INDUSTRIAL POLICY AND INTRA-INDUSTRY TRADE: STRUCTURAL REGULATION IN AN OPEN ECONOMY

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Abstract - This paper explores the effect of an industrial policy in an open economy. We present a two-country, two-good, two-factor general equilibrium model of intra-industry trade, in which one good is in monopolistic competition. We analyze the effect of structural regulation when a country regulates the number of companies in the monopolistic competitive sector in its country. This policy increases the utility level of the country in an open economy. We also show that in some conditions, such an industrial policy increases the utility level of the foreign country. Furthermore, if the factor endowment ratio of two countries is the same, the policy always increases the utility levels of both countries.

Keywords: intra-industry trade, industrial policy, structural regulation

INTRODUCTION

Dixit=Stiglitz (1977) presented a general equilibrium model of monopolistic competition. The utility function of this model is called a love-of-variety type, where the more varieties we consume, the higher the utility level. In this model, if the government regulates to expand the output of one company, the price of the company's product becomes cheaper due to economies of scale. If the government regulates to expand the number of companies, the product varieties become larger. As a result, Dixit=Stiglitz (1977) showed that the utility level when the government regulates is higher than that of the market equilibrium. In other words, this model explains the significance of an industrial policy, with a production function under economies of scale and a utility function of a love-of-variety type,.

Krugman (1979), Lawrence=Spiller (1983), and Helpman=Krugman (1985) have presented intra-industry trade models based on Dixit=Stiglitz (1977). Venables (1982), Flam=Helpman (1987), Gros (1987), Venables (1987), and Helpman=Krugman (1989) analyzed the impact of tariffs and production subsidies on the models. The result of their research was that a tariff increased the utility level of the home country and decreased that of the foreign country.

On the other hand, with a model under economies of scale and the utility function of a love-of-variety type, Koenker=Perry (1981) and Horn (1984) analyzed the impact of an industrial policy. Koenker=Perry (1981) presented a one-product (differentiated good), one-factor general equilibrium model. Horn (1984) presented a two-product (differentiated good and homogeneous good), one-factor general equilibrium model. They compared the market equilibrium with three optima, that is, the unconstrained optimum and two constrained optima. The unconstrained optimum is the optimum in which the government regulates both the number of companies and the output of one company in the monopolistic competitive sector. Two constrained optima are the optima in which the government regulates either the number of companies or the output of one company in the monopolistic competitive sector. The policy of regulating the output of one company is called behavioral regulation, and the policy of regulating the number of companies is called structural regulation. Koenker=Perry (1981) and Horn (1984) showed that the constrained optima of structural regulation is always better than the market equilibrium.

Lawrence=Spiller (1983) presented a two-country, two-product (differentiated good and homogeneous good), and two-factor general equilibrium model of intra-industry trade. The model explored the market equilibrium and the unconstrained optimum, but it didn't show constrained optima.

Therefore, we first explore the constrained optima of structural regulation of Lawrence=Spiller's closed economy model, and compare it with the market equilibrium.

Our analysis shows that when a government undertakes structural regulation, the utility level is always higher than that of the market equilibrium. This means that if two countries, which trade each other and have similar production technology and consumption pattern, cooperate by adopting the same industrial policy, both countries increase their utility levels.

Actually, it is unrealistic to suppose that two countries that engage in trade (or, all countries with mutual trade) will cooperate in structural regulation. Rather we should attend to the industrial policy of one country in an open economy. It is often observed that a country undertakes structural regulation by some barriers or regulations in an open economy.

In this paper, we suppose a country undertakes structural regulation in an open economy, and we explore the policy's effect on the utility levels of the home country and the foreign country. Our analysis shows if two countries have similar factor endowment ratios, structural regulation in one country increases the utility levels of both countries. Moreover, if the factor endowment ratios of two countries are the same, the policy always increases the utility levels of both countries.

As stated above, a tariff benefits the home country at the cost of the foreign country. Thus, the policy's effect is largely different from the tariff's effect. In other words, our conclusion means that if two countries trade each other and have similar property in technology, consumption pattern and factor endowment ratio, structural regulation, whether done by a country or two countries together, benefits both the home country and the foreign country.

