

Transformation and Development of China's Traditional Industry in the Context of Carbon Neutrality

--Take the Beijing-Tianjin-Hebei Region as an Example

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Abstract

In order to cope with global climate change, China has put forward the goal of carbon neutrality, promising to offset the anthropogenic emissions of CO₂ with anthropogenic removal within a specified period of time. The proposal of this goal has had a huge impact on China's industrial economy, forcing many traditional industrial enterprises to transform into low-carbon enterprises. This paper takes the Beijing-Tianjin-Hebei region as an example to explore the new development of regional industrial economy under the background of carbon neutrality, and explore the collaborative governance methods within the Beijing-Tianjin-Hebei region and among the provinces involved. Through the research and analysis of the industrial carbon emissions of Beijing-Tianjin-Hebei region, the GDP of Beijing-Tianjin-Hebei region in recent years and other relevant data, this paper draws the following conclusions: (1) The industrial structure is constantly optimized, and the low-carbon transformation of industrial industry is obvious. (2) The proportion of high-carbon fossil energy consumption continued to decline. Industrial enterprises will consider their green costs more carefully when selecting raw materials and fuels. (3) Pay more attention to the coordinated development between regions, divide functional areas, and transfer high-emission and high-pollution enterprises. (4) Industrial enterprises will increase investment in environmental protection, which is obviously affected by the policy.

Keywords

Beijing, Tianjin and Hebei; Carbon neutralization; Industrial economy; Regional coordinated development.

1. Introduction

In September 2020, the Chinese government proposed at the seventy-fifth session of the United Nations General Assembly that China will increase its national independent contribution, adopt more effective policies and measures, and strive to reach the peak of carbon dioxide emissions by 2030, and strive to achieve carbon neutrality by 2060. With the proposal and implementation of this goal, the industrial industry will once again usher in supply-side structural reform. The Beijing-Tianjin-Hebei region is the "capital economic circle" of China, and is also strongly affected by policies. As one of the three regions with rapid economic growth in China, the Beijing-Tianjin-Hebei region accounts for about 8.50% of the country's GDP and 7.82% of the country's population, but the proportion of carbon dioxide emissions is up to 11.85%, and the proportion of carbon dioxide emissions is relatively high. The Beijing-Tianjin-Hebei region will face greater pressure when implementing carbon neutrality. Therefore, the research on the development of industrial economy in Beijing-Tianjin-Hebei region is of exemplary significance for the development of industrial economy in other regions. In recent

years, with the deepening of cooperation in transportation, ecological and environmental protection among Beijing, Tianjin and Hebei, the economy and society have been moving towards green and low-carbon, and industrial enterprises have improved their carbon emissions.

2. Literature Review

Since September 2020, when it was clearly stated that "carbon dioxide emissions should reach the peak by 2030 and strive to achieve carbon neutrality by 2060", carbon reduction has become the key strategic direction of China's ecological civilization construction. The proposal of the "double carbon" goal will have a profound impact on China's regional economic development, and is an inevitable requirement for high-quality development of regional economy. Through the investigation and research of a large number of scholars, the green development of industry in Beijing, Tianjin and Hebei is relatively coordinated, but the development of resources, environment and economy is relatively unbalanced. In the economic structure, the economy of Beijing-Tianjin-Hebei region mainly depends on heavy industry, equipment manufacturing and high-tech industries. Therefore, it is far less rapid than other regions such as the Yangtze River Delta and the Pearl River Delta, and because of its special industrial structure, industrial enterprises in the Beijing-Tianjin-Hebei region are particularly affected by the goal of carbon neutrality.

