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Trade Liberalization and Strategic Outsourcing

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Abstract

This paper develops a theory of strategic outsourcing that arises due to trade liberalization. With trade liberalization, a domestic firm may choose to purchase the intermediate good from a more efficient foreign producer, who also competes with the domestic firm in the final-good market. This can result in higher prices for both the intermediate and final goods. Although trade liberalization in the final product would lower the price of the final good, it could cause the price of the intermediate product to either increase or decrease, depending on the characteristics of the final products. Therefore, in the presence of strategic outsourcing, trade liberation can have ambiguous effects on consumer prices, depending on the relative tariff reductions for intermediate and final goods.

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1. INTRODUCTION

One of the most significant effects of trade liberalization on patterns of production and trade during the last decade is the phenomenon of international 'outsourcing' and/or 'fragmentation'. Although it is hard to clearly distinguish these two terminologies, 'fragmentation' often describes the break-up of a production process, while 'outsourcing' describes a firm's decision about its production structure.[1] International outsourcing and fragmentation have been well documented and their effects on production and input markets are the subject of many recent empirical studies.[2] They are often seen as ways for firms to look for cheaper suppliers (especially from lower wage countries) to cope with increasing international competition. The theories developed in this area are broadly based on two approaches. The first approach, which is adopted in most studies in the literature, focuses on competitive market structure, especially regarding the intermediate product market [e.g., Jones (2000), Jones and Kierzkowski (2001)]. The second approach, which has its origin in the industrial organization literature, focuses on a firm's vertical structure [e.g., McLaren (2000)].[3] Under these theories the effects of outsourcing are pro-competitive and economically efficient, in the sense that they result in lower prices for both intermediate and final products.

In this paper, we consider an unnoticed feature of outsourcing, namely, that outsourcing firms sometimes purchase intermediate products from more efficient suppliers that are also their rivals in markets for final products. International outsoucing of this nature is common in many industries, such as the computer industry and the automobile industry (see discussion later). We argue that in this case the usual cost-saving motive for outsourcing could be accompanied by a strategic motive, and that the *strategic outsourcing* in response to trade liberalization in intermediate goods can have anti-competitive effects, resulting in

[1] See *Deardorf's Glossary of International Economics* for other similar terminologies.

[2] For example, see Feenstra and Hanson (1996a, 1996b), Hanson (1996), Slaughter (1995), and many others.

[3] Recent studies on outsourcing (or *international* outsourcing) focus on international aspects, which is very different from earlier research on vertical structure.

higher prices for both intermediate and final goods. Our basic insight is that outsourcing enables competitors to form customer-supplier relationships, which can have a collusive effect on competition.[4] Trade liberation could therefore have an ambiguous effect on consumer prices, depending on the relative tariff reductions for intermediate and final goods.

We consider a model where two firms, one domestic and one foreign, produce a differentiated product using a homogenous intermediate input and compete only in the domestic market. The foreign firm has the lower (marginal) cost, m_F, in producing the intermediate input and thus always stays integrated. The domestic firm, however, can either produce the intermediate input itself (or purchase it from a competitive domestic supplier) at higher cost, m_D ($m_D > m_F$), or purchase the intermediate input from the integrated foreign firm.[5] Recognizing that these two firms may compete in the final product market, we allow the domestic firm to behave strategically in choosing its input suppliers. In a two-stage game where the choice of the supplier of intermediate inputs is determined in the first stage and then the two firms engage in Bertrand competition in the final product market, we establish the following three main results.

First, strategic outsourcing occurs in equilibrium if and only if the level of the import tariff on the intermediate product is smaller than $m_D - m_F$, the difference between the two firms' costs of producing the intermediate good. When outsourcing occurs, the domestic firm actually pays more (including the tariff) for the intermediate input than it would cost to produce the good domestically. To understand this counter-intuitive result, one needs to realize that the foreign firm would have less incentive to cut its price in the final good market when it supplies the domestic firm. This motivates the domestic firm to buy the intermediate input from the foreign firm if the import cost is the same as or slightly higher than the domestic cost of production. Thus, trade liberalization in the intermediate good creates opportunities for multi-market interdependence between competitors in the final

[4]Chen (2000) also points out that a vertical merger may have a collusive effect due to the integrated firm becoming a supplier to its downstream rivals.

[5]It would make little difference if we allow that there exist other competitive foreign suppliers of the intermediate good at the same higher cost, m_D.

product market, resulting in a collusive effect.

Second, in the outsourcing equilibrium a further reduction of import tariffs on the intermediate good would increase what the domestic firm actually pays (including the tariff) for the intermediate input. It is clear that the foreign firm would raise the (producer) price of the intermediate good when the import tariff decreases. But it is surprising that the foreign firm would be able to increase the (producer) price more than proportionately when it has multi-market contact with its rival. This result is important, because it also implies that the prices of the differentiated final products would become higher when trade in the intermediate input is being liberalized. Therefore, in contrast to the common view in the current literature, trade liberalization in intermediate products could have anti-competitive effects on consumer prices.

Third, in the outsourcing equilibrium trade liberalization in the final good would reduce the prices of the final goods but the effect on the price of the intermediate input is not obvious. It would increase (decrease) the price of the intermediate input if the final differentiated products are 'weak substitutes' ('strong substitutes').[6] If the demand function for the final good is linear, then trade liberalization in the final good market has no effect on the price of the intermediate input.

