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Research on the efficiency of carbon trading market in China

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ABSTRACT

In 2014, China proposed medium and long-term low carbon development goals in China-U.S. Joint Statement on Climate Change that the emission of carbon dioxide would reach its peak and the proportion of non-fossil energy accounted for the primary energy consumption would increase to 20% in 2030. In order to achieve these goals, the unified carbon emission trading system should be put into effect by 2017, the implementation of the unified carbon emission trading system depends on the effectiveness of the current carbon trading market in China. On the basis of the effective market theory and fair game model, the unit root test and the run test are developed to analyze the carbon emission market of four representative cities in China. The results show that (1) the carbon trading market in China has only achieved weak efficiency, while the semi strong efficiency and the strong efficiency have not been reached; (2) with the expansion of the market scale, the increase of trading volume, the carbon trading market would converge from the state of inefficiency to weak form efficiency gradually, and the carbon trading market in China shows signs of restoring market efficiency.

1. Introduction

To cope with climate change, the international community formulated and adopted “the United Nations framework convention on climate change” and “the Kyoto protocol” under the framework. In this context, as a major carbon emitter, China is facing an unprecedented pressure to reduce its carbon dioxide emission [1]. In order to ease the pressure of China, emissions trading scheme(ETS)is thought to be an effective measures. It is also considered an important mechanism to address climate change, and an effective measure to reduce global greenhouse gas emissions [2,3].

In June 2012, the national development and reform commission issued “interim measures for voluntary greenhouse gas emissions trading management”, to pursue voluntary emissions trading program in China, which is regarded as, lays a foundation for the further implementation of the mandatory carbon trading mechanism. Subsequently, the carbon emission rights exchanges in Beijing, Shanghai, Tianjin, Guangdong and other provinces were set up in succession, and the compulsory carbon emission rights trading pilot work were started up [4]. In June 2013, the carbon emission exchange in Shenzhen took the lead, and then Shanghai and Beijing also started at the end of November in 2013, which means China's carbon trading market has achieved a key step from theory to practice and come to the substantial operation phase. In the year of 2014, China proposed medium and long-term low carbon development goals in China-U.S. Joint Statement on Climate Change that the emission of carbon dioxide would reach its peak and the proportion of non-fossil energy accounted for the primary energy consumption would increase to 20% in 2030. To make this possible, the unified carbon emission trading system should be put into effect by 2017 [5].

Therefore, it is critical to complete the construction of current carbon market and to accumulate experience in order to guarantee the completion of the national carbon emission market, and fulfilling the goal of China's carbon reduction and energy structure optimization, thus, the study of the efficiency of China's carbon trading market has become an urgent priority. However, Carbon trading system in China is still in the experimental phase, and there are lots of problem existed in the market, such as low market participation, the defective of mechanisms in pricing, supervision, rewards and punishment. Liu Liwei et al. (2014) considered that the prominent problem of China's carbon trading market is market segmentation, low participation and the defective of pricing mechanism, which seriously affect the expansion of market trading volume, price formation and the development of a unified market [6]. Zhou Wenbo et al. (2011) analyzed China's carbon trading market from the perspective of macroeconomic and microeconomic respectively, they believe that the main problems are the unreasonable carbon emission trading price, the defective of government supervision and the initial allocation of emission allowance, etc [7]. Huang Ping et al. (2014) compared the development status of domestic and international carbon trading market and point out that the main problems of China's emerging carbon trading markets are the lack of incentive mechanism, market fragmentation, the defective of

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fairness and a series of systemic problems [8]. In addition to that, due to the immaturity of the market, China's carbon trading market reveal a series of systemic problems, such as inaccuracy of quota allocation, imperfect trading mechanism, lagging legislation, etc [9,10]. China should build a mature carbon trading market as soon as possible.

To solve these problems, scholars in China studied on the efficiency of China's carbon trading market, which mainly divided into two stages: CERs OTC and the pilot carbon trade. In the research on early CERs etc., Wang Can et al. (2005) used the global carbon emissions trading partial equilibrium model to analyze the market potential of China's CDM [11]. Hong Juan et al. (2010) described the long-run equilibrium relationship of CERs spot and CERs futures and the correlation between CERs and EUAs through the ADF test, cointegration analysis, granger causality test and impulse response function [12]. In the research on carbon trading market, Wang Qian (2014) used a series of variance ratio tests and the ADF tests to investigate whether the China's carbon trading market is efficient based on the data from the pilot trading market and the results shows that part of the pilot trading market achieved the weak efficiency [13]. Tang Ling et al. (2015) developed a multi-agent model to investigate the impact of different CET design, with a view of finding the most suitable CET design for China [14]. Zhao Xingang et al.(2016)analyzed the market efficiency of China's carbon trading market from price, trading volume, market liquidity,and information transparency, they found that the market efficiency is not satisfactory [15].

