Trading Company and Indirect Exports

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Abstract

This article develops an oligopoly model of trade intermediation. In the model, manufacturing firm(s) wanting to export their products cannot do so by themselves at the beginning, because of lack of necessary facilities such as distribution/sales network or information for exporting. They have two choices: (1) paying a fixed cost to be able to conduct exporting by themselves (direct exports), or (2) paying a commission fee to a trading company to use its trade intermediation (indirect exports). After choosing their ways of exports, they compete in quantity in the foreign market. Main results of this article are the following. (i) Unlike the previous literature, it is possible that manufacturers prefer indirect exports regardless of their cost (dis)advantages due to Cournot competition in the foreign market. (ii) Although in the model the trading company always prefers indirect exports because of zero profit with direct exports, Nash bargaining may lower the level of commission fee for a given level of fixed cost of direct exports. (iii) Considering welfare of the exporting country, a government subsidy to the trading company may lower the level of commission fee, make the indirect exports desirable for manufacturer(s), and increase the welfare. The last result may justify the experience of Meiji-era Japan, in which its general trading companies got financial and other supports from the central government at its takeoff and then contributed to the economic development of Japan.

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1 Introduction

Wholesalers have an important role in international trade. For instance, manufacturing firms trying to enter foreign markets do not have necessary facilities such as distribution network or knowledge about the foreign markets at the beginning. By utilizing trade-intermediation services provided by wholesalers, such manufacturers may save possible fixed costs of foreign entry.

Previous theoretical studies of trade intermediation have two strands. One strand has built variants of the heterogeneous-firm trade model a la Melitz (2003) with a trade-intermediation industry in which wholesalers are homogeneous and that is free entry (Ahn, Khandelwal, and Wei 2011, Akerman 2012, for instance). The second strand is an application of search theory, assuming that it takes some search costs for manufacturers to find clients demanding their products, called "search frictions "(Rauch 1996, Antras and Costinot 2011, for instance). Although those two strands focus different aspects of international trade with intermediary, both of them show that manufacturers with intermediate productivity levels use trade intermediation, while those with high productivity levels do not. However, Some studies show that wholesalers are heterogeneous and concentrated in Japan, US, and some EU countries (Rauch 1996, Tanaka 2013). Therefore, considering some strategic interaction between manufacturers and wholesaler(s) may help us understand more about the role of wholesalers in international trade, which is the motivation for this study.

This article develops an oligopoly model of trade intermediation. In the model, manufacturing firm(s) wanting to export their products cannot do so by themselves at the beginning, because of lack of necessary facilities such as distribution/sales network or information for exporting. They have two choices: (1) paying a fixed cost to be able to conduct exporting by themselves (direct exports), or (2) paying a commission fee to a trading company to use its trade intermediation (indirect exports). After choosing their ways of exports, they compete in quantity in the foreign market. Main results of this article are the following. (i) Unlike the previous literature, it is possible that manufacturers prefer indirect exports regardless of their cost (dis)advantages due to Cournot competition in the foreign market. (ii) Although in the model the trading company always prefers indirect exports because of zero profit with direct exports, Nash bargaining may lower the level of commission fee for a given level of fixed cost of direct exports. (iii) Considering welfare of the exporting country, a government subsidy to the trading company may lower the level of commission fee, make the indirect exports desirable for manufacturer(s), and increase the welfare. The last result may justify the experience of Meiji-era Japan, in which its general trading companies got financial and other supports from the central government at its takeoff and then contributed to the economic development of Japan.

This paper is arranged as follows. In section two, the basic setup of the model and the benchmark case are described. In section three, heterogeneity among the manufacturing firms are introduced. Section four discusses Nash bargaining between the trading company and manufacturer over commission fee. Section five examines manufacturer's behavior when facing foreign incumbent and draw some implications for welfare of exporting country and its policy. Lastly, Section six summarizes the results and show remaining issues this paper should discuss.

2 Model of Two Manufacturers

Suppose that two manufacturing firms, 1 and 2, exist in a country and both of them plan to enter a foreign market. For the manufacturers, two ways of entry are available. One way is "direct exports," i.e. paying fixed costs of exports, f_M, and then exporting their products by themselves. The other way is "indirect exports," i.e. utilizing an exporting service provided by a trading company. If either firms 1 or 2 choose indirect exports, they have to pay per-unit commission fee, c_T to the trading company, but they can save the fixed costs of exports, necessary with direct exports.

Decisions of the two manufacturers and trading company are described by the following three-stage game: in stage one, the trading company determines the level of c_T. In stage two, firms 1 and 2 choose one of the two ways of exports respectively. In stage three, firms 1 and 2 compete in quantity in the foreign market, which has no incumbent firms. First, as a benchmark, a case of symmetric manufacturing firms is discussed. Then, the model is extended to the asymmetric case.

2.1 Symmetric Manufacturers

Suppose that the inverse demand function of the foreign market is

$$p(x_1, x_2) = 1 - (x_1 + x_2)$$

where p is the price and x_i is the quantity produced by firm i ($i = 1, 2$). For simplicity, either production or shipping costs are assumed to be zero. Firm i's profits in each of the two exporting modes are as follows:

$$\begin{aligned} \pi_i^{IX} &= \{p(x_1, x_2) - c_T\}x_i, \\ \pi_i^{DX} &= p(x_1, x_2)x_i - f_M, \ i = 1, 2. \end{aligned}$$

where IX (DX) denotes (in)direct exports respectively. About the profits of the trading company, three cases might occur. Cases 1 and 3 are symmetric about two firms's choices of exporting mode, while Case 2 is asymmetric.

$$\pi_T = \begin{cases} c_T(x_1 + x_2) & \text{if firms 1 and 2 choose IX (Case 1),} \\ c_T \times x_i & \text{if firms } i \text{ chooses IX and if firm } j \text{ chooses DX } (i \neq j) \text{ (Case 2),} \\ 0 & \text{if firms 1 and 2 choose DX (Case 3).} \end{cases}$$

The model is solved by backward induction: first for the manufacturers, and then for the trading company.

