2016 International Conference on Management Science & Engineering (23rd)
August 18-20, 2016 Olten, Switzerland

Research on the Level of Carbon Finance Development and its Influence Factors in Tianjin, Hebei and Beijing

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Abstract: Consider to the ecological environment in Beijing Tianjin and Hebei region is severe, this paper for of this area of carbon finance as the research object, based on related sample data from 2007 to 2013 Beijing Tianjin and Hebei region development of carbon finance, Then take carbon finance development strength and potential index system, using factor analysis method to evaluate scientifically and assess the carbon finance development level in Beijing, Tianjin and Hebei ,come to in Beijing, Tianjin and Hebei carbon finance development is still at a low level of conclusions. Therefore, the factors that affect the development of carbon finance in the region, and finally according to this, show the five suggestions of the development of low carbon industry, expanding forest cover, focus on the development of new energy, the development of carbon finance market, and the strengthening of policy incentives.

Keywords: carbon finance, factor analysis, CDM, carbon sink

1 Introduction

Since the "Kyoto Protocol" came into effect in 2005, 2012 is the first deadline for the commitment period and the second commitment period was passed at the end of 2011 with difficulty. The Chinese government made a commitment that by 2020, C_2O emissions per unit of GDP of China decreased by 40% to 50% compared with 2005 in 2009, Copenhagen. 2015 at the United Nations climate change leaders working luncheon, President Xi said the Chinese government has to deal with climate change issues fully integrated into the overall strategy of national economic and social development. 2014, C2O emissions per unit of GDP fell by 33.8% over 2005. The future, China will make further efforts to control greenhouse gas emissions, strive to achieve the target by 2020 carbon intensity decreased by 40% -45%.

Taking the gradual improvement of the quality of our economic life into account for this background, people's high-demand of environment will be more and more urgent, so the research of China's carbon finance development issues is particularly important, especially in BTH region where environment and air quality are serious problems.

This paper chooses carbon finance as research subjects has a strong practical significance, because the carbon emissions are not only directly related to the survival and the development of enterprises, the quality of people's lives, but also directly affect the management objectives of government. Meanwhile, industrial upgrading and controlling greenhouse gas emissions is the double objectives of the "second Five-Year Plan" , with a deeper focus on low-carbon economy and people's urgent pursuit of high-quality life, as well as other financial sector's more significant role in supporting industries, the leading role of carbon finance to improve the environment is particularly important and urgent. In this paper, the reason to choose BTH region is mainly on account of its special status in China's political, economic and social development, and also in recent years the poor environmental quality of the region has caused widespread concern in the community, so it has important practical significance to study the impact of Carbon Finance on industrial upgrading and the development level of carbon finance.

Supported by The National Social Science Foundation of China“Research on Carbon finance support Based on Regional Industrial Upgrading”（15BJL059）

2 The selection and definition of carbon finance development level evaluation index

2.1 The selection of carbon finance development level evaluation index

The assessment of carbon finance development level refers to the assessment of low carbon development level supported by regional finance. It not only can fully reveal the gap between carbon finance development level in all regions, but also can find factors that affect carbon finance development level, thus make the relevant departments to put forward measures to improve the level of carbon finance development. According to the four principles, the combination of integrity and pertinence, feasibility and comparability, accuracy and practicability, static and dynamic, carbon finance development level is evaluated from two aspects of financial strength and development potential. Meanwhile, in each indicator there are multiple sub-index. Assessment of carbon finance development level

indicator system is shown in Table 1.

Tab.1 Carbon finance development level indicator system

carbon finance development level	Carbon Finance Development Strength	The number of registered CDM projects
		Industrial governance investment intensity
	Carbon finance development potential	The number of patents
		The proportion of the tertiary industry output value
		Government financial support
		Carbon credit intensity

2.2 Meaning and calculation method of each index

(1) CDM project registration number

CDM, called the Clean Development Mechanism. Registration refers to the process that designated operational entity of the project has been confirmed the project meets the requirements of CDM, sign the certification report and then the United Nations CDM Executive Council approved the registration .The reason why this indicator does not select the number of issued CDM programs is the time-sectional data in BTH area is more difficult to extract, and registrations can be a good explanation of carbon emission reductions under the financial support, it reflects financial support to curb carbon emissions. The number of registered CDM projects, the more the stronger carbon emissions.

