

Analysis of China's Export Trade Competitiveness Under the Background of Carbon Regulation

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ABSTRACT

Based on panel data from the United States, Japan, France, the United Kingdom, Spain, and China from 2002 to 2014, a fixed-effect model is used to study the impact of low-carbon regulation on Chinese international competitiveness. The results of the study show that the carbon regulation of China by developed countries is a new type of trade protectionism, which has established barriers to China's main export trade commodities to a certain extent, resulting in a reduction in the market share of its exports in exporting countries and the competitiveness of export trade will decline. Technology plays an important role in improving the competitiveness of China's export trade in the context of carbon regulation. Finally, relevant policy recommendations are put forward based on the empirical results.

Keywords: the carbon regulation, China's export trade competitiveness, trade protectionism, policy recommendations

1. INTRODUCTION

In recent years, facing the severe challenges of global climate change and energy depletion, the low-carbon economy, an economic development model that takes into account the environment and development, has received more and more attention from all countries in the world. And the development of low-carbon technology has become a major strategic move for the major economic body to improve its international competitiveness. Out of the concern that the dual-track emission reduction regulations will damage their own competitiveness, developed countries and their multinational companies have implemented carbon regulations on developing countries and their enterprises. The sum of the policies and measures implemented for the purpose of reducing carbon emissions, it mainly includes two categories: marginal carbon adjustment tax and carbon standard. "Carbon tariffs" are mainly proposed and advocated by European and American countries, and the tax targets are mainly developing countries including China. The carbon tariff policies proposed by developed countries such as Europe and the United States will have a greater impact on China's economic development, especially foreign trade. As the largest exporter of commodities, China also ranks first in carbon emissions in the world. It bears the brunt of the carbon tariff policy, which will have a greater impact on the social welfare, output, and trade. Besides, its energy sources are mainly coal with high carbon emissions, and the embodied carbon exported to European and American countries is relatively high, who is one of the main victims of European and American border carbon adjustment regulation. As the international community pays attention

to the climate and environment, carbon tariffs may be unavoidable in the future. Facing this new challenge, China should strive for time and space to form a green development model with low energy consumption and low emissions. Therefore, studying the influence of low-carbon regulations on China's international competitiveness has important reference value for guiding its export trade and even economic growth.

2. RESEARCH STATUS AT HOME AND ABROAD

At present, there is no unified understanding of the influence of carbon emission regulations on trade. Regarding the impact of dual-track carbon regulations on developed countries, it is generally believed that industries that are vulnerable to be damaged have three characteristics: high energy consumption in the production process, non-replaceable products, inability to reduce costs and improve efficiency. Empirical studies by Carbon Trust (2004), Reinaud (2005), Houcade et al. (2007) and Houser et al. (2008) have shown that the steel, aluminum, paper, chemical and cement industries in developed countries are affected by the dual-track emission reduction, which have the most prominent regulatory impacts, and their sensitivity to impacts are significantly related to their main technologies and energy sources. Regarding the effect of carbon regulation (hereinafter, carbon regulation refers to border carbon adjustment regulation, rather than dual-track emission reduction regulation) on China's exports

influence. Lingyun Huang and Xing Li (2010) used the GTAP model to simulate the impact of US border carbon adjustment on Chinese exports. The result was that the mineral products industry suffered the most negative impact, with a decrease of 35.86% to 63.32%, respectively. Yu-Huan ZHAO (2011) adopted the gravity model and found that carbon tax has a significant negative influence on the international competitiveness of energy-intensive industries.

In summary, the research of foreign scholars mostly focuses on the motives and reasons that developed countries adopt border carbon regulation on developing countries; domestic scholars' research is mainly based on their own national conditions, and theoretical research draws on foreign research literatures. However, regardless of whether the conclusion reached is that carbon regulation promotes or inhibits the growth of export trades, scholars tend to focus on its impact on the export scale of a particular industry, and less attention to the impact of carbon regulation on China's export trade competitiveness influences. From the perspective of focusing on overall export trade competitiveness, scholars mainly cut from the perspective of traditional factors (such as capital and labor), instead of the technology. Therefore, it is necessary to study the impact of carbon regulation on the competitiveness of China's export trades so that developing countries such as China can respond promptly when facing carbon regulation in developed countries.

