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Industry Specific Interests and Trade Protection: A Game Theoretic Analysis*/

by

Masahiro Okuno-Fujiwara

and

Kaoru Ueda

Masahiro Okuno-Fujiwara
Faculty of Economics
University of Tokyo

Kaoru Ueda
Department of Economics
Nanzan University

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1. Introduction

Recently, many trade disputes arose between importing and exporting countries. Often times and notably between the U.S. and Japan, these disputes were resolved by bilateral negotiations over a specific commodity which resulted in some form of domestic market protection. This tendency for managed trade forms a sharp contrast to the philosophy of GATT, which aims at a non-discriminating multilateral agreement to achieve free trade in commodities and services.

Undoubtedly, one of the major causes of this tendency lies in a rise of protectionism, which is aggravated by political activities to obtain protection for domestic industries. It is the industry-specific interests that are the major factor in producing protection of the industry. As is reviewd by Hillman [1989] and Magee, Brock and Young [1989], this assertion is confirmed in empirical studies as well. As long as these political activities are allowed and the choice of a policy is affected by these activities, some form of protection may be unavoidable. Nonetheless, actual outcome would depend on the international rules of how trade negotiations take place and what trade policies are at issue. GATT represents one such rule and managed trade is another. In this paper, we compare economic implications of different rules over trade negotiation and trade policy, focusing on the problem of deversified interests among import-competing industries in a country.

Whether trade protection policy is implemented through import tariff or import quota, its main effect is to raise the domestic price of an import-competing good. When producer groups of several industries engage in lobbying activities, they compete each other to raise relative price of

their product. Several papers, such as Findley and Wellisz [1982] and Wellisz and Wilson [1986], have studied these conflicts of industry-specific interests. They modeled conflicts as those between an import-competing industry and an exporting industry.

In the real world, however, more than one import-competing industries engage in lobbying activities to obtain trade protection. Thus, in many situations, it is more realistic to consider conflicts of industry-specific interests among import-competing industries. We analyze a situation where many import-competing industries seek for tariff and quota protection for their own products in order to raise relative price of their products.

To be concrete, we consider a small country which produces three goods with industry specific factors. Among three industries, two are import-competing and the third is exporting. For simplicity, the exporting industry is assumed to remain politically passive and only import-competing industries apply their political power to achieve the level of protection they desire. To focus on welfare and distributional implications, we ignore lobbying costs.

Using this setting, we first compare two different processes to determine tariff level of the industries; in one, protection to each industry is determined independent of decision for other industries (non-cooperative game) and, in the other, protection to all industries is determined jointly and simultaneously (cooperative game).

Difference between these two types of lobbying games is intended to reflect a difference in actual international trade negotiations. When an importing country and an exporting country negotiate over possible trade protections over more than one products, two countries can negotiate either on protection of each individual good separately (hereafter, single-issue

negotiation), or on protection of all the relevant products simultaneously (hereafter, multi-issue negotiation). In our set-up, the importing country being a small country in the world, protection of domestic industries would not affect the welfare of the rest of the world. Thus, there is no incentive to resist protection in the part of exporting countries and the outcome of international negotiation should directly reflect the demand of the importing country. In the case of multi-issue negotiation, however, once protection of all industries is determined, each lobbying industry cannot let the government unilaterally change protection of its own product. Thus lobbying industries must commit themselves to simultaneously determined protection level. Lobbying industries can use this committment to accomplish binding agreements. Difference in outcomes between single-issue and multi-issue negotiations must lie in the fact that whether the lobbying industries of one country act independently, as in the single-issue negotiation, or they negotiate the levels of protection before they demand protection in the international table, as in the multi-issue negotiation.

Comparing the outcomes of non-cooperative game and cooperative game, we find that cooperative game outcome may be better not only for the lobbying industries but also for non-lobbying (exporting) industry. Significance of this result is clear if we remember the hypothesis of "rational ignorance" implicit in the models of policy determination through lobbying activities. That is, in representative democracy, little gain from voting can be expected for individuals whose costs of voting and acquiring information are large. These costs prevent them from participating in voting unless there is a strong specific interest that more than offsets these costs. This is why relatively small coalition of the producers can affect trade policy for

industry, while consumers, who are massive in number, exert little political influence.

Because of this hypothesis, one often expects lobbying activities would not improve welfare of any group other than the group engaging in the lobbying. Feenstra and Bhagwati [1982] even went to point out the possibility that the government gives incentive to lobbying groups to refrain their activities using income transfers financed from tariff revenue. Our proposition suggests drastically different possibility of welfare improvement by requiring all import-competing industries to decide their protection level jointly.

The comparison just described will be shown for the rule that requires countries to employ tariff as a trade restriction measure. Next we compare it with the rule that uses quota. Recently, non-equivalence of tariff and quota is shown to occur from several causes such as imperfect competition, retaliation, and uncertainty, etc. Among others, Bhagwati and Srinivasan [1980] showed that lobbying activities of revenue seeking causes non-equivalence of tariff and quota. We shall identify yet another cause of non-equivalence by lobbying activities that results from the strategic nature of tariff and quota in lobbying industries. After characterizing the difference between the non-cooperative equilibria with tariff (the tariff competition equilibrium) and with quota (the quota competition equilibrium), we shall show that even the welfare-ranking of these equilibria is possible in the symmetric case. This ranking does not require strict symmetry of the import-competing industries, and based on this observation one could determine whether import-tariff or import-quota is desirable for a country as a means of protection if the industries under protection are not so asymmetric.

