Exploration of Opening Futures Market in the Development of Wind Power Market

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Abstract: Vigorously developing wind power market is propitious to drive the development of Chinese green electric power market. This paper addresses the problem of volatility of price and revenue caused by the instability of wind and focuses on solving it from the perspective of market. The primary project of this paper is to explore the feasibility of opening the wind power futures market. The case analysis method and the data analysis method are applied by analyzing the samples of electricity futures market abroad and domestic thermal coal futures market. It is found that opening wind power futures market can have a positive effect on developing wind power market and even Chinese green power market. Hedging principle can play an active role as China has the condition and ability to establish a new commodity futures market of electricity suitable for Chinese characteristics. The wind power market has enough generation capacity to supply the material object of futures trade. It has enormous potential according to much emerging policy. The study suggests that China can open wind power futures market as a way of solving the above-mentioned problem and also a pilot of exploring and developing electricity futures.

1. Introduction

In 2019, China's wind power Grid-connected capacity has increased by 25.74 million kilowatts, with a total grid-connected capacity of 210 million kilowatts. The annual net electricity consumption is 405.7 billion kWh, and the annual wind power utilization hour is 2082 hours [1]. China's wind power industry has gradually grown into a global leader in wind power in the past decade. However, when the policy support of quota subsidy and the average grid price of the local main power supply are neglected, the volatility and instability of the wind power output will inevitably lead to the instability of the instantaneous electricity price and uncertainty of the income of the wind power suppliers so that it hinders the initiative of developing wind power on the generation side in some way. For wind power enterprises, it is also necessary to take certain measures to hedge risks. In 1995, the world's first electricity futures contract was launched by Nord Pool. After more than 20 years of development, the global electricity derivatives trading scale has reached more than 80 million lots, gradually forming electricity futures markets represented by the New York Mercantile Exchange (NYMEX), the Intercontinental Exchange (ICE) and the Nasdaq Futures (NFX), which play an important role in ensuring the stability of electricity production and prices in North America and Europe.

China's electricity market is not yet possible to establish an electricity futures market, but according to the Opinions on Implementing the Construction of Electric Power Market promulgated by the National Development and Reform Commission and the State Energy Administration on November 30, 2015, it has been made clear that the electricity market should "when conditions are ripe, explore the development of capacity markets, electricity futures and derivatives transactions [2]." At present, the research on electric power futures market is still in its infancy, so studying the relevant laws and problems of electric power futures market and accumulating necessary experience will certainly play a positive role in the establishment and development of China's electric power futures market in the future.

The paper, firstly, analyzes the impact and role of the power futures market on the development of green power market, and secondly, demonstrates whether China can cultivate the conditions for opening the power futures market. We collected cases and much market data to draw our point of view.

2. Methods

Case Analysis Method

Development of American Electricity Futures Market

In the United States, electricity is a regional commodity. Long-distance transmission is not economical and effective, and the types of power plants are closely related to local resources. Most of the thermal power plants are located in the east, while the power plants in the northwest of the Pacific utilize water resources. In the process of electricity market reform since 1970s, the spot market of electricity was first formed, but the spot market also has the risk of violent fluctuation of electricity price during peak period, so the electricity futures were gradually introduced into the electricity market. After years of continuous development, the early developed countries in the world have launched relatively perfect electric power futures market and corresponding electric power futures contracts. From 1996 to 2000, as the first country in the world to launch power futures, the United States and other countries launched power futures and options contracts. From the successful operation experience of three power markets in the eastern United States, combining spot trading with futures contract trading has become an important means to deal with power price fluctuations. The transaction of these power futures contracts and the related options contracts are developing very rapidly, and the volume continues to grow. The price discovery and hedging functions of power futures and power options provide a better risk management tool for the U.S. electricity market, and reduce the operational risk caused by the high volatility of spot market electricity prices [3].

