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# Corporate Social Responsibility, Tariff and Technological Innovation in an Open Economy

-- Theoretical Research Based on Oligopoly Competition Model

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**Abstract:** By constructing a mixed oligopoly competition model in an open economy, the internal relationship between tariff policy changes, domestic corporate social responsibility and technological innovation is deeply revealed. The theoretical deduction shows that the tariff rate has a negative correlation with the social responsibility preference of domestic consumer-friendly enterprises, and reducing the tariff can improve the social responsibility preference of domestic enterprises; Higher tariff rates will reduce domestic consumer surplus and reduce the efficiency of tariff collection of regulators. Higher investment in technological innovation can increase domestic consumer surplus and improve domestic corporate social responsibility preference.

**Keywords:** Mixed oligopoly competition model, Tariff, Social responsibility, Social welfare level, Technological innovation.

## 1. Introduction

This means that the era of opening to the outside world at a high level and opening up a new situation of win-win cooperation has come. From the Boao Forum for Asia in 2018 to the convening of the third China Import Expo in 2020, all of them have fulfilled China's commitment to opening up at a high level, highlighting the implementation of various measures to ease market access in China. The key point for the country to promote international cooperation and trade is how to formulate tariff policies to attract foreign investment and promote a virtuous trade cycle, and how to promote the long-term healthy development of Chinese enterprises while trade.

While the society is developing, the entrepreneurial spirit is also keeping pace with the times. Since the reform and opening up 40 years ago, Chinese entrepreneurs have been forging ahead with the great rejuvenation of the Chinese nation. While stimulating the vitality of the social economy, they have not forgotten to fulfill their social responsibilities (CSR) from actively participating in public welfare undertakings, protecting the environment, promoting employment, etc. The reasons why enterprises pay attention to social responsibility can be explained from two aspects: from the micro perspective, multinational companies must consider the demands of stakeholders, pay attention to environmental protection and the realization of consumer interests in order to seize the market of other countries or try to achieve long-term effective operation in the market; From a macro perspective, transnational enterprises benefit from economic globalization and shoulder the responsibility of expanding the scope of economic globalization. Eliminating the negative impact of globalization on consumers will help expand the scope of globalization, otherwise their long-term economic benefits will not be realized. Therefore, enterprises pay more attention to social responsibility. Then, as time goes by, people gradually find that the pursuit of economic interests needs to be implemented within the scope of local laws and regulations (Carroll, 1991). In order to meet the regulations formulated by regulators, enterprises have to turn their attention to meeting the needs of stakeholders (Clark - son, 1995), that is, to take moral issues and the collective welfare of consumers as a part of decision-making, This is the reflection of enterprises' attention to social responsibility under the guidance of the government.

Taking the initiative to undertake technological innovation and social responsibility is the new historical mission of current Chinese enterprises, and achieving the integration and coordination of the two is the key to promoting high-quality development of enterprises. The primary task of improving the national innovation capability is to promote the technological innovation of enterprises. Some scholars believe that encouraging enterprise innovation needs to improve the tolerance of early failure, and long-term compensation plan, employee job security, and timely feedback can also effectively encourage innovation. A series of empirical studies further tested the macro and micro factors that affect enterprise innovation. From the perspective of enterprises, enterprises have their own needs for technological innovation. Increasing R&D investment can optimize products and technological processes, reduce production costs and improve product quality. Therefore, for a long time, technological innovation has been an important determinant of enterprise competitiveness, which determines the survival, comparative advantage, market value and return on investment of enterprises. However, in recent years, the frequent safety problems in China's food and drug industry have led to the gradual awakening of consumers' awareness of social responsibility, and began to pay attention to corporate social responsibility or business ethics issues, and give them new ways of thinking and behavior. Many consumers are willing to pay extra fees for the products of enterprises that perform social responsibilities, and "responsible consumption" is becoming a trend. In this context, many enterprises have realized the limitations of competitive means such as monopoly position, product technology, resource endowment, etc. They no longer simply regard social responsibility as an economic burden, but instead attribute it to corporate strategic management behavior, competing to develop social responsibility practices

in many fields such as society, environment, morality, human rights, etc. In order to meet consumers' demands for social responsibility, enterprises strive to add CSR attributes to their products to increase the differentiation with similar products.

# 2. Model Building

## 2.1. Basic assumptions of the model

We construct an oligopoly competition model in an open economy, in which a domestic enterprise (enterprise 1) competes with a foreign enterprise (enterprise 2). Both enterprises provide homogeneous products and are also participants in the competition for Cournot production. The inverse demand function is defined as $P=(1-\sum_{i=1}^{2} q_i)$, Where $q_i$ represents the output of the enterprise. Assuming that all enterprises use the same technology, the marginal cost function increases and is expressed as $C(q_i)=\frac{1}{2}q_i^2$, i=1, 2.