(2) Industrial governance investment intensity

Industrial governance investment intensity refers to industrial governance completed investment amount for each unit of industrial added value of the region, reflecting the ability to control the carbon emissions generated by all regions in industrial development process, characterizes the governance capacity of carbon emissions under investment support. Calculated as follows:

Industrial governance investment intensity = Industrial governance completed investment amount of all regions / Industrial added value (1)

(3) The number of regional patents

The number of regional patents reflect the results of scientific research in this area, the more number of patents, the stronger research ability of this region shows and low-carbon technology R&D capabilities increase, and the more low-carbon products developed by financial institutions ,the more likely to attract the investment by financial institutions , thereby increasing the level of carbon finance.

(4) The proportion of the tertiary industry output value

The proportion of the tertiary industry output value refers to the tertiary industry output value accounting for the GDP in the region of the year. On the one hand, the more developed the tertiary industry is, the better development of the financial sector will be; on the other hand, means that the region's dependence on the secondary industry is relatively reduced, and to a great extent, carbon emissions comes from the second industry. The greater the tertiary industry output value accounted for, the greater the development of carbon finance prospects are.

(5) Government financial support

Government financial support means that R&D intramural expenditure accounts for the GDP. It reflects the government support of research and trials, the greater the financial support is, the more scientific research results are, the carbon finance development level also increases.

(6) Carbon credit intensity

Carbon credit intensity refers to carbon emissions from the balance of financial institutions' loans at the end of the year, the index reflects the financial support for carbon emissions from financial institutions. It characterizes the potential of their loans due to carbon emissions. Calculated as follows:

Carbon credit intensity = Total carbon emissions intensity by Region / The balance of foreign currency loans of financial institutions at the end of the year (2)

3 The basic idea of factor analysis

Factor analysis is a statistical method used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors. The basic idea is to group the variables based on the correlation, so it can make a higher correlation between the variables in the same group, a lower correlation between the variables in different groups. Each group of variables represent a basic structure, known as the common factor in the factor analysis The purpose of factor analysis is to find the basic structure of variables, to simplify the observation system, to reduce the number of variable dimension and with a small number of variables to explain the whole issue. Assuming there are N samples, P indicators, $X=(x_1,x_2,\cdots x_p)T$ is a random variable can be observed, the common factor to be found is $F=(F_1,F_2,\cdots,F_m)^T$, $m<p$, then the model is as follows:

Factor Model
$$\begin{cases} X_1=a_{11}F_1+a_{12}F_2+\cdots+a_{1m}F_m+\varepsilon_1 \\ X_2=a_{21}F_1+a_{22}F_2+\cdots+a_{2m}F_m+\varepsilon_2 \\ \cdots\cdots \\ X_p=a_{p1}F_1+a_{p2}F_2+\cdots+a_{pm}F_m+\varepsilon_p \end{cases}$$

$X_1,X_2,\cdots X_p$ are the measured variables; $F_i(i=1,2,\cdots p)$ is a group factor and ε_i (i = 1,2, ... p) is a special factor(often negligible in practice). It can also be expressed in matrix form: $X = AF + \varepsilon$, the matrix $A=(a_{ij})$ known as factor loading matrix. As long as we find out the factor loading matrix A, we can find out the common factor obtained for each factor. First observe them on the variable loading size, then illustrate the meaning of factors according to their contents of the variable. Combined with the principal component factor analysis,

the steps are as follows:

①Set up the index system and the original matrix.

②Standardize the original data and the standardized matrix X is obtained.

③ Calculate the correlation coefficient matrix through original matrix or standardized matrix.

④Solve the characteristic equation $||R-\lambda I|=0$, calculate the correlation matrix eigenvalues λ_i, if $\lambda 1 \geqslant \lambda 2 \geqslant \cdots \geqslant \lambda p \geqslant 0$,, then the characteristic root greater than 1 is the main factor.

⑤ Calculate eigenvectors and the initial factor loading matrix A.

⑥ If the factor is not obvious ,it generally uses varimax rotation ,then obtain the main factor solution B (b_{ij}).

⑦ Build the main factor score model and calculate the main factor score. Each main factor is expressed as a linear combination of the variables, and then estimate the value of each factor with a normalized value of the variable.

⑧ Build comprehensive factor score model to calculate composite scores.

⑨ Make the appropriate analysis and evaluation according to main factor scores and comprehensive factor scores.

