Research on the Influence of Carbon Tariff on China's Energy Market Based on Computable General Equilibrium Model

Sha Li*
Shandong Vocational and Technical University of International Studies, China, 276826

*Corresponding author e-mail: shali@163.com

Abstract. In the process of continuous development of China's economy, it has also brought great damage to the ecological environment. In recent years, China's carbon emissions have ranked first in the world. Therefore, the collection of carbon tariffs will inevitably have a great impact on China's energy market. Based on this, this paper first analyses the construction and expansion of the general equilibrium model, as well as the data and calibration of the general equilibrium model, then studies the numerical analysis of the impact of different carbon tariff pricing on high energy consumption goods, and finally analyses the impact of different carbon tariff pricing on China's energy market.

Keywords: Carbon Tariff, Energy Market, Computable General Equilibrium Model

1. Introduction
While China has made great achievements in economic development, it has also paid a large environmental cost, the most significant of which is that carbon emissions have become the first in the world[1]. As China's energy structure is still dominated by energy with high greenhouse gas emissions, the ecological environment is greatly affected. In addition, as the collection of carbon tariffs can help developed countries to maintain their competitiveness by setting up technical barriers to some extent, and it will pose a greater threat to China's export trade and reduce the competitiveness of China's manufacturing industry[2]. Therefore, the impact of carbon tariff on China's energy market is a problem worthy of attention. Fully understanding the impact of carbon tariff policy on China's energy market has become an urgent problem to be solved. Based on the general equilibrium model to calculate the impact of carbon tariffs, it can reflect the decision-making equilibrium of various micro entities in the economy[3]. The general equilibrium model is helpful to analyze the impact of carbon tariffs on carbon emission reduction, enterprise competitiveness and international trade[4]. Therefore, it is of great practical significance to study the impact of carbon tariffs based on the computable general equilibrium model on China's energy market.
2. Construction and development of general equilibrium model
Under the condition of complete competition, when the whole economy is in a general equilibrium state, the economic system produces a set of prices, which makes the supply and demand of all products and elements equal, and all consumers and producers can achieve their own equilibrium - utility maximization and profit maximization[5]. The general equilibrium model for calculating carbon tariff mainly includes several modules as shown in Figure 1 below.

![Figure 1. The general equilibrium model for calculating carbon tariff](image)

Among them, the production module adds energy synthesis and capital to get capital energy synthesis, and then adds it and labour to get capital energy labour synthesis, that is, the added value part of total output[6]. The foreign trade module uses two nested functions to investigate the impact of carbon tariffs on foreign trade. The income and expenditure module describes the income and expenditure status of each economic entity. In the general equilibrium of economy, the supply of goods is equal to the demand, and the hypothesis of labour and capital adjustment is adopted in the factor market. When calculating the carbon emission per unit commodity of various commodities, the carbon tariff module converts the energy input into the standard coal consumption through the standard coal conversion coefficient, and then calculates the carbon emission in the process of producing the commodity by using the coefficients shown in Figure 2 below.

![Figure 2. Process of producing the commodity](image)

3. General equilibrium model data and calibration
First of all, based on the pure exchange general equilibrium model of multi-regional products, this paper discusses the impact of carbon tariff on China's energy consumption goods and energy market, and introduces the extraction cost function used by energy exporting countries into this model. Model
demand assumes that each country has a utility function covering commodity and global temperature changes. Secondly, the temperature change function is included in the model to reflect the relationship between temperature and carbon emission level, to show the changes of economic growth and emission intensity, so as to build a simple model. There is a correlation between the establishment of a possible policy intervention model and the use of national carbon pricing and border regulation measures. Different forms of carbon motivated import tariffs and export tax rebates exist. In addition, the energy technology labour force factor is introduced into the model to expand, so as to clarify the impact of energy technology labour force factor on carbon tariff policy. Energy technology needs specialized talents to operate, and mature technology will have a more significant resistance to carbon tariff policy.

3.1. General equilibrium model data
Model calibration and elastic parameters play an important role in the analysis process. The size of carbon pricing related to border adjustment measures will be used in numerical simulation analysis. After the carbon content of goods is specified, the relationship between border adjustment measures and trade barriers is in inverse proportion. In addition, emissions vary greatly between countries, so it is obviously not feasible to tax emissions produced by exporting countries.

