Analysis of Green Logistics Efficiency in Chinese Provinces Along the Belt and Road

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Abstract

In order to better understand the development of green logistics in provinces along the Belt and Road in China, it is important to investigate the carbon emission efficiency and evolution trend of logistics industry.In this paper, by using the "area" all the way along the route 17 key provinces in 2011-2019 data of logistics, the emissions of carbon dioxide as the expected output, build green logistics system efficiency evaluation, using the Malmquist index model measure used to measure regional carbon emissions each year compared with the previous year performance change of carbon emissions performance of dynamic logistics, The annual static carbon emission performance of logistics industry in each province is obtained by USING SBM model. The results show that the average annual total factor productivity of dynamic green logistics is on the rise in all provinces along the line except Gansu, Guangxi, Heilongjiang, Ningxia, Qinghai and Chongqing. The value of green logistics efficiency in Shanghai and Zhejiang is always valid. The value of green logistics efficiency in Fujian, Guangdong, Inner Mongolia and Ningxia is effective in some years, while the value of green logistics efficiency in other provinces is not satisfactory. This paper puts forward some suggestions to effectively improve the carbon emission efficiency of China's logistics industry, such as improving energy structure, improving resource utilization efficiency, strengthening the construction of logistics infrastructure and logistics parks, promoting the coordinated development of regional logistics, sorting out the development concept of green logistics, etc. This paper will help to improve China's environment.

Keywords

Carbon Emissions; Logistics Industry; The Belt and Road.

1. Introduction

At the BRICS meeting in 2020, President Xi Jinping reaffirmed China's commitment to increase its nationally determined contribution and adopt more forceful policies and measures to peak CARBON dioxide emissions by 2030 and achieve carbon neutrality by 2060.In 2021, "carbon peak" and "carbon neutral" have been written into the government work report of the national two sessions for the first time. Logistics industry is the basic, strategic and leading industry supporting the development of national economy, and plays an important role in promoting the high-quality development of national economy. China's total social logistics has grown from 197.8 trillion yuan in 2013 to 298 trillion yuan in 2019, and the total income of the logistics industry has increased from 7.1 trillion yuan in 2014 to 10.3 trillion yuan in 2019. The development of the logistics industry shows a trend of medium-high speed development, and it is the "third party profit source" of the national economy. At the same time, as the logistics industry has been taking extensive mode, is listed as high energy consumption, high pollution industry, there are large energy consumption, serious carbon emissions and low efficiency and other problems, the transformation and upgrading of the logistics industry and high-quality development caused a great deal of trouble. "One Belt and One Road" is China's initiative to comprehensively improve the level and pattern of opening-up in the new era, and logistics industry as the basis to achieve "connectivity", reducing the carbon emissions of logistics industry in provinces along the "One Belt and One Road" and improving the efficiency of logistics resource allocation is of great significance to China's development of green economy and achieve low carbon goals. At present, many achievements have been made in the study of carbon emission efficiency at home and abroad. Early studies mainly used carbon index, energy intensity and carbon emission intensity as measurement indexes, which only considered the relationship between carbon emissions and a certain variable, did not take economy, energy and environment as a unified whole, and did not fully consider the technical efficiency of relevant input factors. Later, scholars used data envelopment analysis (DEA) to measure the total factor carbon emission efficiency more comprehensively, which can be divided into two categories. One is static carbon emission efficiency based on DEA model. For example, Mariano et al. [1] calculated and analyzed the low carbon logistics efficiency of 104 countries by using DEA-SBM method. Dalai Ma et al. [2] selected the minimum distance method (mSBM) of the maximum effective frontier to calculate China's industrial carbon emission efficiency. Based on the DEA-BCC model, Hui Li and Wei Li[3] measured and analyzed the carbon emission efficiency of logistics industry in 9 provinces along the "Silk Road Economic Belt". The other is the dynamic carbon emission performance index obtained by introducing Malmquist index on the basis of DEA. For example, Jing Han [4] et al. calculated the dynamic industrial carbon emission efficiency of 30 provinces in China from 2005 to 2011 by constructing the DEA-Malmquist index model and analyzed the regional differences. Using malmquist-Luenberger index model, Ming Gao and Hongyuan Song [5] calculated the agricultural carbon emission efficiency of provinces in China from 1999 to 2010, and compared the dynamic efficiency by region. Xiumei Sun[6] et al. used Malmquist index to dynamically analyze the carbon emission efficiency of prefecture-level cities in Shandong Province. In addition, researches on the influencing factors of carbon emission efficiency are mostly carried out by building panel econometric models. For example, Ke Cao and Xiaoe Qu [7] explored the influencing factors of carbon emission efficiency in China from 1995 to 2010 by establishing panel econometric models. It is found that increasing the government's environmental protection efforts, increasing the level of R&D investment, and optimizing the industrial structure and energy consumption structure are conducive to the improvement of carbon emission efficiency. Feng Li and Lunzhi He [8] explored the influencing factors of China's total factor energy efficiency under the constraint of carbon emissions by constructing an econometric model, and found that the impact of government intervention capacity and fixed asset investment on total factor energy efficiency is negative. Ming Gao and Qiuhong Chen[9] estimated the relationship between agricultural trade openness, human capital, agricultural economic growth and agricultural carbon emission efficiency by establishing static panel Xttobit model and dynamic panel DIff-GMM model using panel data of 30 provinces from 2000 to 2011.