Industrial enterprises in the region also face many problems. For example, as a high-energy consumption industry, flat glass once occupied a very important position in the industrial structure of the Beijing-Tianjin-Hebei region and made an important contribution to the regional economic development. However, due to the need of environmental protection in recent years, the goal of carbon peak and carbon neutrality was put forward, and flat glass was forced to embark on the path of industrial green transformation. With the development of economy and society, it is basically impossible for a city to achieve sustainable development only by relying on its own strength and not paying attention to the cooperation with surrounding cities or regions. However, due to the lack of an effective planning docking mechanism, the industrial planning of the three regions in Beijing, Tianjin and Hebei has the problem of "fighting alone". The industrial segmentation areas proposed by the key regions in Tianjin and Hebei are highly similar to the direction of Beijing's high-end and high-end industries, and the characteristics of industrial dislocation and differentiation are not prominent. This also led to the fact that the industrial enterprises in the region could not well enjoy the dividends of regional development integration. Therefore, the transformation of industrial enterprises in the Beijing-Tianjin-Hebei region is urgent. Other scholars pointed out that the technological innovation level of high-tech industries in Beijing, Tianjin and Hebei will directly affect the development of regional industrial enterprises, the improvement of independent innovation ability and even the integration development process of Beijing, Tianjin and Hebei. This formulation is still of great reference significance today. The above scholars have elaborated on the coordinated integration and low-carbon development of Beijing-Tianjin-Hebei region, but few scholars have made specific analysis of industrial enterprises in Beijing-Tianjin-Hebei region and proposed corresponding measures based on the background of carbon neutrality. Starting from the goal of carbon neutrality, this paper investigates and studies industrial enterprises in the Beijing-Tianjin-Hebei region in order to understand the opportunities and challenges that carbon neutrality brings to industrial enterprises in the Beijing-Tianjin-Hebei region. And put forward corresponding measures and policies.

3. Empirical Analysis

3.1. Model construction

According to the extended form of Cobb Douglas production function, C (carbon emissions) is introduced into the production function, and the following results are obtained:

$$Y = AL^\alpha K^\beta C^\gamma$$

Where, A refers to structural parameters and technical influence factors; L is the labor input; K is the amount of capital investment; C is carbon emission; α is the output elasticity of labor; β is the output elasticity of capital; γ it is the output elasticity of carbon emissions. The least squares method (OLS method) is used for regression, and the logarithm of both sides of the equation is taken at the same time to obtain:

$$\ln Y = \ln A + \alpha \ln L + \beta \ln K + \gamma \ln C$$

3.2. Parameter estimation

The GDP data of Beijing, Tianjin and Hebei are all from the China Statistical Yearbook. For the calculation method of capital stock, please refer to Zhang Jun's calculation method. Select 2000 as the base period, and divide the total fixed capital formation in 2000 by 10% as the base period capital stock.

$$K_I = I_I / 10\%$$

Where, K represents the capital stock and I represents the amount of investment, which is the total fixed capital formation.

The capital stock of Beijing in the base period is calculated to be 7041. Tianjin's capital stock in the base period is 3846. The base period capital stock of Hebei Province is 9486. According to Zhang Junfa's calculation formula - perpetual inventory method, the formula is as follows:

$$K_{i,t} = K_{i,t-1}(1 - \alpha_t) + I_{i,t}/P_{i,t}$$

Where, α is the depreciation rate (the depreciation rate of Zhang Junfa is 9.6%), and P is the investment price index.

The capital stock data of Beijing, Tianjin and Hebei in the Beijing-Tianjin-Hebei region can be obtained through the analysis and processing of data by Stata software, as shown in Table 1 and Table 2.

Table 1. Total fixed capital formation in Beijing-Tianjin-Hebei region

Year	Region	Total fixed capital formation	Region	Total fixed capital formation	Region	Total fixed capital formation
2014	Beijing	7957.2	Tianjin	11337.95	Hebei	17064.67
2015	Beijing	8155.36	Tianjin	10495.81	Hebei	17298.83
2016	Beijing	9716.05	Tianjin	10113.89	Hebei	18595.7
2017	Beijing	10375.27	Tianjin	10137.46	Hebei	19035.42

Table 2. Fixed asset investment price index in Beijing-Tianjin-Hebei region

Year	Region	Fixed asset investment price index	Region	Fixed asset investment price index	Region	Fixed asset investment price index
2014	Beijing	99.98	Tianjin	100.5	Hebei	100.2

