RULES OF ORIGIN AS A STRATEGIC POLICY TOWARDS MULTINATIONAL FIRMS

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Abstract

This paper investigates how rules of origin imposed on a vertically integrated multinational firm's subsidiary affect output and welfare under a Cournot competition. Two types of rules are investigated: one requiring the multinational firm's subsidiary a minimum ratio of expenditures on its domestic intermediate inputs to those on its total intermediate inputs, and the other requiring a minimum ratio of the subsidiary's expenditures on domestic components to its total revenue. It is shown that both types of rules lead the multinational firm to shift their component factories from the source country to the host country. However, they may have the opposite effects on output of the final good. Furthermore, when the domestic firm has higher marginal cost than the multinational firm's subsidiary, the second type of rule of origin can increase both domestic and foreign welfare.

I. Introduction

In addition to determining the nationality of products traded in international commerce, rules of origin are frequently used to achieve trade policy objectives. When foreign producers increase the market share of domestic producers, the domestic government may impose a rule of origin to give advantage to the domestic indigenous firms and protect domestic producers.

To illustrate the point, in 1988 the French government suddenly announced a rule of origin such that at least 80 percent of the total cost of Japanese automobiles built in the United Kingdom must be of locally originated components to qualify as "European" cars. Thus, France counted the Japanese automobiles imported from the UK toward the three percent quota on Japanese cars. Consequently, this regulation protected French automobile producers from the expansion of market share by the Japanese automobile makers[1]. This is an example of a strategic industrial policy directed towards multinational enterprises. We investigate how a rule of origin affects strategic conditions for the host and source country's producers.

Davidson et al. (1987) studied a duopoly situation between a domestic firm and a foreign firm in the final goods market. They show that a preferential rule of origin such as a local content requirement with the penalty tariff reduces output of the foreign firm and increases output of the domestic firm, thereby making the domestic firm better off. However, they assume that marginal cost is fixed for both producers and they do not consider any effects of preferential rules of origin on the demand for the intermediate goods.

In order to consider the effects of the preferential rules of origin as a strategic policy on the demand for intermediate goods, we employ a "multistage production model" in which production is thought of as a successive processing sequence where components are combined until a final good is produced. Dixit and Grossman (1982) introduced this model in a competitive environment. They showed that a content requirement as a rule of origin expands the number of stages per unit of final output in the home country but at the same time leads to a decline in the number of units produced. Hollander (1987) investigated the case where a final good supplier is a foreign monopolist. He shows that it is possible for a preferential rules of origin to increase the range of intermediate goods as well as the quantity of the final good produced in a monopoly setting. James and Umemoto (2000) also employed an extended version of this model to assess trade diversion effects of the North American Free Trade Agreement (NAFTA) under a three-country setting. It explains how rules of origin on textile and apparel industries lead welfare to worsen and supports the results by some of the earlier theoretical literatures such as Krishna and Kruger (1995) and Kruger (1995, 1996).

We consider the multistage production model in a Cournot competition environment between a domestic indigenous firm and a multinational firm's subsidiary. We investigate the effects of two types of rules of origin. The content requirement as rules of origin is usually specified in value-added terms and their requirement can take two forms. The first requires that a certain minimum spending on domestic components must be embodied in the total cost of production to confer domestic origin. For example, the NAFTA for automobiles used to

[1] Mason and Turay (1994) provide the detail story.

require that 62.5 percent of the total cost of locally manufactured cars in the North American countries (Canada, the United States, and Mexico) must consist of local intermediate parts. The second requires that a certain minimum expenditure on domestic components must be embodied in the total revenue of the products in order to be recognized as domestic products. For example, a minimum of 85 percent of the wholesale value of domestically manufactured cars in Australia must be of domestic materials and labors[2]. We investigate the effects of these two forms of rules of origin.

The remainder of this paper is organized as follows. In the next section, we develop a multistage production model for a duopoly environment and derive the Cournot-Nash equilibrium. In the third section, we evaluate the effects of the cost-based rule of origin on the range of production processes and output of the multinational firm in the host country. In the fourth section, we assess the effects of an alternative revenue-based rule of origin. Welfare issues are addressed in the fifth section, and conclusions are presented in the final section..

II. The Model

We consider a two-country world: the source country, where foreign direct investment (FDI) originates, and the host country, where FDI occurs. Each country has one domestic firm producing a commodity X using constant returns to scale technology. The source country's firm, that is, multinational firm is a monopolist in its own country but also sells goods in the host country, where it competes with the host country's firm.

