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Study on the Fluctuation Spillover Effect between China's Carbon Market and New Energy Market

Jiulong Peng, Xinyi Wu, Lalai Zi, and Weixia Zuo*

Anhui University of Finance and Economics, Bengbu, China

Abstract

This project analyzes the volatility spillover effect of China's carbon market and new energy market, which is crucial to effectively prevent Systematic risk, promote low-carbon transformation of the energy market and ensure stable economic growth. Firstly, based on the spillover index model, we examine the dynamic interdependence between China's carbon market and the new energy market; Secondly, in order to capture market asymmetry, this project decomposes the total volatility into good volatility and bad volatility based on the GJR-GARCH model, and further explores the asymmetric spillover effects between these two types of markets. Finally, the marginal net spillover index (MNS) method is used to explore the main sources and paths of risk transmission in China's carbon market and new energy market under the impact of major events such as the China–United States trade war, the COVID-19 and the Russia-Ukraine conflict. Therefore, this project has important practical significance in promoting the establishment of a national carbon market, low-carbon transformation of the energy system, and improving macro risk prevention measures.

Keywords

Trade; Transformation; Russia-Ukraine.

1. Introduction

The international community has made unremitting efforts to meet the energy and climate challenges and achieve the 2 ℃ temperature control target set out in the Paris Agreement. China, as the country with the highest carbon emissions, proposed the "30.60" dual carbon target in 2020, and the "coordinated promotion of carbon reduction, pollution reduction, green expansion, growth, ecological priority, conservation and intensification, green and low-carbon development" proposed in the report of the 20th National Congress of the Communist Party of China in 2022, which play an important role in promoting the optimization and upgrading of the carbon market, the structural transformation of the energy system, and the reduction of greenhouse gas emissions. In theory, policy makers make "carbon emissions" a limited right to use environmental resources through carbon Emissions trading. Enterprises can trade freely according to their own demand for carbon emissions quotas, and achieve the optimal equilibrium price of carbon emissions through the market mechanism, so as to reduce the emission of low-temperature chamber air. While promoting carbon emission trading mechanisms, the government has also provided new financing channels for new energy enterprises, promoting the development of the new energy industry and driving the low-carbon transformation of the entire society. Therefore, the improvement of carbon gold melting has enhanced the spillover effect between carbon markets, which means that there will be higher Systematic risk between markets. Therefore, exploring the dynamic correlation of the market system (China's carbon market and new energy market) with carbon market trading as the core will help promote the establishment of the national carbon market, the transformation of the energy system and prevent Systematic risk between markets.

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In the research on the spillover effects of volatility between the carbon market and other markets, some scholars analyze based on the GARCH family model and VAR model. Although models based on the GARCH family and VAR can be used to capture volatility spillover effects between different markets, they ignore the directional and nonlinear characteristics between markets. In addition, some scholars have combined the Copula model with the CoVaR method to reveal the nonlinear risk spillover between China's energy market and carbon market. Although the Copula model can overcome the nonlinear problem that VAR models cannot describe by describing symmetric and asymmetric structures, it cannot determine the direction of market spillover effects. Given this, the DY spillover index model proposed by Diebold and Yilmaz (2012) can not only measure the size of spillover effects between markets, but also determine the direction of volatility spillovers. Furthermore, research has shown that there is an asymmetric effect in general financial assets, where the return and volatility of assets are negatively correlated. Based on this, BenSa ï da (2019) divided the volatility of assets into good volatility and bad volatility based on the GJR-GARCH model, and combined it with the spillover index model to analyze the asymmetric volatility spillover effects between different financial markets. To further explore the changes in volatility spillover effects between different markets under major event shocks, Yang Zihui (2020) proposed a marginal net spillover method (MNS) based on the DY model.

Based on the above analysis, this project first examines the dynamic interdependence between China's carbon market and new energy market using the DY spillover index model; Secondly, in order to capture market asymmetry, this project decomposes volatility into good volatility and bad volatility based on the GJR-GARCH model, and further explores the asymmetric spillover effects between these two types of markets. Finally, using the method of marginal net spillover index (MNS), this paper explores the main sources and paths of risk transmission between China's carbon market and new energy market under the impact of major events such as the China–United States trade war, the COVID-19 and the Russia-Ukraine conflict.