In the second section in this paper, we explain Lawrence=Spiller's closed economy model and its market equilibrium. In the third section, we explore the constrained optima of structural regulation in this model. In the fourth section, we use the model to compare the constrained optima with the market equilibrium, and analyze the effect of structural regulation. In the fifth section, we explain Lawrence=Spiller's open economy model and its market equilibrium. In the sixth section, we explore the constrained optima of structural regulation of this model. In the seventh section, we use the model to analyze the structural regulation's effect on the foreign country. The last section is our conclusion.

MARKET EQUILIBRIUM IN A CLOSED ECONOMY

In this section, we explain the closed economy model of Lawrence=Spiller (1983).

Consider an economy composed of identical consumers whose preferences can be characterized by a utility function, (2.1) $$U = Y^{1-s}\left(\sum_{i=1}^{n} X_i^{\theta}\right)^{\frac{s}{\theta}}, \qquad 0<\theta,\ \ s\le 1.$$

Y is a homogeneous commodity produced in a competitive market. The X_i's are of a heterogeneous quality. There are n number of differentiated goods. θ is a constant, and $\theta = (\sigma-1)/\sigma$, where σ is the elasticity of substitution between X_i and X_j, $j \neq i$.

The production function of the competitive sector is assumed to be a Cobb-Douglas function,

(2.2) $$Y = K_y^{\varepsilon} L_y^{1-\varepsilon}, \qquad 0<\varepsilon<1,$$

where K_y is the capital input and L_y the labor input in the Y industry. We consider this good as a numeraire, and assume its price as 1.

The cost function for any X_i is

(2.3) $$TC_i = r\gamma + w\beta X_i, \qquad i = 1,\cdots,n,$$

where γ is the capital setup cost, r the rental cost, w the wage rate. Hence the production function of a company is $X_i = L_i/\beta$, where L_i is the labor input.

The economy-wide capital-labor ratio is

$$k = \frac{K}{L},$$

where L is the stock of labor and K is the stock of capital in the economy.

The first-order condition for utility maximization is

(2.4) $$P_i = \frac{s}{1-s} Y X_i^{\theta-1} \Big/ \sum_{i=1}^{n} X_i^{\theta},$$

where P_i is the price of a differentiated product. The utility function, the production function and the cost function imply symmetrical solutions of the outputs of companies and their prices in the monopolistic competitive sector. Therefore, if the outputs of each company are the same, the price is

(2.4a) $$P = \frac{s}{1-s} Y \frac{1}{Xn}.$$

If the number of companies is sufficiently large, the condition for profit maximization for companies is

(2.5) $$P\theta = w\beta.$$

The zero profit condition for companies is

(2.6) $$PX = r\gamma + w\beta X.$$

In the sector of constant returns to scale, the condition for profit maximization is

(2.7), (2.8) $$wL_y = (1-\varepsilon)Y, \qquad rK_y = \varepsilon Y.$$

The endowment constraints in the economy are

(2.9), (2.10) $$L = L_y + nL_x, \qquad K = K_y + n\gamma.$$

By solving these equations, the number of companies in the monopolistic competitive sector, the output of one company, and the output of the homogeneous good are

(2.11) $$n_m = \frac{K}{\gamma}\cdot\frac{s(1-\theta)}{z},$$

(2.12) $$X_m = \frac{\gamma}{k\beta}\cdot\frac{\theta z}{(1-\theta)(1-z)},$$

(2.13) $$Y_m = k^{\varepsilon}L\cdot(1-s)\left(\frac{\varepsilon}{z}\right)^{\varepsilon}\left(\frac{1-\varepsilon}{1-z}\right)^{1-\varepsilon},$$

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

Using (2.1) and (2.11)-(2.13), we obtain the utility level U_m.

STRUCTURAL REGULATION IN A CLOSED ECONOMY

The market equilibrium is the equilibrium of free-entry and zero profit. However, we now suppose that the government has a strong authority and a wise administration. That is, a government is a planner who can regulate the number of companies in the monopolistic competitive sector. Besides, as a result of the regulation, if the companies are in a deficit, the planner gives them a subsidy to cover the deficit so that the companies can produce even in a deficit. This means that the government can transfer income from households (workers and owners of capital) to companies through taxes and subsidies. In this policy, when the highest utility level is achieved, it is a constrained social optimum. We call this the constrained optimum.

When such a regulation is put into action, each company acts on profit maximization as "marginal revenue equals marginal cost". As a result, if companies are in a deficit, the government transfers income to cover the deficit.