According to the development of electric power futures in the United States, there are many kinds of electric power futures in the United States, with different contract sizes and delivery locations, which is also the direct reason for the classification of electric power futures contracts. In the United States, electric power futures contracts are not universal standards. Because the actual power generation situation in various places is different, including wind power generation, hydropower generation and thermal power generation, the power production is different, so the standards of electric power futures contracts are also different. Different electric power futures contracts are designed in different regions and delivered in different places.

Example of China's commodity futures market at the present stage (thermal coal futures)

The trading volume and positions of power coal futures have taken shape, and they basically have the liquidity to meet the hedging needs of real enterprises. In September 2013, the thermal coal futures were listed on the Zhengzhou Commodity Exchange. After more than six years of operation, it has been recognized by the vast number of coal production, trade and consumption enterprises. In June of 2020, thermal coal futures successfully completed delivery of 1.6 million tons, once again setting a new record for single contract delivery volume of domestic commodity futures. There are two peaks of coal consumption in summer and winter in China, resulting in a significant fluctuation of coal prices in a year with seasonal characteristics. Coal and power enterprises can use the high and low price intervals of each year to carry out coal futures and spot hedging purchasing activities. For example, in the two seasonal low-price areas of spring and autumn each year, using the leverage principle of futures market, the spot purchasing volume is scheduled for half a year or the whole year with a 6% margin, so as to improve the risk of large fluctuations in coal market prices for power generation enterprises, and stabilize the operating efficiency of enterprises [4].

The advantages of power coal futures are reflected in many aspects. In addition to price discovery and hedging, futures trading only needs to pay a small amount of margin in advance to carry out bulk futures contract trading, avoid large amount of capital occupation and coal inventory, and speed up capital turnover. Furthermore, the development of coal futures market can fully rely on the huge scale of the spot market, participate in the process of international coal pricing, form

favorable coal prices in the international market, and increase the discourse power of coal pricing. With the steady development of power coal futures market, the number of entities participating in futures market hedging will continue to increase, and the market structure will continue to be optimized [5].

Data Analysis Method

Table 1 and Table 2 are based on the data provided by FIA, and the tables formed by the valuable parts of this study were selected. We selected four commodity futures and added the trading volume of futures and options respectively to obtain the total trading volume, and used this data to get table 1. We also got the data of all kinds of energy futures in 2016 and 2017 through similar methods.

Table 1. Global Futures Market Trading Volume (Unit: hundred million lot)

	Precious metals	Agriculture	Non-precious metals	Energy
2016	3.12	19.32	18.77	22.14
2017	2.79	13.06	17.40	21.71
2018	2.91	14.88	15.23	22.38

Source: FIA

Table 2. Global Energy Futures Market Trading Volume (Unit: hundred million lot)

	Crude oil	Refined oil	Natural gas	Electric power	Coal	Others	Total
2016	12.48	1.21	2.26	0.86	1.47	3.87	22.14
2017	13.15	1.11	1.82	0.74	1.15	3.74	21.71

Source: FIA

Table 3. Electricity Consumption in Global Countries (Unit: billion kWh)

	China	U.S.	EU	Australia	Others	World
2017	6604.4	4302.5	3290.0	259.1	11187.0	25643.0
2018	7166.1	4457.4	3270.1	263.1	11496.0	26652.7
2019	7503.4	4401.3	3215.3	265.1	11619.6	27004.7

Source: BP Statistical Review

Table 4. Installation and Power Generation in China Wind Power Market

	Generating capacity(billion kWh)	Installed gross capacity(MW)
2017	305.7	16367
2018	366.0	18426
2019	405.7	21005

Source: Polaris power grid

According to BP Statistical Review of World Energy 2020, the global national electricity consumption table shown in Table 3 was obtained. In order to accurately describe the volume of China's wind power market, we selected the data of wind power generation capacity and installation capacity in the past three years from the quarterly and annual power industry reports published by China Electricity Council, National Development and Reform Commission and related power statistics websites and drew the Table 4.

