

Does Encourage Inward FDI Always Be a Dominant Strategy for Domestic Government? A Theoretical Analysis of Vertically Differentiated Industry

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Abstract: In a vertically differentiated industry with complete information, I analyze a situation which involves an ex-ante tariff game and compares with FDI. The main results show that the FDI-promotion attitude of domestic government does not always be a dominant strategy. When a foreign firm decides to adopt FDI because of the motive of tariff-saving, the findings of this paper indicate that the domestic government's optimal trade policy is to impose a specific tariff on the foreign firm. Simultaneously, the foreign firm has no incentive to deviate the export strategy to FDI.

Keywords: Vertical differentiation; Import tariffs; foreign direct investment; Quality

JEL classification: F12; F13; L13

1. Introduction

Nearly two decades, the foreign direct investment (FDI) already becomes an important trade type in the whole world. During the years, developing countries got relatively higher economic growth by FDI. Besides, the FDI may generate externalities in the form of technology transfers and spillovers. Romer (1993) presents that the "idea gaps" exists among the rich and poor countries. By the foreign investment, the transfers of technology and business know-how can divert to poorer countries. Hence, the FDI will promote the productivity improvement of all firms.

Some empirical studies also hold a supportive attitude toward FDI. De Mello (1999) uses the time series and panel data evidence which are provided for OECD and non-OECD countries in the period 1970-90. The author found that both of developing and developed countries would get positive effect from FDI. The main reasons comes from the spillovers of technology and knowledge from the investing countries to host countries. Besides, a country owns strong financial systems which also lead a positive effect from FDI. Alfaro et al. (2004) and Durham (2004) support the above discussions.

However, some existing studies give us different viewpoints as follows. Glass and Saggi (1999) notes that the inward FDI generates increased labor demand, which raises the wage in the host country but simultaneously damages the profits of host firms. Reis (2001) presents that the FDI may decrease national welfare due to the

transfer of capital returns to the foreign firms. She finds that, the foreigners are able to introduce new goods at a lower cost relative to the nationals. It implies that the foreign-investor entry leads the domestic producers no longer to act in the R&D sector; thereby, it will generate a loss of profits. Wen (2007) presents that the FDI only generates positive effects on economic growth toward China's coastal provinces. But, the opposite results are generated in central China which implies that the inward FDI brings negative impact on the inland provinces. The main reason is that the impact of FDI inflow reduces the regional income growth.

The pros and cons of inward FDI comes from many complex factors. Hence, this paper try to discuss above issues in a vertically differentiated industry. This paper follows Inigo Herguera et al. (2002) to consider a two-country trade model with complete information. This is a vertical product differentiation model which involves several reasons are worth to adopt this model as follows. First, the intra industry trade characterized by different levels of quality being taken seriously because which accounts for a large proportion of international trade. Fukao et al. (2003) and others have observed the above phenomenon. Second, these models enable us to observe the differences between high- and low-quality, which directly affect the variations of domestic consumer surplus. The similar models had used in several important literature such as Motta (1993), Shaked and Sutton (1982).

In this paper, I analyze a situation which involves an ex-ante tariff game and compares with FDI. When the foreign firm's motive is tariff-saving, our results present that the domestic government's optimal trade policy is to impose a specific tariff on foreign firm. Simultaneously, the foreign firm has no incentive to deviate the export strategy to FDI. In addition, this research further considers that the high quality foreign firm bears a higher exogenous fixed sunk cost, and then the domestic government owns more advantages to impose higher specific tariff on foreign firm. According the above descriptions, the FDI-promotion policy does not always be a dominant trade decision for the domestic government.

In section 2, this paper presents the basic settings of vertical product differentiation model under quantity competition. Especially, the foundations of export- and FDI-mode are described in this section. In section 3, the export- and FDI-trade equilibriums are derived by the above settings. The ex-ante tariff game is analyzed and the outcomes are compared to FDI. In section 4, concludes.

