Strategic Trade Policy with Potential for Import Substitution*

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This paper examines international trade policy when domestic firms compete against vertically integrated foreign rivals. The domestic firm has the choice of producing its own intermediate input after incurring a fixed cost, or of importing it from the foreign firm at a price set by the latter. In this setting, and under general cost and demand assumptions, there exists an entry deterring equilibrium where the foreign firm will choose to supply all the inputs the domestic firm needs. Import substitution of intermediate inputs takes place only if the domestic demand for the final output is sufficiently large to offset the scale economies associated with input production. At an entry deterring equilibrium, a tariff placed on the imports of the input by the home government will mostly be borne by the foreign firm and will be welfare increasing. When the home government chooses to subsidize the domestic firm's fixed development costs for the input, the optimal subsidy will exceed the total fixed costs required, but will not have to be disbursed in equilibrium. A tariff on the final good will in general lower the input price, but can spur import substitution for the input.

I. Introduction

International competition between a domestic firm and its vertically integrated foreign rival has recently become one of important trade policy concerns (see for example OECD Report (1987), and Spencer and

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Jones (1991 and 1992)). The integrated foreign firm produces its own intermediate input, while the home firm is not integrated, and must either import the input from its foreign rival or develop its own (more costly) production capability. What will be the outcome of the ensuing competition between the two firms and under what circumstances would the import substitution strategy be desirable? Is there a role for government policy in improving domestic welfare?

This stylized picture captures a situation that arises frequently in international trade, and now perhaps most visibly in the context of Japan’s trade. As many of Japan’s leading exporters are integrated backwards, U.S., European, and other East Asian companies encounter them as suppliers upstream and competitors downstream.¹ Consider the following examples:

In late 1989 the Perkin-Elmer Corporation, a U.S.-owned high-tech company, held talks with a Japanese company, Nikon, to sell its optical lithography division. As a technology leader, the division has monopoly control over some of the machines that develop the world’s most advanced computer chips. If the sale had gone through, U.S. companies (including IBM) would have become dependent on a key input controlled by a Japanese company which is also a competitor in downstream markets. In the event, an IBM-led consortium bought the division to prevent the technology from falling into the Japanese company’s hands.

In the early 1980s, ICL — Britain’s sole mainframe computer manufacturer — struck a deal with Fujitsu to purchase many key inputs (chips, circuit boards, and sophisticated cooling systems), which were perceived as too expensive for ICL to develop on its own. The company relied upon the proprietary technology of a firm with which it competes downstream in the mainframe market. (In July 1990, plans were announced for the acquisition of ICL by Fujitsu).

The Korean car maker Hyundai used to import engines and other parts from Mitsubishi. During the lifecycle of a particular model in the export market, Mitsubishi was a monopoly supplier to Hyundai. The two companies were competitors in the passenger car markets in the U.S. and elsewhere. Fast growing markets at home and abroad eventually enabled Hyundai to invest heavily in upgrading its technological capability to design and manufacturing engines at home.

These cases share two central characteristics: (i) the foreign firm is a

¹ Between 1971 and 1985, the import content of finished manufactures has risen dramatically in the U.S. (from 9 to 24 percent), Germany (from 16 to 26 percent), U.K. (from 12 to 29 percent), and France (from 17 to 27 percent). In Japan, by contrast, the analogous figure has increased only from 4 percent to 6 percent during the same period (OECD, 1987, Table S.1).
monopoly supplier of a key input (or has the prospect of becoming one); and (ii) it is a competitor downstream with the customer of the input. The policy questions are whether this harms domestic competitiveness, and if so, what the domestic government can do about it.

We provide in this paper a formal analysis of some of these issues in the context of international competition between two firms, one integrated and the other unintegrated. We assume that the integrated firm already produces the input, and that it is the sole foreign supplier. The domestic firm can also develop its own production capability for the input, but only after making a capital investment in the upstream technology. In such a setting, it is natural to think that the foreign firm can exercise Stackelberg-type leadership in the market for the intermediate input. In the competition that ensues, we examine a set of circumstances where the foreign firm will have an incentive to supply the input to its rival. Under a wide range of circumstances where upstream scale economies are important, it will charge a price for the input which is high enough to maximize its total profits, but low enough to deter upstream entry by the domestic firm. On the other hand if scale economies are not large enough, the import substitution of the intermediate input takes place as an equilibrium response to competition from its foreign rival in the final good market.

In their recent papers, Spencer and Jones (1991, 1992) consider strategic trade policies in a framework in which there already exists a competitive upstream industry (less efficient than its foreign rival) at home with an upward-sloping average (and marginal) cost curve for the input. Their model emphasizes the coexistence of imports with domestic production and does not question why such costly import substitution has taken place. In this paper we show that as the fixed entry cost increases, such an equilibrium becomes less likely and an entry-deterring equilibrium prevails. But if the fixed cost decreases, a new equilibrium with (partial) import substitution prevails. In the limiting case of no fixed costs in the domestic industry, our framework becomes identical to theirs and produces the same results. This way, the option to invest upstream makes our analysis more relevant to instances where the unintegrated home firm is the technological newcomer, and domestic production has the potential to, but does not yet, coexist with imports.

