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CBAM and China Carbon Market: Policy Synergy, Trade Impacts and Research Outlook Review

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Abstract

One of the most important tools for changing international trade and climate regulations is the EU Carbon Border Adjustment Mechanism (CBAM). The institutional ramifications of CBAM, its global positioning, and its overall influence on China's carbon market are all thoroughly reviewed in this paper. According to the study, CBAM drives domestic industries toward green and low-carbon transformation while simultaneously raising export costs and tightening carbon management regulations, which have a structural impact on China's high-carbon goods like steel, aluminum, and chemicals' ability to compete internationally. In contrast to the carbon market in the EU, China's carbon market is still in its infancy and has structural flaws. With carbon pricing coordination, industry standard alignment, and green financial support serving as important avenues for addressing external pressures, CBAM also offers external stimulus for institutional improvement in China's carbon market. Research on topics like corporate microbehaviors, the effects of regional differences, the use of transition finance tools, and tactics for international rule competition is still lacking. In order to foster institutional innovation in carbon markets and cooperation with international regulations, future initiatives should concentrate on interdisciplinary research.

Keywords

carbon border adjustment mechanism (CBAM), China carbon market, policy coordination, international trade

1. Introduction

With the deepening of global climate governance and the evolution of trade rules, the Carbon Border Adjustment Mechanism (CBAM) has become a core issue in the interaction between international climate and trade rules. The EU plans to impose differentiated carbon tariffs on imported high-carbon products, which will have a dual impact on global trade: on one hand, it will increase trade costs and burden exporting countries; on the other hand, it will incentivize green industrial transformation across countries and enhance long-term competitiveness. As the largest source of EU imports, China accounts for 13.43% of the EU's total imports of tax-related products [1], and 80% of carbon emissions from exported intermediate products originate from high-risk leakage industries [2]. The implementation of CBAM will widely affect China-related trade. Currently, China is at a critical stage of low-carbon economic restructuring but faces challenges

such as insufficient technological innovation capabilities and extensive development models in certain industries [3]. Consequently, a systematic examination of the CBAM mechanism and an assessment of its impact on China's carbon market and industrial policies are imperative.

The present study is an examination of extant research on the impact of CBAM on global trade and China's carbon market, and its synergistic mechanisms with domestic policies. The paper commences with an outline of the fundamental implications and global positioning of CBAM. It then assesses its impact on China's high-carbon industry trade, structural adjustment, and emission reduction pathways. The paper goes on to examine the current state of development of China's carbon market and its potential for synergy with CBAM. Finally, it summarises research shortcomings and future directions.

2. Mechanism Connotation and Global Positioning of EU CBAM

2.1 Policy Evolution and Core Design of CBAM

The concept of the Carbon Border Adjustment Mechanism (CBAM) traces back to the carbon tariff system initially proposed by the European Union to protect domestic carbon-intensive industries [2]. In 2019, the EU introduced the CBAM framework under the European Green Deal, which was formally enacted into law in April 2023. The legislation stipulates a transition period starting October 1, 2023, with full implementation scheduled to begin in 2026.

In terms of mechanism design, the Carbon Border Adjustment Mechanism (CBAM) operates under a "nominal carbon market" framework, achieving its policy objectives through a certificate purchase mechanism closely aligned with the European Union Emissions Trading System (EU ETS). According to the legislation, importers must purchase electronic certificates for carbon emissions contained in imported products. Certificate prices are dynamically linked to the weekly average auction prices of EU ETS allowances, with annual settlement requirements [4]. Initially, certificates cover high-carbon industries such as cement, power generation, fertilizers, steel, aluminum, and hydrogen, with coverage gradually expanding in sync with the EU ETS free allowance reduction program. From 2026 to 2034, free allowances for these industries will be reduced by 10% annually until complete elimination by 2035 [5]. By removing the "double protection" problem brought about by earlier free allowances, this design should make it possible to more fairly coordinate domestic emission reductions with border adjustments. The EU uses default values based on the average emission intensity of exporting nations and imposes punitive standards based on the lowest performance benchmarks within the same industry when data is unavailable, despite the fact that actual emission data is encouraged [4]. Due to possible discriminatory pricing practices, this could lead to international trade disputes in addition to putting pressure on carbon monitoring and accounting systems in developing nations.