2. The Basic Model

The settings of this paper assume that there are two countries in the world, one foreign and one domestic. These two countries separately owns a monopolistic firm to

produce a kind of vertically differentiated goods and then selling in the domestic market. Furthermore, the demand for the vertically differentiated goods just only exist in the domestic country. It means that the outputs of the foreign country just only sell to the domestic market. At the same time, I also denote that the market mode is uncovered market, it describes that not all of consumers in domestic market would buy one unit goods. Moreover, this research will introduce two modes of trade, one is FDI-mode and the other one is export-mode. For the export-mode, I consider a three-stage, non-cooperative, ex-ante game as follows. At the first stage, the domestic government decides their tariff policy on imports and then the second stage is that each firm in the market (simultaneously) competes to select their qualities. Finally, firms simultaneously choose the quantities of their goods to maximize their profits. For the FDI-mode, this paper also considers a two-stages, non-cooperative game. The foreign firm adopts a FDI strategy to compete their qualities with domestic firm, and then simultaneously choose the quantities of their goods to maximize their profits at the second stage.

2.1 The Demand Side

There is a continuum consumers in the domestic market and each of them identified by his taste parameter θ . The taste of consumers is uniformly distributed over the interval $[0, \bar{\theta}]$. The $\bar{\theta}$ represents the size of the market. Each consumer owns a demand function by one unit of good of quality s_i and taste parameter θ :

$$\begin{cases} U = (\theta s_i - p_i) & \text{if he buys one unit goods with the quality level } s_i; \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

Quality, s_i , is endogenous and denotes that s_h is high quality and s_l is low quality with $s_h > s_l$. In the uncovered market, I derive the taste of the marginal consumer, $\hat{\theta}$, who has the same utility to buy the high quality or low quality good, respectively. Similarly, I also derive the taste of the marginal consumer, $\tilde{\theta}$, who has the same utility to buy the low quality good or none, respectively.

$$\theta s_h - p_h = \theta s_l - p_l \Rightarrow \hat{\theta} = \frac{p_h - p_l}{s_h - s_l} \quad (\text{assuming } p_h \geq p_l)$$

$$\theta s_l - p_l = 0 \Rightarrow \tilde{\theta} = \frac{p_l}{s_l}$$

In the other words, the consumers at the interval $[\hat{\theta}, \bar{\theta}]$ purchase the kind of goods

with s_h and the consumers at the interval $[\tilde{\theta}, \hat{\theta}]$ purchase the kind of goods with s_l .

Hence the demand for the high and low quality goods are presented as follows,

$$x_h = \bar{\theta} - \frac{p_h - p_l}{s_h - s_l}; x_l = \frac{p_h - p_l}{s_h - s_l} - \frac{p_l}{s_l} \tag{2}$$

And the inverse demand are shown as

$$p_h = \bar{\theta}s_h - x_h s_h - x_l s_l; p_l = (\bar{\theta} - x_h - x_l)s_l \tag{3}$$

2.2 The Supply Side

I denote that the foreign firm and the domestic firm produce high- and low-quality goods, respectively. Both of domestic and foreign firms are assumed to face the cost functions as $C(s_l, x_l) = \alpha x_l + \frac{(s_l)^2}{2}$ and $C(s_h, x_h) = \alpha x_h + \frac{(s_h)^2}{2\gamma}$. α is the marginal cost of production, and which is constant. Without loss of generality, this research assumes the marginal cost (α) is zero for both the domestic and the foreign firms. Hence, the cost functions will be reduced to

$C(s_l, x_l) = \frac{(s_l)^2}{2}$ and $C(s_h, x_h) = \frac{(s_h)^2}{2\gamma}$. On the other hand, I assume that the foreign firm has a greater technology advantage on quality improving than the domestic firm. Hence, at the same quality level, the foreign firm's quality improving cost relatively lower than the domestic firm's quality improving cost. I define the symbol, $\gamma \geq 1$, to represent the foreign firm's technology advantage. According to this setting, I can easy to describe that the foreign firm's quality improving cost will decrease over through the higher technology advantage, γ . For analytical convenience, taking the foreign firm's technology advantage as given, $\gamma = 2$. It implies that the foreign firm's quality improving cost is half of the domestic firm's quality improving cost.

Moreover, the quality cost function must satisfy the following conditions, $C(\mathbf{0}) = 0, C^{tr}(\mathbf{0}) = 0, C''(s_i) > 0, \lim_{s_i \rightarrow \infty} [C^{tr}(s_i)] = \infty$. These conditions show that the quality improving cost and the quality of outputs are described a positive relationship. If a firm set its quality level as $s_i = \mathbf{0}$, then the quality improving cost will equal to zero. Similarly, if a firm sets its quality level to infinity, then the quality improving cost will diverge to infinity. By the considerations of cost side, both of domestic and foreign firms will not have any motive to set their quality level to infinity. According to the above descriptions, both firms' profit functions in FDI- and export-mode are presented as follows.

