Research on the Impact of Carbon Tariffs on China's Export Trade and Countermeasures
—Taking Sino-US Trade as an Example

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Abstract. Carbon tariff is a new type of green trade barrier proposed by the United States to levy taxes on high-energy-consuming imported products in international trade. Based on the current situation of Sino-US trade, this article takes the implementation of US carbon tariffs as the premise and lists the actual trade data from 2010 to 2020 in order to examines the upcoming impact imposed by the United States on China's export trade. The results show that there is a significant negative effect between carbon tariffs and China's export volume. Based on the above analysis, this paper puts forward policy suggestions in order to provide a theoretical reference for China's export trade to respond to the US carbon tariff policy.

Keywords: carbon tariff · export trade · Sino-US trade

1 Introduction

The carbon tariff was first proposed by French President Jacques Chirac. However, the "Clean Energy Security Act" passed by the United States in 2009 really attracted the attention of the international community. As early as 2007, the U.S. Climate Security Act submitted by U.S. Senate members Joseph Lieberman and John Warner contained relevant provisions on carbon tariffs. In 2008, the "2008 Lieberman-Werner Climate Security Act" submitted by Barbara Boxer, a member of the US Senate, has more detailed provisions on carbon tariffs. The "US Clean Energy Security Act" passed in 2009 stipulates that the United States began to implement the "capacity control and emission trading" mechanism in its country in 2012, and from 2020 it will impose taxes on export products from countries that do not implement carbon emission reduction quotas.

According to the WITS database of the World Bank, in 2020, China is the only country among the top three countries in the United States' foreign trade with positive growth. Therefore, the imposition of carbon tariffs by the United States will virtually force China's export products to face new market access pressures.

In view of this, this article combines the current situation of Sino-US trade, takes the implementation of the US carbon tariff as the assumption, lists the data, starts from the theory and combines the actual trade environment, based on the current situation of China's export trade, and examines the upcoming impact of the US carbon tariff on China's export trade in order to provide a theoretical reference for China's export trade to respond to the US carbon tariff policy.

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2 Literature Review

Although carbon tariffs have not been formally implemented in any country or region so far, the issue of carbon tariffs has been put on the agenda of many developed countries, and has even been implemented in disguise.

Carbon tariffs refer to the imposition of special CO_2 emission tariffs on imported products with high energy consumption. The closest concept to carbon tariffs is border tax adjustment (BTA). Yuan Lujia (2010) pointed out that in the United Nations climate change negotiations, carbon tariffs are often referred to as "border carbon adjustment" or "border tax adjustment" [1]. However, Huang Wenxu (2011) believes that carbon tariffs are not completely equivalent to border adjustment taxes. Not all border adjustment taxes can be called carbon tariffs, only border adjustment taxes based on carbon emissions can be called carbon tariffs [2].

In terms of research on the impact of carbon tariffs, most scholars believe that the imposition of carbon tariffs will have a negative impact on China's export trade. Yang Liqiang and Maman (2011) used the GTAP model to calculate the impact of carbon tariffs on China's export trade [3]. The results showed that the collection of carbon tariffs will have a negative impact on the development of China's export trade to a certain extent, and the degree of impact depends on the carbon tariff rate.

Some scholars believe that carbon tariffs have a series of positive effects while having a negative impact on China's export trade. Pan Hui (2012) analyzed the impact of carbon tariffs on China's export trade from short-term and long-term aspects [4]: in the short term, the price effect of carbon tariffs will increase the cost of export products, reduce export volume, and cause economic welfare losses for exporting countries. Internally, the environmental regulatory effect produced by carbon tariffs will prompt export companies to implement innovation and improve efficiency, thereby enhancing corporate competitiveness.

Based on the existing literature, scholars have not yet reached a consensus on the impact of carbon tariffs on China's export trade.

Compared with the existing literature, the possible improvements of this paper are as follows: First, this paper discusses the mechanism of carbon tariffs on China's export trade, which is different from the single path of carbon tariffs weakening international trade by increasing buyers' market prices in traditional analysis. Secondly, this paper selects trade data that is updated in time compared with the existing literature, making the analysis results more comprehensive. It has timeliness and reference significance.

3 Mechanism Analysis and Research Hypothesis

3.1 Analysis on the Theoretical Mechanism of Carbon Tariffs Affecting China's Export Trade

From the definition point of view, the scope of carbon tariff collection is extensive. The listed products cover almost half of China's export trade commodities, which greatly limit the types of China's export commodities.

The imposition of carbon tariffs is economically punitive, which makes China subject to various controls in the process of export trade. In the process of carbon tariff collection,

no matter who bears the tax amount, the common result is that the greater the carbon dioxide emissions, the higher the taxation, and thus the higher the cost. So there is a positive correlation between carbon dioxide emissions and product prices.

In addition, the pertinence of carbon tariff collection makes China no longer have a competitive advantage in exporting high-carbon products compared with other suppliers. These countries can rely on this regulation to exempt high-carbon products from carbon tariffs, which may cause the market share of China's exports to developed countries to face the possibility of shrinking.

From the perspective of contagion, the conduction of carbon tariffs affects the development of China's overall economy from export trade is like a domino effect. Export trade is one of the three major carriages that drive Chinese economy. This transmission mechanism leads to an increase in China's unemployment rate and a decline in GDP, which checks and balances China's economic development.

To sum up, the impact mechanism of developed countries on China's export trade through the collection of carbon tariffs is a comprehensive manifestation of the extensiveness of carbon tariffs, economic punitiveness, pertinence, and transmission. The economic penalty of carbon tariffs is The core means of restricting China's export trade.

