Abstract

This article develops an oligopoly model of trade intermediation. In the model, two manufacturing firms that want to export their products cannot do so by themselves at the beginning, because of lack of distribution network or other necessary facilities for exporting. It is assumed that 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. This article shows the following. (i) In the benchmark case (symmetric manufacturers with zero production costs), depending on the fixed costs and the commission fee, the choices of the two firms may be threefold: (Case 1) both choose indirect exports, (Case 2: asymmetric choices) one chooses indirect while the other chooses direct exports (the two firms are identical though), or (Case 3) both choose direct exports. However, the trading company always prefer Case 1 and set its commission fee to let the two manufacturers choose indirect exports. (ii) In the asymmetric production-cost case (firm 1’s marginal cost is zero while firm 2’s is positive), Case 2 in the benchmark case bifurcates. That is, indirect exports by firm 1 or firm 2 and direct exports by firm 2 or firm 1. In the previous literature, the case when the both manufacturing firms choose indirect exports, which is likely in the model, is not.
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.

To my knowledge, the previous theoretical studies of trade intermediation have 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 (AFN, Khandelwal, and Wei 2011, Akerman 2012, for instance). These studies 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 (see Rauch 1996 and Tanaka 2013 about Japan). 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, two manufacturing firms that want to export their products cannot do so by themselves at the beginning, because of lack of distribution network or other necessary facilities for exporting. It is assumed that 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. This article shows the following. (i) In the benchmark case (symmetric manufacturers with zero production costs), depending on the fixed costs and the commission fee, the choices of the two firms may be threefold: (Case 1) both choose indirect exports, (Case 2: asymmetric choices) one chooses indirect while the other chooses direct exports (the two firms are identical though), or (Case 3) both choose direct exports. However, the trading company always prefer Case 1 and set its commission fee to let the two manufacturers choose indirect exports. (ii) In the asymmetric production-cost case (firm 1’s marginal cost is zero while firm 2’s is positive), Case 2 in the benchmark case bifurcates. That is, indirect exports by firm 1 or firm 2 and direct exports by firm 2 or firm 1. In the previous literature, the case when the both manufacturing firms choose indirect exports, which is likely in the model, is not.

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 summarizes the results and show remaining issues this paper should discuss.
2 Model

In this section, the basic setup of the model is described. Suppose that two manufacturing firms, 1 and 2, exist in a country and both of them plan to enter the market of a foreign country. 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, T. 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. 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 Benchmark: 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:

$$ \pi_{IX}^i = \{p(x_1, x_2) - c_T\}x_i, $$

$$ \pi_{DX}^i = p(x_1, x_2)x_i - f_M, \quad i = 1, 2. $$

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

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

The model is solved by backward induction.

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:

$$ x_{IX}^i = x_{IX} = \frac{1 - c_T}{3}, \quad i = 1, 2. $$

$$ \pi_{IX}^i = (x_{IX})^2 = \left(\frac{1 - c_T}{3}\right)^2. $$

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

\[ x_{i}^{DX} = x^{DX} = \frac{1}{3}, \quad i = 1, 2 \quad (3) \]

\[ \pi_{i}^{DX} = (x^{DX})^2 - f_{M} = \frac{1}{9} - f_{M}. \quad (4) \]

Because of non-negative profits, \( f_{M} \leq \frac{1}{9} \) is assumed.

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

\[ x_{1}^{IX} = \frac{1 - 2c_{T}}{3}, \quad (5) \]

\[ \pi_{1}^{IX} = (x_{1}^{IX})^2 = \left(\frac{1 - 2c_{T}}{3}\right)^2, \quad (6) \]

\[ x_{2}^{DX} = \frac{1 + c_{T}}{3}, \quad (7) \]

\[ \pi_{2}^{DX} = (x_{2}^{DX})^2 = \left(\frac{1 + c_{T}}{3}\right)^2 - f_{M}. \quad (8) \]

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 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. This 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 \( c_{T} < \frac{1 - \sqrt{1 - 9 f_{M}}}{2} \). However, as Figure 1 implies, if the first inequality holds, the second one also holds. In Figure 1, the straight line is a tangent line for the curve at the origin.

