

A Review of Carbon Emissions Trading Research

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Abstract: The introduction of carbon trading as a market-based tool to reduce carbon dioxide emissions began with the Kyoto Protocol in 1997. The main contents of this paper are the following: the relevance of carbon trading, carbon trading mechanism, carbon impact assessment of carbon trading and other related literature, which shows that its main mechanism is to control carbon emissions through market mechanisms and the pricing of carbon emission rights. In the long run, emissions trading can contribute to energy saving and emission reduction, in addition to bringing innovation benefits, economic gains and impact on business value. Based on this, it is important to strengthen the research on emissions trading schemes in order to achieve China's 30-60 year carbon emission reduction target.

1. Introduction

It is noteworthy that China has made significant advancements in economic construction in recent years. However, environmental pollution has also become a growing problem. Industrial activities consume a large amount of energy, causing large quantities of CO₂ emissions, which in turn leads to the greenhouse effect. In September 2020, China proposed peaking carbon emissions by 2030 and carbon neutrality by 2060. Market-based environmental regulation based on the Coase theorem, carbon trading is a price-based emission control mechanism that treats the negative externalities of human activity as a commodity.

For the purposes of this literature review, this paper will focus on the concept of carbon trading, the mechanics of carbon trading, and the impacts of carbon trading.

2. The Basic Connotation of Carbon Emissions Trading

In the 21st century, countries around the world have strengthened environmental laws and regulations, promulgated a lots of policies in order to reduce energy consumption and emissions, and carbon emissions trading is one of the market-based environmental policy tools. The IPCC officially defines carbon credits as "a commodity in which the government allocates to each company a percentage of the emissions it is allowed to emit for a specified period of time based on the company's environmental performance and past carbon emissions," and that these carbon credits are property rights and can be traded. Thus, carbon credits are a new asset for companies, and carbon trading is the trading of carbon credits as a commodity in the market. The concept of carbon trading is based on emission rights trading, the rationale for which was first proposed by Coase, who argued that negative externalities can be freely traded in the market as commodities, ownership

is clear, and all stakeholders can benefit from the trading mechanism^[1]. This not only achieves resource allocation in the market, but also improves socio-economic benefits. 1968, the American economist Dales defined emission rights on its basis and proposed the design of emission trading^[2]. The U.S. EPA in 1976, for the first time, applied emissions trading to combat air pollution as well as river pollution, which was also the first time that market-based environmental policies were applied in practice. After that, many European countries, such as the UK and Germany, started emissions trading. In 1997, the Kyoto Protocol introduced carbon emissions trading as an emission reduction mechanism. The adoption of the Protocol contributed to the development of carbon dioxide emissions trading.

3. Carbon Emission Trading Operation Mechanism

Carbon trading is based on Coase's Theorem, which treats the negative externalities of carbon emissions as a commodity^[3] and uses market mechanisms to solve environmental problems. Therefore, carbon trading market does not directly control carbon emissions, but follows the general market law, and the price of carbon trading is formed by the law of market supply and demand. As an important market signal, the price of carbon emission rights provides guidance for enterprises to make production decisions, prompting them to adjust their production methods and speed up technological innovation; on the other hand, it provides reference for the government's macro-control and policy formulation, optimizing the industrial structure and industrial structure^[4].

Before carbon trading, it is especially important to determine the allocation of initial emission rights. Generally speaking, the government allocates carbon credits by combining environmental capacity and historical carbon emissions of enterprises, and there are mainly free distribution, auction, and mixed methods in the allocation of initial emission credits. The main methods for calculating carbon allowances are the historical method and the benchmark method. Liao et al.^[5] compare and analyze the impact of the historical emission method and the benchmark method on reducing carbon emissions, and find that the historical emission method is not conducive to efficient and low-emission enterprises to reduce carbon emissions, and the historical emission method can be used in the early stage of carbon trading policy implementation. Chang et al.^[6] compare and analyze the effectiveness of the historical emission method and the benchmark method to incentivize monopolistic manufacturers to remanufacture, and find that the benchmark method is more effective in incentivizing low-carbon remanufacturing by manufacturers. Cong et al.^[7] compare and analyze the effects of carbon emission-based and output-based allowance allocation methods on the Chinese power industry, and find that the emission-based allocation method is more conducive to controlling carbon emissions in the power industry. Chen et al.^[8] examined the impact of different rent-seeking environments on the operational efficiency of the carbon market and found that compared to free allocation of carbon allowances, the price-based sale or auction method of allocating carbon allowances not only provides a clear price signal but also reduces the opportunity for firms to seek rent.

