

Study on the Influencing Factors of Thermal Coal Price

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Abstract

Basic energy such as coal is of strategic significance to national development. It has long supported China's industrial and economic development and laid the foundation for China's energy use. The change of coal price reflects the change of coal market and energy market, affects the supply and demand balance of coal market, and also affects the change of internal structure and importance of coal industry. Scientific and effective prediction of future changes in coal prices can stabilize the development of the coal industry, provide a feasible reference for the prediction of other energy prices, and help the formulation of national macroeconomic regulation and control policies. Research and development of sustainable energy development and utilization is the only way for China to become a powerful country, and it is also a major country for China to cope with global climate change and promote low-carbon green development. This paper combines statistical knowledge, uses grey correlation analysis method, and combines SPSSPRO, EXCEL and other software to rank the nine factors affecting coal prices, and provides relevant policy recommendations to government departments according to the results, so as to provide guarantee for the stable development of the coal industry in the future.

Keywords

Thermal Coal; Coal Price; Grey Relational Analysis.

1. Environment of Problems

Coal is a kind of solid combustible mineral, which is transformed from plant remains buried in the ground after a long and complex biochemical, geochemical and physical-chemical process. It is not only an indispensable main fuel for industry, agriculture and people's life, but also an important raw material for metallurgy, chemical industry, medicine and other sectors. All kinds of coal are products in a certain stage of coalification. According to the degree of coalification, coal is generally divided into lignite, bituminous coal and anthracite. According to the use, it can be divided into thermal coal, coking coal and coke. Among them, coking coal is mainly used for coking, while steam coal is self-contained, and there is not much direct connection with the former two.

Power coal refers to coal used as a power raw material, mainly using the performance of coal combustion and heat as fuel, such as heating, power generation, building materials manufacturing, and of course, it can also be used as raw coal for modern coal chemical industry. For a long time, coal has always occupied the main position of China's energy, which is related to the effect of ensuring supply and price stability. Under the influence of supply and demand, transportation capacity, policy and other factors, the supply and demand relationship and price of thermal coal economy have obvious adjustments. The reasonable intervention of the relevant departments makes the price basically stable in the appropriate range.

In the face of changes in macroeconomics, global energy tensions, and climate and international situations, domestic energy supply and demand have entered a stage of tight balance. As the world's largest coal producer and consumer, China's timely and accurate statistics, analysis and prediction of coal price fluctuation trend plays an important role in national economic and

social development. Power coal, as a type of coal for energy supply, occupies an important position.

Since January 2022, the price of thermal coal has fluctuated frequently and greatly, which has increased the uncertainty of the operation of coal-related upstream and downstream enterprises. In order to ensure the stable development of China's future coal market, this paper provides effective auxiliary information for the decision-making of the government and related enterprises.

2. Model Establishment

In this paper, the grey correlation analysis is used to evaluate the influence of various factors on the price of thermal coal. The grey correlation analysis is to analyze the correlation degree between the factors of the system by comparing the similarity degree of the geometric relationship of the data sequence and the geometric shape of the curve.

First of all, this paper first determines the subsequence and the mother sequence.

In this paper, the monthly cumulative value of China's thermal power generation, monthly carbon dioxide emissions, monthly average of crude oil prices, monthly import and export volume of coal, consumer price index, China's coastal freight index, Bohai Rim thermal coal price index, and monthly average output of coal mining face of enterprises are put into the comparison sequence (i.e., subsequence). The formula is :

$$\begin{bmatrix} X'_1 & X'_2 & \cdots & X'_n \end{bmatrix} = \begin{bmatrix} x'_1(1) & x'_2(1) & \cdots & x'_n(1) \\ x'_1(2) & x'_2(2) & \cdots & x'_n(2) \\ \vdots & \vdots & & \vdots \\ x'_1(m) & x'_2(m) & \cdots & x'_n(m) \end{bmatrix} \quad (1)$$

Secondly, this paper puts China's new energy vehicle production into the parent sequence (i.e.evaluation criteria), and the formula is :

$$X'_0 = (x'_0(1), x'_0(2), \cdots, x'_0(m))^T \quad (2)$$

In order to eliminate the influence of the difference between the units of each index and the difference between the numerical orders of magnitude, and to avoid the difficulty of comparison or the unreasonable comparison results, it is necessary to standardize the indicators. Since this data set is stable and increasing data, the initial value processing is selected, and the formula is :

$$x_i(k) = \frac{x_i(k)}{x_i(1)}, i = 1, 2, \cdots, m, k = 1, 2, \cdots, n \quad (3)$$

