The Spillover Effect of China's Carbon Trading Market

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Abstract: This article starts with the subjects of carbon trading and promotes the analysis of the status carbon trading development. At the same time, we compare the eight pilot markets from various angles, and analyze the background of the establishment of the national market. The study of spillover effects in carbon trading markets mainly uses various models related to the mean-value spillover effect to test the mutual influence of price fluctuations in different markets. Understand the joint volatility of the national carbon market in order to provide basic data for the establishment of a national carbon market. This study finds that although price transmission and risk transmission among the regional carbon markets in the country are not related to each other, the mutual influence between the pilot sites has gradually begun to emerge. With the integration of the national carbon trading market, the impact will become more and more significant.

1. Introduction

The buildup of greenhouse gases is putting the planet into a state of overload. As a historical and cultural power, China has actively shouldering the responsibility of carbon emission reduction. First, in 2011, China set up pilot projects to conduct carbon trading in nine major economic regions. Sichuan carbon trading pilot is under construction, has not yet been traded. This paper mainly studies the spillover effect of regional carbon pilot projects by understanding the current situation of carbon financial trading at home and abroad. That is, the impact of a market change on the price of pilot carbon emission rights after the change of relevant information causes the other price change. How will the national market change under the initial network of carbon pilot crossings? What are the leading carbon pilot areas in this process ?With the help of relevant information, investors can balance relevant risks and benefits to choose the right asset portfolio, the government can improve risks, the administrative management mechanism of early warning, and the carbon market can operate more smoothly and efficiently.

2. Literature Review

2.1 Carbon Emission trading

Carbon emissions trading is a market mechanism created by countries aiming to reduce global greenhouse gas emissions. There has been previous research on the initial motivation for carbon emission rights to be traded. Based on the analysis of a single enterprise, on the premise of the existence of transaction costs, the optimal emissions of an enterprise are the corresponding carbon emissions when the marginal cost and marginal benefit are equal, and the marginal cost is related to the carbon emission rights [1]. In terms of the construction of carbon trading market mechanism, Lu and Cang (2018) constructed a dynamic game model, taking the government and enterprises as the main body, to get the probability that the initial quota would affect the illegal emission of enterprises, and the excessively low price would reduce the trading enthusiasm and the motivation of illegal emission [2]. Looking at the impact of various international markets, Yu and Mallory (2014) found that the depreciation (appreciation) of European currencies could lead to lower carbon prices through energy alternatives. The fluctuation of exchange rate indirectly affects the fluctuation of carbon trading through the energy market. Currency depreciation will lead to the rise of coal prices and the

decline of carbon credit prices [3]. Regarding China's carbon financial trading market, Jing (2018) also pointed that China's carbon trading has shortcomings such as imperfect management system construction, distortion of carbon price fluctuations, and "emphasis on reporting and light on verification" of carbon emission data [4].

2.2 Spillover effects

Spillover effect is the influence of different subjects on each other. Numerous investors with information use financial instruments to conduct investment operations, which leads to the impact of mutual transmission of earnings fluctuations between markets. Literature on spillover effects. Byun and Cho (2013) used GARCH model to study the relationship between carbon futures price and Brent crude oil futures price, British natural gas, European coal futures and European electricity [5]. By using the spillover effect, Reboredo (2014) studied the financial uncertainty with oil prices as the material [6].

3. The development of China's carbon trading market

China's carbon market was created in June 2013. The six major carbon trials involving six economic regions across the country mark a solid start for China's carbon market, all of which began formal trading in 2014. As a rising star, the pilot project in Fujian started trading in the Haixia equity trading center in 2016, while the pilot project in Sichuan is still under construction and has not yet started quota trading. This part mainly collects the information of each carbon pilot and makes a comparative analysis.

The pilot project in Shenzhen was established in June 2013, and the trading restrictions mainly include project types (various power generation projects in renewable energy and new energy projects, clean transportation emission reduction projects, Marine carbon sequestration projects, forestry carbon sink projects, and agricultural emission reduction projects) and project areas. Shanghai pilot has the largest carbon trading volume in China, mainly engaged in energy conservation and emission reduction, environmental protection and energy improvement technology property rights and comprehensive trading. Beijing is the first pilot to break regional restrictions, with the most abundant trading varieties. The Guangdong trial was the first to exceed 1 billion yuan. The Tianjin pilot project is also a regional pilot for low-carbon provinces, cities and greenhouse gas emission inventories. In the year when the pilot project was launched, Hubei province took the first place in all major market indicators and had comprehensive and advanced carbon finance innovation. Chongqing pilot is state-owned property trading platform. The pilot project in Fujian is the first to be included in the ceramic industry and established in accordance with the national accounting standards, which has played a benchmarking role in the whole country.