We assume that each firm is vertically integrated and operates a sequence of production stages where components are produced and combined until a final commodity is produced. Each stage or component is available in both countries. In reality, domestic firms like the U.S. automotive industry typically use a much higher ratio of domestic to imported components than foreign assemblers in the domestic country. Therefore, we assume that each firm produces the commodity for consumers in its own country by producing components in its own country. However, the source country's firm can shift production processes across

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[2] Vermulst et al. (1994) provides information of how the value of labor and materials of goods is calculated in Australia.

two countries to sell the commodity in the host country. Thus, some stages of the production are carried out by the multinational firm's subsidiary in the host country.

How does the multinational firm choose the production stages that are carried out by the subsidiary in the host country rather than import the components from the source country? Let us index each stage of production (or the component that is produced at a production stage) by a variable k belonging to a continuum [0,1]; $k \in [0,1]$. The unit production cost at the stage k (or the unit cost of component k) in the host and source countries is denoted by $w[k]$ and $w^*[k]$, respectively.

We assume that the firm selects the location of k depending on which of the two locations is cheaper. Consequently, the overall unit cost is

$$\int_0^1 \min\left(w[s], w^*[s]\right) ds \,. \tag{1}$$

For simplicity we index the components in such a way that $\frac{w[k]}{w^*[k]}$ is increasing and continuous so that components with a lower k are relatively more cost-efficient to produce in the host country. Moreover, we assume that $w[0] < w^*[0]$ and $w[1] > w^*[1]$, which rules out the trivial case where one country is a cheaper location for all components. Figure 1 shows the relative unit cost function, $\frac{w[k]}{w^*[k]}$.

Under these assumptions there exists a $k^0 \in [0,1]$ such that $w[k^0] = w^*[k^0]$. The multinational firm can minimizes the unit cost of production by choosing the indexes such that all components with indexes below k^0 are produced in the host country, while those with indexes above k^0 are produced in the source country. Let $W\left[k^0\right] = \int_0^{k^0} w[s] ds$ be the portion of unit costs attributable to host-country products and $W^*\left[k^0\right] = \int_{k^0}^1 w^*[s] ds$ be the portion that is attributable to source-country products. Then the unit cost of production is $W[k^0] + W^*[k^0]$.

A representative consumer in the host country has a utility function:

$$U = u\left[X + X^*\right] + Y, \tag{2}$$

where X is the quantity consumed of the commodity produced by the indigenous firm and X^* is produced by the multinational firm. Y is consumption of a numeraire good that is assumed to be competitively supplied. The inverse demand is given by

$$P[X + X^*] \equiv u'[X + X^*].$$

We assume that demand is linear and downward sloping, so that $P' \equiv u'' < 0$ and $P'' \equiv u''' = 0$. Denote the inverse demand function as

$$P = -a[X + X^*] + b \tag{3}$$

where a and b are positive constants.

To determine the Cournot-Nash equilibrium outputs of the firms, we assume that the multinational firm perceives each country as a separate market in making its quantity decisions. That means there is no trade of the final products between the two countries. Therefore, we focus on the market in the host country. The profits of the indigenous firm and multinational firm in the host country are respectively

$$\Pi = \left(P\left[X + X^*\right] - \overline{W}\right)X \tag{4}$$

and

$$\Pi^* = \left(P\left[X + X^*\right] - W\left[k\right] - W^*\left[k\right]\right)X^*. \tag{5}$$

Each firm maximizes its own profit by choosing output considering the competitor's output as given.

The indigenous firm has a constant marginal cost $\overline{W}$, which is total sum of the cost at each production stage in the host country. Profits are maximized when the marginal revenue equals to the marginal cost. Therefore, the profit-maximizing condition for the indigenous firm is

$$P[X + \overline{X}^*] + P'[X + \overline{X}^*]X = \overline{W}; \tag{6}$$

i.e.,

$$-a\left(2X+\overline{X}^*\right)+b=\overline{W}\ . \tag{6'}$$

Thus, the reaction function of the indigenous firm is given by

$$X=h[X^*]=-\frac{1}{2}X^*+\frac{b-\overline{W}}{2a}\,. \tag{7}$$

The profit-maximizing condition for the multinational firm is

$$P[\overline{X}+X^*]+P'[\overline{X}+X^*]X^*=W[k^0]+W^*[k^0]\,; \tag{8}$$

i.e.,

$$-a\left(\overline{X}+2X^*\right)+b=W[k^0]+W^*[k^0]\,. \tag{8'}$$

The reaction function of the foreign firm is given by

$$X^*=h[X]=-\frac{1}{2}X+\frac{b-\left(W[k^0]+W^*[k^0]\right)}{2a}\,.$$

The equilibrium output for each firm is found where the two reaction functions intersect. We obtain

$$\left(X^0,X^{*0}\right)=\left(\frac{b+\left(W[k^0]+W^*[k^0]\right)-2\overline{W}}{3a},\frac{b+\overline{W}-2\left(W[k^0]+W^*[k^0]\right)}{3a}\right) \tag{9}$$

as the equilibrium output. The equilibrium price, which is determined by the inverse demand function, can be written as

$$P^0=\frac{1}{3}\left\{b+\overline{W}+\left(W[k^0]+W^*[k^0]\right)\right\}. \tag{10}$$

In the next two sections, we consider the case where the domestic government imposes a rule of origin for favoring the indigenous producer. We attempt to investigate the effects of the two types of rules of origin under the Cournot competitive environment.

