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Intra-Industry Trade and National Entry Policy

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Abstract. This paper analyzes entry policy in an open economy using an intra-industry trade model. Entry policy is the policy by which a government regulates the number of firms in the country. Implementation of this policy is accompanied by production subsidies. In this paper, only one country implements this policy and the other country does not enforce any regulations. We show that the national entry policy makes both countries better off than they would be at the market equilibrium under a certain condition. This means that the national entry policy is not always a beggar-thy-neighbor policy.
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1. Introduction

Most studies show that imposition of tariffs sacrifices other countries' interests, that is, imposing tariffs is a beggar-thy-neighbor policy. This result is also applied to intra-industry trade models with the utility function of the Dixit=Stiglitz type and monopolistic competitive firms (Venables, 1982, 1987, Helpman=Krugman, 1985, 1989, Flam=Helpman, 1987, Gros, 1987). Sometimes, export subsidies have the same effect as imposing tariffs on other countries. The strategic trade policy is also a beggar-thy-neighbor policy.

However, research on industrial policy in an open economy has progressed less than that on tariffs and export subsidies, and there has been insufficient analysis on the effects of industrial policy on economies with the Dixit=Stiglitz type utility functions and monopolistic competition. Yet, this is an interesting topic. An increase in the number of firms affects the variety of differentiated goods available in both countries. An increase in the output of a firm heightens its productivity because of increasing returns to scale. Since the 1970s, these types of industrial policies have been analyzed using closed economy models with the Dixit=Stiglitz type utility functions and monopolistic competition (Dixit=Stiglitz, 1977, Koenker=Perry, 1981, Horn, 1984). They showed the government should increase the number of firms to more than under the market equilibrium and that the policy is beneficial to closed economies.

The policy by which the government regulates only the number of firms in the monopolistic competitive sector is called entry policy.[1)] Each firm decides the amount of output by itself to maximize its profit, but if firms are in deficit, the government must cover the deficit with subsidies. Ohyama (1997) analyzed entry policy in an open economy. In his two-country partial equilibrium model, both countries implemented entry policy at the same time. His result was that entry policy was beneficial to each country under a certain condition.[2)] However, we should research entry policy in more general situations, so we use a general equilibrium model and assume that only one country implements entry policy and that the other country does not enforce any regulations.

Our analysis reveals that both countries enjoy higher utility through the national entry policy than under the market equilibrium when factor endowment ratios of the countries are close to each other. That is, the national entry policy is not a beggar-thy-neighbor policy, but is welcomed by other countries. This means the national entry policy is suitable between developed countries or between developing countries.

On the other hand, when the factor endowment ratios of the two countries are distant from each other, it can happen the national entry policy does become a beggar-thy-neighbor policy. In this case, an increase in the number of the firms in the home country can have detrimental effect on the country. This is counter-intuitive and different from the results of closed-economy models.

It is common knowledge that the use of production subsidies is widespread; for example, the EU's support of Airbus and the Korean government's support of Posco (Pohang Iron and Steel Company) are representative examples of entry promotion through production subsidies. In addition, in 2002, the British government granted a subsidy of 40 million pounds to Nissan Motor's Sunderland factory, which planned to export their cars to European countries. The government implemented the subsidy to ensure that Nissan would continue to produce their latest model cars at the factory. This is a type of entry promotion by production subsidy. Implementation of entry policy is accompanied by production subsidies. Our analysis shows that production subsidies are beneficial not only to the home country but also to other countries.

These days, trade liberalization and unification of competitive conditions are frequently negotiated at WTO, APEC, and other meetings. Those negotiations often attempt to reduce production subsidies. The result of our paper, however, is inconsistent with the aims of these trade negotiations. Our result supports the combination of free trade and industrial policy.

In addition, this paper proves the national entry policy has various effects on the world. Consequently, this paper suggests that international coordination of industrial policy is very important to avoid international conflict.

This paper is organized as follows. Section 2 presents the model used in this paper and explains the market equilibrium in an open economy. Section 3 analyzes the national entry policy. Section 4 is our conclusion.

2. Market equilibrium in an open economy

In this section, we explain the market equilibrium in an open economy, using the model of Lawrence=Spiller (1983).

Consider two economies that are composed of the same kind of consumers. The utility functions of the home country and the foreign country are

(2.1-1) $$U = y^{1-s}\left(\sum_{i=1}^{n} x_{1i}{}^{\theta} + \sum_{i=1}^{n^*} x_{2i}{}^{\theta}\right)^{s/\theta},$$

(2.1-2) $$U^* = y^{*1-s}\left(\sum_{i=1}^{n} x_{1i}{}^{*\theta} + \sum_{i=1}^{n^*} x_{2i}{}^{*\theta}\right)^{s/\theta}, \qquad 0<\theta, s<1,$$

where y, x_{1i}, and x_{2i} are the home country's consumption of the homogeneous good, the i th differentiated good made in the home country, and the i th differentiated good made in the foreign country, respectively. And * refers to the foreign country's consumption. n and n^* are numbers of firms in the monopolistically competitive sector in the home and the foreign country, respectively. We assume each firm makes one type of differentiated good. θ is a constant and $\theta = (\sigma - 1)/\sigma$, where σ is the elasticity of substitution between differentiated products.

The output of a firm in the monopolistically competitive sector, X_{ji}, is defined as

$$X_{ji} = x_{ji} + x_{ji}*, \qquad j=1,\ \ i=1,\ldots,n,\ \text{and}\ \ j=2,\ \ i=1,\ldots,n*,$$

where X_{1i} is the output of a firm in the home country and X_{2i} is that in the foreign country.