There is considerable real-world evidence for the kind of international outsourcing that we discuss in this paper. For example, it is well known that Taiwanese PC producers (e.g., Acer) supply mother boards, PCBs, and other inputs to other foreign PC producers. Similar practices can also be found in automotive industries. Traditionally, the production of engines has been kept in-house and engines are only used in the manufacturer's *own* vehicles. This practice is not difficult to understand given that engines are the most important component in automobiles. However, according to *Automotive Industries* (July 1999), Mitsubishi is now poised to sign a series of deals with Fiat Auto and it is likely that Mitsubishi's GDI (gasoline direct injection) engines will power several new Fiat models. Also, a Japanese newspaper (*Nihon Keizai Shimbun* (April 2, 2001)) reports that Peugeot supplies about 60,000 diesel engines every year to Nissan, Suzuki, Volkswagen, etc. More

[6]We will define 'strong substitutes' and 'weak substitutes' in Section 3.

interestingly, Honda is famous for its unique DCR (direction of crankshaft rotation) engines and their superior quality but the company recently has decided to abandon DCR and will incorporate its technology to produce more conventional GDI engines that are suitable for installation in other carmakers' models. "From now on we will be able to sell our engines to other carmakers", said a Chief Executive Hiroyuki Yoshino of Honda Motor Co. (*Automotive News Europe, 25* (October 1999)).

To our knowledge, there are no studies in the present literature that explore the collusive incentives of international outsourcing (or strategic outsourcing) and its potential anti-competitive effects associated with trade liberalization, although there are a few papers that focus on trade liberalization and vertical structure under imperfect competition. Based on the approach of 'transaction costs' and 'incomplete contracts' (which is very different from ours), McLaren (2000) shows how globalization would lead to changes in firms' vertical organization, and how outsourcing arises in equilibrium. The contribution is made possible because McLaren incisively recognizes that trade liberalization lowers transaction costs and makes it easier for an input supplier to find an attractive buyer abroad, which strengthens its bargaining power *ex post* and thus makes an arm's-length arrangement more attractive. Trade liberalization therefore unambiguously enhances efficiency because of thickening of the market.

Zhao (2000) also considers outsourcing and the vertical (and horizontal) structure of a multinational firm. However, the paper focuses on the effects of domestic unionization, particularly how unionization in vertically related markets can make firms become both vertically and horizontally related multinationals. The basic insight is that, when domestic labour is unionized, vertical integration could raise both union employment and the negotiated wage, but may reduce total industry profits. In order to counter the benefits rendered to the domestic unions due to vertical integration, an integrated firm may have incentives to go multinational horizontally for outsourcing, regardless of whether or not the foreign country is unionized. The competitive effects of such outsourcing depends on the relative degree of two distortions: 'double marginalization' versus unionization.

The basic framework of our model is also related to Spencer and Jones (1991, 1992)

on vertical structure and optimal trade policy.[7] They are concerned with trade policies that affect the vertical supply decision of the vertically integrated foreign firm. Assuming Cournot competition with a homogeneous good in the final product market[8], they find that the difference in profit margins from the export of the intermediate and final products to be crucial to their analyses. In their paper, the decision of the integrated firm on whether to restrict the export of the intermediate input is also associated with the general idea in industrial organization that a firm may gain from raising its rivals' costs even at some expense to itself. It will become clear, however, the collusive effect of strategic outsourcing identified in our paper would not arise under the Cournot assumption. Moreover, the asymmetric assumption that the input is produced with constant MC in the foreign country but with increasing MC in the domestic country is crucial for their analyses and results.

The rest of the paper is organized as follows. Section 2 characterizes the equilibrium under no-outsourcing and outsourcing. Section 3 analyzes the effects of trade liberalization on the equilibrium outcome (outsourcing versus no-outsourcing) and competitive effects of trade liberalization on the prices of intermediate and final products. Section 4 discusses some alternative assumptions and the robustness of our results. Section 5 concludes the paper.

2. THE MODEL

There are two firms: firm D is located in the *domestic* country and firm F is located in the *foreign* country. These firms produce a differentiated final product, Y, using a homogenous intermediate good, X. There is potential trade in both good X and good Y, and both firms

[7]Spencer and Jones (1991, 1992), respectively, examine trade policies taken by the input-exporting country (the foreign country) and those by the input-importing country (the domestic country). Other studies that deal with various kinds of trade policies in vertical related markets include Ishikawa (1997, 1998), Krishna and Morgan (1998), and Ishikawa and Spencer (1999).

[8]In the first paper (Spencer and Jones, 1991), they briefly mentioned the Bertrand competition to discuss whether it would reverse their results from the Cournot competition.

compete in the *domestic* market only.[9] The (domestic) demand for the two firms' products is $q^i(p_i, p_j)$, $i, j = D, F$. The marginal cost of producing the intermediate good X is a constant, m_D for firm D and m_F for firm F, where $0 \leq m_F < m_D$. Thus the foreign firm is more efficient in producing the intermediate good. It would not affect any of the results in our paper if the intermediate good X is available competitively from other (whether domestic or foreign) suppliers at price m_D. In the model we assume that only firm F produces the intermediate good X in the foreign country. Other costs of producing Y are normalized to zero, and to produce one unit of good Y requires one unit of the intermediate good X. In the domestic country, there are specific tariffs on imports of both goods: t_y for the final good Y and t_x for the intermediate good X. Since optimal trade policy is not the focus of this paper, we do not introduce active domestic or foreign governments into the model. Our main interests are the effects of trade liberalization (which is represented by a reduction in t_x or/and t_y) on the equilibrium decision about outsourcing and on the prices of intermediate and final products.