2 Domestic competition among companies with varying degrees of integration raises a number of anti-trust questions, and has mostly been addressed in that context. See for example Hart and Tirole (1989), and Ordover, Saloner, and Salop (1990); see also the related paper by Katz (1987) among others.
We show that even when import substitution is not triggered, still the potential for it acts as a restraint on the foreign firm. This has a subtle policy implication: as long as upstream scale economies are important, and the foreign firm remains the more efficient producer of the input, encouraging import substitution upstream is desirable, but (higher cost) import substitution itself is now. We show that an import tariff or a capital subsidy at an entry deterring equilibrium will be quite effective in shifting rents from the foreign firm to the domestic economy. But if it is large enough to spur the domestic firm to undertake the upstream investment, it may well defeat its purpose. The optimal levels of these policies generally fall short of the levels that would entail domestic production of the input. Hence, when scale economies are important, policy makers must walk a tightrope between free trade and too aggressive an industrial policy.

Our model focuses on the cases where there is a sole foreign supplier, as in the examples cited above. To be sure, in many standardized intermediate-goods industries, competition may prevail among different foreign suppliers, in which case some of our conclusion will need to be modified. But in these cases, however, a common perception is that they collude in their foreign activities.\(^3\) In effect the behaviour of leading U.S. firms is predicted on the presence of such collusion. IMB had been once actively shoring up segments of the U.S. semiconductor industry to ensure that it has sources of supply independent from Japanese firms, a strategy that makes sense only on the assumption that the latter would put up a unified front.

II. The Framework

There are two firms in the market, home and foreign, and the foreign firm is merged vertically with its upstream supplier. Let \(i = 1\) and 2 index the home and foreign firm, respectively. The two firms are assumed to share a common technology in producing a final homogeneous good for sale in a domestic market. The inverse demand function for the final good is given by \(p(x_1 + x_2)\), where \(x_i\) denotes the output of good 1 and \(p'(\cdot) < 0\), with \(2p'(\cdot) + p''(\cdot)x_i < 0\). We assume fixed-coefficients technology, and define units such that one unit of the intermediate good is needed to produce a unit of the final good.

The foreign firm produces the intermediate-good at a constant cost,

\(^3\) See Hart and Tyson (1989, p. 138) and Ferguson (1990, p. 64) for the implicit collusion among chip producers.
c. The home firm is the technological laggard in the intermediate-good market, and can produce that good only after a fixed amount of K is spent on research and development. We assume that its variable cost function \( h(x) \) is convex in \( x \). Unless the marginal cost \( h'(x) \) is constant and equal to \( v \) \((\geq c)\), we assume that there exists a unique scale of output \( x^* \), which minimizes average costs, \( AC(x) = \frac{K + h(x_i)}{x_i} \). When the marginal cost is constant, we simply let \( x^* = \infty \).\(^4\) When the foreign firm does not foreclose, the home firm can also choose to import the input at the price, \( w \) set by the foreign firm unless this decision harms its competitiveness in the final good market.

We conceptualize the interaction between the two firms as a two-stage game. In the first stage, the foreign firm sets \( w \), and in the second stage the two firms play Nash-Cournot in output. In the second stage, the home firm takes \( w \) as given and can import as much as it wants. But the foreign firm takes full account of the implication of its choice of \( w \) in the subsequent output game, and the equilibrium is subgame perfect.

The second-stage Cournot equilibrium can be characterized by the equilibrium output levels \( x_i(w, c) \) or \( x_i(c) \), \( i = 1, 2 \), depending on whether the home firm imports the input or develops it domestically. These output levels solve the following pair of first-order conditions:

\[
\begin{align*}
p'(x_1 + x_2)x_1 + [p(x_1 + x_2) - w] & = 0 \\
p'(x_1 + x_2)x_2 + [p(x_1 + x_2) - c] & = 0,
\end{align*}
\]

or, alternatively, when domestic inputs are used:

\[
\begin{align*}
p'(x_1 + x_2)x_1 + [p(x_1 + x_2) - h'(x_1)] & = 0 \\
p'(x_1 + x_2)x_2 + [p(x_1 + x_2) - c] & = 0
\end{align*}
\]

For the moment we assume that domestic production and imports do not co-exist. Although most of the equilibria we will look at will have the property that imports are the sole source of the input for the domestic sourcing, we will also examine later the other equilibria where domestic production co-exists with imports.