In section 2, we describe a model. Section 3 defines the non-cooperative game of protection with tariff and characterizes the tariff competition equilibrium. In section 4, we introduce the possibility of negotiation between import-competing industries and investigate its welfare implication for the entire economy. In section 5, we extend our model to compare tariff competition and quota competition and derive a welfare ranking of these different means of protection of domestic industries. Section 6 concludes the paper.

2. The Model

We consider a small country which produces three goods. The first good (called the 0-th good) is export under free trade and will be treated as the numeraire. Both of the first and the second goods are import under free trade. In each of the industries that produces import, we assume producers form a pressure group in order to force the government of the country to protect their domestic market. For simplicity, producers of the export industry are assumed not to engage in such political activities. In other words, only producers of the import-competing industries, the lobbying industries for short, are players of our trade protection game.

Throughout this paper, we shall adopt an extreme version of the specific factors model in which all factors are immobile in the short-run from the industry where they are initially employed. Individuals are assumed to own factors that are used in only one industry. It follows that the difference in the name of factors is irrelevant and factor owners of an industry can be treated as if they have a fixed amount of the industry's product.[1/] In the rest of this paper, we shall call factor owners of i-th

industry, who are assumed to be identical, producers of the i-th industry and denote its number by L_i. Moreover we employ a usual assumption that all individuals in this country have an identical homothetic preference. In doing so, we focus on conflict of interests generated by a change in income share among different industries when different form of trade protections takes place.

Prior to the political game of trade protection, we assume free trade prevails in this country. In the long-run, all factors are mobile and the standard competitive equilibrium is assumed to have been realized. This country being a small country, the world price is given by a triplet (π_0, π_1, π_2) where π_0 is assumed to be unity as 0-th good is the numeraire. Let production at the original free trade equilibrium be given by (X_0, X_1, X_2). It follows that the national income is given by

$$(2\text{-}1) \qquad y(\pi_1, \pi_2) = X_0 + \pi_1 X_1 + \pi_2 X_2$$

Because of the assumption of identical and homothetic preferences, welfare of the representative individual is given by

$$(2\text{-}2) \qquad V(\pi_1, \pi_2) = v(\pi_1, \pi_2) \cdot y(\pi_1, \pi_2)/L$$

where $v(\pi_1, \pi_2)$ is the indirect utility function of the representative individual when his income is unity, and $L = L_0 + L_1 + L_2$ is the number of producers in the industry. By the assumption of free trade, $V(p_1, p_2)$ is maximized at (π_1, π_2).

Let $\phi^i(\pi_1, \pi_2) = \pi_i X_i / y(\pi_1, \pi_2)$, the income share of the i-th industry. It follows that the welfare level of the representative producer of i-th industry is written as

$$(2\text{-}3) \qquad V^i(\pi_1, \pi_2) = v(\pi_1, \pi_2) \cdot \phi^i(\pi_1, \pi_2) \cdot y(\pi_1, \pi_2)/L_i \qquad i = 0, 1, 2.$$

In this and the next two sections, we shall analyze the effect of trade protection game when protection is provided in the form of import tariff,

while in section 4 we shall analyze a similar game when protection takes the form of import quota. Because only the import industries obtain protection, $\boldsymbol{\rho} = (\rho_1, \rho_2)$ summarizes the resulting tariff protection where ρ_i is the tariff per quantity on i-th industry's product.

Given $\boldsymbol{\rho}$, the equilibrium domestic price $\mathbf{p}(\boldsymbol{\rho}) = (p_1(\boldsymbol{\rho}), p_2(\boldsymbol{\rho}))$ is characterized as

$$(2\text{-}4) \qquad y(\mathbf{p}(\boldsymbol{\rho})) = X_0 + p_1(\boldsymbol{\rho})X_1 + p_2(\boldsymbol{\rho})X_2 + \rho_1 M_1(\mathbf{p}(\boldsymbol{\rho})) + \rho_2 M_2(\mathbf{p}(\boldsymbol{\rho}))$$

where $y(\mathbf{p}(\boldsymbol{\rho}))$ is the national income and $M_i(\mathbf{p}(\boldsymbol{\rho}))$ is the amount of import of i-th good. Note that, in view of Roy's identity, $\frac{\partial}{\partial p_i} v(\mathbf{p}(\boldsymbol{\rho}))/v$ denotes the representative individual's demand for i-th good when his income is unity. Then,

$$(2\text{-}5) \qquad M_i(\mathbf{p}(\boldsymbol{\rho})) = y(\mathbf{p}(\boldsymbol{\rho})) \cdot \frac{\partial}{\partial p_i} v(\mathbf{p}(\boldsymbol{\rho}))/v - X_i \qquad \text{for } i = 1, 2.$$

Because of tariff, domestic price must satisfy

$$(2\text{-}6) \qquad p_i(\rho) = \pi_i + \rho_i \qquad \text{for } i = 0, 1, 2.$$

where $\rho_0 = 0$.