The game proceeds as follows. In the first stage firm F commits to a (producer) price, w (where $w \geq m_F$)[10], for the intermediate good (if it sells X) and firm D decides whether to contract to buy the intermediate good from firm F or to have it produced domestically.[11] In the second stage firm D and firm F compete in price (Bertrand) for the differentiated final good Y in the domestic market (we will briefly discuss quantity competition in Section 4). As usual, we solve the sub-game perfect equilibrium of the model by backward induction. We first characterize Nash equilibrium in the subgame where firm D chooses no-outsourcing. We then characterize the equilibrium in the subgame where firm D chooses outsoucing, that

[9]The foreign firm can also serve its own domestic market, but this would matter little as long as the two markets are segmented.

[10]It will come clear that it would never be optimal for firm F to sell the intermediate good at a price less than its marginal cost m_F.

[11]Equivalently, firm F could commit the quantity of the intermediate good to export given that its price w is determined by its supply and demand from firm D. Also, if the intermediate good X is competitively available in the domestic country at price m_D, then firm D decides whether to contract to buy the intermediate good from a domestic supplier at price m_D or from firm F at price w.

is, to purchase the intermediate good from firm F. The equilibrium outsourcing decision, as well as the equilibrium price for X (if D purchases from F) is then determined.

Equilibrium under no-outsourcing

If firm D produces the intermediate good by itself, the profit functions for firms D and F are

$$\pi^D = (p_D - m_D)q^D(p_D, p_F) \tag{1}$$

and

$$\pi^F = [p_F - (m_F + t_y)]q^F(p_F, p_D) \tag{2}$$

respectively.

The equilibrium prices, which are assumed to exist uniquely for any given parameter value t_y and are denoted as $p_i(m_D, t_y)$, satisfy the following first-order conditions:

$$q^D(p_D(t_y), p_F(t_y)) + p_D(t_y) - m_D)q_1^D(p_D(t_y), p_F(t_y)) = 0, \tag{3}$$

$$q^F(p_D(t_y), p_F(t_y)) + [p_F(t_y) - (m_F + t_y)]q_1^F(p_D(t_y), p_F(t_y)) = 0. \tag{4}$$

Denote the equilibrium profits by $\pi^D(m_D, t_y)$ and $\pi^F(m_D, t_y)$. Notice that $\pi^D(m_D, t_y)$ will be the benchmark level of its profit when firm D decides whether or not to go outsourcing.

Equilibrium under outsourcing

If firm D contracts to buy the intermediate good X from firm F at price w (and pays the import tariff t_x), the profit functions for D and F are

$$\pi^D = (p_D - w - t_x)q^D(p_D, p_F) \tag{5}$$

and

$$\pi^F = [p_F - (m_F + t_y)]q^F(p_F, p_D) + (w - m_F)q^D(p_D, p_F) \tag{6}$$

respectively. The equilibrium prices, which are assumed to exist uniquely for any given parameter value t_x and t_y and denoted as $\tilde{p}_i(w + t_x, t_y)$, satisfy the following first-order

conditions:

$$\left(\begin{array}{c} q^D\left(\tilde{p}_D\left(w+t_x,t_y\right),\tilde{p}_F\left(w+t_x,t_y\right)\right) \\ +[\tilde{p}_D\left(w+t_x,t_y\right)-(w+t_x)]q_1^D\left(\tilde{p}_D\left(w+t_x,t_y\right),\tilde{p}_F\left(w+t_x,t_y\right)\right) \end{array} \right) = 0, \qquad (7)$$

$$\left(\begin{array}{c} q^F\left(\tilde{p}_F\left(w+t_x,t_y\right),\tilde{p}_D\left(w+t_x,t_y\right)\right) \\ +[\tilde{p}_F\left(w+t_x,t_y\right)-(m_F+t_y)]q_1^F\left(\tilde{p}_F\left(w+t_x,t_y\right),\tilde{p}_D\left(w+t_x,t_y\right)\right) \\ +\left(w-m_F\right)q_2^D\left(\tilde{p}_D\left(w+t_x,t_y\right),\tilde{p}_F\left(w+t_x,t_y\right)\right) \end{array} \right) = 0 \qquad (8)$$

Denote the equilibrium profits by $\tilde{\pi}^D\left(w+t_x,t_y\right)$ and $\tilde{\pi}^F\left(w+t_x,t_y\right)$. The equilibrium profits also have to satisfy the conditions that $\tilde{\pi}^i\left(w+t_x,t_y\right) \geq \pi^i\left(m_D,t_y\right)$, $i=D,F$. Notice that $w+t_x$ is the effective marginal cost for firm D. It is straightforward to show that each firm's equilibrium profit decreases in its own cost and increases in its rival's cost. Therefore, in equilibrium firm F will increase w (in stage 1) such that the above constraint on firm D's profit under outsourcing is binding. Therefore we have the following preliminary result.

Lemma 1 *The equilibrium price of the intermediate good, $w(t_x)$, satisfies* $\tilde{\pi}^D\left(w(t_x)+t_x,t_y\right)=\pi^D\left(m_D,t_y\right)$.

Also notice that equations (7) and (8) would be the same as equations (3) and (4) when $w(t_x)=m_F$ and $w(t_x)+t_x=m_D$. Therefore, we also have:

Lemma 2 $\tilde{\pi}^i\left(m_D,t_y\right)=\pi^i\left(m_D,t_y\right)$ *if* $w=m_F, i=D,F$.

3. THE EFFECTS OF TRADE LIBERALIZATION

3.1 Trade liberalization in the intermediate good

Now we solve for the equilibrium decision in stage 1 and show how trade liberalization might affect the subgame perfect equilibrium in this model (i.e., outsourcing or no-outsourcing). Although we only discuss import tariffs in this model, we interpret a decrease in their level more broadly as a reduction in trade barriers and/or an increase in globalization (i.e., reduction in trade costs in general). More specifically, we focus on the effects of

a reduction in the import tariff on the intermediate good, t_x. First we find that the level of t_x will determine what kind of equilibrium we have, which is characterized by the next proposition.