2015	Beijing	97.58	Tianjin	99.89	Hebei	97.97
2016	Beijing	99.66	Tianjin	99.37	Hebei	99.41
2017	Beijing	104.67	Tianjin	104.27	Hebei	106.73

The regional carbon dioxide emission data is from China's carbon accounting database. Since the coefficient of C is negative at the time of regression, the carbon productivity P_c is used for regression, and the results are as follows:

Table 3. Results of regression analysis

Variable	Coefficient
lnL	0.4261*** (-0.0313)
lnK	0.5349*** (-0.0268)
lnPC	0.3755*** (-0.0291)
Constant	0.7291*** (-0.2177)
sample size	270
AdjustR2	0.932

It can be calculated that: $\alpha=0.3188, \beta=0.4002, \gamma=0.281$.

So the expression of the model can be written in the following form:

$$Y^* = P_L^{0.3188} \times P_L^{0.4002} \times P_C^{0.281}$$

3.3. Model application

Through data substitution, we can get the productivity Y^* of output in Beijing, Tianjin and Hebei, as shown in Table 4.

Table 4. Productivity of output in Beijing-Tianjin-Hebei region

Region	2014	2015	2016	2017
Beijing	2.7734	2.8494	2.9495	3.0883
Tianjin	1.0882	1.095	1.1081	1.1236
Hebei	0.6986	0.706	0.7119	0.7359

It can be seen from Table 4 that the productivity of Beijing, Tianjin and Hebei Province has shown an upward trend, which proves that their low carbon level has been developing in recent years, and the industrial economic level of these regions is also developing at a faster speed. In combination with the industrial value added of these three regions in recent years (Table 5), it can be seen that the industrial value added of Beijing is the fastest growing, and that of Hebei Province is the largest. The development between regions is not balanced. Beijing has done the best in carbon neutralization, and its industrial enterprises have not been greatly affected. The local industrial enterprises are still growing at a certain speed, as shown in Table 6.

However, the productivity of Tianjin and Hebei is relatively low, even less than half of that of Beijing. The added value of industry has decreased, and the number of local industrial enterprises has also decreased. The industry has shown a downward trend in the local area. Affected by the policy, the traditional industry has decreased rapidly, and many industrial enterprises that have not been able to transform have been eliminated.

Table 5. Industrial added value in Beijing-Tianjin-Hebei region

Year	Beijing	Tianjin	Hebei
2014	3522.8	3972.4	10056.3
2015	3458.9	3815.1	10026.4

2016	3635.5	3773	10755.9
2017	3885.9	3942.5	11015.7
2018	4139.9	4276.9	10930.3
2019	4243.31	4372.27	11310.4
2020	4255.06	4296.38	11664.13

Table 6. Number of industrial enterprises above designated size in Beijing-Tianjin-Hebei region

Year	Beijing	Tianjin	Hebei
2014	3686	5501	14792
2015	3548	5525	15295
2016	3340	5203	14764
2017	3231	4286	14790
2018	3197	4292	14943
2019	3121	4813	13181
2020	3028	5120	14239

3.4. Result analysis

(1) The industrial structure of Beijing-Tianjin-Hebei region has been continuously optimized, and the low-carbon transformation of industrial industry has been obvious. In recent years, the Beijing-Tianjin-Hebei region has given priority to the development of the tertiary industry, promoted the upgrading of the industrial structure of industry and service industries, and actively cultivated high-tech industries. A new pattern of regional industrial development has gradually formed. The industrial structure has also been constantly upgraded and improved, and traditional industries have also been constantly transformed. After the goal of carbon neutrality was put forward, all regions in China responded and launched corresponding local policies. Beijing, as the capital of China, took the lead in carbon reduction, carbon neutrality and carbon peak, rapidly promoted the transformation of traditional industrial enterprises to low-carbon and environment-friendly high-tech industrial enterprises, and made great contributions in reducing carbon emissions and promoting carbon financial products. The Beijing-Tianjin-Hebei region was led by Beijing, and Tianjin and Hebei worked together to promote the transformation and upgrading of the regional industrial economy, optimize the industrial structure of the region, and achieve obvious results in industrial industry low-carbon, which also reflects the institutional advantages of China and the importance of establishing the Beijing-Tianjin-Hebei region.