The budget constraint in each country is

$$\text{(2.2-1)} \qquad y + \sum_{i=1}^{n} P_{1i}x_{1i} + \sum_{i=1}^{n*} P_{2i}x_{2i} = Y + \sum_{i=1}^{n} P_{1i}x_{1i} + \sum_{i=1}^{n} P_{1i}x_{1i}*,$$

$$\text{(2.2-2)} \qquad y* + \sum_{i=1}^{n} P_{1i}x_{1i}* + \sum_{i=1}^{n*} P_{2i}x_{2i}* = Y* + \sum_{i=1}^{n*} P_{2i}x_{2i} + \sum_{i=1}^{n*} P_{2i}x_{2i}*,$$

where P_{1i} is the price of the i th home-made differentiated good, P_{2i} is the price of i th foreign-made differentiated good, and Y and $Y*$ are the outputs of homogeneous good in the home country and in the foreign country, respectively. We consider the homogeneous good as a numeraire, and assume its price as 1. (2.2) also means that trade is balanced between the two countries.

Maximizing (2.1) yields the first-order condition:

$$\text{(2.3-1)} \qquad P_{ji} = \frac{s}{1-s} y x_{ji}^{\theta-1} \Bigg/ \left(\sum_{i=1}^{n} x_{1i}^{\theta} + \sum_{i=1}^{n*} x_{2i}^{\theta} \right), \qquad j=1,2,$$

$$\text{(2.3-2)} \qquad P_{ji} = \frac{s}{1-s} y* x_{ji} *^{\theta-1} \Bigg/ \left(\sum_{i=1}^{n} x_{1i} *^{\theta} + \sum_{i=1}^{n*} x_{2i} *^{\theta} \right), \qquad j=1,2.$$

The utility function, the production function, and the cost function imply symmetrical solutions of the outputs of firms and their prices in the monopolistic competitive sector. Thus (2.3) becomes

$$\text{(2.4-1), (2.4-2)} \qquad P_1 = \frac{s}{1-s} y \frac{x_1^{\theta-1}}{n x_1^{\theta} + n* x_2^{\theta}}, \quad P_1 = \frac{s}{1-s} y* \frac{x_1 *^{\theta-1}}{n x_1 *^{\theta} + n* x_2 *^{\theta}},$$

$$\text{(2.4-3), (2.4-4)} \qquad P_2 = \frac{s}{1-s} y \frac{x_2^{\theta-1}}{n x_1^{\theta} + n* x_2^{\theta}}, \quad P_2 = \frac{s}{1-s} y* \frac{x_2 *^{\theta-1}}{n x_1 *^{\theta} + n* x_2 *^{\theta}},$$

where P_1 is the price of a home-made differentiated good and P_2 is the price of a foreign-made differentiated good.

We assume that the two countries have the same production technology. The production functions of the homogeneous good are

$$\text{(2.5-1), (2.5-2)} \qquad Y = K_y^{\varepsilon} L_y^{1-\varepsilon}, \qquad Y* = K_y *^{\varepsilon} L_y *^{1-\varepsilon}, \qquad 0<\varepsilon<1.$$

where Y is the output, K_y is the capital input, and L_y is the labor input in the competitive sector. The first-order conditions for profit maximization are

(2.6-1), (2.6-2) $wL_y = (1-\varepsilon)Y$, $w^* L_y^* = (1-\varepsilon)Y^*$,

(2.7-1), (2.7-2) $rK_y = \varepsilon Y$, $r^* K_y^* = \varepsilon Y^*$.

The endowment constraints are

(2.8-1), (2.8-2) $L = L_y + n\beta(x_1 + x_1^*)$, $L^* = L_y^* + n^*\beta(x_2 + x_2^*)$,

(2.9-1), (2.9-2) $K = K_y + n\gamma$, $K^* = K_y^* + n^*\gamma$,

where L and K are the stock of labor and capital in the home country.

The cost function for any X_{ji} in each country is

$$TC_{ji} = r\gamma + w\beta X_{ji},$$

where γ is the capital setup cost, r is the rental cost, and w is the wage rate. Hence the production function of a firm is $X_{ji} = L_{ji}/\beta$, where L_{ji} is the labor input by the i th firm in the country j. If the number of firms is sufficiently large, the first-order conditions for profit maximization are

(2.10-1), (2.10-2) $P_1\theta = w\beta$, $P_2\theta = w^*\beta$.

The zero profit conditions are

(2.11-1) $P_1(x_1 + x_1^*) = r\gamma + w\beta(x_1 + x_1^*)$,

(2.11-2) $P_2(x_2 + x_2^*) = r^*\gamma + w^*\beta(x_2 + x_2^*)$.

The sum of the output of homogeneous good in both countries is equal to the sum of consumption. This relation is represented as

(2.12) $Y + Y^* = y + y^*$.

We have supposed that the two countries have the same production technology. We also suppose that the endowment distribution is located within the factor price equalization set. At this time, factor prices are equalized between the two countries, that is, $w = w^*$ and $r = r^*$. Accordingly, the prices of a home-made differentiated good and that of a foreign-made differentiated good are equalized, that is, $P_1 = P_2$ is realized. Then, the outputs of a firm in the home country and in the foreign country become equal. Therefore, we calculate the number of firms and the output of a firm using these equations.

We define the economy-wide capital-labor ratio as k, the factor endowments of capital and labor in the world as K' and L', and the worldwide capital-labor ratio as k'. These are

$$k = K/L, \quad K' = K + K^*, \quad L' = L + L^*, \quad k' = K'/L' = \delta k,$$

where $\delta = \dfrac{1 + K^*/K}{1 + L^*/L}$. Using these variables, the total number of firms in both countries is

(2.13) $$N = n + n^* = \frac{K'}{\gamma} \cdot \frac{s(1-\theta)}{z},$$

where

$$z = s(1-\theta) + (1-s)\varepsilon .$$

From $0 < \theta, s, \varepsilon < 1$, $0 < z < 1$ holds. The output of a firm and the output of the homogeneous good in the world are

(2.14), (2.15) $$X = \frac{\gamma}{k'\beta} \cdot \frac{\theta z}{(1-\theta)(1-z)}, \qquad Y + Y^* = k'^{\varepsilon} L'(1-s)\left(\frac{\varepsilon}{z}\right)^{\varepsilon}\left(\frac{1-\varepsilon}{1-z}\right)^{1-\varepsilon}.$$