The planner decides the number of companies in the monopolistic competitive sector as n_n. Then, solving (2.2), (2.4a), (2.5) and (2.7)-(2.10), we express the output of one company and homogeneous product, X_n and Y_n, as

$$X_n = \frac{s\theta}{\beta\{1-(1-s)\varepsilon - s(1-\theta)\}n_n} L,$$

$$Y_n = (K - n_n\gamma)^{\varepsilon}\left(\frac{(1-s)(1-\varepsilon)}{1-(1-s)\varepsilon - s(1-\theta)} L\right)^{1-\varepsilon}.$$

Optimum n_n is the solution of the following calculation

$$\max_{n_n} \quad U = Y_n^{1-s}(n_n X_n^{\theta})^{\frac{s}{\theta}}.$$

Solving this, we obtain optimum n_n as

(3.1) $$n_n = \frac{K}{\gamma} \cdot \frac{s(1-\theta)}{\theta(1-s)\varepsilon + s(1-\theta)}.$$

Using (3.1), we obtain

(3.2) $$X_n = \frac{\gamma}{k\beta} \cdot \frac{\theta\{\theta(1-s)\varepsilon + s(1-\theta)\}}{(1-\theta)(1-z)},$$

(3.3) $$Y_n = k^{\varepsilon} L(1-s) \cdot \left(\frac{\theta\varepsilon}{\theta(1-s)\varepsilon + s(1-\theta)}\right)^{\varepsilon}\left(\frac{1-\varepsilon}{1-z}\right)^{1-\varepsilon}.$$

With (2.1) and (3.1)-(3.3), we obtain the utility level U_n.

EFFECT OF STRUCTURAL REGULATION IN A CLOSED ECONOMY

In the preceding section, we obtained the optimum outputs, the number of companies, and the utility levels of structural regulation. We compare each amount in this section.

Comparing (2.11)-(2.13) with (3.1)-(3.3), we obtain the following result.[1]

$$\frac{n_n}{n_m} = \frac{(1-s)\varepsilon + s(1-\theta)}{\theta(1-s)\varepsilon + s(1-\theta)} > 1, \quad \frac{X_n}{X_m} = \frac{\theta(1-s)\varepsilon + s(1-\theta)}{(1-s)\varepsilon + s(1-\theta)} < 1, \quad n_m X_m = n_n X_n,$$

$$\frac{Y_n}{Y_m} = \left(\frac{\theta\{(1-s)\varepsilon + s(1-\theta)\}}{\theta(1-s)\varepsilon + s(1-\theta)}\right)^{\varepsilon} < 1, \quad \frac{U_n}{U_m} = \theta^{\varepsilon(1-s)}\left(\frac{(1-s)\varepsilon + s(1-\theta)}{\theta(1-s)\varepsilon + s(1-\theta)}\right)^{\varepsilon(1-s)+\frac{s}{\theta}(1-\theta)} > 1.$$

We get $n_n > n_m$, that is, the number of companies in the constrained optimum is larger than that in the market equilibrium. This means the government must promote companies to enter in the monopolistic competitive sector, and must cover the deficits of each company. The government must increase the number of varieties because the utility function (2.1) is a love-of-variety type.

However at this time, the government must reduce the output of one company. In the differentiated good sector, the production function is under economies of scale. By reducing the output of one company, the merit of economies of scale is lost. Therefore, the government reduces the output of the homogeneous good and concentrates the endowment in the differentiated good sector. Then $n_m X_m = n_n X_n$ is realized.

As a result, the utility level of constrained optima is always higher than that of the market equilibrium. This means that if two countries (or a country and the rest of the world), which trade each other and have similar production technology and consumption patterns, institute the same industrial policy, both countries (or the world) increase their utility levels.

MARKET EQUILIBRIUM IN AN OPEN ECONOMY

In this section, we explain the open economy model of Lawrence=Spiller (1983).

The utility functions in each country are

(5.1-1)
$$U = y^{1-s}\left(\sum_{i=1}^{n} x_{1i}{}^{\theta} + \sum_{i=1}^{n^*} x_{2i}{}^{\theta}\right)^{\frac{s}{\theta}},$$

(5.1-2)
$$U^* = y^{*1-s}\left(\sum_{i=1}^{n} x_{1i}{}^{*\theta} + \sum_{i=1}^{n^*} x_{2i}{}^{*\theta}\right)^{\frac{s}{\theta}},$$

where y is the consumption of the homogeneous good, x_{ji} is the consumption of one differentiated good in the home country, and * refers to the consumption in the foreign country. The subscripts 1 and 2 refer to the production location of the good: 1 is home production, while 2 is foreign production. n and n^* are the number of companies in the monopolistic competitive sector in home and foreign country, respectively.