III. The Cost-Based Rule of Origin

In this section we consider the effects of one type of rule of origin. A *cost-based rule of origin* requires that the value of domestic components must be greater than or equal to a given proportion γ of total cost for components to gain recognition as a product of domestic origin. The cost-based rule of origin is represented as $W[k]X^* \geq \gamma(W[k]+W^*[k])X^*$, or $W[k] \geq \gamma(W[k]+W^*[k])$. We assume that it will be a constraint only for the source country's producer in the host country.

Marginal cost

The multinational firm will determine the level of k that minimizes its production cost subject to the rule of origin. When $\gamma > \dfrac{W[k^0]}{W[k^0]+W^*[k^0]}$, the required ratio of domestic components is greater than the initial fraction of the cost of production stages in the host country to the total unit production cost. Under this situation, the rule of origin would affect the situation of this Cournot competitive environment. In response to the rule of origin, the foreign firm will select k^C for which the constraint is just satisfied; i.e., $W[k^C] = \gamma(W[k^C]+W^*[k^C])$ or $W[k^C] = \dfrac{\gamma}{1-\gamma}W^*[k^C]$. Since the multinational firm has to shift more production stages into the host country in order to satisfy this condition, $k^C > k^0$. The production stages $k \in (k^0, k^C]$, which had been carried out at a cost of $w^*[k]$ in the source country, now take place in the host country at a cost of $w[k] > w^*[k]$. Therefore, the unit cost $W[k^C]+W^*[k^C]$ under the cost-based rule of origin is greater than the initial unconstrained unit cost.

In order to see the relationship between the rule of origin and the cutoff level k^C, we take a total derivative of the origin rule constraint:

$$w[k^C]dk = (W[k^C]+W^*[k^C])d\gamma + \gamma(w[k^C]-w^*[k^C])dk\,. \tag{11}$$

Therefore,

$$\frac{dk^C}{d\gamma} = \frac{W[k^C]+W^*[k^C]}{(1-\gamma)w[k^C]+\gamma w^*[k^C]} > 0. \tag{12}$$

This result means that more restrictive rule of origin increases the value of k^C and expands the production stages in the host country, thereby leading to the following proposition.

Proposition 1: *A cost-based rule of origin promotes more foreign direct investment and expands the range of production processes for the multinational firm in the host country.*

Effects on the reaction functions and output

How does the cost-based rule of origin affect the output of the commodity? First, we analyze the effect on the reaction function of each firm. The rule of origin does not affect the decision of the indigenous firm because it is not subject to the rule. Therefore, the reaction function of the indigenous firm does not change.

However, the rule of origin leads to an increase in the marginal cost of the multinational firm. The profit-maximization condition for the foreign firm is $MR^* = W[k^C] + W^*[k^C]$. Thus, the new reaction function for foreign firm under cost-based rule of origin is

$$X^* = h^{*C}[X] = -\frac{1}{2}X + \frac{b - \left(W[k^C] + W^*[k^C]\right)}{2}. \tag{13}$$

Taking the derivative of the profit-maximization condition with respect to the requirement ratio gives

$$MR^{*\prime} \frac{dX^{*C}}{d\gamma} = \left(w[k^C] - w^*[k^C]\right)\frac{dk^C}{d\gamma}. \tag{14}$$

Hence,

$$\frac{dX^{*C}}{d\gamma} = \frac{\left(w[k^C] - w^*[k^C]\right)\left(W[k^C] + W^*[k^C]\right)}{\left\{(1-\gamma)w[k^C] + \gamma w^*[k^C]\right\}MR^{*\prime}} < 0, \tag{15}$$

where $MR^{*\prime} = \dfrac{d\left(P\left[\overline{X}^C + X^{*C}\right] + P'\left[\overline{X}^C + X^{*C}\right]X^{C*}\right)}{dX^{*C}} = 2P' = -2a < 0$.

The above result says that more restrictive rule of origin reduces the output of the multinational firm for each output level of the indigenous firm. In other words, the reaction function of the multinational firm shifts to the left. This takes place due to the increase in the marginal cost of the multinational firm.