Proposition 1 *There is equilibrium outsourcing if and only if* $t_x < m_D - m_F$.

P roof. We first show the "if" part. Suppose that $t_x < m_D - m_F$ but there is no outsourcing. Then F can offer some w that is slightly higher than m_F but $w + t_x < m_D$.(since $w+t_x < w-m_F+m_D < m_D$) Then contracting to purchase the input from F will increase both D and $F's$ profits - a contradiction. While firm D increases its profit because of a reduction in the marginal cost, firm F increases its profits from selling the intermediate product. We next show the "only if" part. Suppose that $t_x > m_D - m_F$ but there is outsourcing. Since $t_x > m_D - m_F$, we would have $w(t_x) + t_x > w(t_x) - m_F + m_D > m_D$. But since $\tilde{\pi}^D(m_D, t_y) = \pi^D(m_D, t_y)$ if $w(t_x) = m_F$ (Lemma 2) and $\tilde{\pi}_1^D(\cdot, t_y) < 0$, we would have $\tilde{\pi}^D(w(t_x) + t_x, t_y) < \pi^D(m_D, t_y)$, or no outsourcing occurs, a contradiction. ■

We define $\bar{t}_x = m_D - m_F$ and call $\bar{t}_x$ the prohibitive level of tariff. When $t_x > \bar{t}_x$, the equilibrium is no-outsourcing - firm D produces the intermediate good by itself. When $t_x < \bar{t}_x$, the equilibrium is outsourcing - firm D purchases the intermediate good from firm F at price $w(t_x)$, where $w(t_x)$ is the equilibrium price for the intermediate good. Therefore, if we suppose that t_x is initially high, then we would observe that firm D moves from the no-outsourcing regime to the outsourcing regime as the tariff on the intermediate good decreases.

It seems that Proposition 1 is very intuitive, but the intuition for the result is more subtle than it appears. From Proposition 1 we may believe that it should also be true that $w(t_x) + t_x < m_D$. That is, firm D would pay less (including the tariff) for the intermediate good when it decides to go outsourcing. However, it will be shown next that this is not the case. It is important to realize that the necessary and sufficient condition for firm D to decide to go outsourcing is $\tilde{\pi}^D(w + t_x, t_y) \geq \pi^D(m_D, t_y)$ rather than $w(t_x) + t_x < m_D$.

Proposition 2 *When the outsourcing equilibrium occurs, in general* $w(t_x) + t_x > m_D$ *and* $\tilde{p}_i(w + t_x, t_y) > p_i(m_D, t_y), i = D, F$.

P roof. Suppose that $w + t_x = m_D$ initially. Then firm D's best response function would be the same as under no-outsourcing. However, under no-outsourcing firm F's best response function is $\pi_1^F(p_F, p_D) = 0$ while under outsourcing it becomes $\widetilde{\pi}_1^F(p_F, p_D) = \pi_1^F(p_F, p_D) + (w - m_F)\frac{dq^D}{dp_F} = 0$. Since $(w - m_F)\frac{dq^D}{dp_F} > 0$, it shifts up firm F's reaction function (see Figure 1). This softens the competition in the final goods market and raises firm D's profit. However, firm F only needs to keep firm D indifferent compared to the situation of no-outsourcing. Thus, firm F could increase w (which shifts firm D's reaction function to the right) until $\widetilde{\pi}^D(w + t_x, t_y) = \pi^D(m_D, t_y)$. Therefore in equilibrium $w(t_x) + t_x > m_D$. Since m_D and $w(t_x) + t_x$ enter as marginal costs, it is straightforward to show that the prices of the final goods become higher. ■

It is surprising that, when moving to outsourcing, firm D actually pays more for the intermediate good than its own cost to produce the good. To understand this result, one needs to recognize that firm F would have less incentive to cut its price in the final good market if it supplies the intermediate good to D. This implies that firm D would strictly prefer to buy the intermediate input from firm F if the cost of imports is the same as that of its own production. This then enables firm F to raise the price of the intermediate good. As a result, the prices of the final products are higher under outsourcing than under no-outsourcing. Therefore, outsourcing here has a strategic effect: it changes the competition in the final-good market and results in less competition there.

We have shown that strategic outsourcing can arise when trade in the intermediate product is liberalized. In the outsourcing equilibrium, would further trade liberalization in the intermediate good also have similar anti-competitive effects? When $t_x < \bar{t}_x$ and the subgame perfect equilibrium is outsourcing, a further reduction of t_x would actually increase the equilibrium prices for both the intermediate and final goods, as shown in the next proposition.