The shares of capital and labor in production are z and $1-z$. Therefore, the share of the home country in the world's production is

$$\pi_1 = z \cdot \frac{K}{K+K^*} + (1-z) \cdot \frac{L}{L+L^*}.$$

Hence, the consumption of a differentiated good and of the homogeneous good in the home country is

(2.16) $$x = \pi_1 X = \frac{\theta z \gamma L}{\beta(1-\theta)(K+K^*)}\left(\frac{z}{1-z} \cdot \frac{1}{\delta} + 1\right),$$

(2.17) $$y = \pi_1 (Y + Y^*) = k'^{\varepsilon} L(1-s)(1-\varepsilon)\psi^{\varepsilon}\left(\frac{z}{1-z} \cdot \frac{1}{\delta} + 1\right),$$

where $\psi = \dfrac{\varepsilon(1-z)}{z(1-\varepsilon)}$. The consumption in the foreign country is obtained as $x^* = X - x$ and $y^* = Y + Y^* - y$. Using these variables, we achieve the utility of the two countries. In addition, we obtain

(2.18), (2.19) $$w = (1-\varepsilon)(\psi k')^{\varepsilon}, \qquad r = \varepsilon(\psi k')^{\varepsilon-1}.$$

Equating (2.6-1), (2.7-1), (2.8-1), (2.9-1), (2.18) and (2.19) yields

(2.20) $$Y = (\psi k')^{\varepsilon}\{(1-\varepsilon)(1-\theta) - \varepsilon\theta/(\psi\delta)\}L/(1-\varepsilon-\theta).$$

Substituting (2.7-1), (2.19) and (2.20) in (2.9-1), we obtain the number of firms in home country:

(2.21) $$n = \frac{K}{\gamma}\frac{s(1-\theta)}{z}\frac{1-\psi\delta}{1-\psi}.$$

The result of this model shows that if $\varepsilon + \theta < 1$, then the differentiated goods are capital intensive.[3)] On the other hand, if $\varepsilon + \theta > 1$, then the differentiated goods are labor intensive. For the time being, we assume that $\varepsilon + \theta < 1$. We will discuss this assumption later (Lawrence=Spiller, 1983, pp. 68-74).

3. National entry policy in an open economy

In this section, we analyze the national entry policy in an open economy. First, we will explain about entry policy. A government has strong authority to vary or maintain the number of firms in the monopolistically competitive sector in the country. Each firm decides the amount of output by itself to maximize its profit. As the result of this regulation, if firms are in deficit, the government must give them a subsidy to cover the deficit so that firms can produce even when in deficit. Therefore, the government must tax holders of factors of production (labor forces and owners of capital). This means that the government must carry out income transfer from holders of factors to firms. These measures are included in entry policy.

We assume that only one country implements entry policy and that the other country does not enforce any regulations. The home country regulates the number of firms in the country, n. The consumers in both countries behave to maximize their utility. The firms in both countries behave to maximize their profit. Thus, the number of firms in the foreign country and the amount of output and consumption in both countries are decided in the market. At this time, because the home country government must use subsidy (or tax) for her entry policy, the prices of a home-made differentiated good and a foreign-made differentiated good are not equalized, that is, $P_1 \neq P_2$. At the same time, factor prices are not equalized between the two countries, that is, $w \neq w^*$ and $r \neq r^*$. We also assume that the factors of production cannot move to other countries.

We use the budget constraint (2.2) in the above circumstances for the following reason. When the firms are in deficit, the government must tax the labors and the owners of capital in the country and give the money to the firms. At that time, the cost of production of all goods in the home country is equal to the income of the labors and the owners of capital, $wL + rK$. The amount of production in the home country is $Y + \Sigma_{i=1}^{n} P_{1i} x_{1i} + \Sigma_{i=1}^{n} P_{1i} x_{1i}{}^*$. When we define the lump sum transfer from the households to firms as LST, we obtain $LST = wL + rK - Y - \Sigma_{i=1}^{n} P_{1i} x_{1i} - \Sigma_{i=1}^{n} P_{1i} x_{1i}{}^*$. On the other hand, the amount of consumption in the home country is the subtraction of the lump sum transfer from the income of the labors and the owners of capital. Thus, we obtain $y + \Sigma_{i=1}^{n} P_{1i} x_{1i} + \Sigma_{i=1}^{n^*} P_{2i} x_{2i} = wL + rK - LST$. From these expressions, we obtain (2.2). If firms gain profit, the profit is allocated to the labors and the owners of capital.

Subsequently, we obtain (2.2) again. Therefore, (2.2) holds true in any case. It should be noted that when (2.2-1) holds, (2.2-2) is redundant because of the Walras Law.

We now have 19 variables, P_1, P_2, x_1, x_1*, x_2, x_2*, y, $y*$, Y, $Y*$, w, $w*$, r, $r*$, K_y, K_y*, L_y, L_y*, and $n*$. These variables are solutions of the 19 simultaneous equations (2.2-1), (2.4)-(2.10), (2.11-2) and (2.12).

Here, we define a new variable:

(3.1) $$t = x_2 / x_1 .$$

We substitute tx_1 for x_2 in the 19 equations and solve the simultaneous equations (See Appendix 1). Then, we obtain

(3.2) $$n = \frac{K(1-\theta)}{\gamma} \times$$

$$\frac{(1-\varepsilon-\theta)s + (1-\varepsilon)z\frac{L*}{L}t^{\theta-1} - \varepsilon(1-z)\frac{K*}{K}t^{(1-\varepsilon)(1-\theta)/\varepsilon}}{(1-\theta)(1-\varepsilon-\theta)s + \varepsilon(1-\varepsilon-\theta)(1-s)t^{(1-\varepsilon-\theta)/\varepsilon} + (1-\varepsilon)(1-\theta)z\frac{L*}{L}t^{\theta-1} - \varepsilon\theta z\frac{L*}{L}t^{(1-\varepsilon)(1-\theta)/\varepsilon-1}}.$$

This equation expresses the relation between n and t. That is, if the value of n is given, the value of t is gotten from this expression.[4)] Using n and t, we now express all other variables. Then, we obtain the utility in both countries.