Since only the reaction function of the multinational firm shifts inward, the new equilibrium output of the domestic producer increases, while the output of the multinational decreases (See Figure 2). How much will they change? Since we assume a linear demand function for the final product, the effect of the rule of origin on the output of the indigenous firm is determined by taking the derivative of the reaction function of the indigenous firm with respect to the required ratio:

$$\frac{dX^{C}}{d\gamma} = \frac{dh[X^{*C}]}{d\gamma} = -\frac{1}{2}\frac{dX^{*C}}{d\gamma}, \tag{16}$$

The total change of output can be written as

$$\frac{d\left(X^{C} + X^{*C}\right)}{d\gamma} = \frac{1}{2}\frac{dX^{*C}}{d\gamma}. \tag{17}$$

Consequently, we have the following result.

Proposition 2: *A cost-based rule of origin lowers the output of the multinational firm in the host country, while it increases the output of the indigenous firm. The total output produced in the host country decreases.*

IV. The Revenue-Based Rule of Origin

Next, we consider the case of an alternative rule of origin. A *revenue-based rule of origin* requires that the cost of domestic components should not be less than a prescribed share of total revenue to obtain recognition as a domestic product. The rule of origin can be written as $W[k]X^{*} \geq \gamma P[X + X^{*}]X^{*}$ where $\gamma \in [0,1]$ is the required ratio for recognition. We can rewrite the constraint as

$$W[k] \geq \gamma P[X + X^*]. \qquad (18)$$

In words, the unit production cost of the domestic components should not be less than a certain fraction of the price.

The revenue-based rule of origin affects the behavior of the multinational firm when $\gamma > \dfrac{W[k^0]}{P[X^0 + X^{*0}]}$. In order to satisfy the rule of origin, the multinational firm has to shift some production processes into the host country and use more components there, thereby increasing the value of index k as in the case of the cost-based rule of origin. However, under the revenue-based rule of origin, the foreign firm can shift back some production processes to the source country by increasing its output. This is because an increase in output decreases the price of the final good. Consequently, the reduction in the price makes the rule of origin easier to satisfy; i.e., the foreign firm can reduce the number of production processes in the host country.

Unlike the case of the cost-based rule of origin, the index of the production process depends upon the output level of the multinational firm under the revenue-based rule of origin. Under a certain rule of origin, we take the total derivative from the constraint to measure the effect of a change in the output of the foreign firm on the range of the production stages. This yields $\dfrac{dk}{dX^*} = \dfrac{\gamma P'}{w} < 0$. This means that an increase in quantity makes it possible to meet the rule of origin with fewer components originating in the host country. In other words, it is possible to meet the rule of origin with fewer high-cost components originating in the host country.

Marginal cost function

When the rule of origin exists, the cost function for the multinational firm is the unit cost times the quantity produced by the multinational firm:

$$C^*[X^*] = \left(W[k[X^*]] + W^*[k[X^*]]\right)X^*. \qquad (19)$$

However, under this case the index k depends upon the output of the multinational firm in the host country. Therefore, the marginal cost can be written as

$$MC^* = \left(W + W^*\right) + \left(w - w^*\right)X^* \frac{dk}{dX^*}$$

$$\begin{aligned}
&= \left(W + W^*\right) + \left(1 - \frac{w^*}{w}\right) wX^* \left(\frac{\gamma P'}{w}\right) = \left(W + W^*\right) + \left(1 - \frac{w^*}{w}\right)\gamma\left(P'X^*\right) \\
&= \left(W + W^*\right) - \left(1 - \frac{w^*}{w}\right)\gamma\left(P - MR^*\right)
\end{aligned} \tag{20}$$

The marginal cost is lower than the average cost $\left(W + W^*\right)$ because an increase in quantity makes it possible to meet the rule of origin with fewer high cost components in the host country.

Effects on the reaction functions and output

The new reaction function is determined from the profit-maximization condition that marginal revenue equals marginal cost:

$$MR^* = \left(W + W^*\right) - \left(1 - \frac{w^*}{w}\right)\gamma\left(P - MR^*\right). \tag{21}$$

Then the new reaction function is

$$X^* = h^{*R}[X] = -\frac{1}{2 - \left(1 - \frac{w^*[k^R]}{w[k^R]}\right)\gamma} X + \frac{b - \left(W[k^R] + W^*[k^R]\right)}{2 - \left(1 - \frac{w^*[k^R]}{w[k^R]}\right)\gamma}, \tag{22}$$

where k^R is the optimal choice of the production stage index under the revenue-based rule of origin.