The corresponding profits in the final goods market are given by \( \pi_i(w, c) \) or \( \pi_i(h, K, c) \), \( i = 1, 2 \);

\(^4\) When the marginal cost is constant, these assumptions on the cost side are identical to those made by Katz (1987). Katz focuses on the incentives of an unintegrated upstream supplier to price discriminate between downstream producers which operate at different scale. The analysis is carried out in the domestic context.
\[ \pi_1(w,c) = [p(w,c) - w]x_1(w,c) \]
\[ \pi_2(w,c) = [p(w,c) - c]x_2(w,c) \]

Or,

\[ \pi_1(h,K,c) = p(c)x_1(c) - h(x_1(c)) - K \]
\[ \pi_2(h,c) = [p(c) - c]x_2(c) \]

where \( p(w,c) = p(x_1(w,c) + x_2(w,c)) \), and \( p(c) = p(x_1(c) - x_2(c)) \). The properties of such an equilibrium are well known (see for example Dixit, 1986), and will depend on whether outputs are strategic substitutes or complements (Bulow, Geanakoplos, and Klemperer, 1986). If the equilibrium is unique, the following comparative static results must hold:

\[ dx_1(w,c)/dw < 0, \]
\[ dx_2(w,c)/dw \begin{cases} > 0 & \text{if outputs are strategic substitutes to} \\ & \text{foreign firm,} \\ < 0 & \text{if outputs are strategic complements to} \\ & \text{foreign firm} \end{cases} \]
\[ dp(w,c)/dw > 0, \]

(6) \[ d\pi_1(w,c)/dw < 0, \text{ if outputs are strategic substitutes} \]
\[ d\pi_2(w,c)/dw > 0 \]

These follow from stated restrictions imposed on the cost and demand functions.

**A. Vertical Supply**

Now consider the first-period choice of the foreign firm. It has to decide whether to sell the input to its rival, and if it does, what price to charge. Assume for \( x_1 > 0 \), \( \inf AC(x_1) \geq c \). Then a necessary condition for the foreign firm to supply the home firm is that \( \pi_1(h,K,c) \geq 0 \). Since otherwise the foreign can monopolize the final-good market by refusing to supply the home firm with the intermediate input.

When \( \pi_1(h,K,c) \geq 0 \), on the other hand, the domestic firm cannot be deterred from entry in the final-good market. The foreign firm may then have the incentive to prevent the home firm from developing the domestic technology (i.e., deter upstream entry) by supplying the input
at an appropriate price. We now identify the conditions under which vertical supply and upstream entry deterrence will occur.

Suppose first that $h'(x_1) = v$. Then at the very least the foreign firm can charge $w = v$ to increase profits on account of intermediate-good sales.

Suppose next that $h''(x_1) > 0$, but $x_1(c) < x^*$ (see Figure 1). Let $w_0 = h'(x_1(c))$. If the home firm can import the input at $w_0$, its best response to the foreign firm's output, $x_2(c)$ remains at $x_1(c)$. This implies that $x_i(w_0, c) = x_i(c)$ for $i = 1, 2$ and $\pi_i(w_0, c) > \pi_i(h, K, c)$. Then by charging a slightly higher input price than $w_0$, the foreign firm can increase its market share of the final output, while adding more profits by exporting the input. This proves the following proposition.

**PROPOSITION 1:** Suppose $x_1(c) < x^*$. If $\inf AC(x_1) \geq c$, the condition $\pi_1(h, K, c) > 0$ becomes both necessary and sufficient for the existence of an equilibrium with trade in the intermediate input.\(^5\)

**B. Entry Deterrence with a Profit Squeeze on the Home Firm**

In fact, the foreign firm can do better than we just described. To see this, denote by $\bar{w}$ the maximal level of the input price that leaves the home firm indifferent between developing its own technology and importing it. For $x_1(c) = x^*$, this is defined implicitly by:

$$\bar{w} = \sup\{w | \pi_1(w, c) = \pi_1(h, K, C)\}.\(^6\)
$$

For a later reference we note that

$$\bar{w} > h'(x_1(c)) \tag{7}$$

Now if the home firm is offered the input at $\bar{w}$, its profits will be the same as those under vertical foreclosure. Denote in turn the foreign firm's optimal choice of input price by $w^*$. We will show that under plausible circumstances, $w^* = \bar{w}$.

\(^5\) Given the rising marginal cost, $x_1(c)$ is less than $x^*$ if and only if $K$ is greater than some critical value $K_c$. Note also that if $x_1(c) > x^*$, the foreign firm may refuse to supply the input even when $\pi_1(h, K, c) > 0$. For further details, see section (C).

\(^6\) $\bar{w}$ is well defined if we make the following assumption: for any $\epsilon > 0$, there exists $w(\epsilon)$ such that for all $w \geq w(\epsilon)$, $\pi_i(w, c) < \epsilon$. This assumption is satisfied whenever $p(0)$ is bounded. Note also that the potential learning effects that accrue from the development of domestic technology will be already taken into account in these profit functions, provided they are fully internal to the firm.
PROPOSITION 2: Assume that $x_1(c) < x^*$. When foreclosure is not optimal, the foreign firm will always select the limit price for the input, $\tilde{w}$, leaving the home firm indifferent between developing domestic technology and importing the input.

Proof: In the first stage of the game, the foreign firm selects $w^*$ to maximize its second-period profits (inclusive of rents on intermediate-good sales) subject to the constraint that the home firm continues to import the input. The associated Lagrangean expression is given by:

\begin{equation}
L = (w - c)x_1(w, c) + \pi_2(w, c) + \lambda[\pi_1(w, c) - \pi_1(h, K, c)]
\end{equation}

Suppose there exists an interior solution and $\lambda = 0$. Noting that $dp = p'(dx_1 + dx_2)$, and that $w - c = p'(x_1 - x_2)$ from the first-order conditions (1), we have

\begin{equation}
\frac{dL}{dw} = x_1[1 + p'dx_1/dw] > 0,
\end{equation}

which contradicts the necessary condition for an optimum.