To sum up, the existing literature mainly studies carbon emission efficiency from static or dynamic perspectives, and lacks comprehensive studies combining static and dynamic perspectives. Therefore, this paper intends to select Malmquist index model and super-efficiency SBM to measure and analyze the carbon emission efficiency of static and dynamic logistics industry in provinces along the Belt and Road from 2011 to 2019, so as to provide a basis for the improvement of carbon emission efficiency of logistics industry and optimal allocation of resources in provinces along the Belt and Road.

2. Data and Variables

At present, there is no statistical category of "logistics industry" in the statistical classification system of various countries, but it can be seen from the Statistical Yearbook of China's Tertiary Industry that transportation, storage and postal services occupy more than 83% of the share of the logistics industry. Therefore, transportation, storage and postal services are used to represent the logistics industry in this paper. The basic data are mainly from the National Bureau of Statistics, CEADs China Carbon Accounting Database and China Energy Statistical Yearbook. In view of the serious data loss in Tibet, Tibet is not included in the research scope in this paper.

The input index takes into account capital, labor, energy and infrastructure. Considering the quantification of indicators and availability of data, capital input is expressed by the fixed asset investment amount of logistics industry in 17 key provinces along the belt and Road from 2011 to 2019.Labor input selected logistics industry employees data; Energy consumption represented by energy input in logistics industry; Infrastructure investment selects comprehensive total mileage data of transportation lines. The expected output index is composed of economic output and scale output. Economic output is expressed by added value of logistics industry. Scale output is expressed by freight volume and cargo turnover. The undesired output index is carbon dioxide emissions of logistics industry, and the carbon emissions data of transportation, storage and postal industry from China Carbon Accounting database are selected. See Table 1.

Table 1. Input and output indicators of logistics carbon emissions

Category of Indicator	1st Tier Indicator	2nd Tier Indicator
Input	Capital investment	Fixed assets investment of logistics industry
	Labor input	Number of logistics workers
	The energy input	Energy consumption of logistics industry
	Infrastructure investment	Transport line comprehensive total mileage
Output	Expect output	Logistics industry added value
		Cargo volume
		Cargo turnover
	Undesired output	Logistics industry carbon emissions

3. Methods

3.1. Malmquist

Malmquist index is used to measure the input-output efficiency of DMU with multiple input and output variables by the ratio of distance function under the premise that the production technology remains unchanged during a specific period.Taking each province as a DMU, the input and output in the year t+1 and the year t are (xt+1,yt+1(x),t,yt), the Malmquist index of change in carbon emission efficiency can be expressed as:

$$M\left(x_{t+1},\ y_{t+1},\ x_t,\ y_t\right)=\left[\frac{d^t(x_{t+1},y_{t+1})}{d^t(x_t,y_t)}\times\frac{d^{t+1}(x_{t+1},y_{t+1})}{d^{t+1}(x_t,y_t)}\right]^{\frac{1}{2}} \tag{1}$$