Throughout the paper, we shall asume that:

A.1. $\mathbf{M}(\mathbf{p}) = (M_1(\mathbf{p}), M_2(\mathbf{p}))$ is continuously differentiable and its Jacobian is positive definite for all $\mathbf{p}$.

This assumption is innocuous, as the properties often assumed in the literature, such as the dominant diagonal property of the Jacobian matrix, are consistent with this assumption. However, it will play a critical role in the rest of the paper.

Actually, the formulation (2-6) is not exact. Tariff protection should reduce imports, but it should not make imports negative. Thus if tariff is prohibitive and $M_i(\mathbf{p}(\boldsymbol{\rho})) = 0$, domestic prices settle at the level where

domestic consumption equals domestic production, and (2-6) must be replaced by an inequality $p_i(\boldsymbol{\rho}) \leq \pi_i + \rho_i$. We shall, however, employ the formulation (2-4)-(2-6) for the sake of expositional simplicity and provide remarks on prohibitive tariff whenever appropriate.

By the assumption of identical and homothetic preference, welfare level of the representative producer of the i-th industry can be written as

$$(2\text{-}7) \qquad V^i(\mathbf{p}(\boldsymbol{\rho})) = v(\mathbf{p}(\boldsymbol{\rho}))\cdot\phi^i(\mathbf{p}(\boldsymbol{\rho}))\cdot y(\mathbf{p}(\boldsymbol{\rho}))/L_i$$
$$= V(\mathbf{p}(\boldsymbol{\rho}))\cdot\phi^i(\mathbf{p}(\boldsymbol{\rho}))\cdot L/L_i, \qquad \text{for } i = 0, 1, 2,$$

where ϕ^i is the i-th industry's income share and $V(\mathbf{p})$ is indirect utility of the representative individual of the economy. Following Mayer [1984], we assume that the tariff revenue is distributed to factor owners neutrally; neutral in that a factor owner's share of tariff revenue is the same as his factor income share. Then, i-th industry's income share is identical to its share in the value added,[2/]

$$\phi^i(\mathbf{p}(\boldsymbol{\rho})) = \frac{p_i(\boldsymbol{\rho})X_i}{X_0 + p_1(\boldsymbol{\rho})X_1 + p_2(\boldsymbol{\rho})X_2} \qquad \text{for } i = 0, 1, 2,$$

Suppose, initially, free trade prevails and $(\rho_1,\rho_2) = (0,0)$. For industry i = 1, 2, desires to protect its own industry may be measured by the derivative of its own indirect utility function with respect to its own tariff, which measures the change in its utility level generated by an increase in domestic price of its product. In view of (2-7) and using Roy's identity, the derivative with respect to j-th tariff is given by,

$$(2\text{-}8) \qquad \frac{1}{V^i}\cdot\frac{\partial V^i}{\partial \rho_j} = \frac{\partial\phi^i/\partial\rho_j}{\phi^i} + \frac{\partial y/\partial\rho_j}{y} - \delta_j \qquad \text{for } i = 1, 2,$$

where δ_j is the normalized demand for the j-th commodity when income is unity. Note that, from the property of homothetic utility function, demand

is proportional to income. (2-8) decomposes a change of utility for i-th industry producers into three separate effects.

The first term of the RHS corresponds to the effect from a change in the income share of the i-th industry. The second term corresponds to the effect from a change in national income, and the third to the effect from a change in the relative price. Note that the latter two effects universally affect all members of the country (universal effect), while the first effect is specific to the i-th industry (industry specific effect).

At free trade, the latter two effects of RHS (national income and relative price effects) must be zero as free trade must be the optimal for average individual. In view of the definition of ϕ^i, explicitly calculating the first term of the derivative with respect to i-th tariff and using the fact that $(p_1, p_2) = (0,0)$ yields

$$\frac{1}{V^i}\cdot\frac{\partial V^i}{\partial p_i} = [1 - \phi^i(\pi)]/L_i \qquad \text{for } i = 1, 2. \tag{2-9}$$

Producers of a lobbying industry hopes to realize tariff rates so as to make the value of the RHS of (2-9) zero. Roughly speaking, this value measures the incentive to protect the industry.

The following result is then immediate.

Proposition 1: (i) At free trade, each importing industry has a positive incentive to protect its own industry. (ii) This incentive is larger, the smaller is the industry's share of income, ϕ^i, in the economy.

