

China's Countermeasures from the Perspective of Trade Protection

-- Based on Stackelberg model

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Abstract

Based on Stackelberg model, this paper analyzes the coping strategies of the leading import enterprises in the three situations of tariff, trade quota and new trade protection. The results show that under the circumstances of trade protection considering the change of trade tax, Chinese enterprises should try their best to understand the overall welfare of the host country, improve their production technology, reduce their production costs, and seek higher profits. In the case of trade protection considering the change of trade quota, the import enterprise should decide whether to cancel the trade quota in the way of non production cost according to the relationship between marginal cost and parameter a and the range of quota number M . when the import enterprise cancels the trade quota with non production cost, it should not give up its leading position. In the case of trade protection considering the change of tax and trade quota, the import enterprise should decide whether to cancel the trade quota by means of non cost, bidding and transfer according to the marginal cost and the scope of the quota. If the import enterprise cancels the trade quota at non production cost, it should also maintain its leading position.

Keywords

Stackelberg model; trade protectionism; tax; trade quota.

1. INTRODUCTION

Since the beginning of the US trade war in 2018, the Sino-US trade war has lasted for two years. The trade dispute originated from the United States imposing tariffs on Chinese imports and setting up other trade barriers to force China to change its "unfair trade practices." Since the trade war, the political, economic and international relations between the two countries have become increasingly prominent, and Sino-US trade disputes have intensified. The rise of trade protectionism nowadays is an analysis of my country's countermeasures from the perspective of trade protection. This article will use the stackelberg model to analyze whether my country's leading import companies should maintain their leading positions in three situations of trade protectionism, and take the first move decision.

2. JOURNALS REVIEWED

Papers on trade protection

Wang Pin (2010) concluded based on case analysis that when facing trade protectionism, my country should actively respond to it [1]. Jiang Ling et al. (2010) analyzed from the perspective of political economy and pointed out that the Sino-US trade dispute has a greater negative impact, and China should strengthen its strength and adopt corresponding strategies to deal

with it [2]. Tao Haidong (2017) put forward various countermeasures and suggestions based on the development of Sino-US trade, the characteristics and current situation of frictions [3]. After enumerating the impact of trade protectionism on my country's export trade, Li Shuang (2020) pointed out that Chinese enterprises should take more initiative in the trade war [4]. It can be seen that domestic research on trade protectionism is mainly based on theoretical analysis, and it is pointed out that my country should try its best to adopt proactive policy responses. In foreign research on Sino-US trade, Yanshuang (2020) uses a complex network method to analyze the impact of the Sino-US trade friction event on the Chinese stock market in 2018 [5]. Gabriel (2020) used Chinese customs data to investigate the trade impact of anti-dumping policies and found that anti-dumping duties led Chinese companies to enter the market of a third country [6]. Lijing (2020) simulated the Sino-US trade friction and its different long-term trends and found that trade barriers harm the economies of the two countries, but non-participants benefit indirectly. It can be seen that foreign studies have paid less attention to China's countermeasures to trade protection [7].

Regarding the application of the stackelberg model, Yang Xiaojing (2012) used stackelberg model analysis to conclude that import companies should consider whether to authorize the host country based on their own status [8]. Cheng Yongbo et al. (2016) explored and analyzed the cooperation mode between the main manufacturer and supplier of complex equipment such as aircraft by constructing a stackelberg model between main manufacturers and suppliers [9]. Zhou Hongwei et al. (2020) used Stackelberg model analysis and found that there is no optimal contract under symmetric information between banks and cooperative intermediaries [10]. Pu Yongjian et al. (2020) constructed a two-head Stackelberg model for game analysis based on independent power companies [11]. Dong Lizhi, Liu Haoming, etc. (2020) also studied power companies and showed that they can use the Stackelberg model for pricing to ensure profitability [12]. Li Xi, Ma Rui et al. (2017) proposed the optimal pricing of electricity companies based on the stackelberg model [13]. Guangqing (2018) systematically analyzes the optimal price strategy of microgrid and the optimal demand strategy of users by constructing a Stackelberg model between microgrid and users [14]. Yu (2014) used the model to model the interaction between the retailer and the manufacturer. In this framework, the retailer maximizes the profit by considering the manufacturer's trade subsidy response [15]. Yu et al. (2016) constructed Stackelberg theoretical model for numerical simulation to discuss the problem of model balance [16]. Jing et al. (2018) used the Stackelberg model to study the income changes of the two coal and electricity price linkage mechanisms [17]. Sun Dongshi et al. (2018) used the Stackelberg model to perform repeated games and proved that after effective information sharing and cooperation, the overall profit of the agricultural product supply chain can be effectively improved [18]. Wu Chengfeng et al. (2019) used Stackelberg model to compare and analyze the best decision of suppliers' commercial credit supply chain [19]. It can be seen that many documents use the stackelberg model to analyze the pricing problems of power companies, and there are few documents used to study other fields.