2. Research Meaning

2.1. Realistic Meaning

China's carbon market and new energy market, as important emerging markets and traditional financial markets in China, explore the volatility spillover effects between these two types of markets, reveal their internal mechanisms and laws, which is of great significance for effectively preventing carbon financial risks, promoting the healthy and stable operation of the carbon market, and promoting the achievement of the national "dual carbon" goal. Furthermore, in recent years, major emergencies have erupted in various countries around the world, which not only threaten the social stability of countries around the world, but also bring huge challenges to the development of China's economy and market stability. Therefore, the project further explores the volatility spillover effect of China's carbon market and new energy market under the impact of major events such as the China–United States trade war, the COVID-19 and the Russia-Ukraine conflict, which has important practical significance for the stable development of China's market and economy, avoiding Systematic risk between markets, and promoting low-carbon transformation of the energy industry.

2.2. Theoretical Significance

This project first examines the dynamic interdependence between China's carbon market and new energy market based on the DY spillover index model. On this basis, on the one hand, the total volatility of returns is divided into good volatility and bad volatility to capture market leverage effects, further exploring the asymmetric spillover effects of China's carbon and new energy markets; On the other hand, by calculating the marginal net spillover index (MNS)

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among the markets, it explores the main sources and transmission paths of risks between China's carbon market and the new energy market under the impact of major events such as the China–United States trade war, the COVID-19 and the Russia-Ukraine conflict, which has important theoretical significance for improving the macro response governance mechanism and preventing risk transmission between markets.

3. Research Status and Development Trends at Home and Abroad:

As an important emerging market in China, the frequent fluctuations of Carbon emission trading prices have made China constantly strive to establish and improve its own carbon market. In particular, the in-depth promotion of the "dual carbon" target task in people's economic life and the gradual improvement of the carbon Emissions trading mechanism provide new financing channels for new energy enterprises, promote the development of new energy industry, and then drive the low-carbon transformation of the whole society (Lin Boqiang, 2021). Due to the fact that carbon prices are not only influenced by their own supply and demand mechanisms, but also by various factors such as policies and extreme weather (Wang Bo and Xu Piaoyang, 2022). Therefore, the improvement of carbon gold melting has enhanced the spillover effect between the carbon market and the new energy market, which means that there will be a higher Systematic risk between the markets. Therefore, exploring the dynamic correlation of the financial system (China's carbon market and new energy market) with carbon market transactions as the core will help promote the establishment of the national carbon market, the transformation of the energy system and prevent Systematic risk between markets.

3.1. Research on Dynamic Correlation between Markets

The dynamic correlation between the carbon market and other markets has been one of the important and hot topics in recent years, and the academic community has also conducted extensive and in-depth research on this topic. Among them, domestic and foreign scholars generally focus on analyzing the carbon market and traditional energy market (carbon energy) (Zhao Tianyu, 2022). Scholars have confirmed that the carbon market is closely related to both the natural gas market and the crude oil market (Wang and Guo, 2019; Zou Shaohui and Zhang Tian, 2020). With the increasing proportion of low-carbon energy in the total energy consumption in recent years, the new energy sector has gradually become one of the fastest-growing energy sectors. Nie et al. (2022) and Wang Xiping (2022) found that the new energy market has a significant spillover effect on the carbon market (new energy carbon). However, few scholars in existing research have simultaneously examined the dynamic correlation between China's two important emerging markets (carbon market and new energy market), and the stable development of these two major emerging markets and traditional financial markets is of great significance for further promoting China's stable economic development and low-carbon industrial transformation. In view of this, the purpose of this project is to study the volatility spillover effect between these three markets, understand the time-varying correlation degree and risk transmission direction between the two emerging markets (carbon market and new energy market), which is crucial for the stable development of China's market and economy, avoiding Systematic risk between markets and promoting low-carbon transformation of the energy industry.