When (xt+1,yt+1,xt,yt) <1, it indicates that the carbon emission efficiency of t+1 period is lower than that of T period;Otherwise, it indicates that the carbon emission efficiency of t+1 phase is improved compared with that of T phase.When return to scale remains unchanged, Malmquist index can be decomposed into Efficiency change (Effch, EC) and Technical change (Techch, TC), as shown in Equation (2).When Scale returns are variable, Effch can be decomposed into Pure technical efficiency change index (Pech, PEC) and Scale efficiency change index (Scale efficiency change index). Sexh, SEC), see Equation (3).In Formula (4), Pech reflects the change of DMU's internal management level;Sech reflects the change of DMU scale return;Techch reflects the moving degree of efficiency boundary and is used to measure the application of DMU to new technologies and products.

$$M（x_{t+1}, y_{t+1}, x_t, y_t）=\frac{d^{t+1}(x_{t+1},y_{t+1})}{d^{t}(x_t,y_t)}\times\left[\frac{d^{t+1}(x_{t+1},y_{t+1})}{d^{t+1}(x_t,y_t)}\times\frac{d^{t}(x_{t+1},y_{t+1})}{d^{t}(x_t,y_t)}\right]^{\frac{1}{2}}=Effch\times Techch \quad (2)$$

$$\begin{aligned}&M（x_{t+1}, y_{t+1}, x_t, y_t）\\&=\frac{d_v^{t+1}(x_{t+1},y_{t+1})}{d_v^{t}(x_t,y_t)}\times\left[\frac{d_v^{t}(x_t,y_t)}{d_v^{t+1}(x_{t+1},y_{t+1})}\times\frac{d_c^{t+1}(x_{t+1},y_{t+1})}{d_c^{t+1}(x_t,y_t)}\right]\times\left[\frac{d_c^{t}(x_t,y_t)}{d_c^{t+1}(x_t,y_t)}\times\frac{d_c^{t}(x_{t+1},y_{t+1})}{d_c^{t+1}(x_{t+1},y_{t+1})}\right]^{\frac{1}{2}}\\&=Pech\times Sech\times Techch\end{aligned} \quad (3)$$

3.2. SBM

In view of the input-output slack and radial selection deviation of traditional DEA, Tone proposed the super-efficiency SBM model, which solved the deficiency that multiple evaluation results were 1 and could not be compared. the formula of variable return to scale in the super-efficiency SBM model considering undesired output is

$$\begin{cases}\rho^{*}=\min\dfrac{\dfrac{1}{q}\sum\limits_{i=1}^{q}\dfrac{\bar{x}}{x_{ik}}}{\dfrac{1}{u_1+u_2}\left(\sum\limits_{r=1}^{u_1}\dfrac{\bar{y}^{g}}{y_{rk}^{g}}+\sum\limits_{i=1}^{u_2}\dfrac{\bar{y}^{b}}{y_{lk}^{b}}\right)}\\ s.t.\\ \bar{x}\geq\sum\limits_{j=1,\neq k}^{n}\lambda_j x_{ij}\\ \bar{y}^{g}\leq\sum\limits_{j=1,\neq k}^{n}\lambda_j y_r^{g}\\ \bar{y}^{b}\geq\sum\limits_{j=1,\neq k}^{n}\lambda_j y_l^{b}\\ \bar{x}\geq x_k\\ \bar{y}^{g}\geq y_k^{g}\\ \bar{y}^{b}\geq y_k^{b}\\ \sum\limits_{j=1,\neq k}^{n}\lambda_j=1\\ \lambda_j\geq 0,\\ i=1,2,\cdots,q\\ j=1,2,\cdots,n\\ r=1,2,\cdots,u_1\\ l=1,2,\cdots,u_2\end{cases} \quad (4)$$

Where, ρ* is the target efficiency value; N is the number of decision-making units; Q is the input quantity of decision-making unit; u_1Is expected output; u_2Is the undesired output; x_i, yg r, yb L are the elements of corresponding input matrix, expected output matrix and unexpected output matrix respectively. Lambda. $_j$Is the weight vector; The variable with subscript "K" is the evaluated unit; $(\bar{x},\bar{y}^{g},\bar{y}^{b})$ Is the decision variable reference point of the KTH decision-making unit.

