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Effect Analysis of China's Carbon Emission Trading Pilot Policy on Carbon Emission Control

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Abstract: Many countries have achieved a fundamental consensus to decrease carbon dioxide emissions in order to address environmental and climate issues. China, as the foremost energy consumer and carbon emitter globally, has significantly contributed to the exacerbation of greenhouse gas issues. The most effective method for lowering carbon emissions is through the trade of carbon emissions. In 2011, China began the process of implementing pilot projects for pricing carbon emissions as a means of addressing environmental and climate-related issues. This study use the literature review approach to examine the current state of China's carbon emission trading pilot policies on carbon emission management. It also analyzes the technical and economic impacts of these pilot policies in comparison to non-pilot carbon emission trading policies. The objective of this study is to propose recommendations for the implementation of the national carbon emission trading market in 2021.

Keywords: ETS, Carbon emission reduction, China's carbon emission trading pilot

1. Introduction

China, as the greatest developing nation globally, has achieved economic progress in recent decades by heavily relying on excessive energy use. In China, air pollution and greenhouse gas emissions have emerged as significant environmental issues [1]. Notably, China holds the distinction of being the greatest user of energy and the largest emitter of carbon globally [2]. In 2022, China's carbon dioxide emissions are projected to reach 11.34 billion tons. It represents 30.68% of the global carbon dioxide emissions, significantly surpassing the carbon emissions of any other countries or regions [3]. Many countries have made a preliminary agreement to decrease carbon dioxide emissions in order to address environmental and climate challenges. During the Copenhagen summit in 2009, China put out a proposition to decrease carbon emissions per unit of GDP by 40-45% by the year 2020, in comparison to the levels recorded in 2005 [4]. Carbon emission trading is the optimal method for mitigating carbon emissions. China initiated the pilot program for carbon emission trading in 2011 as part of its efforts to meet the aim of reducing carbon emissions. The national carbon emission trading market is scheduled to commence on July 16, 2021.

This paper through methods of literature review and analysis, examines the current state of seven pilot carbon emission trading schemes and analyzes their technical and economic impacts in comparison to non-pilot schemes, based on the existing literature assessment. The paper presents

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several proposals for China's future carbon emission trading, focusing on policy, technology, and economy.

2. Review of China's Emissions Trading System (ETS) policy

2.1. Overview of China's Emissions Trading System

The emissions trading system in China, which is a key component of China's efforts to address climate change, was originally introduced as a cost-efficient alternative to traditional command and control approaches for reducing greenhouse gas emissions. Over the course of the last ten years, it has experienced consistent and gradual growth. During the year of 2013-2014, a total of seven Emission Trading Scheme (ETS) pilot programs were initiated in the provinces of Guangdong and Hubei, as well as in the cities of Beijing, Shanghai, Tianjin, Shenzhen, and Chongqing. Fujian and Sichuan provinces participated in the second phase of the ETS in both 2016 and 2017 [5]. Provincial and local authorities of each pilot have established policies to designate the specific areas, industries, and businesses that would be regulated. They have also implemented various methods for allocating quotas and enforcing these regulations through different agencies. In 2017, the pilot carbon emission trading system achieved a 22.8% reduction in energy consumption and a 15.5% reduction in CO2 emissions compared to the non-pilot system. This was accomplished through improvements in technical efficiency and changes in the industry structure [6]. China's national online carbon trading was formally initiated on July 16, 2021. This marks a significant institutional advancement in China's utilization of market mechanisms to regulate and diminish greenhouse gas emissions, while fostering environmentally friendly and low-carbon growth. The 2023 Annual Report on China's Policies and Actions to Address Climate Change, released by the Ministry of Ecology and Environment, states that as of June 2023, the total amount of carbon emission allowances (CEA) traded in China's carbon market reached 238 million tons, with a total value of 10.912 billion yuan [7].

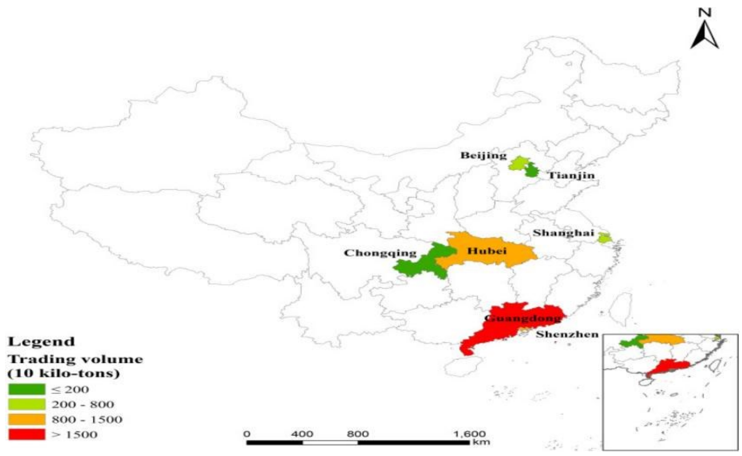

Figure 1: Distribution of pilot carbon emission trading in China [8]

2.2. Status of China's Carbon Emission Trading Pilot

China has implemented carbon emission market pilots in many places across the country, each with distinct variations in economic development, carbon emission intensity, and industrial composition [9]. Consequently, the functioning of the carbon emission trading pilot has undergone changes since its inception.

