DISCUSSION PAPERS IN ECONOMICS

Trade Liberalization and Strategic Outsourcing

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Abstract

This paper develops a model of strategic outsourcing. ith trade liberalization in the intermediate-product market, a domestic firm may choose to purchase a key intermediate good from a more efficient foreign producer, who also competes with the domestic firm for a final good. This has a strategic effect on competition. Unlike the outsourcing motivated by cost saving, the strategic outsourcing has a collusive effect that could raise the prices of both intermediate and final goods. Trade liberalization in the intermediate-good market could have a very different effect compared with trade liberalization in the final-good market.

Key Words: Outsourcing; Vertical oligopolies; Collusive effect

JE classifica ion: F12; F13

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1. INTR DUCTI N

always stays integrated. The domestic firm, however, can either produce the intermediate input itself at a higher cost or purchase the intermediate input from the integrated foreign firm. Recognizing that they may compete in the final-product market, the domestic firm has an extra incentive to purchase its input from the foreign firm because this will weaken the incentive of the latter to compete in the final-good market. In a two-stage game where the choice of the supplier of the intermediate input is determined in the first stage and the two firms then engage in Bertrand competition in the final-product market, we establish the following three main results.

First, trade liberalization for the intermediate input would lead to strategic outsourcing. But when the strategic outsourcing occurs, the domestic firm may actually pay more (including the tariff) for the intermediate input than it would cost to produce the good domestically, resulting in higher prices for the final product. Second, in contrast to the common view in the current literature, we show that in the outsourcing equilibrium, further trade liberalization in the intermediate input could raise the prices of both the intermediate and final products. Third, the effects on the intermediate and final coeOtradldiniffectt2med0MW poised to sign a series of deals with Fiat Auto and it is likely that Mitsubishi's GDI (gasoline the input domestically (at a higher cost), which reduces the demand for imported supplies. The purpose of their paper is to show that the reduction in demand may sufficiently reduce the price charged by the foreign monopolist to overcome the domestic cost disadvantage.

The equilibrium prices, denoted as $p_D(m_D, t_y)$ and $p_F(m_D, t_y)$, satisfy the following first-order conditions:[10]

$$q_D\left(p_D\left(m_D, t_y\right), p_F\left(m_D, t_y\right)\right) + \left[p_D\left(m_D, t_y\right) - m_D\right]\frac{\partial q_D\left(p_D, p_F\right)}{\partial p_D} = 0 \tag{3}$$

$$q_F\left(p_F\left(m_D, t_y\right), p_D\left(m_D, t_y\right)\right) + \left[p_F\left(m_D, t_y\right) - \left(m_F + t_y\right)\right]\frac{\partial q_F\left(p_F, p_D\right)}{\partial p_F} = 0 \tag{4}$$

We assume that the stability condition is satisfied and there exists a unique equilibrium for relevant parameter values of m_D and t_y. The equilibrium profits of firms D and F are denoted by $\pi_D(m_D, t_y)$ and $\pi_F(m_D, t_y)$. Notice that $\pi_D(m_{D,}t_y)$ will be firm $D's$ fall-back level of profit when it 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 firms D and F are

$$\widetilde{\pi}_D = (p_D - w - t_x)q_D(p_D, p_F) \tag{5}$$

$$\widetilde{\pi}_F = [p_F - (m_F + t_y)]q_F(p_F, p_D) + (w - m_F)\,q_D\,(p_D, p_F)\,. \tag{6}$$

The equilibrium prices, denoted as $\tilde{p}_D$ (

We denote the equilibrium profits by $\tilde{\pi}_D\,(w, t_x, t_y)$ and $\tilde{\pi}_F\,(w, t_x$

which is positive if the difference between w and m_F is not too large. Thus, for the relevant range of w in our analysis,[15] we assume:

$$\frac{\partial \tilde{\pi}_F (w, t_x, t_y)}{\partial w} > 0, \tag{11}$$

or firm $F's$ equilibrium profit increases in w when it sells the input to firm D. Conditions (10) and (11), which are similar to the familiar assumptions made in the literature that a firm's equilibrium profit decreases in its own input costs and increases in its rival's input costs, are generally satisfied under plausible demand conditions (e.g., Chen, 2001). In the appendix we provide an example of linear demands where both conditions (10) and (11) hold together with other assumptions of the model.