4. Results

4.1. Dynamic Evolution Analysis of Logistics Carbon Emission Efficiency based on the Malmquist Index Model

Table 2. Dynamic evolution of logistics carbon emission efficiency of each province along the Belt and Road (B&R) , 2011–2019.

Provinces	MI	EC	PEC	SEC	TC
Fujian	1.075	1.007	1.005	1.001	1.077
Gansu	0.975	0.989	0.980	1.012	0.990
Guangdong	1.091	1.106	1.024	1.080	1.004
Guangxi	0.977	1.042	0.997	1.044	0.962
Hainan	1.052	1.025	0.947	1.141	1.018
Heilongjiang	0.991	0.966	0.965	1.003	1.029
Jilin	1.018	0.996	0.990	1.007	1.021
Liaoning	1.100	1.090	1.037	1.052	1.006
Inner Mongolia	1.128	1.114	1.017	1.092	1.006
Ningxia	0.957	1.004	1.009	1.008	0.991
Qinghai	0.950	0.948	0.881	1.148	1.007
Shaanxi	1.103	1.108	1.084	1.035	1.006
Shanghai	1.050	1.006	1.023	0.984	1.042
Xinjiang	1.029	1.008	0.989	1.020	1.022
Yunnan	1.256	1.064	1.298	0.912	1.222
Zhejiang	1.040	1.021	1.004	1.019	1.019
Chongqing	0.998	0.980	0.934	1.069	1.020

Table 2 shows the mean value of total factor productivity of green logistics in provinces along the belt and Road through Malmquist index calculation. The average annual dynamic total factor productivity of green logistics in provinces along the Belt and Road is greater than 1 except Gansu, Guangxi, Heilongjiang, Ningxia, Qinghai and Chongqing. That is, within the research time range, more than 60 percent of provinces have improved their green logistics productivity, especially Liaoning, Inner Mongolia, Shaanxi and Yunnan, with an average annual improvement rate of more than 10 percent. From the decomposition results, fujian, guangdong, hainan, liaoning, Inner Mongolia, shaanxi, Shanghai, xinjiang, yunnan, zhejiang green logistics productivity due to technical efficiency and technical progress of double drive, and JiLinZe as a result of technological progress to produce positive effect is greater than the negative effects brought by the technical efficiency decline. As for the provinces with declining green logistics productivity, the average annual decline in Heilongjiang, Qinghai and Chongqing is 0.92%, 5.05% and 0.17%, respectively, because the negative impact caused by the decline in technical efficiency is greater than the positive effect caused by technological progress. The average annual decline in Guangxi and Ningxia is 2.33% and 4.29%, respectively, mainly affected by technological regression. Gansu's average annual decline was 2.49%, which was caused by the double drag of technological efficiency decline and technological regression.

The average geometric calculation of the total factor productivity of dynamic green logistics in each province is carried out annually, and the annual average total factor productivity of dynamic green logistics in key provinces along the "Belt and Road" from 2011 to 2019 can be obtained, as shown in Table 3.

On the whole, the total factor productivity of green logistics in provinces along the "Belt and Road" in the research time range kept rising, with an average annual increase rate of 4.6%. Affected by technological regression in 2013 and 2015, the total factor productivity of green logistics declined, especially in 2013, with a decrease rate of 14%.It may be because China carried out the tax reform of replacing business tax with VALUE-ADDED tax in logistics industry in 2013, and the actual tax burden of logistics enterprises increased by 2.9%, which led to the crisis faced by some enterprises and problems in resource allocation, thus causing the regression of total factor productivity of green logistics.