2.1.1 Stage Three: Manufacturers's Decision

In Case 1, when both firms 1 and 2 choose indirect exports, their optimal quantity and profits are:

$$x_i^{IX} = x^{IX} = \frac{1-c_T}{3},\ i=1,2. \tag{1}$$

$$\pi_i^{IX} = (x^{IX})^2 = \left(\frac{1-c_T}{3}\right)^2. \tag{2}$$

In Case 3, when both firms 1 and 2 choose direct exports, their optimal quantity and profits are:

$$x_i^{DX} = x^{DX} = \frac{1}{3},\ i=1,2 \tag{3}$$

$$\pi_i^{DX} = (x^{DX})^2 - f_M = \frac{1}{9} - f_M. \tag{4}$$

Because of non-negative profits of the two manufacturers, $f_M \leq \frac{1}{9}$ is assumed.

In Case 2, when firm 1 chooses indirect exports and firm 2 chooses direct exports respectively, their optimal quantity and profits are:

$$x_1^{IX} = \frac{1-2c_T}{3}, \tag{5}$$

$$\pi_1^{IX} = (x_1^{IX})^2 = \left(\frac{1-2c_T}{3}\right)^2, \tag{6}$$

$$x_2^{DX} = \frac{1+c_T}{3}, \tag{7}$$

$$\pi_2^{DX} = (x_2^{DX})^2 - f_M = \left(\frac{1+c_T}{3}\right)^2 - f_M. \tag{8}$$

Table 1 is the payoff matrix of the subgame by the two manufacturers. In each of the four boxes of the matrix, the first number is the profits of firm 1, and the second number is the those of firm 2. The northwest box is Case 1, when both firms choose indirect exports, while the southeast box is Case 3, when both firms choose direct exports. The northeast and southwest boxes are Case 2, when one firm chooses indirect exports and the other chooses direct exports.

Which case is the equilibrium in the subgame between the two manufacturers depends on the fixed costs of direct exports, f_M, and the commission fee charged by the trading company, c_T. On the plane of (f_M, c_T), Figure 1 shows which case occurs with a given pair of these two variables. If $c_T \leq \frac{9}{4} f_M$, Case 1 is the equilibrium of the subgame. The first inequality implies that firm i prefers indirect exports if firm j's strategy is indirect exports. In order for Case 1 to be the equilibrium of the subgame, another condition under which firm i prefers indirect exports if firm j's strategy is direct exports is needed. It is $c_T < \frac{1-\sqrt{1-9f_M}}{2}$. These two inequalities imply that indirect exports is the dominant strategy for the two manufacturers, and the intuition behind these inequalities is that for manufacturers, indirect exports is more attractive as the level of c_T decreases. These inequalities also implies that such thresholds of c_T decrease as the level of f_T gets higher. However, as Figure 1 implies, if the first inequality holds, the second one also holds.[1]

If $c_T > \frac{1-\sqrt{1-9f_M}}{2}$, Case 3 is the equilibrium of the subgame. In Figure 1, this condition corresponds to the area above the curve. Although another inequality, $c_T > \frac{9}{4}f_M$, is needed in order for Case 3 to be the equilibrium, this inequality holds when the fist inequality holds.[2] Both inequalities imply that direct exports is attractive for the manufacturers if c_T is relatively high for a give f_T. As Figure 1 shows, Case 3 is likely to occur when f_M is small and c_T is large at the same time, which is another polar case besides Case 1, i.e. large f_M and small c_T. Finally, if $\frac{9}{4}f_M < c_T \leq \frac{1-\sqrt{1-9f_M}}{2}$, Case 2 is the equilibrium of the subgame. Case 2 is between Cases 1 and 3, as Figure 1 shows. This case is interesting because it occurs among identical manufactures, which does not in the models of the previous literature, although it is an equilibrium of a subgame at the stage for manufacturers.[3]

2.1.2 Stages Two and One: Trading Company's Decision

The trading company determines the level of its commission fee based on the subgame of the two manufacturing firms discussed above. First, in Case 1, the profits of the trading company is $\frac{2c_T(1-c_T)}{3}$. The level of commission fee maximizing these profits is $\frac{1}{2}$. However, the trading company cannot choose this value. The border of Case 1 is the straight line $c_T = \frac{9}{4}f_M$. Also, $f_M \leq \frac{1}{9}$ is assumed. These two things imply that the maximum value of c_T that the trading company can choose is $\frac{1}{4}$. With $c_T = \frac{1}{4}$, the profits of the trading company is $\frac{1}{8}$. More generally, with $c_T = \frac{9f_M}{4}$, the profits of the trading company in Case 1 are

$$\pi_T^{Case1} = \frac{3f_M}{2}\left(1 - \frac{9f_M}{4}\right) = \frac{3f_M}{2} - \frac{27(f_M)^2}{8}.$$

Note that π_T^{Case1} increases as f_M increases for $0 \leq f_M \leq \frac{1}{9}$. Note also that with $c_T = \frac{9f_M}{4}$, it is indifferent for the two manufacturers to choose indirect or direct exports. However, it is assumed that both of them choose indirect exports.

How about the other two cases? Obviously, the trading company does not choose any level of the commission fee satisfying $c_T > \frac{1-\sqrt{1-9f_M}}{2}$, because in Case 3, its profits are zero. In Case 2, its profits are $\frac{c_T(1-2c_T)}{3}$, whose maximum is $\frac{1}{24}$ with $c_T = \frac{1}{4}$. Whether the trading company can charge this level of the commission fee depends on f_M. For a given level of f_M, the maximum level of c_T that the trading company can charge is $\frac{1-\sqrt{1-9f_M}}{2}$, which is the upper limit of Case 2 region in

[1] In Figure 1, the straight line is a tangent line for the curve at the origin.

[2] The first inequality means that firm i prefers direct exports if firm j chooses direct exports. The second inequality means that firm i prefers direct exports if firm j chooses indirect exports. Therefore in Case 3, direct exports is the dominant strategy.

[3] The forth possibility that no equilibrium exists does not occur, because it makes contradictions among inequalities showing preferences of manufacturers for a given strategy of their rival firms.