Wang et al. conducted a study where they used a DEA supermodel to evaluate the efficiency of carbon Emissions Trading Mechanism (ETM) in 7 pilots. They selected 13 input-output indicators to assess the efficiency from four dimensions: transaction process, law and inspection system, internal operation of carbon ETM, and impact of carbon ETM operation on regional economy. The findings indicate that the Shenzhen Carbon Emission Rights Exchange, being established early on, has led to the presence of a greater number of carbon ETM emission control enterprises in Shenzhen. These industries benefit from well-developed market operation mechanisms and government supervision. Despite having a limited overall carbon ETM quota, Shenzhen continues to have a significant trading volume, and the turnover rate and economic efficiency of carbon ETM remain consistently strong. Furthermore, the proximity between Guangdong and Shenzhen allows for a relatively short distance, facilitating convenient information interchange. Thus, the carbon Emissions Trading Mechanism (ETM) in Shenzhen has the greatest impact on the neighboring region of Guangdong. The carbon emissions trading market in Guangdong has experienced significant growth in recent years, surpassing all other regions in China in terms of both trading volume and transaction value.

However, the majority of the firms involved in the Shanghai Carbon ETM are industrial enterprises, and these enterprises have a reasonably straightforward structure, resulting in a relatively uncomplicated market participation. Simultaneously, Beijing's carbon trading volume and turnover have the potential to increase, resulting in issues such as elevated carbon prices, relative volatility, limited market size, and inadequate market liquidity. Since the inception of the pilot program, both Tianjin and Chongqing have maintained consistent policy, resulting in a relatively limited scope of carbon trading [9].

2.3. Technical effects of pilot carbon emissions trading

Carbon emission trading in pilot regions can incentivize high-energy-consuming industrial companies to adopt low-carbon, energy-saving, and emission-reduction technologies and equipment. This, in turn, leads to a reduction in carbon emissions and an improvement in industrial and regional emission performance. Implementation of the Emissions Trading Scheme (ETS) will result in a rise in the expenses associated with the utilization of fossil fuels. Simultaneously, factories that produce high levels of pollution will be obligated to cover the extra expenses associated with the enforcement of the Emissions Trading Scheme (ETS). This will ultimately result in the modification and fine-tuning of input factors for production in energy-intensive industrial firms or the relocation of input factors for production across various sectors. This will result in an increase in green total factor productivity (CTFP) in the pilot cities. Simultaneously, the carbon emission pilot program will generate a spatial spillover impact, prompting businesses in non-pilot areas to engage in the development of environmentally friendly, low-carbon technology and survival equipment innovation, resulting in a beneficial spillover effect. Nevertheless, pollution-intensive industries could potentially relocate to non-pilot regions as a result of too stringent regulations in the pilot regions. Areas without pilots will lead to more substantial environmental pollution, resulting in negative spill-over impacts [10].

Li C et al. utilized the multi-cycle Difference-in-Difference (DID) model. The researchers analyzed the effects of China's carbon emission trading pilot programs on the overall efficiency of green production at the city level, utilizing data on CO2 emissions from 284 cities in China between 2008 and 2019. Further investigation is conducted on the impacts of diversity and the transmission of effects across space. The subsequent deductions are made: The emissions trading market in China has a substantial influence on the city-level Green Total Factor Productivity (GTFP). In contrast to areas without pilot programs, the pilot cities of ETS exhibit a robust promotion of GTFP and a mean increase of 11.4%. Nevertheless, this advantageous circumstance is restricted to the immediate future, and further investigation is required to ascertain the long-term consequences.The Greenhouse Gas Emission Trading Framework (GTFP) has shown significant enhancements in industry-led cities included in China's carbon market pilot, as compared to non-industry-led cities. Simultaneously,

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China's carbon market pilot policy has noticeable spatial spillover effects on both pilot and non-pilot cities, as a result of policy trends and the spread of new technology [10].

2.4. Economic effects of pilot carbon emissions trading

The carbon trading system in China primarily relies on compulsory quota trading and voluntary certified carbon reduction (CCER) trading. In the primary market, the central government employs the administrative allocation technique in pilot areas to establish emission limits and thereafter distributes quotas to carbon emission firms through auction and bidding. Within the secondary market, low-emission firms have the opportunity to sell their leftover quotas to other enterprises in order to achieve a reduction in overall emissions [11]. Nevertheless, China's carbon trading market is now in its early stages, characterized by a lack of comprehensive data and a mixture of certainty and ambiguity regarding carbon emission reduction, particularly in relation to the associated costs and benefits. Furthermore, the outcomes of implementing the cap-and-trade approach may be more gratifying [12], and there is concern regarding the cost-efficient regulation of greenhouse gas emissions [13]. Hence, carbon reduction plans must take into account both the cost-effectiveness and efficacy.

