

A game theory analysis - dumping by multinational company and antidumping in China

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Received 1 March 2014, www.tsi.lv

Abstract

Based on a dynamic game model, this paper analyses dumping by multinational firm and Chinese government's antidumping behaviour. It is shown that no matter how many products are dumped in domestic market; Chinese authority should impose punitive damages against the foreign firm as long as the scale of antidumping duty is not too high to stop multinational company's investment. This strategy will improve social welfare.

Keywords: Multinational company, Dumping, Antidumping, Game

1 Introduction

Foreign capital inflows have been considered as an engine for Chinese economic growth since China's reform and open [1]. The capacity and sale of multinational companies turn to be very large scale. At the same time, the indisputable fact is that multinational companies dump their products in not only Chinese traditional industries but also the emerging industry [2]. There was dumping by foreign firm in many industries like steel, chemical, oil, machine tool, plywood, computer, food and beverages. This is inevitably harmful to the development of relevant industries in China.

It is worth mentioning that the form of dumping is not confined to regular dumping but also pre sales, a foreign investment preferential policy provided by Chinese government. Pre-sales means the foreign companies introduce products, which are produced in other market into the host country before their capacity in the host country goes into operation. In this way, foreign firms can expand their market shares thereafter. The penetration pricing method is broadly adopted by multinational companies in the early stage of the market development (namely a way of pricing marketing in which foreign firms intentionally sell a product at a lower price to stimulate the market demand and improve the market share) [3]. However, this way of selling and pricing is a typical form of dumping and becomes the focus of the Chinese government import anti-dumping.

By the end of March 2011, China has launched 189 cases of anti-dumping investigation on imported products, 177 cases of which are filed after China's access to the WTO [4]. In ten years, China has become one of the countries that implement anti-dumping investigations most frequently. In this period, 26

countries and regions were involved in anti-dumping investigations by China's authority. United States and Japan attracted the majority of antidumping suits. Their combined share accounted for up to 48%. South Korea was in the second place, about 46% [5]. The third is the European Union, about 25%. It is not hard to see the countries or regions that were ruled guilty of dumping mainly are developed countries, which have industrial strength and high responding ability.

The foreign firms engaged in dumping mostly concentrate in nine industries such as chemicals, steel, metalworking, automobile, mechanical and electrical products, papermaking, textile and food [6]. This is relevant to the development tendency of China's internal and external trade policy after China became a member of the WTO. Although chemical industry and steel metallurgy industry attracted significant foreign investment, there were the most number of anti-dumping appeals [7].

2 The Setup

2.1 ASSUMPTION

We use dynamic game theory to analyse the foreign enterprise's use of pre-sales for dumping and anti-dumping measures taken by the Chinese government, and make the following assumptions [8]:

- (1) The initial market structure of the industry is a symmetry oligopoly. There are static or dynamic economies of scale, i.e. each firm in the game has a decreasing marginal cost curve.
- (2) Government provides certain preferential policies to foreign enterprises, which makes difference in the cost functions of foreign and Chinese firm.

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Assumption (1) and (2) imply that average cost of foreign companies is lower than that of Chinese company because the foreign firm is relatively larger than Chinese firm and can enjoy the preferential policies only available to alien firm.

(3) Firms are producing a homogenous good. Hence, the products of foreign firm and Chinese firm are perfect substitutable.

(4) Foreign firms and Chinese companies engage in Cournot competition and will not quit the game in the $[1, t]$ period since they are pursuing long-term strategic interests.

Moreover, let T_p be a dummy variable and p be the time. $T_p = 1$ indicates there is dumping by foreign firm in pre-sales period (p) and in ($p+1$) period Chinese government imposes anti-dumping duty which equals the margin of dumping. $T_p = 0$ means there is dumping by foreign firm in pre-sales (p) period without anti-dumping charge from the Chinese government in period ($p+1$). The multinational's and the domestic firms' profits (W) are then:

$$W_{p,h} = [P_{p,h}(Q_p) - C_{p,h}]Q_{p,h}, \tag{1}$$

$$W_{p,f} = [P_{p,h}(Q_p) - C_{p,f} - T_{p-1}S_{p-1}]Q_{p,f}, \tag{2}$$

where C is cost and Q is quantity. S_{p-1} denotes the margin of dumping and $P_{p,h}(Q_p)$ is price in Chinese market.

