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Decomposition of CO_2 Emission Factors in Baoding

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Abstract. Baoding, as one of the first "five provinces and eight cities" low carbon pilot cities, undertakes an important task and mission. The urgent task is to explore a peak route and emission reduction path suitable for Baoding's own development, so as to provide reference for the construction of low-carbon pilot cities. At present, the carbon emissions of Baoding city and its subordinate districts and counties are not clear, and the carbon emissions, change trends and emission characteristics of various industries have not been systematically studied. This lead researcherscan not carry out further attribution analysis, the prediction of future emissions trends and put forward specific measures to reduce emissions are impossible.If the government can not accurately and comprehensively understand the problems faced in the construction and development of low-carbon cities, it is difficult to fundamentally put forward effective emission reduction policies and measures.

1. Introduction

The carbon emissions were taken as the research object. Angapplythe new proposed Division indexdecomposition method to study Chinese carbon dioxide and the energy consumption of the industrial sector to solve the remaining problems and data decomposition in 0 value problems. This decomposition covers 4 kinds of fuel and the 8 sectors, the results of the study showed that 1985-1990 the industrial sector carbon emissions have a positive effect on the change in total output, and the change of industrial energy consumption intensity play a an inhibitor effect on the sector’s carbon emissions [1].Wang used logarithmic Division index decomposition method to discuss Chinese carbon dioxide emissions in 1957-2000, decomposition results showedthatenergy consumption intensity is the strongest factor to reduce carbon emissions, energy structure effect restrain carbon emissions growth, economic growth factors play a role to increase carbon emissions[2].Taking carbon emission intensity as the object of study. Shrestha and Timilsina address Division index decomposition method to study the 12 Asian country electric power industry carbon dioxide emissions intensity changes, including China, the results showed that the effect of carbon dioxide emissions from 1980-1990 Asia power industry are the change of fuel intensity[3]. Fan adopted adaptive weighted Divisia decomposition method devoted to China carbon emission intensity in 1980-2003, the CO_2 emissions trend in Chinais rising, but the intensity of carbon emissions continued to decline, and by distinguishing a carbon intensity of primary energy consumption intensity and terminal energy consumption factors. The primary energy carbon emission intensity has a significant influence on the carbon emissions intensity change, the energy structure factors, which have an important influence on the carbon emission intensity [4].Constructing linear relationship model to forecast carbon emission scenarios. Lesterbased on the combination of 3 kinds of Kaya equation set the situation Waxman-Markey and Obama policy target to forecast U.S. carbon emissions. [5].

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2. Material and methods

Based on the six traditional industries, as well as 17 kinds conventional energy, to decompose the Baoding carbon dioxide emissions factor, which can be decomposed into six factors: population effect, economic output effect, industrial structure effect, energy intensity effect, energy structure effect and carbon dioxide emission intensity effect, according to the energy consumption of carbon emissions equation:

$$C=\sum_{i,j}C_{i,j}=\sum_{i,j}\frac{C_{i,j}}{E_{i,j}}\times\frac{E_{i,j}}{E_i}\times\frac{E_i}{Q_i}\times\frac{Q_i}{Q}\times\frac{Q}{P}\times P \qquad (1)$$

Where C represents the CO2 emissions in Baoding andCij indicates that the amount of CO2 emissions consumed by the energy j in sector i,Eijexpressed the energy consumption j in sector i, Ei represents the amount of energy consumed by the sector i, Qirepresent the economic output of the sector i, Q delegate the city's GDP, P indicate the population.

$$C=\sum_{i,j}C_{i,j}=\sum_{i,j}F_{i,j}\times M_{i,j}\times R_i\times H\times Y\times P \qquad (2)$$