The output of one company in the monopolistic competitive sector, X_{ji}, is defined as

$$X_{ji} = x_{ji} + x_{ji}^*, \qquad \text{for } j=1,2, \quad i=1,\cdots,n.$$

Y and Y^* are the outputs of homogeneous good in the home country and in the foreign country, respectively. Their sum is the same as the sum of consumption in both countries. This relation is represented as

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

The budget constraints in each country are

(5.3-1) $$y+\sum_{i=1}^{n} P_{1i}x_{1i} +\sum_{i=1}^{n^*} P_{2i}x_{2i} = Y+\sum_{i=1}^{n} P_{1i}x_{1i} +\sum_{i=1}^{n} P_{1i}^{*}x_{1i}^{*},$$

(5.3-2) $$y^* +\sum_{i=1}^{n} P_{1i}^{*}x_{1i}^{*} +\sum_{i=1}^{n^*} P_{2i}^{*}x_{2i}^{*} = Y^*+\sum_{i=1}^{n^*} P_{2i}x_{2i} +\sum_{i=1}^{n^*} P_{2i}^{*}x_{2i}^{*},$$

where P_{ji} and $P_{ji}*$ are the price of the differentiated good in the home country and in the foreign country, respectively.

Maximizing (5-1) yields the first-order condition:

(5.4-1) $$P_{ji} =\frac{s}{1-s} yx_{ji}^{\theta-1} \Big/ \left(\sum_{i=1}^{n} x_{1i}^{\theta} +\sum_{i=1}^{n^*} x_{2i}^{\theta}\right), \qquad \text{for } j=1,2,$$

(5.4-2) $$P_{ji}^* =\frac{s}{1-s} y^* x_{ji}^{*\theta-1} \Big/ \left(\sum_{i=1}^{n} x_{1i}^{*\theta} +\sum_{i=1}^{n^*} x_{2i}^{*\theta}\right), \qquad \text{for } j=1,2.$$

We assume that each company of the two countries has the same production technology. This assumption implies symmetrical solutions of the output of companies in the monopolistic competitive sector inside each country.

In an open economy, the prices of a differentiated good become the same in the two countries. Thus (5.4) becomes

(5.5-1) $$P_1 =\frac{s}{1-s} y\frac{x_1^{\theta-1}}{nx_1^{\theta} + n^* x_2^{\theta}} =\frac{s}{1-s} y^*\frac{x_1^{*\theta-1}}{nx_1^{*\theta} +n^* x_2^{*\theta}},$$

(5.5-2) $$P_2 =\frac{s}{1-s} y\frac{x_2^{\theta-1}}{nx_1^{\theta} + n^* x_2^{\theta}} =\frac{s}{1-s} y^*\frac{x_2^{*\theta-1}}{nx_1^{*\theta} +n^* x_2^{*\theta}},$$

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

The production functions of the homogeneous good are

(5.6-1), (5.6-2) $$Y = K_y^{\varepsilon} L_y^{1-\varepsilon}, \qquad Y^* = K_y^{*\varepsilon} L_y^{*1-\varepsilon}.$$

Therefore, the first-order conditions for profit maximization in the homogeneous good industry are

(5.7-1), (5.7-2) $$wL_y = (1-\varepsilon)Y, \qquad w^* L_y^* = (1-\varepsilon)Y^*,$$

(5.8-1), (5.8-2) $$rK_y = \varepsilon Y, \qquad r^* K_y^* = \varepsilon Y^*.$$

The endowment constraints are

(5.9-1), (5.9-2) $$L = L_y + n\beta(x_1 + x_1^*), \qquad L^* = L_y^* + n^* \beta(x_2 + x_2^*),$$

(5.10-1), (5.10-2) $$K = K_y + n\gamma, \qquad K^* = K_y^* + n^* \gamma.$$

The first-order conditions for profit maximization in the heterogeneous good industry are

(5.11-1), (5.11-2) $\qquad P_1\theta = w\beta, \qquad P_2\theta = w^*\beta$.