3.2 Research Assumptions on the Impact of Carbon Tariffs on China's Export Trade

Since the economic punishment of carbon tariffs is the core means of restricting China's export trade, after the carbon tariffs were imposed by the United States, importers had to purchase corresponding emission permits for importing high-carbon products, leading to rising prices of imported high-carbon products, a decline in market competitiveness, and a reduction in import demand. And because the carbon tariff has not yet been implemented, it is impossible to obtain relevant data on its control over factors such as the price of export commodities.

Therefore, the following hypothesis H is made: the imposition of carbon tariffs by the United States will lead to an increase in the buyer's price of China's export products in the US market, and will reduce the demand for China's export products in the US market, thus having a certain impact on the scale of China's export trade.

4 Empirical Analysis

4.1 Model Building and Variable Selection

Since the United States has not specifically implemented carbon tariffs at present, it has not had a substantial impact on China's export trade, and we cannot obtain data on carbon tariffs. However, as a special manifestation of tariffs, carbon tariffs have the same connotation as tariffs. Therefore, referring to the practices of scholars such as Wang Youxin (2013) [5] and Shi Honglian (2018) [6], we can predict the impact of carbon tariffs on China based on past tariff-trade effects. The impact of export trade.

First, this paper selects China's exports to the United States and the average tariff rate of the United States to China from 2010 to 2020 to analyze the tariff-export effect,

and establishes the following model:

$$EX_t = \alpha + \beta TARIFF_t + \varepsilon_t$$

Among them, EX_t represents the annual export volume of China to the United States, in tens of millions of dollars; $TARIFF_t$ represents the annual average tariff rate of the United States to China, in %. ε_t represents the residual item. In order to eliminate the impact of price fluctuations, the export value is deflated by the export commodity price index (based on 2010). The data are all from the World Bank's WITS database.

4.2 Analysis of Empirical Results

Stationarity test

This paper adopts the method of time series analysis to empirically test the tariff -export effect of China and the United States. EX refers to the time series of China's exports to the United States, and TARIFF refers to the time series of tariff rates imposed by the United States on China.

Further do the ADF test, and use the ADF method to test the stationarity of each time series and its difference sequence. It can be seen from Table1 that EX and TARIFF are both stable after the second-order difference, that is, they are both second-order integrated sequences, which can be further correlated.

Cointegration test

After the test of stationarity, it is found that EX and TARIFF are non-stationary sequences. Therefore, this paper uses cointegration theory to study whether there is a long-term equilibrium between them relation.

First, linear regression is performed on the two, and the regression results are shown in Table 2. Among them, the goodness of fit R^2 is 0.908062, and the goodness of fit after adjustment $\overline{R}^2$ is 0.904297, indicating that the model fits well and the equation is established effectively.

Furthermore, the stationarity test was carried out on the residuals of the above regression results. The test results show that the ADF test value of the residual item is -5.256171, and the P value is 0.0007, indicating that the residual series is a stationary series. Therefore, there is a co-integration relationship between EX and TARIFF, that is, there is a

Table 1. Unit root test results for each variable

variable	ADF statistics	P value	conclusion
E X	−1.883873	0.5905	unstable
$\Delta^2 EX$	−9.931117	0.0009	smooth
T ARIFF	6.058495	1.0000	unstable
$\Delta^2 TARIFF$	−19.31241	0.0001	smooth

Note: Calculated using EViews 9 software, the same below.

Table 2. Regression result

variable	coefficient	T-statistic	P value
T ARIFF	−2.34803	−11.75463	0.0000
C	14.27989	42.90755	0.0000
$R^2 = 0.908062$		$\overline{R}^2 = 0.904297$	

long-term dynamic equilibrium relationship between them. From the regression results, it can be seen that for every 1% increase in the US tariff rate on China, China's exports to the US will decrease by 2.3%.

Analysis of regression results
From the regression results, it can be seen that from 2010 to 2020, there is a negative correlation between the US tariff rate on China and China's exports to the US. For every 1% increase in the US tariff rate on China, China's exports to the US will decrease by 2.3%. The higher the tariff, the higher the cost of trade will be, which is an obvious inhibitory factor to Sino-US trade. If things go on like this, China will be in an extremely disadvantageous position in Sino-US trade.

5 Conclusions and Policy Recommendations

This paper conducts qualitative and quantitative analysis on the impact of carbon tariffs on China's export trade, and draws the following basic conclusions: Firstly, from the results of qualitative analysis, because of the implement of carbon tariffs, the types, prices and quantities of China's export commodities are controlled to a certain extent, and the competitiveness of export commodities declines, which leads to a squeeze on China's export market share. Secondly, from the quantitative analysis results, once the carbon tariff is imposed, the export value of China's products will be greatly impacted. There is a long-term negative equilibrium relationship between China's exports to the United States and the U.S. import tariff rate, so it can be predicted that carbon tariffs will have a significant negative effect on the export value of the levied country. Based on this, this paper puts forward the following policy recommendations.

First of all, from a national perspective, China should carry out "environmental diplomacy" and actively participate in the formulation of international carbon emission standards and international carbon tariff rules. Secondly, China should actively expand foreign trade space. Emerging markets should be vigorously developed. Only by fully expanding the targets of China's foreign trade exports can we change the status quo of China's foreign trade exports overly relying on developed countries. Thirdly, China should gradually introduce carbon tax and establish China's carbon trading market. Because the WTO stipulates that the same content cannot be taxed repeatedly, after China imposes a carbon tax on the export products of enterprises, the United States will not be able to continue to impose carbon tariffs on them.

6 Project Information

Heilongjiang Provincial Philosophy and Social Science Research Planning Project "Research on the Path and Countermeasures of Heilongjiang Province's Deep Integration into Domestic and International Dual Cycles under the Background of RCEP" (22JYB237).

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