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Research on the Calculation and Influencing Factors of the Green Development of Regional Industry in China

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Abstract: From the perspective of input, this paper focuses on the link of resource conservation in the development of industry, and regards the reduction of the amount of resources consumed under the same technical conditions as the development of green industry. The expected energy consumption, power consumption and water consumption calculated on the basis of the technical level in the base period are compared with the actual consumption, and the difference between the obtained resource consumption and the actual consumption is used to represent whether the industrial development is green, and the monetization treatment is carried out to quantitatively measure the proportion of the green part in the industrial added value, so as to measure the output of 30 provinces (municipalities, autonomous regions) in 2004-2017 Green development effect and level of the industry. Then, according to the measured industrial green value, the panel data regression model is used to analyze the influencing factors. The empirical research results show that the economic development level, the proportion of the tertiary industry, the high-tech level and the total investment in environmental pollution control have a significant role in promoting the development of industrial green. It shows that there are some differences in the level of green development of industries in all provinces (cities and autonomous regions), so we can improve the overall level of green development of regional industries by adjusting measures to local conditions and classifying measures.

***Keywords*:** industry, green development, panel data, analysis of influencing factors

1. Introduction

"Green" is an important content in the study of national development, urban development and industrial development in recent years. With the gradual recognition and attention to the concept of sustainable development and the concept of ecological civilization development, the word "green" plays an increasingly important role in the evaluation of the effect of national, urban and industrial development.

The research on "green development" can be traced back to 1962, when American biologist Carson published "Silent Spring" and proposed that the use of pesticides would cause harm to people and the environment. Ten years later, the non-governmental academic organization Rome club published a research report "the limit of growth", warning the world and calling on the world to pay attention to the relationship between people, the environment and resource consumption. In the past ten years, with the economic growth of various countries, green economy and the concept of green development have sprung up, green industrial policy is gradually attracting widespread attention and becoming an important policy choice for countries to realize the concept of green development. More and more economic development and policy researchers (Penna, 2012; Rodrik, 2014; Lütkenhorst et al., 2014; Altenburg T, 2012)[1-4] and international organizations (Hallegate Etc., 2013; Schwarzer, 2013)[5–6] conducted in-depth research on green development, industrial green and other issues, put forward the concepts of "green economy", "green growth", and incorporated resources and ecological environment indicators into social development and economic growth. For example, the OECD believes that "green growth can be regarded as a way to pursue economic growth and development while preventing environmental degradation, biodiversity loss and unsustainable use of natural resources. It aims to use cleaner sources of growth so as to achieve a more environmentally sustainable growth model"[7].

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In this paper, we do not seek to build a complete evaluation system of the development effect of industrial green, aiming to build a simple and easy to operate method to measure the development effect of industrial green, and to achieve the computability and measurement of the development level of industrial green. Focusing on the link of resource conservation in the development of green industry, the reduction of the amount of resources consumed under the same technical conditions of an industry is regarded as the green development of the industry, and the value of the consumed resources can be compared with the published industrial added value to measure the effect of green development, which is helpful to evaluate and reflect the level of regional green development in China. At the same time, according to the empirical model of panel data to study the factors that affect the development of green industry, through the analysis of the influencing factors, we can provide targeted suggestions for the development of green industry in each province (city, autonomous region), which has important reference significance for promoting the construction of green ecological civilization.

2. Literature review

2.1 Research on the development of green industry at home and abroad

The research and evaluation of green industrial development abroad include the Asian green industrial development index system established by the United Nations Industrial Development Organization[8], the green economic index system established by the United Nations Environment Programme[9], and the green growth index system established by the organization for economic cooperation and development[10]. Allenby[11], Hall[12], Erkman[13], Jänicke[14] and other scholars respectively defined the concept of industrial green development from the perspective of imitation ecology, microeconomic subject, system theory, industrial green development goals and other perspectives. Charles R. Hall[15] conducted an in-depth evaluation of the green spillover effect of the booming US related industries by using the input-output method. Ulgaiati S[16] points out that with the development of economy, the shortage of material resources, especially the shortage of energy, has increasingly become the focus of attention. In this paper, the author points out that we should change the mode of production and consumption, realize the reorganization of economy and life style, and achieve the purpose of saving resources and reducing pollution. Martin Jänicke[17] analyzed the "green growth" proposed by OECD, according to the industrial data of Germany, Japan, China and other countries, proposed the need to improve resource productivity, such as improving resource saving technology (renewable energy, energy efficiency, recycling, etc.), as well as environmental and resource saving to achieve sustainable growth.