Economic contents of this proposition is straightforward. By obtaining protection for its product, an industry can raise the price of its product and, hence, its share of income. Since this gain in income share is realized

by depriving shares from other industries, an industry with small original share has a larger incentive for protection.[3/]

Further, there must be a pair of positive tariffs $(\rho_1, \rho_2) > 0$ which makes both lobbying industries better off. This fact is easily verified by observing the following. Starting from free trade, impose tariffs on the first and the second goods at the same rate, i.e., $(\rho_1(t), \rho_2(t)) = (t\pi_1, t\pi_2)$ where $t > 0$. Then, if t is small enough, the income share of the lobbying industries, ϕ^i $(i = 1, 2)$, becomes approximately $(1+t)\phi^i(\pi)$. As free trade is the optimum for the representative individual of the economy, in view of (2-7) both lobbying industries will be better off at $(\rho_1(t), \rho_2(t))$ than at free trade when t is sufficiently small.

In the next section, we shall analyze the outcome of lobbying activities if more than one industries seek for protection of their own products.

3. Tariff Competition between Industries

Producers of lobbying industries aim to maximize the value of their representative indirect utility. For simplicity, we assume that each of these groups has enough political power so that the tariff rate of an industry is determined according to the industry's desire. It is frequently observed that producers of an industry succeed in obtaining their desirable trade protection. This is usually explained by the existence of information cost and voting cost in the real political environment and by the fact that the welfare losses that consumer's suffer from protecting an industry are widely dispersed, diminishing each consumer's incentive to resist such

protection.[4/] We assume the extreme where there is no political resistance to adoption of protection for the sake of simplicity.

In the following, we shall analyze two different types of lobbying games. In the first type, which we call non-cooperative games, producers of each industry seek for their protection independently. In the second type, which we call cooperative games, producers of both lobbying industries negotiate the levels of protection before final political decision is reached.

In non-cooperative games each producer group determines its tariff rate independently, and resultant overall tariff policy and economic welfare can be analysed by a Nash equilibrium of this game. In the equilibrium, each producer group of the lobbying industries chooses its tariff rate so as to maxmize its representative utility, given the other group's demand for tariff rate.

To analyze this equilibrium, we further assume:

A.2. For all i = 1, 2 and $\mathbf{p}$, $V^i(\mathbf{p})$ is continuously differentiable and strictly quasi-convex for all $\mathbf{p}$.

Then reaction (or best response) function for i-th industry (i = 1, 2) can be defined as;

$$R^i(\rho_j) = \underset{\rho_i}{\text{argmax}}\ V^i(\mathbf{p}(\rho)),$$

which we assume to be well-defined.

(Nash) equilibrium of our non-cooperative game is defined as the pair of tariff rates, $\boldsymbol{\rho}^{TN} = (\rho^{TN}_1, \rho^{TN}_2)$, such that, for i, j = 1, 2, $(i \neq j)$, $R^i(\rho^{TN}_j) = \rho^{TN}_i$. In order to simplify our exposition, we shall assume that:

A.3. There exists a unique equlibrium, $(\rho_1^{TN}, \rho_2^{TN})$, which is stable in the usual adjustment process.

4. The Effect of Tariff Negotiations

It is straightforward that the non-cooperative equilibrium is necessarily inefficient both from the viewpoint of entire economy and from the viewpoint of lobbying industries. This inefficiency results from the absence of redistribution policies that appropriate trade gains to each industry. We shall show, however, that another political process of our tariff game can improve welfare of all individuals without introducing a redistribution or eliminating protectionist lobby from the model.

To do this, we introduce a possibility of negotiation between the lobbying industries over tariff rates. Suppose the government offers a formal procedure so that, if and only if these industries reach an agreement, the government will implement it. Under the rules of multi-issue negotiation this procedure enables the lobbying industries to commit themselves to the agreement. Without such commitment, non-cooperative equilibrium in the previous section will necessarily arise as the outcome of the lobbying activities.

Outcome of the negotiation normally depends upon how the negotiation process takes place. If the negotiators are rational, however, the outcome should satisfy the following two properties. First, resulting tariff rates must be mutually efficient for the negotiating industries. Second, under the resulting tariff rates, neither of these industries should be worse off than under the non-cooperative equilibrium that would have been realized had the negotiation failed. In short, resulting tariff rates must be individually

rational (threat point of negotiation must be the non-cooperative equilibrium). In what follows, we shall assume the cooperative equilibrium must be mutually efficient and individually rational.

We can now compare welfare levels of each industry at the non-cooperative equilibrium and at the cooperative equilibrium.

Proposition 2: (i) Any equilibrium tariffs in cooperative game, $\boldsymbol{\rho}^C = (\rho_1^C, \rho_2^C)$, are necessarily lower than the equilibrium tariffs in non-cooperative game for both i = 1, 2, and (ii) not only both lobbying industries but also industry 0 are better off at any cooperative equilibrium than at the non-cooperative equilibrium.