Proposition 3 *In the equilibrium of outsourcing, a reduction of t_x increases $w(t_x) + t_x$ (i.e., $|\frac{dw(t_x)}{dt_x}| > 1$) and the prices of the final product.*

P roof. Suppose that $t''_x < t'_x < \bar{t}_x$. First we want to show that $w(t''_x) + t''_x > w(t'_x) + t'_x$. By construction, $\tilde{\pi}^D(w(t''_x) + t''_x, t_y) = \tilde{\pi}^D(w(t'_x) + t'_x, t_y) = \pi^D(m_D, t_y)$. Then it must be true that $w(t''_x) > w(t'_x) > m_F$. This will shift up firm F's reaction function and thus for any given price of firm D for its final good, firm $F's$ price for its final good will be higher under $w(t''_x)$ than under $w(t'_x)$. Therefore if $w(t''_x) + t''_x \leq w(t'_x) + t'_x$, we would have $\tilde{\pi}^D(w(t''_x) + t''_x, t_y) > \tilde{\pi}^D(w(t'_x) + t'_x, t_y)$, a contradiction. This proves that $w(t''_x) + t''_x > w(t'_x) + t'_x$. It then follows that the equilibrium prices in the final-good market are higher. ■

The intuition of the result is as follows. The initial reduction of t_x increases firm D's profit. This allows firm F to raise w. When w increases, firm F cares more about the profit from selling the intermediate good and hence further softens its competition with firm D in the final product market, which has the effect of increasing $\tilde{\pi}^D$. This allows firm F to raise w even further. Since, in equilibrium, firm D's profit is always kept to its level under no-outsourcing, π^D, the combined forces would allow firm F to raise w more than proportionately.

Thus, Proposition 3 also indicates that trade liberalization in the intermediate good could have anti-competitive effects on both intermediate and final product markets.

For illustration of these results, we shall consider a linear-demand example:

Example 1 *Suppose*

$$q^i(p_i, p_j) = 1 - p_i + \beta(p_j - p_i);\ i, j = D, F,\ \beta \in (0, \infty), \tag{9}$$

Following eqs. 3 and 4, we obtain the equilibrium prices of the final product under no-outsourcing:

$$p_D(m_D, t_y) = \frac{2 + 3\beta + 2(1+\beta)^2 m_D + \beta(1+\beta)(m_F + t_y)}{(2+\beta)(2+3\beta)} \tag{10}$$

for firm D and

$$p_F(m_D, t_y) = \frac{2 + 3\beta + 2(1+\beta)^2 (m_F + t_y) + \beta(1+\beta) m_D}{(2+\beta)(2+3\beta)}. \tag{11}$$

for firm F. Also, it is straightforward to obtain that

$$\pi_D(m_D, t_y) = (1+\beta)\frac{[2 + 3\beta - (2 + 4\beta + \beta^2) m_D + \beta(1+\beta)(m_F + t_y)]^2}{(2+\beta)^2(2+3\beta)^2}. \tag{12}$$

Following eqs 7 and 8, we obtain the corresponding equilibrium prices under outsourcing:

$$\widetilde{p}_D(w+t_x) = \frac{2(1+w+t_x)+\beta\{3+m_F+t_y+4(w+t_x)+\beta[t_y-t_x+3(w+t_x)]\}}{(2+\beta)(2+3\beta)} \quad (13)$$

and

$$\widetilde{p}_F(w+t_x) = \left(\begin{array}{c} \frac{2(1+m_F+t_y)}{(2+\beta)(2+3\beta)} \\ +\frac{\beta\{-2(1+\beta)(m_F+t_x)+2(2+\beta)(m_F+t_y)+3[1+w+t_x+\beta(w+t_x)]\}}{(2+\beta)(2+3\beta)} \end{array} \right). \quad (14)$$

And the equilibrium profit for firm D becomes

$$\widetilde{\pi}_D(w+t_x) = (1+\beta)\frac{\{2(w+t_x-1)+\beta[-3+\beta(t_x-t_y)-(m_F+t_y)+4(w+t_x)]\}^2}{(2+\beta)^2(2+3\beta)^2}. \quad (15)$$

Therefore, from Lemma 1 the equilibrium price for the intermediate product is obtained by setting $\widetilde{\pi}_D(w+t_x)$ *to* $\pi_D(m_D,t_y)$*, which is*

$$w(t_x)+t_x = m_D + \frac{\beta^2(m_D-m_F-t_x)}{4\beta+2} \quad (16)$$

Notice that $w(t_x)+t_x > m_D$ *because* $t_x < m_D - m_F$*. Also, it is straightforward to show that* $dw/dt_x = -(\beta^2+4\beta+2)/(4\beta+2) < -1$*, and* $d\widetilde{p}_D/dt_x < 0$ *and* $d\widetilde{p}_F/dt_x < 0$*. These results are also illustrated by the diagrams in Figure 2.*

3.2 Trade liberalization in the final good

Above we have focused on the effects of trade liberalization in the intermediate good. The effect of trade liberalization in the final good can be analyzed by examining the effects of a reduction in the tariff on the final good. In this section we carry our analysis under the equilibrium of outsourcing although we will also discuss how trade liberalization in the final good will affect the equilibrium outcomes: outsourcing versus no-outsourcing.

A reduction of t_y is a reduction of the marginal cost for firm F in producing the final good. Therefore it is straightforward to show that this will reduce the prices of the final goods.

Proposition 4 *A reduction of* t_y *reduces the prices of good Y (*$\widetilde{p}_D$*, and* $\widetilde{p}_F$*). More generally,* $d\widetilde{p}_i/dt_y > 0, i = D, F$*.*

Trade liberalization in the final good has an unambiguously competitive effect on the final product market. However, the above result does not suggest that a reduction of t_y would also unambiguously lower the price of the intermediate input. It turns out that the effects of a reduction of t_y on w depend on the characteristics of the differentiated final products (below we simply use w, rather than $w(t_x)$, to denote the equilibrium price of the intermediate good X).