(m is the number of factors, n is the data dimension of each factor)

The correlation coefficient between each comparison sequence and the corresponding element of the reference sequence is calculated by the following formula :

$$\gamma(x_0(k), x_i(k)) = \frac{\Delta \min + \rho \Delta \max}{\Delta_{ik} + \rho \Delta \max}$$

$$\Delta \min = \min_i \min_k |x_0(k) - x_i(k)|$$

$$\Delta \max = \max_i \max_k |x_0(k) - x_i(k)|$$

$$\Delta_{ik} = |x_0(k) - x_i(k)|$$
(4)

ρ is the resolution coefficient, which is valued within (0, 1). The smaller the resolution coefficient is, the greater the difference between the correlation coefficients is, and the stronger the discrimination ability is. This paper takes 0.5.

The weighted average of the correlation coefficients between each index and the corresponding elements of the reference sequence is calculated respectively to reflect the correlation between each control device object and the reference sequence, which is called the correlation degree and recorded as:

$$r_{0i} = \frac{1}{m} \sum_{k=1}^m W_k \zeta_i(k)$$
(5)

Among them, W_k is the weight of the index.

The following figure is the correlation coefficient diagram of each index to the price of thermal coal :

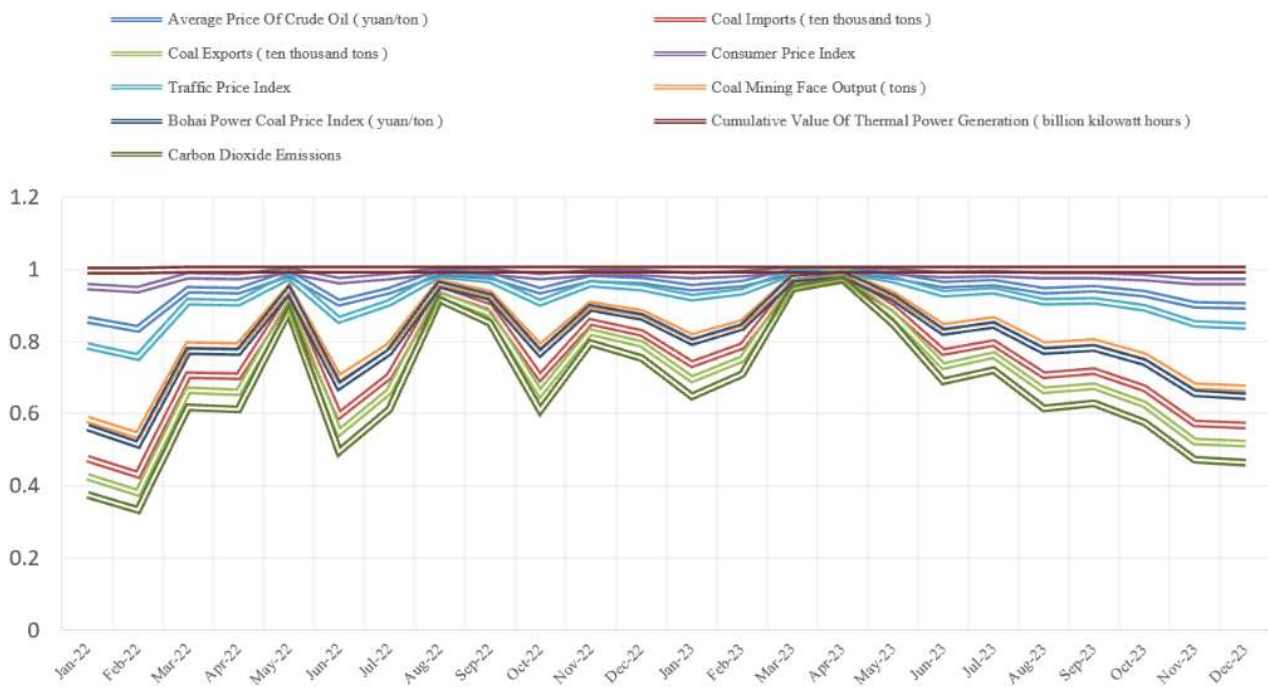


Fig.1 The correlation coefficient of each index to the price of thermal coal

The following is the ranking of the correlation degree results of each index to the price of thermal coal :

