, while the three indicators in Gansu are all different. It cannot form a reasonable Kuznets curve relationship with per capita GDP. The environmental Kuznets curve hypothesis is only a simple and practical analysis method for the relationship between economic growth and environmental pollution based on experience, and it has certain reference significance for analyzing the coordinated development of nature, society and economy in the two provinces. By sorting out the economic development status, industrial structure, energy conservation and emission reduction policies of Hubei and Gansu in the past ten years and other perspectives, the causes of the Kuznets curve of pollution emissions in the two provinces are discussed.

By interpreting the economics, policies and industrial structures of the two provinces, the following suggestions are put forward to reduce pollutant emissions in Hubei and Gansu:

5.1 Efforts to realize the transformation of the industrial structure.

As an important factor in determining the mode of economic growth, the industrial structure indirectly reflects the overall quality of the national economy. Gansu is currently in the early stage of industrialization, and the secondary industry is still the leading industry of economic development and the main growth force of the province's economic development; After 2004, Hubei adjusted its industrial structure to a development pattern of "second to third to first step" according to the actual needs of development. Therefore, the focus of the adjustment and optimization of the industrial structure of the two provinces is to continuously improve the technological content, improve the capability of independent innovation of enterprises, accelerate the development of modern service industry, and reasonably combine the adjustment of industrial structure with the regional development strategy.

On the other hand, despite the continuous growth in the scale of large-scale heavy industry projects in Hubei and Gansu provinces, if all the above-mentioned companies are required to reduce energy

consumption based on carbon emissions, it will undoubtedly slow down the development of the local economy to a great extent. Therefore, in the pursuit of development, low-carbon energy is particularly important to maintain high-speed and sustainable economic growth. The prospects of renewable low-carbon energy such as solar energy are very broad, but their development is restricted due to backward technology, huge cost and high electricity price. To enhance the competitiveness of low-carbon energy and make it popular among large and small enterprises in all walks of life, it is necessary to pay attention to the research and development and promotion of low-carbon energy technologies, and to use technological innovation to continuously reduce the cost of renewable energy, so as to make it more competitive in production capacity, price, efficiency and many other aspects are on par with or even surpass traditional energy sources, so as to rapidly popularize and use them and become the main energy sources in the future. It is also possible to strengthen policy guidance and establish a policy system and market environment conducive to the development of a low-carbon economy, such as taking coercive measures against a small number of long-term high-pollution and high-energy-consumption industries; promoting role, using price, tax, finance and other economic means to promote the "low-carbon, high-growth" economic development model, encouraging micro-enterprises to take the road of low-carbon development, driving economic development through capital, and guiding other factors and resources to agglomerate and develop into low-carbon industries. Change the way of development.

The economic growth of Hubei and Gansu is largely achieved by the great consumption of environmental resources. Efforts should be made to realize the transformation of the economic growth mode from extensive to intensive, and take the road of intensive growth with technological progress and independent innovation as the core. Focusing on industrial optimization and upgrading, focus on pollution control in key industries, and vigorously develop the tertiary industry to reduce environmental pressure. Intensify the research and development and promotion of low-carbon energy technologies, reduce the cost of renewable energy, and strengthen policy guidance, encourage all walks of life to develop low-carbon industries, and guide the transformation of the industrial structure to a low-carbon model through financial incentives and constraints. In terms of pollution control, we should improve the control efforts. While making reasonable investments in environmental pollution control, we should make overall plans and coordinate environmental policy measures, economic development and new technologies for pollution control.

5.2 Maintain a moderate economic growth rate.

The fitting results of the Kuznets curve for the two provinces show that reasonable economic growth has a certain effect on reducing the emission of pollutants, and at the same time, the excessive growth rate will increase the emission of pollutants. my country's current stage of social development requires the economy to maintain a high growth rate, but the limitation of the environment's carrying capacity urges the government to make corresponding efforts to environmental protection and pollution reduction. Therefore, under the dual pressure of reducing emissions and maintaining economic growth, policies should take into account the two goals of reducing emissions and promoting the economy. By levying corresponding environmental taxes to control the combustion of fossil fuels such as oil, natural gas, and coal, reduce the emissions of high-energy-consuming and high-emission enterprises, and reduce the consumption of carbon-emitting products to reduce carbon dioxide emissions, and achieve the purpose of energy conservation and emission reduction. This will inhibit economic growth to a certain extent. In this case, the overall coordination function of fiscal and taxation policies should be brought into play, fiscal revenue should be rationally allocated, and fiscal revenue and expenditure should be balanced. While using tax policies to curb pollution emissions, fiscal and taxation spending policies are used to balance the steady growth of the economy.

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