From the perspective of time sequence, the fluctuation cycle of green logistics total factor productivity from 2011 to 2019 can be divided into three stages. From 2011 to 2012, the total factor productivity of green logistics showed a rising trend. Thanks to the Adjustment and Revitalization Plan of Logistics Industry issued by The State Council at that time, the total factor productivity of green logistics increased by 20% with the strong support of the country to the logistics industry and the development of logistics technology and energy conservation and emission reduction technology. From 2013 to 2015, the variation trend of total factor productivity of green logistics turned to decline again. In this stage, enterprises have completed relatively easy energy-saving and emission reduction measures in the process of promoting the development of low-carbon logistics, and the costs of other measures are rising day by day. Therefore, they must make greater efforts and pay higher costs to continue to achieve low-carbon achievements. Therefore, the total factor productivity of green logistics in this stage presents a downward trend. Since 2016, the total factor productivity of green logistics has continued to show an upward trend. This stage mainly benefits from technological progress. With the gradual promotion and use of new energy freight vehicles, the popularity of TWO-DIMENSIONAL code technology, and the improvement of mobile Internet and logistics informatization, the total factor productivity of green logistics has grown steadily.

Table 3. Temporal dynamic evolution in logistics carbon emission efficiency of the provinces along B&R, 2011–2019

Time	MI	EC	PEC	SEC	TC
2011-2012	1.198	1.089	1.018	1.083	1.098
2012-2013	0.858	1.084	1.042	1.045	0.803
2013-2014	1.020	1.044	0.995	1.050	0.977
2014-2015	0.951	1.007	0.976	1.032	0.948
2015-2016	1.045	1.011	1.020	0.992	1.033
2016-2017	1.077	0.998	0.977	1.059	1.081
2017-2018	1.172	0.950	0.996	0.957	1.241
2018-2019	1.051	1.039	1.064	1.077	1.027
Avg.	1.046	1.028	1.011	1.037	1.026

4.2. Measurement of Logistics Carbon Emission Efficiency based on SBM

The mean value of green logistics efficiency from 2011 to 2019 considering the unexpected output of carbon emissions is calculated, and the green logistics efficiency of provinces along the belt and Road under the super-efficiency SBM model is shown in Table 4. the super-efficiency SBM value reflects the static evaluation data of green logistics efficiency. Generally, the average annual green logistics efficiency value of 17 key provinces along the "Belt and Road" is 0.794, among which Shanghai is the highest and Heilongjiang is the lowest. The green logistics efficiency values of Shanghai and Zhejiang provinces are always valid in the research time range, and the green logistics efficiency values of Fujian, Guangdong, Inner Mongolia and Ningxia reach the effective level in some years, indicating that the green logistics efficiency of these provinces is at a high level. The efficiency of green logistics in other provinces is not satisfactory, especially in heilongjiang, Jilin, Qinghai, Xinjiang and Yunnan, which are in the bottom five, with average values below 0.5, which has great potential of carbon emission reduction. It is worth noting that although ningxia's economic development is relatively slow and the absolute output of logistics industry is low, its low input index shows a good resource utilization rate, so the efficiency of green logistics is high.

Table 4. Comprehensive technical efficiency of logistics carbon emissions of the key provinces along the B&R within 2011–2019