Let us analyze the effect of the national entry policy on both countries. At this point, we assume that the two countries are now in the market equilibrium. In this situation, the home country slightly increases the number of firms in the country and the foreign country does not enforce any regulations. Considering the value of n in (2.21) and t=1 at the market equilibrium, the derivatives of the utility are

(3.3-1) $$\frac{dU}{dn} = \alpha\gamma\left(\frac{K+K*}{L+L*}\right)^{\varepsilon(1-s)-1}\left(\frac{K+K*}{\gamma}\right)^{s/\theta-s}(1-\varepsilon-\theta)\frac{A}{C},$$

(3.3-2) $$\frac{dU*}{dn} = \alpha\gamma\left(\frac{K+K*}{L+L*}\right)^{\varepsilon(1-s)-1}\left(\frac{K+K*}{\gamma}\right)^{s/\theta-s}(1-\varepsilon-\theta)\frac{B}{C},$$

where $\alpha = s^{s/\theta}\left\{\frac{(1-s)(1-\varepsilon)}{\theta}\right\}^{1-s}(1-\theta)^{s/\theta-s}\left\{\frac{\varepsilon(1-z)}{z(1-\varepsilon)}\right\}^{\varepsilon(1-s)}\frac{z^{1+s-s/\theta}}{1-z}\frac{1}{\beta}$,

$$A = z\{-\theta+\varepsilon\theta+s(1-\varepsilon-\theta)(1-s+s\theta)\}\frac{L*}{L} + (1-z)\{\varepsilon\theta+s(1-\varepsilon-\theta)(1-s+s\theta)\}\frac{K*}{K}$$
$$+ s(1-s)(1-\theta)(1-\varepsilon-\theta),$$

$$B=(1-z)\{\varepsilon\theta+s(1-\varepsilon-\theta)(1-s+s\theta)\}\frac{L^*}{L}+z\{-\theta+\varepsilon\theta+s(1-\varepsilon-\theta)(1-s+s\theta)\}\frac{K^*}{K}$$

$$+s(1-s)(1-\theta)(1-\varepsilon-\theta)\frac{L^*}{L}\frac{K^*}{K},$$

$$C=s(1-s)(1-\varepsilon-\theta)^2+z\{(1-\varepsilon)(1-\theta-\varepsilon\theta)-s(1-\varepsilon-\theta)(1+\theta-\varepsilon\theta)\}\frac{L^*}{L}$$

$$+(1-z)\{\varepsilon^2\theta+s(1-\varepsilon-\theta)(1-\theta+\varepsilon\theta)\}\frac{K^*}{K}-\theta(1-\varepsilon)z^2\left(\frac{L^*}{L}\right)^2+z(1-z)(1-\theta+\varepsilon\theta)\frac{L^*}{L}\frac{K^*}{K}.$$

$C>0$ by the condition of factor price equalization. 5) And we have already assumed that $\varepsilon+\theta<1$. Thus, we gain the following lemma.

Lemma 1. We assume the differentiated goods are capital intensive. When the home country implements the national entry policy in the market equilibrium, the necessary and sufficient condition to change the utility of each country is

$$\frac{dU}{dn}>0\Leftrightarrow A>0,\qquad \frac{dU^*}{dn}>0\Leftrightarrow B>0.$$

If A (or B) is negative, an increase in n diminishes the utility of the home country (or the foreign country). This result is different from that in a closed economy and is counter-intuitive.

We will examine the signs of A and B. Here, we shall donate the measure of the capital-labor differential of the two countries as h, that is,

$$\frac{K^*}{L^*}=h\frac{K}{L}.$$

If we regard A and B as functions of h, we write

$$A(h)=(1-z)\{\varepsilon\theta+s(1-\varepsilon-\theta)(1-s+s\theta)\}(L^*/L)h$$
$$+z\{-\theta+\varepsilon\theta+s(1-\varepsilon-\theta)(1-s+s\theta)\}(L^*/L)+s(1-s)(1-\theta)(1-\varepsilon-\theta),$$
$$B(h)=\left[z\{-\theta+\varepsilon\theta+s(1-\varepsilon-\theta)(1-s+s\theta)\}+s(1-s)(1-\theta)(1-\varepsilon-\theta)(L^*/L)\right](L^*/L)h$$
$$+(1-z)\{\varepsilon\theta+s(1-\varepsilon-\theta)(1-s+s\theta)\}(L^*/L),$$

When h =1, we obtain

$$A(1)=s(1-s)(1-\theta)(1-\varepsilon-\theta)(1+L^*/L)>0,$$
$$B(1)=s(1-s)(1-\theta)(1-\varepsilon-\theta)(1+L^*/L)(L^*/L)>0.$$

$A(1)$ is positive and $A(h)$ is a monotonically increasing function of h. Hence,

A is at least positive when the value of h is around 1 or greater than 1. On the other hand, when h is less than 1, that is, the home country is the capital-abundant country, it could happen that A is negative.

$B(h)$ is a linear function of h, and both $B(1)$ and $B(0)$ are positive. This means that B is at least positive when the value of h is around 1 or less than 1. On the other hand, when h is greater than 1, that is, the foreign country is the capital-abundant country, it could happen that B is negative.

Therefore, when the value of h is approximately 1, that is, the factor endowment ratios of the two countries are close to each other, $dU/dn > 0$ and $dU^*/dn > 0$ are achieved. Otherwise, either $dU/dn < 0$ or $dU^*/dn < 0$ can happen. In the case that $dU/dn > 0$ and $dU^*/dn < 0$, the national entry policy that increases n deteriorates the foreign country's utility. In the case that $dU/dn < 0$ and $dU^*/dn > 0$, the policy that decreases n deteriorates the foreign country's utility. So those policies are beggar-thy-neighbor policies.