The conclusion is that if scale economies in the upstream industry are large enough so that the Cournot output $x_1(c)$ lies below the most ef-

![Figure 1](image-url)
sufficient scale of output, the profits of the home firm will be squeezed all the way down to its reservation level: the level that would obtain in an equilibrium in which home-grown technology is used, \( \pi_1 (h, K, c) \). Even though this home technology is not utilized in equilibrium, it still exercises a determining influence on home profits. Note that our results hold true whether outputs are strategic substitutes or complements.

C. Entry Deterrence under Modest Scale Economies

Turn now to the case with more limited scale economies, where \( x^* \leq x_1(c) \). We will show that an entry-deterring equilibrium is still possible in this case, provided scale economies are not "too small." In this entry-deterring equilibrium, the foreign monopoly will charge the price \( \hat{w} = AC(x^*) \) to sell all the inputs the home firm needs at this price. We will see shortly that in this equilibrium both firms' profits become greater than at a no-trade equilibrium in which the home firm relies solely on its own technology. Domestic consumers also gain from the increased supply of the final goods at a lower price.

Figure 2 shows the case where \( x_1(c) \geq x^* \). Let \( w_f = h'(x_1(c)) \). Then for \( w \geq w_f \), there will be no trade in the input. For \( \hat{w} < w < w_f \), \( x_1(w, c) > w_1(c) \) because the home firm faces the marginal cost curve \( MC(x_1) = h'(x_1) \) for \( x_1 < h^{-1}(w) \), and \( MC(x_1) = w \) for \( x_1 > h^{-1}(w) \). Home production of inputs is \( x_D(w) = h^{-1}(w) \), and the quantity of imports is \( x_M = x_1 - x_D(w) \).

Now define the profit function of the two firms:

\[
\Pi_2(w, c) = (w - c)x_M(w) + \pi_2(w, c), \quad \text{and} \\
\Pi_1(w, c) = \pi_1(w, c) + \int_0^x D(x)(w - h'(x))dx - K.
\]

Note that home profits differ from that expressed in (3) and (4) since we allow explicitly for the possibility that domestic production may co-exist with imports. We first show that there is a presumption that home profits decline as \( w \) increases. We notice that

\[
d\Pi_1(w, c)/dw = x_1\pi_p'[dx_2/dw] - (x_1(w, c) - x_D(w)) \\
= -p[s_1/\varepsilon_p][dx_2/dw] - x_M(w)
\]

where \( s_1 \) is the home firm's market share and \( \varepsilon_p \) is the price elasticity of final good demand. If the foreign firm regards output as strategic substitutes, then \( dx_2/dw > 0 \), and consequently \( d\Pi_1(w, c)/dw < 0 \). On the other, if outputs are viewed as strategic complements, we have \( dx_2/dw < 0 \). But if \( s_1 \) is small, \( \Pi_1(w, c) \) can still be decreasing in \( w \).
The foreign firm chooses $w$ as follows:

$$\max_{w \leq w_f} \Pi_2(w, c) \text{ subject to } \Pi_1(w, c) \geq \pi_1(h, K, c)$$

Consider now how foreign profits change with $w$:

$$d\Pi_2(w, c)/dw = d[(w - c)x_1 + \pi_2(w, c) - (w - c)x_D(w)]/dw = x_1[1 + p'(dx_1/dw)] - x_D[(1 - (c/w))\beta_w + 1]$$

where $\beta_w$ denotes the elasticity of home production of the input with respect to $w$. It will increase as the marginal cost curve becomes flat (or the production technology becomes more flexible). Although the sign $d\Pi_2(w, c)/dw$ is in general ambiguous, a few qualitative features can be examined.

As $w$ approaches $\hat{w}$ from above, $\Pi_2(w, c)$ varies continuously. But at $w = \hat{w}$, $x_D(w)$ drops to zero and $\Pi_2(w, c)$ jumps up by $x^*(\hat{w} - c)$. Below $\hat{w}$, $\Pi_2(w, c)$ decreases again continuously. Suppose outputs are strategic substitutes. Then since $d\Pi_1/dw < 0$, $\Pi_1(\hat{w}, c)$ for all $w > \hat{w}$. By definition $h'(x_1(c)) = w_f > \hat{w}$. It follows that $\Pi_1(\hat{w}, c) > \pi_1(h, K, c)$. We have the following proposition.

PROPOSITION 3: Suppose the foreign firm regards outputs as strategic
substitutes. Then given $x^*$, $\bar{w}$, and $c$, we can find $\delta(x^*, \bar{w}, c) > 0$, such that if $x^* - x_1(c) < x^* + \delta$, the foreign firm sets the input price $w^*$ at the entry deterring level $\bar{w}$.