At this time, under the spontaneous preference of enterprises for social responsibility, we assume that domestic enterprises 1 pay attention to the interests of consumers as well as the profits they create. At the same time, referring to Zhang Wei et al $\lambda \geqslant 1$ represents the R&D efficiency of the enterprise. Therefore, the objective function of Enterprise 1 may be set as the weighted sum of profit and consumer surplus minus R&D cost, namely:

$$\bar{\pi} = \pi_1 + \alpha CS = (1-q_1-q_2)q_1 - \frac{1}{2}q_1^2 + \frac{1}{2}\alpha(q_1+q_2) - \frac{1}{2}\lambda x_1^2 - x_1 q_1 \quad (1)$$

Where, CS refers to consumer surplus, which can be expressed as a function of output $CS=\frac{1}{2}\alpha(q_1+q_2)^2$, And $\alpha \in (0,1)$ indicates that the weight of enterprises' attention to consumer surplus is social responsibility preference; When $\alpha$ is 0, it means that the enterprise takes profit maximization as its production goal. When $\alpha$ is 1, it means that the enterprise is extremely concerned about social responsibility and ignores profit maximization. According to the existing literature, when $\alpha \in (0,1)$ is defined, such enterprises are "consumer-friendly enterprises." Similarly, because it is an open economy, there are foreign-funded enterprises entering the domestic market and participating in competition. It is assumed that they do not pay attention to consumer surplus and corporate social responsibility, and they do not carry out technological innovation in the country. It is assumed that China's government will impose tariffs on foreign enterprises in a specific amount, and the tax rate is t $\in (0,1)$, Then the objective function of foreign-funded enterprises can be expressed as:

$$\pi_2 = (1-q_1-q_2)q_2 - \frac{1}{2}q_2^2 - tq_2 \quad (2)$$

After determining the income of enterprises, the target function of the government is also the focus of this two-stage game. In addition to the employment, economic growth and other "hidden benefits" brought by the profits of enterprises, the income of enterprises in the market also belongs to social welfare. The tariffs imposed by foreign enterprises when entering the market are also part of the government's objective function, but there are costs and efficiency losses in the process of collecting tariffs. We assume that the net tariff collection efficiency excluding this loss can be summed up to obtain the government's objective function, expressed in SW:

$$SW = \bar{\pi} + \pi_2 + CS + \beta q_2 \quad (3)$$

Through the analysis of the two-stage game between the government and enterprises, in the first stage, the government determines the tariff rate that it thinks is the best tariff policy; In the second stage, all enterprises in the market determine the optimal output through Cournot's method, so as to maximize their objective function, and solve the sub-game Nash equilibrium using the backward induction method.

First of all, the analysis starts from the final stage, that is, the enterprise determines the optimal output. The consumer-friendly enterprises with technological innovation compete with foreign-funded enterprises. At the given $\alpha$ and t, the consumer-friendly enterprises with technological innovation determine the output $q_1$ when the profit is maximized, as shown in (1), its maximization objective function $\bar{\pi}$ First order condition of:

$$\frac{\partial \bar{\pi}}{\partial q_1} = 1 - 3q_1 - q_2 + \alpha(q_1+q_2) - x_1 = 0 \quad (4)$$

Similarly, foreign enterprises also determine the optimal output, and the first-order conditions of the maximization objective function are as follows:

$$\frac{\partial \pi_2}{\partial q_2} = 1 - t - q_1 - 3q_2 = 0 \quad (5)$$

Using mathematica12 simultaneous equations (4) and (5), the following equilibrium results can be solved:

$$q_1^* = \frac{2+t+\alpha-t\alpha-3x_1}{8-2\alpha} \quad (6)$$

$$q_2^* = \frac{2-3t-\alpha+t\alpha+x_1}{8-2\alpha} \quad (7)$$

At this time, to ensure that the enterprise output is at least 0. Then $1>t>\frac{2+\alpha-3x_1}{\alpha-1}$, the rest of the equilibrium solutions can be further obtained as follows:

$$P^* = \frac{2+t-\alpha+x_1}{4-\alpha} \quad (8)$$

$$\pi_2^* = \frac{3(2-3t+\alpha t-\alpha+x_1)^2}{8(-4+\alpha)^2} \quad (9)$$

$$CS^* = \frac{(-2+t+x_1)^2}{2(-4+\alpha)^2} \quad (10)$$

The above equilibrium results show that the tariff rate $t$ set by the government, the social responsibility preference a of the enterprise itself and the technological innovation $x_1$ of

the enterprise can indeed affect the output decision of the enterprise, the equilibrium price, and the consumer surplus, and the equilibrium social welfare is also affected by $t$, α, β, and $x_1$.