To understand this policy, we examine its effect on each variable (See Appendix 2):

(3.4) $$\frac{dt}{dn} = \frac{d}{dn}\left(\frac{P_1}{P_2}\right)^{1/(1-\theta)} = \frac{d}{dn}\left(\frac{w}{w^*}\right)^{1/(1-\theta)} < 0,$$

(3.5-1), (3.5-2) $$\frac{dP_1}{dn} < 0, \qquad \frac{dP_2}{dn} > 0,$$

(3.6-1), (3.6-2) $$\frac{dX_1}{dn} = \frac{d}{dn}(x_1 + x_1^*) > 0, \qquad \frac{dX_2}{dn} = \frac{d}{dn}(x_2 + x_2^*) < 0,$$

(3.7-1), (3.7-2) $$\frac{dn^*}{dn} < 0, \qquad \frac{d}{dn}(n + n^*) : ?$$

These inequalities mean that the national entry policy brings some positive and negative effects to each country. An increase in n brings both a deterioration in the terms-of-trade and a benefit of increasing returns to scale to the home country. However, it has not been determined whether the total number of the variety $(n + n^*)$ increases or not. If the number increases, it would be beneficial to consumers in the both countries. Consequently, dU/dn is positive when the positive effects dominate the negative effects. Otherwise, it is negative. Similarly, the sign of dU^*/dn depends on difference between positive and negative effects on the foreign country.

Additionally, using (3.3), we obtain

$$(3.8)\quad \frac{d(U+U^*)}{dn}=\frac{dU}{dn}+\frac{dU^*}{dn}$$

$$=\alpha(1-s)(1-\theta)(1-\varepsilon-\theta)^2\gamma\left(\frac{K+K^*}{L+L^*}\right)^{\varepsilon(1-s)-1}\left(1+\frac{L^*}{L}\right)\left(1+\frac{K^*}{K}\right)\frac{1}{C}.$$

This value is positive. Therefore, the national entry policy that increases the number of firms in the home country is beneficial to the world welfare. When either dU/dn or dU^*/dn is negative, its absolute value is less than the other.

We still have a question remaining: In the above analysis, dU/dn (or dU^*/dn) can be negative only when the home country (or the foreign country) is the capital-abundant country. What does this mean? To consider this question, we revise the assumption of $\varepsilon+\theta<1$ and now assume $\varepsilon+\theta>1$; the product variety sector is labor intensive.

Under the assumption that $\varepsilon+\theta>1$, Lemma 1 is revised to

$$dU/dn>0\Leftrightarrow A<0,\qquad dU^*/dn>0\Leftrightarrow B<0,$$

and our calculation shows that both A and B are negative when the factor endowment ratios of the two countries are close to each other. However, when the home country is the labor-abundant country, it can happen that A is positive. On the contrary, when the foreign country is the labor-abundant country, it can happen that B is positive. This is the exactly opposite result to the former one. In addition, signs of terms in (3.4), (3.5), and (3.6) are also reversed. That is, some of the positive and negative effects, which we mentioned before, are reversed. This means that the result under the assumption that $\varepsilon+\theta>1$ is symmetric to that under the assumption that $\varepsilon+\theta<1$.

From the above analysis, we derive an important result. The signs of both dU/dn and dU^*/dn are positive when the factor endowment ratios of the two countries are close to each other. So the national entry policy is welcomed between the countries. On the other hand, when the factor endowment ratios of the two countries are distant from each other, it can happen that either dU/dn or dU^*/dn is negative. (It never happens both of them are simultaneously negative.) When the sign of dU/dn is different from that of dU^*/dn, this policy is a beggar-thy-neighbor policy. Thus, we obtain the following proposition.

Proposition 1. When the factor endowment ratios of the two countries are close to each other, the national entry policy makes both countries better off than they would be at the market equilibrium. On the other hand, when the factor endowment ratios of the two countries are distant from each other, it can happen that the national entry policy at the market equilibrium is a beggar-thy-neighbor policy.

Let us analyze the above things further. Under the assumption that $\varepsilon + \theta < 1$, dU/dn (or dU^*/dn) can be negative when the home country (or the foreign country) is the capital-abundant country, while under the assumption that $\varepsilon + \theta > 1$, dU/dn (or dU^*/dn) can be negative when the home country (or the foreign country) is the labor-abundant country. Therefore, we obtain another important result: dU/dn (or dU^*/dn) can be negative when the home country (or the foreign country) specializes in the differentiated goods.[6] At this time, as n increases, the decrease in U (or U^*) can occur. Thus, we obtain the following proposition.

Proposition 2. It can happen a country that specializes in the differentiated goods suffers from the increase in the number of firms in the home country. On the contrary, a country that specializes in the homogeneous good always gains from the increase in the number of firms in the home country.

We still have a question: why can a country that specializes in the differentiated goods suffer from the increase in n?

(3.8) shows $d(U+U^*)/dn > 0$. Therefore, we do not think the world is in the excess entry situation. The excess entry theorem would hold if $d(U+U^*)/dn < 0$ or $d(U+U^*)/d(n+n^*) < 0$ were realized.

When a country specializes in the differentiated goods, its ratio of the number of the firms to GDP is higher than that in the other country. In other words, the density of firms inside the country is higher than that of the other country. We assume this is closely related to our result.

One interpretation is that an increase in firms entails high setup costs. Hence, some of the capital allocated for producing homogeneous goods must be transferred to the monopoly competitive sector in the home country. At the same time, the number of firms in the foreign country decreases, which means some of the capital used for producing differentiated goods is re-allocated to the competitive sector in the foreign country. These transfers move production possibility frontiers and each firm's output quantity. If these changes bring some negative effects to each country through production processes, the country that specializes in the differentiated goods would suffer heavily compared to the other country.

Another interpretation is our result is due to the distortion. We may interpret $t = (P_1 / P_2)^{1/(1-\theta)} = (w / w^*)^{1/(1-\theta)}$ as the distortion created by the difference between (w, P_1) and (w^*, P_2). That is, because of the production subsidies (or taxes), the marginal rate of transformation in the home country is not equal to that in the foreign country. As mentioned before, $d(U + U^*)/dn > 0$ means that the national entry policy is beneficial. The changes of the number of firms and output can improve the world welfare. However, the distortion created by the policy would bring some negative effects to each country through production processes. So our result happens.