At present, many scholars in China have studied the development of green industry, with a focus on what it means or the pathway to achieve it. The first type of study, epitomized by research by [18–23], explores the significance ,connotation and theoretical explanation of green development and industrial green development in China, and provides insight into the nature and advantages of green industry. The second type of study includes, for example, the one made by [24] which discusses the basic regional measures to strengthen the green industry in China to drive the green development of industries. Han Jing, et al.[25] and Zhang Jiangxue, et al.[26] discussed the development path of industrial green growth through the measurement of industrial green degree and work green growth index and the research of influencing factors. Feng Xiaoxu[27] proceeds from the perspective of the green growth of the industry, and calculates the green industrial development index of Sichuan Province from 2009 to 2014 using the entropy and SBM-DDF methods respectively. Feng points out that Sichuan should pay close attention to promoting green development of its heavy chemical industry and resource-based cities. Ma Li, et. al.[28], in their study of the coastal prefecture-level cities, build the industrial green transformation coefficient, examine the spatial pattern of industrial transformation (including both structural transformation and a change in efficiency) in the coastal areas from 2005 to 2013. Based on the characteristics of industrial development and environmental pressure in different types of regions, they probvide recommendations on industrial green transformation and environmental control. Tian Ze[29] analyzes the green development in the east, central and west regions of China, and concludes that there are gaps between regions, and that the green development of industries in China's different regions can only be improved by taking measures according to local conditions.

Also, scholars pay increasing attention to the evaluation of the outcome of green development of regional industries. Zhu Chunhong and Ma Tao[30], for example, examine the purpose of such evaluation, principles underlying the building of the evaluation model, its contents and methods, the application of the model built on the basis of the network hierarchy method, and build an index system for the evaluation. However, they make no attempt to use the model for an evaluative analysis in selected regions. Li Lin, et al.[31] build the indicator system for the regional industrial green development index from three dimensions-green growth of industries, resources and environmental carrying capacity and support of

government policies, and adopted the principal component analysis (PCA) to evaluate the performance of 31 provinces in this index from 2007 to 2012 and to make a dynamic and comprehensive comparison. Apart from providing an overall picture of green development of industries, they evaluate the green development of agriculture, industry and services specifically. Lu Qiang, et al.[32], on the basis of the core concept in the decoupling theory, analyze the characteristic indicators of resource and environment. They use the elastic decoupling value of industrial resource consumption or pollutant emission to industrial value-added as a dynamic indicator to measure industrial green transformation and upgrading, build an indicator system in the three dimensions of environmental pressure of industrial resources, elastic decoupling of industrial resources and environment and the greenness of industrial development, use the system to evaluate 21 cities above the prefecture level in Guangdong Province. Pang Ruizhi, et al.[33] use the improved Bootstrap two-stage approach to empirically examine the environmental total factor efficiency (ETFE) of China's service sector and the influencing factors including energy consumption, pollution and emission; within the framework of green growth, they calculate the EFTE of the service sector in 30 provinces and municipalities during 2010-2013. Wei Qi, et al.[34] develop China's agricultural green development index which combines 14 indicators in four dimensions-resource saving, environment-friendliness, ecological conservation, quality and efficiency-and evaluate the level of agricultural green development in various provinces in recent years.

2.2 Research on the influencing factors of industrial green development

The green development of industries is important not only for long-term sustained growth of regional economy, but also for environmental protection and development, and more importantly for the healthy living of residents in the regions. It thus requires the industry to leverage technological innovations to improve factor input and utilize resources more efficiently.