2.2 ANTIDUMPING STRATEGY BY CHINESE AUTHORITY

Profit maximizing with respect to quantity gives out the first order condition as following:

$$\partial W_{p,h} / \partial Q_{p,h} = P_{p,h} + P'_{p,h}Q_{p,h} - C_{p,h} = 0, \tag{3}$$

$$\partial W_{p,f} / \partial Q_{p,f} = P_{p,h} - C_{p,f} - T_{p-1}S_{p-1} + P'_{p,h}Q_{p,f} = 0. \tag{4}$$

As it is perfect substitutive between foreign product and domestic product, the following condition needs to be satisfied:

$$\begin{aligned} \partial^2 W_{p,h} / \partial Q_{p,h} \partial Q_{p,f} < 0, & \quad \partial^2 W_{p,h} / \partial Q^2_{p,h} < 0, \\ \partial^2 W_{p,f} / \partial Q_{p,h} \partial Q_{p,f} < 0, & \quad \partial^2 W_{p,h} / \partial Q^2_{p,h} < 0, \\ \partial^2 W_{p,f} / \partial Q^2_{p,f} < 0. & \end{aligned}$$

Then

$$\begin{cases} \partial^2 W_{p,h} / \partial Q^2_{p,h} = 2P'_{p,h} + P''_{p,h}Q_{p,h} < 0 \\ \partial^2 W_{p,f} / \partial Q^2_{p,f} = 2P'_{p,f} + P''_{p,h}Q_{p,h} < 0 \\ \partial^2 W_{p,h} / \partial Q_{p,h} \partial Q_{p,f} = \partial^2 W_{p,f} / \partial Q_{p,h} \partial Q_{p,f} = 2P'_{p,h} + P''_{p,h}Q_{p,f} < 0 \\ \partial^2 W_{p,h} / \partial Q^2_{p,h} < \partial^2 Q_{p,h} / \partial Q_{p,h} \partial Q_{p,f} \\ \partial^2 W_{p,f} / \partial Q^2_{p,f} < \partial^2 Q_{p,f} / \partial Q_{p,f} \partial Q_{p,h} \end{cases} \tag{5}$$

$$H_p = \det \begin{bmatrix} \partial^2 W_{p,h} / \partial Q^2_{p,h} & \partial^2 W_{p,h} / \partial Q_{p,h} \partial Q_{p,f} \\ \partial^2 W_{p,f} / \partial Q_{p,f} \partial Q_{p,h} & \partial^2 W_{p,f} / \partial Q^2_{p,f} \end{bmatrix} < 0 \tag{6}$$

The unique Cournot-Nash equilibrium from equations (1)-(4) can be labelled as $P_{p,h}^{CN}(T_{p-1}S_{p-1})$ and $Q_{p,h}^{CN}(T_{p-1}S_{p-1})$, $Q_{p,f}^{CN}(T_{p-1}S_{p-1})$. If foreign firm is dumping in the pre-sale period ($p-1$), Chinese government imposes anti-dumping duty, namely $T_{p-1} = 1$, derivative of equations (3)-(4) with respect to Cramer's rule will give the following formula:

$$\begin{cases} \partial Q_{p,h}^{CN} / \partial S_{p-1} = -P'_{p,h} (P'_{p,h} + P''_{p,h}Q_{p,h}) / H_p > 0 \\ \partial Q_{p,f}^{CN} / \partial S_{p-1} = P'_{p,h} (3P'_{p,h} + P''_{p,h}Q_{p,h}) / H_p < 0 \\ \partial P_{p,h}^{CN} / \partial S_{p-1} = P'_{p,h} \bullet \partial Q_{p,h}^{CN} / \partial S_{p-1} > 0 \end{cases} \tag{7}$$

As a result, we obtain Proposition 1.