Export-mode:

$$\pi_h^{ex} = p_h^{ex} x_h^{ex} - t\bar{\theta}x_h^{ex} - \frac{(s_h^{ex})^2}{4}$$

$$\pi_i^{ex} = p_i^{ex} x_i^{ex} - \frac{(s_i^{ex})^2}{2}$$

The symbol, ex , is used to represent that the trade structure is export-mode. The p_h^{ex} and p_i^{ex} are the prices which decided by the low quality domestic firm and the high quality foreign firm. x_h^{ex} and x_i^{ex} are the demand for the high and low quality goods in the home market. Furthermore, I let \bar{t} be a per-unit output trade cost which is imposed on the high quality foreign firm. In here, the trade cost just only involve the tariff rates. For analytical convenience, define $t = \bar{t}/\theta$. The details of deriving process will introduce in the following sections.

FDI-mode:

$$\pi_h^{FDI} = p_h^{FDI} x_h^{FDI} - \frac{(s_h^{FDI})^2}{4} - F$$

$$\pi_i^{FDI} = p_i^{FDI} x_i^{FDI} - \frac{(s_i^{FDI})^2}{2}$$

Similarly, the symbol, FDI , is used to represent that the trade structure is FDI-type. In this structure of trade, the high quality foreign firm decides to adopt the FDI strategy and competes with the low quality domestic firm in the home market. Although the per-unit output trade cost does not imposed on the high quality foreign firm, but the foreign firm still needs to shoulder a fixed sunk cost, F , that includes any required investment cost for multinationals. Moreover, $\gamma = 2(\gamma \geq 1)$ is the foreign firm's technology advantage that I have described above. The p_h^{FDI} and p_i^{FDI} are the prices under the FDI-mode, and x_h^{FDI} and x_i^{FDI} are the demand for the high- and low-quality goods in the home market, respectively.

3. The Equilibriums

In this section, I present the outcomes for the export- and FDI-mode. Under these two modes, I will list systematically the following important variables, e.g., the price, quantity and quality levels of domestic and foreign outputs, the both firms' profits, and the consumer surplus and social welfare in the home country, etc. Furthermore, comparing with these two modes, this paper will investigate the motive and reaction of the domestic government and both firms. The exporting and FDI equilibriums are illustrated at the following subsections.

3.1 The Equilibrium of Export-Mode

Firstly, I talk about the export-mode. Under the three-stages, non-cooperative, ex-ante game, the conventional assumption at the first stage is that the domestic government

decides its tariff policy on imports. In this game, the domestic government plays as a Stackelberg leader towards making the social welfare maximization. Taking the tariff policy of government as given, the domestic and foreign firms plays as Stackelberg followers and simultaneously decide their quality level of outputs at the second stage. And then both firms (simultaneously) make their decisions in quantity levels. By the above steps of sequence, this paper uses the backward induction to find the analytical solutions of endogenous variables. Each firm chooses its quantity level of outputs to maximize profits taking the rival's outputs as given. Taking the first order conditions into both firms' profit functions, I obtain the best response functions of domestic and foreign firms as follows,

$$x_h^{ex} = \frac{\bar{\theta}s_h^{ex} - s_l^{ex}x_l^{ex} - \bar{\theta}t}{2s_h^{ex}}; x_l^{ex} = \frac{\bar{\theta} - x_h^{ex}}{2} \tag{4}$$

By the above two formulas, it is easy to show that the tariff and the outputs of high quality foreign firm present a negative relationship. It means that as long as the domestic government imposes higher tariff on foreign firm, then the outputs of foreign firm will decrease. From (4) the equilibrium outputs are derived as:

$$x_h^{ex*} = \left[\frac{2s_h^{ex} - s_l^{ex} - 2t}{4s_h^{ex} - s_l^{ex}} \right] \bar{\theta}; x_l^{ex*} = \left[\frac{s_h^{ex} + t}{4s_h^{ex} - s_l^{ex}} \right] \bar{\theta} \tag{5}$$