Proposition 5 *(i)* $\frac{dw}{dt_y} > 0$ *if* $\frac{d^2(q^D)}{d(p_F)^2} > 0$ *(goods Y are 'strong substitute'); (ii)* $\frac{dw}{dt_y} = 0$ *if* $\frac{d^2(q^D)}{d(p_F)^2} = 0$ *(linear demand); (iii)* $\frac{dw}{dt_y} < 0$ *if* $\frac{d^2(q^D)}{d(p_F)^2} < 0$ *(goods Y are 'weak substitutes').*

P roof. Notice that $\widetilde{\pi}^D(w + t_x, t_y)$ and $\pi^D(m_D, t_y)$ are both indirectly affected by t_y. Changes in t_y affect firm F's marginal cost, which in turn shift its reaction function curve. To determine the sing of dw/dt_y we must compare $d\widetilde{\pi}^D(w + t_x, t_y)/dt_y$ with $d\pi^D(m_D, t_y)/dt_y$ since in equilibrium firm F will use w to satisfy that $\widetilde{\pi}^D(w + t_x, t_y)$ and $\pi^D(m_D, t_y)$. Therefore, the equilibrium level of w crucially depends on how a change in t_y shifts firm F's reaction function curves under no-outsourcing and outsourcing, respectively. We write the two first-order conditions for eq. 2 and 6 as $\frac{\partial \pi^F}{\partial p_F} = 0$ and $\frac{\partial \pi^F}{\partial p_F} + (w - m_F)\frac{\partial q^D}{\partial p_F} = 0$, respectively. Totally differentiating these two first-order conditions with respect to t_y, we obtain (after rearranging):

$$\frac{dp_F(m_D)}{dt_y} = \frac{\frac{\partial^2 \pi^F}{\partial p_F \partial t_y}}{-\frac{\partial^2 \pi^F}{\partial p_F^2}} > 0 \tag{17}$$

under no-outsourcing and

$$\frac{d\tilde{p}_F(w + t_x)}{dt_y} = \frac{\frac{\partial^2 \pi^F}{\partial p_F \partial t_y} + (w - m_F)\frac{\partial^2 q^D}{\partial p_F^2}}{-\frac{\partial^2 \pi^F}{\partial p_F^2}} > 0 \text{ (Proposition 4)} \tag{18}$$

under outsourcing. Therefore, for example, an increase in t_y would shift up firm F' reaction curve under the outsourcing equilibrium more (less) than that in the no-outsourcing equilibrium if $\frac{d^2(q^D)}{d(p_F)^2} > 0$ ($\frac{d^2(q^D)}{d(p_F)^2} < 0$). That is, for any given price of firm D for its final good, firm $F's$ price for its final good will be higher under in outsourcing (i.e., $\frac{d\tilde{p}_F(w+t_x)}{dt_y} > \frac{dp_F(m_D)}{dt_y}$) if $\frac{d^2(q^D)}{d(p_F)^2} > 0$, lower if $\frac{d^2(q^D)}{d(p_F)^2} < 0$. To satisfy the condition $\widetilde{\pi}^D(w + t_x, t_y) = \pi^D(m_D, t_y)$.

firm F will raises (lower) w accordingly. With a linear demand function (where $\frac{d^2(q^D)}{d(p_F)^2} = 0$), we have $\frac{d\tilde{p}_F(w+t_x)}{dt_y} = \frac{dp_F(m_D)}{dt_y}$ Therefore w will be unchanged. Similarly, we can prove the results with a reduction in t_y. ■

Notice that the sign of $\frac{dq^i}{dp_j}$ tells the direction towards which a demand function shifts. In our model $\frac{dq^i}{dp_j} > 0$ since differentiated goods Y are substitutes. The sign of $\frac{d^2(q^i)}{d(p_j)^2}$, however, tells the 'speed' at which the demand function shifts. For example, a rise of p_j would increase q^i at an increasing (decreasing) rate if $\frac{d^2(q^i)}{d(p_j)^2} > 0$ (if $\frac{d^2(q^i)}{d(p_j)^2} < 0$). Therefore, we name goods Y are 'strong substitutes' ('weak substitutes') when $\frac{d^2(q^i)}{d(p_j)^2} > 0$ ($\frac{d^2(q^i)}{d(p_j)^2} < 0$). Therefore, the effects of trade liberalization in final good on the equilibrium price of the intermediate good will depend on the characteristics of the differentiated final products. A reduction of t_y would lower w if goods Y were strong substitutes, but it would increase w if goods Y were weak substitutes.

A reduction in t_y, however, also has implications for the equilibrium outcome of outsourcing and no-outsourcing. Notice that, for outsourcing to be the equilibrium, w cannot be smaller than m_F. Thus a reduction in w would make outsourcing less likely to occur. Therefore we have the following remark.

Remark 1 *With trade liberalization in the final good market, strategic outsourcing is more (less) likely to occur if the final goods are weak (strong) substitutes.*

4. DISCUSSION

It is important to realize that the collusive effect of strategic outsourcing identified in this paper relies on firm F taking into account the profit from the intermediate good market. Therefore such a collusive effect would not arise in Cournot competition (with a homogeneous final product),[12] since firm F does not take into account that its more aggressive action in the final good market may reduce firm D's output and its purchase of the intermediate good from firm F. However, if one believes that firm F would realize that its strategic action in the final product market could affect its profit from the intermediate

[12]Notice that outsourcing (or vertical supply as in Spencer and Jones, 1991&1992) could still occur.

good market, then the Cournot assumption would seem inappropriate.

Nevertheless, it is not difficult to see that the collusive effect of strategic outsourcing could still arise in quantity competition if firm F is a Stackelberg leader in the final good market. As a Stackelberg leader, firm F would then incorporate the effect of its strategic action in the final good market on its profit of selling the intermediate good to firm D. Thus the collusive incentive of strategic outsourcing can again arise.