Proposition 1: When there is dumping by foreign firm in pre-sale period ($p-1$), and Chinese government issues an antidumping duty order to offset the injury, the international market prices will rise in (p) period, and foreign country's exports decline, but Chinese domestic enterprises will expand production.

Partial derivative of equilibrium profits with respect to S_{p-1} obtain the following inequality

$$\begin{cases} \partial W_{p,h}^{CN} / \partial S_{p-1} = (P'_{p,h})^2 \bullet Q_{p,h}^{CN} \bullet (2P'_{p,h} + P''_{p,h}Q_{p,h}) / H_p > 0 \\ \partial W_{p,f}^{CN} / \partial S_{p-1} = -Q_{p,f}^{CN} [1 + (P'_{p,h})^2 \bullet (2P'_{p,h} + P''_{p,h}Q_{p,h})] H_p < 0 \end{cases} \tag{8}$$

Long-term profit maximization is defined as:

$$\begin{cases} \max W_h = W_{p-1,h} + \tau \xi \partial W_{p,h}^{CN} + \tau(1-\xi)W_{p,h}^{CN} (0) \\ \max W_f = W_{p-1,f} + \tau \xi \partial W_{p,f}^{CN} + \tau(1-\xi)W_{p,f}^{CN} (0) + \\ W_{p-1,0}(L_{p-1}) + \tau W_{p,0}(L_p) \end{cases} \tag{9}$$

where $W_{p,0}$ and L_p denote profit and sales of foreign firm in home country, respectively while ξ is probability that Chinese government issues an anti-dumping duty order in pre-sale period.

The equilibrium output can be determined by solving the first-order condition for equation (8):

$$\begin{cases} \partial W_h / \partial Q_{p-1,h} = \partial W_{p-1,h} / \partial Q_{p-1,h} + \tau \xi \partial W_{p,h}^{CN} / \partial S_{p-1} \bullet \partial S_{p-1} / \partial Q_{p-1,h} = 0 \\ \partial W_f / \partial Q_{p-1,f} = \partial W_{p-1,f} / \partial Q_{p-1,f} + \tau \xi \partial W_{p,f}^{CN} / \partial S_{p-1} \bullet \partial S_{p-1} / \partial Q_{p-1,f} = 0 \\ \partial W_f / \partial Q_{p-1} = \partial W_{p-1,0} / \partial L_{p-1} + \tau \xi \partial W_{p,h}^{CN} / \partial S_{p-1} \bullet \partial S_{p-1} / \partial L_{p-1} = 0 \end{cases} \quad (10)$$

Since $\partial S_{p-1} / \partial Q_{p-1,h} = -P'_{p-1,h} > 0$, $\partial W_{p,h}^{CN} / \partial S_{p-1} > 0$, equation (10) implies $\partial W_{p-1,h} / \partial Q_{p-1,h} < 0$. It means Chinese firm's profit will fall when foreign company dump in China and will rise when Chinese government imposes anti-dumping duty.

If there is dumping by foreign firm in pre-sale period, i.e. $S_{p-1} > 0$, with $\partial S_{p-1} / \partial L_{p-1} = P'_{p-1,h} < 0$ and $\partial W_{p,f}^{CN} / \partial S_{p-1} < 0$, the following inequality satisfies $\begin{cases} \partial W_{p-1,f} / \partial Q_{p-1,f} > 0 \\ \partial W_{p-1,0} / \partial L_{p-1} < 0 \end{cases}$, which imply that dumping by foreign company will make its export earnings rise, but profit of foreign firm in its home country will decline. As a result, we have Proposition 2 and Proposition 3.