As mentioned before, outsourcing would be an equilibrium if no firm is worse off and at least one firm has higher profit under outsourcing. This means that given the game specified above, in any equilibrium that involves firm $D's$ outsourcing from firm F, firm F will optimally choose its w (in stage 1) such that firm D's profit under outsourcing is the same as if it produces the input internally.[16] We therefore have:

Lemma 1 *The equilibrium rice of the intermediate good, denoted as $w(t_x, t_y)$, satisfies $\tilde{\pi}_D (w(t_x, t_y), t_x, t_y) = \pi_D (m_D, t_y)$ and $\tilde{\pi}_F (w(t_x, t_y), t_x, t_y) > \pi_F (m_D, t_y)$.*

Furthermore, notice that the first-order conditions in equations (7) and (8) would be the same as those in equations (3) and (4) when both $w = m_F$ and $w + t_x = m_D$ hold. This means that $\tilde{p}_i (m_F, m_D - m_F, t_y) = p_i (m_D, t_y)$ and $\tilde{\pi}_i (m_F, m_D - m_F, t_y) = \pi_i (m_D, t_y)$, $i = D, F$. This observation is important for establishing the next result.

Lemma 2 *(i) In equilibrium $w(t_x, t_y) > m_F$ holds; (ii) hen $w > m_F$ and $t_x = m_D - w$, e have $\tilde{p}_i (w, m_D - w, t_y) > p_i (m_D, t_y)$, $i = D, F$.*

[15] Since an increase in w reduces firm $D's$ profit, firm D may not want to purchase from firm F if w ecomes too high. This limits how high firm F may e a le to set its w.

[16] O viously, $w \geq m_F$, since otherwise firm F would e etter off not selling to firm D. We have assumed that firm F makes the offer of w that firm D can chooe either accept or reject. If firm D can argain with firm F on the price for the intermediate good, our results would e essentially the same as long as firm $D's$ argaining power is not too strong. See the discussion in Section 4 .

Proof: **(i)** Suppose to the contrary that $w(t_x, t_y) = m_F$. Then, since $\tilde{\pi}_D(w(t_x, t_y), t_x, t_y) = \pi_D(m_D, t_y)$

firm F becomes less willing to cut that price. Therefore, although firm D's input cost is $w + t_x = m_D$, the same as if it produces the input internally, it has a higher equilibrium would have $\tilde{\pi}_D (w(t_x), t_x, t_y) < \pi_D (m_D, t_y)$, implying that there will be no outsourcing, a contradiction. ■

We define $\bar{t}_x = m_D - m_F$ and call $\bar{t}_x$ the prohibitive level of tariff. When $t_x \geq \bar{t}_x$, the equilibrium is non-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 $w(t_x)$, the equilibrium price for the intermediate good. Therefore, if t_x is initially high that deters trade in the intermediate good, we could observe that firm D moves from the non-outsourcing regime to the outsourcing regime as the tariff on the intermediate good decreases.

From Proposition 1, one may think that it should be true that $w(t_x) + t_x < m_D$ in the outsourcing equilibrium; i.e., firm D would pay less (including the tariff) for the intermediate good when it decides to go outsourcing. However, Proposition 1 is actually more subtle than it appears and, as the next proposition shows, the above conjecture is false.