4. Carbon Trading Impact Study

4.1. Technological Innovation Effect of Carbon Emissions Trading

Most studies show a positive impact of emissions trading on technological innovation. Caley & Dechezleprêtre^[9] show that EU ETS increases the level of low-carbon innovation among emission-controlled firms by 36.2% without affecting other technologies and contributes at least 1% to the increase in the number of low-carbon patents in Europe. Qi Shaozhou et al.^[10] empirically investigated the impact of technological innovation and stage-specific features of the EU ETS

mechanism based on three-dimensional country-specific panel diagrams for renewable energy, and the impact is more significant in the third stage of the EU ETS, where the mechanism is better designed. It should be noted, however, that in some cases the empirical evidence does not support the effect of technological innovation^[11,12]. Shi^[13] and Feng^[14] find that emissions trading policies significantly impede firm innovation.

4.2. Economic Effects of Carbon Emissions Trading

While measures to reduce emissions certainly have economic costs in the short run, the economic costs of not reducing emissions are higher in the long run. In theory, carbon trading should be done in a way that enhances rather than hinders economic efficiency. Related studies also tend to confirm the role of carbon trading in stimulating economic growth^[15]; Dong et al^[16] argue for the positive effects of long-term and permanent carbon markets on macroeconomic growth, and Sun Lieven et al^[17] find that carbon trading can reduce the carbon capture rate of industries in a region and other nearby spatial spillover effects that can effectively reduce carbon capture rates in the region; Tang Jing et al^[18] studied the spillover effects of carbon trading on the upgrading of the regional industrial structure, as reflected in the development of industrial ratios and the increase in industrial productivity; and Tang Jing et al^[19] studied the spillover effects of carbon trading on the development of the regional industrial structure, as reflected in the development of industrial ratios and the increase in industrial productivity.

4.3. Impact of Carbon Emissions Trading on Enterprise Value

Because companies are the central unit of economic activity and a major participant in the carbon market, the impact of carbon trading on the value of companies has received considerable attention. Some studies have concluded that carbon trading can help increase company value^[19]. Zhou et al^[20] found that carbon trading can largely increase enterprise value and improve financial performance. Shen Hongtao et al^[21] refined the discussion from a time perspective and found that carbon trading mechanisms can increase the value of the company in the short time, but have no effect on the long-term value of the company. However, some researchers take a different view, arguing that the costs of implementing carbon trading mechanisms are inevitably passed on to companies in the short term, affecting their production and having a negative impact on company value^[22]. A study by Zhang et al^[23] shows that the price of carbon credits has a important negative impact on company value. In addition, fluctuations in the price of carbon can enhance a company's risk and indirectly reduce its value.

5. Conclusion

This paper provides the first theoretical overview of emissions trading. It is mainly divided into the definition of emission trading concept, emission trading mechanism and emission trading impact assessment study. The main purpose is to explain the basic principles of carbon trading and its consequences in order to give Chinese enterprises some guidance to participate in carbon trading.

However, in the pre-reduction period, there was little carbon trading in China, mainly through voluntary emission reductions by enterprises or through the Clean Development Mechanism. In view of the openness of the carbon market, China established pilot carbon trading zones in Beijing, Hubei, Shenzhen, Guangdong, Tianjin, Shanghai and Chongqing in 2011. Since the establishment of the seven pilot zones in 2013, Chinese policymakers have focused on "full control and emissions trading" to combat climate change. In 2019, the State Council issued the Interim Carbon

Accounting and Calculation Rules, and in December 2020, the State Council adopted the Administrative Measures on Carbon Trading (Trial Mode), which means that China's carbon trading system is ready for commercialization, but at this stage, China's carbon trading market is not yet complete. In the longer term, it is important to strengthen research on carbon trading system so that our country can achieve the goal of double decarbonization, as it is one of the important policy tools to achieve the "30-60" goal.

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