First, calculate the first derivative of equation (6)~(11) for α, and the following results can be obtained:

Lemma 1 is that in the oligopoly competition of foreign enterprises, with the preference of Chinese enterprises in social responsibility (α) gradually increasing,

$\frac{\partial q_1^*}{\partial \alpha} = -\frac{3(-2+t+x_1)}{2(-4+\alpha)^2}$ >0, The output of domestic consumer-friendly enterprises increased;

$\frac{\partial q_2^*}{\partial \alpha} = \frac{-2+t+x_1}{2(-4+\alpha)^2}$ <0, decrease in output of foreign-funded enterprises;

$\frac{\partial P^*}{\partial \alpha} = \frac{-2+t+x_1}{2(-4+\alpha)^2}$ <0, The market price of products is rising;

$\frac{\partial CS^*}{\partial \alpha} = -\frac{(-2+t+x_1)^2}{(-4+\alpha)^3}$ >0, increase in consumer surplus;

$\frac{\partial \overline{\pi}^*}{\partial \alpha} = \frac{(-2+t+x_1)(18-7\alpha-7t+21\alpha-11x_1+4\alpha x_1)}{4(-4+\alpha)^3}$

>0, That is, the target function $\overline{\pi}^*$ of domestic enterprise 1 increases.

From the above results, when consumer-friendly enterprises pay more attention to social responsibility, their output and consumer surplus increase. That is to say, when domestic enterprises pay more attention to corporate social responsibility and foreign-funded enterprises only pay attention to corporate income, consumer demand for products increases and domestic enterprises' income increases, but the goods of the two enterprises in the market are homogeneous, why does the output of foreign-funded enterprises decrease? This just can be found from the reality. The tariff cost paid by foreign enterprises when entering the market makes them consider whether to enter the market. In the process of balancing costs and benefits, tariff becomes one of the costs for foreign enterprises to enter the Chinese market. Therefore, it is speculated that tariff as a trade barrier affects the market share of foreign enterprises, thus affecting the profits of domestic enterprises and thus the social responsibility preference of consumer-friendly enterprises.

Then analyze the impact of tariff rate on local consumer-oriented enterprises and transnational foreign-funded enterprises, i.e. (6)~(11) calculate the first derivative of t, and the following results can be obtained:

Lemma 2 In the oligopoly competition model with foreign enterprises participating in the competition, when the government increases the tariff rate on foreign enterprises, $\frac{\partial q_1^*}{\partial t} = -\frac{1-\alpha}{2(-4+\alpha)}$ >0, increase in output of domestic consumer-friendly enterprises; $\frac{\partial q_2^*}{\partial t} = \frac{\alpha-3}{8-2\alpha}$ <0, the total output of foreign-funded enterprises decreased; $\frac{\partial P^*}{\partial t} = \frac{1}{-4+\alpha}$ >0 increase in market price of products; $\frac{\partial CS^*}{\partial t} = \frac{-2(-2+t+x_1)}{(-4+\alpha)^3}$ <0, decrease in consumer surplus; $\frac{\partial \pi_2^*}{\partial t} = \frac{3(2-3t+\alpha t-\alpha+x_1)^2}{4(-4+\alpha)^2}$ When $t > \frac{\alpha-x_1-2}{-3+\alpha}$, the income of foreign-funded enterprises increases, and when $t < \frac{\alpha-x_1-2}{-3+\alpha}$, the income of foreign-funded enterprises decreases.

As a means of national trade barriers, tariffs are policy-oriented. From the above results, the higher tariff rate t reduces consumer surplus, but the lower tariff rate $t < \frac{-2+3\alpha+3x_1-2\alpha x_1}{1+\alpha}$ will reduce the income of Chinese enterprises. Therefore, how to set an appropriate tariff rate to increase consumer surplus while taking into account enterprise income is a problem that relevant departments should consider.

Further, analyze the impact of technological innovation on domestic enterprises, i.e. (6)~(11) to obtain the first derivative, and the following results can be obtained:

Lemma 3 In the oligopoly competition model with foreign enterprises participating in the competition, when local enterprises increase the investment in technological innovation, $\frac{\partial q_1^*}{\partial x_1} = \frac{3}{8-2\alpha}$ >0, the output of domestic friendly enterprises increases, $\frac{\partial q_2^*}{\partial x_1} = \frac{-3+\alpha}{8-2\alpha}$ <0, the total output of foreign-funded enterprises decreased; $\frac{\partial P^*}{\partial x_1} = \frac{1}{\alpha-4}$ <0, decrease in market price of products; $\frac{\partial CS^*}{\partial x_1} = \frac{-2+t+x_1}{(-4+\alpha)^2}$, When $x_1 > 2-t$, consumer surplus increases, and when $x_1 < 2-t$, consumer surplus decreases, $\frac{\partial \pi_2^*}{\partial x_1} = \frac{3(2+t(-3+\alpha)-\alpha+x_1}{4(-4+\alpha)^2}$ When $x_1 > -2+3t+\alpha-t\alpha$, the income of foreign-funded enterprises increases, and when $x_1 < -2+3t+\alpha-t\alpha$, the income of foreign-funded enterprises decreases.