As the unity of human creativity and the complexity of natural and social relations, the green development process of industrial activities is not only the problem of harmonious coexistence within the industry, but also the result of the joint action of internal and external social factors. By analyzing the green development of Australian chemical industry, the author points out that it is necessary to develop the existing green technology, so that the technology can reduce environmental pollution and improve the efficiency of resource utilization[35]. It is not only technological innovation but also policy promotion that affects the green development of industry.In order to promote the application of green technology, the government of Southern California has adopted a variety of policies. By evaluating the effectiveness of different policy tools, it is found that the adoption rate of green technology has increased by more than 200%. It can be seen that the policy will promote the development of green industry[36].

Based on the imbalance of regional development in China, Chinese scholars mostly analyze from the aspects of economy, policy and technology. For example, Li Ye[37] pointed out that the factors that affect the effect of industrial green transformation and upgrading can be divided into external factors, situational factors and internal factors. Specifically, policy support, talent accumulation, economic development, technological innovation level and other factors will play a certain role in the industrial green development. Zhang Guojun[38] selected six variables: globalization, marketization, urbanization, residents' income level, government regulation and technology level to reflect internal and external factors such as economy, system and society, so as to analyze the influencing factors of spatial distribution of industrial green development level in Guangdong Province. Sun Yixuan[39] used the obstacle model to analyze the industrial green transformation in the Bohai Rim region from 2000 to 2015, so as to determine the main obstacle factors affecting the industrial green transformation in the Bohai Rim region. The factors such as per capita GDP, the proportion of tertiary industry in GDP, the proportion of science and education expenditure in total financial expenditure, the number of students per 10000 students in school and the proportion of information industry employees in total employees have significant influence on the level of regional industrial green transformation. At the same time, combined with the research on the influencing factors of industrial green development by [25−26], these papers intends to select five representative indicators of economic level, urban scale, industrial structure, high-tech level and environmental governance to analyze the influencing factors.

3. Model

3.1 Calculation model of industrial green

From the perspective of input, this paper measures the outcome of green development of industries in monetary terms, gauges in a quantitative manner the share of the industrial value-added that is environmentally friendly, and evaluates the overall performance in the green development of industries. Specifically, based on the industrial value-added during the

base period and the corresponding energy, water and electricity consumption intensity, we may use the industrial value-added over the years to estimate the expected level of energy, water and electricity consumption during the calculation period as well as the disparity between it and the actual level of consumption. Whether the result is positive or negative indicates whether the industry has pursued green development. The gap and the size of the monetized value reflect how green the industry has turned. The monetized value as a proportion of the value-added for the years shows the outcome of the industries' green development.

First, the monetized value of the energy indicator is calculated as follows:

$$GMV_{Ti} = (TEC_{Ri} - GDP_{Ri} * TEI_0)\, P_{T0} \quad (1)$$

Here, GMV_{Ti} represents the monetized value of energy during the calculation period, TEC_{Ri} the actual energy consumption of the calculation period, GDP_{Ri} the actual GDP of the calculation period, GDP represents industrial added value, TEI_0 the energy intensity of the base period, and P_{T0} the unit price of standard coal during the base period (the average unitprice in 2000 in this study). Energy input is measured by energy consumption data from the energy statistics yearbook and the statistics yearbooks of provinces (municipalities, autonomous regions). In this paper, other forms of energy are converted into equivalent standard coal and the electricity consumption is taken away from the energy consumption. Thus, the change of the consumption of all forms of energy except for electricity can be analyzed.

Second, the monetized value of the electricity indicator is calculated as shown in the following formula:

$$GMV_{Ei} = (EC_{Ri} - GDP_{Ri} * EI_0)\, P_{E0} \quad (2)$$

Here, GMV_{Ei} represents the monetized value of electricity during the calculation period, EC_{Ri} the actual electricity consumption and GDP_{Ri} the actual GDP during the same period. EI_0 and P_{E0} represent the electricity consumption intensity and the average sale price of electricity during the base period. Electricity input is measured by electricity consumption data based on the energy statistics yearbook and the statistics yearbooks of provinces (municipalities, autonomous regions). As domestic electricity use accounts for only a small proportion of the total, and part of electricity consumption in the three sectors (primary, secondary and tertiary sectors) is actually put in this category, we would use electricity consumption in place of the total industrial consumption.