If \( c_{T} > \frac{1 - \sqrt{1 - 9 f_{M}}}{2} \), Case 3 is the equilibrium of the subgame. 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 (large \( f_{M} \) and small \( c_{T} \)). Finally, if \( \frac{9}{4} f_{M} < c_{T} \leq \frac{1 - \sqrt{1 - 9 f_{M}}}{2} \), Case 2 is the equilibrium of the subgame. Case 2 is between Cases 1 and 3, as Figure 1 shows.

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 $2c_T \left( \frac{1-c_T}{3} \right)$. 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 $c_T = \frac{9}{4} M$. Also, $f_M \leq \frac{1}{9}$ is assumed. These two things implies 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 $\frac{1}{5}$. More generally, with $c_T = \frac{9}{4} M$, the profits of the trading company in Case 1 are

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

Note that $\pi^{\text{Case1}}_T$ increases as $f_M$ increases for $0 \leq f_M \leq \frac{1}{9}$.

How about 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 $c_T \left( \frac{1-2c_T}{3} \right)$, whose maximum is $\frac{1}{21}$ 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 Figure 1. It is shown that if $f_M \geq \frac{1}{12}$, then $\frac{1-\sqrt{1-9f_M}}{2} \geq \frac{1}{3}$. Therefore, with Case 2, the trading company’s profits are as follows:

$$\pi^{\text{Case2}}_T = \begin{cases} \frac{1}{21} & \text{if } \frac{1}{12} \leq f_M \leq \frac{1}{9} \\ \frac{3f_M}{2} - \frac{1-\sqrt{1-9f_M}}{6} & \text{if } 0 \leq f_M < \frac{1}{12} \end{cases}$$

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.

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

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 $\frac{63}{16}$ 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 $\frac{1}{21}$. 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 $\frac{1}{21}$. Thus, $\pi^{\text{Case1}}_T > \pi^{\text{Case2}}_T$ for any $0 \leq f_M \leq \frac{1}{9}$. Therefore, the trading company always chooses $c_T = \frac{9}{4} M$ and Case 1 is realized.

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

Now, asymmetric production costs are introduced. Suppose that firm 1 can produce its products by no costs while firm 2 pays a constant marginal cost of $c_M$. 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.

With this production-cost asymmetry, the following four cases are analyzed:

- 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 Cases 2 and 3 together correspond to Case 2 in the benchmark case. 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 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

$$\pi_{1\text{Case1}} = \left(\frac{1 + c_M - c_T}{3}\right)^2,$$
$$\pi_{2\text{Case1}} = \left(\frac{1 - 2c_M - c_T}{3}\right)^2.$$

- Case 2

$$\pi_{1\text{Case2}} = \left(\frac{1 + c_M - 2c_T}{3}\right)^2,$$
$$\pi_{2\text{Case2}} = \left(\frac{1 - 2c_M + c_T}{3}\right)^2 - f_M.$$
Case 3

\[ \pi_{\text{Case3}}^1 = \left( \frac{1 + c_M + c_T}{3} \right)^2 - f_M, \]
\[ \pi_{\text{Case3}}^2 = \left( \frac{1 - 2c_M - 2c_T}{3} \right)^2. \]

Case 4

\[ \pi_{\text{Case4}}^1 = \left( \frac{1 + c_M}{3} \right)^2 - f_M, \]
\[ \pi_{\text{Case4}}^2 = \left( \frac{1 - 2c_M}{3} \right)^2 - f_M. \]

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. 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.

### 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 2 chooses direct exports. Finally, the southwest box is Case 3, when firm 1 chooses direct exports and firm 2 chooses indirect exports. 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 shows 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 straight line and curve bifurcate, and the vertical line 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 $0 \leq f_M \leq (1 - \frac{2c_M}{3})^2$, 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 two other lines, $c_T = \frac{9f_M}{4(1 - 2c_M)}$ and $c_T = \frac{1 - 2c_M - \sqrt{(1 + c_M)^2 - 9f_M}}{2}$, which implies that Case 2 is less likely than Case 3.