In the second stage, I further insert (5) into the domestic and foreign firm's profit function and (simultaneously) select their qualities to maximize profits. Moreover, this research defines a proportional relationship between the high- and low-quality outputs, $\omega = s_l/s_h$ and $0 \leq \omega \leq 1$. In addition, defining $\lambda = t/s_h$. Hence, the first order conditions for the domestic and foreign firm's profit function are:

$$s_h^{ex} = \frac{2(2 - \omega - 2\lambda)(8 - 2\omega + \omega^2 + 8\lambda + 2\omega\lambda)\bar{\theta}^2}{(4 - \omega)^3} \tag{6}$$

$$s_l^{ex} = \frac{(4 + \omega)(1 + \lambda)^2\bar{\theta}^2}{(4 - \omega)^3} \tag{7}$$

In here, I do not directly solve these two algebras ω and λ . By the following way, dividing (6) and (7), I can get the equation which only involves ω and λ . Below I analyze the three statuses in which the tariff equals to zero ($t = 0$), the tariff satisfy the foreign firm's zero profit condition ($\hat{t} = 0$) and the tariffs in the interval $0 < t < \hat{t}$. The symbol, \hat{t} , is used to represent the maximum tariff which drives the high quality foreign firm satisfies the zero profit condition and still stays in the home market. At the first status, the tariff equals to zero ($t = 0$). It implies that the λ also equals to

zero, then the relationship among ω and λ will reduce to

$$\omega = \frac{4 + \omega}{2(2 - \omega)(8 - 2\omega + \omega^2)}$$

Hence, I can solve the roots of ω , and one of them, $\omega = 0.14443$, satisfies the conditions as $0 \leq \omega \leq 1$. On the other hand, the maximum tariff would be derived at the second status in which the foreign firm still stays in the home market and earns zero profits. Using the zero profit condition and the quality ratio, I can derive the

following relationship among $\tilde{\omega}$ and $\tilde{\lambda}$. In here, $\tilde{\lambda} = \tilde{t} / \tilde{s}_h$.

$$\tilde{\lambda} = \frac{\tilde{\omega}^2 - 10\tilde{\omega} + 8}{2(12 - \tilde{\omega})}$$

According the above relationship, this paper can get the ratio of qualities $\tilde{\omega} = \tilde{s}_i^{ex} / \tilde{s}_h^{ex} = 0.26701$ and obtain the maximum tariff $\tilde{t} = 0.10701\bar{\theta}^2$. Hence, the relevant interval of ω and λ are $[0.14443, 0.26701]$ and $[0, 0.23017]$, respectively.

It implies that $d\lambda/d\omega > 0$. Furthermore, substituting $\lambda(\omega)$ in (6) and (7), the $s_h^{ex}(\omega)$ and $s_i^{ex}(\omega)$ are derived in the interval $\omega \in [0.14443, 0.26701]$. Plotting $s_h^{ex}(\omega)$ and $s_i^{ex}(\omega)$, I can show that the $s_h^{ex}(\omega)$ is decreasing in ω and the $s_i^{ex}(\omega)$ is increasing in ω . On the other hand, the relationship among the t and ω is positive via the equation $t(\omega)$ in the interval $\omega \in [0.14443, 0.26701]$. It

means that $dt/d\omega > 0$. Below I present the figure 1 involves above three statuses in which to show the changing of the domestic and foreign firms' quality levels when the tariff on the imports increases. At the same time, substituting $s_h^{ex}(\omega)$, $s_i^{ex}(\omega)$ and $t(\omega)$ in both firms' profit functions and the social welfare in domestic country, I also present the results in the figure 2 when the import tariff changes. By these expressions, the welfares maximizing tariff on the imports is $\hat{t} = \tilde{t} = 0.10701\bar{\theta}^2$. The equilibrium outcomes are listed systematically as follows table 1.

In here, I discuss the results by using the figure 1 and 2. For analytical convenience, this research assumes the highest taste parameter $\bar{\theta}$ equals to one. By the descriptions in the figure 2, the domestic welfare is increasing in the interval $t \in [0, 0.10701]$. Taking the foreign firm's technology advantage ($\gamma = 2$) as given, the domestic government has a strong motive to impose the maximizing import tariff ($\hat{t} = 0.10701$) on foreign firm via the social welfare maximization. The intuitions are discussed as