From the research of the above scholars, it is found that no research has combined trade protectionism and stackelberg model for analysis and application. Using Stackelberg model to discuss my country's response strategies under trade protection can dynamically analyze the game decision-making between enterprises of the two countries under different trade protection situations, so as to explore my country's response strategies more comprehensively. Based on this situation, this study uses the Stackelberg model to analyze the decision-making of Chinese enterprises under trade protection.

3. BASED ON STACKELBERG MODEL, THIS PAPER ANALYZES THE COPING STRATEGIES UNDER DIFFERENT TRADE PROTECTION MEASURES

Stackelberg model was put forward by German economist Stackelberg in 1930s. Stackelberg model is mainly used to analyze the asymmetric decision-making order caused by the asymmetric status of competitors in the market. In trade, there is asymmetric status among enterprises among countries, so this paper uses Stackelberg model to explore the coping strategies of enterprises under trade protectionism, and divides trade protectionism into three situations: considering the change of trade tax, trade quota, quantitative tax and trade quota.

3.1. An Analysis of Coping Strategies under the Circumstances of Trade Tax Changes

Enterprise B is affected by the trade protection policy. Assuming that the impact is from taxation, if the tax is a quantitative tax, then enterprise A's profit $\pi = P_1x - cx$, company B profit $\pi = P_1y - ty - cy$, enterprise B is the first-moving enterprise, and enterprise A is the latter-moving enterprise. Therefore, first obtain a partial derivative of the profit of enterprise A and make the equation equal to zero, then the reaction function of enterprise A is $x = \frac{a - c - by}{2b}$

(Assuming $b \neq 0$), the price of commodity 1 is $P = \frac{a + c - by}{2}$, so company B profit

$\pi = (\frac{a + c - by}{2} - t - c)y$. Take the partial derivative of the profit function of enterprise B

and make it equal to zero, so $y = \frac{a - c - 2t}{2b}$ while $x = \frac{a - c + 2t}{4b}$.

Total output $Q_1 = x + y = \frac{3a - 3c - 2t}{4b}$, the price of the indifference product is $P_1 = \frac{a + 3c + 2t}{4}$.

The profit of enterprise A producing commodity 1 is $\pi = P_1x - cx = \frac{(a - c + 2t)^2}{16b}$, the profit of enterprise B producing commodity 1 is $\pi = P_1y - cy - ty = \frac{(a - c - 2t)^2}{8b}$.

Appropriate through analysis $\pi = P_1y - cy - ty = \frac{(a - c - 2t)^2}{8b}$, at this time, $t > 0$ the profit of enterprise A is higher than that of the non-trade policy, and the profit of enterprise B is lower than that of the non-trade policy.

Obviously, when there is a trade protection policy, the profits of import companies that move first will decrease, and the profits of host country enterprises that move later will increase. Let the profit of enterprise A produce goods 1 equal to the profit of enterprise B produce goods 1, then $t = \frac{3 \pm 2\sqrt{2}}{2}(a - c)$. Due to $t \geq 0$, when $t \in (\frac{3 - 2\sqrt{2}}{2}(a - c), \frac{3 + 2\sqrt{2}}{2}(a - c))$ the profit of enterprise A is greater than the profit of enterprise B. While $t \in (0, \frac{3 - 2\sqrt{2}}{2}(a - c)) \cup (\frac{3 + 2\sqrt{2}}{2}(a - c), \infty)$, the profit of enterprise B is greater than the profit of enterprise A.

The purpose of enterprise A's national quantitative taxation is to maximize the country's social welfare, which consists of the sum of consumer surplus, tax revenue, and corporate profits. Take the derivative of consumer surplus in the country where company A is located and

make it equal to zero then $t = \frac{3(a - c)}{10}$. Due to $t = \frac{3(a - c)}{10} \in (\frac{3 - 2\sqrt{2}}{2}(a - c), \frac{3 + 2\sqrt{2}}{2}(a - c))$, the profit of enterprise A is higher than the profit of enterprise B. Company B's output should be set to $y = \frac{(a - c)}{5b}$ but there is no first mover advantage in output, that is, there is no advantage in its leadership position.

If a company abandons its leadership position, that is, when two oligarchs compete simultaneously, it is equivalent to the simple Cournot model.

Take the partial derivative of the profit of enterprise A and make it equal to zero then $x = \frac{a - c - by}{2b}$. The profit of enterprise B is to obtain a partial derivative and make it equal to zero then $y = \frac{a - t - c - bx}{2b}$. Combining the two functions finds that company B abandons its leadership position and its output decreases.