Figure 1. It is shown that if $f_M \geq \frac{1}{12}$, then $\frac{1-\sqrt{1-9f_M}}{2} \geq \frac{1}{4}$, the maximum of c_T the trading company can charge. Therefore, with Case 2, the trading company's profits are as follows:

$$\pi_T^{Case2} = \begin{cases} \frac{1}{24} & \text{if } \frac{1}{12} \leq f_M \leq \frac{1}{9} \\ \frac{3f_M}{2} - \frac{1-\sqrt{1-9f_M}}{6} & \text{if } 0 \leq f_M < \frac{1}{12} \end{cases}$$

To show which case, Cases 1 or 2, the trading company should choose, the profits of the two cases are compared. Two steps are taken. First, suppose that for $0 \leq f_M < \frac{1}{12}$, the profits in Case 1 are larger than those in Case 2. If this inequality holds, then the following inequality also holds.

$$4 - 81f_M^2 > 4\sqrt{1 - 9f_M}.$$

Note that both sides are decreasing functions of f_M, and they are equal to 4 when $f_M = 0$. When $f_M = \frac{1}{12}$, the left hand side is equal to $\frac{55}{16}$ while the right hand side is equal to 2, so the former is larger than the latter. By taking derivatives of the both sides with respect to f_M, it is shown that for any $0 \leq f_M < \frac{1}{12}$, the left hand side is larger than the right hand side, because the absolute value of the derivative of the right hand side is always larger than that of the left hand side. Therefore, the above inequality holds. Next, if $\frac{1}{12} \leq f_M \leq \frac{1}{9}$, the profit in Case 2 is $\frac{1}{24}$. The profits in Case 1 is equal to $\frac{1}{24}$ when $f_M = \frac{2-\sqrt{3}}{9} < \frac{1}{12}$. Because the profits in Case 1 is an increasing function of f_M, if $\frac{1}{12} \leq f_M \leq \frac{1}{9}$, they are always larger than $\frac{1}{24}$. Thus, $\pi_T^{Case1} > \pi_T^{Case2}$ for any $0 \leq f_M \leq \frac{1}{9}$. Therefore, the trading company always chooses $c_T = \frac{9f_M}{4}$ and Case 1 is realized.

The following proposition summarizes the results in the symmetric-manufacturer case.

Proposition 1 *In the case of symmetric manufacturers, the trading company always prefers Case 1, i.e. both manufacturers choose indirect exports, and it sets the level of the commission fee at $c_T = \frac{9}{4}f_M$, which is the maximum with which the manufacturers choose indirect exports for a given level of the fixed costs of direct exports.*

The benchmark case shows that the trading company sets the level of commission fee by considering the level of the fixed costs of direct exports for the manufacturing firms as described above. By doing so, the trading company can let the two manufacturers choose indirect exports for any level of f_M.

However, in the benchmark case, the manufacturers are homogeneous. Therefore, the effect of heterogeneity among manufacturing firms in terms of production costs is not examined, which is the focus in the next section.

3 Asymmetric Manufacturing Firms

Suppose that firm 1 can produce its products by no costs while firm 2 pays a constant marginal cost of $c_M > 0$. Since the main focus of this section is the effect of marginal-cost heterogeneity among manufacturers, the fixed costs of direct exports f_M are assumed to be the same between firms 1 and 2. Also, no shipping costs are assumed.

With this production-cost asymmetry, the following four cases are analyzed. Note that Case 2 with symmetric manufacturers is now divided into two cases because of production-cost asymmetry.[4]

- Case 1: both manufacturing firms choose indirect exports.
- Case 2: Firm 1 (zero MC) chooses indirect exports while firm 2 (positive MC) chooses direct exports.
- Case 3: Firm 1 chooses direct exports while firm 2 chooses indirect exports.
- Case 4: both manufacturing firms choose direct exports.

Note that Case 2 does not occur in the models of the previous literature while Case 3 does. Because of the marginal-cost difference, Cases 2 and 3 have different quantity produced by each of the two manufacturers and thus different profits. As in the benchmark case, optimal quantities produced by the two manufacturing firms and resulting profits in the subgame are examined first. Then, trading company's decision is analyzed.

3.1 Profits of Manufacturers in the Four Cases

Profits of the two manufacturing firms in each of the four cases are as follows:
· Case 1

$$\begin{aligned}\pi_1^{Case1} &= \left(\frac{1+c_M-c_T}{3}\right)^2, \\ \pi_2^{Case1} &= \left(\frac{1-2c_M-c_T}{3}\right)^2.\end{aligned}$$

· Case 2

$$\begin{aligned}\pi_1^{Case2} &= \left(\frac{1+c_M-2c_T}{3}\right)^2, \\ \pi_2^{Case2} &= \left(\frac{1-2c_M+c_T}{3}\right)^2 - f_M.\end{aligned}$$

· Case 3

$$\begin{aligned}\pi_1^{Case3} &= \left(\frac{1+c_M+c_T}{3}\right)^2 - f_M, \\ \pi_2^{Case3} &= \left(\frac{1-2c_M-2c_T}{3}\right)^2.\end{aligned}$$

[4]Case 3 with symmetric manufacturers is now Case 4.

· Case 4

$$\pi_1^{Case4} = \left(\frac{1+c_M}{3}\right)^2 - f_M,$$
$$\pi_2^{Case4} = \left(\frac{1-2c_M}{3}\right)^2 - f_M.$$

It is assumed that $f_M \leq \frac{(1-2c_M)^2}{9}$ to make the outputs and profits of both firms in cases 2 to 4 nonnegative. Note that this maximum of f_M is lower than that in the symmetric case, $\frac{1}{9}$, due to the positive marginal cost of firm 2, c_M. Also, $c_M < \frac{1}{2}$ is assumed, because this inequality is needed for the profits of firm 2 in Cases of 3 and 4 to be positive.