Technological innovation investment can affect enterprises, but according to the above analysis, technological innovation investment needs to be greater than a certain value to increase the income of Chinese enterprises, so how to effectively carry out technological innovation investment is a problem that enterprises need to consider.

It is worth noting that with the increase of tax rate, the price of products will rise, which means that the increase of tariff will indeed protect the production of Chinese enterprises and thus the price of products will rise, which is similar to the

"monopoly" market at this time. But the consumer surplus is reduced, so is the protection brought by tariffs optimistic for the overall market? Under the high tariff rate, even the very high tax rate can not really be converted into the actual tariff income, and then the cost of monitoring this aspect to improve the corporate social responsibility status is reduced. Therefore, when formulating the tariff policy, the government departments should not only regard it as a means of trade, but also link it with the social responsibility of local enterprises. At the same time, the increase of technological innovation investment will reduce the price of products and increase consumer surplus when reaching a certain level of investment. So what kind of technological investment can bring a positive effect on Chinese enterprises and the overall market? Less investment in technological innovation will not increase the income of enterprises, nor will it increase the consumer surplus. Therefore, it is necessary to analyze the relationship between tariff setting, social responsibility of local enterprises and technological innovation. To sum up, proposition 1 can be obtained.

The increase of tariff rate will reduce consumer surplus CS and the efficiency of tariff collection β, the increase of corporate preference for social responsibility α will increase consumer surplus CS, and the increase of corporate investment in technological innovation $x_1$ will increase consumer surplus CS.

To sum up, the tariff policy formulated by the government will affect the operation and development of consumer-friendly enterprises, social responsibility preferences, technological innovation investment and even the healthy development of the entire market.

# 3. Conclusion

By establishing an oligopoly competition model with foreign enterprises in an open economy, this paper examines the relationship and impact of tariff rates, corporate social responsibility and technological innovation when enterprises spontaneously pay attention to corporate social responsibility. Tariff will have a significant negative impact on corporate social responsibility, and when the national economy is more developed, tariff will have a greater impact on the social responsibility preference of domestic enterprises. However, when foreign enterprises enter, it will weaken the tariff expansion effect brought by this economic advantage. Setting too high tariff rates will not only damage the domestic market balance and worsen the production situation of enterprises, but also reduce the preference of enterprises for social responsibility. Proper reduction of tariff rate can significantly increase consumer surplus, but it cannot be too low. Otherwise, too many foreign enterprises will enter, which will weaken the preference of Chinese enterprises for social responsibility. Therefore, appropriate tariff level setting can "protect" Chinese enterprises and improve consumer surplus. Our government should strengthen the supervision of tariff collection, strictly prevent enterprises' rent-seeking behavior, improve the efficiency of tariff collection, and create a good environment for opening up. Finally, the policy formulation of corporate social responsibility should be carried out in different regions according to the economic development status,

Under the limited resources, corporate social responsibility may indeed inhibit technological innovation. Although it costs to bear social responsibility, enterprises should not blindly resist. It is not advisable to focus on one's own interests and ignore the economic benefits of society. On the contrary, when an enterprise's market strategy is at a disadvantage (such as its low level of innovation), its market strategy is similar (such as product homogeneity) or its market strategy is invalid (such as the export advantage cannot be obtained by relying on product quality), it can obtain irreplaceable market resources by giving full play to its subjective initiative and performing its corporate social responsibility reasonably, appropriately and within its capabilities. The government should strengthen the guidance of "responsible innovation", with the goal of achieving sustainable development and public value, encourage enterprises to carry out technological innovation behaviors that are responded by a wider range of stakeholders, and make effective feedback on national competitiveness and economic fairness at the same time, so as to ultimately ensure that development depends on better social benefits rather than just economic growth and technological leadership. Enterprises should constantly deepen the innovation-driven strategy, seize the new opportunities of the new technological revolution, practice the new concept of "two mountains" green development, promote new changes in the quality of development, effectively improve product quality, build new ways to improve, establish a new corporate social responsibility evaluation system, and regularly publish the evaluation results.

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