The zero profit conditions in the heterogeneous good industry are

(5.12-1) $\qquad P_1(x_1 + x_1^*) = r\gamma + w\beta(x_1 + x_1^*)$,

(5.12-2) $\qquad P_2(x_2 + x_2^*) = r^*\gamma + w^*\beta(x_2 + x_2^*)$,

where K_y, L_y, r, and w are the capital input in the homogeneous industry, the labor input in the homogeneous industry, the rental rate, and the wage rate in the home country, respectively. * refers to the foreign country.

We have supposed that each company of the two countries has the same production technology. In an open economy, we also suppose that factor prices are equalized between the two countries, that is, $w = w^*$ and $r = r^*$. Accordingly, we suppose that the prices of a home-made differentiated good and that of a foreign-made differentiated good are equalized, that is, $P = P^*$. Then, the outputs of a company in the home country and in the foreign country become equal.

At this time, taking $y/x = y^*/x^* = (y + y^*)/X$ into account, (5.5) is expressed as

(5.13) $$P = \frac{s}{1-s}\frac{y + y^*}{(n + n^*)X}.$$

Then, we obtain the output of each good in both countries by solving these equations in the same way as the closed economy model.

Now, we introduce the following variables,

(5.14) $$a = \frac{2K^*/L^*}{K/L + K^*/L^*}, \qquad 0 \le a \le 2,$$

(5.15) $$\lambda = \frac{1}{2}\left(\frac{K^*}{K} + \frac{L^*}{L}\right), \qquad \lambda > 0.$$

a is a measure of the capital-labor differential, and λ is a measure of size. When $a > 1$, the foreign country is capital-abundant.

Thus, the factor endowments in the world are

$$K' = K + K^* = (1 + a\lambda)K, \qquad L' = L + L^* = \{1 + (2 - a)\lambda\}L, \qquad k' = \frac{K'}{L'} = \delta k,$$

where $\delta = \dfrac{1 + a\lambda}{1 + (2 - a\lambda)}$.

As a result, the number of companies in the world is

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

The output of a company is

$$X = \frac{\gamma}{k'\beta} \cdot \frac{\theta z}{(1-\theta)(1-z)}.$$

The output of the homogeneous good in the world is

$$Y + Y^* = k'^{\varepsilon} L' \cdot (1-s)\left(\frac{\varepsilon}{z}\right)^{\varepsilon}\left(\frac{1-\varepsilon}{1-z}\right)^{1-\varepsilon}.$$

Here, the shares of capital and labor in production are z and $1-z$, so the share of GNP of the home country in the world is

$$\pi_1 = z \cdot \frac{K}{K+K^*} + (1-z) \cdot \frac{L}{L+L^*} = \frac{z}{1+a\lambda} + \frac{1-z}{1+(2-a)\lambda}.$$

Then the consumption of a differentiated good in the home country is

(5.17) $$x = \pi_1 X = \frac{z\gamma\theta}{\beta(1-\theta)(1+a\lambda)k}\left(\frac{z}{1-z} \cdot \frac{1}{\delta} + 1\right).$$

The consumption of a homogeneous good in the home country is

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

Using these variables, we obtain the utility level of the home country U.

We can now calculate the consumption in the foreign country, x^* and y^*, as $x^* = X - x$ and $y^* = Y + Y^* - y$, and also obtain the utility level of the foreign country U^*.

STRUCTURAL REGULATION IN AN OPEN ECONOMY

In the fourth section, we showed that the utility level realized by structural regulation is higher than that of the market equilibrium. Therefore, if two countries engage in the same industrial policy, both countries increase their utility levels.

In actuality, it is unrealistic to suppose that two countries trading with each other (or, all countries trading with one another) will cooperate on the same industrial policy. Rather we should attend to the industrial policy of one country in an open economy. In fact, it is often observed that a country undertakes structural regulation by some barriers or regulations in an open economy.

In this section, we analyze the situation when only one country enacts structural regulation in an open economy.

In this situation, factor prices are not equalized between the two countries. Accordingly, the price of a home-made differentiated good and a foreign-made differentiated good are not equalized, that is, $P_1 \neq P_2$. Furthermore, the condition of zero profit in the heterogeneous good industry in the home country is not realized, but this condition is realized in the foreign country.

K, L, K^*, L^*, γ, β, ε, s and θ are constants. When n is given, x_1, x_2, y, x_1^*, x_2^*, y^*, n^* and other variables are solutions to the simultaneous equation (5.2), (5.3), (5.5)-(5.11) and (5.12-2). However, we cannot solve this simultaneous equation. By simulating different values for the parameters (constants and n), we obtain a solution for this simultaneous equation.