Next, the monetized value of the water resources indicator is calculated, as shown in the following formula:

$$GMV_{Wi} = (WC_{Ri} - GDP_{Ri} * WI_0)\, P_{W0} \quad (3)$$

Here, GMV_{Wi} represents the monetized value of water resources in the calculation period, WC_{Ri} and GDP_{Ri} the actual water consumptionand the actual GDP in the calculation period. WI_0 and P_{W0} represent the water consumption intensity and the industrial and commercial water consumption in the base period, respectively. Water input is measured by total water consumption data based on the water resource bulletins of various places. As water use in the tertiary sector and the construction industry is included in the domestic water use data and households water use accounts for only a small proportion of the total, we would use total water consumption in place of the total industrial consumption.

Finally, we add all the monetized value for different types of resources together to obtain their total monetized value:

$$GMV_i = GMV_{Ti} + GMV_{Ei} + GMV_{Wi} \quad (4)$$

In this formula, if GMV_i is negative, it means the actual input of energy, water resources, and electricity is less than the expected level, and the industries' green development shows a higher level than in the base period. If it is positive, it means the actual input is larger than the expected level, and the green development shows a lower level than in the base period.

3.2 Regression analysis model of panel data

This empirical study mainly uses the panel data regression analysis. Because the factors influencing the green development of industries cannot be considered in a single dimension, it is necessary to study and analyze various factors as a whole. Panel data is a combination of time-series data and cross-sectional data, and a study on the basis of panel data would yield more accurate and comprehensive results. The panel data regression model[40] is constructed to explore the relations between various factors and the green development of industries. More specifically, a multiple regression model is established to analyze monetized value of green development of industries and panel data of various influencing factors.

A regression analysis model based on panel data is called panel data regression model. It may be classified as varying-coefficient regression model, varying-intercept regression model and integrated regression model depending on difference in variable coefficient and intercept limit. This study uses an integrated regression model, assuming that the explanatory variable coefficients and the intercept are identical to all individual members in the sample. That means the model does not influence the individuals differently, nor do the results vary. Because correlations may exist between the individual equations, the study uses the generalized least squares (the seemingly uncorrelated estimation) in system equations.

In this paper, GLS estimation is used to analyze the influencing factors of green development of industries in each province (municipalities, autonomous region), and to find out the driving force behind green development of industries, so as to identify the problems these provinces need to pay attention to and the methods and models that they may use in this process and provide useful advice for green development of industries nationwide. By summarizing the research of other scholars, we can see that the green development of industries is influenced by many factors that are not only related to the industrial structure, industrial transformation, but also to the level of economic and technological development and the environmental governance. As the pillar of economy, the industrial development is closely related to economic growth. The level of economic development will affect the green development of industries, while the latter will, in turn, affect the way the economy grows. At the same time, the scientific and technological input and advances will improve the efficiency of resources utilization and waste emission, thus playing an important role in the green development of industries. Finally, the government's environmental governance will affect the pathway and process of green development of industries to some extent. Therefore, in the five dimensions of level of economic development, city size, industrial structure, technological advances and environmental governance, this paper selects one representative indicator as the explanatory variable to carry out GLS estimation and analysis, as shown in Table 1:

Table 1. Factors influencing green development of industries

Indicators		Variables
Green development of industries	Response variable	Y GMV_i / GDP_{Ri}
Level of economic development	Explanatory variable	X_1 GDP per capita
City size		X_2 Urbanization rate
Industrial structure		X_3 Proportion of tertiary industry
Technology level		X_4 Technology market turnover
Environmental governance		X_5 Investment in pollution control as a proportion of the regional GDP

On the basis of the existing research, the panel data regression model is built as shown in the formula below:

$$gmv_{ij} = \alpha + \beta_1 gdp_{ij} + \beta_2 UR_{ij} + \beta_3 TV_{ij} + \beta_4 TE_{ij} + \beta_5 Eplo_{ij} + \varepsilon$$

Here, *gmv* represents the proportion of industrial green monetization value to real GDP of each province (city, autonomous region) from 2004 to 2017, *gdp* is the per capita GDP, *UR* is the urbanization rate, *TV* is the proportion of tertiary industry, *TE* is the turnover of technology market and *Eplo* is the investment in pollution control as a proportion of the regional GDP. α, β_1, β_2, β_3, β_4,and β_5 are estimation coefficients, and is the random disturbance term.