Proof:(i) Note first the following two properties hold at (ρ_1^N, ρ_2^N).

$$L_i \frac{\partial V^i}{\partial \rho_i} = \frac{\partial \phi^i}{\partial \rho_i} \cdot v \cdot y + \frac{\partial vy}{\partial \rho_i} \cdot \phi^i = 0 \quad (i = 1, 2),$$

by the first order condition of the first industry. As $\partial \phi^i / \partial \rho_i = (1 - \phi^i) \cdot \phi^i / p_i$ is positive and $\partial \phi^j / \partial \rho_i = - \phi^i \phi^j / p_j$ is negative,

$$L_j \frac{\partial V^j}{\partial \rho_i} = \frac{\partial \phi^j}{\partial \rho_i} \cdot v \cdot y + \frac{\partial vy}{\partial \rho_i} \cdot \phi^j < 0 \qquad (i, j = 1, 2, \ i \neq j)$$

We shall prove that, if any tariff pair (ρ_1, ρ_2) is preferred by the first industry to $(\rho^{TN}_1, \rho^{TN}_2)$, then $\rho_2 < \rho^{TN}_2$. Suppose, contrary to the assertion, there is a pair of tariffs (ρ_1, ρ_2) which is preferred by the first industry to $(\rho^{TN}_1, \rho^{TN}_2)$ and $\rho_2 \geq \rho^{TN}_2$ holds. Take a pair of tariffs $(\rho^{TN}_1, \rho^{TN}_2 - \varepsilon)$ for sufficiently small $\varepsilon > 0$. This is preferred by the first industry to $(\rho^{TN}_1, \rho^{TN}_2)$, because $\frac{\partial V^1}{\partial \rho_2}$ is negative at $(\rho^{TN}_1, \rho^{TN}_2)$. From A.1., any a convex combination of (ρ_1, ρ_2) and $(\rho^{TN}_1, \rho^{TN}_2 - \varepsilon)$ is preferred by the first industry to $(\rho^{TN}_1, \rho^{TN}_2)$. However, by the supposition, there is a convex

combination $(\hat{\rho}_1, \hat{\rho}_2)$ that satisfies $\hat{\rho}_2 = \rho^{TN}_2$ and it must be strictly better than $(\rho^{TN}_1, \rho^{TN}_2)$ for the first industry. This is a contradiction to the fact that ρ^{TN}_1 is the best response to ρ^{TN}_2.

It follows that any tariff pair (ρ_1, ρ_2) which is preferred by the first industry to $(\rho^{TN}_1, \rho^{TN}_2)$ must satisfy $\rho_2 < \rho^{TN}_2$. A similar line of argument establishes the same relationship for the second industry. By the individual rationality of cooperative outcome, (ρ^C_1, ρ^C_2) is Pareto superior to $(\rho^{TN}_1, \rho^{TN}_2)$ for the lobbying industries. It then follows $\rho^C_1 < \rho^{TN}_1$ and $\rho^C_2 < \rho^{TN}_2$.

(ii) Note that $\phi^0(\mathbf{p}(\boldsymbol{\rho})) = \dfrac{X_0}{X_0 + p_1(\boldsymbol{\rho})\cdot X_1 + p_2(\boldsymbol{\rho})\cdot X_2}$ is an decreasing function of ρ_1 and ρ_2. From the results of (i), $\phi^0(\mathbf{p}(\boldsymbol{\rho}^C)) > \phi^0(\mathbf{p}(\boldsymbol{\rho}^{TN}))$ readily follows. As $\phi^0(\mathbf{p}) + \phi^1(\mathbf{p}) + \phi^2(\mathbf{p}) = 1$ for any $\mathbf{p}$, either $\phi^1(\mathbf{p}(\boldsymbol{\rho}^C)) < \phi^1(\mathbf{p}(\boldsymbol{\rho}^{TN}))$ or $\phi^2(\mathbf{p}(\boldsymbol{\rho}^C)) < \phi^2(\mathbf{p}(\boldsymbol{\rho}^{TN}))$ must necessarily hold. That is, compared with $\boldsymbol{\rho}^{TN}$, at least one lobbying industry's income share must be smaller at $\boldsymbol{\rho}^C$.

However, for both $i = 1, 2$, the value of indirect utility, $V^i(\mathbf{p}(\boldsymbol{\rho})) = \phi^i(\mathbf{p}(\boldsymbol{\rho}))\cdot v(\mathbf{p}(\boldsymbol{\rho}))\cdot y(\mathbf{p}(\boldsymbol{\rho}))/L_i$, and hence $V(\mathbf{p}(\boldsymbol{\rho})) = v(\mathbf{p}(\boldsymbol{\rho}))\cdot y(\mathbf{p}(\boldsymbol{\rho}))/L$, is larger at $\boldsymbol{\rho}^C$ than at $\boldsymbol{\rho}^{TN}$, and it follows that $V^0(\mathbf{p}(\boldsymbol{\rho})) = \phi^0(\mathbf{p}(\boldsymbol{\rho}))\cdot v(\mathbf{p}(\boldsymbol{\rho}))$ is also larger at $\boldsymbol{\rho}^C$ than at $\boldsymbol{\rho}^{TN}$.

Q.E.D.

Thus, cooperative game (or multi-issue international negotiation) gives an outcome which is Pareto superior to the non-cooperative outcome (or single-issue international negotiation).