Provinces	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average	Rank
Fujian	1.031	1.029	1.025	1.016	1.017	1.003	1.004	0.775	1.014	0.990	5
Gansu	0.532	0.538	0.545	0.510	0.520	0.497	0.493	0.454	0.481	0.508	11
Guangdong	0.509	0.628	1.002	1.005	1.018	1.016	1.022	1.014	1.018	0.915	7
Guangxi	0.609	0.628	1.002	0.816	0.754	0.809	1.008	1.001	0.659	0.810	9
Hainan	0.588	0.574	0.414	0.586	0.529	0.503	0.431	0.373	0.563	0.507	12
Heilongjiang	0.278	0.283	0.320	0.287	0.251	0.244	0.242	0.235	0.206	0.261	17
Jilin	0.440	0.463	0.467	0.464	0.401	0.419	0.420	0.428	0.419	0.436	13
Liaoning	0.729	1.004	1.042	1.034	1.017	1.315	1.288	1.252	1.356	1.115	2
Inner Mongolia	0.607	1.020	0.670	0.785	1.006	1.082	1.200	1.299	1.114	0.976	6
Ningxia	1.253	1.303	1.220	1.152	1.160	1.095	1.003	0.659	1.045	1.099	4
Qinghai	0.348	0.324	0.323	0.357	0.356	0.330	0.288	0.254	0.221	0.311	16
Shaanxi	0.469	0.531	0.634	0.751	1.011	1.025	1.031	1.006	1.016	0.830	8
Shanghai	1.460	1.398	1.337	1.478	1.398	1.290	1.316	1.410	1.563	1.406	1
Xinjiang	0.312	0.331	0.358	0.407	0.376	0.367	0.364	0.383	0.320	0.358	14
Yunnan	0.211	0.241	0.358	0.347	0.366	0.365	0.374	0.343	0.316	0.325	15
Zhejiang	1.043	1.038	1.082	1.084	1.110	1.137	1.120	1.157	1.231	1.111	3
Chongqing	0.609	0.524	0.511	0.570	0.537	0.537	0.519	0.522	0.508	0.537	10
Avg.	0.649	0.698	0.724	0.744	0.755	0.767	0.772	0.739	0.768	0.735	-

Provinces along the Belt and Road have great differences in pure technical efficiency. Further decomposition of super-efficiency SBM values shows that pure technical efficiency is the main reason for such differences based on Table 5. Provinces with low green logistics efficiency are all dragged down by pure technical efficiency. On the other hand, all provinces except Guangdong, Guangxi, Hainan, Ningxia and Qinghai are close to the optimal frontier, indicating that all provinces attach great importance to the logistics industry, the logistics industry develops rapidly, and the effect of scale economy is constantly emerging.

Table 5. Pure technical efficiency of logistics carbon emissions of the key provinces along the B&R within 2011–2019

Provinces	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average	Rank
Fujian	1.043	1.038	1.035	1.021	1.020	1.004	1.006	0.791	1.017	0.997	9
Gansu	0.612	0.630	0.562	0.511	0.521	0.507	0.550	0.530	0.514	0.549	13
Guangdong	1.162	1.206	1.286	1.383	1.371	1.542	1.551	1.462	1.388	1.372	3
Guangxi	1.029	1.046	1.059	1.030	1.017	1.016	1.009	1.003	1.000	1.023	7
Hainan	1.063	1.032	1.044	1.064	1.060	1.057	1.038	1.009	0.635	1.000	8
Heilongjiang	0.306	0.305	0.335	0.287	0.252	0.269	0.266	0.263	0.222	0.278	17
Jilin	0.492	0.535	0.498	0.468	0.408	0.436	0.444	0.467	0.445	0.466	14
Liaoning	1.043	1.048	1.074	1.065	1.072	1.329	1.293	1.256	1.357	1.171	4
Inner Mongolia	1.095	1.111	1.037	1.072	1.087	1.104	1.203	1.305	1.242	1.140	6
Ningxia	2.108	2.168	2.269	1.969	1.953	1.907	2.027	2.286	2.209	2.100	1
Qinghai	1.147	1.184	1.164	1.135	1.102	1.025	0.429	0.409	0.322	0.880	11
Shaanxi	0.574	0.742	1.028	1.065	1.061	1.028	1.035	1.008	1.019	0.951	10
Shanghai	1.545	1.502	1.463	1.745	1.603	1.544	1.668	1.818	2.024	1.657	2
Xinjiang	0.364	0.385	0.403	0.430	0.388	0.402	0.380	0.404	0.321	0.386	16
Yunnan	0.217	0.255	0.385	0.369	0.380	0.370	0.383	0.367	1.006	0.415	15
Zhejiang	1.205	1.186	1.114	1.123	1.164	1.144	1.120	1.158	1.233	1.161	5
Chongqing	1.011	0.612	0.523	0.574	0.541	0.552	0.533	0.537	0.527	0.601	12
Avg.	0.942	0.940	0.958	0.959	0.941	0.955	0.937	0.945	0.970	0.950	-