4 An Empirical Analysis of the carbon finance development level in BTH

4.1 Data collection and quantization

Based on carbon finance development of the selected evaluation index, CDM project registration number X_1, industrial governance investment intensity X_2, number of patents X_3, the proportion of the tertiary industry output value X_4, government financial support X_5, carbon credit intensity X_6, select the relevant data from Statistical Yearbook of BTH(2007-2013), "China National Statistical Yearbook" and "China Financial Statistics Yearbook," then quantize the time and region data using order-reduction with SPSS (17.0 version), and standardize the original data to obtain the correlation coefficient matrix of variables X_1,X_2,X_3,X_4,X_5,X_6:

4.2 KMO test and Bartlett test

KMO test and Bartlett test results are shown in Table 2. As can be seen from the table, KMO test result is 0.789, so factor analysis can be used because it is in a "normal" level. At the same time, Bartlett's approximate chi-square test is large enough, and the concomitant probability is 0.000, significantly lower than the level of 0.05, it also passes the Bartlett's test of sphericity. In addition, as can be seen from the correlation coefficient matrix, most of the correlation coefficient is greater than 0.3, so assessment of the carbon financial development level is suitable for factor analysis.

Tab.2 KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.789
Bartlett's Test of Sphericity	Approx. Chi-Square	185.587
	df	15
	Sig.	.000

4.3 Common factor analysis

SPSS output results are in Table 3, it can be seen from the table,The cumulative contribution rate of the two common factors is 88.562%, greater than 85% of the standard, we can use them to analyze the original data.

Tab.3 Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.043	67.387	67.387	4.043	67.387	67.387
2	1.271	21.175	88.562	1.271	21.175	88.562

4.4 Calculate factor scores

Table 4 shows the factor score coefficient matrix, based on the value of each component score coefficient and the original variables can be obtained factor scores for each observation, and further obtain the total score. Composite score is calculated as follows:

$$\text{Composite score} = (67.387\% \times F_1 + 21.175\% \times F_2) / 88.562\% \quad (3)$$

Tab.4 Comprehensive Score of Carbon Finance Development Level

Year	Comprehensive Score of Carbon Finance Development Level		
	Beijing	Tianjin	Hebei
2007	0.706765	-0.15657	-0.64351
2008	0.721483	-0.16222	-0.66213
2009	0.798051	-0.09309	-0.73789
2010	0.915475	-0.10089	-0.81467
2011	1.017376	-0.12502	-1.11057
2012	1.145042	-0.04272	-1.53461
2013	1.361531	0.054742	-0.53655

4.5 Assessment results

Assessment results of s in Beijing, Tianjin and Hebei province are shown in Table 4 and Figure 1. As can be seen from Figure 4 and Table 1, Beijing and Tianjin are in first and second place respectively, while

Hebei ranks last. The carbon financial development level of Beijing is much better than both Tianjin and Hebei. Specifically, the carbon finance in Beijing has steadily increased, while Tianjin improve slowly. After gradually deteriorated, Hebei province improves significantly in 2013 and exceeded the 2007 level, achieved a record high narrowing the gap with Tianjin.

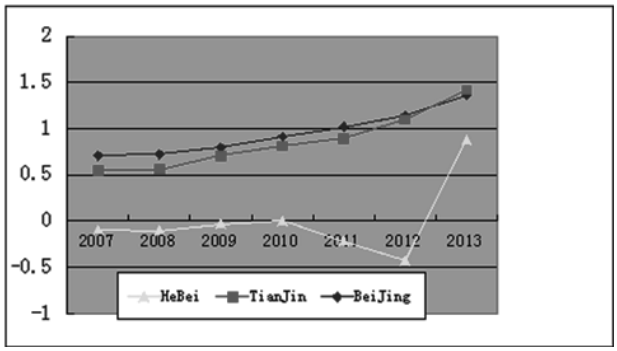

Fig.1 The carbon financial development level of BTH regions

5 Factors affecting carbon finance of BTH (Beijing , Tianjin and Hebei)regions

The carbon financial development levels among three areas are significantly different, it is necessary to analyze the influence factors, accelerate the carbon financial development and then target for improvement. Firstly, select influence factors and explain its connotation, and use multiple regression, then obtain the results.