Now let us consider the effect of a change in the required ratio on the reaction function of the multinational firm. Taking the derivative of the revenue-based rule of origin under the condition that the expression (18) holds equality and the profit-maximizing condition given the domestic firm's output gives

$$w \frac{dk}{d\gamma} = P + \gamma P' \frac{dX^*}{d\gamma} \tag{23}$$

and

$$MR'\frac{dX^*}{d\gamma}$$
$$=\left(w-w^*+\gamma(P-MR)\frac{d\frac{w^*}{w}}{dk}\right)\frac{dk}{d\gamma}-\left(1-\frac{w^*}{w}\right)\gamma(P'-MR')\frac{dX^*}{d\gamma}-\left(1-\frac{w^*}{w}\right)(P-MR) \tag{24}$$

In order to see the relationship between the change in the index and the output level, rewrite equation (23) as:

$$\frac{dk}{d\gamma}=\frac{P}{w}+\frac{\gamma P'}{w}\frac{dX^*}{d\gamma}. \tag{23'}$$

Substitution of (23') into (24) yields:

$$MR'\frac{dX^*}{d\gamma}=\left(\left(1-\frac{w^*}{w}\right)MR-\frac{\gamma PP'X^*}{w}\frac{d\frac{w^*}{w}}{dk}\right)+\left(\left(1-\frac{w^*}{w}\right)\gamma MR'-\frac{\gamma^2P'^2X^*}{w}\frac{d\frac{w^*}{w}}{dk}\right)\frac{dX^*}{d\gamma} \tag{25}$$

Hence,

$$\frac{dX^*}{d\gamma}=-\left\{(w-w^*)MR-\gamma PP'X^*\frac{d\frac{w^*}{w}}{dk}\right\}\Big/\Delta \tag{26}$$

and

$$\frac{dk}{d\gamma}=-\left\{\left(1-\gamma\left(1-\frac{w^*}{w}\right)\right)PMR'+\gamma\left(1-\frac{w^*}{w}\right)P'MR\right\}\Big/\Delta, \tag{27}$$

where $\Delta=-MR'\{(1-\gamma)w+\gamma w^*\}-(\gamma P')^2X^*\frac{d\frac{w^*}{w}}{dk}>0.$

For value $\gamma=\gamma^0$ at which the rule of origin is just binding, we have $w[k^R]=w^*[k^R]$. Thus, equations (26) and (27) can be rewritten as

$$\left.\frac{dX^*}{d\gamma}\right|_{\gamma=\gamma^0} = \frac{\gamma P P' X^*}{\Delta} \frac{d\,\frac{w^*}{w}}{dk} > 0 \tag{26'}$$

and

$$\left.\frac{dk}{d\gamma}\right|_{\gamma=\gamma^0} = -\frac{PMR'}{\Delta} > 0\,. \tag{27'}$$

These results suggest that a small change in the rule of origin causes the foreign reaction curve to shift outward (See a right panel of Figure 2). This shift results in an increase in output of the multinational firm and a reduction in output of the indigenous firm.

A more restrictive rule of origin always leads the multinational firm to bring more production stages into the host country. However, we cannot determine the sign of the change in output of the multinational firm. Since the first term of (26) is positive for $\gamma > \gamma^0$ and the second term is always negative, there can exist a value of γ at which X^* starts declining. Hence, we have the following proposition.

Proposition 3: *A marginally restrictive change in a revenue-based rule of origin from the level that the origin rule is just binding may induce the multinational firm's subsidiary to increase both the range of production processes in the host country and the quantity of final output.*

V. Welfare Effects

We now examine the welfare effects of each type of rule of origin on the host country. The welfare of the host country is the sum of the consumer surplus and the profit of the indigenous firm. It may be written as

$$G = \left(\int_0^{X+X^*} P[Z]dZ - P\left[X + X^*\right]\left(X + X^*\right) \right) + \Pi\,, \tag{28}$$

where the term in the bracket represents consumer surplus and Π denotes the profit of the indigenous producer.

To see the effects of the rule of origin on welfare in the host country, we take the derivative of the welfare function with respect to the required ratio of the rule of origin, which gives

$$\frac{dG}{d\gamma} = \left\{ P\frac{d\left(X + X^*\right)}{d\gamma} - P'\left(X + X^*\right)\frac{d\left(X + X^*\right)}{d\gamma} - P\frac{d\left(X + X^*\right)}{d\gamma} \right\} + \frac{d\Pi}{d\gamma}$$

$$= -P'\left(X + X^*\right)\frac{d\left(X + X^*\right)}{d\gamma} + \left\{ P'X\frac{d\left(X + X^*\right)}{d\gamma} + \left(P - \overline{W}\right)\frac{dX}{d\gamma} \right\}$$

$$= -\frac{P'\left(X + X^*\right)}{2}\frac{dX^*}{d\gamma} + P'X\frac{dX^*}{d\gamma} \tag{29}$$