4. Spillover effect analysis

4.1 Data selection and processing

The sample data are mainly from the data listed on the carbon market channel of China carbon trading network (http://m.tanpaifang.com), mainly including the daily carbon trading data of the six trading markets from the date of their establishment to April 23, 2018. In order to make the data more stable, overcome the heteroscedasticity of the data itself and improve the symmetry of the data without changing the correlation between the data, the original data, namely the carbon trading day closing price of each carbon pilot, is processed by the following formula:

$$R_t = 100 * \ln(P_t / P_{t-1})$$

4.2 Mean spillover effect

Stationarity test. Among all kinds of transactions in the financial market, the mean spillover effect refers to the interaction of prices and represents the correlation of the first moment of prices. This

paper firstly conducts ADF test on the carbon price data of six pilots (Beijing, Shanghai, Guangdong, Shenzhen, Tianjin and Hubei), and mainly tests the stability of the carbon quota rate of return series of the six pilots. The test results of ADF prove that the statistical value of ADF test for the carbon quota yield sequence of these six carbon pilots is all less than the critical value at the significance level of 1%, 5% and 10%, which is not a unit root process and stable enough to establish the VAR model.

Granger causality test. According to empirical test data, at the significance level of 5%, the carbon quota return rate in Beijing is the Granger cause of the carbon quota return rate in Guangdong; the carbon quota return rate in Guangdong is the Granger cause of the carbon quota return rate in Beijing; the carbon quota return rate in Shenzhen is the Grangerr cause of the carbon quota return rate in Beijing. At the significance level of 10%, the return rate of carbon quota in Beijing is the Granger cause of the return rate of carbon quota in Shenzhen, and the return rate of carbon quota in Tianjin is the Granger cause of the return rate of carbon quota in Guangdong. The rest accept the null hypothesis, that is, there is no Granger causality between them. It can be represented by a tree graph.

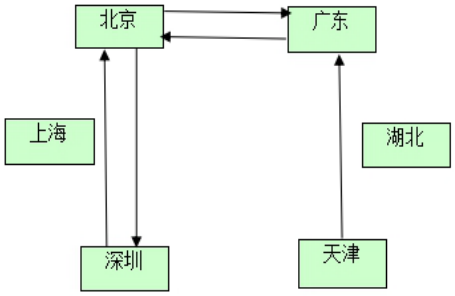

Figure 1. Fruit-like structure of Granger in pilot exchange

VAR model validation. In this empirical analysis, vector autoregression model is used to establish the mean value equation. The mean value equation in this paper adopts the 6-element VAR model. The 6-element VAR (n) equation is as follows:

$$BJ_t = \omega_1 + \sum_{i=1}^{n} a_{1i} BJ_{t-i} + \sum_{i=1}^{n} b_{1i} GD_{t-i} + \sum_{i=1}^{n} c_{1i} SH_{t-i} + \sum_{i=1}^{n} d_{1i} HB_{t-i} + \sum_{i=1}^{n} e_{1i} SZ_{t-i} + \sum_{i=1}^{n} f_{1i} TJ_{t-i} + \varepsilon_{1t}$$

n is the optimal lag order, which represents the lagging I period of the carbon quota yield rate sequence in Beijing. Similarly, the significance of other carbon pilot data can be obtained. Omega is a constant and omega is a residual sequence. Determining the lag period is a necessary step before constructing the VAR model, and the empirical test determines that the optimal lag period is 2. VAR (2) model was established in the whole sample period. AR root test is introduced into the stationarity test in this paper, which falls into the unit circle. The above model is very stable.

