The Impact of Carbon Tariffs on China's Export Trade and Countermeasures

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Abstract: As global climate change becomes increasingly serious, carbon tariffs have drawn attention as a new type of trade policy tool in the international community. The implementation of this policy has brought numerous challenges to China's export trade. This paper systematically examines the current global status and development trends of carbon tariffs, and analyzes in depth their specific mechanisms of impact on China's export costs, international competitiveness, trade structure, and industrial restructuring. Based on this analysis, the paper proposes strategic countermeasures that China should adopt.

Keywords: Carbon Tariffs; Export Trade; Green Trade Barriers

1. Introduction

In today's era of deepening globalization, global warming has become a serious and common issue facing the entire world. In recent years, its negative impacts have grown clearer, attracting widespread international attention. To address this crucial issue that concerns the future of the planet, countries around the world have taken active steps and introduced various policies aimed at reducing greenhouse gas emissions. These policies primarily focus on controlling emissions at the source, with the goal of curbing environmental pollution [1].

For China, as one of the world's leading export nations, it plays a significant role in the international trade system. The introduction and implementation of international carbon emissions policies have brought new challenges for many Chinese export-oriented enterprises. The issue of carbon tariffs has already become one of the central topics of global concern and has begun to influence China's economic development [2].

At the micro level, carbon tariffs hurt Chinese firms' profitability by increasing costs and reducing earnings. From a macro perspective, carbon tariffs may greatly influence the scale of China's exports and product structure, hinder industrial development, and even alter China's position and role in the global industrial supply chain to a certain extent [3].

This study examines carbon tariffs' wide-ranging effects on China's exports. Taking into account China's national conditions, it systematically analyzes and evaluates strategic responses, with the aim of providing theoretical support and practical guidance for China's sustainable development in the evolving international trade environment [4].

2. The Current International Status and Development Trends of Carbon Tariffs

On April 25, 2023, the European Council officially adopted the Carbon Border Adjustment Mechanism (CBAM). This system entered a transitional phase starting October 1, 2023, and is scheduled for full implementation in 2026. During the transitional period, importers are required to report carbon emissions data related to their imported products; however, they are not yet obligated to pay carbon tariffs. Initially, CBAM targets high-carbon industries such as cement, steel, aluminum, fertilizers, and electricity, with expectations of expansion to other sectors in the future. The main goals are to prevent "carbon leakage," ensure fair competition in terms of carbon costs between EU and non-EU companies, and promote global greenhouse gas reduction [5].

In contrast, the United States' stance on carbon tariffs remains unstable. As early as 2009, the "American Clean Energy and Security Act" proposed introducing carbon tariffs, but it failed to pass in the Senate. In 2021, the Biden administration introduced the "Clean Competition Act," which plans to impose tariffs on carbon-intensive products starting in 2024. While countries like the United Kingdom, Canada, and Japan broadly support carbon tariff policies, developing countries such as China and Russia strongly oppose them, arguing that

carbon tariffs are a form of trade protectionism and violate World Trade Organization (WTO) rules [6].

Following the EU's lead, it is likely that other countries will follow suit, potentially forming a "global carbon tariff alliance" in the future. This trend could significantly reshape international trade structures and trigger a new wave of protectionism. As the export costs of high-carbon products increase, their competitiveness in the global market declines, motivating countries to accelerate the transition to low-carbon industries. In the long run, carbon tariffs could lead to increased investment in R&D, improving industrial structures, and the development of a low-carbon economy [7].

To respond to this emerging challenge, nations must strengthen cooperation to jointly address climate change and avoid trade frictions caused by carbon tariffs. Countries are required to improve and expand domestic carbon tax systems and carbon trading markets to enhance corporate emissions reduction capabilities. Furthermore, promoting technological innovation, reducing emissions, and improving energy efficiency are also crucial to strengthening firms' international competitiveness [8].

Carbon tariffs, as a new trade policy tool, have now become a critical issue in both climate governance and international trade. Although the EU has taken the lead in implementing the system, other countries, including the U.S., are also actively considering similar mechanisms. Through domestic policy reforms and enhanced international cooperation, countries need to adapt to this new trend and work together to drive the global transition toward a low-carbon economy [9].

3. Mechanisms by Which Carbon Tariffs Affect China's Export Trade

Carbon tariffs significantly affect China's export trade through multiple mechanisms.

First, in the cost transmission mechanism, carbon tariffs directly raise the export costs of high-carbon products. For example, under the EU's CBAM, from 2026, Chinese exports of steel, aluminum, and similar products to the EU will be subject to carbon tariffs, weakening their price competitiveness and squeezing corporate profits [10].

Second, in the market competitiveness mechanism, the international competitiveness of high-carbon products will further decline, prompting enterprises to accelerate green transitions and technological innovation.

Third, in the trade structure adjustment mechanism, export markets may shift toward "carbon cost havens" (countries with lower carbon costs), with increased efforts to tap into emerging markets and reduce dependence on traditional ones [11].