Before examining manufacturers's behavior further, let us make sure which case is the best for the trading company. The profits of the trading company in the four cases are as follows:

$$\pi_T = \begin{cases} c_T \times (x_1 + x_2) & \text{in case 1,} \\ c_T \times x_1 & \text{in case 2,} \\ c_T \times x_2 & \text{in case 3,} \\ 0 & \text{in case 4.} \end{cases}$$

Note that the profits of the trading company in Case 2 are different than those in Case 3. In Case 2, firm 1 pays the commission fee of indirect exports to the trading company, while in Case 3, firm 2 does it. As mentioned before, the quantities produced by firms 1 and 2 are different because of different levels of marginal costs. As shown later, Case 1 is the best for the trading firm, followed by Case 2, Case 3, and finally Case 4 (zero profits.)

3.1.1 Equilibrium of the Stage-Three Subgame

Table 2 is the payoff matrix of the subgame by the two manufacturers. The northwest box is Case 1, when both firms choose indirect exports. while the southeast box is Case 4, when both firms choose direct exports. The northeast box is Case 2, when firm 1 chooses indirect exports and firm 2 chooses direct exports. Finally, the southwest box is Case 3, when firm 1 chooses direct exports and firm 2 chooses indirect exports. As well as the case of symmetric manufacturers, which case is the equilibrium depends on the fixed costs of direct exports, f_M, and the commission fee charged by the trading company, c_T. Besides these two variables, the marginal cost of firm 2, c_M also plays an important role, as Figure 2 shows.

On the plane of (f_M, c_T), Figure 2 describes which case occurs with a given pair of these two variables. Note that the dotted straight line, the dotted curve, and the dotted vertical line were all solid in Figure 1. Therefore, by introducing the marginal-cost asymmetry, both the upward-sloping straight line and curve bifurcate, and the vertical line showing the upper limit of f_M is shifted leftward. In the result, the regions of Case 1 and Case 4 (Case 3 in the symmetric production-cost case) get smaller. About asymmetric cases, Cases 2 and 3, whether the whole region is expanded is not obvious due to the leftward shift of the vertical line. However, for $0 \leq f_M \leq \frac{(1-2c_M)^2}{9}$, the region of asymmetric cases is expanded (between two lines $c_T = \frac{9f_M}{4(1+c_M)}$ and $c_T = \frac{(1-2c_M)-\sqrt{(1-2c_M)^2-9f_M}}{2}$). The region of Case 3, when firm 1 chooses direct exports and firm 2 chooses indirect exports, is the whole region of the asymmetric cases. On the other hand, the region of Case 2, when firm 1 chooses indirect exports and firm 2 chooses direct exports, is between other two lines, $c_T = \frac{9f_M}{4(1-2c_M)}$ and $c_T = \frac{(1+c_M)-\sqrt{(1+c_M)^2-9f_M}}{2}$, which implies that Case 2 is less likely than Case 3.

Like the symmetric-manufacturer case, conditions necessary for each of Cases 1 through 4 can be specified. For Case 1, indirect exports is the dominant strategy, as well as the symmetric case. For Case 2, one might expect two possibilities: (1) only Case 2 occurs, and (2) multiple equilibria of Cases 2 and 3, like the symmetric case. However, the first possibility will never be realized.[5] Case 3 makes up the multiple equilibria of the subgame, jointly with Case 2, whose area is between the following two lines: $c_T = \frac{9f_M}{4(1-2c_M)}$ and $c_T = \frac{1}{2}\{(1+c_M) - \sqrt{(1+c_M)^2 - 9f_M}\}$. However, unlike Case 2, Case 3 may occur solely. As Figure 2 shows, for a given level of f_M, a high-c_T case and a low-c_T case may occur. Therefore, with the multiple equilibria, introducing a marginal-cost difference make the following situation likely to occur, i.e. one firm, especially firm 2, chooses indirect exports while the other firm chooses direct exports. Note that firms 2 is the low productivity firm relative to firm 1.

In the previous literature, a similar result that is described in the third-stage subgame in this model was attained. However, in this model, the case that only the high-productivity firm chooses indirect exports, i.e. Case 2, is possible, which is a big difference from the previous literature, although this is about the subgame among manufacturers.[6] Finally, in Case 4, direct exports is the dominant strategy, as in the symmetric case.

3.1.2 Stages Two and One: Trading Company's Decision

As in the symmetric production-cost case, the trading company determines the level of its commission fee based on the subgame of the two manufacturing firms discussed above. First, in Case 1, the profits of the trading company is $\frac{c_T(2-c_M-2c_T)}{3}$. The level of commission fee maximizing these profits is $\frac{2-c_M}{4}$. However, the trading company cannot choose this value. The border of Case 1 is the straight line $c_T = \frac{9f_M}{4(1+c_M)}$. Also, $f_M \leq \left(\frac{1-2c_M}{3}\right)^2$ is assumed. These two things imply that the maximum value of c_T that the trading company can choose is $\frac{(1-2c_M)^2}{4(1+c_M)}$, which is lower than $\frac{2-c_M}{4}$. More generally, with $c_T = \frac{9f_M}{4(1+c_M)}$, the profits of the trading

[5] To realize the first possibility, the following two conditions are needed: (i) firm 1 prefers indirect exports if firm 2 chooses indirect exports, and (ii) firm 2 prefers direct exports if firm 1 chooses indirect exports. These two conditions do not contradict with each other. However, other conditions in order for the first possibility to be realized contradict with one of these two conditions.

[6] As shown later, the trading company determines the level of the commission fee with which only Case 1 occurs.

company in Case 1 are

$$\pi_T^{Case1} = \frac{3f_M}{4(1+c_M)}\left(2 - c_M - \frac{9f_M}{2(1+c_M)}\right) = \frac{(6-3c_M)f_M}{4(1+c_M)} - \frac{27f_M^2}{8(1+c_M)^2}.$$