When we solve this simultaneous equation, the home country must find the optimum number of companies to maximize the utility level of the home country. The number, n, is the solution to the calculation

$$\max_{n} \quad U = y^{1-s}(nx_1^{\theta} + n^* x_2^{\theta})^{\frac{s}{\theta}}$$

$$\text{s. t.} \quad (5.2),\ (5.3),\ (5.5)\text{-}(5.11) \text{ and } (5.12\text{-}2).$$

Thus, we obtain the optimum value of n.

At the same time, we also obtain the utility levels of the home country and the foreign country.

EFFECT OF STRUCTURAL REGULATION IN AN OPEN ECONOMY

In the preceding section, we obtained the optimum outputs, the number of companies, and the utility levels of structural regulation. In this section, we compare and then analyze the effect of structural regulation on the home country and the foreign country.

Our analysis shows that structural regulation in the home country, which increases the utility level of the home country, may also increase the utility level of the foreign country. This result is interesting.

For example, we have a result of structural regulation in Table 1 where $K=K^*=400$, $L=L^*=500$, $\gamma=4$, $\beta=3$, $\varepsilon=0.3$, $s=0.5$, $\theta=0.4$.

Table 1: Number of companies in foreign country, consumption, prices, and utility levels in both countries (compared with market equilibrium) when home country undertakes structural regulation on $K=K^*=400$, $L=L^*=500$, $\gamma=4$, $\beta=3$, $\varepsilon=0.3$, $s=0.5$, $\theta=0.4$.

n	n^*	x_1	x_1^*	P	x_2	x_2^*	P^*	y	y^*	U	U^*	note
63	65.52	.995	.995	1.003	1.005	1.005	.997	1.0003	10003.	.9998	.9998	
64	64.56	.999	.999	1.001	1.001	1.001	.999	1.0001	1.0001	.9999	.9999	
64.29	64.29	1	1	1	1	1	1	1	1	1	1	
65	63.59	1.003	1.003	.998	.997	.997	1.001	.9998	.9998	1.0001	1.0001	
⋮												
72	56.61	1.029	1.029	.980	.968	.969	1.016	.9977	.9982	1.00065	1.0012	
73	55.58	1.033	1.034	.977	.964	.965	1.018	.9973	.9980	1.00066	1.0013	U max
74	54.54	1.037	1.038	.974	.960	.961	1.020	.9970	.9978	1.00065	1.0015	
⋮												
81	46.99	1.067	1.070	.954	.930	.933	1.036	.9939	.9964	1.0001	1.0026	
82	45.87	1.072	1.075	.951	.926	.929	1.038	.9934	.9962	.9999	1.0028	
83	44.74	1.077	1.080	.948	.922	.925	1.041	.9928	.9960	.9997	1.0029	

Table 1 shows a case in which structural regulation increases the utility level of the foreign country. In the market equilibrium, the number of companies in the home country is 64.29. As the home country increases this number, the utility level of both countries increase. When the home country regulates the number as 73, the utility level of the home country is maximized, so the optimum n is 73. When the home country increases the number over 73, the utility level of the home country decreases. However the utility level of the foreign country continues to increase. On the contrary, when the home country reduces the number of companies to under 64.29, the utility levels of both countries decrease.

Table 1 also shows interesting changes in each amount. As stated in the fourth section, structural regulation that increases the number of companies reduces the output of a company in the closed economy. However, as shown in Table 1, as the home country increases the number of companies in the home country, the consumption of a home-made differentiated good, x_1 and x_1^*, increases. Its price then becomes cheaper due to economies of scale. At the same time, this policy reduces the consumption of a foreign-made differentiated good, x_2 and x_2*.

We find that if $\varepsilon+\theta<1$, this strange phenomenon happens.[2] On the contrary, if $\varepsilon+\theta>1$, structural regulation that increases the number of companies in the home country reduces x_1 and x_1*, and increases x_2 and x_2*.

From other simulations, we obtain the result where if $K/L=K*/L*$ is realized, structural regulation that increases the number of companies in the home country increases the utility levels of both countries on any value of each constant.[3] This means that $\frac{\partial U}{\partial n}>0$ and $\frac{\partial U*}{\partial n}>0$ is locally realized at the point of the market equilibrium.[4] Then we obtain proposition 1.