It is often thought that collusion of some members of a society hurts the welfare of the remaining members. E.g., formation of a cartel must harm

the welfare of consumers. In our model, however, collusion of politically active groups makes the remaining members of the society better off. Intuitively, this result can be explained as follows. Recall that the effect of a rise in a industry's tariff on the industry's welfare is decomposed to two effects; universal effect and industry specific effect. With a slight abuse of terminology, we might call the first effect as effect for consumers, while the latter effect for producers.

At the non-cooperative equilibrium, industry specific effect, which is always positive, must cancel with the negative universal effect at the margin. Thus, members of a lobbying industry wishes to raise its tariff in spite of the cost that they have to incur as consumers, inasmuch as they gain more as producers. This gain for producers is specific to the industry and other members of the economy only suffer from a rise in the price. Other industries suffer from increased cost of price distortion, diminished purchasing power, and decline of their income share.

In sum, a rise in the tariff of an lobbying industry's product import induces external diseconomy to the rest of the society. When several industries raise their tariff rates independently, they neglect these externalities and push tariff rates and domestic prices too high. If they have an opportunity to revise their tariff rates cooperatively, however, they will find it mutually advantageous to reduce tariffs simultaneously. As the external diseconomy extends to those who do not engage in the political activity, the reduction of the tariff improves their welfare as well.

It is not difficult to incorporate the possibility of prohibitive tariff into our model. If equilibrium of non-cooperative game is attained where neither tariff is prohibitive, all the results are kept intact. If at least one tariff is prohibitive, tariff negotiation of cooperative game may

yield the same outcome as equilibrium in non-cooperative game. But, qualitatively, our results still remain valid.

5. Tariff Seeking versus Quota Seeking

In the previous sections, we have analyzed a competition of tariff seeking among import-competing industries. This can be interpreted as lobbying activities under the rule that trade restriction must be implemented through tariff. Of course one can imagine another rule that require governments to use quota as an instrument of protection. In this section, we shall consider a non-cooperative game of quota seeking (quota competition game) and compare its result with that of tariff seeking which we have analysed in the previous sections (tariff competition game) and with that of cooperative game. Bhagwati and Srinivasan [1980] showed that protection through tariff and quota are non-equivalent in the model where tariff/quota revenue is distributed non-neutrally and sought competitively. In this section, we shall identify an another factor that may generate non-equivalence of tariff and quota, i.e., strategic interactions between lobbying groups. We shall also clarify conditions under which tariff protection is less bad than quota protection from the viewpoint of economic welfare.

To consider the quota competition, we shall employ the same extreme version of the specific factors model that we used in the previous sections. Equilibrium conditions under a pair of quota are $\mathbf{q} = (q_1, q_2)$,

$$M_i(\mathbf{p}) = q_i \qquad i = 1, 2. \tag{5-1}$$

$$y = X_0 + p_1X_1 + p_2X_2 + (p_1 - \pi_1)q_1 + (p_2 - \pi_2)q_2, \tag{5-2}$$

where q_i is the i-th industry's quota. We call $(p_i - \pi_i)$ the implicit tariff of the i-th industry and denote it by $\rho_i(\mathbf{q})$. Although (5-1) and (5-2) are

the same as (2-5) and (2-6), in the equations parameters are not ρ_1, ρ_2 but q_1 and q_2. We assume:

A.4. There exists a continuously differentiable function $\mathbf{P}(\mathbf{q}) = (P_1(\mathbf{q}), P_2(\mathbf{q}))$ that satisfies (5-1).

Note that, being the inverse of $\mathbf{M}(\mathbf{p}) = (M_1(\mathbf{p}), M_2(\mathbf{p}))$, $\mathbf{P}(\mathbf{q})$ is essentially the inverse demand function, as $X_i + q_i$ represents domestic demand for i-th good. We may thus define i-th and j-th goods to be gross substitutes if $\partial P_i/\partial q_j < 0$ and they are q-gross complements if $\partial P_i/\partial q_j > 0$.[5/] These definitions are equivalent to the usual definitions in view of A.1.[6/]

As for the distribution of quota revenues, we assume again the neutral redistribution by the government; government absorbs all the revenues through a competitive auction of the licence of quotas, and distribute them neutrally so that each industry has the same share of income as their factor income share.

Utility of i-th industry's representative producer is then expressed as

(5-3) $$V^i(\mathbf{P}(\mathbf{q})) = v(\mathbf{P}(\mathbf{q}))\cdot\phi^i(\mathbf{P}(\mathbf{q}))\cdot y(\mathbf{P}(\mathbf{q}))/L_i.$$

Given j-th industry's quota, q_j, i-th ($i \neq j$) industry's best response is given as

$$\hat{R}^i(q_j) = \underset{q_i}{\operatorname{argmax}}\ V^i(P(q_i, q_j)).$$

We assume that $\hat{R}^i(q_j)$ is well-defined.

As before, we assume that those groups that actively seek for quotas are producers of the first and the second industries and they have enough political power to realize their most favorable quota in each industry. If producers of these industries determine the quota independently, a competi-

tion of quota seeking occurs and its consequence is described as a non-cooperative equilibrium. That is, the quotas are determined at $\mathbf{q}^{QN} = (q_1^{QN}, q_2^{QN})$ where $q_i^{QN} = \hat{R}^i(q_j^{QN})$ for i = 1, 2. It is impossible for each industry to set a negative quota and it naturally sets the lower bound for the set of feasible quota. We shall assume

A.5. There exists an unique Nash equilibrium, $\mathbf{q}^{QN} = (q_1^{QN}, q_2^{QN})$, of quota competition game.