Table 6. Scale efficiency of logistics carbon emissions of the key provinces along the B&R within 2011–2019

Provinces	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average	Rank
Fujian	0.988	0.992	0.990	0.995	0.998	0.999	0.998	0.980	0.998	0.993	1
Gansu	0.869	0.855	0.969	0.999	0.998	0.982	0.897	0.856	0.936	0.929	6
Guangdong	0.438	0.521	0.779	0.727	0.743	0.659	0.659	0.694	0.733	0.661	14
Guangxi	0.592	0.601	0.946	0.793	0.742	0.796	0.998	0.998	0.659	0.792	13
Hainan	0.553	0.556	0.397	0.551	0.499	0.476	0.416	0.369	0.886	0.523	16
Heilongjiang	0.909	0.928	0.955	0.999	0.997	0.907	0.911	0.893	0.926	0.936	5
Jilin	0.895	0.866	0.938	0.991	0.982	0.961	0.946	0.917	0.942	0.938	4
Liaoning	0.699	0.958	0.971	0.971	0.949	0.989	0.997	0.997	1.000	0.948	3
Inner Mongolia	0.554	0.918	0.646	0.733	0.926	0.980	0.997	0.995	0.897	0.850	12
Ningxia	0.594	0.601	0.538	0.585	0.594	0.574	0.495	0.288	0.473	0.527	15
Qinghai	0.303	0.274	0.278	0.315	0.323	0.322	0.670	0.621	0.687	0.421	17
Shaanxi	0.817	0.716	0.617	0.705	0.953	0.997	0.996	0.998	0.997	0.866	10
Shanghai	0.945	0.931	0.914	0.847	0.872	0.835	0.789	0.776	0.772	0.853	11
Xinjiang	0.855	0.860	0.887	0.947	0.970	0.912	0.958	0.948	0.999	0.926	7
Yunnan	0.973	0.946	0.929	0.941	0.962	0.987	0.978	0.933	0.314	0.885	9
Zhejiang	0.865	0.875	0.972	0.965	0.953	0.993	1.000	0.999	0.998	0.958	2

Chongqing	0.602	0.857	0.976	0.994	0.992	0.974	0.973	0.972	0.965	0.923	8
Avg.	0.733	0.780	0.806	0.827	0.850	0.844	0.863	0.837	0.834	0.819	-

5. Discussions and Conclusion

5.1. Discussions

Based on the above research results and analysis, this paper puts forward some suggestions to effectively improve the efficiency of agricultural carbon emissions in China.

5.1.1. Improve Energy Structure, Increase Resource Utilization Rate, and Increase the Growth of Pure Technical Efficiency of Carbon Emission in Logistics Industry

First, in terms of energy use, it is necessary to reduce the consumption of coal, oil and other highly polluting traditional energy, and vigorously develop and utilize renewable clean energy such as wind and solar energy. Secondly, in terms of the mode of transportation, it is necessary to establish a visual transportation platform and continuously optimize and upgrade the transportation route through Internet technology. At the same time, it is also necessary to develop multimodal transportation to minimize the energy waste in the transportation process and reduce carbon emissions.

5.1.2. Strengthen the Construction of Logistics Infrastructure and Logistics Parks, and Improve the Growth of Logistics Industry Carbon Emission Scale Efficiency

The realization of the logistics modernization depends greatly on the construction of infrastructure, "One Belt And One Road" along the various provinces and cities in the building of the modern comprehensive logistics park should give full consideration to their own logistics development situation, the facilities condition and the level of supply and demand and other objective conditions, targeted to promote all kinds of logistics mode of transportation of cohesion and form a complete set, The logistics park has four functions of production, freight, processing and trade. On the one hand, coastal provinces should intensify the construction of ports, speed up the construction of domestic and foreign logistics channels, and pay attention to the specialization, socialization and integration of logistics infrastructure. On the other hand, it is necessary to pay attention to the cost and benefit in logistics infrastructure construction, and carry out reasonable allocation and overall planning of logistics resources in various regions, so as to achieve the purpose of saving costs and protecting the environment to a great extent.