It is not difficult to find that carbon incentive policies have little impact on the country through the calibration of carbon emissions and cross-border commodity flows. Border regulation measures are generally based on the comparison of domestic products of the importing country, rather than the implied carbon content in the imported goods. There are differences in the emission intensity between countries, and the carbon emission measures of domestic products of the importing country are in line with the border regulation measures.

3.2. The influence of different carbon tariff pricing on high energy consumption goods
Because of the particularity between departments, the influence of border tax adjustment is not without deviation, it will further affect the relative price. Compared with the impact on emissions, the adjustment of border tax has achieved the expected effect on the mitigation of carbon leakage, which also offsets the cost of emission reduction in countries that implement carbon pricing. Compared with the trade circulation without border tax adjustment measures, border tax adjustment reduces the import of the countries implementing the measures and increases the import of other countries. The value of products in the countries with carbon tax and related carbon pricing and border tax adjustments will increase, while the production value will decrease compared with the countries without border tax adjustments.

4. The impact of carbon tariff pricing on China's energy market
Based on the results of general equilibrium model, it is not difficult to find that the Levy of carbon tariff will greatly reduce the international competitiveness of China's energy consuming products, and the Levy of carbon tariff will further damage the competitive environment of international trade. Therefore, China's energy market will inevitably be impacted by carbon tariffs, which are mainly reflected in the following three aspects.
Figure 3. Carbon tariffs’ impacts on China's energy market

4.1. The influence of carbon tariff on energy intensity
The implementation of carbon tariff forces the transfer of production factors to low-carbon emission sectors, and substitutes capital and labour production factors for energy. The substitution effect of production factors on energy is limited. The tax rate of carbon tariff is directly related to the intensity of energy consumption, which is in inverse proportion. That is to say, the lower the tax rate of carbon tariff is, the faster the intensity of energy consumption will decline, which will have a serious impact on the normal operation of the whole economy.

4.2. The impact of carbon tariff on energy demand
The implementation of carbon tariff will lead to a sharp decline in energy demand. In the process of energy demand change, the innovation of energy technology will focus on the development of low-carbon technology, so that the demand for all kinds of energy will be adjusted to a reasonable state in a short time, that is, the demand for high energy consumption resources will be reduced, while the use and demand for relatively low energy consumption resources will be increased.

4.3. The impact of carbon tariff on carbon emission reduction quota
Obviously, carbon tariff will lead to the improvement of China's carbon emission reduction rate, but at present, China is relatively backward in both carbon emission reduction technology and carbon emission reduction policy mechanism, so it will inevitably lead to some problems in the process of improving China's carbon emission reduction rate. Therefore, we can only promote the continuous improvement of carbon emission reduction rate through the technology research and development of energy technology-based labour force. In short, carbon tariff is not the best way to promote carbon emission reduction, but the key is to improve carbon emission reduction technology, so as to promote the achievement of carbon emission reduction measures.

5. Conclusions
In summary, with the increase of China's carbon emissions year by year, carbon tariff will inevitably have an important impact on China's energy market. Based on the general equilibrium model, this paper calculates the impact of carbon tariffs, mainly through the analysis of the impact of carbon tariffs on China's energy intensity, energy demand, and energy structure and emission reduction quota, to study the impact of carbon tariffs on China's energy market. Therefore, it should take necessary measures to deal with the impact of carbon tariff policy on China's energy market, ensure the stable development of China's energy industry, and promote the optimization and adjustment of energy industry structure.
References

[1] Fan Xiao. Research on the relationship between energy consumption, economic growth and carbon emission in Brazil [J]. Development Research, 2010, (3):20-23.

[2] Wei Chu, Yu Dongyun. Study on the industrial structure effect of greenhouse gas emissions in productive industries [J]. Industrial Economic Research, 2013 (1): 22-32.

[3] Zhang Qingfeng, (U.S.) Robert Crookes. Towards the future of environmental sustainability: National Environmental Analysis of the People’s Republic of China [M]. Beijing: China finance and Economics Press, 2012.

[4] Chen liming, Deng Lingling. Evaluation of 3E system coordination based on canonical correlation analysis [J]. Forum on Statistics and Information, 2012, 27 (5): 24-29.

[5] Zhou Peng, Zhou Dequn, Yuan Hu. Low carbon development policy: international experience and China's strategy [M]. Beijing: Economic Science Press, 2012.

[6] Sustainable development strategy research group of Chinese Academy of Sciences. 2013 China sustainable development strategy report: the road of ecological civilization in the next 10 years. Beijing: Science Press, 2013.