Given these assumptions, we can derive a fundamental property of comparison between the tariff equilibrium and the quota equilibrium.

Proposition 3: Given the combination of quotas $\mathbf{q}^{TN}$ that realizes the same domestic price as the equilibrium of the tariff competition game, each lobbying industry, at least locally, wishes to loosen (tighten) its quota if the lobbying industry's products are gross substitutes (complements).

Proof: Because $\partial V^i(\mathbf{P}(\mathbf{q}^{TN}))/\partial p_i = 0$ (i = 1, 2) at the equilibrium of the tariff competition game,

$$\frac{\partial}{\partial q_i} V^i(\mathbf{P}(\mathbf{q}^{TN})) = \frac{\partial V^i}{\partial p_i}\cdot\frac{\partial P_i}{\partial q_i} + \frac{\partial V^i}{\partial p_j}\cdot\frac{\partial P_j}{\partial q_i} = \frac{\partial V^i}{\partial p_j}\cdot\frac{\partial P_j}{\partial q_i} \qquad (j \neq i)$$

We have already established that $\partial V^i(\mathbf{P}(\mathbf{q}^{TN}))/\partial p_j < 0$ at this equilibrium.

Thus $\partial V^i(\mathbf{P}(\mathbf{q}^{TN}))/\partial q_i > 0$ (< 0, resp.) when $\frac{\partial P_j}{\partial q_i} < 0$ (> 0, resp.).

Q.E.D.

It is clear from this proposition that tariff competition and quota competition yield different outcomes in our model despite the fact that tariff/quota revenues are distributed neutrally (without competitive revenue or rent seeking). Intuitively, this non-equivalence result is explained as follows.

In both tariff competition and quota competition, equilibrium outcomes are generally Pareto inefficient. Under our assumption of factor immobility, a rise in the price of a good improves the welfare of the industry that produces the good, as it increases the industry's income share. However, it induces external diseconomy to the rest of the economy, making the other lobbying industry to demand even more protection. The resulting non-cooperative outcome is necessarily Pareto inefficient (except a case of prohibitive tariff).

In the case of quota competition, there is an additional effect that plays an important role. As the total supply of each good is fixed by quota, any increase in the price of a good induces a change in the price of other goods. If products of the lobbying industries are gross substitutes, an increase in the price of a good induces an increase in the price of the other lobbying industry's product. Resulting increase in the former industry's income share is less than it would have been under the tariff competition. This fact weakens the incentive of the lobbying industries to raise the price of their products. Obviously, the reverse holds when two products are gross complements.

Suppose, instead of non-cooperative game where quota of each industry is determined independently, lobbying industry's quotas are determined jointly. Outcomes of this cooperative game must again satisfy mutual efficiency and individual rationality. As long as the mutual efficiency is

concerned, whether the means of protection is tariff or quota makes no difference in the outcome. Thus the means of protection may make difference in cooperative outcomes only in that the disagreement outcome is the corresponding non-cooperative equlibrium of each game. If the lobbying industries are symmetric and the symmetric cooperative outcome is the equilibrium of both cooperative games, however, the cooperative outcome is identical.

From proposition 3 and the following remarks, we expect the extent of protection under the quota competition game is less than the one under the tariff competition game, if the lobbying industries' products are gross substitutes. The equilibrium of the quota competition game is better for both of the lobbying industries because the extent of protection is too high at the equilibrium of the tariff competition game. Thus we might conjecture that quota competition must be Pareto superior to tariff competition in view of proposition 2. Similarly, the reverse is expected to hold when two products are gross complements. In the case that the lobbying industries are symmetric (and cooperative outcome is symmetric), we can show this conjecture is indeed correct.

Proposition 4: Suppose the lobbying industries are symmetric and their products are gross substitutes. Let $\boldsymbol{\rho}^C = (\rho_1^C, \rho_2^C)$ be the implicit tariff under the symmetric cooperative outcome and $\boldsymbol{\rho}^{QN} = (\rho_1^{QN}, \rho_2^{QN})$ be the implicit tariff that would be realized at import quota $\mathbf{q}^{QN}$. Then,

$$\rho_i^C < \rho_i^{QN} < \rho_i^{TN} \qquad \text{for } i = 1, 2.$$

Furthermore,

$$V^i(\mathbf{P}(\rho^C)) > V^i(\mathbf{P}(\rho^{QN})) > V^i(\mathbf{P}(\rho^{TN})) \qquad \text{for } i = 0, 1, 2.$$

Proof: Note first that all these outcomes are symmetric ($\rho_1^C = \rho_2^C = \rho^C$, $\rho_1^{QN} = \rho_2^{QN} = \rho^{QN}$ and $\rho_1^{TN} = \rho_2^{TN} = \rho^{TN}$) because of the assumptions of symmetry and unique equilibrium.