Proposition 2: The profit of parent company in the home country is decreasing in the anti-dumping duty imposed on their affiliate in China in the pre-sales period. While the profit of Chinese domestic enterprises is increasing in the anti-dumping tax, but the enthusiasm of foreign investment may be affected.

How many anti-dumping duties should the Chinese government to impose? It should have warning and sanction effect on foreign companies but should not affect their investment enthusiasm. We will turn to this issue later.

Proposition 3: The aim of Chinese government to impose anti-dumping duty is to encourage domestic enterprises to increase output and warrant fair competition. Anti-dumping is a threaten action ex ante and has sanction effect ex post.

Let U denote utility function. Because anti-dumping tax is levied on Chinese firms that import the product involving dumping, it is not relevant to national welfare. Specifically, China's social welfare is defined as:

$$F_{p,h} = U(Q_p) - P_{p,h}Q_p + (P_{p,h} - C_{p,h})Q_{p,h} \quad (11)$$

Derivative with respect to S_{p-1} is given by:

$$dF_{p,h} / dS_{p-1} = (P'_{p,h})^2 [Q_p [P'_{p,h} - \Psi_{p,h} (2P'_{p,h} + P''_{p,h} Q_{p,h})] / H_p] \quad (12)$$

where $\Psi_{p,h} = Q_{p,h} / Q_p$ is the market share of Chinese firm in t period.

Proposition 4: If $\Psi_{p,h} > (= or <) P'_{p,h} / (2P'_{p,h} + P''_{p,h} Q_{p,h})$, anti-dumping policy by Chinese government will increase (not change or decrease) the domestic social welfare. The greater the dumping margin, the better (or worse) China's social welfare will become.

If $\Psi_{p,h} \rightarrow 1$, i.e. import volume is trivial, as $dF_{p,h} / dS_{p-1}$ is proportional to $dQ_{p,h} / dS_{p-1}$, China's national welfare still can be better off when the authority take anti-dumping measures.

It implies that it is necessary for China's government to fight unfair competition from imported product, no matter how small the amount of dumping.

2.3 THE SCALE OF ANTIDUMPING DUTY

The effect of industrial preferential policies and anti-dumping tax on cost of foreign firms are denoted by μ and λ , respectively, which are distributed according to a continuous 0 mean distribution. $\mu > 0$ represents that cost of a foreign company is superior to that of a Chinese firm; $\lambda > 0$ implies that foreign firms are levied heavier tax burden than Chinese firms. According to the former definition about foreign investment policies and taxing policies, we denote $\alpha\lambda$ the effect of anti-dumping on unit cost of a Chinese firm. Then we specify the profit function of a foreign firm and a Chinese firm as follows:

$$w_h = \sum_{i=1}^{\alpha} [\pi_i(x)] = \sum_{i=1}^{\alpha} [x_i p(x) - c_i(x_i) - \mu x_i + \alpha \lambda x_i] \quad (13)$$

$$= x_h p(x) - c_h(x_h) - \mu x_h + \alpha \lambda x_h$$

$$w_f = \sum_{j=1}^{\beta} [\pi_j(x)] = \sum_{j=1}^{\beta} [x_j p(x) - c_j(x_j) - \mu x_j - \lambda x_j] \quad (14)$$

$$= x_f p(x) - c_f(x_f) + \mu x_f - \lambda x_f$$

where $\pi_i(x)$ is the profit function of China's domestic firm and $\pi_j(x)$ is the profit function of foreign firm. Profits depend on output x_1, x_2, \dots, x_n , inverse demand function $p(x)$ and total production cost $c_h(x_h), c_f(x_f)$.

Specifically, we define $p_i(t) = \frac{1}{\alpha e^{\beta_i t}}$, where t is time node and β_i is the price of the i-th product, as a result $p(x) = \int_0^{\infty} p_i(t) = \int_0^{\infty} \frac{1}{\alpha e^{\beta_i t}}$. In addition, production costs satisfy $C'_h, C'_f > 0, C''_h, C''_f < 0$.