In the equation, $F_{i,j}=\frac{C_{i,j}}{E_{i,j}}$ represents the intensity of CO_2 emissions from the energy consumed by the i sector, and the changes in carbon emissions, due to the change of CO_2 emissions is called the CO_2 emission intensity effect. $M_{i,j}=\frac{E_{i,j}}{E_i}$ Represent in the sector i, the consumption of j energy accounted for the proportion of total energy consumption, due to the changes in the energy structure of the various sectors caused by changes in the total amount of carbon emissions is known as the energy structure effect. $R_i=\frac{E_i}{Q_i}$ indicate the energy intensity of the sector i, the impact of its changes on carbon emissions is called energy intensity effects; $H=\frac{Q_i}{Q}$ indicate the economic output of the sector i accounted for the proportion of the city's GDP, industrial adjustment to influence on the carbon emissions is called the industrial structure effect. $Y=\frac{Q}{P}$ represent per capita GDP, its changes reflect the impact of economic growth on Baoding carbon emissions is called the economic output effect's represents the population, and the impact of demographic changes on the carbon emissions of Baoding is called the population effect.

$$\Delta C=C^T-C^0=\Delta C_F+\Delta C_M+\Delta C_R+\Delta C_H+\Delta C_Y+\Delta C_P \qquad (3)$$

ΔC Indicate the total CO_2 emissions changes, ΔC_F indicate the CO_2 emission intensity effect, ΔC_M represent the energy structure effect, ΔC_R indicate the energy intensity effect, ΔC_H represent the industrial structure effect, ΔC_Y indicate the economic output effect, ΔC_P and represent the population effect. 0 and T represent the base year and the target year respectively. In this study, the LMDI method is used to decompose in the equation.

$$\Delta C_F=\sum_{i=1}^{6}\sum_{j=1}^{12}\left[L(\mathrm{C}_{i,j}^T,\mathrm{C}_{i,j}^0)\times\ln\frac{F_{i,j}^T}{F_{i,j}^0}\right] \qquad (4)$$

$$\Delta C_M = \sum_{i=1}^{6}\sum_{j=1}^{12}\left[L(C_{i,j}^T, C_{i,j}^0) \times \ln \frac{M_{i,j}^T}{M_{i,j}^0} \right] \quad (5)$$

$$\Delta C_R = \sum_{i=1}^{6}\sum_{j=1}^{12}\left[L(C_{i,j}^T, C_{i,j}^0) \times \ln \frac{R_i^T}{R_i^0} \right] \quad (6)$$

$$\Delta C_H = \sum_{i=1}^{6}\sum_{j=1}^{12}\left[L(C_{,i,j}^T, C_{i,j}^0) \times \ln \frac{H^T}{H^0} \right] \quad (7)$$

$$\Delta C_Y = \sum_{i=1}^{6}\sum_{j=1}^{12}\left[L(C_{i,j}^T, C_{i,j}^0) \times \ln \frac{Y^T}{Y^0} \right] \quad (8)$$

$$\Delta C_P = \sum_{i=1}^{6}\sum_{j=1}^{12}\left[L(C_{i,j}^T, C_{i,j}^0) \times \ln \frac{P^T}{P^0} \right] \quad (9)$$

$$L(C_{i,j}^T, C_{i,j}^0) = \begin{cases} \dfrac{C_{i,j}^T - C_{i,j}^0}{\ln C_{i,j}^T - \ln C_{i,j}^0} & C_{i,j}^T \neq C_{i,j}^0 \\ C_{i,j}^T & C_{i,j}^T = C_{i,j}^0 \end{cases} \quad (10)$$

Analyze the decomposition process, It can be seen that the CO_2 emissions energy intensity of all kinds energy fixed constant so that $\Delta C_F = 0$