3.3 Data sources

The data of industrial added value, energy consumption, electricity consumption, GDP per capita, urbanization rate and proportion of tertiary industry are from the statistical yearbook of each province (city, autonomous region) from 2005 to 2018, and the data of water consumption are from the water resources bulletin of each province (city, autonomous region) from 2005 to 2018. Investment in pollution control as a proportion of the regional GDP is from 2005-2018 China Environmental Statistics Yearbook. The turnover of technology market comes from China's regional economic database.

4. Analysis of results

4.1 Estimation of green development of industry

This paper evaluates the outcome of green development of industries in 30 Chinese provinces (municipalities, autonomous regions), as shown in Table 2.[1] Using 2004 as the base year, Table 2 shows the monetized value of industry input in 2005, 2010, 2015 and 2017.

Table 2. Outcome of green development of industries in 30 provinces (municipalities and autonomous regions)

GMV_i (RMB100 million)	2004	2005	2010	2015	2017
Anhui	0.00	-115.98	-769.28	-2345.77	-3056.29
Beijing	0.00	-30.38	-325.70	-782.30	-951.946
Fujian	0.00	-70.96	-923.23	-2432.22	- 3138.7
Gansu	0.00	-60.12	-553.00	-1459.34	-1763.24
Guangdong	0.00	-269.72	-2452.13	-5619.71	-7024.66
Guangxi	0.00	-63.57	-1418.52	-3328.51	-4142.57
Guizhou	0.00	-101.15	-564.61	-1753.18	-2304.35
Hainan	0.00	-25.47	-201.75	-416.97	-518.692
Hebei	0.00	-60.47	-1098.24	-3047.92	-3832.29
Henan	0.00	-148.31	-1178.72	-3317.88	-4267.11
Heilongjiang	0.00	-133.55	-784.37	-2114.96	- 2614.17
Hubei	0.00	-81.92	-1262.13	-3518.53	-4483.55
Hunan	0.00	-72.25	-1572.39	-4084.69	-546.28
Jilin	0.00	-119.57	-750.28	-1750.40	-2141.79
Jiangsu	0.00	-211.80	-2584.05	-6248.47	-7742.4
Jiangxi	0.00	-84.09	-835.69	-2119.37	-2745.41
Liaoning	0.00	-124.70	-1107. 92	-2564.65	-2706.35
Inner Mongolia	0.00	-137.28	-1403.92	-3128.93	-3610.45
Ningxia	0.00	-17.39	-364.43	-795.26	-998.562
Qinghai	0.00	-7.88	-105.09	-328.38	-462.381
Shandong	0.00	-56.39	-1431.88	-3721.05	-4908.19
Shanxi	0.00	-22.02	-433.34	-1152.85	-1393.03
Shaanxi	0.00	-22.93	-491.99	-1299.37	-1593.66
Shanghai	0.00	-37.55	-612.68	-1618.47	- 1999. 62
Sichuan	0.00	-121.89	-1216.44	- 3277.93	-4157.09
Tianjin	0.00	-19.50	-305.07	-955.48	-1196.54
Xinjiang	0.00	-166.46	-1515.57	- 3320.13	-4545.86
Yunnan	0.00	-12.70	-572.74	-1710.49	-2258.91
Zhejiang	0.00	-79.65	-1067.87	-2571.91	-3194.55
Chongqing	0.00	33.72	-294.97	-1259.68	-1692.61

Note: The (+) sign indicates the actual level was greater than expected and the outcome of green development was worse than in 2004; the (-) sign indicates the actual level was lower than expected and the outcome of green development was better than in 2004. Excluding Hong Kong, Macao and Taiwan and Tibet (due to data unavailability)