follows. The high quality foreign firm would face higher production costs when the domestic government imposes higher tariffs on imports. According to the considerations of profits, the foreign firm does not have any motive or ability to choose higher quality levels. It implies that the foreign firm's quality level is decreasing in tariffs. At the same time, the low quality domestic firm has motives to improve its quality levels and gets more profits that are based on the high quality foreign firm's production costs increasing. It implies that the domestic firm's quality level is increasing in tariffs. Hence, the low quality domestic firm chooses the quality level at $\hat{s}_l^{ex} = 0.12413$, and gets the profits $\hat{\pi}_l^{ex} = 0.00578$. Similarly, the high quality foreign firm chooses the quality level at $\hat{s}_h^{ex} = 0.46491$, but earns the zero profits and still stays at the home market. On the other hand, I observe that the differences between the high- and low-quality are narrowed down when the tariffs increases. It means that the consumer surplus of domestic country is decreasing in tariffs. The main reason depends on that the differences of qualities are reduced, and the decline of high quality levels relative to the addition of low quality levels which generates more negative influences on the total consumer surplus. Proposition 1 summarizes the results obtained at the export-mode.

Proposition 1 *Under export-mode, the domestic government has a stronger incentive to impose the maximizing import tariff on the high quality foreign firm by the views of social welfare maximization. The differences between high- and low-quality are smallest. And the foreign firm earns the zero profits but still stays at the home market.*

3.2 The Equilibrium of FDI-Mode

I describe a structure of trade that the high quality foreign firm decide to invest directly on the home market without exporting. Moreover, our work in here focuses on the "horizontal" foreign direct investment (FDI). It implies that the foreign firm transplants the same facility in the home market, but must face a fixed sunk cost, F , that involves any required investment cost for multinationals (MNEs). On the other hand, the foreign firm's main motive for FDI is to save the tariffs. Taking the foreign firm's technology advantage as given, $\gamma = 2$. This paper considers a two-stages, non-cooperative game. The foreign firm adopts the FDI to compete their qualities with domestic firm, and then simultaneously choose the quantities of their goods to maximize their profits at the second stage. By the above steps of sequence, I still use the backward induction to find out the analytical solutions. At the last stage, each firm chooses its quantity level of outputs to maximize profits by given the quantity of its rival. From the first order conditions, this paper can get the equilibrium outputs as follows.

$$x_h^{FDI*} = \left[\frac{2s_h^{FDI} - s_l^{FDI}}{4s_h^{FDI} - s_l^{FDI}} \right] \bar{\theta}; \quad x_l^{FDI*} = \left[\frac{s_h^{FDI}}{4s_h^{FDI} - s_l^{FDI}} \right] \bar{\theta} \quad (8)$$

In the first stage, I further insert (8) into the domestic and foreign firm's profit function and (simultaneously) select their qualities to maximize profits. By the same way that I described above, setting a proportional relationship between the high- and low-quality outputs, $\omega = s_l/s_h$. Similarly, the first order conditions of the domestic and foreign firm's profit functions are

$$s_h^{FDI} = \frac{2(2 - \omega)(8 - 2\omega + \omega^2)\bar{\theta}^2}{(4 - \omega)^3} \quad (9)$$

$$s_l^{FDI} = \frac{(4 + \omega)\bar{\theta}^2}{(4 - \omega)^3} \quad (10)$$

Dividing the first order conditions, I can get the equation which only involves ω . Furthermore, solving the roots of ω , and one of them, $\omega = 0.14443$, still satisfies the conditions as $0 \leq \omega \leq 1$. This result is similar to the following situations in which the domestic government imposes a zero tariff on imports or the foreign firm saves the transportation costs. However, the difference between the FDI- and export-mode is that the high quality firm must bear a fixed sunk cost (F) for FDI. Hence, this research lists the equilibrium outcomes systematically as follows table 2.