3. THEORETICAL BASIS

From the aspect of supply and demand, the trade competitiveness of exporting countries' products is affected by the comparative advantage, competitive advantage (supply), and the demand (demand) of the importing country for the exporting country's products. In theory, export demand is mainly determined by export prices and the income of importing countries, so the traditional export demand model formula is:

$$EQ = f(P, Y) \tag{1}$$

In the formula (1), EQ represents the quantity of export demand, P represents the export price, and Y represents the income of the importing country.

Considering internal factors, export demand is determined by the comparative advantages and competitive advantages of exported commodities. Therefore, we can rewrite (1) into (2):

$$EQ = g(CCI, ICI) \tag{2}$$

$$Y = \alpha + \beta_1 \ln CR + \beta_2 \ln TECH + \beta_3 \ln CR * \ln TECH + \beta_4 \ln CGDP + \beta_5 \ln RE + \varepsilon$$

Among them, α and ε are the constant term and the random error term, respectively, and \ln represents the natural logarithm of the variable. The remaining variables are explained as follows:

Y (explained variable) represents China's export trade competitiveness relative to its trading partners ($Y = TCIa - TCIb$). A country's trade competitiveness index (TCI) is measured by $TCI_i = (EX)_i$, where EX_i

In the formula (2), EQ represents the quantity of export demand, ICI represents the comparative advantage of exported goods, and CCI represents the competitive advantage of imported goods. Learn from McGuire's expansion method to add low-carbon regulatory variables to expand the H-O model. Since the main form of carbon regulation is carbon tariff, the impact of carbon tariff on the production of export enterprises can be specifically analyzed from a theoretical perspective: according to the production theory, in the two-factor model, the production possibility curve is formula (3); When regulatory factors are taken into consideration, the production possibility curve of the exporting company becomes formula (4). (K, L, T correspond to capital, labor, and carbon tariff rate). In formulas (5) and (6), the first derivative of labor and capital is positive, and the second derivative is negative. But for the carbon regulation variable T, the first derivative is negative and the second derivative is positive. That is to say, as the carbon tariff rate increases, the cost of the enterprise rises and the profit cuts, so the enterprise's production enthusiasm is frustrated, and the output decreases; with the increase in carbon tariff rate, the decline in output is getting bigger and bigger.

$$Y = F(K, L) \tag{3}$$

$$Y = F(K, L, T) \tag{4}$$

$$F_K > 0, F_L > 0, F_T < 0 \tag{5}$$

$$F_{KK} < 0, F_{LL} < 0, F_{TT} > 0 \tag{6}$$

4. EMPIRICAL ANALYSIS

4.1. Model Setting

On the basis of this theory, this article improves the formulas (1) and (2). The export trade competitiveness index and the income index of importing countries are all measured by relative indexes after processing the data of the importing and exporting countries. Incorporating the intensity of carbon regulation and the economic levels of importing and exporting countries into the model, and considering the impact of technical factors on the upgrading of China's export products and the impact of changes in the RMB exchange rate on the exports, the following regression model is constructed:

represents the total export volume of a country in a specific year, and IM_i represents the total import volume of a country in a specific year. From 2002 to 2014, China has been in a trade surplus position, but its trade competitiveness index has been fluctuating up and down; the UK has been in a trade deficit position, and France has changed from a trade surplus to a trade deficit in 2005; Spain has been in a trade deficit from 2002 to 2010, achieving a trade surplus from 2011 to 2014; the United

