Chapter 8



Academic Highlights: Recent Studies on China's Carbon Market (Selected)

(1) Assessment of Carbon Market's Impact

(2) Research on Carbon Market Design

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(1) Assessment of Carbon Market's Impact

(a)Policy Effects of China's Carbon Market: Review and Prospect

Li Lei, Lu Xianxiang

China Population, Resources and Environment, Issue 10, 2023

With the growing problem of climate change, the sustainable growth of human society is confronting a more serious challenge. The carbon emission trading market is not only a typical practice of applying the Coase Theorem to solving the problem of environmental externalities, but also an important policy tool for China to address climate change and achieve its goals of reaching peak carbon emissions and carbon neutrality. From the commencement of the carbon emission trading pilot project in 2011 to the launch of the national carbon market in 2021, policymakers and academics have been concerned about the policy impacts of China's carbon markets. This paper reviews the latest literature on the evaluation of the policy effects of China's carbon markets from environmental, economic, and innovation dimensions. This paper finds that: (1) In terms of the environmental effect, China's carbon markets not only promote carbon emission reduction at the macro, meso, and micro levels, but also produce collaborative emission reduction effects on other pollutants such as haze. (2) In terms of the economic effect, China's carbon markets exert a positive impact on green development, energy efficiency, and business performance, and play a positive role in promoting industrial structure upgrading, employment, and income distribution. (3) In terms of the innovation effect, China's carbon market can encourage enterprises to increase investment in innovation and promote the quantity and quality of green technological innovation. Finally, this paper summarizes the shortcomings of the existing research from three aspects: research perspective, research content, and research conclusion, and looks forward to the possible direction of future research. This paper believes that, based on the Chinese scenario, future research can expand the perspective to the welfare effects of carbon markets, pay more attention to the spillover effects of carbon markets between regions and industries, and clarify the intrinsic correlation between the institutional design and the policy effects of carbon markets in the context of the differentiated institutional design of China's carbon emission trading pilots, in order to provide guidelines for the institutional optimization of the national carbon market. Additionally, future research should standardize the research methodology of carbon market policy effect evaluation, so as to enhance the value of carbon market impact assessment research in the practice of constructing China's national carbon market.

(b)Carbon Emission Reduction Effects of Biased Technological Change in Enterprises: Evidence from the Impact of the Carbon Emission Trading Policy

Lei Zhujiahua, Luo Liangwen

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Identifying the sources of corporate carbon reduction effects from the perspective of production efficiency is not only a necessary prerequisite for alleviating the contradiction between low-carbon reduction and production operations, but also a key step in promoting the green and low-carbon transformation of enterprises. This paper utilized methods from atmospheric quantitative remote sensing to estimate the carbon emissions and biased technological change of listed companies from 2007 to 2021 and applied the two-way fixed effects difference-in-differences model to analyze the carbon reduction effects of carbon trading policies and their institutional elements (carbon price, carbon market activity, carbon market size). Furthermore, it explored the underlying mechanisms between carbon trading policies, biased technological change in enterprises, and the carbon emission reduction effects. The results indicated that: (1) The carbon emission trading policy and its institutional elements significantly promoted carbon emission reduction in listed companies. At the same time, the policy significantly enhanced output-biased technological change (OBTC) in enterprises and inhibited the magnitude of technological change (MATC), but had no significant impact on input-biased technological change (IBTC). This suggested that the carbon emission reduction effects of listed companies primarily came from reducing the production frontier rather than technological progress, a result supported by robustness tests. (2) Differences in enterprise types led to heterogeneous effects of the carbon trading policy on carbon emission reduction and biased technological change. Labor-intensive enterprises exhibited more significant carbon emission reduction effects and biased technological change than capital-intensive enterprises, and the impact was more pronounced in high energy-consuming enterprises than in low energy-consuming enterprises. Differences in technological bias types also led to heterogeneity in the carbon emission reduction effects of carbon trading policy, with output-reducing enterprises showing more significant effects than output-increasing enterprises. Additionally, the reduction in energy input and the increase in labor input promoted carbon emission reduction in enterprises. (3) When listed companies faced the impact of carbon trading policy institutional elements, the carbon emission reduction effects of technologically advancing enterprises were significantly superior to those of technologically regressing enterprises. Simultaneously, lower levels of carbon prices and carbon market activity, as well as higher levels of carbon market size, could significantly regulate the carbon emission reduction effects generated by biased technological change in enterprises through carbon trading policy.