Proof: We have already shown that $\bar{w}$ satisfies the constraint that the home firm's profit must be at least as high as the reservation level $\pi_1(h, K, c)$. Now define $\lim_{w \to \bar{w}^+} \Pi_2(w, c) = \pi_2(\bar{w}, c)$ and $\lim_{w \to \bar{w}^+} \Pi_2(w, c) = \pi_2(\bar{w}, c) + x^*(\bar{w} - c)$. Then by continuity of $\Pi_2(w, c)$ in $w$ for $w > \bar{w}$, there exists $\epsilon > 0$ such that if $\bar{w} - \epsilon < w \leq \bar{w}$, $|\Pi_2(w, c) - \pi_2(\bar{w}, c)| < (\bar{w}, c)x^*$. Let $\delta = \{\sup_{\bar{w} - \epsilon < w \leq \bar{w}} h'^{-1}(w)\} - x^*$. The proposition is then proved.

We notice that $\delta$ is greater the larger is the efficient scale of output, $x^*$, and the flatter is the marginal cost curve. Also $\delta$ is increasing in the gap between the minimum average cost of the home firm, $\bar{w} = AC(x^*)$, and the foreign average cost, $c$. At this entry-deterring equilibrium, each firm's profit is greater than at no-trade (vertical foreclosure) equilibrium. Since $p(\bar{w}, c) < p(c)$, consumer surplus is higher also.

But if $x_1(c)$ lies beyond $x^* + \delta(x^*, \bar{w}, c)$, we cannot guarantee that an efficient entry-deterring equilibrium prevails. In fact we cannot exclude an interior maximum $w^*$ such that $w^* > \bar{w}$, and

$$d\Pi_2(w, c)/dw|_{w = w^*} = 0, \text{ with } \Pi_1(w^*, c) \geq \pi_1(h, K, c).$$

If $w^* \geq w_f$, no imports take place. This corresponds to the case where even if $\pi_1(h, K, c) > 0$, no vertical supply is assured. But if $w^* < w_f$, the home firm uses inputs produced both at home and abroad and earn more profits than when relying only on the domestically produced inputs.\(^7\)

### III. The Role for Home-Country Policy

We now consider the role that government policy in the home country can play in improving domestic welfare. In keeping with usual practice, we take the government to set its policies before either of the two firms act. We limit the analysis to situations where the foreign firm cannot

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\(^7\) In their work Spencer and Jones (1991, 1992) assumed that $K = 0$. Therefore the minimum efficient scale of output, $x^*$, is zero, and $\delta(0, w, c) = 0$. Let $p_m$ denote the final good price when the foreign firm monopolizes the entire home market. Then if $p_m < h'^{-1}(0)$, the foreign firm will foreclose the input market. But other than that both firms compete in the final good market, and in most cases inefficient domestic production co-exists with imports in the upstream industry.
monopolize the market for the final good, so chooses not to withhold supplies of the input. The monopoly case does not add any original insights.  

From the perspective of home welfare, a first-best policy packages needs to do two things: (a) close the gap between price and marginal cost, \( c \), in the final-good market; (b) shift rents accruing to the foreign firm (both upstream and downstream). Although the first of these could be achieved via a production subsidy, and the second by a profit tax (or a lump-sum fee), neither of these is practical in oligopoly model. We will focus instead on two alternatives which serve the purpose with varying degrees of efficiency: an import tariff on the imported input and an investment subsidy to the domestic firm. We will also briefly consider the effects of an import tariff on the final good.

A. A Tariff on the Intermediate Input

In perfectly competitive markets, a tariff on the input would simply cripple the ability of the home firm(s) to compete with foreign rivals. In the present context this intuition turns out to be incorrect. The reason is that it does not take into account the response of the foreign firm to the imposition of the tariff.

Let the specific tariff on the input be denoted by \( \tau \). Assume for the moment that the input continues to be traded, while \( x_1(c) < x^* \) so that we are in the limit-pricing equilibrium. Then, a simple calculation shows that the analogue of expression (9) when \( \lambda = 0 \) is:

\[
(9') \quad dL/dw = x_1[1 + p' dx_1/dw] - \tau dx_1/dw > 0,
\]

The new term at the end shows that the input tariff creates an additional reason for the foreign firm to select a corner solution for \( w^* \). It implies:

\[
(13) \quad \pi_1(w^* + \tau, c) = \pi_1(h, K, c)
\]

It follows immediately that \( dw^*/d\tau = -1 \), and the tariff-inclusive price of the input stays constant at \( \bar{w} \). Note the implication that a subsidy on imports of the input will amount to a pure transfer from the domestic treasury to the foreign firm.

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Now at what point does the tariff become so onerous that the foreign firm stops supplying the home firm? At first sight, it might seem that the switch-over comes at the point where the foreign firm starts making losses on its sales of the input, i.e. when \( w = c \). But that is not quite correct. The foreign firm will generally prefer making some losses on input sales to having the home firm develop its own technology. This result holds whenever \( K \) is strictly positive, that is whenever a fixed cost of product development is required. From (7), we know that the tariff-inclusive price of the imported input is larger than what the marginal cost of domestic technology would have been under vertical foreclosure. Since the output level of the home firm is determined by its marginal, rather than average, costs,\(^9\) this renders it a less aggressive competitor vis-a-vis the foreign firm compared to the case where it uses its own input. Therefore, over a certain range, the foreign firm may prefer to supply the input below cost to ensure that the home firm is restrained by its higher marginal cost. Define \( \tau^c \) as the critical level of the input tariff at which the foreign firm stops supplying the input. We have

\[
(\tilde{w} - \tau^c - c)x_1(\tilde{w}, c) + \pi_2(\tilde{w}, c) = \pi_2(h, c)
\]

Since \( \pi_2(\tilde{w}, c) > \pi_2(h, c) \) whenever \( K > 0 \), and \( x_1(c) < x^* \), it must be the case that \( \tau^c > \tilde{w} - c \). We do not have the following proposition.