How about other two cases? Obviously, the trading company does not choose any level of the commission fee satisfying $c_T > \frac{(1-2c_M)-\sqrt{(1-2c_M)-^2-9f_M}}{2}$, because in Case 4, its profits are zero. In Case 2, its profits are $\frac{c_T(1+c_M-2c_T)}{3}$, whose maximum is $\frac{(1+c_M)^2}{24}$ with $c_T = \frac{1+c_M}{4}$. Whether the trading company can charge this level of the commission fee depends on f_M. For a given level of f_M, the maximum level of c_T that the trading company can charge is $\frac{(1+c_M)-\sqrt{(1+c_M)^2-9f_M}}{2}$, which is the upper limit of Case 2 region in Figure 2. It is shown that if $f_M \geq \frac{(1+c_M)^2}{12}$, then $\frac{(1+c_M)-\sqrt{(1+c_M)^2-9f_M}}{2} \geq \frac{1+c_M}{4}$, the maximum of c_T the trading company can charge. Therefore, with Case 2, the trading company's profits are as follows:

$$\pi_T^{Case2} = \begin{cases} \frac{(1+c_M)^2}{24} & \text{if } \frac{(1+c_M)^2}{12} \leq f_M \leq \frac{(1-2c_M)^2}{9} \\ \frac{3f_M}{2} - \frac{(1+c_M)\{(1+c_M)-\sqrt{(1+c_M)^2-9f_M}\}}{6} & \text{if } 0 \leq f_M < \frac{(1+c_M)^2}{12} \end{cases}$$

Note that in order for $\frac{(1+c_M)^2}{12} < \frac{(1-2c_M)^2}{9}$, c_M must be equal to or smaller than $\frac{11-6\sqrt{3}}{13}$, which is assumed in the rest of this article. Otherwise, the first line of the profits in Case 2 disappears and only the second line is left (now it is for $0 \leq f_M \leq \frac{(1-2c_M)^2}{9}$). Also, For the profits in Case 3, a similar formula can be used by replacing $1 + c_M$ with $1 - 2c_M$.

As in the symmetric production-cost case, the profits in Cases 1, 2, and 3 should be compared to show which case is the best for the trading company, and how the best choice is affected by the level of c_M. Basically, the same way as in the symmetric case can be used. First, Cases 1 and 2 are compared.

As in the symmetric-manufacturer case, two steps are taken. First, suppose that for $0 \leq f_M < \frac{(1+c_M)^2}{12}$, the profits in Case 1 are larger than those in Case 2. If this inequality holds, then the following inequality also holds.

$$\left\{4(1+c_M)^4 - 54c_M(1+c_M)f_M\right\} - 81f_M^2 > 4(1+c_M)^3\sqrt{(1+c_M)^2 - 9f_M}. \quad (9)$$

Note that if $c_M = 0$, inequality (9) is the same as in the symmetric case. Also, note that both sides are decreasing functions of f_M. and they are equal to $4(1+c_M)^4$ when $f_M = 0$. When $f_M = \frac{(1+c_M)^2}{12}$, the left hand side of inequality (9) is equal to $\frac{1}{16}(1+c_M)^3(55-17c_M)$ while the right hand side is equal to $2(1+c_M)^4$. Because $c_M < \frac{11-6\sqrt{3}}{16}$ is assumed, the former is larger than the latter.[7] By taking derivatives of the both sides with respect to f_M, it is shown that for any $0 \leq f_M < \frac{1}{12}$, the left hand side is larger than the right hand side, because the absolute value of the derivative of the right hand side is always larger than that of the left hand side.[8]

[7]When $f_M = \frac{(1+c_M)^2}{12}$, inequality (9) is changed to $\frac{23}{49} > c_M$. The left hand side is a bit smaller than $\frac{1}{2}$, so if $f_M = \frac{(1+c_M)^2}{12}$, the above inequality holds in many cases without the assumption used.

[8]See Appendix 1 for details.

Therefore, the above inequality holds. Next, if $\frac{(1+c_M)^2}{12} \leq f_M \leq \frac{(1-2c_M)^2}{9}$, the profit in Case 2 is $\frac{(1+c_M)^2}{24}$. The profits in Case 1 is equal to $\frac{(1+c_M)^2}{24}$ when $f_M = \frac{(1+c_M)\{(2-c_M)-\sqrt{(2-c_M)^2-(1+c_M)^2}\}}{9} < \frac{(1+c_M)^2}{12}$. Because the profits in Case 1 is an increasing function of f_M, if $\frac{(1+c_M)^2}{12} \leq f_M \leq \frac{(1-2c_M)^2}{9}$, they are always larger than $\frac{(1+c_M)^2}{24}$. Thus, $\pi_T^{Case1} > \pi_T^{Case2}$ for any $0 \leq f_M \leq \frac{(1-2c_M)^2}{9}$. Therefore, the trading company always chooses $c_T = \frac{9f_M}{4(1+c_M)}$ and Case 1 is realized.

As the comparison of profits of the trading company in Cases 1 and 2, comparing the profits in Cases 1 and 3 are possible. However, it is shown that for all $0 \leq f_M \leq \frac{(1-2c_M)^2}{9}$, the profits of the trading company in Case 2 are always higher than those in Case 3.[9] Because the trading company always prefers Case 1 to Case 2, Case 3 is not chosen by the trading company. The following proposition summarizes the results in the symmetric-manufacturer case.

Proposition 2 *Even in the case of asymmetric manufacturers, the trading company always prefers Case 1, i.e. both manufacturers choose indirect exports, and it sets the level of the commission fee at $c_T = \frac{9f_M}{4(1+c_M)}$, which is the maximum with which the manufacturers choose indirect exports for a given level of the fixed costs of direct exports.*

Proposition 2 shows that the same result holds even with asymmetric manufacturers. However, the maximum level of commission fee the trading company may charge is lower than that with symmetric manufacturers, due to existence of positive marginal cost of production for firm 2. So far, it is assumed that when a pair of c_T, f_M gives the same profits to manufacturers with both Case 1 and others, the manufacturers will choose indirect exports. However, it is likely that manufacturer(s) may threat the trading company, saying "I will choose direct exports." If this threat works, manufacturer(s) may win a lower commission fee. The next section considers such a possibility.

4 Nash Bargaining over Commission Fee

As Sections two and three shows, with the current model, the trading company chooses the level of commission fee with which the manufacturing firm(s) may accept and therefore only indirect exports will occur, which is an unrealistic conclusion. As an attempt to fix this problem, in this section, Nash bargaining between a trading company and a manufacturer is considered.[10] For each economic agent, the threat point of the bargaining is as follows respectively.

- Trading company: zero profit with direct exports by the manufacturer.
- Manufacturer: profit with direct exports.