2.2 The Role of CBAM in Global Climate Governance

The Carbon Border Adjustment Mechanism (CBAM) has a deeper strategic goal of changing global climate governance frameworks and green economic competition regulations, even though its primary objectives are to stop carbon leakage and preserve industrial competitiveness. According to Zeng et al. [4], carbon leakage is the phenomenon whereby carbon-intensive industries move to nations with less stringent emission reduction policies after a country implements emission reduction measures. This results in higher carbon tax burdens for the original country. In an effort to control international green trade laws and create long-term competitive advantages in green industries like renewable energy and low-carbon technologies, the EU has expanded its internal carbon pricing standards internationally through CBAM [3, 6]. Nevertheless, this mechanism does not fully address the actual needs of developing countries with regard to green innovation, nor does it adequately reflect the emission reduction responsibilities of developed nations. Such practices have the potential to not only exacerbate existing inequities in global climate governance but also to undermine the foundations of political trust in international cooperation. This, in turn, has the capacity to hinder the progress being made towards the establishment of a community with a shared future for humankind.

2.3 The Reshaping Role of CBAM on International Trade Rules

From a legal perspective, CBAM compliance faces conflicts with the international economic and trade rules system. Based on EU internal carbon pricing standards, CBAM may violate the WTO principle of non-

discrimination and conflict with Article 20 “General Exceptions” and Article 21 “Security Exceptions” of GATT 1994 [5]. Additionally, the high compliance costs and complex technical requirements of CBAM pose substantial technical trade barriers for developing countries with underdeveloped monitoring, reporting, and verification (MRV) systems. Research has summarized that while CBAM appears to practice green protectionism on the surface, its essence is trade protectionism aimed at maintaining EU traditional industries’ competitiveness and alleviating internal economic pressures [3, 6]. Its unilateralist nature may prompt other major economies to adopt similar measures or counteractions, leading to fragmented global trade rules, escalating green trade barriers, and ultimately undermining the multilateral free trade system and global climate cooperation efforts.

3. Review on the Impact of CBAM on Chinas Carbon Market and Policy Synergy Research

3.1 The Development Process and Current Characteristics of Chinas Carbon Market

The construction of China’s carbon market follows the principle of “pilot projects at the local level first, then gradually expanding nationwide.” In July 2021, the national carbon emission trading market was officially launched, marking the entry of China’s carbon market into its first development stage with the power generation industry as the breakthrough point. Currently, the national carbon market covers the world’s largest power generation industry enterprises, primarily adopting a free quota allocation method based on intensity control, while gradually exploring the introduction of paid allocation [7].

However, compared with the mature EU Emissions Trading System (EU ETS), China’s carbon market is still in its early stages of development. First, the industry coverage is relatively limited. China currently only includes the power generation sector, while high-carbon industries such as steel, cement, and chemicals have not yet been incorporated. With limited industry coverage, the price discovery function and resource allocation efficiency of the carbon market are constrained, making it difficult to guide low-carbon investments across the entire economy. Second, carbon prices are relatively low and lack sufficient volatility. The average transaction price of high-carbon industrial products in China has long fluctuated between 50-80 RMB per ton of CO_2, which is several times lower than the price in the EU ETS. For many enterprises, the cost of purchasing allowances remains far lower than the investment required for technological upgrades, so carbon prices fail to accurately reflect the marginal abatement costs society must bear to achieve the “dual carbon” goals. Third, market liquidity needs improvement, with transactions primarily focused on compliance and low financialization [8, 9]. The gap between China’s carbon market and international markets will weaken the signal that carbon prices reflect the cost of carbon emissions under the implementation of CBAM.