5.1 Factors affecting carbon finance of BTH regions and its connotation

Carbon-emissions reduction can fully improve the environment, raise people's quality of life, while the carbon emissions is inseparable from the development of carbon finance. This paper will use auto emissions, carbon sinks, industrial restructure, financial institutions supply and financial support as the inducing factors of the development of carbon finance.

(1)Private owned automobile quantity (MYQCYYL)

The main pollutants in vehicle exhaust are carbon monoxide, none burning hydrocarbons, nitrogen oxides, lead compounds and soot, etc. They constitute a major source of urban PM2.5 pollution. With the increase in car ownership, carbon emissions have become even more serious ,at the same time, R & D and creation of carbon financial products are also likely to be affected.

(2)Forest Coverage Rate (SLFGL)

Trees can absorb carbon dioxide and release oxygen. According to scientists, about 1 hectare of broad-leaved forest can consume 1 tons of carbon dioxide per day, absorb nitrogen oxides, purify the air, filter and block the dust. The increase in forest cover can effectively reduce carbon emissions in the air, thereby affecting the process of innovation and demand for carbon financial products.

(3)**Proportion of added value of financial industry (JRYZJZBZ)**

The proportion of added value of financial industry reflects the development level of financial industry. The development of financial industry promotes the research and development of financial products, accelerates the development of financial products and financial instruments related to energy saving and environmental pr otection industry. This is from a macro perspective to an -alyze

5.2An empirical analysis of factors affecting carbon finance

(1) Data sources and collection

In this paper, the data of influencing factors of carbon finance is in "China Statistical Yearbook"(2008-2014), the Statistical Yearbook of Beijing, Tianjin and Hebei and "China Financial Yearbook" EViews6.0 is used as a data analysis tool in this article. We choose private owned automobile quantity, the forest coverage rate, the proportion of tertiary industry output value, proportio n of added value of financial industry and financial support for energy saving and environmental protection as explanatory variables, comprehensive score of carbon finance development level as the dependent variable, dev eloping a multiple regression analysis.

(2)Model Setting

This paper uses the data of Beijing, Tianjin and Hebei from 2007 to 2013 as a sample. Due to the existence of three-dimensional data (time, area, variable), so we make the use of panel data approach. Model set as follows:

$$TJRFZSPit=\alpha_i+\beta 1iMYQCYYLit+\beta 2iSLFGLit+\beta 3iJRY\ ZJZBZit+\mu it \quad (4)$$

$i=1, 2, 3\ t=2007, 2008,\ldots 2013$

Among them, the dependent variable TJRFZSP

represents comprehensive score of the development level of carbon finance.

(3) Estimation results under mixed model

Results from the EViews6.0 analysis (Table 5) can be seen, corporate ownership, the forest coverage rate and proportion of added value of financial industry reject the null hypothesis and pass the t-test, and the goodness of fit and the amendments to the goodness of fit are up to 0.947335 and 0.938041, while the Durbin-Watson test result is 1.953485(between 1.5 to 2.0, in a reasonable range). The obtained model can be expressed as:

TJRFZSP=-2.120841-0.001875×MYQCYYL+0.050075×SLFGL+0.131814×JRYZJZBZ (5)

Tab. 5 Estimation results under mixed model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MYQCYYL?	-0.001875	0.000353	-5.314210	0.0001
SLFGL?	0.050075	0.007628	6.564378	0.0000
JRYZJZBZ?	0.131814	0.013021	10.12324	0.0000
C	-2.120841	0.195066	-10.87243	0.0000
R-squared	0.947335	Mean dependent var	1.19E-06	
Adjusted R-squared	0.938041	S.D. dependent var	0.797561	
Durbin-Watson stat	1.953485			

(4)Estimation of individual fixed effects regression model

Three indicators also pass t-test, goodness of fit is also very good. Meanwhile the value of Durbin-Watson test is 2.0492, only a little beyond the reasonable range. Because of individual fixed, it produces three sets of calculation formula for Beijing, Tianjin and Hebei. The calculated mode is:

TJRFZSPBJ=0.083764-0.00166×MYQCYYLBJ+0.050669×SLFGLBJ+0.108177×JRYZJZBZBJ -1.883867 （Beijing）；（6）

TJRFZSPTJ=0.073474-0.00166×MYQCYYLTJ+0.050669×SLFGLTJ+0.108177×JRYZJZBZTJ -1.883867 （Tianjin）； （7）

TJRFZSPHB=0.157239-0.00166×MYQCYYLHB+0.050669×SLFGLHB+0.108177×JRYZJZBZHB -1.883867 （Hebei）。（8）

(5) Redundant variables of fixed effects by likelihood ratio test

Probability 0.8597 supported the original hypothesis, this model is suitable for mixed model, namely individual fixed effects does not exist.