States has always been in a trade deficit position, but its trade deficit situation is gradually improving; Japan's trade situation cannot draw an accurate trend, because different years have shown different trade surplus and deficit situations. Since the Y value obtained is negative, it is impossible to take the logarithm of the Y value. CR (main explanatory variable) stands for carbon regulation. The main purpose of this article is to consider the impact of future carbon regulations in developed countries led by the United States on China's export trade competitiveness. For this reason, this article draws on Xianping Yin (2008) and adopts the ratio of carbon dioxide emissions (metric tons per capita) to reflect the changes of carbon regulations. CGDP (controlled Variable) represents China's economic development level relative to its trading partners. The export of Chinese goods is based on the country's economic strength and the needs of trading partners. Therefore, $CGDP = BGDP / PGDP$ is used to measure China's economic development level relative to its trading partners (BGDP and PGDP respectively represent China and trading partners' GDP, calculated at constant 2010 prices (millions dollars)). RE (control variable) represents the real effective exchange rate, which is used to measure the purchasing power of China's currency. The increase in the real effective exchange rate index means the appreciation of the RMB, and vice versa. For general trade, the increase in the real effective exchange rate of the RMB is good for imports but not good for exports. TECH (controlled Variable) represents China's technological level and is measured by China's R&D investment in science and technology (100 million yuan) from 2002 to 2014. $\ln CR * \ln TECH$ (interactive item).

4.2. Data Description

In the time dimension, since the CO_2 emission related index is only published until 2014, so the sample data from 2002 to 2014 is selected. In the spatial dimension, select the relevant data of China's trade and the United States, Japan, France, the United Kingdom, and Spain, who are trading with China. Therefore, the final number of samples in this article is 65. The import and export volume of each

country comes from the OECD database; the CO_2 emissions (metric tons per capita) and the GDP of the United States, Japan, France, the United Kingdom, and Spain are all derived from the World Bank database; China's GDP and R&D investment in science and technology come from the National Bureau of Statistics in 2002 -2014 annual report. The real effective exchange rate RE is represented by the RMB effective exchange rate index published by the Bank for International Settlements, but since it is a monthly index, it is converted into an annual index after averaging. In order to eliminate the influence of price fluctuations, the indicators involving prices are all measured in 2010 constant prices in dollars.

5. EMPIRICAL RESULTS AND ANALYSIS

5.1. Regression Model Selection

Table 1 shows the coefficients obtained after regression using ordinary least squares model, fixed effects model, and random effects model. In the fixed-effects model regression, the original hypothesis that all samples do not have their own intercept terms is significantly rejected, so we can initially consider that each individual is used for different intercept terms, and the fixed-effects model is superior to ordinary least squares model to a certain extent. After further constructing the least squares dummy variable model, the significance P value of each individual dummy variable is less than 0.05, so this article is more confident that it can reject the null hypothesis that "all individual dummy variables are 0". So the fixed effects model is better than the ordinary least squares model. The original hypothesis of Hausmann's test is to use a random effects model. After applying Hausmann's test, the significance P value (Prob>chi2=0.0150) is lower than 5%. Therefore, this article rejects the initial hypothesis and believes that the fixed effects model is more reasonable. In summary, it is concluded that the fixed effects model is used for regression analysis.

Table 1 Model selection

PROJECT	POLS	IFEM	RE
Constant term C	1.439939***	-0.655367	-5.803239***
LnCR	-0.5438143***	-0.6041861***	-0.560422***
LnCGDP	0.043351**	-0.4248337***	0.0501511
LnRE	-0.6203498***	-0.550224***	-0.6316307***
LnTECH	0.1769567***	0.418828***	0.1865252***
LnCR*LnTECH	0.0424855**	-0.0408493**	0.0418138***
R²	0.5945	0.6175	0.5938

Note: *, ** and *** indicate significance levels of 10%, 5%, and 1%, respectively.

5.2. Analysis of Regression Results

$$Y = -0.655367 - 0.6041861\ln CR - 0.4248337\ln CGDP - 0.550224\ln RE + 0.4188228\ln TECH + 0.0408493\ln CR * \ln TECH + \varepsilon$$

Except for the constant term, the coefficients of the model are all significant at the 5% level; the F statistic is 8.68, and Prob>F=0.0000 indicates that the regression result is significant as a whole; the coefficient of determination is above 60%, which shows that the fitting effect of the model is acceptable.