3.2 The Impact of CBAM on Chinas Carbon Market

3.2.1 Direct Impact on Export Trade: Costs, Competitiveness, and Market Access

In the context of international trade, the direct impact mechanism of CBAM on China’s carbon industry exports is centred on the rising cost of carbon emissions, with the potential to significantly alter the export economics, competitive landscape, and market access conditions of China’s high-carbon products. Evidence from extant research suggests that, within the EU’s levying framework, the export costs for China’s chemical industry, steel, aluminium, and cement sectors will increase substantially. It has been demonstrated that carbon tariff rates have the potential to approach or even exceed the operating profit margins of specific industries, thereby directly weakening price competitiveness [3]. In the event of a decline in price competitiveness, it is possible that certain enterprises may encounter a reduction in profits as a consequence of increased trade costs. Consequently, this could potentially precipitate an alteration in the production focus towards alternative products, which might ultimately result in a decline in market share. The repercussions of CBAM on costs are also evident in financial markets, primarily manifesting as an influence on market expectations and sentiment. In their analysis of the returns of carbon products in financial markets, Boqiang and Hengsong [10] utilised the STIRPAT and Ridge models. The findings of the study indicated that the implementation of CBAM legislation resulted in substantial declines in China's aluminium and steel futures yields. This decline is indicative of market pessimism concerning future profits in CBAM-related industries.

The regulatory framework governing market access has undergone a fundamental transformation, evolving from traditional tariff-based barriers to novel barriers centred on carbon management capabilities. The complex MRV (Monitoring, Reporting and Verification) requirements under CBAM have been shown to impose substantial technical trade barriers on developing enterprises with weak data foundations [5]. In response to the pressures engendered by CBAM, large corporations are adopting dynamic strategies. These include the transition from passive trade flow adjustments and compliance-driven data management to proactive investments in low-carbon technologies and green supply chain practices. The objective of these strategies is to reshape long-term competitive advantages [1]. Conversely, less developed enterprises encounter significant challenges due to constrained market flexibility. In summary, the CBAM's effect on the carbon industry's costs extends over a broad spectrum of cost chains. Consequently, comprehensive and meticulous evaluations at numerous levels are required to cultivate new competitive edges.

3.2.2 Promotion and Challenges of Industrial Structure Adjustment

CBAM, as an external pressure, has been demonstrated to synergise with domestic carbon peaking and carbon neutrality goals, thereby driving high-carbon industries in China to make structural adjustments towards green and low-carbon development. The study revealed that this adjustment process is characterised by the presence of both significant impetus and resistance.

In terms of policy incentives, the Carbon Border Adjustment Mechanism (CBAM) encourages enterprises to reduce carbon intensity through technological upgrades and energy substitution by increasing export costs, with particularly strong transformation incentives for export-oriented regions [11]. Nevertheless, the transition of the carbon industry is confronted by numerous deep-seated challenges: Firstly, significant technological and financial impediments must be considered. The low-carbon innovation process necessitates considerable investment and carries elevated levels of risk, whilst concurrently exhibiting an absence of sufficient corporate autonomy [4]. Secondly, the imperfections of domestic market mechanisms must be acknowledged. The national carbon market is still in its infancy and is experiencing difficulties in effectively guiding resource allocation [7]. Thirdly, imbalances in regional and industrial transitions may be exacerbated. The CBAM will have far-reaching consequences for industrial chains, exerting a substantial impact on employment and household incomes in energy-intensive and heavy industry clusters. In the absence of rational regional coordination and equitable transition mechanisms, this could exacerbate domestic regional development disparities [11]. Consequently, in addressing external carbon constraints, China is required to establish a systematic policy framework that achieves a balance between efficiency and equity, coordinates long-term transitions with short-term adjustments, and promotes inclusive and sustainable industrial restructuring.

3.2.3 Impact Effects on Emission Reduction Technology Pathways and Technological Innovation

The CBAM has a profound impact on the emission reduction technology choices and innovation systems of China's high-carbon industries. This external policy signal has been shown to have a significant effect on the stimulation of innovation in green technology. Empirical studies using the difference-in-differences method found that after the CBAM issue gained momentum, the number of green patent applications in China's high-carbon manufacturing sector increased significantly under the regulatory and mediating effects of public environmental concerns and government fiscal support [1]. This innovation incentive exhibits industry heterogeneity, with the petrochemical and non-ferrous metal industries responding more sensitively than the steel and cement industries.

In terms of technical approaches, the study found that compared to passively bearing EU carbon tariffs, China could more effectively promote fundamental transformation of its energy and power systems, achieve better overall emission reduction outcomes, and mitigate external trade shocks by actively implementing domestic carbon taxes or strengthening carbon markets [12]. This highlights the importance of transforming external pressures into internal reform momentum. Future efforts should focus on improving the innovative carbon industry system, deepening green financial instruments, strengthening industry-academia-research collaboration mechanisms, and expanding international technology cooperation channels.