Wen, H et al. implemented a supply chain management (SCM) strategy that focused on the major industrial sectors (Mining, manufacturing, electricity, heat, and water production and supply) responsible for 80% of carbon emissions in China's carbon market. This strategy was applied in 24 non-pilot provinces and six pilot provinces from 2006 to 2015. The environmental variables were assessed by measuring CO2 emissions and industrial production value. The findings indicate a lack of conclusive evidence supporting the notion that China's emissions trading market is mutually beneficial in terms of reducing carbon emissions and generating economic advantages. The data indicates that the ETS pilot areas successfully decreased carbon dioxide emissions by 1,165.72 metric tons between 2011 and 2015, which accounted for 12.78% of the total emissions from pilot industries. However, there was a significant 56% fall in industrial output during the same period. The amount is 8.88 billion yuan. Furthermore, the examination of heterogeneity reveals that the impact on emission reduction and economic outcomes varies among different ETS pilots, demonstrating inconsistency. Beijing and Shanghai exhibit the most rapid response to the impact of emission reduction. Nevertheless, Guangdong has the most significant impact in reducing emissions, while simultaneously experiencing the largest economic loss, amounting to 4.6% of the industrial output value. Simultaneously, the report also forecasts that the implementation of a national carbon emission trading scheme in China will result in more substantial economic downturns [14].

3. Discussion

In light of the present circumstances surrounding China's carbon emission trading pilot, it is imperative for China to establish a regulatory mechanism for carbon Emission Trading Market (ETM) that delineates clear powers and responsibilities, as well as a transparent division of labor. Additionally, it is crucial to promptly modify and revise the operation of the carbon trading pilot to ensure the maintenance of an equitable and unbiased market. To enhance the effectiveness of emission reduction, China should expand the inclusion of trading entities, particularly those with significant energy use, to diversify the market for trading entities and products. Simultaneously, China should adopt the EU norms and actively engage in international carbon emissions trading mechanisms to establish a more advanced and developed carbon emissions trading market.

China's carbon emission trading pilot policies have a favorable influence on green production factors at the city level, when compared to cities without such policies, in terms of technical consequences. Nevertheless, the overall impact is restricted, and the transfer of knowledge and practices between other cities is crucial in enhancing environmentally-friendly production elements, allowing non-pilot regions' governments to benefit from the policies and experiences of pilot regions. Energy-intensive firms in non-pilot regions adopt the green innovative technology employed by enterprises in pilot regions. However, it is imperative to likewise prohibit firms in pilot zones from relocating polluting factories to non-pilot areas in order to circumvent emission rules.

To mitigate substantial economic losses resulting from the initial implementation of a national carbon trading market policy, policymakers should employ a range of measures, including subsidies, during the early stages of establishing a national ETS. It is advisable to adopt a gradual approach rather than an abrupt one. Simultaneously, it is imperative for national governments to grant local governments a degree of autonomy in establishing the carbon trading framework in the near future, rather than imposing a standardized method.

4. Conclusion

This paper investigates the present condition of seven Chinese emissions trading pilots and their technological impacts in comparison to non-pilot carbon trading pilots, based on a prior literature assessment. The research findings indicate that Shenzhen possesses a very comprehensive system and regulatory measures, resulting in a large increase in Shenzhen's carbon Emissions Trading Market (ETM). Thanks to the prompt and effective exchange of information and policy communication about carbon emission trading between Guangdong and Shenzhen, Guangdong has achieved the highest carbon ETM trading volume and turnover in China. Both Beijing and Shanghai face the challenge of limited market size and a lack of diversity in industries. Tianjin and Fujian failed to adapt their policies to address the prevailing issues, resulting in a potential increase in turnover. Compared to areas without pilot programs, the carbon emission trading pilot program has good benefits on the technical aspects, specifically in fostering technological innovation among firms in the pilot areas and generating favorable spatial spillover effects in non-pilot areas. Nevertheless, relocating environmentally harmful businesses to non-pilot regions also generates adverse spillover consequences. Regarding the economic impact, the carbon emission trading policy has resulted in specific reductions in carbon emissions in the pilot areas, but it has also dramatically decreased the overall industrial production in those areas when compared to non-pilot areas.Henceforth, China ought to establish a well-defined ETS oversight mechanism that delineates roles and responsibilities, incorporates a greater number of trading enterprises, refrains from employing a uniform strategy during the initial phase of the national ETS, and formulates adaptable and promptly updated policies for carbon emission trading in various regions. Additionally, strongly encourage non-pilot regions to acquire knowledge of sophisticated environmentally friendly and innovative carbon emission technologies from pilot regions.

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