The first term has the same sign as $\frac{dX^*}{d\gamma}$, implying that consumer surplus increases when the output of the multinational firm increases. The second term has the opposite sign from $\frac{dX^*}{d\gamma}$, implying that the domestic firm's profit decreases when the output of the multinational firm increases. We can rewrite the above equation as:

$$\frac{dG}{d\gamma} = -\frac{P'\left(X^* - X\right)}{2}\frac{dX^*}{d\gamma}$$

The output level of each firm depends on the marginal cost of each firm. In the case of the cost-based rule of origin, the multinational firm's reaction curve shifts inward and its output decreases. If domestic output is initially greater than foreign output, i.e., if the marginal cost of the indigenous firm is less than that of the multinational firm, then domestic welfare increases. By contrast, welfare decreases in the opposite case.

A marginal change in a revenue-based rule of origin from the pre-regulation state increases the output of the multinational firm's subsidiary. Thus, when domestic output is greater than foreign output, i.e., if the marginal cost of the indigenous firm is less than that of the multinational firm, domestic welfare decreases. Similarly, welfare increases in the opposite case. Hence, we have the following result.

Proposition 4: *When the marginal cost of the indigenous firm is less than that of the multinational firm, the cost-based rule of origin increases the host country's welfare, whereas the marginally restrictive change in a revenue-based rule of origin from the level that the origin rule is just binding decreases its welfare. When the marginal cost of the indigenous firm is greater than that of the multinational firm, the cost-based rule of origin reduces welfare and the revenue-based rule of origin raises its welfare.*

Welfare of the source country

Next, we analyze the effects of the host country's rule of origin on the source country's welfare. This depends on the profit of the subsidiary in the host country because the rule of origin does not directly affect the market in the source country. The effect of the rule of origin on the profit of the multinational firm's subsidiary is

$$\frac{d\Pi^*}{d\gamma} = \left(P + \frac{P'X^*}{2} - \left(W + W^*\right)\right)\frac{dX^*}{d\gamma} - \frac{d\left(W + W^*\right)}{d\gamma}X^*. \tag{30}$$

Under the cost-based rule of origin, the coefficient of the first term is positive from the profit-maximization condition for the multinational firm:

$$P + \frac{P'X^*}{2} - \left(W + W^*\right) > P + P'X^* - \left(W + W^*\right) = 0. \tag{31}$$

Since the sign of $\frac{dX^*}{d\gamma}$ is negative, the first term becomes negative. The second term is $\frac{d\left(W + W^*\right)}{d\gamma} = \left(w - w^*\right)\frac{dk}{d\gamma} = \frac{\left(w - w^*\right)\left(W + W^*\right)}{(1-\gamma)w + \gamma w^*} > 0$. Therefore, the cost-based rule of origin must reduce the welfare of the source country.

Similarly, under the marginal change in a revenue-based rule of origin from the pre-regulation state, the coefficient of the first term is also positive from the profit-maximization condition. Since the sign of $\frac{dX^*}{d\gamma}$ is positive, the first term is positive. The second term is zero because $\frac{d\left(W + W^*\right)}{d\gamma} = \left(w - w^*\right)\frac{dk}{d\gamma} = 0$. Hence, the marginal change in a revenue-based rule of origin from the pre-regulation state increases the profit of the multinational firm and foreign welfare. However, a rule of origin may not assure an increase in foreign welfare when it is too restrictive.

As we look over the results of the effects of rules of origin on each country's welfare, we note the following proposition.

Proposition 5: *When the indigenous firm has higher marginal costs than the multinational firm, the marginally restrictive change in a revenue-based rule of origin from the level that the origin rule is just binding increases both countries' welfare, whereas the cost-based rule of origin decreases their welfare.*

VI. Conclusion

We have investigated the impact of two types of rules of origin on welfare and output in a duopoly model. A cost-based rule of origin raises the output of the indigenous firm while it reduces the output of the multinational firm's subsidiary in the host country. This result follows from the fact that the rule of origin increases the marginal cost of production for the multinational firm. Consequently, total output available for sale in the host country declines.

The marginally restrictive change in a revenue-based rule of origin from the level that the origin rule is just binding, however, leads to quite different results. In particular, this policy induces the multinational firm to increase the range of processing stages in the host country and the quantity of final output. This is because an increase in output makes it possible to meet the rule of origin with a lower share of high-cost components originating in the host country. Hence, the revenue-based rule of origin lowers the output share of the indigenous firm.