**PROPOSITION 4:** Suppose \( x_1(c) < x^* \). Then the critical level \( \tau^c \) is greater than \( \tilde{w} - c \). As long as the input tariff \( \tau \) is less than \( \tau^c \), the tariff burden is borne in its entirety by the foreign firm, and the equilibrium in the final market is unaffected.

The input tariff acts as a pure profit-shifting device. This implies that a tariff on the intermediate input can be welfare improving.\(^10\)

Consider now an entry-deterring equilibrium with \( w^* = \tilde{w}(= AC(x^*)) \). It is obvious that a small tariff \( \tau \) will again be entirely borne by the foreign monopolist. If the latter determines \( w^*(\tau) \) above \( \tilde{w} - \tau \), it loses profits of \( (\tilde{w} - c - \tau)x^* \) from foregone sales of inputs. The range \( (x^*, x^* + \delta(\tilde{w}, x^*, c, \tau)) \) of no trade output, \( x_1(c) \), within which an entry-deterring equilibrium prevails (Proposition 3) now shrinks, as \( d\delta/d\tau < 0 \). The following proposition summarizes the results in this case.

**PROPOSITION 5:** Under the stated assumptions of Proposition 3, a

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\(^9\) Provided, of course, that it does not enter the market. Notice that our argument here does not depend upon strategic substitutability.

\(^10\) For more details on the optimal tariff, and some issues related to price competition with differentiated products, see Rodrik and Yoon (1989).
small tariff on the input will be borne fully by the foreign firm. The optimum tariff \( \tau^* \) is the maximum possible level of the tariff consistent with imports of \( x^* \) units.

Proof: The first part is straightforward. The second part follows from the fact that as \( w^*(\tau) \) increases above \( \hat{w} - \tau \), firms' profits and consumer surplus both decrease. In addition, tariff revenue falls discontinuously by \( \tau x^* \).

To conclude our analysis of the input tariff, consider finally the case where neither the limit pricing nor the entry-deterring equilibrium of Proposition 3 holds. In this case an interior solution for \( w^0 = w^*(\tau) + \tau \) will result whenever

\[
\frac{d\Pi_2(w, c)}{dw} - \tau \frac{dx_M(w)}{dw} = 0
\]

for some \( \hat{w} < w^0 < w_F \). It can be checked that when this is the case, \( 1 > \frac{d(w^* + \tau)}{d\tau} > 0 \) so that some of the tariff will now be borne by the home firm. This reduces the benefits of an input tariff, but leaves a small enough tariff still superior to free trade. The problem becomes the familiar one of designing optimal trade policy when facing a foreign monopolist (e.g. Brander and Spencer, 1981).

\[B. \ A \ Capital \ Subsidy\]

While the input tariff is a useful profit-shifting device, it has one shortcoming: In a limit-pricing equilibrium, domestic consumers get no benefit from it as long as it is not set at a prohibitive level (\( \tau > \tau^* \)). We now consider a direct subsidy to cover the home firm's fixed (product development) costs, \( K \), when \( h'(x_I) = v \geq c \). To anticipate the results, we will show that the optimal subsidy exceeds total fixed costs, and, moreover, that it will never have to be disbursed in equilibrium. The right way to think of the subsidy policy, then, is as a credible commitment on the part of the government to provide the subsidy if the home firm chooses to develop home technology. This policy is less effective than the input tariff in transferring rents from the foreign firm, but is better for domestic consumers of the final good.

As in the previous section, we first derive the foreign firm's optimal response to the capital subsidy. Let \( S \) denote the subsidy, and \( S^c \) the critical level of the subsidy at which the foreign firm will start withholding supplies of the input. Since the capital subsidy affects only the constraint in the Lagrangean expression (8), \( w^* \) will remain at a corner as long as the input continues to be traded. The reservation level of
home-firm profits continue to act as a binding constraint. Define

$$\bar{w}(S) = \text{Sup}\{w | \pi_1(w, c) = \pi_1(h, K - S, c)\}$$

This defines a decreasing function $\bar{w} = \bar{w}(S)$. Since the constraint always binds when the input is exported, this also defines the optimal input price $w^* = \bar{w}(S)$, for $S < S^c$. The interpretation is that, in the presence of the subsidy, the foreign firm has to reduce the input price to prevent the home firm from switching over to the domestic technology. Notice that an increase in the subsidy increases home profits one-for-one via the effects on $w^*$, even though the subsidy will not be disbursed as long as the input continues to be imported. We note also that as long as $S < S^c$, the subsidy is unambiguously welfare improving: home profits rise; consumers benefit from the induced reduction in prices as $w$ is reduced; and the government does not have to spend a penny.