3. Results & Discussion

In general, the viewpoints are concluded in four respects. In futures function itself, hedging principle can play an active role. Wind power futures and other green power financial derivatives are an effective risk aversion means. In Chinese adaption, China has the condition and ability to establish a new commodity futures market of electricity suitable for Chinese characteristics. With the passage of time, China's energy futures are bound to gradually mature, become an effective tool for related enterprises to hedge risks, and promote the development of China's energy market sustainably. In trading volume, the wind power market has enough generation capacity, which will be the material object of futures trade. In developing foreground, opening wind power futures market has enormous potential in China.

It is not difficult to see from the case of the development of the US electricity futures market that China's green electricity market is also facing similar problems. In many countries in the world represented by the United States, the emergence of the electricity futures market makes these problems solved. Therefore, we can infer that the establishment of the electricity futures market in China will probably play a positive role.

The example of thermal coal futures shows that thermal power enterprises have a precedent of using futures tools to help the power industry develop continuously and steadily. As a raw material of thermal power generation, coal price fluctuation is the risk faced by power enterprises, while thermal coal futures increase the means of avoiding the risk of coal price fluctuation for power enterprises. Thermal coal and power futures both belong to energy commodity futures and have a linkage relationship, and their market system and contract formulation have similarities in some way. The successful case of thermal coal futures trading in China shows that China has the experience of establishing a complete energy commodity futures market system related to electricity market at the present stage. Under the current socialist market system with Chinese characteristics, the futures market can still play its role in improving the market system.

Table 1 and Table 2 shows that the energy futures market is developing vigorously and the electricity power futures has great potential, as it has not shown its huge market. The development of China's electricity futures market is an opportunity for the country to consolidate its position in the energy field. Table 3 shows the huge market volume in China’s electricity market. Table 4 shows that the spot electricity market in China, especially wind power, has a large volume of spot transactions, and the spot market is perfect. It can establish a full competition mechanism, which has the basic characteristics of establishing a futures and spot electricity futures market. Futures market is the inevitable product of the development of market economy to a certain stage. The function of futures market is based on the broad participation of commodity supply and demand. Only commodities with large spot supply and demand can compete fully in a wide range and form authoritative prices. Through comprehensive analysis of Table 3 and Table 4, Australia has established a power futures market, and its total electricity generation in 2016 and 2017 averaged 259.4 billion kWh, while China's wind power generation reached 242 billion kWh in 2016 and 305.7 billion kWh in 2017. In terms of the actual wind power generation, China has enough volume.

Conclusion

By analyzing the experience of foreign electricity futures markets and the successful examples of the establishment of China's crude oil futures market, this paper collects and collates the relevant data of the global electricity futures market and wind power market, demonstrates the feasibility of accelerating the development of the green electricity market represented by wind power market by establishing the electricity futures market, and proposes that China can take the green electricity market as a pioneer to explore the development of electricity futures market and its derivatives.

The electric power futures market is a successful advanced market form proved by the practice of developed countries. It is an indispensable and important part of the electric power market system and plays an increasingly important role in the operation of the electric power market in the

world. Starting from the wind power market and taking solving the problems faced by wind power development as the entrance, the research and development of power futures market is an alternative way to further deepen the reform of China's power market.

The new point of this paper is a supplement to the research on the development of green electricity market in China from the perspective of financial market, and it will provide reference for China's reform in green power market and power financial market. However, the research itself has its limitations. Some studies have proposed that the effect of electricity futures on price discovery function is not obvious, so the market price cannot rely on the guidance of futures on spot price. The linkage of electricity price in different links and the mechanism of electricity price need to be improved continuously. Since the research on the electric power futures market in China is still in its infancy, and there is no theoretical system of electric power futures contracts suitable for the actual situation of our country in academic circles, it is only a speculation that what will happen once the electric power futures market is formed in this paper. Because of the insufficient research conditions, the cases and data used in this paper are collected, not first-hand actual statistics. It is hoped that the following researchers can increase more empirical research in this field.

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