(6) Conclusion of the influence factors of carbon finance in Beijing, Tianjin and Hebei

From the analysis, the fitting degree of each index is good and also pass the t-test, meanwhile the Durbin-Watson test results are satisfactory. It indicates that the three indicators selected in the model can explain the development level of carbon finance in Beijing, Tianjin and Hebei carbon The results from the model can draw the following conclusions:

(1)Private owned automobile quantity has negative effects on carbon finance, the forest coverage rate and the proportion of added value of financial industry has a positive effect;

(2)Judging from the com parison of the interce pt term on the three indices, the impact on carbon finance through proportion of added value of financial industry is the highest in Beijing, moderate in Tianjin and relatively low in Hebei;

(3)The proportion of added value of financial industry increased by 1% can drive the carbon finance comprehensive score increased by 0.131814%, the forest coverage rate increased by 1% and promote carbon finance comprehensive score increased by 0.050075%,whil -e car ownership increases 1% ,carbon finance can bring th e total score decrease by 0.001875%.

(4)Due to individual fixed effects does not exist and there is a mixed effect, so the carbon finance in the three areas does not exist individual differences.

6 Policy recommendations for carbon finance development of Beijing, Tianjin and Hebei region

As can be seen from the results of the above empirical analysis, the level of carbon finance development in Beijing, Tianjin and Hebei region is still relatively low, and the three provinces are quite different, but they all mainly affected by the proportion of added value of financial industry, the forest coverage rate and car ownership. According to the analysis of this paper ,we give five suggestions on promoting carbon finance and carbon-emissions reduction.

6.1 Support and nurture low-carbon industry, optimize the industrial structure and R&D of low-carbon technologies

To improve the carbon environment, we first need to start from the source, eliminate backward production

capacity, reduce the high-polluting and energy-intensive industries especially as the chemical industry, paper industry, non-ferrous financial industry, steel industry, cement industry, and electroplating industry. Developing low-carbon industry can solve high carbon emissions fundamentally and optimize the industrial structure. At the same time, increase research and development of low-carbon technologies and low-carbon innovation or improvement of facilities and equipment can make carbon emissions under control and improve the local ecological environment effectively

6.2 Make efforts to voluntary tree-planting management and expand forest coverage

According to "China Statistical Yearbook "(2014)and "Hebei Environmental Status Bulletin", the number of days that air quality has met or better than Grade II of Beijing, Tianjin and Hebei in 2013 are 167, 145 and 152, no more than half number of days throughout the whole year. The air quality problems are severe. The trees can absorb large amounts of carbon dioxide and nitrogen oxides, clean up the polluted source, reduce the haze phenomenon and effectively improve the regional air quality in BTH. We should focus on strengthening the management of tree planting, expanding forest coverage and improving local air quality.

6.3 Adjust the energy structure and reduce energy intensity

Energy structure of Beijing, Tianjin and Hebei is still mainly based on coal and other traditional energy sources, natural emissions are not curbed in order to promote regional economic development. But we should not focus on short-term economic development, we must adjust the energy structure, develop and use clean energy. Make efforts to reduce energy intensity, focus on energy saving and leave the clean air to the next generation.

6.4 Develop carbon finance markets and increase carbon finance transactions

At present, China's carbon finance market is still young. Although there are four major carbon emissions exchanges,, trading volume and turnover are very inactive and do not receive the attention and participation of most investors. China should study the experiences of developed countries, particularly the European Union to develop carbon finance market and increase carbon finance transactions, with the development of carbon finance to reduce the carbon emissions.

6.5 Continue to increase carbon finance development with policy incentives

The government should play a leading role in reducing carbon emissions and promoting carbon finance development. Investment in low-carbon industries has been subject to investors' aversion, mainly because of its high risk, uncertainty and strong features. Therefore, the government should continue to increase its investment in low-carbon loans, support and promote innovation and application of financial derivatives, and intend to tilt its policies to promote financial market and the development of low-carbon industries.

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