Enterprise A profit $\pi = \frac{(a + t - c)^2}{9b}$, the profit of enterprise B is $\pi = \frac{(a - 2t - c)^2}{9b}$. From the profit comparison of enterprise B, it can be seen that the profit of enterprise B in a leading position in the face of tax and trade policies is higher than the profit of giving up the leading position. Tariffs will make the leading import company's first mover advantage disappear, but even if this is the case, the leading import company should not give up its leadership.

3.2. An Analysis of Coping Strategies under the Circumstances of Trade Quota Change

The previous analysis all regarded the trade protection policy directly as the setting of quantitative taxation. Now the quantitative quota is considered for analysis. Now suppose that the host country's import limit for company B is m, so here the import quantity of company B is set as a constant m. Due to the trade protection policy, m is set by the host country, that is, the output of company B is y=m.

From the above analysis, it is known that enterprise A is a follower enterprise, so $x = \frac{a - by - c}{2b} = \frac{a - bm - c}{2b}$

Commodity 1 output $Q_1 = x + y = \frac{a + bm - c}{2b}$, commodity 1 price is $P = a - b(\frac{a + bm - c}{2b}) = \frac{a - bm + c}{2}$, the profit of enterprise A producing commodity 1 is $\pi = \frac{(a - bm - c)^2}{4b}$, the profit of enterprise B producing commodity 1 is $\pi = (\frac{a - bm - c}{2})m = \frac{am - bm^2 - cm}{2}$. Appropriate through analysis $m \in (\frac{(a - c)}{2b}, \frac{3(a - c)}{2b})$, enterprise A's profit for producing goods 1 will be lower than the profit when trade quotas are not applied. When $m \in (0, \frac{(a - c)}{2b}) \cup (\frac{3(a - c)}{2b}, \infty)$, the profit of enterprise A's production of goods 1 is higher than that when no trade quotas are implemented.

When $m = \frac{a-c}{2b}$, company B's profit is the same as the profit without trade quotas. When $m \neq \frac{a-c}{2b}$, company B's profit is lower than the profit when it has not faced the trade protection policy.

If the profit of enterprise A producing commodity 1 is equal to the profit of enterprise B producing commodity 1, then the analysis shows that when $m \in (\frac{a-c}{3b}, \frac{a-c}{b})$, enterprise B still maintains the first mover advantage when producing goods 1, but because of the current trade quotas, whether enterprise B can maintain the first mover advantage when producing goods 1 depends on the decision of the host country.

Now analyze the trade quota situation of the country where company A is located as above, seek guidance on the welfare of the country where company A is located, and make it equal to zero then $m = \frac{3a-c}{3b}$. Found when $m = \frac{3a-c}{3b}$, the company's benefits reach the smallest. The country where company A is located in order to make the welfare greater, which should set $m > 0$ and $m \neq \frac{3a-c}{3b}$. It can be seen that compared with tax and trade protection, the value of the trade limit for trade protection cannot be determined here. It can only be analyzed to conclude that the host country should set the trade limit as $m > 0$ and $m \neq \frac{3a-c}{3b}$.

From the above analysis, it can be seen that the host country's trade protection policy cannot be clarified by maximizing the host country's welfare, so it will be analyzed whether company B can optimize the trade situation through non-production costs.

When the trade quota is cancelled through non-production costs such as bidding, transfer, etc., the trade quota restriction is cancelled by increasing the cost. Therefore, the marginal cost of enterprise B is set as. When company B cancels trade quotas at non-production costs, the profit of company A is $\pi = \frac{(a-3c+2c')^2}{16b}$, the profit of company B is $\pi = \frac{(a+c-2c')^2}{8b}$.

Make company B use the increased cost to cancel the trade quota restrictions and the profit obtained is the same as the profit obtained by company B simply facing the trade quota. I found that when $c' > a$, regardless of the size of the trade limit, the profit obtained by canceling the trade limit through non-production costs is greater. When $c' < a$ and $m \in (\frac{(a-c) - 2\sqrt{(a-c')(c'-c)}}{2b}, \frac{(a-c) + 2\sqrt{(a-c')(c'-c)}}{2b})$, company B should not eliminate trade quotas through non-production costs. When m is outside this range and $m > 0$, enterprise B should eliminate trade quotas through bidding, transfer, etc.

If company B is simultaneously playing games with company A on the basis of canceling trade quotas at non-production costs, then company A's profit is $\pi = \frac{(a-2c+c')^2}{9b}$, the profit of company B is $\pi = \frac{(a+c-2c')^2}{9b}$.

It can be seen that import companies should not give up their leading position when they cancel trade quotas at non-production costs. And it can be seen that when the non-production cost is greater than the parameter a , the import company that takes the non-production cost method to cancel the trade quota will get a larger profit.