(c)Research on the Spillover Effects among Carbon Market, Green Finance, and Energy Market from a Time-Frequency Perspective

Hui Diaoyan, Wang Zhi, He Zhenhua

Soft Science, 2025

Using time-frequency analysis methods, this study delves into the spillover effects among the carbon market, green finance, and energy markets under normal and extreme conditions. The results indicate that under normal conditions, there are significant spillover effects among the markets from a time-domain perspective, with short-term risk spillover effects being markedly greater than long-term ones from a frequency-domain perspective, exhibiting high sensitivity and dynamism. Secondly, in the overall spillover network, the secondary energy market and the new energy market occupy core positions, playing a key role in market risk transmission. Extreme events, market fluctuations, and policy changes significantly intensify the risk interconnections among markets. Furthermore, under extreme conditions, the secondary energy market has a significant spillover effect on the green finance market and the primary energy market, and the new energy market exhibits a significant spillover effect on both the green finance and secondary energy markets. Additionally, there is an asymmetry between downward and upward risk spillovers, with the former having a significantly higher spillover effect, indicating that markets exhibit higher sensitivity and reaction intensity to downward pressures.

(2) Research on Carbon Market Design

(a)China's Provincial Carbon Emission Rights Allocation under the Sustainable Framework: Based on the 2030 Carbon Emission Reduction Dual Control Targets

Zou Xiuqing, Zheng Zhuolin, Gu Jia, Wen Zhangyan

China Population, Resources and Environment, Issue 1, 2025

The establishment of a scientific and reasonable carbon emission rights allocation scheme aligned with China's national conditions is a strong guarantee for ensuring the stable, healthy, and orderly operation of China's carbon market. Based on China's 2030 carbon intensity target and 'dual control' targets for reaching peak carbon emissions, this study developed a provincial carbon emission rights allocation model incorporating five dimensions of a sustainable framework: human, nature, material, economy, and society. The model was used to effectively allocate carbon quotas across 30 provinces from 2022 to 2035, aiming to promote China's 2030 carbon reduction 'dual control' targets. The research results showed that: (1) Under the 'medium speed growth, high speed emission reduction' scenario, the total national carbon emission rights allocation calculated represented the optimal choice to meet the 'dual control' targets of carbon emission reduction. The total allocation measured in this scenario not only met these targets but also aligned best with China's current context, as it emphasized steady development while significantly enhancing emission reduction intensity. (2) The amount of carbon emission rights varied significantly among 30 provinces in China. By 2030, the total quotas of the top five provinces would all exceed 5.60 billion t, while the total quotas of the bottom five provinces would not reach 1.90 billion t. (3) The national distribution of carbon emission rights showed a 'low in the west and high in the east' pattern, with a 'stepped' spatial distribution that increased from the northwestern inland regions to the eastern coast areas. The core quota group was mostly distributed in the eastern and southeastern coastal areas, while the key group was predominantly distributed in the eastern and southern regions. The moderate group was primarily distributed in the central-eastern, southwestern, and southeastern regions. The observation group was mostly located in the northeastern and central regions, while the promotion group was mainly located in the northern and northwestern regions. (4) The quotas for all provinces would decline after reaching the peak in 2030, with the average annual change from 2030 to 2035 being less than that from 2025 to 2030. Accordingly, some policy suggestions are proposed, such as establishing provincial differentiated distribution schemes to improve the

national carbon trading market, implementing annual quota management to achieve target quota levels, and developing provincial allocation mechanisms to promote coordinated regional development.