[9] See Appendix 2 for the proof.

[10] With one manufacturer, $x^{IX} = \frac{1-c_T}{2}$, $\pi_M^{IX} = \left(\frac{1-c_T}{2}\right)^2$, $x^{DX} = \frac{1}{2}$, and $\pi_M^{IX} = \frac{1}{4} - f_M$ respectively (subscript M denotes manufacturer).

Therefore, the Nash-bargaining solution is to maximize the following function:

$$\frac{c_T(1-c_T)}{2} \times \left\{ \frac{(1-c_T)^2 - 1}{4} + f_M \right\}$$

Because multiplying a constant with the above function does not change the bargaining solution, the following function is used hereafter:

$$\Pi = (c_T - c_T^2)\left\{(1-c_T)^2 - 1 + 4f_M\right\}. \tag{10}$$

The first order condition for function (10) is

$$-4c_T^3 + 9c_T^2 - 4(1+2f_M)c_T + 4f_M = 0.$$

This is a third-order polynomial and thus the solution is hard to interpret.[11] However, using the implicit function theorem over the above polynomial, it is shown that the fixed cost for the manufacturer, f_M, has a positive effect on the commission fee. Taking the total derivative of the first-order condition yields

$$\left\{-12c_T^2 + 18c_T - 4(1+2f_M)\right\} dc_T + (-8c_T + 4)df_M = 0.$$

From the implicit function theorem, the effect of f_M on c_T is

$$\frac{dc_T}{df_M} = \frac{4c_T - 2}{-6c_T^2 + 9c_T - 2(1+2f_M)}. \tag{11}$$

The effect is positive for all $c_T < 1$ and $f_M < \frac{1}{4}$. This positive effect is also confirmed by numerical examples. Figure 3 shows that when f_M increases from 0.1 to 0.2, the objective function of Nash-Bargaining shifts up and the level of c_T maximizing the objective function also increases. These numerical examples also show that the Nash-bargaining solutions are lower than the level of commission fees maximizing the profits of the trading company. From Figure 3, the Nash-bargaining solutions are about 0.1 and 0.2 when $f_M = 0.1$ and 0.2 respectively. The commission fees optimal for the trading company are about 0.225 and 0.5 respectively. Therefore, manufacturer's threat works to lower the level of commission fee.

[11] One solution for this polynomial is

$$\frac{1}{12}\left(81 - 432f_M + 24\sqrt{-51 + 423f_M - 1260f_M^2 + 1536f_M^3}\right)^{\frac{1}{3}}$$
$$-\frac{12\left(-\frac{11}{48} + \frac{2}{3}f_M\right)}{\left(81 - 432f_M + 24\sqrt{-51 + 423f_M - 1260f_M^2 + 1536f_M^3}\right)^{\frac{1}{3}}} + \frac{3}{4}$$

(Other two solutions include imaginary numbers).

5 Competition with Foreign Incumbent

In this section, a more realistic case when the manufacturer competes with the foreign incumbent is examined. The two-manufacturer model already discussed is modified to apply for this case. Two sub-cases are possible: (1) the manufacturer has a cost advantage, and (2) the foreign rival has a cost advantage. Because these two subcases do not make a big difference qualitatively, only the first subcase is discussed.

Suppose that the home manufacturer, firm 1, has zero marginal cost of production while the foreign incumbent, firm 2, has a constant marginal cost of c_2. From the first-order conditions of the two firms with indirect exports or direct exports, the following threshold value of c_T, $c_T^{\pi_1}$, is derived:

$$\begin{aligned} c_T^{\pi_1} &= \frac{(1+c_2) - \sqrt{(1+c_2)^2 - 9f_M}}{2}, \\ & \text{where } c_2 < \frac{1}{2}. \end{aligned} \tag{12}$$

If the commission fee is higher than this cutoff level, firm 1 chooses direct exports, and if the commission fee is lower than this threshold, firm 1 chooses indirect exports.

Next, the welfare of the home country, i.e. exporting country, is defined as follows. In case of indirect exports, the welfare is the sum of the profits of manufacturer and trading company. In case of direct exports, it is only the profits of manufacturer.

$$\begin{aligned} W^{IX} &= \pi_1^{IX} + \pi_T^{IX} = \frac{1}{9}(1+c_2-2c_T)(1+c_2+c_T). \\ W^{DX} &= \pi_1^{DX} = \frac{1}{9}(1+c_2)^2 - f_M. \end{aligned}$$

From the home welfare in two modes of exports, the cutoff value of commission fee is derived.

$$c_T^W = \frac{-(1+c_2) + \sqrt{(1+c_2)^2 + 72f_M}}{4}, \tag{13}$$

Equations (12) and (13) show the difference over the optimal level of commission fee in terms of firm 1's profits and the home welfare. First, when the fixed cost of direct exports, f_M is either its minimum, i.e. zero, or the maximum, i.e. $\left(\frac{1+c_2}{3}\right)$, the two thresholds are equal. Otherwise, the cutoff value for welfare is higher than that for firm 1's profits. Therefore, it is possible that for a given f_M, a level of commission fee lets the home government prefer indirect exports while it lets firm 1 prefer direct exports. In such a case, a government subsidy to the trading company to lower the level of commission fee may change the mode of exports from direct to indirect exports, resulting in a increase in the home welfare.

This implication is consistent with a Japanese experience in its Meiji era, i.e. the late 1860s to the early 1910s. In this period, Japan opened up its border and the government wanted to facilitate its exports for economic development. Besides trying to grow its manufacturing sector, the Japanese government subsidized its trading companies in various ways, resulting in growing manufacturing exports of textile and other products.

6 Conclusion

This article develops an oligopoly model of trade intermediation. Main results of this article are the following. (i) Unlike the previous literature, it is possible that high-productivity manufacturer may prefer indirect exports regardless of their cost (dis)advantages due to Cournot competition in the foreign market. (ii) Although in the model the trading company always prefers indirect exports, Nash bargaining may lower the level of commission fee for a given level of fixed cost of direct exports. (iii) Considering welfare of the exporting country, a government subsidy to the trading company may lower the level of commission fee, make the indirect exports desirable for manufacturer(s), and increase the welfare.