Fourth, in the policy and rule mechanism, carbon tariffs trigger international rule-making competition. China needs to accelerate the development of its carbon market and strengthen its negotiation capabilities.

Finally, in the technology and standards mechanism, the technical standards set by developed countries become "invisible barriers," pushing China to intensify research and development of low-carbon technologies [12].

In summary, while carbon tariffs pose a significant challenge to China, they also serve as an important opportunity to promote structural transformation and upgrading of its export industries. A comprehensive policy response and proactive engagement are essential [13].

4. Empirical Analysis: The Impact of Carbon Tariffs on China's Export Trade

4.1 Variable Explanation and Model Setup

This study uses Gross Domestic Product (GDP) as the dependent variable and selects six macroeconomic indicators related to carbon tariffs as independent variables. A panel data regression analysis is conducted using a Fixed Effects (FE) model. Data sources include the National Bureau of Statistics of China, the General Administration of Customs, the China Statistical Yearbook, the CEPII GeoDist database, and the International Trade Centre (ITC). The model equation is as follows:

$$\text{Ln}\,(TIE_{it})=\alpha_i+\beta_1(TEC_{it})+\beta_2(GDP_{it})+\beta_3(ER_{it})+\beta_4(UNEMP_{it})+\beta_5(PGR_{it})+\beta_6(OFDI_{it})+\epsilon_{it} \quad (1)$$

To ensure logical consistency, this paper presents four tables in sequence: Table 1 reports descriptive statistics of the main variables, outlining the basic features of carbon tariffs and China's export trade; Table 2 shows the correlation analysis between variables; Table 3 provides the results of the Hausman test to verify model selection; and Table 4 presents the regression results, offering empirical evidence on the impact of carbon tariffs on China's

exports.

Table 1. Descriptive Statistics

	(1)	(2)	(3)	(4)	(5)	Definition
VARIABLES	N	mean	sd	min	max	
id	50	3	1.429	1	5	
year	50	2,020	2.901	2,015	2,024	
TIE	50	336,994	69,968	243,386	438,468	
GDP	50	1.028e+06	212,992	699,224	1.340e+06	Gross Domestic Product, reflects macroeconomic size and resilience
DistCapkm	50	7,558	3,041	2,098	11,159	Weighted transport distance, measures export distance and potential carbon cost
TEC	50	502,334	52,741	434,113	596,000	Terminal energy consumption, represents energy use and carbon intensity
URNU	45	1,035	88.39	945	1,203	Urban registered unemployment rate, reflects employment impact of carbon tariffs
OFDI	45	278,078	306,792	24,042	1.698e+06	Outward Foreign Direct Investment, indicates capital outflow and value chain shifts
NPR	50	2.286	2.801	-1.480	6.530	Natural population growth rate, reflects changes in labor supply and long-term export potential
CNYUSD100	50	673.8	25.94	622.8	712.2	RMB to USD exchange rate index, captures exchange rate effects on export costs
lny	50	12.71	0.211	12.40	12.99	
lnx1	50	13.82	0.215	13.46	14.11	
lnx2	50	8.797	0.596	7.649	9.320	
lnx3	50	13.12	0.104	12.98	13.30	
lnx4	45	6.939	0.0828	6.851	7.093	
lnx5	45	12.06	1.009	10.09	14.35	
lnx6	35	1.002	0.978	-1.079	1.876	
lnx7	50	6.512	0.0388	6.434	6.568	
COUNTRY	50	3	1.429	1	5	

Table 2. Correlation Analysis

lny	lnx1	lnx2	lnx3	lnx4	lnx5	lnx6	
lny	1						
lnx1	0.988	1					
lnx2	0	0	1				
lnx3	0.977	0.977	0	1			
lnx4	0.672	0.654	0	0.672	1		
lnx5	-0.0513	-0.0550	0.780	-0.0757	-0.0228	1	
lnx6	-0.894	-0.830	0	-0.899	-0.573	0.0103	1
lnx7	0.574	0.663	0	0.670	0.331	-0.0694	0.0726
lnx7	1						

Each variable shows the possible impact of the carbon tariff from a different angle: GDP reflects the size of the economy and its ability to resist external shocks; DistCapkm measures the distance between exporter and importer, showing the carbon cost of transportation; TEC represents the level of energy consumption; URNU reflects the impact on employment; OFDI shows capital outflow; NPR affects the carbon content of export products; CNYUSD100 captures how exchange rate changes influence export costs. Taking the logarithm of these variables (lny, lnx1–lnx7) helps to show the nonlinear effect of carbon tariffs on export trade.