**PROPOSITION 6:** Assume $h'(x_i) = v > c$. Let $S^*$ denote the optimal level of the capital subsidy. (a) $S^* = S^c$ (minus epsilon) $\geq K$. (b) $w^* = \bar{w}(S^*) \geq c$.

The proposition states that (a) the optimal subsidy will more than cover the home firm's fixed costs, and (b) the foreign firm will continue to earn rents on input sales even when $S$ is set optimally.

To understand the first part of the proposition, consider the foreign firm's profits when $S = K$. From (16), $\bar{w}(K) \geq v > c$. Therefore when the home government finances the fixed cost in its entirety, the foreign firm earns at least $(v - c)$ on its input sales, while the profits in the output game are at least as great as those that would be obtained with foreclosure. The profits made on the final good must fall sufficiently for the foreign firm to forsake the rents on the input. Formally, $S^c$ is defined implicitly by the relationship that equates total profits with foreclosure to those without:

$$\pi_2(v, c) = [\bar{w}(S^c) - c]x_1(\bar{w}(S^c), c) + \pi_2(\bar{w}(S^c), c)$$

At $S = K$, $[\bar{w}(K) - c] > [v - c] \geq 0$ and $\pi_2(v, c) \leq \pi_2(\bar{w}(K), c)$. Assume that $v$ is strictly greater than $c$, which leaves the right-hand side larger than the left-hand side. Notice that the left-hand side is invariant to $S^c$, while $S^c$ affects the right-hand side only through $\bar{w}$. Further, we know from (9) that the right-hand side is increasing in $w$. Therefore to establish the equality in (17), $S^c$ must be larger than $K$. Moreover, when $S > K$, $v > \bar{w}(S)$ and therefore $\pi_2(v, c) > \pi_2(\bar{w}(S^c), c)$. This implies, in turn, that $[\bar{w}(S^c) - c] > 0$. In other words, the foreign firm will stop supplying the
input at a point where it still earns rents in the input market.

Would the government ever want to increase $S$ beyond $S^c$? The answer is no. The optimal policy is to set $S^*$ at slightly below $S^c$, so as not to induce vertical foreclosure and import substitution. Past $S^c$, two undesirable things happen. First, there is a one-time, discrete increase in the final-good price as the home firm’s marginal cost switches from $\bar{w}(S^0)$ to the larger $v$, which affects domestic consumers negatively. Secondly, the home government has to disburse the subsidy, the increase in home profits now coming at the expense of the treasury rather than the foreign firm. As the input is no longer imported — (16) no longer holds — the equilibrium in the final-good market remains unchanged with further increase in $S$. Once there is a switch to the home technology, then, the domestic economy experiences a consumer surplus loss plus a loss of $S^c$.

The strong results stated in Proposition 6 were obtained for the case where the home firm’s marginal cost is constant ($h'(x_t) = v$) and higher than the foreign firm’s ($v \geq c$). Now consider briefly the effects of a capital subsidy when $h''(x_t) > 0$ and $x_t(c) < x^*$. In this case, an undisbursed capital subsidy is still beneficial, but there is no guarantee that the level of such a subsidy will exceed $K$.

To see this, define $x^*(S)$ as that level of output which minimizes $[K - S + h(x)]/x$ for $S \leq K$. Then $x^*(S)$ will be decreasing in $S$. As long as $x_t(c) < x^*(S)$, limit-pricing continues to hold, and $w^*(S) = \bar{w}(S)$. Since $\pi_1(\bar{w}(S), c) = \pi_1(h, K - S, c)$, the home firm’s profit increase via a decrease in $\bar{w}(S)$. At some $S^0 < K$, we have $x^*(S^0) = x_t(c)$. Define also

$$\hat{w}(S) = [K - S + h(x^*(S))]/x^*(S)$$

As $S$ increases beyond $S^0$, $x^*(S)$ decreases (see Figure 3). But as long as $x_t(c)$ remains in the interval $[x^*(S), x^*(S) + \delta(x^*(S), \bar{w}(S), c)]$, we still have $w^*(S) = \hat{w}(S)$ for $S \geq S^0$. Therefore the home firm’s profits and consumer surplus continue to increase. But since $x^*(S)$ and $\hat{w}(S)$ are decreasing in $S$, $\delta$ shrinks as $S$ increases. Before $S$ reaches $K$, it could well be that the capital subsidy induces import substitution and the subsidy has to be paid. The welfare consequences of this further increase are ambiguous.