However, many issues are not solved yet. Especially, in this article, the (fixed) costs of the trading company is assumed to be zero. One rationale for this assumption is that the trading company already developed its exporting networks worldwide before the game starts. However, to analyze the trading company's role more, how its (fixed) costs of exporting may be an important issue.[12] Therefore, endogenizing the (fixed) costs of the trading company and also the marginal costs of production is another possible extension. For instance, introducing costs of trading company increasing with the number of manufacturers it helps or with volume of exports it mediate may change the results that trade intermediation always occurs.

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[12] See Akerman (2012) for his formula of wholesalers's fixed costs.

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Appendix 1: Proof for Inequality (9)

In inequality (9), the derivative of the left hand side with respect to f_M, the fixed costs of direct exports, is $-54c_M(1+c_M) - 162f_M$ while its counterpart of the right hand side is $-\frac{18(1+c_M)^3}{\sqrt{(1+c_M)^2-9f_M}}$. Thus, it is necessary to show that the following inequality holds.

$$54c_M(1+c_M) + 162f_M < \frac{18(1+c_M)^3}{\sqrt{(1+c_M)^2 - 9f_M}}.$$

This inequality is changed to the following.

$$\begin{aligned} g(f_M) &= -729(f_M)^3 + 81(1+c_M)(1-5c_M)(f_M)^2 + 27c_M(1+c_M)^2(2-c_M)f_M \\ &\quad -(1+c_M)^4(1+4c_M)(1-2c_M) < 0. \end{aligned}$$

To show that $g(f_M)$, i.e. a third-order polynomial of f_M is less than zero, it is enough to show that the maximum of $g(f_M)$ is negative. The level of f_M maximizing $g(f_M)$, denoted by f_M^* is $\frac{(1+c_M)(2-c_M)}{27}$ and

$$\begin{aligned} g(f_M^*) &= \frac{(1+c_M)^3(1+13c_M)(2-c_M)^2}{27} - (1+c_M)^4(1+4c_M)(1-2c_M). \\ &= \frac{(1+c_M)^3}{27}\left\{(1+13c_M)(2-c_M)^2 - 27(1+c_M)(1+4c_M)(1-2c_M)\right\}. \\ &= \frac{(1+c_M)^3}{27}(229c_M^3 + 111c_M^2 - 33c_M - 23). \end{aligned}$$

In the last line, the value inside the parenthesis is negative for any $0 < c_M < \frac{11-6\sqrt{3}}{13}$, Therefore, $g(f_M)$ is always negative for any $0 \leq f_M \leq \frac{(1+c_M)^2}{12}$. QED.

Appendix 2: Proof for $\pi_T^{Case2} > \pi_T^{Case3}$

The profits of the trading company in Cases 2 and 3 have the following formula:

$$\pi_T^{Case2} = \begin{cases} \frac{1}{24}x^2 & \text{if } \frac{x^2}{12} \leq f_M \leq \frac{(1-2c_M)^2}{9} \\ \frac{3}{2}f_M - \frac{x\left\{x-\sqrt{x^2-9f_M}\right\}}{6} & \text{if } 0 \leq f_M < \frac{x^2}{12} \end{cases}$$

In Case 2, $x = 1 + c_M$ and in Case 3, $x = 1 - 2c_M$. Obviously, $1 + c_M > 1 - 2c_M$ for any positive c_M, and thus $\frac{(1+c_M)^2}{24} > \frac{(1-2c_M)^2}{24}$. Therefore, if $h(x) = \frac{x\left\{x-\sqrt{x^2-9f_M}\right\}}{6}$ is a decreasing function of x, $\pi_T^{Case2} > \pi_T^{Case3}$ for all $0 \leq f_M \leq \frac{(1-2c_M)^2}{9}$.

The derivative of $h(x)$ is

$$\frac{dh}{dx} = 2x - \sqrt{x^2 - 9f_M} - \frac{x^2}{\sqrt{x^2 - 9f_M}}.$$

When $f_M = 0$, the derivative is zero. Taking h's derivative further with respect f_M yields:

$$\frac{d^2h}{dxdf_M} = \frac{9}{2}\sqrt{x^2 - 9f_M}\left(1 - \frac{x^2}{x^2 - 9f_M}\right) < 0.$$

Therefore, for all $0 \leq f_M \leq \frac{(1-2c_M)^2}{9}$, h decreases as x increases. QED.

Firms	Firm 2		
Firm 1	Exporting mode	IX	DX
	IX	$\left(\frac{1-c_T}{3}\right)^2, \left(\frac{1-c_T}{3}\right)^2$	$\left(\frac{1-2c_T}{3}\right)^2, \left(\frac{1+c_T}{3}\right)^2 - f_M$
	DX	$\left(\frac{1+c_T}{3}\right)^2 - f_M, \left(\frac{1-2c_T}{3}\right)^2$	$\frac{1}{9} - f_M, \frac{1}{9} - f_M$

Table 1: Payoff matrix in stage 3 (quantity competition between firms 1 and 2).

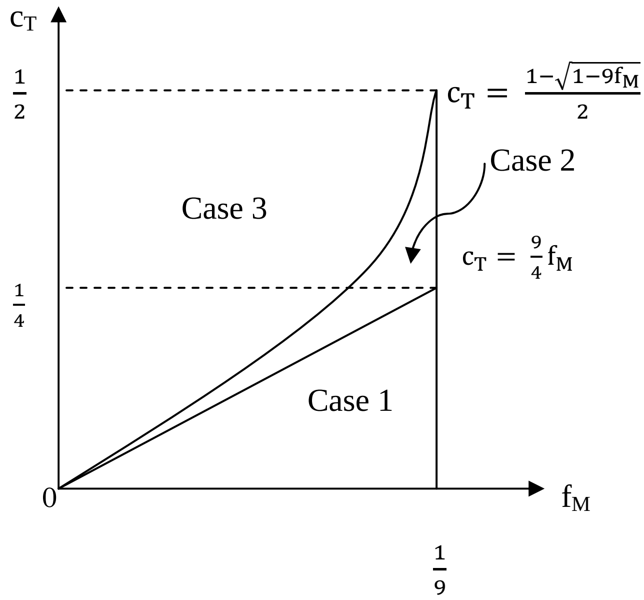

Figure 1: Fixed costs of direct exports, commission fee, and manufacturers's optimal choices.