3.3. An Analysis of the Coping Strategies in the Case of Quantitative Taxation and Trade Quota

If the trade protection policy here requires both quantitative taxes and trade quotas, then the profit of enterprise A producing commodity 1 is still $\pi = \frac{(a - bm - c)^2}{4b}$, the profit of enterprise B producing commodity 1 is $\pi = \frac{am - bm^2 - cm}{2} - mt$.

The new trade protection policy is based on trade quotas and supplemented by taxation. Therefore, the analysis here first sets t as a quantitative value, and the value of m is for the purpose of maximizing the welfare of the country where enterprise A is located.

Take the derivation of the welfare of company A and make it equal to zero $m = \frac{3a - c - 4t}{3b}$. Compared with the case of only facing trade quotas, the value of m is reduced. To make the welfare greater, the value of m should be $m \neq \frac{3a - c - 4t}{3b}$.

If the country where company B is located at this time adopts a subsidy policy to alleviate the tax policy faced by company B, then the profit of company B is $\pi = \frac{am - bm^2 - cm}{2} - mt + ms$.

When $t=s$, enterprise B faces a situation that is like the host country only implements the trade protection policy of trade quotas. When the country where company B is located uses a subsidy policy to protect company B from the impact of tax and trade policies, company B faces the same situation as described above, but the welfare of the country where company B is located will be reduced due to the subsidy policy.

When company B is receiving subsidies $s = t$, company B can decide whether to take non-cost methods to cancel trade quotas based on non-production costs and the scope of trade quotas. The situation is consistent with the situation of only facing trade quotas.

Consider taking non-production cost methods to cancel trade quotas and subsidize $s = 0$. If company B uses the non-production cost method to eliminate the trade limit, set the marginal cost as c'' . In case 2, when company B cancels trade quotas by non-production cost, the profit

of company A is $\pi = \frac{(a - 3c + 2c'' + 2t)^2}{16b}$, the profit of company B is $\pi = \frac{(a+c - 2c'' - 2t)^2}{8b}$.

Make company B use the increase of non-production costs to remove the trade quota restrictions and the profits obtained when the company B faces the new trade protection are equal. When $c'' > a - 2t$ and faced with the new type of trade protection, the profits obtained by canceling trade quotas through non-production cost methods are greater. when $c'' < a - 2t$ and

$m \in \left(\frac{(a - c - 2t) - 2\sqrt{(c'' - c)(a - 2t - c'')}}{2}, \frac{(a - c - 2t) + 2\sqrt{(c'' - c)(a - 2t - c'')}}{2} \right)$, company B

should not eliminate trade quotas through non-production costs. When m is outside this range and, enterprise B should eliminate trade quotas through bidding, transfer, etc.

If company B is simultaneously playing games with company A on the basis of canceling trade quotas at non-production costs, then company A's profit is $\pi = \frac{(a - 2c + c'' + t)^2}{9b}$, the profit

of company B is $\pi = \frac{(a+c-2c''-2t)^2}{9b}$. It can be seen that when the company cancels the trade quota by means of non-production costs, company B should still maintain its leading position as in case 2.

Through the comparison of profit, the above inference can be verified, when the non-production cost $c'' > a - 2t$, the profits obtained by importing enterprises that take non-production costs to cancel trade quotas are more. And when the importing company adopts non-production cost method to cancel the trade quota, if the importing company abandons its leading position, its profit will decrease. That is, when the importing company adopts the non-production cost method to cancel the trade quota, it should not abandon its leadership status.

4. MAIN CONCLUSIONS

Based on the Stackelberg model, this article analyzes whether leading import companies should keep their strategies first under protectionism. Among them, trade protectionism is divided into three situations that consider the combination of trade taxation, trade quotas, quantitative taxation and trade quotas. It is found that when trade protection considers changing trade taxation, as a manager of an importing company, it is facing trade protectionism. In order to collect a certain amount of higher taxes, it is necessary to understand the overall welfare status of the host country, so as to try to predict the tax policy that the host country will introduce. When trade protection considers changing trade quotas, when the marginal cost of the importing company is greater than the value of parameter a, the importing company should take the non-production cost method to cancel the trade quota. When the marginal cost of the importing company is less than the value of parameter a and the limit number m is within a certain range, the importing company should not eliminate trade quotas through non-production costs. When the quota m is outside a certain range, the importing company should eliminate the trade quota through bidding, transfer, etc. At the same time, import companies should not give up their leading position when canceling trade quotas at non-production costs. Trade protection considers changing taxes and trade quotas. When the marginal cost of an importing company is greater than a certain amount, the profit obtained by canceling trade quotas through non-production costs is greater. When the marginal cost of the importing company is less than a certain amount and the trade quota m is within a certain range, the importing company should not eliminate the trade quota through non-production costs. When m is outside this range, import companies should eliminate trade quotas through bidding, transfer, etc. At the same time, import companies should not give up their leading position when canceling trade quotas at non-production costs.

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