**C. A Tariff on the Final Good**

We finally consider a tariff, $t$, imposed on imports of the final good, as this is a common prescription for strategic purposes. Unless
Figure 3

\[ h'(x_i) = v, \text{ define } t_E \text{ as } x_i(c + t_E) = x^* \text{ when } x_i(c) < x^*. \text{ If } h'(x_i) = v, \text{ simply let } t_E = \infty. \text{ We first examine the effects of a tariff that is smaller than } t_E. \]

For reasons analogous to those given for Proposition 4, the foreign firm will continue to supply the input past the point where \( w \) just covers \( c \), provided \( K > 0 \). Denote by \( w_{min} \) the lowest \( w \) that the foreign firm is willing to charge before it gives up supplying the input altogether. Notice also that the tariff is formally identical to an increase in the marginal costs of the foreign firm from \( c \) to \( c + t \). Then the analogue of (9) when \( \lambda = 0 \) becomes:

\[ (9') \quad dL/dw = x_i[1 + p'dx_i/dw] + tdx_i/dw \]

Notice that since the last term is now negative, it is conceivable that we may have an equilibrium where the constraint does not bind and where (9") is set equal to zero. Denote by \( \tilde{t} \) the level of tariff, when such exists, at which (9") just becomes zero. Now there are two regions to be analyzed:

(a) \( t \leq \tilde{t} \). The response of \( w \) to changes in \( t \) is now determined exclusively by the binding constraint \( \pi_1(w, c+t) = \pi_1(h, K, c+t) \). Let the
maximum level of w that maintains this equality be defined by \( \bar{w} = \tilde{w}(t) \). Since \( \bar{w} > h'(x(c+t)) \), there is a presumption that, with w kept unchanged, the tariff increases the level of profits with vertical supply by a lower absolute amount than the reservation level of profits. This is because if the home firm relies on the imported inputs, its output level becomes less than when those inputs are domestically produced. The general expression for the response of profits to the increase in tariffs (holding w constant) is given by

\[
d\pi_1/dt = \pi_1 p'(dx_2/dt),
\]

which, in the linear demand case for example, is simply proportional to \( x_1 \) as \( p' \) and \( dx_2/dt \) are then both constant. The implication is that \( dw^*/dt = d\bar{w}/dt < 0 \): the foreign firm has to lower its input price to offset the differential gain in profitability in favor of the domestic technology. The tariff not only shifts profits to the home firm by increasing the cost of the foreign firm in servicing the home market (as in the well-known Brander and Spencer (1984) model), but reduces the import cost of the home firm.

(b) \( t > \tilde{t} \). In this region, the constraint no longer binds and the response of \( w^* \) to \( t \) is determined by setting the first-order condition (9") equal to zero. Note that, when \( t \) first crosses into this region, there is a discrete fall in \( w \), corresponding to this different condition. The comparative-statics of (9") then determines the response of \( w \) to further increase in \( t \). In this region \( dw^*/dt \) cannot be signed in general. Increases and decreases are both possible within the bounds set by \( \bar{w}(t) \) and \( w_{min} \). But something more specific can be said in the case of linear demand function \( x_1 + x_2 = A - Bp \). Here \( dw^*/dt < 0 \) if and only if \( (B^4 - 6) > 0 \).

(c) \( t \geq t_E \). Assume now that \( t \geq t_E \) is possible (when \( h''(x_1) > 0 \). Note that at \( t = t_E \), we have \( w^*(t_E) = \bar{w} = [K + h(x^*)]/x^* \). It follows that when outputs are strategic substitutes, \( w^*(t) = \bar{w} \) for \( t \geq t_E \) if \( x^* \leq x_1(c+t) < x^* + \delta(x^*, \bar{w}, c) \) (cf. Proposition 3). But by imposing a sufficiently large tariff beyond this range, the government can induce import substitution of the intermediate input.

We note that without more specific parameters on the demand and cost side, it is not possible to determine whether \( t^* \) will lie below \( \tilde{t} \) or above it. However, there is a presumption that input-cost effect strengthens the case for the tariff compared to the situation where the two firms do not interact in the market for the intermediate good.
IV. Concluding Remarks

The framework used here demonstrates that there is a case for policy intervention when a home firm purchases intermediate inputs from its oligopolistic rival from abroad. Under a wide range of circumstances where the scale economies are important, the foreign firm will charge a price for the input low enough to leave the latter indifferent between importing it and manufacturing it locally. As is usual in models of oligopoly, there is no single optimal policy for the home government. An import tariff on the intermediate input and a capital subsidy for upstream investment are both beneficial, but they cannot be ranked unambiguously against each other: the tariff is the better instrument for extracting rents from the foreign firm, but the capital subsidy is preferable for domestic consumers.

On the other hand when the demand for the final output is sufficiently large, the domestic production coexists with imports at an equilibrium. As examined by Spencer and Jones (1992), the case for import substitution has drastic consequences for the welfare effects of strategic trade policies. Even a subsidy on the imported input could be optimal if the foreign monopoly refrains from supplying the input to the home firm.

These results show that the appropriate response to the exercise of upstream market power by foreign firms depends upon the extent of the scale economy. If the scale economy is important, squeezing foreign firms to yield some of their rents to the domestic economy is better than driving the home firms to invest in higher-cost domestic industries for intermediate inputs. Of course, the policies needed to do so, and in particular the capital subsidy, may not be easy to institute and calibrate appropriately. But we showed that rent-transferring policies will in general be more efficient than inducing wasteful import substitution.

We conclude our paper by noting that the analysis of paper applies well to cases where the home firm competes in the intermediate-good market instead, with the downstream monopolized by the rival. While the final-good tariff does not have a direct analogue, the two other policies considered above do: the input tariff can now be thought of as an export tax for the intermediate, and the capital subsidy becomes a subsidy to cover downstream investment costs.