Firms	Firm 2		
Firm 1	Exporting mode	IX	DX
	IX	$\left(\frac{1+c_M-c_T}{3}\right)^2$, $\left(\frac{1-2c_M-c_T}{3}\right)^2$	$\left(\frac{1+c_M-2c_T}{3}\right)^2$, $\left(\frac{1-2c_M+c_T}{3}\right)^2-f_M$
	DX	$\left(\frac{1+c_M+c_T}{3}\right)^2-f_M$, $\left(\frac{1-2c_M-2c_T}{3}\right)^2$	$\left(\frac{1+c_M}{3}\right)^2-f_M$, $\left(\frac{1-2c_M}{3}\right)^2-f_M$

Table 2: Payoff matrix in stage 3 with different marginal costs of production.

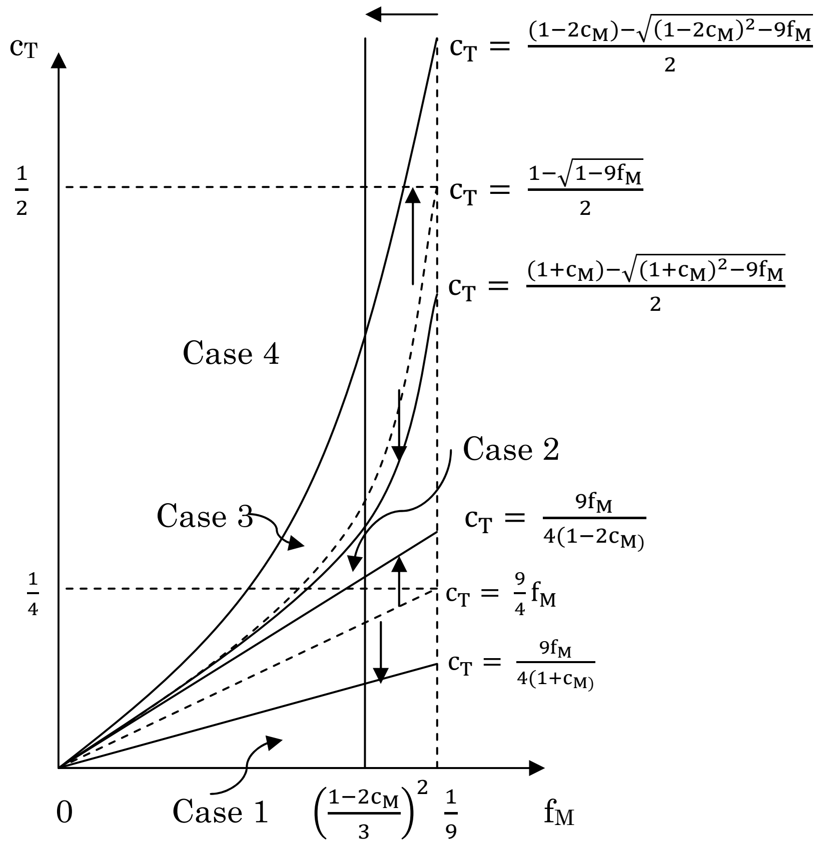

Figure 2: Fixed costs of direct exports, commission fee, and manufacturers's optimal choices under asymmetric marginal costs of production.

Note: Cases 2 and 3 are between the following two lines respectively:

Case 2: $c_T = \frac{9f_M}{4(1-2c_M)}$ and $c_T = \frac{(1+c_M)-\sqrt{(1+c_M)^2-9f_M}}{2}$.

Case 3: $c_T = \frac{9f_M}{4(1+c_M)}$ and $c_T = \frac{(1-2c_M)-\sqrt{(1-2c_M)^2-9f_M}}{2}$.

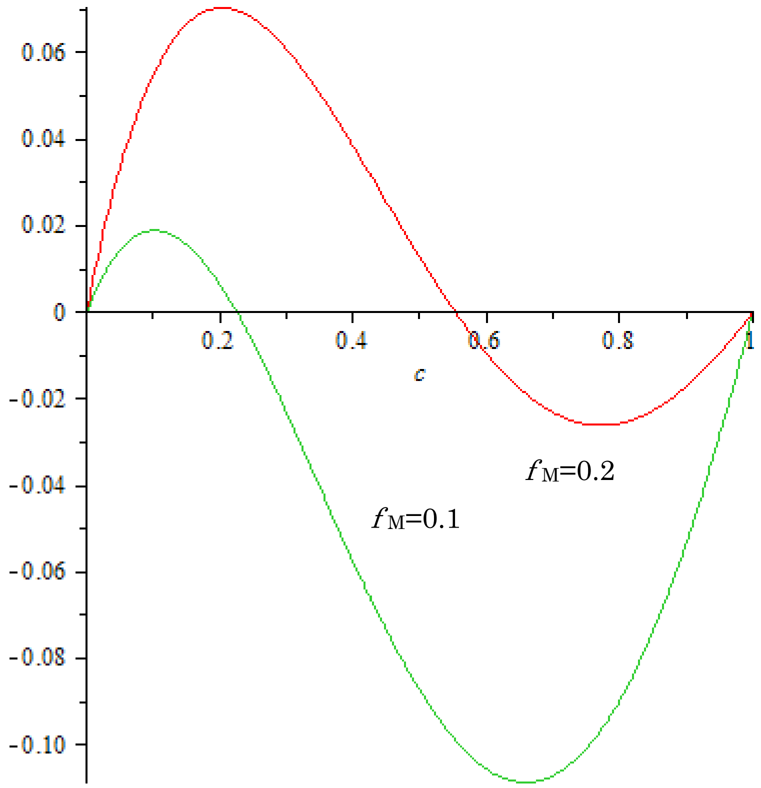

Figure 3 Numerical Examples of Nash-Bargaining Solution (f_M=0.1 and 0.2).

Note: Horizontal axis is the level of commission fee (c_T).