As can be seen in Table 2, Chongqing shows a positive monetized value in 2005, which denotes a decline in its green development performance. This was because the municipality registered an energy consumption intensity higher than in the previous year, and failed to achieve effective energy utilization and resource savings. This situation, however, was promoted in the following years. Continuously improved resource utilization promoted green development of industries. Other provinces (municipalities and autonomous regions) displayed negative monetized values of input in 2005, 2010, 2015 and 2017, indicating improved performance in green development of industries. It can be seen compared with the base year 2004, all these provinces (municipalities, autonomous regions) showed a trend towards better performance. Against the backdrop of resources saving and technological upgrade, the industries became more environmentally friendly, and achieved impressive savings in energy, electricity and water resources. It can be predicted that China will fare better in the green development of industries. However, it should also be noted that the level of social and economic development and the resource endowment vary widely among the provinces (municipalities and autonomous regions), so do the basic conditions for promoting green development of industries. Thus, the model, path and countermeasures pursued will also vary. Therefore, it is necessary to introduce tailormade management measures for different regions to better explore the potential of new green development.

Specifically, see the spatial distribution of industrial green development, as shown in Figure 1. The proportion of the green part in the industrial added value of each province (city, autonomous region) is divided into three categories from large to small. The top ten are marked as dark green, the middle ten are medium green, and the bottom ten are light green. The dark green to light green respectively represent the state of the industrial green development. The deeper the color, the greater the proportion of the green part in the industrial added value, The effect of green industrial development is better. Figure 1 shows the proportion space change chart of the green part in the industrial added value of each province (city, autonomous region) from 2005 to 2017. It can be seen that the effect of the industrial green development of each province (city, autonomous region) shows a darker color in the northwest and a lighter color in the East and middle. Most of the central and eastern regions are in a light green state, and their green GDP share is smaller than that of the northwest, including Beijing, Shanghai, Tianjin and other developed regions. In 2005, Heilongjiang Province and Jilin Province ranked in the top ten in the development effect of industrial green, but in the following years, the ranking declined. It can be seen that the development of industrial green in Northeast China has a certain degree of retrogression, which may be related to the situation of its own industrial development and technical level, or because the development speed of industrial green is slower than other provinces. In recent years, the effect of industrial green development in the western region has been stable, while the ranking of industrial green development effect in the central region has changed. For the regions with better development in the Middle East, due to the better initial endowment conditions for the green development of their industries, it is more difficult for the less developed regions in the subsequent development, and the space for progress is also small. It is necessary to focus on finding new green growth points to promote the sustainable development of the green development of these regions. For the southern region, most of them are in the state of medium green, and the development of industrial green is better. For Xinjiang and other underdeveloped areas, in recent years, under the influence of the "green" ideological trend, to promote the construction of ecology and environmental protection, from the low level of technology to the improvement of technology, the utilization rate of resources has been greatly improved, and the development effect of industrial green is obvious.