(b)Normative Construction of Carbon Emissions Trading Market

Zhan Shiyuan

China Population, Resources and Environment, Issue 8, 2023

Although the Interim Regulations on the Management of Carbon Emissions Trading have been included in the annual legislative plan of China's State Council for two years, they are still pending. The reason is that the existing carbon emissions trading system has not been standardized within the existing legal system. Therefore, as the logical starting point for the construction of the carbon emissions trading system, carbon emissions should be clarified as a usufructuary right at first, which is beneficial to the distribution and transfer of carbon emission rights in the primary market and to the circulation of carbon emission rights in the secondary market. This also conforms to the legislative purpose of the Interim Regulations on the Management of Carbon Emissions Trading and the logic of the legal economics theory. Secondly, the carbon emissions trading market should be constructed at three levels: (1) The allocation and trading of carbon emission rights in the primary market can be conducted in two ways: for free or in the form of a paid auction. For projects involving major public interests, carbon emission rights can be allocated for free; for other carbon emission subjects, carbon emission rights should be allocated in the form of a paid auction. (2) In the secondary market, it should be clarified that the transaction of security by carbon emission rights is in the form of a mortgage, not a pledge. At the same time, carbon emission right guarantee transactions should be registered in the registration system of the People's Bank of China. (3) In the tertiary market, asset-backed securitization and factoring financing of carbon emission rights should be developed. Finally, in order to resist the price fluctuation and transaction risk caused by the failure of the market, it is necessary to establish an administrative supervision system. It is also vital to establish a repurchase and release mechanism and a storage and lending mechanism related to the stabilization of the carbon emission right transaction price so that the carbon emissions trading market can develop in a stable way.

(c)The Structure Design of China Blockchain Carbon Market for the Future Big Data Environment

Ye Qiang, Gao Chaoyue, Jiang Guangxin

Journal of Management World, 2022, Issue 1

A well-functioning carbon market system is crucial to achieving China's “dual-carbon” goals. As a current effective supplement to enterprise-level carbon trading, personal-level carbon trading can significantly contribute to the efficient attainment of these targets. This study

proposes the use of blockchain technology to empower the construction of the carbon market. It designs a blockchain-based carbon market system architecture suitable for the future big data environment and introduces a personal carbon asset pricing mechanism model within the blockchain carbon market. The study first analyzes the development trends of the carbon market and emphasizes the importance of personal-level carbon trading. It then proposes a "public chain + side chain" system design: enterprise-level carbon trading is conducted on the public chain, while high-frequency, small-volume personal carbon trading is handled on side chains. This design leverages blockchain's advantages—such as decentralization, transparency, and immutability—to reduce management costs, strengthen supervision, and solve the congestion problem caused by large-scale personal carbon data on the public chain. The system also enables the aggregation of personal carbon assets and ensures trading efficiency. Each side-chain ecosystem can prepare smart contracts for autonomous operation according to regional or project characteristics, which not only realizes "tailor-made" but also reduces the operation cost, and ensures the privacy of users and the security of data assets of data providers. Finally, this paper analyzes the economic modeling of the scheme and demonstrates its social benefits through model derivation and data simulation, which provides a reference basis for government decision-making.

(3) Research on Multi-Market Coordination

(a)Synergistic Optimization of Trading Decisions and Market Mechanisms in the 'Electricity-Carbon-Certificate' Markets.