The researches on the efficiency of the European carbon trading market mainly focus on the volatility and the predictability of the carbon price. Chesney and Taschini (2008) point out that discounting the price of carbon options is the martingale process about the correlation filtering [16]. Richard Starkey (2012) made a critical survey on personal carbon trading to discuss the efficiency and effectiveness of carbon market [17]. Daskalakis et al. (2009) point out that the EU ETS spot prices show a jump and non-stationary behavior [18]. Paolella and Taschini (2008) believe that carbon prices cannot be predicted by model [19]. Feng at al (2011) used the random walk model to investigate the volatility of carbon price, they found that the carbon prices cannot fully reflect all historical information and show a short-term memory [20]. While Another part of the scholars mainly discussed liquidity, volume volatility, and price clustering of European carbon trading market [21–24]. Takashi Kanamura (2016) examines the role of carbon swap trading and energy prices in volatilities and price correlations between the EU and Kyoto Protocol emissions trading schemes. Yves Rannou, Pascal Barneto(2016) analysis the relationship between European carbon market efficiency and their volatility/liquidity. Anca Claudia Balietti (2016) believe that the trading activity-volatility link is relevant for evaluating the efficiency of the EU ETS.

Though the literature on the price dynamics of CO_2 allowances as part of the EU ETS is steadily increasing, the issue of carbon trading in relation to the EMH has not been addressed so far. Some scholars believe that the European carbon market is efficient. Seifert et al. (2008) presented a stochastic equilibrium model to test the efficiency of European carbon market by using empirical test and summarized the martingale characteristic of European carbon market, thus the conclusion that the European carbon market is informational efficient is drawn [25]. Amelie Charles et al. (2011) confirmed that the EU ETS is efficient from the perspective of the execution cost [26]. Daskalakis G (2013) also confirmed the weak form efficiency of the EU ETS is based on the simple technical analysis rules and naive forecasts [27]. While Alberto Montagnoli et al. (2010) used the variance ratio tests to verify the efficiency of the EU ETS, and they conclude that the EU ETS is periodic efficient. The first and the third phases are not of weak efficiency while the second phase achieved the weak efficiency [28]. Feng Xiaoying (2014) also studied the efficiency of the EU ETS. The results came out that the market efficiency of EU ETS has different phase features and the trading market efficiency is related to not only the market mechanism, but also the stability of policies [29]. Bao-jun Tang et al. (2013) discussed the relationship between the EUA futures market and spot market based on the unit root test and the cointegration test. They conclude that the EUA futures market is efficient within 1 month. Furthermore, the impact of the price would continue for 3 months, examined by a vector error correction model (VECM) [30]. However, some scholars believe that the European carbon trading market is inefficient. For example, Daskalakis and Markellos (2008) used the empirically test to examine the weak form efficiency in the European carbon market and have found that the European carbon market is inefficient [31].

Carbon finance is a whole new area for Chinese enterprises and even management authorities, there are many deficiencies in carbon emissions measurement, carbon asset pricing, carbon trading system construction and market supervision. The study of the efficiency of China's carbon trading market is conducive for China to speed up the familiarity of the rules of carbon trading market, in-depth understanding of the operation and effect, is also conducive to the establishment of a unified national carbon market. The establishment of the unified national carbon market can help reduce carbon emissions, develop low-carbon economy, help to reduce people's dependence on fossil fuels, thus promoting the development and utilization of renewable energy [32]. At the same time, there are intersections between the carbon emission rights and the renewable energy certificates, and the policies of the two are also affected [33]. The opinions of the carbon trading market in this paper also have reference for the policy of renewable energy. In short, this study is conducive to the promotion of renewable energy development and utilization, and its policy recommendations has a guiding significance for the development of renewable energy policy.

This paper investigates the efficiency of present China's carbon trading market and to provide suggestions to the unified national carbon trading market. The carbon price of four typical cities during 2013–2015 are selected as sample data in this paper and the empirical analysis is employed based on unit root test and runs test. This paper is organized as follows:Section 2 introduces the related policy and system framework of China's carbon trading market, Section 3 analyzes the efficiency of China's carbon trading market based on three hypotheses of EMH, the empirical analysis is presented in Section 4, followed by conclusions and policy implications in Section 5.

2. The situation and the framework of the carbon trading market in China

2.1. The development course

China's carbon trading development process can be divided into two phases. In the first phase, China was given priority to the development of CDM and gradually became the largest country in the world in CDM project. In the second phase, China started to develop carbon trading system. In 2008, China's national development and reform commission (NDRC) put forward to the work of building carbon trading pilot for the first time [34]. In 2009, a target to control greenhouse gas emission was announced officially by Chinese government that, by year 2020, the carbon dioxide emission per unit GDP will drop by 40–45% compared with 2005 [35]. In October 2010, China's State Council proposed to establish and to improve the system of emissions trading [36]. In November 2011, the national development and reform commission approved the plan of carrying out the pilot work of carbon trading in Beijing, Tianjin, Shanghai, Chongqing, Hubei, Guangdong, Shenzhen and other municipalities. On June 18, 2013, the first carbon trading pilot of China was launched in Shenzhen [37,38]. In August 2013, the state council confirmed the work of building carbon trading pilot as a way to push the development of marketing mechanism [39]. By the end of the July 2014, all these seven major carbon trading pilot have started operating and the unified carbon emission trading system will be put into effect in 2017 [5].