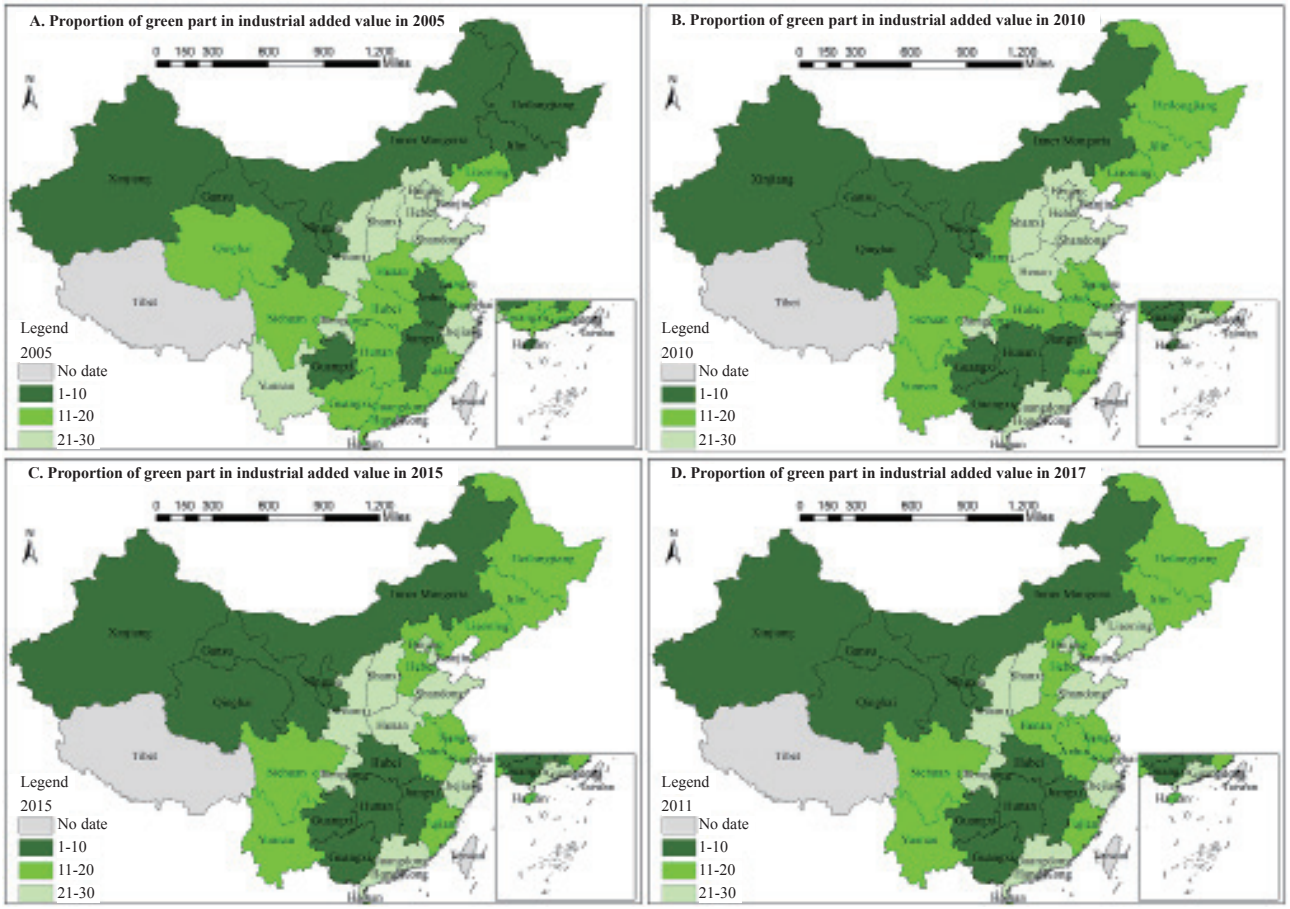

Figure 1. Spatial distribution of industrial green development effect in 2005-2017

From the above analysis, it can be seen that in the environment of resource conservation and technological upgrading, industries of all provinces (municipalities and autonomous regions) are developing towards the direction of green, and have made good achievements in energy conservation and water resource conservation. Specifically, the provinces (municipalities and autonomous regions) that were underdeveloped, low-level technology and weak industrial base have made more progress in the development of industrial green than the provinces (municipalities and autonomous regions) that had strong industrial base. At present, the development of green industry in China is in the stage of transformation and upgrading. With the promotion of energy conservation and emission reduction, the space and potential for energy conservation and emission reduction to be explored are shrinking, and the corresponding cost will be higher and higher. How to tap new and cost acceptable potential of energy conservation and emission reduction is a major challenge to be solved. It is a long way to go to find new green growth points.

4.2 Analysis of influencing factors

Using multiple linear regression analysis in Stata software based on the model constructed, we obtain the results shown in table 3 which allow us to draw conclusions.

Table 3. Regression analysis coefficients for factors influencing green development of industries

gmv	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
gdp	0.003686	0.003978	0.93	0.354	-0.00411	0.011484
UR	-0.08918	0.062059	-1.44	0.151	-0.21081	0.032458
TV	0.349218	0.060099	5.81	0	0.231427	0.467009
TE	-0.00819	0.00177	-4.63	0	-0.01166	-0.00473
Epol	7.137452	0.609565	11.71	0	5.942727	8.332176

The conclusions are as follows:

(1) There is a positive correlation between the economic level and the development of green industry, which shows that the per capita GDP has a positive impact on the development level of regional green industry. GDP per capita can objectively reflect the level and degree of development. The improvement of economic development level can promote the development of green industry in technology level, pollution control investment and other aspects. However, only relying on economic growth can not promote the green development of regional industry, and extensive economic development mode can not improve the level of green development of regional industry. While improving the level of economic development, we should pay attention to the harmonious development of economy and environment, reduce environmental pollution in the process of economic development, give priority to the development of high-efficiency and low pollution industries, and improve the level of green development of regional industries. However, in this paper, it is not significant that the per capita GDP is directly proportional to the effect of industrial green development, which is also consistent with the results in the previous spatial distribution map. The effect of industrial green development in Beijing is light green, while the effect of industrial green development in Xinjiang is dark green, and the less developed areas have made great progress in the development of industrial green, which is easier to improve the utilization rate of resource efficiency to improve the level of green industry.