Substituting $p(x) = \int_0^{\infty} p_i(t) = \int_0^{\infty} \frac{1}{\alpha e^{\beta_i t}}$ into equations (13)-(14) yields the competitors' profit maximization function:

$$\begin{aligned} \max W_h &= \max \sum_{i=1}^{\alpha} [\pi_i(x)] \\ &= \max [x_h \int_0^{\infty} \frac{1}{\alpha e^{\beta_i t}} - c_h(x_h) - \mu x_h + \alpha \lambda x_h] \end{aligned} \quad (15)$$

$$\begin{aligned} \max W_f &= \max \sum_{j=1}^{\beta} [\pi_j(x)] \\ &= \max [x_f \int_0^{\infty} \frac{1}{\alpha e^{\beta t}} - c_f(x_f) - \mu x_f - \alpha x_f] \end{aligned} \tag{16}$$

If dumping by foreign firms is imposed anti-dumping duties, there is investigation cost and other relative expenditure. We denote by γ this kind of cost satisfying $0 < \gamma < 1$. Therefore the effect of anti-dumping on unit cost of a Chinese firm changes from $\alpha\lambda x_h$ to $\alpha\gamma\lambda x_h$. Partial derivative yields the competitors' first-order conditions:

$$\begin{cases} \frac{\partial w_h}{\partial w_f} = p(x) + x_h p'(x) - c'_h(x_h) - \mu + \alpha\gamma\lambda = 0 \\ \frac{\partial w_f}{\partial w_h} = p(x) + x_f p'(x) - c'_f(x_f) + \mu - \lambda = 0 \end{cases} \tag{17}$$

Solving the first order condition gives the slope of respond function:

$$\begin{cases} k_h = - \frac{\partial^2 w_h / \partial w_f^2}{\partial^2 w_h / \partial w_h \partial w_f} \\ k_f = - \frac{\partial^2 w_f / \partial w_h^2}{\partial^2 w_f / \partial w_h \partial w_f} \end{cases} \tag{18}$$

The inverse demand function indicates that $\frac{\partial^2 w_h}{\partial w_h \partial w_f} < 0$; $\frac{\partial^2 w_f}{\partial w_h \partial w_f} < 0$ and $\frac{\partial^2 w_h}{\partial x_h^2} > \frac{\partial^2 w_h}{\partial x_h \partial x_f}$; $\frac{\partial^2 w_f}{\partial x_f^2} > \frac{\partial^2 w_f}{\partial x_f \partial x_h}$.

Therefore, $k_h < 0$, $k_f < 0$ and $|k_h| \geq |k_f|$. The equilibrium is $|k_h| = |k_f|$.

According to equations (17)-(18), we solve the equilibrium $\lambda = p\alpha/k$. This is the threshold condition for government to impose anti-dumping duties.

Consequently, the structure of the game is outlined in Figure 1, where foreign firm is player 1 and Chinese government is player 2. In the first stage, the foreign firm decides whether to dump in Chinese market. In the second stage, the Chinese government can react to the foreign firm's dumping decision in the first stage. That is whether to impose anti-dumping duty on foreign firm. In the third stage of the game, foreign firms decide either to withdrawal investment from China or keep investing in China but stop dumping.