3.2. Research on Asymmetric Spillover Effects between Markets

In fact, there is a common asymmetric effect in financial assets, where the return and volatility of assets are negatively correlated. Previous studies have tended to analyze the asymmetry of the stock market (Xu et al., 2019; Tuna et al., 2021; Li, 2021). In recent years, some scholars have found that there are also asymmetric effects in the carbon market (Fan Liwei et al., 2022), but most of them pay more attention to the EU carbon market (Reboredo et al., 2014; Kim et al., 2017; Liu Jian et al., 2020). As for China's carbon market, Wang Qian and Lu Jingjing (2017) found that there are regional differences in the positive and negative impacts of RMB exchange rate fluctuations on carbon prices based on the Markov transformation model, but the impact directions in low and high volatility states are consistent across regions. Zhou et al. (2019) only revealed the existence of asymmetric effects in a single carbon market. On this basis, Jian et al. (2020) used a leverage random volatility model to demonstrate that the carbon price fluctuations in the five pilot markets in China have different leverage effects. Liu Jian et al. (2020) used the SV Copula model to study the multifractal characteristics and market efficiency of carbon market price fluctuations in China and the European Union. The empirical results show that there is significant volatility persistence and leverage effect in these two markets. To further investigate the asymmetric spillover effects between markets, Barun í k et al. (2016) divided volatility into good volatility and bad volatility, and studied the spillover relationship between stocks in seven industries in the United States by combining the realized semi volatility and volatility spillover index. Due to the susceptibility of high-frequency data to micro perturbations, the estimation of volatility may deviate. BenSa ï da (2019) proposed a new method that combines the GJR model and the spillover index model from positive and negative shocks to analyze the asymmetric volatility spillover effects in different financial markets. In view of this, this project divides the volatility of each market into good volatility and bad volatility based on the GJR model, further exploring the asymmetric spillover effect between China's carbon market and new energy market.

$$X_t = \sum_{i=1}^{p} Y_i X_{t-i} + \varepsilon_t$$

$$X_t = \sum_{i=0}^{\infty} A_i \varepsilon_{t-i}$$

Based on the above vector autoregressive model, the improved DY spillover index model (Diebold and Yilmaz, 2012) adopts the KPPS method (generalized variance decomposition) proposed by Koop et al. (1996), Pesaran and Shin (1998) to deal with the impact of the predicted residual term, thereby eliminating the dependence of the results on the lag order of the variables. Compared with Cholesky ANOVA, the results obtained by generalized ANOVA do not depend on the lag order of the variables and do not require error orthogonal processing of the equation. Therefore, the sum of the contributions of the variance of the prediction error obtained by the generalized ANOVA method (that is, the sum of the elements of each column in the ANOVA table) is not necessarily equal to 1. The DY spillover index model is as follows.

$$\theta_{ij}^{g}(H) = \frac{\sigma_{jj}^{-1} \sum_{h=0}^{H-1} \left(e_i^{'} A_h \Omega e_j \right)^2}{\sum_{h=0}^{H-1} \left(e_i^{'} A_h \Omega A_h^{'} e_i \right)}$$

$$X_{i,t} = \left(1 - \alpha - \beta - \frac{\gamma}{2}\right) + \left(\alpha + D\left\{r_{i,t-1} > 0\right\} \cdot \gamma\right)\left(r_{i,t-1} - \mu_i\right)^2 + \beta X_{i,t-1}$$

On this basis, in order to characterize the impact of good shocks and bad shocks on the spillover effect of volatility between markets, this project divides total volatility into good volatility and bad volatility.

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4. Literature Review

Based on the above analysis, scholars have paid more attention to the dynamic correlation research between the carbon market and the energy market, while few scholars have paid attention to the time-varying correlation degree and risk transmission direction between China's two major emerging markets (carbon market and new energy market). In addition, in the study of volatility spillover effects between China's carbon market and other different markets, scholars generally overlook the asymmetry of the market, and accurately capturing the asymmetry of the market is crucial for estimating volatility. Most importantly, the impact of major events on national and even global economies and markets is enormous. It is of great practical significance to explore the impact of such events on volatility spillover effects between different markets for improving macro prevention of Systematic risk. Given this, this project first examines the dynamic interdependence between China's carbon market and new energy market based on the DY spillover index model; Secondly, in order to capture market asymmetry, this project decomposes volatility into good volatility and bad volatility based on the GJR-GARCH model, and further explores the asymmetric spillover effects between these three types of markets. Finally, using the marginal net spillover index (MNS) method, this paper explores the main sources and paths of risk transmission between China's carbon market and new energy market under the impact of major events such as the China–United States trade war, the COVID-19 and the Russia-Ukraine conflict.

The research of this project is mainly based on the DY spillover index model to examine the dynamic correlation between China's carbon market and new energy market. Specifically, to explore the volatility spillover effects of a single market under positive and negative shocks on other markets, the GJR-GARCH model is used to investigate the asymmetric volatility spillover effects between these two types of markets.

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