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 $c_T = \frac{2-c_M}{4}$. 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, $f_M \leq (1 - \frac{2c_M}{3})^2$ is assumed. These two things imply that the maximum value of $c_T$ that the trading company can choose is $(1 - \frac{2c_M}{3})^2$, 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 company in Case 1 are $\frac{3f_M}{4(1+c_M)}(2 - c_M - \frac{9f_M}{2(1+c_M)}) = \frac{(6-3c_M)f_M}{4(1+c_M)} - \frac{27f_M}{8(1+c_M)^2}$.

How about other two cases? Obviously, the trading company does not choose any level of the commission fee satisfying $c_T > (1 - \frac{2c_M}{3}) - \frac{\sqrt{(1 - 2c_M)^2 - 9f_M}}{2}$, because in Case 4, its profits are zero. In Case 2, its profits are $c_T = \frac{1+c_M - \sqrt{2}c_M}{3}$, whose maximum is $\frac{(1+c_M)^2}{24}$ with $c_T = \frac{1 + c_M}{3}$. 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 $f_M \geq \frac{2 - \sqrt{2}}{18}$, then $\frac{(1 - \sqrt{1 - 9f_M})^2}{2} \geq \frac{1}{4}$. Therefore, with Case 2, the trading company’s profits are as follows:

$$
\left\{ \begin{array}{ll}
\frac{(1+c_M)^2}{24} & \text{if } \frac{(1+c_M)^2}{12} \leq f_M \leq \left(1 - \frac{2c_M}{3}\right)^2 \\
\frac{3f_M}{2} - \frac{(1+c_M)(1+c_M) - \sqrt{(1+c_M)^2 - 9f_M}}{6} & \text{if } 0 \leq f_M < \frac{(1+c_M)^2}{12}
\end{array} \right.
$$

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

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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 $c_M$. However, the formulae of the profits of these three cases are so complicated that deriving some results analytically is not sure at this point.

4 Conclusion

This article develops an oligopoly model of trade intermediation and shows the following. (i) In the benchmark case (symmetric manufacturers with zero production costs), depending on the fixed costs and the commission fee, the choices of the two firms may be threefold: (Case 1) both choose indirect exports, (Case 2: asymmetric choices) one chooses indirect while the other chooses direct exports (the two firms are identical though), or (Case 3) both choose direct exports. However, the trading company always prefer Case 1 and set its commission fee to let the two manufacturers choose indirect exports. (ii) In the asymmetric production-cost case (firm 1’s marginal cost is zero while firm 2’s is positive), Case 2 in the benchmark case bifurcates. That is, indirect exports by firm 1 or firm 2 and direct exports by firm 2 or firm 1. In the previous literature, the case when the both manufacturing firms choose indirect exports, which is likely in the model, is not.

However, many issues are not solved yet. First of all, in the asymmetric production-cost case, the decision of the trading company is not clear. Whether asymmetric exporting-mode choices (Cases 2 and 3) may be equilibria should be resolved. Second, by exchanging stages 1 and 2/3, checking the robustness may be possible. Finally, welfare analysis is necessary to draw policy implications.

References


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<tr>
<td></td>
<td>DX</td>
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Table 1: Payoff matrix in stage 3 (quantity competition between firms 1 and 2).

Figure 1: Fixed costs of direct exports, commission fee, and manufacturer’s optimal choices.
Table 2: Payoff matrix in stage 3 with different marginal costs of production.

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<th>Firms</th>
<th>Exporting mode</th>
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<th>Firm 2</th>
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<td>Firm 1</td>
<td>IX</td>
<td>( \frac{1 + c_M - c_T}{3} )</td>
<td>( \frac{1 + c_M - 2c_T}{3} )</td>
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<td></td>
<td>DX</td>
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<td>Firm 2</td>
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<td>( \frac{1 + c_M}{3} - f_M )</td>
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<td>( \frac{1 - 2c_M}{3} - f_M )</td>
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Figure 2: Fixed costs of direct exports, commission fee, and manufacturers's optimal choices under asymmetric marginal costs of production.