3.2.4 Impact on the Welfare Effects of Chinas Carbon Market

In terms of welfare effects, the impact of CBAM on China's carbon market is multidimensional and uneven. Duan Yuwan et al. [8] previously analyzed using the GCE model, showing that the establishment of Chinas carbon market itself promotes domestic emission reductions, but may affect output and emissions in other economies by lowering international energy prices and generating trade substitution effects, exhibiting the complexity of "leakage" and "backflow" in global emission reductions. Sun Yuanchen [11] further found that the superposition of CBAM may, in the short term, exert pressure on domestic producer welfare and employment for specific labor groups due to rising costs. However, from a long-term and holistic perspective, promoting green transition is expected to bring long-term positive welfare benefits such as improved environmental quality, enhanced energy security, and growth of emerging industries. International research also indicates that, if properly designed, the revenue generated by CBAM can be used to support low-carbon transitions in developing countries, thereby enhancing the inclusiveness and fairness of global policies [13]. Therefore, evaluating the welfare effects of CBAM requires balancing short-term pain with long-term benefits and local shocks with global optimization. Overall, CBAM's welfare impact on China's carbon market is relatively negative in the short term, necessitating coordinated policy efforts between governments and enterprises to jointly mitigate the cost shocks brought by carbon tariffs.

3.3 Policy Interaction and Synergy Potential Between CBAM and Domestic Carbon Markets

In terms of emission reduction and structural transformation, studies generally agree that China's carbon market has initially established a market-based incentive mechanism of "costs for carbon emissions and benefits for carbon reduction" by setting emission caps and creating carbon assets, thereby promoting energy efficiency improvements and low-carbon technology applications across enterprises [8].

However, the policy issues exposed by China's carbon market cannot be overlooked. Firstly, the data quality foundation remains a weak link, and a comprehensive and robust monitoring, reporting, and verification (MRV) system for carbon emissions needs to be established and consolidated [4]. Secondly, market activity is insufficient, with transactions concentrated around compliance periods, and the price discovery function has yet to be fully utilized. Thirdly, corporate participation depth is limited, as many enterprises still view carbon trading as a passive compliance task rather than a strategic tool for active carbon asset management and low-carbon development planning [7]. The existence of these issues to some extent constrains the full realization of carbon market policy effects. Therefore, a thorough analysis of the relationship between China's carbon market and this external mechanism is of great significance for formulating more targeted and forward-looking domestic policies.

Based on the aforementioned interactive mechanisms, both academic research and policy practice have identified multiple collaborative pathways in response to domestic policies and the CBAM mechanism.

The Synergy of Carbon Pricing Mechanisms. The core of coordinating CBAM with domestic carbon pricing lies in driving domestic carbon prices to rise steadily within a controllable range while accurately reflecting genuine emission reduction costs. This means carbon price coordination should not involve linear price hikes, but rather implement supply-side reforms such as expanding industry coverage and optimizing quota allocation to ensure carbon prices truly reflect marginal domestic emission reduction costs., Building on this foundation, through dialogue and integration with international carbon markets, China can gradually enhance its influence within the global carbon pricing network. This approach not only reduces the additional costs associated with CBAM but, more importantly, sends clear low-carbon investment signals to the domestic economic system, guiding resource allocation toward green sectors [8].

The synergy between industry standards and technologies. Although CBAM increases the cost of carbon emissions, it also drives high-carbon industries such as steel, aluminum, and cement to catch up with international advanced levels by establishing and implementing strict carbon emission intensity benchmarks. Aligning domestic emission reduction actions with CBAM accounting rules enables domestic emission reduction efforts to be directly translated into carbon cost reductions for exports to Europe, forming a positive incentive cycle of "domestic emission reduction-international recognition-cost reduction" [14]. This synergistic mechanism not only involves the coordination of industry standards and technologies but should also seize this opportunity to lead or encourage industry alliances at the national level to develop

scientifically sound and China-specific deep decarbonization roadmaps and low-carbon technology standard systems for key industries. Efforts should be made to transform the green trade barriers constituted by CBAM into green transformation practices for China's manufacturing sector and further export them as quantifiable, verifiable, and comparable green standards.