4. The Comparative Analysis

Taking the foreign firm's technology advantage ($\gamma = 2$) as given, the domestic government has a strong motive to impose the maximizing import tariff ($\hat{t} = 0.10701\bar{\theta}^2$) on foreign firm via the social welfare maximization. Hence, the high quality foreign firm chooses the quality level at $\hat{s}_h^{ex} = 0.46491\bar{\theta}^2$, but earns the zero profits and still stays at the home market. When I further consider the export- and FDI-mode at the same time, the high quality foreign firm will have stronger motives to deviate the exporting to FDI. So that, the maximizing import tariff will be failures. It implies that the domestic government does not impose the maximizing import tariff on foreign firm to maximize the social welfare. In the FDI-mode, I observe that the domestic welfare equals to $\bar{T}\bar{W}_{FDI} = 0.07169\bar{\theta}^4$. However, the domestic government has incentive as much as possible to get more social welfare. Hence, the domestic government will impose a specific tariff ($\check{t} - \varepsilon$) on high quality foreign firm at the first stage, in which the foreign firm's profits at the margin-tariff (\check{t}) just equal to the levels of FDI. Where the ε is represented as an any small value, but larger than zero. For analytical convenience, I assume the exogenous fixed sunk cost equals to $0.01\bar{\theta}^4$. And then this paper derives the margin-tariff at $\check{t} = 0.01870\bar{\theta}^2$. The specific tariff is used to avoid the foreign firm adopts the FDI. In addition, the domestic government's social welfare is greater than the levels of FDI. Below I list the equilibrium outcomes systematically as follows table 3.

The following figure 3 and 4 are used to illustrate the above results. I similarly assume that the highest taste parameter $\bar{\theta}$ equals to one. By the descriptions in the figure 3, comparing to the FDI-mode, I can observe the differences of the qualities are narrowed down between the high quality foreign firm and the low quality domestic firm. According to the calculations, I find that the decreasing degrees of domestic consumer surplus by the high-quality consumptions are larger than the increasing degrees of domestic consumer surplus by the low-quality consumptions. It presents that the decline of high quality levels brings higher negative effects to high-taste consumers. Hence, the domestic total consumer surplus would reduce. However, the domestic social welfare still improves because on the tariff revenues and the domestic firm's profits increasing. The reasons for the domestic firm's profits increasing which are based on the foreign firm's production costs increasing. Hence, the domestic firm has more possibility to compete with the foreign firm. Moreover, the high quality foreign firm chooses the level of quality at the specific tariff which is higher than the marginal level at $\bar{s}_h^{ex} = 0.49982$. Besides, the foreign firm's profits are larger than the levels of FDI. By the above reasons, the foreign firm has no incentive to deviate the export to FDI.

In addition, I further consider that the high quality foreign firm bears a higher exogenous fixed sunk cost, F' . According to the figure 5, the foreign firm's profits of FDI are decreased when the exogenous fixed sunk cost increases. Hence, this research can observe that the domestic government has more advantages to impose a higher specific tariff on foreign firm. So that the foreign firm's profits under the higher specific tariff would be down, but still equal to the levels of FDI. Furthermore, the domestic social welfare and domestic firm's profits are improved. Proposition 2 summarizes the main results obtained at the situation in which I consider the export-mode and the FDI-mode at the same time.

Proposition 2 *Considering simultaneously the export- and FDI-mode, the domestic government should impose a specific import tariff ($\bar{t} - \epsilon$) on the high quality foreign firm to increase the social welfare as much as possible. The specific tariff is used to avoid the foreign firm adopts the FDI. So that the foreign firm has no incentive to deviate the export to FDI.*

5. Conclusion

Does encourage inward FDI always be a dominant strategy for domestic government? For answering this question, I follow Inigo Herguera et al. (2002) to consider a two-country trade model with complete information. Here, this paper considers simultaneously the export- and FDI-mode. In this situation, the domestic government

and foreign firm exhibit an opposite attitude for FDI. The results present that the domestic government will impose an ex-ante specific tariff on high quality foreign firm, in which the foreign firm's profits at the specific tariff are larger than the levels of FDI. The specific tariff is used to avoid the foreign firm adopts the FDI. It means that the FDI-promotion does not always be a dominant strategy. Besides, the domestic social welfare is greater than the level of FDI. But, the differences of quality levels relatively are lesser than the differences of quality levels of FDI. It implies that the domestic consumer surplus would be reduced. However, the growth of domestic social welfare depends on the tariff revenues and the domestic firm's profits increasing. Finally, this paper considers that the high quality foreign firm bears a higher exogenous fixed sunk cost, F' . By observations, the domestic government owns more advantages to impose a higher specific tariff on foreign firm. The reason is basically on the foreign firm faces higher fixed sunk cost of FDI. Hence, it presents the following results which involve the foreign firm's profits decreases, the domestic firm's profits increases and the domestic social welfare improves. For the decline of the differences of quality levels, it brings a negative percentage of total effect for the consumer surplus.