We only have two firms in our model. In the no-outsourcing equilibrium firm D produces the intermediate good by itself at cost m_D. However, this is not the only interpretation of the set-up. In the context of international outsourcing, this is equivalent to firm D initially purchasing the intermediate good from a competitive domestic supplier at price m_D. When moving to outsourcing, firm D switches its purchase of the intermediate good from the domestic supplier to firm F.

In the model, firm F is the only foreign supplier of the intermediate good. Firm F is able to set price w such that $\widetilde{\pi}^D(w + t_x, t_y) = \pi^D(m_D, t_y)$ (or $\widetilde{\pi}^D(w + t_x, t_y) = \pi^D(m_D, t_y) + \varepsilon$, $\varepsilon > 0$ - this would not make any real difference to our results). This ability would certainly be limited if there were other foreign suppliers of the intermediate good.[13] However, as long as firm F is the most efficient and other foreign suppliers are relatively less efficient (to some extent) in producing the intermediate good, the insights of our results would still prevail. If the marginal cost (in producing the intermediate good X) of other foreign suppliers is very close to m_D (rather than m_F), it would have little effects to our results.

5. CONCLUSION

In this paper we have identified a strategic incentive for international outsourcing, which arises from multi-market interactions among firms. It is shown that trade liberalization may create opportunities for multi-market interdependence and cause strategic outsourcing to occur. Unlike the outsourcing decision based on cost saving, strategic outsourcing has anti-

[13] One could also use Nash bargaining to determine w. Our model, however, allows us to highlight the basic insight of this paper. That is, the collusive behavior identified here is supported by multi-market interaction rather than explicit transfer payments.

competitive effects in the market. In the presence of strategic outsourcing, further trade liberalization in the intermediate product market could produce an anti-competitive effect on the final product market. Therefore, the effects on consumer prices of trade liberalization in general could be ambiguous, depending on the relative degree of trade liberalization in the intermediate and final goods. While the usual cost-saving motive for international outsourcing might be more common, the strategic oursourcing identified in this paper could also be important in some situations. A comprehensive understanding of the effects of trade liberalization and the resulting outsourcing needs to take into account the possible presence of such strategic effects.

REFERENCES

[1] Chen, Yongmin, "On vertical mergers and their competitive effects." Working Paper, University of Colorado at Boulder, 2000.

[2] *Deardorf's Glossary of International Economics,* on his home-page at: http://www-personal.umich.edu/~alandear/glossary/

[3] Feenstra, Robert C. and Gordon H. Hanson. "Foreign direct investment, outsourcing and relative wages." in R.C. Feenstra, G.M. Grossman and D.A. Irwin eds., *Political Economy of Trade Policy: Eassays in Honor of Jagdish Bhagwati.*MIT Press, Cambridge, Mass 1996a.

[4] Feenstra, Robert C. and Gordon H. Hanson. "Globalization, outsourcing and wage inequalit." *American Economic Review,* 1996b, 86(2), p240-245.

[5] Hanson, Gordon H. "Localization Economics, Vertical Organization, and Trade." *American Economic Review,* December 1996, 86(5), p1266-1278.

[6] Ishikawa, Jota. "Expanding the purchase of a foreign intermediate good: An analysis of VIEs and content protection under oligopoly." in: R. Sato, Ryuzo, R. V. Ramachandran, and K. Mino, eds., *Global Competition and Integration,* Boston: Kluwer Academic Publishers, 1999.

[7] Ishikawa, Jota and Ki-Dong Lee. "Backfiring tariffs in vertically related markets." *Journal of International Economics,* May 1997, v42, p395-423.

[8] Ishikawa, Jota and Barbara Spencer. "Rent-shifting export subsidies with an imported intermediate product." *Journal of International Economics,* August 1999, v48, p199-232.

[9] Jones, Ronald W. *Globalization and the Theory of Input Trade,* Cambridge, MASS: MIT Press, 2000.

[10] Jones, Ronald W. and Henryk Kierzkowski, "Globalization and the consequences of international fragmentation." in R. Dornbusch, G. Calvo, and M. Obstfeld, eds., *Money, Factor Mobility, and Trade: The Festschrift in Horor of Robert A. Mundell*, Cambridge, Mass: MIT Press. 2001

[11] Krishna, Kala and John Morgan. "Implementing results-oriented trade policies: The case of the US-Japanese auto parts dispute" *European Economic Review*, September 1998, v42, p1443-67.

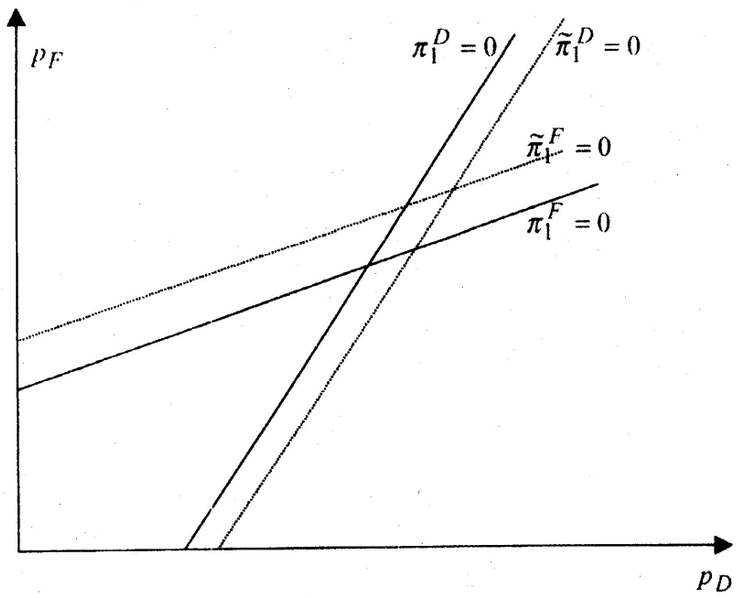
[12] McLaren, John. "'Globalization' and Vertical Structure." *American Economic Review*, December 2000, 90(5), p1239-1254.