Under the assumption of a linear demand function, we can see clear-cut welfare effects of the two types of rules of origin. The cost-based rule of origin leads to a reduction in the host country's welfare and an increase in the indigenous firm's profit. In contrast, the revenue-based rule of origin leads to an increase in the host country's welfare and a decrease in the indigenous firm's profit. The cost-based rule of origin reduces the source country's welfare, whereas the revenue-based rule of origin raises it. Consequently, the marginal change in the revenue-based rule of origin from the pre-regulation state can increase both countries' welfare. However, the indigenous firm' profit decreases.

What are the policy implications of this paper's findings? As a type of strategic policy to protect the indigenous firm, the cost-based rule of origin is superior to the revenue-based one despite the revenue-based rule of origin may increase both countries' welfare. From a strategic industrial policy perspective, it is not critical that the former raises the indigenous firm's profit while the latter reduces its profit. Thus, if the purpose of imposing a rule of origin is to protect the indigenous firm, it is more likely that the host-country government will adopt the cost-based rule of origin although it might reduce both countries' welfare.

An extension of this research is to consider the effect of rules of origin in the event that an indigenous firm and a foreign subsidiary compete in the price of the final output, i.e., a Bertrand competition. A cost-based rule of origin raises the marginal cost of the foreign firm, and it will have the same effects as in the Cournot competition model. However, the revenue-based rule of origin may give the foreign competitor an incentive to increase production and reduce the final output price in fulfilling the requirement of this type of rule of origin.

References

Davidson, Carl, Steven Matusz, and Mordechai Kreinin (1985). "Analysis of Performance Standards for Direct Foreign Investments," *Canadian Journal of Economics*, 18: 876-890.

Dixit, Avinash and Gene M. Grossman (1982). "Trade and Protection with Multistage Production," *Review of Economic Studies*, 49: 583-594.

Hollander, Abraham (1987). "Content Protection and Transnational Monopoly," *Journal of International Economics*, 23: 283-297.

James, William E. and Masaru Umemoto (2000). "NAFTA Trade with East Asia: Rules of Origin and Market Access in Textiles, Apparel, Footwear and Electrical Machinery," *ASEAN Economic Bulletin*, 17: 293-311.

Krishna, Kala and Anne Krueger (1995). "Implementing Free Trade Areas: Rules of Origin and Hidden Protection," in Deardorff, Levinsohn, and Stern (eds.), *New Directions in Trade Theory*. Ann Arbor: University of Michigan Press.

Kruger, Anne O. (1995). "Free Trade Agreements versus Customs Unions." NBER Working Paper no. 5084.

Kruger, Anne O. (1996). "Rules of Origin as Protectionist Devices," in Melvin, Moore, and Riezman (eds.), *International Trade Theory: Essays in Honour of John Chipman*. London: Routledge.

Mason, David and Abdul Turay (1994). *Japan, NAFTA and Europe*. New York: St. Martin's Press.

Vermulst, Edwin, Paul Waer, and Jacques Bourgeois (eds.) (1994). *Rules of Origin in International Trade: A Comparative Study*. Ann Arbor: University of Michigan Press.