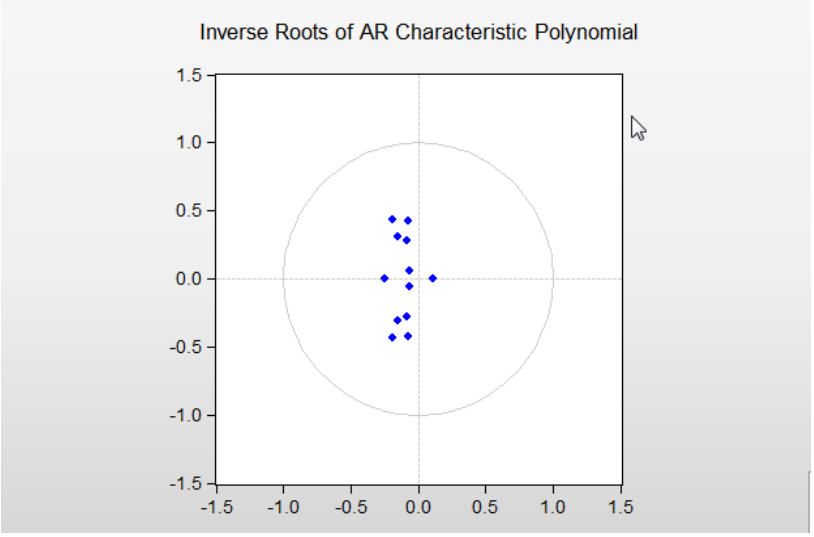

Figure 2. AR Root figure

Impulse response analysis. At any stage, the six carbon exchanges had the strongest impact on themselves. The response of each carbon quota yield rate to the impact of other exchanges' carbon quota yield rate is general. The six impulse response graphs show that the response period is about seven. Other markets respond to fluctuations in the trading data of each carbon market in terms of prices. There is still a certain degree of correlation and influence between the carbon pilots.