We need further investigation, although our result represents a very interesting characteristic of the national entry policy.

Consequently, our paper showed that a country changes the utility of itself and other countries with the national entry policy. Even if a country is comparatively smaller than other countries, its policy affects the utility of larger countries.[7)] Therefore, smaller countries can negotiate with other countries taking advantage of the policy. In this type of the world, international coordination of industrial policy is very important to avoid international conflict.

We must comment on Proposition 1. The national entry policy does not continue to raise the utility of both countries forever. Through numerical calculations, we have searched the utility of both countries when the home country continues to increase the number of firms from the situation at the market equilibrium, and the result is as follows. At the beginning, the utility of both countries continues to increase. However, when the number of firms in the home country reaches a certain value, the utility of the home country starts decreasing, whereas that of the foreign country continues to increase. This indicates that two countries' interests do not always coincide when this policy continues to be implemented. Therefore, we repeat the importance of international coordination of industrial policy. Without international coordination, the national entry policy may cause conflict between countries.

4. Conclusion

We obtained the following conclusions. First, the national entry policy makes both countries better off when their factor endowment ratios are close to each other. On the other hand, when the factor endowment ratios of the two countries are quite different, it can happen that the national entry policy is a beggar-thy-neighbor policy. So this policy is suitable between developed countries or between developing countries.

Second, the country that specializes in the differentiated goods can suffer from an increase in the number of firms in the home country. Therefore, the effect of this policy in an open economy is different from that of closed economy.

Third, even if a country is comparatively smaller than other countries, the country may be able to increase or decrease the utility of other countries. Therefore, smaller countries can negotiate with larger countries taking advantage of the policy. In this type of the world, international coordination of industrial policy is very important to avoid international conflict.

The second result is a disproof of the excess entry theorem. As Mankiw and Whinston (1986) showed, the theorem doesn't hold true with the models of differentiated goods. Our result agrees with the paper on this point.

We have not sufficiently studied the effect of the national entry policy when this policy continues to be implemented from the market equilibrium. In addition, the international political power of countries influences each country's decision making. These issues are next subjects in our research.

Notes

1) So far, entry policy and the excess entry theorem have been examined mostly with the model of homogeneous goods. See Mankiw and Whinston (1986) or Matsumura (2000).
2) Ohyama (1997) defined a variable as the degree of love for variety of differentiated goods. His paper showed that if the degree was smaller than a certain value, the national entry policy is beneficial to each country.
3) The factor intensity of the differentiated goods and that of the homogeneous

good are

$$\frac{\gamma}{L_x} = \left\{1 + \frac{(1-s)(1-\varepsilon-\theta)}{\theta z}\right\}k', \qquad \frac{K_y}{L_y} = \left\{1 - \frac{s(1-\varepsilon-\theta)}{z(1-\varepsilon)}\right\}k'.$$

(k' is the worldwide capital-labor ratio.) Therefore, if $\varepsilon + \theta < 1$, then the differentiated goods are capital intensive.

4) When the value of n is that of (2.21), $t=1$ is realized.

5) We don't write the proof of $C > 0$ because of limited space. Ask the author.

6) On the Lawrence=Spiller model, on which our model is based, the home country's net export of the differentiated goods is

$$\frac{LL^*}{1-\varepsilon-\theta}\frac{z(1-\varepsilon)}{K+K^*}\left\{\frac{\varepsilon(1-z)}{z(1-\varepsilon)}\frac{K+K^*}{L+L^*}\right\}^{\varepsilon}\left(\frac{K}{L}-\frac{K^*}{L^*}\right).$$

So the capital-abundant country specializes in the capital-intensive good. That is, the Heckscher=Ohlin theorem holds true in this model.

7) In the small country case, the policy's impact is negligible as below.

$$\lim_{L^*,K^*\to\infty}\frac{dU/dn}{U} = \lim_{L^*,K^*\to\infty}\frac{dU^*/dn}{U^*} = \lim_{L,K\to\infty}\frac{dU/dn}{U} = \lim_{L,K\to\infty}\frac{dU^*/dn}{U^*} = 0.$$

However, the next equations reveal that even if the terms-of-trade effect is purged, the policy has some other effects on both countries.

$$\lim_{L^*,K^*\to\infty}\frac{dU}{dn} = \infty \text{ or } -\infty \quad \text{if } \theta < s/(1+s), \qquad \lim_{L^*,K^*\to\infty}\frac{dU^*}{dn} = \infty \text{ or } -\infty.$$

Appendix 1 Introduction of the derivatives of the utility

Using (2.4) and (3.1), we express $x_2{}^*$ and P_2 as

(A1.1), (A1.2) $\qquad x_2{}^* = tx_1{}^*, \quad P_2 = t^{\theta-1}P_1.$

From (2.10), we see

(A1.3) $\qquad P_1/P_2 = w/w^*.$

Therefore, using (A1.2) and (A1.3), we obtain

(A1.4) $\qquad w^* = t^{\theta-1}w.$

Substituting (2.5-1), (2.8-1) and (2.9-1) into (2.6-1), we express w as

(A1.5) $$w = (1-\varepsilon)\left\{\frac{K-n\gamma}{L-n\beta(x_1+x_1{}^*)}\right\}^{\varepsilon}.$$

Substituting (2.6-2), (2.7-2), (2.10-2), (A1.4) and (A1.5) into (2.11-2), we express $x_1 + x_1{}^*$ as

(A1.6) $$x_1 + x_1^* = \frac{t^{(1-\varepsilon-\theta)/\varepsilon}\varepsilon\theta\gamma}{(1-\varepsilon)(1-\theta)(K-n\gamma)+t^{(1-\varepsilon-\theta)/\varepsilon}\varepsilon\theta\gamma n}\cdot\frac{L}{\beta}.$$