PROPOSITION 1. If the factor endowment ratios of two countries are the same, structural regulation in the home country increases the utility levels of both countries.

However, if the factor endowment ratio of two countries is not the same, structural regulation that increases the utility level of the home country does not always increase the utility levels of the foreign country.

To analyze this, we use the following variables,

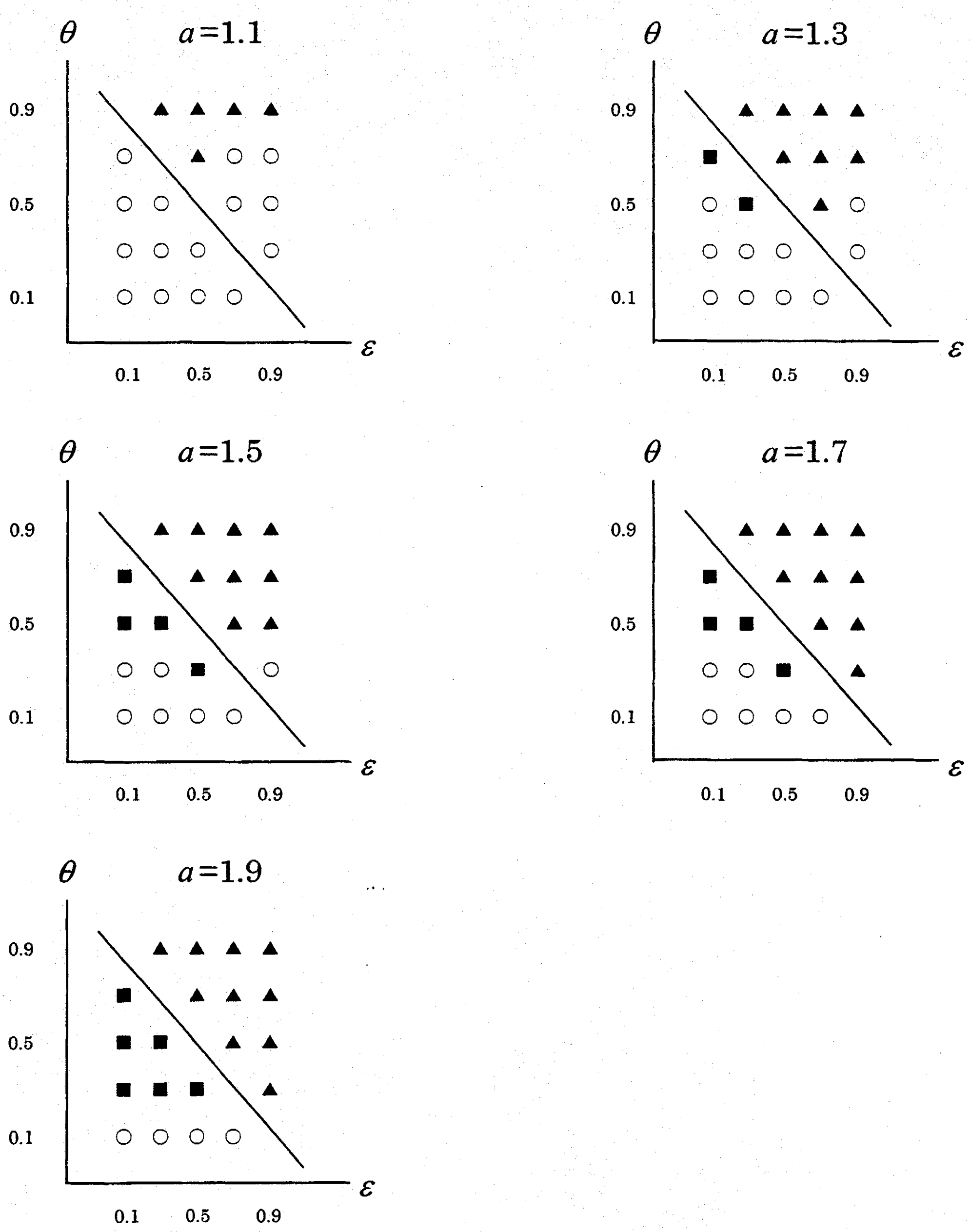
$$a=\frac{2K*/L*}{K/L+K*/L*}, \qquad 0\le a\le 2, \tag{5.14}$$

$$\lambda=\frac{1}{2}\left(\frac{K*}{K}+\frac{L*}{L}\right), \qquad \lambda>0. \tag{5.15}$$