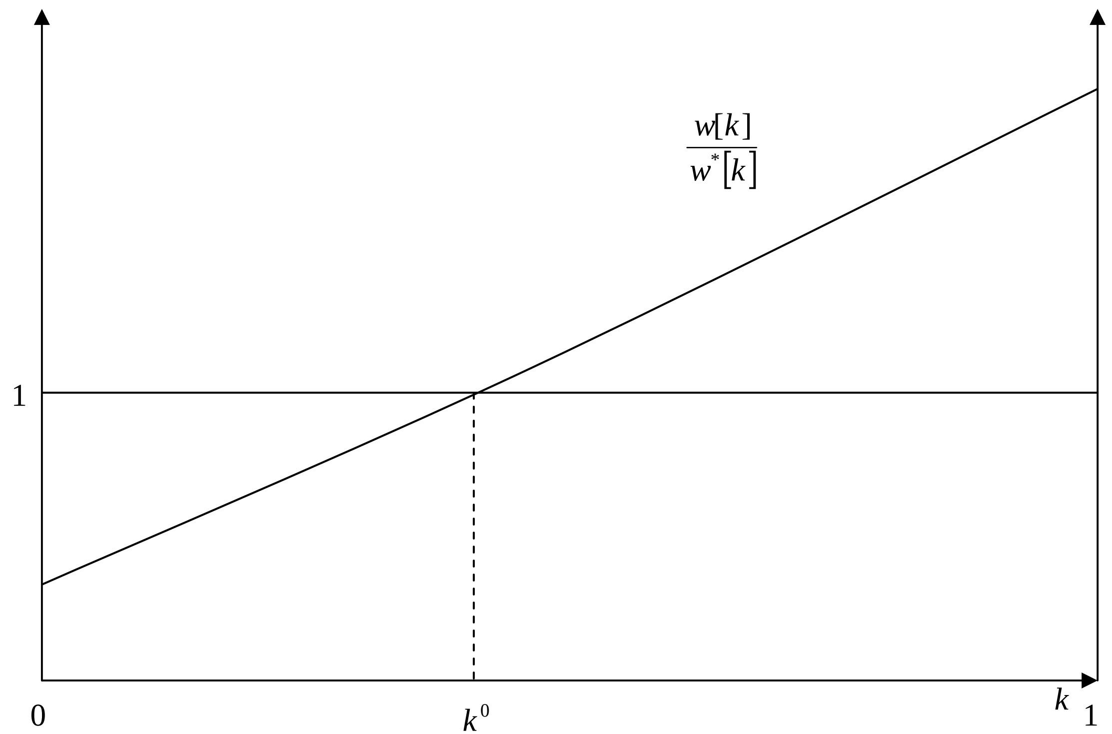
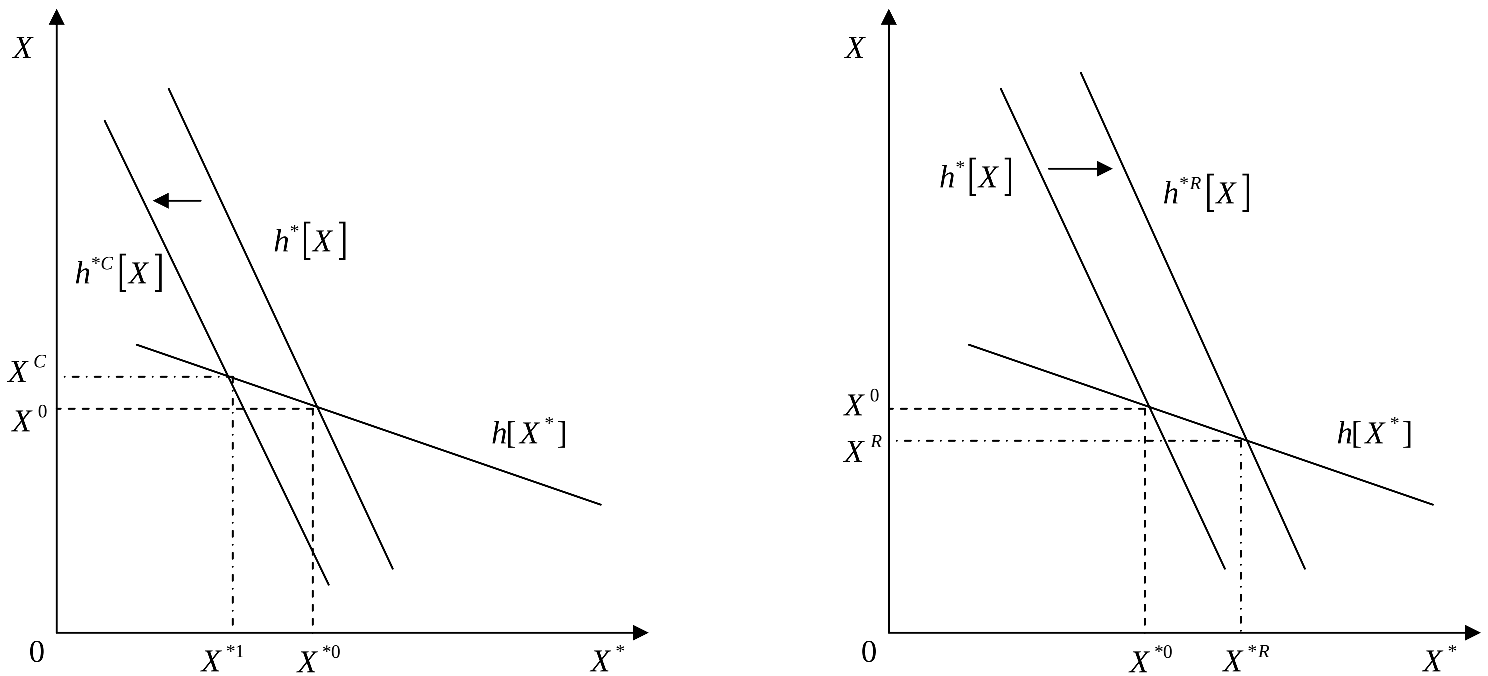


Figure 1 Relative Unit Cost Function



Effects of Cost Based Rule of Origin

Effects of Marginally Effective
Revenue Based Rule of Origin

Figure 2 The Effects of Rules of Origin on Reaction Functions