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

Proof:

Using (12) we obtain

$$\frac{dw\left(t_x\right)}{dt_x}=-\frac{\frac{\partial\tilde{\pi}_D(\ ,t_x,t_y)}{\partial t_x}}{\frac{\partial\tilde{\pi}_D(\ ,t_x,t_y)}{\partial}}<-1, or \frac{d\left[w\left(t_x\right)+t_x\right]}{dt_x}<0$$

Now using the above result and condition (9'), we obtain that

$$\begin{aligned}\frac{d\tilde{p}_i\left(w\left(t_x\right),t_x,t_y\right)}{dt_x} &= \frac{\partial\tilde{p}_i\left(w,t_x,t_y\right)}{\partial w}\frac{dw\left(t_x\right)}{dt_x}+\frac{\partial\tilde{p}_i\left(w,t_x,t_y\right)}{\partial t_x}\\ &< \frac{\partial\tilde{p}_i\left(w,t_x,t_y\right)}{\partial w}\frac{dw\left(t_x\right)}{dt_x}+\frac{\partial\tilde{p}_i\left(w,t_x,t_y\right)}{\partial w}<0\ \blacksquare\end{aligned}$$

To see the intuition behind Proposition 3, consider the following thought experiment. In equilibrium, firm D has the same profit between outsourcing the intermediate good and producing it internally (i.e., $\widetilde{\pi}_D=\pi_D$). Suppose that there is a reduction in t_x. If firm F raises w the same amount as the reduction in t_x, firm $D's$ marginal cost in purchasing from firm F, $w+t_x$, would be unchanged. But since w is higher, firm F now cares more

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we obtain

$$\frac{dw(t_y)}{dt_y} = -\frac{\frac{\partial\widetilde{\pi}_D}{\partial t_y} - \frac{\partial\pi_D}{\partial t_y}}{\frac{\partial\widetilde{\pi}_D}{\partial}}.$$

Since the denominator is negative, we only need to compare $\partial\widetilde{\pi}_D/\partial t_y$ with $\partial\pi_D/\partial t_y$ to determine the sign of dw/dt_y. We should note that both $\partial\widetilde{\pi}_D/\partial t_y$ and $\partial\pi_D/\partial t_y$ here are obtained with fixed t_x and w. Using the envelope theorem and the first-order conditions (3) and (7), we obtain

$$\begin{aligned} \frac{\partial\tilde{\pi}_D(w,t_x,t_y)}{\partial t_y} &= (\tilde{p}_D - w - t_x)\frac{\partial q_D(\tilde{p}_D,\tilde{p}_F)}{\partial p_F}\frac{\partial\tilde{p}_F(w,t_x,t_y)}{\partial t_y} \\ &= -\frac{q_D(\tilde{p}_D,\tilde{p}_F)}{\frac{\partial q_D(\tilde{p}_D,\tilde{p}_F)}{\partial p_D}}\frac{\partial q_D(\tilde{p}_D,\tilde{p}_F)}{\partial p_F}\frac{\partial\tilde{p}_F(w,t_x,t_y)}{\partial t_y}, \end{aligned} \tag{13}$$

$$\begin{aligned} \frac{\partial\pi_D(m_D,t_y)}{\partial t_y} &= (p_D - m_D)\frac{\partial q_D(p_D,p_F)}{\partial p_F}\frac{\partial p_F(m_D,t_y)}{\partial t_y} \\ &= -\frac{q_D(p_D,p_F)}{\frac{\partial q_D(p_D,p_F)}{\partial p_D}}\frac{\partial q_D(p_D,p_F)}{\partial p_F}\frac{\partial p_F(m_D,t_y)}{\partial t_y}. \end{aligned} \tag{14}$$

Since the prices of the final products under outsourcing are different from those under non-outsourcing, in general we cannot compare $\partial\widetilde{\pi}_D/\partial t_y$ with $\partial\pi_D/\partial t_y$ without the knowledge

Thus, the effect on $\tilde{p}_i$ of a change in t_y crucially depends on how a change in t_y affects w. from (9) and Proposition 4, it is obvious that in the case of linear demands, a decrease in t_y lowers the prices of the final products. We thus establish the following proposition.