From other simulations, we find the relation between a and $2-a$. If $\frac{\partial U}{\partial n}>0$ and $\frac{\partial U*}{\partial n}>0$ is realized on $a=a'$, $\lambda=\lambda'$, $\varepsilon=\varepsilon'$, $s=s'$ and $\theta=\theta'$, then $\frac{\partial U}{\partial n}>0$ and $\frac{\partial U*}{\partial n}>0$ on $a=2-a'$, $\lambda=\lambda'$, $\varepsilon=\varepsilon'$, $s=s'$ and $\theta=\theta'$. In this case, a and $2-a$ are symmetrical.

However, if $\frac{\partial U}{\partial n}<0$ and $\frac{\partial U*}{\partial n}>0$ is realized on $a=a'$, $\lambda=\lambda'$, $\varepsilon=\varepsilon'$, $s=s'$ and $\theta=\theta'$, then $\frac{\partial U}{\partial n}>0$ and $\frac{\partial U*}{\partial n}<0$ on $a=2-a'$, $\lambda=\lambda'$, $\varepsilon=\varepsilon'$, $s=s'$ and

Figure 1: Effect of structural regulation in an open economy on λ=1, s=0.5.



○: $\frac{\partial U}{\partial n} > 0$ and $\frac{\partial U^*}{\partial n} > 0$, ▲: $\frac{\partial U}{\partial n} < 0$ and $\frac{\partial U^*}{\partial n} > 0$, ■: $\frac{\partial U}{\partial n} > 0$ and $\frac{\partial U^*}{\partial n} < 0$

Declining lines express $\varepsilon + \theta = 1$. When it is realized, there is no factor price equalization range, so we eliminate this case.

$\theta=\theta'$. In this case, a and $2-a$ are asymmetrical.[5]

Furthermore, the values of γ and β do not affect the signs of $\frac{\partial U}{\partial n}$ and $\frac{\partial U^*}{\partial n}$.

PROPOSITION 2. If structural regulation in the home country increases the utility levels of both countries on some values of a, λ, ε, s and θ, a and $2-a$ have a symmetrical effect.

If structural regulation in the home country cannot increase the utility levels of both countries on some values of a, λ, ε, s and θ, a and $2-a$ have an asymmetrical effect.

For size of a, we examine Figure 1.

Figure 1 shows how the capital-labor differential has an impact on structural regulation. As a result, we obtain the tendency where as a grows from 1, and the range of $\frac{\partial U}{\partial n}>0$ and $\frac{\partial U^*}{\partial n}>0$ shrinks. Furthermore, from other simulations, we find that this tendency is realized on any value of λ and s.

PROPOSITION 3. The larger differential two countries have in the factor endowment ratio, the smaller range in which structural regulation increases the utility levels of both countries.

These propositions mean that if two countries (or a country and the rest of the world) have similar factor endowment ratio, structural regulation, which increases the utility level of the home country, have a positive effect on the foreign country (or all the world).

CONCLUSION

This paper has described a two-country, two-good, two-factor general equilibrium model, analyzed the effect of structural regulation, and obtained some results.

First, if two countries, which trade each other and have similar production technology and consumption patterns, enact the same industrial policy, both countries increase their utility levels.

Second, if two countries have similar factor endowment ratios, the policy in a country increases the utility levels of the both countries. Furthermore, if the factor endowment ratios of the two countries are the same, the policy always increases the utility levels of the both countries.

After all, if two countries have similar property in technology, consumption pattern and factor endowment ratio, structural regulation, whether done by one country or the two countries together, benefits both the home country and the foreign country.

We cannot clarify the reason for the second result and require further research to uncover this reason. However, this result implies a new direction in an industrial policy, which is not the same as simple liberalization or protection.

NOTES

1. We simulate different values for the parameters in their respective range to analyze the value of U_n/U_m.
2. $\varepsilon+\theta<1$ means the differentiated good industry is capital-intensive.
3. Parameters are given values in their respective range.
4. The word locally means, as we have seen in Table 1, that these signs may change when n is significantly different from the value of the market equilibrium.
5. $\partial U/\partial n<0$ and $\partial U^*/\partial n>0$ may be realized if $a>1$ and $\varepsilon+\theta>1$, or $a<1$ and $\varepsilon+\theta<1$.

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