Table 1. The correlation results of each index to the price of thermal coal

Name of indicator	Correlation results	rank
cumulative value of thermal power generation (billion-kilowatt hours)	0.999 1	1
consumer price index	0.982 2	2
average price of crude oil (yuan/ton)	0.946 3	3
traffic price index	0.916 4	4
coal mining face output (tons)	0.815 5	5
Bohai power coal price index (yuan/ton)	0.801 6	6
Coal imports (ten thousand tons)	0.747 7	7
Coal exports (ten thousand tons)	0.712 8	8
carbon dioxide emissions	0.673	9

As shown in the chart, the three indicators with the highest correlation are the cumulative value of thermal power generation, the consumer price index, and the average price of crude oil. Based on this, this article can be learned that China's coal prices will fluctuate accordingly from January 1, 2022 to December 30, 2023, as China's demand for electricity increases, the consumption capacity of residents rises, and is affected by fluctuations in the international energy market.

3. Evaluation and Improvement of Mode

3.1. Evaluation and Promotion of the Model

3.1.1. Grey Relational Analysis

Advantages: the idea of grey correlation analysis is clear, the data requirements are low, and the workload is small.

Disadvantages: the subjectivity of grey correlation analysis is too strong, and the optimal value is difficult to determine.

3.2. Improvement and Extension of Model

3.2.1. The Promotion of the Model

In this paper, through the analysis of the price of thermal coal, the main factors affecting the price of thermal coal can be extended to the whole country, so as to assist the government and relevant enterprise decision-makers to refer to, so as to stabilize China's coal energy market, deal with the changes in the structure and importance of the factors affecting the price of coal caused by various situations (such as emergencies) in the future, and promote the development of China's coal market according to the importance of its influencing factors.

3.2.2. Improvement of the Model

(1) There are many factors that affect the price of coal, in the model, we only use the limited information that can be collected, we consider the market economy factors, international political factors, environmental factors, coal storage and transportation factors, while ignoring some factors, and these factors do have a great impact on the price of coal :

1) Major accidents (such as the epidemic, policy reform), these accidents indirectly affect the changes in coal prices.

2) New energy. Due to the continuous improvement and replacement of science and technology, the proportion of new energy in human energy is getting heavier and heavier. This energy competition will also affect the price change of coal.

3) Resource factors, coal, as a non-renewable energy, is slowly running out, and the scarcity is expensive, so the resource content of coal also affects the price of coal.

This paper can collect more data, take more indicators to establish a more complete and complex model and predict future development more accurately.

(2) Although the various models used in this paper have a high degree of fitting and can obtain more reasonable results, the model is relatively simple to use, and the analysis of realistic complex factors is not comprehensive enough. There may be a certain lag, which will deviate the analysis results.

4. Conclusion

This paper concludes that the impact of coal prices is mainly affected by the national macro-control economic regulation, consumer price index, coal price index. According to the linear equation formula, the coal price is proportional to the variable, and there is an upward trend in the next period of time. Because with the improvement of the epidemic, the world economy is gradually on the right track, and the demand for coal, natural gas and crude oil is increasing, which further leads to the increase of carbon dioxide emissions and the intensification of the greenhouse effect. In response to the national " carbon neutrality, " " carbon peak " and " green sustainable development " concept[6], the following recommendations are made :

First, strengthen national macroeconomic regulation and control, reduce the impact of fluctuations in market economic factors on the price of the coal market, improve the stability of coal enterprises, further increase the world trade of coal, under the premise of constant domestic supply, increase coal exports, control coal imports to stabilize domestic coal prices. For a long time, considering that coal is a non-renewable energy source, the current situation of the world 's large-scale use of coal will have a negative impact on future coal mining. It further reduces the future supply of global coal. When there is a shortage of supply, coal prices will fall into the trap of growth. Therefore, the state should vigorously support enterprises in the research and development of new energy and mixed energy use, in order to deal with the shortage of non-renewable energy supply[7].

Establish and improve the coal cost price index, determine the factors affecting the cost price of coal, and conduct specific analysis of the influencing factors, such as gray correlation and regression analysis, and obtain the main influencing factors. The state and related enterprises adopt data results to control and predict coal costs, provide conditions for the prediction of coal prices, timely and truly reflect the production and supply of coal resources, and provide a basis for the country's economic macro-adjustment.

Third, vigorously promote the development of new energy and renewable energy, increase R&D and investment in high-tech, and reduce the dependence on non-renewable resources, such as coal and natural gas. Under the background of generally high prices of new energy, enterprises should further improve new energy detection and mining technology, further reduce energy prices by controlling mining costs and transportation costs, and provide technical support for the widespread use of new energy. At the same time, the state has issued relevant policies to promote the development of new energy to provide protection and support for the development of enterprises.

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