Assessing the operational performance and maturity of the carbon trading pilot program: The case study of Beijing's carbon market

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A B S T R A C T

On November 28, 2013, Beijing's carbon emissions trading opened on Beijing's Environmental Exchange. As one of the pilot cities, Beijing has been pursuing low-carbon development strategies under state intervention and market regulation. This paper chooses the carbon market, a medium through which Beijing manages emission reduction, as the object of study. Firstly, we compare the basic construction circumstances of Beijing with other pilot cities. Then we qualitatively analyze the development of Beijing's carbon market from the perspective of transaction status, execution of the contract, and improvement of the policies and regulations. Finally, we use the TOPSIS model to develop a comprehensive evaluation system of Beijing's carbon market. It is used to quantitatively evaluate the operational performance and maturity of the mechanism. The results show that: Beijing's carbon market has good comprehensive capabilities, ranking second place among seven pilot markets; but the maturity of Beijing's carbon market is relatively poor for insufficient market liquidity; its operations are well managed, but economic efficiency still need to be improved; the depth of transaction and the effect of reduction in emissions make it meaningful. Therefore, in order to improve the construction of Beijing's carbon market, measures should be taken as follows: (1) strengthening the quota management, and increasing carbon trading activity to avoid poor market liquidity; (2) accelerating emission reduction actions and encouraging technology innovation, such as: carrying out several policies and measures supporting new energy and energy saving & emission reduction, and increasing investment and subsidy in research and development for the technology innovation of firms etc.; (3) improving regulatory mechanism and enhancing the disclosure of carbon trading, such as: drawing lessons from the EU Emission Trading Scheme (ETS) about measuring, reporting and verification system (MRV).

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1. Introduction

Low carbon development strategy is a new and good development pursuing to deal with global climate change and the energy crisis. It is also identified as a feasible way and the inevitable choice for cities, especially in the context of environment deterioration and the rapid urbanization of China. As the political, educational and cultural center of China, Beijing's highly successful economic development has been accompanied by huge pressure on natural environment. And its environment deterioration is already evident, particularly on the air quality issue nowadays. Air pollution in Beijing, particularly this PM2.5 concern, has been a trigger for extreme health damages, which is closely linked with Beijing’s road transport. Beijing’s residents have been severely affected. Moreover, Beijing’s image as the capital city of China and its sustainable development has also been severely affected (Chen and He, 2014; He and Chen, 2013; He and Qiu, 2016; Yang and He, 2016; He et al., 2016). Therefore, implementing low carbon strategy in Beijing is in urgent need. Carbon market, as a low cost and high efficiency emission reduction tool, is being implemented worldwide (Cong and Wei, 2012; Cong and Wei, 2010a, 2010b). Beijing is one of the first batch of pilot cities in China carrying out a relatively large carbon emissions trading scheme. Beijing officially launched its carbon emissions trading scheme at Beijing Environmental Exchange.
Exchange on November 28th, 2013. Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia and Shandong signed a cross-regional cooperative agreement of trading carbon emissions together, in order to lay a foundation for promoting regional carbon trading market construction and accumulate experience for forming a unified national carbon trading market of China in 2017. In this paper, carbon market of Beijing is the research object. We are trying to make an integrated assessment of the operational performance and the maturity of Beijing’s pilot carbon market with both qualitative and quantitative methods. And we hope to lay a foundation for the future development of energy conservation and emission reduction of Beijing and the establishment of a national carbon trading market. The operational performance means some benefits including social benefit, economic benefit and mitigation effectiveness from the operating carbon market, and the maturity means the carbon market’s development situation and degree including transaction, coverage breadth and market liquidity.

Currently, the construction of carbon market in China is still in the initial stage. Studies related to carbon market pilot cities are scarce. Most studies focus on the status quo of pilot cities by the qualitative analysis or comparative study. Clayton et al. (2016) conducted a qualitative comparative study of Guangdong, Shanghai and Shenzhen, three of China’s pilot sites. Fu et al. (2014) noted at Beijing’s pilot carbon market and analyzed the status quo from a macro perspective. Yang’s (2013) studies shed light on the sustainable development of Beijing’s carbon trading market. Analyzing the current situation, Yang pointed out that it is important to insist on market orientation and enhance the market competitiveness of Beijing’s carbon trading market. Wu (2013) suggested that free allocation should be implemented in the early stages and gradually be replaced by auction method. He also made some suggestions on market regulation mechanism.