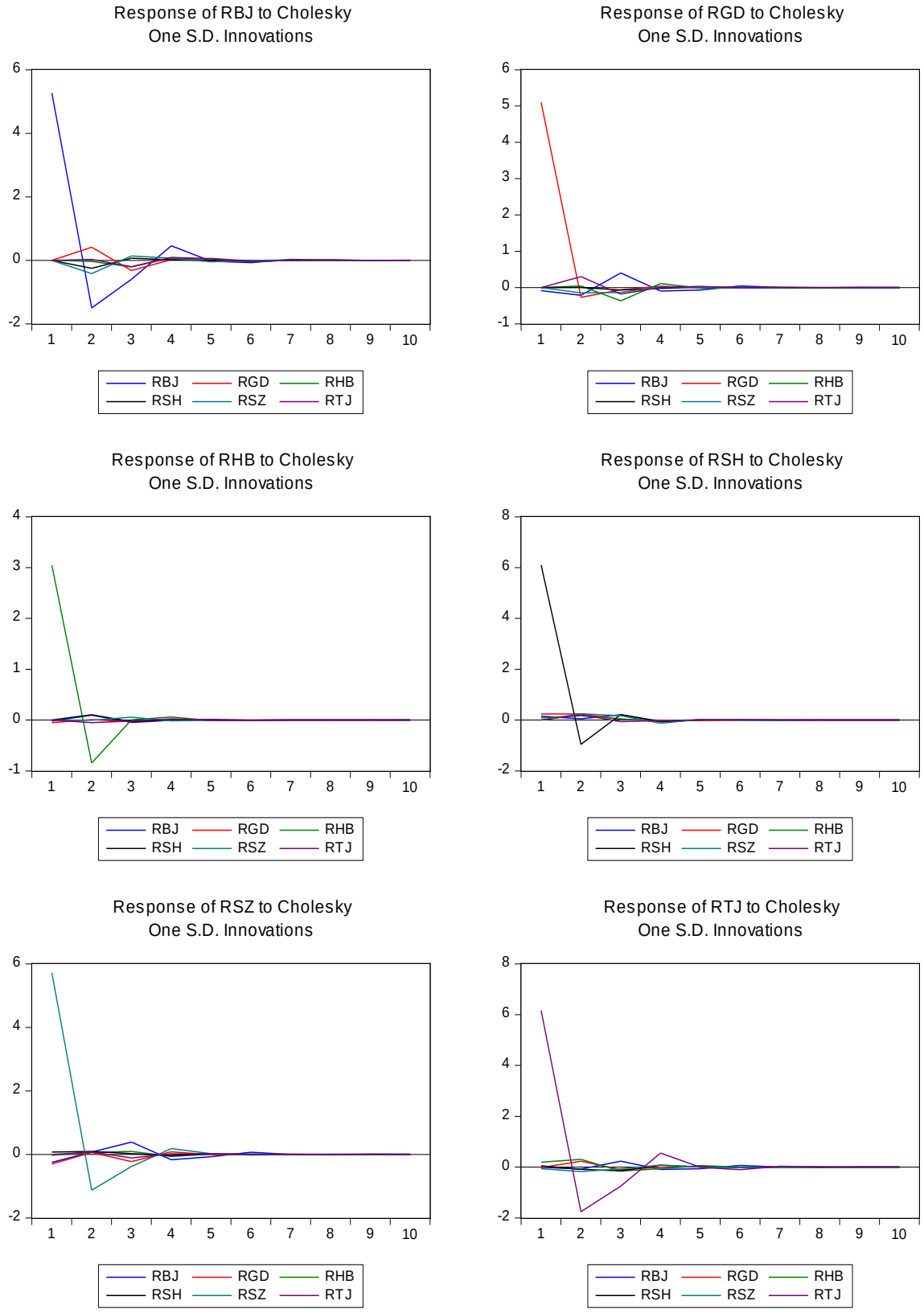

Figure 3. Impulse Response diagram

Analysis of variance, further detailed data analysis. Variance decomposition is a method to analyze the impact contribution of one variable to another variable in each stage, which is expressed as a percentage. The test found that each carbon market had the largest contribution to its own impact, which was almost 100%, and maintained at a certain level after gradually decreasing from the first phase. In addition, the contribution of each carbon market to the impact of other carbon markets was generally not large compared with itself.

According to the results of impulse response graph and variance decomposition, the one-way mean spillover effect of Hubei carbon market on Shenzhen carbon market and Shenzhen carbon market on Hubei carbon market is not obvious, so this paper believes that there is no significant one-way or two-way mean spillover effect between each carbon market in each stage. According to the results of impulse response graph and variance decomposition, Hubei, Shanghai and Tianjin have the greatest impact on themselves, all above 99%, and are not significantly affected by the mean spillover effect of other carbon markets. The first phase of Beijing only by its own influence, in the subsequent phases of Guangdong, Shenzhen gradually have a certain impact, although far less than their own, but has a certain small proportion. Beijing, Tianjin and Hubei also have a small proportion in the variance decomposition percentage of Guangdong. Beijing occupies a small proportion in variance decomposition analysis in Shenzhen.

4.3 Result analysis of empirical test

On the whole, the one-way mean spillover effect between each carbon market is not very obvious, and each carbon market is greatly influenced by itself. Within the sixth period, each variable contributed more than 97% to its own structural impact, and the fluctuation of its own rate of return was greatly affected by the previous fluctuation of its own variable. At the same time, the average spillover effect between the pilot carbon quota trading is gradually beginning to show. According to the analysis and research of the spillover effects between each test markets, national regions between the price of the carbon market risk conduction and conduction though mutual influence between also is not very big, but the mutual influence between pilot has begun to gradually appear, with the integration of the national carbon trading market, the impact will become more and more significant.

According to the above researches and empirical analysis, although the carbon market trading in China has developed rapidly, it still belongs to the market segmentation to a large extent. At the same time, according to the market segmentation theory, when the financial market is in a state of segmentation, there is no interaction between prices. The average spillover effect between provinces and cities is not obvious, but there is a certain degree of spillover effect.

5. Conclusion

This paper firstly studies the basic information of the eight existing exchanges in China. The transaction data of six pilots are analyzed empirically. Collect and integrate literature on carbon trading, carbon markets, and spillovers. This paper makes a detailed comparative analysis of various projects in eight pilot carbon markets in China. The empirical part mainly tests the mean spillover effect in six pilot areas except Fujian, Chongqing and Sichuan. On the whole, the one-way mean spillover effect between each carbon market is not very obvious, and each carbon market is mainly affected by itself, but the mean spillover effect between each pilot carbon quota trade has gradually emerged. According to the test results of spillover effect, although the price transmission and risk transmission between the carbon pilots in various provinces and cities have not had a great influence on each other, the interaction between the pilots has begun to show. With the integration of the national carbon trading market, this influence will become more and more significant. China's carbon trading will enter a higher development platform.

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