Carbon regulation (CR) has a significant negative impact on the competitiveness of China's export trade, which means carbon regulation from developed countries such as Europe and the United States will lead to a decline in China's export trade competitiveness. Under the condition of controlled variables, the increased intensity of carbon regulation by developed countries' trading partners against China will reduce the competitiveness of export trade. It should be noted that the variables of carbon regulation are elastic, and the changes in China's export competitiveness are absolute value changes; For every 1% increase in the strength of developed countries' carbon regulation on China, China's export trade competitiveness index (Y) relative to its trading countries will drop by an absolute value of 0.006041861.

In the understanding of technical variables and the interaction terms between carbon regulation and technology variables, since the regression coefficients of carbon regulation variables are negative, the regression coefficients of technical variables are positive, and the regression coefficients of the interaction terms between carbon regulation variables and technical variables are positive. The three coefficients are all significant at the 5% level. It can be seen that if the level of technology rises, the negative impact of carbon regulations in developed countries on China's export trade competitiveness can be weakened; and the existence of carbon regulations in developed countries makes technology more important in the promotion of China's export trade competitiveness. This shows that developing technology is one of China's measures to deal with carbon regulations in developed countries.

In terms of control variables. One is that China's economic development level (CGDP) relative to its trading partner countries has a significant negative correlation with China's relative export competitiveness, which is contrary to the view that normal economic development promotes export competitiveness. However, we can get an explanation from the characteristics of China's industrial structure and product added value. Although China's economic development level has continued to improve, the industrial focus of economic development from 2002 to 2014 has been concentrated on high-carbon, high-pollution, low-tech, labor-intensive industries, and the competitiveness of high-end technology products is not stable. Subject to external constraints such as intellectual property rights and key parts and components, it is in a lower position in the global value chain. Therefore,

According to the results of the fixed effects model (FEM) analysis in Table 1, the relationship can be drawn:

although the level of China's economic development continues to rise, the competitiveness of export trade will decline when other control variables are considered. Secondly, the real effective exchange rate (RE) has a significant negative impact on the relative competitiveness of China's exports, which is mainly related to changes in production factors and export prices.

6. CONCLUSION AND COUNTERMEASURES

It can be concluded from the empirical analysis that under the condition of controlled variables, the carbon regulation of China by developed countries is actually a new type of trade protectionism, which to a certain extent has established barriers to China's main export trade commodities, leading to the increase costs in exporting Chinese products and the weakening of innovation motivation. As a result, the scale of China's exports is smaller and comparative advantage over developed countries' markets is weaker. China's exports of goods account for less market share in exporting countries, and the export competitiveness will decline. Technology plays an important role in improving the competitiveness of China's export trade in the context of carbon regulation. The relevant policy recommendations are derived from this:

6.1. Strengthen the Cooperation of Developing Countries in the Global Value Chains to deal with Carbon Regulation of Developed Countries

Actively promote the transformation of carbon regulation from developed countries and their multinational companies to global consensus including developing countries. In the allocation of global carbon emissions responsibility, the principles of cumulative emissions and consumer responsibility should be emphasized, to jointly force developed countries to assume more emission reduction responsibilities, and to strive for greater development space for developing countries to participate in global value chains. Actively enhance the power of developing countries and their enterprises in the governance of global value chains.

6.2. Actively Upgrade in the International Industrial Division of Labor and Develop Low-Carbon Production Processes

Product structure is an important factor that affects China's export competitiveness to developed countries' trading partners. This is related to the fact that the industry and trade between China and developed countries are still dominated by the vertical division of labor. A higher level of green technology innovation helps enterprises to circumvent higher green trade barriers for export products, increase the export of products with high technical content, and then optimize the export trade structure.

6.3. Improve the Structure of China's Import and Export Products

China can appropriately reduce the rate of export growth, especially to properly control the export of pollution-intensive industries and industries that are highly dependent on natural resources, and encourage the import of such products. This will not only reduce trade frictions with developed countries, but also the influence of developed countries on China's carbon regulation can be appropriately reduced.

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