Proposition 5 *(i) A reduction of t_y reduces (res . increases) $\tilde{p}_i$ if and only if $dw(t_y)/dt_y$ is greater (res . smaller) than , here* $\equiv -\frac{\partial \tilde{p}_i(\ ,t_x,t_y)/\partial t_y}{\partial \tilde{p}_i(\ ,t}$

when firm F chooses its output, firm F cannot incorporate the effect on the sale of intermediate good by its actions in the final-good market. Thus, the collusive effect identified in our analysis would not arise in a Cournot model.[20] However, it seems more plausible that firm F would consider how its strategic action in the final-good market affects its profit from the intermediate-good market; and if that is the case, the Cournot assumption would seem inappropriate for our analysis. However, within the framework of quantity competition, the collusive effect of strategic outsourcing could also arise if firm F is a Stackelberg leader in setting the quantity in the final-good market. As a Stackelberg leader, firm F would then incorporate the effect of its action in the final-good market on its profit of selling the intermediate good. Then, the collusive incentive of strategic outsourcing can again arise.

In our model, firm F is the only integrated foreign firm that has the lower marginal cost to produce the intermediate good and hence we have assumed that it has the market power to set its price for the intermediate good. In equilibrium, firm F chooses w such that $\widetilde{\pi}_D(w, t_x, t_y) = \pi_D(m_D, t_y)$, or firm D is just indifferent between outsourcing and non-outsourcing. While our assumption about firm $F's$ ability to set w allows us to derive the results in a most clear way, this assumption is not essential to the basic insight of our analysis. Suppose that the price for the intermediate good is negotiated between firms F and D, and firm F does not have all the bargaining power (cannot make a "take-it-or-leave-it" offer). Then, when $t_x < m_D - m_F$, or $m_F + t_x < m_D$, there is surplus to be shared between firms F and D when firm D purchases the input from firm F. Thus, under any bargaining procedure (such as Nash bargaining) that allows the two parties to share the surplus, there will be equilibrium outsourcing, and Proposition 1 will continue to hold.[21] Furthermore, as long as firm $F's$ share of the surplus is not zero, or $w > m_F$, the collusive effect identified in our analysis will again aA2n0ffi2a0MWffiLA2lyu2us0MxRSLW2i0Wffifa2wi0MWffiL2u

measures (or market reform) that would increase competition in these markets.

There are other ways to extend or to interpret our model. For instance, instead of assuming that in the non-outsourcing equilibrium firm D produces the intermediate good by itself at cost m_D, we could assume that firm D initially purchases the intermediate good from a competitive domestic supplier at price m_D. With trade liberalization, firm D moves to international outsourcing, switching its purchase of the intermediate good from the domestic supplier to firm F. Our results would not be changed with this modification of the model. On the other hand, the timing assumption is important for our analysis, as it is in the international trade literature on profit-shifting models (e.g., Arvan, 1991; and Hwang and Schulman, 1993). If, instead of our assumption, the input purchase decision is made after final-good prices are set, then firm F would only be able to sell to firm D at $w = m_D - t_x$. However, if $t_x < m_D - m_F$, outsourcing would again occur, and thus Proposition 1 would continue to hold. Furthermore, when there is outsourcing, the collusive effect identified in our analysis would again arise, and hence the basic insight of our analysis would be valid. In fact, the analysis in this case would be similar to the analysis earlier when both firms have some bargaining power in determining the price of the intermediate good; while outsourcing cannot raise intermediate good price, it can raise the prices of the final good.

5. C NCLUDIN RE ARKS

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 motivated by cost saving, strategic outsourcing can have a collusive effect and raise prices in the intermediate-good and final-good markets. In the presence of strategic outsourcing, further trade liberalization in the intermediate-product market could further increase prices in both markets. Trade liberalization in the intermediate good market could have a very different effect compared with trade liberalization in the final good market.