Wang Haoran, Feng Tiantian, Li Yan, Kong Jiajie

China Population, Resources and Environment, Issue 10, 2024

The implementation of multiple clean and low-carbon policies in the electricity market may lead to redundancies or even contradictions, and the synergy of the power market, carbon trading market, and green certificate market tends to optimize the allocation of power and environmental resources through market mechanisms. However, the synergistic paths of multiple markets to realize the “dual-carbon” goals are not clear yet. Therefore, this study analyzes the interactions among 'electricity-carbon-certificate' markets from the perspectives of market agent decision-making and market mechanisms. This study constructs a market equilibrium model involving buyers and sellers of carbon quotas, thermal power generators, renewable energy power generators, electric power grid enterprises, and active and passive users of electricity consumption by using the multi-agent game theory. A mechanism is designed for offsetting and mutual recognition and exchange of environmental equity products, and a synergy model of 'electricity-carbon-certificate' market mechanism is constructed by using the system dynamics theory. The results show that: (1) Carbon prices are transmitted to market agents through the cost of power generation. Carbon price increases squeeze high-carbon power sources and promote low-carbon and high-efficiency units. Green certificate trading incentivizes renewable energy power producers to install units, increasing the amount of renewable energy power generation. Under the joint guidance of carbon prices and green certificate prices, positive and negative consumption users tend to buy green power. (2) Compared with the baseline scenario, the introduction of the auction mechanism in the carbon market increases the cost of carbon emissions, which significantly pulls up the carbon price from 2026 to 2030. The introduction of a penalty mechanism in the green certificate market strengthens the constraints of the consumption weights, which shortens the time for the green certificate price to rise to its maximum value. (3) CCER is used as an intermediary to convert excess green certificates into warrants that can be offset in the carbon market, realizing the effective connection between the 'electricity-carbon-certificate' markets. Compared with the baseline scenario and the single policy scenario, the comprehensive scenarios, which consider multiple market reform

measures, are more effective. They enhance the structural transformation of the electricity market by the carbon market and increase the competitiveness of renewable electricity. The government should link environmental equity products through carbon accounting, reduce redundancy in low-carbon policies, and utilize the synergistic development of the 'electricity-carbon-certificate' markets in order to achieve the “dual-carbon” goals.

(b)Synergistic Emission Reduction Effects of China's National Carbon Market and Renewable Energy Subsidies in the Power Industry

Song Peng, Chen Guangming, Yin Menglei

China Population, Resources and Environment, Issue 7, 2023

With the launch of a unified national carbon market in China, its synergistic effects on promoting carbon emission reduction in the power industry with renewable energy subsidies are noteworthy. The traditional view is that the total amount of carbon emissions is fixed under the carbon trading policy and the renewable energy subsidy policy under the total amount control will no longer play an additional role in reducing emissions, and would even lead to excessive carbon market quotas, distorting carbon market prices. This paper establishes a general equilibrium analysis framework for national carbon trading and examines the parallel emission reduction effects of renewable energy subsidies in the power industry and the national carbon market, as well as their policy synergy paths. The results show that: (1) The national carbon market and renewable energy subsidy policy for the power industry would both bring about CO2 emission reduction in the whole industry. (2) The carbon market that only covers the power industry would produce a 'carbon leakage' effect, which would lead to an increase in carbon emissions in non-power industries. On this basis, continuing the renewable energy subsidies may alleviate the 'carbon leakage' by means of the transfer of production factors among industries or lead to excessive carbon market quotas by 'greening' the power production structure. (3) Considering two sources of renewable energy subsidies: the one-time tax on residents (resident income tax) and the renewable energy electricity price surcharge (electricity consumption tax), the emission reduction effect of the former resource is better than that of the latter resource, and the latter may even cause 'cross-border damage.' 4 The renewable energy subsidies would lead to a decrease in the carbon market transaction price. The FIT is better than the FIP, and it is necessary to increase the total amount of constraints to effectively restrain the decline of carbon trade prices. As the carbon market expands and improves, renewable energy subsidies can be gradually reduced or even eliminated to avoid their impact on the carbon market price.

(4) Green Finance in Empowering the Carbon Market

(a)An Empirical Study on the Impact of Green Finance on Carbon Information Disclosure Quality