[13] Slaughter, Mathew. "Multinational corporations, outsourcing, and American wage divergence." NBER Working Paper No. 5253..

[14] Spencer, Barbara, and Ronald W. Jones. "Vertical foreclosure and international trade theory." *Review of Economic Studies*, January 1991, 153-170.

[15] Spencer, Barbara, and Ronald W. Jones. "Trade and protection in vertically related markets." *Journal of International Economics*, February 1992, v32, p31-55.

[16] Zhao, Laixun. "Unionization, vertical markets, and outsourcing." Working Paper, Faculty of Economics, Hokkaido University, 2000.



$$\pi_1^D = (p_D - m_D)\frac{dq^D}{dp_D} + q^D$$

$$\tilde{\pi}_1^D = (p_D - w - t_x)\frac{dq^D}{dp_D} + q^D$$

$$\tilde{\pi}_1^F = \pi_1^F + (w - m_F)\frac{dq^D}{dp_F}$$

Notice that $w > m_F$ and $w + t_x > m_D$.

Figure 1

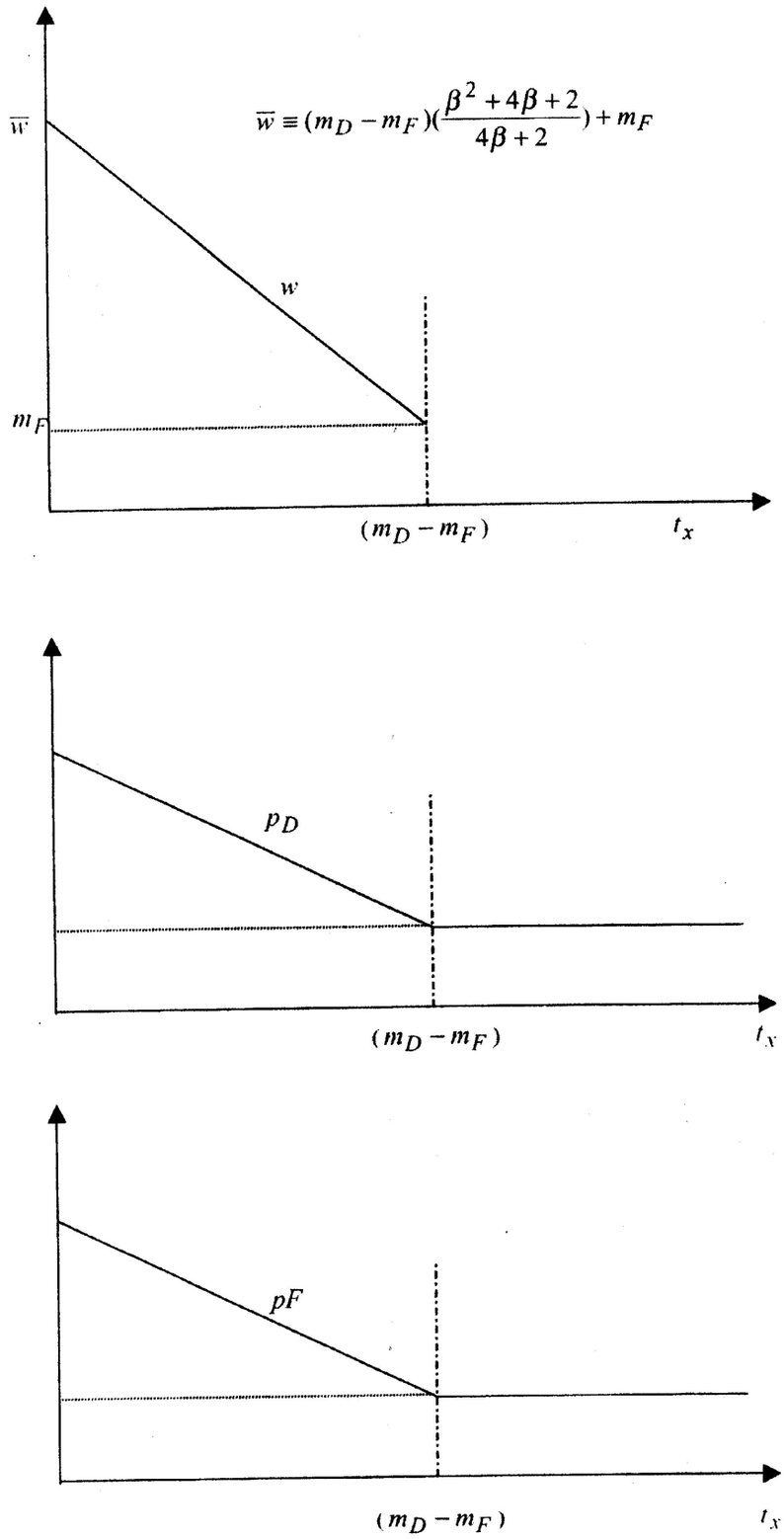

$\overline{w} \equiv (m_D - m_F)(\frac{\beta^2 + 4\beta + 2}{4\beta + 2}) + m_F$
$\overline{w}$
w
m_F
$(m_D - m_F)$
t_x
p_D
$(m_D - m_F)$
t_x
pF
$(m_D - m_F)$
t_x

Figure 2