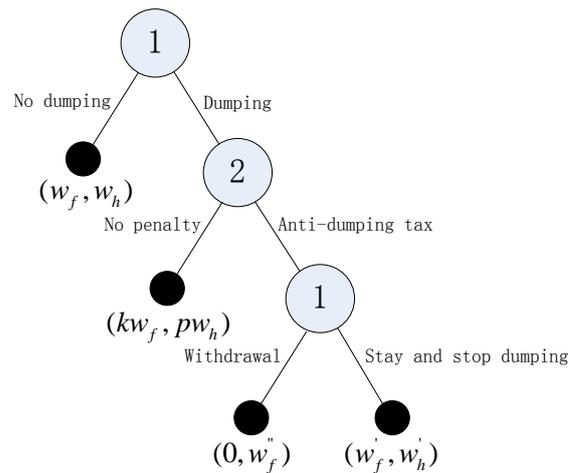


FIGURE1 Game Structure

It is clear from the game tree that the sum of profits of foreign and Chinese firm is maximized, when foreign firm does not dump and when $|k_h| = |k_f|$. In this case, the Chinese firm yields the most profit. Hence, China's government, by making a few laws and regulations to improve market competition and alerts the foreign enterprise, can optimize the total profit and ensure the interests of Chinese enterprises as well. If the foreign company chooses to dump product into Chinese market, its profit will increase to kw_f , but the Chinese firm's profit decrease to pw_h . Then the overall loss of profit is $(1-p)w_k - (k-1)w_f > 0$. In this case, if Chinese government does not intervene, eventually dumping by foreign firms will force Chinese companies out of the market. In case of intervention by imposing anti-dumping duty and providing certain subsidy to Chinese firms, the sum of profit of both kind of firm is $(kw_f - \lambda x_f) - w_f + w_h - (pw_h + \alpha\lambda x_h)$.

If $\lambda < p\alpha/k$, the above overall profit is minus but the foreign firm is still profitable through dumping. So, $\lambda < p\alpha/k$ is the threshold condition for government to impose anti-dumping duty on foreign firms. If the anti-dumping duty is too high, making the foreign capital withdraw from the Chinese market and Chinese companies' profit increase, the market cost and other relevant cost will increase, and because of the destruction of the market structure caused by the previous price war, overall market profits will become $w_h'' < w_h + w_f$. It will lead to Nash equilibrium again in the event that foreign enterprise stop dumping because of anti-dumping tax and stay in China. At this moment, although market is distorted to some extent and profits of foreign and Chinese firm both decline, the overall profit still optimize as $w_f' + w_h'$.

3 Conclusions

Multinational companies play a main role in FDI inflow to China and are influenced by preferential investment policy provided by Chinese government. Theoretically, speaking, the conflict between anti-dumping and investment absorption stem from the clash of interest of Chinese government and multinational companies. The aim for multinational companies to invest internationally is to strengthen their global market competitiveness, so as to realize their own profit maximization, while the Chinese government concerns about promoting China's economic development and enhancing the global competitiveness of Chinese enterprises, so as to improve social welfare.

Based on a dynamic game model, we draw some conclusions:

(1) When there is dumping by foreign firm and Chinese government issues an anti-dumping duty order to offset the dumping, the international market price will rise and foreign firm's exports from its home country decline, but Chinese domestic enterprise will expand its production.

(2) The profit of the parent company in the home country is decreasing in the anti-dumping duty imposed on its affiliate in China in the pre-sales period, while the profit of Chinese domestic enterprise is increasing in the anti-dumping tax.

(3) The aim of Chinese government to impose anti-dumping duty is to encourage domestic enterprises to increase output and warrant fair competition. Anti-dumping is a threaten action ex ante and has sanction effect ex post.

(4) If $\Psi_{p,h} > (= \text{or} <) P'_{p,h} / (2P'_{p,h} + P^*_{p,h} Q_{p,h})$, anti-dumping policy by Chinese government will increase (not change or decrease) the domestic social welfare. The greater the dumping margin, the better (worse) China's

social welfare will become.

If $\Psi_{p,h} \rightarrow 1$, i.e. import volume is trivial, as $dF_{p,h} / dS_{p-1}$ is proportional to $dQ_{p,h} / dS_{p-1}$, China's national welfare still can be better off when the authority take anti-dumping measures. It implies that it is necessary for China's government to fight unfair competition from imported product, no matter how small the amount of dumping.

(5) A proper scale of antidumping duty will not change the mode of entry by the multinational company. There will still be a great amount of FDI inflow.

Acknowledgments

In the process of writing paper, thanks for the help and guidance of my colleagues and supervisor.

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