(2) The proportion of high-carbon fossil energy consumption in the Beijing-Tianjin-Hebei region continued to decline. Industrial enterprises will consider their green costs more carefully when selecting raw materials and fuels. According to the analysis and research, the fossil energy consumption in the region is becoming less and less, accounting for less and less of the total energy consumption. This is because the goal of carbon neutrality and carbon peak has been put forward, the region has issued a series of measures to reduce carbon, and Beijing has issued policies for energy conservation and emission reduction to promote consumption, which further enriched the supply of green consumption, guided the concept of green and low-carbon consumption, stimulated the new consumption potential of energy conservation and emission reduction, and promoted the upgrading of consumption, A certain amount of financial subsidy will be given to eligible taxpayers who purchase energy-saving and emission-reduction products. This measure not only makes consumers more willing to buy green and low-carbon

industrial products, but also reverses the transformation of industrial enterprises to green and low-carbon. The region also restricts enterprises with high emissions and high pollution. In 2021, the Beijing Municipal Bureau of Ecology and Environment issued the document "Notice on the Work of Key Carbon Emission Units Management and Carbon Emission Right Trading Pilot in 2021", which clearly pointed out that the responsibility of key carbon emission units should be strengthened according to relevant policies and regulations, and the market mechanism should play a role in promoting greenhouse gas emission control, so as to effectively reduce greenhouse gas emissions. This measure enables industrial enterprises to pay more attention to the emission of pollutants from energy, effectively reduce the emission of carbon dioxide, consider its green cost, and help to achieve the goal and vision of carbon peak and carbon neutrality at an early date.

(3) The Beijing-Tianjin-Hebei region pays more attention to the coordinated development between regions, divides functional areas, and transfers high-emission and high-pollution enterprises. With the promotion of the Beijing-Tianjin-Hebei coordinated development strategy, the three regions have been clearly positioned. Beijing will optimize the three-industry structure, highlight high-end, service-oriented, integrated, and low-carbon industries, vigorously develop the service economy, knowledge economy, and green economy, and accelerate the construction of a high-end, sophisticated and cutting-edge economic structure; Tianjin optimizes the development of advanced manufacturing industry and vigorously develops strategic emerging industries and modern service industries; Hebei actively undertakes the transfer of industrial functions in the capital and the transformation of scientific and technological achievements in Beijing and Tianjin, transforms and improves traditional advantageous enterprises, promotes industrial transformation and upgrading, vigorously develops advanced manufacturing industry, modern service industry and strategic emerging industries, and builds new industrialization bases and industrial transformation and upgrading pilot areas. Therefore, in the process of Beijing-Tianjin-Hebei coordinated development, the research on the carrying capacity of industrial transfer in Hebei Province is very important.

Although carbon-neutral has developed in the Beijing-Tianjin-Hebei region, the three regions still face a certain degree of industrial structure imbalance. Beijing has obvious advantages in the development of the tertiary industry, Tianjin has made great achievements in the development of modern manufacturing industry, and the problem of excessive industrial structure in Hebei Province is still prominent. From the perspective of the "double carbon" goal, the industrial structure needs to be further optimized. This paper believes that Beijing's low-carbon achievements are more prominent and have an inseparable relationship with Hebei Province and Tianjin to undertake its high-polluting industrial enterprises. As the capital of China, Beijing should vigorously develop high-tech industries and maximize economic benefits on the premise of reducing environmental pollution. Hebei Province should do a good job in undertaking the work, accept industrial enterprises from Beijing and Tianjin, provide them with a good living environment, and strive to make them become the leader in driving the economic development of Hebei Province.