3. Results and discussion

Based on the LMDI model, the influencing factors of CO_2 emission in Baoding City from 2004 to 2016 were analyzed. On the basis of the analysis, the influence of these factors on the CO_2 emissions in Baoding was analyzed quantitatively. The results of the analysis can be concluded that the economic output effect is the most positive factor for the change of CO_2 emissions in Baoding. The economic output effect makes the city's carbon footprint increase by 35.24 million tons in 2004-2016, and the industrial structure effect also caused Baoding CO_2 emissions in the research period increased by 2.72 million tons, the population effect of Baoding CO_2 emissions increased by2.52 million tons. Energy structure effect in the study period to suppress the Baoding CO_2 emissions increased by 4.04 million tons, the energy intensity effect is the strongest factor to suppress the growth of carbon emissions. In 2004-2016 total inhibition of the city's CO_2 emissions is 31.19 million tons, under the combined effect of various effects, CO_2 emissions in Baoding City increased by 1.99 million tons throughout the study period.

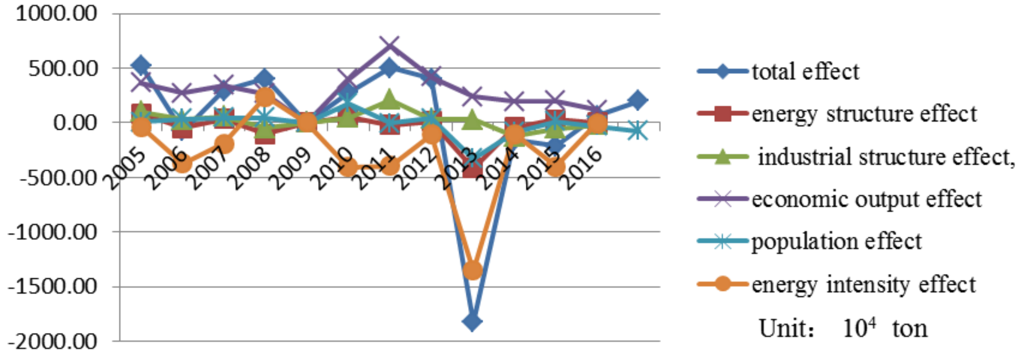

Figure.3-1. LMDI Decomposition Results in 2004-2012.

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Economic output effect is the main factor affect the carbon emissions growth, of Baoding City, industrial structure effect and population effect to promote the Baoding City carbon emissions increase, economic development and population growth of the carbon emissions associated with the other areas of China in the CO_2 emission growth, so in the future, The government should pay attention to balance the relationship between economic development and population growth and energy consumption; in the processofdevelopment, Baoding city should develop actual policy according to their own status, and grasp the integration of Beijing Tianjin Hebei; along with Beijing and Tianjin industrial transfer opportunities, accelerate the optimization and upgrade its industrial structure, build the new energy industries, achieved the transformation to promote the city's carbon emissions growth factors to inhibit the growth of carbon emissions index to the industrial structure effect, On the basis, it is also seriously to follow the impact of low-carbon pilot city construction in Baoding on the concept of low carbon life of residents, which is one of the influencing factors to reduce carbon emissions.
The energy intensity is the strongest inhibition effect on Baoding CO_2 emissions growth, which indicates that the energy efficiency of Baoding increased in the past period, although the amount of energy consumption of unit GDP in 2016 decreased significantly, compared with 2004.Even so, in the "13th Five-Year" period, Baoding should also focus on research and promote energy-saving technology to reduce energy intensity and energy consumption, promote low-carbon and clean energy used, change the mode of economic growth, and strive to achieve the city's carbon emissions peak.
The energy structure effect in the 2004-2016 study period is one of the driving factors of Baoding City, inhibited the growth of CO_2emissions. In recent ten years the energy consumption structure of Baoding, the proportion of low carbon energy increased, clean energy application and project construction work to further promote, but it cannot ignored that in the energy structure. Coal consumption is still accounted for more than 50%, thus promote the use of clean and low carbon energy and non fossil energy, fully tap the potential of emission reduction; still the current emission reduction in Baoding, from the long-term development, the optimization of energy structure will be the carbon emission reduction potential. Draw the lessons of home and abroad, the energy structure effect has become one of the important factors inhibited the growth of carbon emissions.

4. References

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