Substituting (2.5-2), (2.8-2), (2.9-2) and (A1.1) into (2.6-2), we express w^* as

(A1.7) $$w^* = (1-\varepsilon)\left\{\frac{K^*-n^*\gamma}{L^*-n^*\beta t(x_1+x_1^*)}\right\}^{\varepsilon}.$$

And substituting (A1.5) and (A1.7) into (A1.4), we see

(A1.8) $$n^*\left(t^{(\theta-1)/\varepsilon}(K-n\gamma)\beta t(x_1+x_1^*)-\gamma\{L-n\beta(x_1+x_1^*)\}\right)$$
$$= t^{(\theta-1)/\varepsilon}(K-n\gamma)L^*-K^*\{L-n\beta(x_1+x_1^*)\}.$$

Then, we substitute (A1.6) into (A1.8) and express n^* as[3)]

(A1.9) $$n^* = \frac{(1-\varepsilon)(1-\theta)\dfrac{K^*}{\gamma}-\left\{(1-\varepsilon)(1-\theta)\left(\dfrac{K}{\gamma}-n\right)+\varepsilon\theta n t^{(1-\varepsilon-\theta)/\varepsilon}\right\}\dfrac{L^*}{L}t^{(\theta-1)/\varepsilon}}{1-\varepsilon-\theta}.$$

Next, from (2.2-1) and (2.4-1), we see

(A1.10) $$\{(1-s)nx_1+t^{\theta}n^*x_1-snx_1^*\}P_1 = sY.$$

Equating (2.10-1), (A1.5), (2.5-1), (A1.9), (A1.10) and (A1.6) yields

(A1.11) $$x_1 = \frac{L}{\beta}s\theta\frac{(1-\theta)(K/\gamma-n)+\varepsilon n t^{(1-\varepsilon-\theta)/\varepsilon}}{(1-\varepsilon)(1-\theta)(K/\gamma-n)+\varepsilon\theta n t^{(1-\varepsilon-\theta)/\varepsilon}}\times$$
$$\frac{1-\varepsilon-\theta}{(1-\varepsilon-\theta)n-(1-\varepsilon)(1-\theta)\left(\dfrac{K}{\gamma}-n\right)\dfrac{L^*}{L}t^{(\theta+\varepsilon\theta-1)/\varepsilon}-\varepsilon\theta\dfrac{L^*}{L}nt^{\theta-1}+(1-\varepsilon)(1-\theta)\dfrac{K^*}{\gamma}t^{\theta}}.$$

We substitute (A1.11) into (A1.6), and we express x_1^* as

(A1.12) $$x_1^* = \frac{L}{\beta}\cdot\frac{\theta}{(1-\varepsilon)(1-\theta)(K/\gamma-n)+\varepsilon\theta n t^{(1-\varepsilon-\theta)/\varepsilon}}\times$$
$$\frac{\left\{\begin{aligned}&(1-s)\varepsilon(1-\varepsilon-\theta)nt^{(1-\varepsilon-\theta)/\varepsilon}-\varepsilon(1-\varepsilon)(1-\theta)\left(\frac{K}{\gamma}-n\right)\frac{L^*}{L}t^{\theta-1}-\varepsilon^2\theta\frac{L^*}{L}nt^{(1-\varepsilon)(1-\theta)/\varepsilon-1}\\&+\varepsilon(1-\varepsilon)(1-\theta)\frac{K^*}{\gamma}t^{(1-\varepsilon)(1-\theta)/\varepsilon}-s(1-\varepsilon-\theta)(1-\theta)\left(\frac{K}{\gamma}-n\right)\end{aligned}\right\}}{(1-\varepsilon-\theta)n-(1-\varepsilon)(1-\theta)\left(\dfrac{K}{\gamma}-n\right)\dfrac{L^*}{L}t^{(\theta+\varepsilon\theta-1)/\varepsilon}-\varepsilon\theta\dfrac{L^*}{L}nt^{\theta-1}+(1-\varepsilon)(1-\theta)\dfrac{K^*}{\gamma}t^{\theta}}.$$

In addition, from (2.2-1), (2.12) and (2.4-2), we obtain

(A1.13) $$\{nx_1^*+(1-s)n^*x_1^*t^{\theta}-sn^*x_1t^{\theta}\}P_1 = sY^*.$$

Substituting (2.5-2), (A1.9), (A1.11) and (A1.12) into (A1.13), this expression is written as (3.2).

We have already expressed x_1, x_1^* and n^* as (A1.11), (A1.12) and (A1.9), respectively. Then, x_2 and x_2^* are expressed as $x_2 = tx_1$ and $x_2^* = tx_1^*$. In addition, y and y^* are expressed as

(A1.14-1), (A1.14-2) $$y=\frac{1-s}{s}x_1(n+t^{\theta}n^*)P_1, \qquad y^*=\frac{1-s}{s}x_1{}^*(n+t^{\theta}n^*)P_1,$$

where $P_1=\dfrac{\beta}{\theta}(1-\varepsilon)\left\{\dfrac{(1-\varepsilon)(1-\theta)(K/\gamma-n)+\varepsilon\theta nt^{(1-\varepsilon-\theta)/\varepsilon}}{(1-\varepsilon)(1-\theta)}\cdot\dfrac{\gamma}{L}\right\}^{\varepsilon}$.