(4) Industrial enterprises in the Beijing-Tianjin-Hebei region will increase investment in environmental protection, which is significantly affected by the policy. The Beijing-Tianjin-Hebei region is China's "capital economic circle". The Beijing-Tianjin-Hebei urban agglomeration includes Beijing and Tianjin, and also includes most of the cities in Hebei Province. Its special geographical location makes the Beijing-Tianjin-Hebei region a pilot area for reform. The proposal of the carbon neutrality goal has a more severe impact on the Beijing-Tianjin-Hebei region than other regions. The first reason is the special geographical location of Beijing-Tianjin-Hebei, Enterprises in the Beijing-Tianjin-Hebei region will be subject to stricter carbon emission limit indicators and greater policy restrictions, so enterprises in the region are more willing to increase environmental protection investment to achieve carbon neutrality;

The second is the special industrial structure of the Beijing-Tianjin-Hebei region. A large part of the industrial structure of the region is traditional industrial enterprises. The proposal of the goal of carbon neutrality has affected a large number of enterprises in the Beijing-Tianjin-Hebei region. Some enterprises have been forced to go bankrupt. The surviving enterprises are enterprises with independent innovation capabilities, and these enterprises tend to invest more in environmental protection.

4. Suggestions

4.1. Define the function orientation and realize the dislocation development

As a national political center, cultural center, international communication center and scientific and technological innovation center, Beijing's economic functions will be transferred outward, and many industries will be transferred outward; While Tianjin is positioned as the national advanced manufacturing R&D base, the core area of northern international shipping, the demonstration area of financial innovation and operation, and the pilot area of reform and opening up. The manufacturing industry will also be partially relocated; As an important base of modern commerce and logistics in China, an industrial transformation and upgrading pilot area, a demonstration area of new urbanization and urban-rural integration, and a Beijing-Tianjin-Hebei ecological environment support area, Hebei Province will strive to improve the comprehensive carrying capacity and service capacity of its cities in the province, undertake the Beijing-Tianjin industry, optimize the industrial structure, and achieve regional economic integration.

4.2. Continue to optimize the industrial structure and promote the transformation of industrial enterprises

Focus on optimizing the industrial structure of Hebei Province. We will strictly control the new capacity of energy-intensive and heavy chemical industries, and promote the energy-saving transformation of traditional energy-intensive industries such as steel and electric power. Steel and electricity are the industries with the largest scale and intensity of carbon emissions in Hebei. Aiming at the current situation that Hebei's carbon emissions account for nearly 80% of Beijing, Tianjin and Hebei, through industrial internal structural adjustment, some steel and power capacity will be reduced, and the scale and intensity of carbon emissions in Beijing, Tianjin and Hebei will be greatly reduced. We will vigorously promote the development of advanced manufacturing and strategic emerging industries in Hebei Province. The development of the tertiary industry has significantly optimized the energy consumption and emission structure in the Beijing-Tianjin-Hebei region. By vigorously developing advanced manufacturing and strategic emerging industries, the traditional advantageous resource-based industries in Hebei Province have been replaced, and the industrial structure of Hebei Province has been optimized, so that the total carbon emissions in the Beijing-Tianjin-Hebei region have been significantly reduced.

4.3. Attach importance to the training of talents and enhance the role of education

The Beijing-Tianjin-Hebei region should strengthen the cultivation of low-carbon talents and provide public service guarantee for talent cooperation and flow. Consider setting up low-carbon technology specialty as soon as possible to cultivate, attract and retain low-carbon talents. As far as the Beijing-Tianjin-Hebei region is concerned, it is the first to carry out low-carbon economy-related education at different levels of higher vocational education, undergraduate education and graduate education, encourage colleges and universities to cooperate with enterprises to cultivate low-carbon talents, build a regional low-carbon technology human resources training cooperation platform centered on Beijing, and give full

play to the cooperation advantages of the education industry. The Beijing-Tianjin-Hebei region should improve the policies to promote the flow of talents, break the household registration restrictions, strengthen the equal supply of public services in the three regions, and carry out bold reforms in the personnel management system and household registration management system, so that talents can flow in accordance with market rules and free and voluntary principles.

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