(2) City size has a negative impact on the green development of regional industries. The agglomeration effect of cities will affect the green development of regional industries, and the proportion of urban population reflects the agglomeration effect of cities. The high urbanization rate and large city size will bring such problems as industrial agglomeration and environmental pollution, and have a negative impact on the green development of industries. However, in this study, the negative correlation between urbanization and monetized value associated with green development of industries is not significant, so further research is warranted to explore the relation between green development of industries and urbanization rate.

(3) The proportion of the value-added of the tertiary industry in GDP is positively correlated with the level of green development of regional industries. A greater proportion indicates a greater role of the service sector in industrial development. The upgrading of the industrial structure, technological advance and continuously improved quality of the labor force will allow resources to be utilized more efficiently. In this way, the improved industrial structure will be beneficial to the green development of regional industries. Therefore, we should pay attention to the adjustment of industrial structure, industrial upgrading and transformation, and promote the development of the tertiary industry.

(4) The turnover of technology market represents the development of high and new technology, and has a negative

correlation with the development level of regional industry green, but the coefficient is only-0.008, with little negative impact. It may be due to the differences of provinces (municipalities and autonomous regions), which results in the heterogeneity of the effect of regional industrial green development, resulting in the deviation of the results. The higher the level of technological development, the higher the utilization rate of resources, the better the ability of pollution control, the less the environmental pollution, and the green development of regional industry.

(5) Investment in pollution control as a proportion of the regional GDP is positively correlated with the level of green development of regional industries. A significance test of variables shows that strengthened pollution control efforts in a region, more efficient resource utilization in various enterprises, reduced pollutant emissions, and improved pollutant treatment technology are remarkably conducive to the green development of industries in the region. Therefore, we should pay attention to the control of pollution, increase investment, and promote the green development of industries.

5. Conclusions and suggestions

Making use of the panel data from 2004 to 2017, we estimate the monetized value associated with the green development of industries in different provinces (municipalities and autonomous regions), and on this basis, conduct an empirical analysis of the influencing factors.

The results are as follows: (1) All the provinces (municipalities and autonomous regions) fared better in green development of industries from 2004 to 2017, and have made great progress in this regard, driven by the general trend towards environmental protection. However, from the perspective of spatial distribution map, there are still gaps between the regions, and underperforming areas still need to further strengthen their efforts towards green development of industries. (2) From the analysis of the influencing factors, the level of economic development, the proportion of the tertiary industry, and the proportion of investment in pollution control are all positively correlated with the green development of industries. Better performance in these indicators will promote the green development of industries. This may be achieved through technological advances, strengthened environmental protection efforts, and the adjustment of industrial structure. Each province (municipality, autonomous region) should adapt to local conditions, make the most of its advantages, and overcome disadvantages so as to strike a balance between economic development and the protection of resources and the environment.

Based on the research finding, we would offer the following policy suggestions: (1) Continuous efforts are required to advocate the concept of green, improve the industrial structure, and realize the green development. It is important to abandon the industrial mode of high emission, high consumption and high pollution, give priority to the use of new and clean energy, introduce and develop advanced technologies, increase investment in environmental protection, and continuously improve the utilization efficiency of resources and the efficiency of pollutant treatment. Harmony needs to be achieved between economic development and ecological protection, so as to realize green economic development. (2) According to local conditions, efforts need to be made to promote the green development of industries in all provinces (municipalities and autonomous regions). In China, the resources endowment of each province (municipalities, autonomous region) is different, and the level of economic development and technical conditions also vary. Each region should strengthen its advantage, make up for its weakness, increase the government policy support, and implement different green development strategies to realize the green development of regional industries.

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