The synergy of the green financial system. CBAM significantly increases the transition risks of high-carbon industries and the investment value of low-carbon technologies. It is imperative that China's green financial system evolves from a mere facilitator of sustainable development to an agent that proactively catalyses the transformation of high-carbon industries. The development of transition finance instruments that precisely meet the substantial funding needs for technological upgrades in key industries has become a critical bridge connecting carbon market policy signals with real economic investment behaviours [1]. CBAM, as an external pressure, has been demonstrated to synergise with domestic carbon peaking and carbon neutrality goals, thereby driving high-carbon industries in China to make structural adjustments towards green and low-carbon development.

In summary, the potential for a synergistic relationship between CBAM and domestic carbon markets can be seen in three key areas: namely carbon pricing, industrial standards and green finance. It is evident that the enhancement of the authenticity and influence of domestic carbon prices through synergy in carbon pricing has been demonstrated to engender a diminution in the additional costs of CBAM at the level of the root. The alignment of industry standards has been demonstrated to foster the transformation of domestic initiatives aimed at reducing emissions into competitive advantages in international trade. The facilitation of this process is enabled by technical benchmarking and the mutual recognition of accounting practices. The concept of synergy in green finance can be defined as the provision of sustainable financial support for the low-carbon transition of high-carbon industries. This is achieved through the innovation of transformational financial instruments. The three synergistic pathways are mutually reinforcing and presuppose one another, thereby forming a systematic policy framework that spans from price signals to technical standards and capital allocation. Collectively, these pathways drive China's carbon market to achieve institutional improvement and capacity enhancement while addressing external pressures.

4. Research Review and Future Prospects

4.1 Main Consensus and Controversies in Existing Research

Through the above review of existing literature, the academic community has reached a relatively clear consensus on the interactive relationship between CBAM and China's carbon market at several levels.

The impact of CBAM is real and structural. Whether it is the earliest qualitative analysis [2] or later quantitative calculations [3, 14], studies generally confirm that CBAM is not a hollow policy declaration but will genuinely increase the export costs of China's high-carbon products, with its tax burden levels approaching or even exceeding operating profit margins in some industries. This impact is not evenly distributed but exerts differentiated pressure on different industries and enterprises of varying sizes along three pathways: carbon emission intensity, export dependence, and technology.

There exists a systemic gap between China's carbon market and the EU ETS. The industry coverage is limited, carbon prices are low, liquidity is insufficient, and the degree of financialization is low. These findings have been repeatedly identified in studies by Ref. [8, 9, 11]. The existence of this gap serves not only as the technical root of CBAM taxation but also as a space for domestic reform.

External pressures and internal transformation are not zero-sum games. An increasing number of studies are shifting from passive responses to proactive collaboration. As demonstrated by Zeng An et al. [4], Yang et al. [1], and Zhang Bingbing et al. [9], the potential exists to transform CBAM pressures into institutional innovation drivers through perspectives such as MRV system development, green technology innovation, and carbon market expansion. However, controversies remain significant. Firstly, regarding carbon pricing mechanisms, academia generally divides into two camps. However, controversies remain significant. Firstly, regarding carbon pricing mechanisms, academia generally divides into two camps. The first advocates aligning with EU carbon pricing systems to reduce the tax base of CBAM (Carbon Border Adjustment Mechanism). Yet excessively high carbon prices may paradoxically hinder economic growth, leaving

scholars still debating whether emission reduction should take priority over economic development. Secondly, concerning collaborative strategy frameworks, existing research highlights the integration of digital infrastructure development with international carbon pricing systems, though the extent of policy influence requires further exploration. Beyond evaluating synergistic effects, critical considerations include methodological compatibility in measurement approaches and the robustness of analytical frameworks.

4.2 Research Gaps and Recommendations for Future Research Directions

Despite the substantial body of extant research that has established a robust foundation for understanding CBAM, there is a paucity of exploration in the following areas.