Huang Shengzhong, Zhou Jun

Journal of Statistics and Information, Issue 1, 2025

The realization of the "dual carbon target" will require guiding enterprises to improve carbon information transparency and reduce environmental information asymmetry. Quality measurement indicators are constructed for corporate carbon information disclosure via textual analysis of the social responsibility reports of companies listed on the Shanghai and Shenzhen stock exchanges from 2013 to 2021. It is found that green finance has a significant positive impact on corporate carbon information disclosure quality; the degree of marketization can strengthen the positive impact of green finance on corporate carbon information disclosure quality. Further research has found that public environmental concerns can improve corporate carbon information disclosure quality and weaken the positive impact of green finance on corporate carbon information disclosure quality. It is found through heterogeneity analysis that, impact of green finance on the quality of corporate carbon disclosure is greater among state-owned enterprises and firms facing financing constraints; Green finance has a significantly greater promoting effect on carbon reduction planning and action than on monitoring of carbon emission reductions. The research has shown that it is necessary to leverage the positive role of multiple forces in environmental governance to encourage companies to disclose high-quality carbon information, and the findings provide reference significance for the formulation of carbon emission regulatory policies and the promotion of corporate participation in carbon reduction practices.

(b)Secured Financing of Carbon Emissions Rights: Institutional Practices and Theoretical Approaches

Wang Wenxi

Journal of Financial Development Research, Issue 2, 2025

Guaranteed financing of carbon emission rights is one of the important innovations of the financial system to promote carbon peaking and carbon neutrality in a market-oriented manner. Carbon emission rights have the attributes of property rights, transferability and publicity capacity, and have the legitimacy of secured financing. Through an empirical examination of the forms of realization of secured financing for carbon emission rights in various places, it is found that there are three main modes: pledge, mortgage and generalization. In this regard, the mode of

realization of secured financing of carbon emission rights should be clarified and the corresponding rules should be clarified on the basis of the objective of “actively and steadily advancing carbon peaking and carbon neutrality”. Carbon emission rights should adopt the mortgage financing path, and the specific system design should reasonably define the scope of the main parties exercising the rights, including the lender and the borrower, adopt the registration effect doctrine, take the People's Bank of China's Credit Reference Center as the mortgage registration authority, and establish the information synchronization mechanism between the Unified Registration and Publication System for Movable Asset Financing and the National Carbon Emission Rights Registry System, so as to unify the effect of the public notice.

(c)Carbon Reduction Effect of Green Bonds: an Investors' Green Preference Perspective

Gan Tianqi, Li Shengbo, Zhou Zongyu

China Population, Resources and Environment, Issue 11, 2024

Green bonds, characterized by both green and financial attributes, play a crucial role in green finance. Their advantages, such as low costs and high transparency, make them attractive to investors and position them as essential financial instruments in achieving the 'dual carbon' goals. From the perspective of investors' preferences, this study constructed a New Keynesian-Dynamic Stochastic General Equilibrium (NK-DSGE) model introducing heterogeneous production technology shocks and investors' green preference shocks. It simulated and analyzed the impacts of the production technology shocks for both green manufacturers and brown manufacturers, as well as investors' green preference shocks, across multiple scenarios on China's macroeconomic development and ecological environment quality and their transmission pathways. Research findings showed that: (1) Under various scenarios, green bonds could promote consumption, capital, output, and social welfare. Among these scenarios, the absence of issuance costs offered the strongest promotion effect on economic growth but had the weakest inhibitory effect on carbon reserves. The carbon tax scenario provided the weakest promotion effect on economic growth but the strongest inhibitory effect on carbon storage. (2) Advances in production technology by green manufacturers could have a negative impact on the ecological environment, but brown manufacturers that did not conduct green technology research and development could harm the ecological environment when they made production technology progress. (3) Investors' green preference could promote the increase of green bonds, provide manufacturers with more green funds for green technology research and development, and reduce carbon emissions. Based on these findings, this study recommends that: (1) The government and

enterprises are crucial factors in achieving the 'dual carbon' goals. The government should strengthen the promotion of green financial development and support enterprises in their green transformation to meet emission reduction goals. (2) The scale of green bond issuance should be expanded and the entry threshold for green bonds lowered to encourage corporate green technology research and development. The associated cost increases caused by the issuance of green bonds should be mitigated through incentives such as carbon tax reductions and exemptions. (3) The transparency and public participation of the green bond market should be enhanced, the innovation and expansion of green bond-related products should be fostered, residents should be encouraged to purchase green bonds, and the continuous improvement of China's green bond market should be promoted.

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