Endnotes

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Table 1: The equilibrium outcomes of export-mode

$\hat{s}_h^{ex} = 0.46491\bar{\theta}^2$	$\hat{s}_l^{ex} = 0.12413\bar{\theta}^2$	$\bar{s} = 0.29452\bar{\theta}^2$
$\hat{p}_h^{ex} = 0.26550\bar{\theta}^3$	$\hat{p}_l^{ex} = 0.04091\bar{\theta}^3$	$\hat{t} = 0.10701\bar{\theta}^2$
$\hat{x}_h^{ex} = 0.34092\bar{\theta}$	$\hat{x}_l^{ex} = 0.32954\bar{\theta}$	$\bar{CS} = 0.04770\bar{\theta}^4$
$\hat{\pi}_h^{ex} = 0$	$\hat{\pi}_l^{ex} = 0.00578\bar{\theta}^4$	$\bar{TW} = 0.08996\bar{\theta}^4$

The data resources: the calculated values in this model

Table 2: The equilibrium outcomes of FDI-mode

$\hat{s}_h^{FDI} = 0.50065\bar{\theta}^2$	$\hat{s}_l^{FDI} = 0.07231\bar{\theta}^2$	$\bar{s} = 0.28648\bar{\theta}^2$
$\hat{p}_h^{FDI} = 0.24095\bar{\theta}^3$	$\hat{p}_l^{FDI} = 0.01875\bar{\theta}^3$	
$\hat{x}_h^{FDI} = 0.48127\bar{\theta}$	$\hat{x}_l^{FDI} = 0.25937\bar{\theta}$	$\bar{CS}_{FDI} = 0.06944\bar{\theta}^4$
$\hat{\pi}_h^{FDI} = 0.05330\bar{\theta}^4 - F$	$\hat{\pi}_l^{FDI} = 0.00225\bar{\theta}^4$	$\bar{TW}_{FDI} = 0.07169\bar{\theta}^4$

The data resources: the calculated values in this model

Table 3: The equilibrium outcomes at the margin-tariff

$\check{s}_h^{ex} = 0.49982\bar{\theta}^2$	$\check{s}_l^{ex} = 0.07890\bar{\theta}^2$	$\bar{s} = 0.28936\bar{\theta}^2$
$\check{p}_h^{ex} = 0.24861\bar{\theta}^3$	$\check{p}_l^{ex} = 0.02130\bar{\theta}^3$	$\check{t} = 0.01870\bar{\theta}^2$
$\check{x}_h^{ex} = 0.45998\bar{\theta}$	$\check{x}_l^{ex} = 0.27001\bar{\theta}$	$\bar{CS} = 0.06555\bar{\theta}^4$
$\check{\pi}_h^{ex} = 0.04330\bar{\theta}^4$	$\check{\pi}_l^{ex} = 0.00264\bar{\theta}^4$	$\bar{TW} = 0.07679\bar{\theta}^4$