Therefore, the utility in both countries is

(A1.15-1) $$U=\frac{s^s(1-s)^{1-s}\theta^s(1-\varepsilon)^{(1-\varepsilon)(1-s)}}{(1-\theta)^{\varepsilon(1-s)}(1-\varepsilon-\theta)^{s/\theta-s}}\cdot\frac{\gamma^{\varepsilon(1-s)}}{\beta^s}L^{1-\varepsilon(1-s)}\times$$

$$\left\{(1-\theta)\left(\frac{K}{\gamma}-n\right)+\varepsilon nt^{(1-\varepsilon-\theta)/\varepsilon}\right\}\left\{(1-\varepsilon)(1-\theta)\left(\frac{K}{\gamma}-n\right)+\varepsilon\theta nt^{(1-\varepsilon-\theta)/\varepsilon}\right\}^{-(1+\varepsilon s-\varepsilon)}\times$$

$$\left\{(1-\varepsilon-\theta)n-(1-\varepsilon)(1-\theta)\left(\frac{K}{\gamma}-n\right)\frac{L^*}{L}t^{(\theta+\varepsilon\theta-1)/\varepsilon}-\varepsilon\theta\frac{L^*}{L}nt^{\theta-1}+(1-\varepsilon)(1-\theta)\frac{K^*}{\gamma}t^{\theta}\right\}^{s/\theta-s},$$

(A1.15-2) $$U^*=\frac{(1-s)^{1-s}\theta^s(1-\varepsilon)^{(1-\varepsilon)(1-s)}}{s^{1-s}(1-\theta)^{\varepsilon(1-s)}(1-\varepsilon-\theta)^{s/\theta-s+1}}\cdot\frac{\gamma^{\varepsilon(1-s)}}{\beta^s}L^{1-\varepsilon(1-s)}\times$$

$$\left\{(1-\varepsilon)(1-\theta)\left(\frac{K}{\gamma}-n\right)+\varepsilon\theta nt^{(1-\varepsilon-\theta)/\varepsilon}\right\}^{-(1+\varepsilon s-\varepsilon)}\times$$

$$\left\{(1-\varepsilon-\theta)n-(1-\varepsilon)(1-\theta)\left(\frac{K}{\gamma}-n\right)\frac{L^*}{L}t^{(\theta+\varepsilon\theta-1)/\varepsilon}-\varepsilon\theta\frac{L^*}{L}nt^{\theta-1}+(1-\varepsilon)(1-\theta)\frac{K^*}{\gamma}t^{\theta}\right\}^{s/\theta-s}\times$$

$$\left\{\begin{array}{l}(1-s)\varepsilon(1-\varepsilon-\theta)nt^{(1-\varepsilon-\theta)/\varepsilon}-\varepsilon(1-\varepsilon)(1-\theta)\left(\dfrac{K}{\gamma}-n\right)\dfrac{L^*}{L}t^{\theta-1}-\varepsilon^2\theta\dfrac{L^*}{L}nt^{(1-\varepsilon)(1-\theta)/\varepsilon-1}\\+\varepsilon(1-\varepsilon)(1-\theta)\dfrac{K^*}{\gamma}t^{(1-\varepsilon)(1-\theta)/\varepsilon}-s(1-\varepsilon-\theta)(1-\theta)\left(\dfrac{K}{\gamma}-n\right)\end{array}\right\}.$$

(A1.15-1) can be written as $U(t,n)$. From (3.2), t is written as $t(n)$; Hence, $dU/dn=(\partial U/\partial t)(dt/dn)+\partial U/\partial n$. We replace t with 1 and n with (2.21). Then, we obtain (3.3-1). In the same way, (3.3-2) is derived.

Appendix 2 The signs of (3.4)-(3.7)

(A2.1) $$\frac{dt}{dn} = \frac{d}{dn}\frac{x_2}{x_1} = -\frac{\gamma}{K}\frac{1}{1-\theta}(1-\varepsilon-\theta)z^2\left(1+\frac{L^*}{L}\right)^2\frac{1}{C} < 0,$$

(A2.2) $$\frac{dP_1}{dn} = -\frac{\beta\varepsilon(1-\varepsilon-\theta)}{\theta(1-\theta)}\frac{\gamma}{L}\left\{\frac{\varepsilon(1-z)}{z(1-\varepsilon)}\frac{K+K^*}{L+L^*}\right\}^{\varepsilon-1}$$

$$\times\left\{1+\theta(1-\varepsilon)z^2\left(1+\frac{L^*}{L}\right)^2\left(1-\frac{\varepsilon(1-z)}{z(1-\varepsilon)}\frac{1+K^*/K}{1+L^*/L}\right)\frac{1}{C}\right\} < 0,$$

(A2.3) $$\frac{dP_2}{dn} = \frac{\beta\varepsilon^2(1-z)(1-\varepsilon-\theta)}{\theta}\frac{\gamma}{L}\left(1+\frac{K^*}{K}\right)\frac{1}{C}\left\{\frac{\varepsilon(1-z)}{z(1-\varepsilon)}\frac{K+K^*}{L+L^*}\right\}^{\varepsilon-1} > 0,$$

(A2.4) $$\frac{dX_1}{dn} = \left(\frac{\gamma}{K}\right)^2\frac{\theta(1-\varepsilon-\theta)z^2}{(1-\theta)^2(1-z)}\frac{L}{\beta}\frac{(1+L^*/L)^2}{1+K^*/K}\frac{z(L^*/L)-(1-s)(1-\varepsilon-\theta)}{C} > 0$$

(From the condition of factor price equalization, $z(L^*/L)-(1-s)(1-\varepsilon-\theta) > 0$),

(A2.5) $$\frac{dX_2}{dn} = -\left(\frac{\gamma}{K}\right)^2\frac{\theta(1-\varepsilon-\theta)z^2}{(1-\theta)(1-z)}\frac{L}{\beta}\frac{(1+L^*/L)^2}{1+K^*/K}\frac{1}{C} < 0,$$

(A2.6) $$\frac{dn^*}{dn} = -\varepsilon(1-\theta)\frac{L^*}{L}\frac{1+z(L^*/L)+(1-z)(K^*/K)}{C} < 0,$$

(A2.7) $$\frac{d}{dn}(n+n^*) = \left(1+\frac{L^*}{L}\right)\times\begin{bmatrix} s(1-s)(1-\varepsilon-\theta)^2 - z\{\theta(1-\varepsilon)z+\varepsilon(1-\theta)\}(L^*/L) \\ +(1-z)\{(1-\theta+\varepsilon\theta)z-\varepsilon(1-\theta)\}(K^*/K) \end{bmatrix} :?$$

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