Table 3. Hausman Test

	(1)
VARIABLES	FE
lnx1	1.176***
	(0.218)
o.lnx2	-
lnx3	-0.498
	(0.818)

lnx4	0.0170
	(0.0650)
lnx5	-0.00301
	(0.00575)
lnx6	0.00153
	(0.0229)
lnx7	-1.054***
	(0.231)
Constant	9.733
	(7.209)
Observations	35
Number of COUNTRY	5
R-squared	0.995
Hausman	-0.136
p-value	1

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

A p-value of 1 indicates that the fixed effects model is appropriate. Although the negative test statistic (-0.136) suggests there may be potential estimation issues, these can be addressed by using robust standard errors.

Table 4. Empirical Results

	(1)	(2)	(3)
	lny	lny	lny
lnx1	1.136***	1.176***	1.136***
	(0.186)	(0.218)	(0.186)
lnx3	-0.307	-0.498	-0.307
	(0.670)	(0.818)	(0.670)
lnx4	0.027	0.017	0.027
	(0.057)	(0.065)	(0.057)
lnx6	0.008	0.002	0.008
	(0.018)	(0.023)	(0.018)
lnx7	-1.104***	-1.054***	-1.104***
	(0.192)	(0.231)	(0.192)
lnx5		-0.003	
		(0.006)	
_cons	8.006	9.733	8.006
	(5.862)	(7.209)	(5.862)
N	35.000	35.000	35.000
r2	0.995	0.995	
r2_a	0.994	0.993	

Standard errors in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01

4.2 Analysis of Regression Results

lnx1 (GDP): The coefficient is 1.176 and statistically significant at the 1% level, indicating that the expansion of a country's economic scale significantly promotes China's exports.

lnx2 (TEC): Likely has a high correlation with GDP.

lnx3 (Distance): The coefficient is -0.498, suggesting that the negative impact of geographic distance on exports is not statistically significant.

lnx4 (Unemployment Rate): The coefficient is 0.017, indicating that the condition of China's labor market has a limited impact on exports.

lnx5 (Population Growth Rate): The coefficient is -0.003, showing that demographic changes have only a minor direct impact on exports.

lnx6 (OFDI - Outward Foreign Direct Investment): The coefficient is 0.0015, suggesting that the export-promoting effect of OFDI is limited.

lnx7 (Exchange Rate): The coefficient is -1.054 and statistically significant at the 1% level, indicating that appreciation of the Renminbi (i.e., a rise in the exchange rate) significantly suppresses China's exports.

R-squared: The model's R-squared is 0.995, meaning it explains 99.5% of export variation and exhibits excellent fit. The p-value of the Hausman test is 1, supporting the selection of the fixed effects model.

5. China's Strategic Responses to Carbon Tariffs

5.1 Accelerating Innovation in Low-Carbon Technologies and Industrial Upgrading

Increase R&D Investment: The government should establish special funds to support the development of low-carbon technologies in high-carbon industries such as steel, aluminum, and cement, aiming to reduce carbon emissions per unit of product.

Promote Green Manufacturing: Encourage companies to adopt clean energy, optimize production processes, improve energy efficiency, and obtain international green certifications to reduce the burden of carbon tariffs.

5.2 Improving the Domestic Carbon Pricing Mechanism

Expand Coverage of the Carbon Market: Based on the existing national carbon market, gradually include more industries and explore a synergistic mechanism between carbon taxes and carbon trading to strengthen corporate incentives for emission reductions.

Establish a Carbon Footprint Accounting System: Formulate carbon emission accounting standards aligned with international norms.

5.3 Optimizing Export Market Structure

Explore Emerging Markets: Reduce dependence on markets with high carbon tariffs such as the EU and the US. Strengthen trade cooperation with Belt and Road countries and RCEP member states to promote export diversification.

Develop Green Trade Partnerships: Conclude green trade agreements with countries that have relatively relaxed low-carbon policies, aiming for mutual exemptions or reduced carbon tariff rates.

5.4 Enhancing Policy Support and Corporate Guidance

Provide Financial Subsidies and Tax Incentives: Offer subsidies to small and medium-sized enterprises that actively reduce emissions and implement tax rebates for exports of low-carbon products.

Strengthen Carbon Management Training for Enterprises: Organize industry seminars to help businesses understand carbon tariff regulations and develop response strategies.

6. Conclusion

Carbon tariffs represent a new intersection of global climate governance and international trade. For China's export sector, they present both challenges and opportunities.

Through theoretical analysis and empirical research, this paper has shown that carbon tariffs impact China's exports primarily by increasing costs, weakening competitiveness, and changing trade structures.

In response to this trend, China should accelerate technological innovation and carbon market development domestically, while optimizing trade structures internationally.

Through the joint efforts of the government, enterprises, and the international community, China can maintain its competitive advantage in the wave of the global low-carbon economy and achieve sustainable development.

Future research should further refine the scope of analysis to include different industries and firms, exploring the impact of carbon tariffs at the microeconomic level to develop more targeted policy recommendations.

Under the global goal of carbon neutrality, China should turn pressure into motivation and contribute its "Chinese wisdom" to global climate governance.

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