The data resources: the calculated values in this model

Fig. 1: Quality choice and tariffs

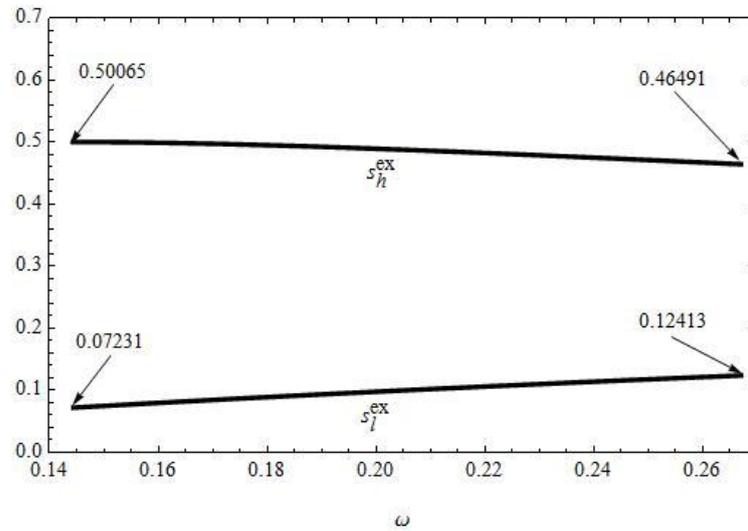


Fig. 2: Profits, domestic CS and welfare under tariffs

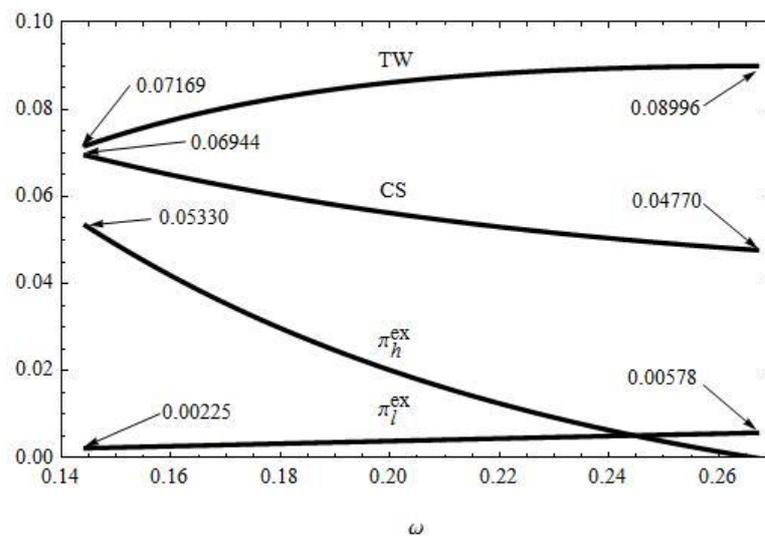


Fig. 3: Quality choice and margin-tariff

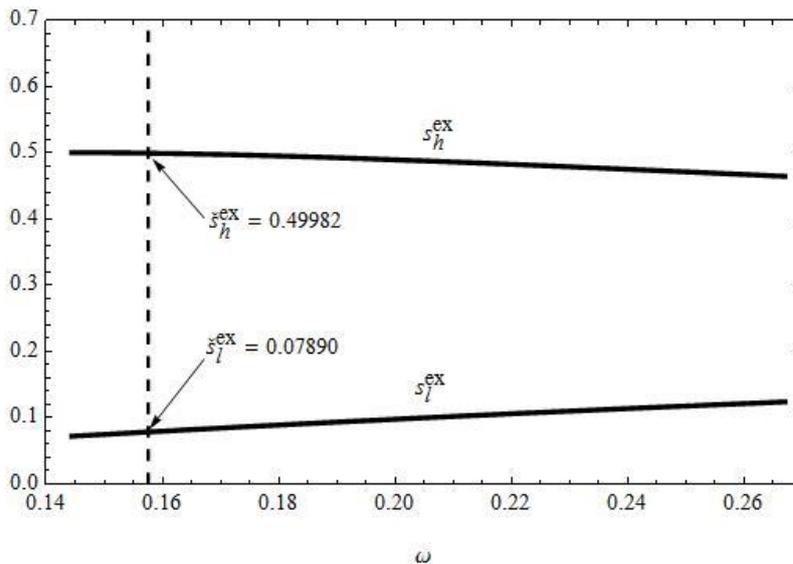


Fig. 4: Profits, domestic CS and welfare at the margin-tariff

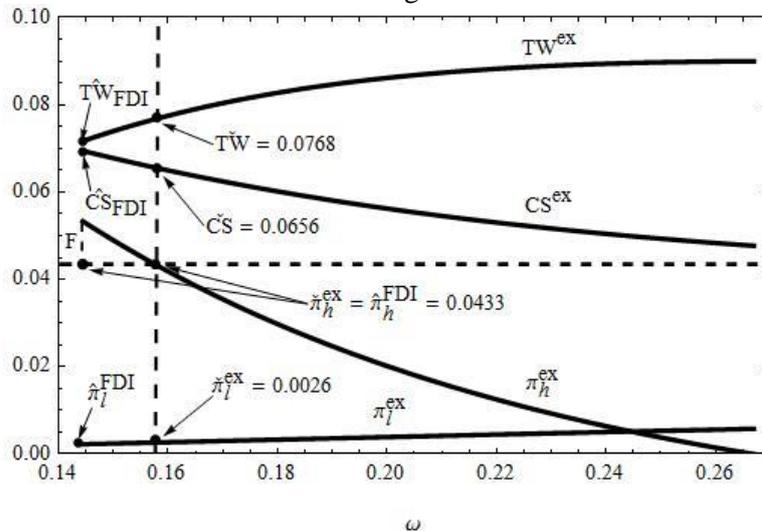


Fig. 5: When the exogenous fixed sunk cost increases