APPENDIX

For illustration of our results, we shall consider a linear-demand example in this appendix. Suppose that the demand function is given by:

$$q_i(p_i, p_j) = 1 - p_i + \beta(p_j - p_i);\ i, j = D, F,\ \beta \in (0, \infty). \tag{15}$$

Following (3) and (4), we obtain both firms' equilibrium prices of the final product under non-outsourcing:

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

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

Then the equilibrium outputs under non-outsourcing are

$$q_D(p_D, p_F) = \frac{(1+\beta)[2 + 3\beta - (2 + 4\beta + \beta^2)m_D + \beta(1+\beta)(m_F + t_y)]}{(2+\beta)(2+3\beta)}$$

$$q_F(p_F, p_D) = \frac{(1+\beta)[2 + 3\beta - (2 + 4\beta + \beta^2)(m_F + t_y) + \beta(1+\beta)m_D]}{(2+\beta)(2+3\beta)}.$$

Using (1) - (4), we can obtain the equilibrium profits for firms D and F since $\pi_i(m_D, t_y) = q_i^2(p_i, p_i)/(1+\beta)$. For example,

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

From (7) and (8), we obtain both firms' corresponding equilibrium prices under outsourcing:

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

$$\begin{aligned}\widetilde{p}_F(w, t_x, p_y) &= \frac{\beta\{2(2+\beta)(m_F + t_y) - 2(1+\beta)(m_F + t_x) + 3[1 + w + t_x + \beta(w + t_x)]\}}{(2+\beta)(2+3\beta)} \\ &\quad + \frac{2(1 + m_F + t_y)}{(2+\beta)(2+3\beta)}.\end{aligned}$$

Then the equilibrium outputs under outsourcing are

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

$$\begin{aligned} q_F(\widetilde{p}_F, \widetilde{p}_D) &= \frac{\beta\{5 - 4m_F + t_x - 6t_y + \beta[3 - m_F + (2+\beta)t_x - (5+\beta)t_y - 2w] - w\}}{(2+\beta)(2+3\beta)} \\ &\quad + \frac{2(1 - m_F - t_y)}{(2+\beta)(2+3\beta)}. \end{aligned}$$

Using (5) and (7), the equilibrium profit for firm D becomes

$$\begin{aligned} \widetilde{\pi}_D(w, t_x, t_y) &= (\frac{1}{1+\beta})q_D^2(\widetilde{p}_D, \widetilde{p}_F) \\ &= (1+\beta)\frac{\{\beta^2(t_y - t_x) + \beta[3 + m_F + t_y - 4(w + t_x)] - 2(w + t_x - 1)\}^2}{(2+\beta)^2(2+3\beta)^2}. \end{aligned}$$

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

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

Notice that $w(t_x) + t_x > m_D$ because $t_x < m_D - m_F$, and it is straightforward to show that $dw/dt_x = -(\beta^2 + 4\beta + 2)/(4\beta + 2) < -1$, $d\widetilde{p}_D/dt_x < 0$ and $d\widetilde{p}_F/dt_x < 0$. Also, w does not depend on t_y, and $d\widetilde{p}_D/dt_y > 0$ and $d\widetilde{p}_F/dt_y > 0$. This can also be verified by the fact that $\partial\widetilde{\pi}_D/\partial t_y = \partial\pi_D/\partial t_y$.[23]

Also, we obtain that

$$\frac{\partial\tilde{\pi}_D(w, t_x, t_y)}{\partial w} = (\frac{2}{1+\beta})q_D(\widetilde{p}_D, \widetilde{p}_F)\frac{\partial q_D(\widetilde{p}_D, \widetilde{p}_F)}{\partial w} = \frac{-4(2\beta+1)}{(2+\beta)(2+3\beta)}q_D(\widetilde{p}_D, \widetilde{p}_F)$$

[23] These results actually hold for general linear-demand functions. We use (15) in order to reduce the num er of parameters for this excercise. For exampFhuce thei t s

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