Firstly, there is a necessity for further exploration into the intricacies of corporate-level decision-making processes. Whilst extant studies chiefly evaluate cost effects at macro or industry levels, empirical analyses based on surveys or micro-level data remain scarce with regard to actual Corporate responses to CBAM (Customs Border Adjustment Mechanism). It is evident that enterprises of various types, scales and locations exhibit significant differences in their coping strategies. However, the influence of these variations on industrial restructuring remains an underexplored area. It is recommended that future research integrates corporate surveys with case studies and customs-enterprise matching data. This would facilitate the characterisation of compliance costs, strategic choices, and transformation bottlenecks across different enterprise types. It is imperative that particular attention be paid to the practical challenges and policy needs of small and medium-sized enterprises (SMEs).

Secondly, the necessity for enhanced attention to regional-level differentiated analysis is highlighted. While CBAM affects coastal and inland regions differently, current research treats these disparities as homogeneous. It is clear that key research areas, like risk assessment, compensation and fair transition, have not been dealt with properly. Future studies are advised to place a priority on the identification of high-risk regions affected by CBAM, employment relocation support and infrastructure compensation. Furthermore, such studies should explore the potential for equitable cost-sharing mechanisms across different regions and demographic groups during transition periods.

Additionally, the practical application of transition finance instruments is found to be lagging behind policy advocacy. As demonstrated in the research conducted by Yang et al. [1], there is a clear necessity to develop transition finance. However, the extant body of research is not yet sufficiently comprehensive to address the real-world implementations and performance evaluations of instruments such as sustainability-linked bonds and transition loans in China’s carbon-intensive industries. The process of converting theoretical frameworks into operational practices requires substantial empirical evidence. It is imperative that future research endeavours concentrate on pivotal sectors, namely the steel, chemicals, and aluminium industries. The present focus should be directed towards investigating the potential application of transition finance instruments in these domains. A number of issues must firstly be addressed, namely the following: the interest rate linkage mechanism between sustainability-linked bonds and carbon intensity reduction targets; secondly, risk management models for transition loans compared to traditional credit instruments; and thirdly, the need for interdisciplinary collaboration across finance, industrial economics, and environmental economics.

However, there is still much to be gained in exploring the strategic space for international rule competition in greater depth. The CBAM does not constitute a rigid framework insofar as it allows for adjustment of its accounting methodologies, industry coverage, and carbon price benchmarks. However, the majority of domestic research focuses on how to respond to these issues rather than on how to participate in the process of rule-making. There is a lack of academic preparation for issues such as the securing of interpretative space within multilateral frameworks, the promotion of mutual recognition of standards in bilateral dialogues, and the accumulation of defence experience under the WTO dispute settlement mechanism. It is asserted that future research should focus on active participation rather than passive compliance, exploring China's position selection in carbon accounting standard mutual recognition negotiations, the feasibility and design approaches of carbon price linkage pilots, and the legal space for CBAM compliance defences under the WTO framework. The subjects in question are characterised by intricate interrelations between legal, international relations, and economic domains, underscoring the imperative for interdisciplinary collaboration.

5. Conclusion

This review concludes that the EU's Carbon Border Adjustment Mechanism (CBAM) has a significant, long-term impact on China's high-carbon industries and carbon market. By raising export costs and tightening carbon compliance requirements, the CBAM directly affects the trade competitiveness of sectors such as steel, aluminium, and chemicals. At the same time, CBAM serves as an external catalyst, pushing China's carbon market — still in its early stages, with limited sectoral coverage, low carbon prices and weak liquidity — towards institutional improvement. There is potential for policy synergy in three areas: carbon pricing coordination, alignment of industry standards and accounting rules, and the use of green and transition finance.

While existing research provides a solid foundation for understanding the trade and welfare implications of CBAM, important gaps remain. Evidence at a micro level on how different types of firms respond to CBAM is scarce, and regional disparities within China are often overlooked. The practical application of transition finance instruments in key industries has not been systematically evaluated. Furthermore, most studies focus on passive adaptation rather than proactive participation in shaping international carbon and trade rules.

Future research should adopt interdisciplinary approaches to address these gaps. Priorities should include empirical studies at firm level, regionally differentiated impact assessments and the design of transition finance mechanisms tailored to China's context. It is equally important to explore legal and strategic pathways for engaging in global rule-making and to turn external pressure into an opportunity for institutional innovation and sustainable competitiveness.

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