5.1.3. Seize the Development Opportunity under the Background of "One Belt and One Road", Make Full Use of the Positive Effect of External Environment on Logistics Industry, and Promote the Coordinated Development of Regional Logistics

The differences in the comprehensive carbon emission efficiency of the logistics industry among provinces in northeast, northwest and southwest China continue to expand. In order to reduce such differences, all regions should coordinate with each other, strengthen overall planning, and promote the logistics industry in the whole region to achieve energy conservation and emission reduction. Government should be released by relevant policies to adjust the regional differences, promote learning and communication between provinces, province in the efficiency low carbon emissions, should strengthen the cooperation and communication with other province, draw lessons from the advanced experience and technology to reduce emissions, for total factor of carbon emissions due to its high efficiency, should take the initiative to assume more responsibility, positive drive the other provinces to enhance the efficiency of total factor of carbon emissions, So as to achieve coordinated development and common progress of provinces.

5.1.4. Eestablish the Logistics Concept of Low Carbon Development

Guide the logistics enterprise must set up low carbon low carbon development enterprise culture, vigorously promote the concept of low carbon, itself in the process of working to independent adopts low carbonization method, government for such enterprises, to encourage, by setting certain standards for enterprise, benchmarking and gives the corresponding policy inclination and economic rewards. At the same time, the logistics industry is a national participation of the industry, to cultivate low-carbon consumption habits, and make personal behavior habits into the daily life of small things.

5.2. Conclusion

The provinces along the belt and Road have both the most developed and relatively backward regions in China. The study on the carbon emission efficiency of logistics industry in the provinces along the Belt and Road will provide reference for the coordinated development of regional logistics, the improvement of logistics resource allocation efficiency and the green development of logistics industry in China. The results show that the efficiency of green logistics varies greatly among different provinces in different time periods, and the comprehensive efficiency of carbon emission has a large room to rise, and the southeast region is significantly higher than other regions. Since there is a significant gap in the efficiency of green logistics in different provinces, the influencing factors can be further studied in the future.

References

[1] Mariano E B, Gobbo Jr. J A, de Castro C, et al.CO2 Emissions and Logistics Performance: A composite index proposal [J]. Journal of Cleaner Production ,2016,163:166-178.

[2] Dalai Ma, Wenli WU, Ziming DONG. China's industrial carbon emission performance and its influencing factors: An empirical study based on spatial panel data model [J]. China Economic Issues, 2017(1): 121-135.

[3] Hui Li, Wei Li. Carbon emission efficiency evaluation and dynamic evolution analysis of logistics industry: A Case study of provinces along the "Silk Road Economic Belt" [J]. Environmental Science & Technology, 2019, 42(3): 165-171.

[4] Jing Han, Yun Wang, Chaofan Chen. Regional differences and influencing factors of Industrial carbon emission performance in China: A spatial econometric analysis based on provincial data [J]. Comparison of economic and social systems, 2015(1): 113-124.

[5] Ming Gao, Hongyuan Song. Spatial convergence and differentiation of Agricultural carbon emission performance in China: an empirical analysis based on Malmquist-Luenberger index and spatial econometrics [J]. Economic geography, 2015(4): 142-148,185.

[6] Xiumei Sun, Hui ZHANG, Ge Wang. Regional carbon emission efficiency based on super-efficiency SBM model: A Case study of 17 prefecture-level cities in Shandong Province [J]. Ecological Economy, 2016, 32(5): 68-73.

[7] Ke Cao, Xiaoe QU.Regional carbon emission performance evaluation and carbon reduction potential in China. [J]Population, Resources and Environment in China2014, 24(8): 24-32.

[8] Feng Li, Lunzhi He.Calculation and influencing factors of total factor energy efficiency under carbon emission constraint in China[J] Ecological Economy, 2017, 33(5): 35-41.

[9] Ming Gao, Qiuhong Chen. Trade openness, economic growth, human capital and carbon emission performance: Evidence from China's agriculture [J]. Journal of Agrotechnical Economics, 2014(11): 101-110.