In terms of studies on assessing the operational performance and maturity of carbon market, different methods had been used in those studies, such as Aggregative Indicator Method, Principal Components Analysis, Multi-Objective Decision-Making Method and Coefficient of Variance Method. Guo (2011) and Xu et al. (2014) applied DEA model to solve the issue of evaluation of the emission reduction performance about different objects. Zhang et al. (2014) used the feasible generalized least squares estimation on international panel data to evaluate the emission reduction performance of global carbon market. Jia et al. (2010) adopted a systematic performance evaluation system to assess the maturity of low carbon economic policies in the construction sector. Comparing to traditional methods, the TOPSIS model, as a widely used Multi-Objective Decision-Making Method, is able to provide more directly perceived analysis principles and require smaller sample size. Hence, it has great applied value especially for quantitative evaluation of preliminary launched pilot sites. Kuang and Chen (2007) conducted an integrated port competitiveness evaluation model based on Entropy and TOPSIS model to reveal the main influencing factor of port competitiveness. Wang (2009) conducted an evaluation study of the Chinese economy based on Combined Weighting Method and improved TOPSIS. Zhang and Liang (2009) created an improved TOPSIS for water quality assessment to better the multi-objective evaluation method. Xu et al. (2012) evaluated the carrying capacity of groundwater resources by using Entropy and improved TOPSIS model. Li et al. (2013) used the same method to assess the land use performance. Li et al. (2014) combined AHP and TOPSIS model to build up an evaluation model and set an in-depth evaluation of overall competitiveness of a logistics zone. Mi et al. (2013) assessed China’s provincial performance in climate protection based on the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method. The TOPSIS model has been widely used in many research topics. But in our research, to solve the issue of subjective weighting, we use the Coefficient of Variation Method, an objective method by using the information contained in the indicators to calculate the weight of each indicator. And this method eliminates the influence of subjective empowerment on some level.

Therefore, this paper intends to discuss the operational performance and maturity of Beijing’s carbon market which is in the current stage of development and with limited research findings based on the TOPSIS model. Our paper is structured as follows: Section 2 provides a brief narrative model for quantitatively assessing Beijing’s carbon market. Section 3 presents an in-depth qualitative analysis of carbon trading, compliance and policies and regulations of Beijing’s pilot carbon market. Section 4 shows the results and discussion of evaluating performance and maturity. Section 5 presents and interprets the policy implications.

2. Methodology

2.1. Research framework

Fig.1 shows the framework of this research. First of all, we make out a plan based on the previous job and collected data for our problems. Secondly, we qualitatively analyze the operation situation of Beijing’s carbon market.

 Thirdly, we assess it based on the TOPSIS and variation coefficient method. Fourthly, Beijing’s carbon market was evaluated from two aspects, namely, the operational performance including environmental benefit, social benefit and economic benefit, and the maturity including market liquidity, market breadth and market depth. Lastly, according to the comprehensive performance of Beijing’s carbon market, several suggestions for improving the Beijing’s carbon market and arrangements for emissions trading system in China were provided.

2.2. Comprehensive evaluation index system

In this section a comprehensive evaluation index system suitable for carbon market construction will be established based on the thorough analysis of Beijing’s carbon emission market. Analyzing the maturity and the operational performance of Beijing’s carbon emission market, we generate a comprehensive discussion about the impact of the low carbon development process of Beijing’s carbon market. In terms of the maturity evaluation of Beijing’s carbon market, this chapter will conduct an in-depth analysis from the depth of the carbon market trading (transaction volume and transaction value), to the breadth of coverage (covered enterprises), as well as market liquidity (average transaction price and the average daily transaction volume). For the operational performance evaluation of the carbon market, an analysis from social benefit (employment, energy companies), economic benefit (per capita GDP, industrial added value, R&D funds and the cost of pollution abatement), emission reduction effect (the main pollutant CDM project number, exhaust emission reductions, the compliance rate) will be conducted. Indicators are constructed in Table 1.

2.3. Components and weights of evaluation index

Beijing’s carbon market was assessed by 13 objective indicators integrated into a single composite indicator. The indicators were divided into two categories: the maturity and the operational performance. Their weights are the same, namely 50%. And the weight of each indicator is worked out by the coefficient of variation (CV), also known as relative standard deviation (RSD), is a standardized measure of dispersion of a
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