At the quota competition equilibrium, since

$$\frac{\partial}{\partial q_i} V^i(\mathbf{P}(\mathbf{q}^{QN})) = \frac{\partial V^i}{\partial p_i} \cdot \frac{\partial P_i}{\partial q_i} + \frac{\partial V^i}{\partial p_j} \cdot \frac{\partial P_j}{\partial q_i}$$

$$= \frac{\partial V^i}{\partial p_i} \cdot \frac{\partial P_i}{\partial q_i} \left(1 + \frac{\partial V^i / \partial p_j}{\partial V^i / \partial p_i} \cdot \frac{\partial P_j / \partial q_i}{\partial P_i / \partial q_i} \right) = 0,$$

$- \dfrac{\partial V^i / \partial p_i}{\partial V^i / \partial p_j} = \dfrac{\partial P_j / \partial q_i}{\partial P_i / \partial q_i}$ must hold. By gross substitutability and the assumption A.1., the value of $\dfrac{\partial P_j / \partial q_i}{\partial P_i / \partial q_i}$, which equals $\dfrac{\partial M_j / \partial p_i}{\partial M_i / \partial p_j}$, must be strictly positive.

Also, $\dfrac{\partial P_j / \partial q_i}{\partial P_i / \partial q_i} < 1$ must hold, for otherwise $\dfrac{\partial p_2 / \partial q_1}{\partial p_1 / \partial q_1} \geq 1$ and $\dfrac{\partial p_1 / \partial q_2}{\partial p_2 / \partial q_2} \geq 1$ would hold from symmetry of the equilibrium. However, this would imply that the Jacobian of $M(\mathbf{P})$ is not positive, contradicting to A.1..

Note that the rate $- \dfrac{\partial V^i / \partial p_i}{\partial V^i / \partial p_j}$, which is the marginal rate of substitution of p_i in terms of p_j for the i-th industry, is 0 at $\mathbf{p}(\rho^{TN})$ and 1 at $\mathbf{p}(\rho^C)$. We already know $\rho^{TN} > \rho^C$ from proposition 2. Since the marginal rate or substitution changes continually from $\mathbf{p}(\rho^{TN})$ to $\mathbf{p}(\rho^C)$ as we rise ρ proportionally, the uniqueness of quota equilibrium assures the first half of the assertion.

The first half of the assertion and the symmetricity of ρ^{QN}, ρ^{TN} and ρ^C imply that ρ^{QN} is a convex combination of $\rho^{TN}$and ρ^C. Thus by A.2., ρ^{QN} is Pareto superior for the lobbying industries to ρ^{TN}. So the second assertion

can be easily proved by the technique employed the second half of proposition 2.

Q.E.D.

Proposition 5: Suppose the lobbying industries are symmetric and their products are gross complements. Then for i = 1, 2,

$$\rho_i^C < \rho_i^{TN} < \rho_i^{QN} \qquad \text{for } i = 1, 2.$$

Furthermore, for i = 0, 1, 2,

$$V^i(\boldsymbol{\rho}^C) > V^i(\boldsymbol{\rho}^{TN}) > V^i(\boldsymbol{\rho}^{QN}).$$

Proof: Since products are gross complements, the marginal rate of substitution for the industry 1 at $\mathbf{P}(\mathbf{q}^{QN})$ is negative.

In view of Proposition 2, one of the following three must be the case; (1) $\rho_i^{QN} < \rho_i^C < \rho_i^{TN}$, (2) $\rho_i^C < \rho_i^{QN} < \rho_i^{TN}$, or (3) $\rho_i^C < \rho_i^{TN} < \rho_i^{QN}$. However, if either (1) or (2) were the case, then there must be another non-cooperative tariff equilibrium between ρ_i^{QN} and ρ_i^C, contrary to the assumption A. 3.

Hence (3) must be the case. So the first assertion of the proposition is derived. The second assertion trivially follows from the proposition 2.

Q.E.D.

From proposition 4 and 5, our conjecture from proposition 3 on the welfare ranking of tariff competition and quota competition is certified at least in the symmetric case. Although our results are stated for the symmetric case, they are robust even if small asymmetry is introduced to our model.

6. Conclusion

We have analysed welfare implications of different rules of trade policy especially from the viewpoint of industry specific interests of import-competing industries. We have shown that it is sometimes possible to unambiguously compare welfare of the entire economy when different rules of political process are employed, e.g., competition is employed instead of negotiation among the lobbying industries, or tariff is used instead of quota as a means of protection.

Our model can be easily extended to the more general specific factor model, where some factors are mobile but some are immobile. Our main conclusion still remain valid if we assume that owners of immobile factors are politically more influential than those of mobile factors. To analyze more general situations may require, however, more complicated models and more sophisticated equilibrium concepts.[7/]

One of the most important and interesting directions to which our model can be extended is to consider the negotiation between two large countries. To do this, however, requires the generalization of our model to take account of a change in international prices and to explicitly analyze various combinations of international negotiation between two countries and domestic negotiation among lobbying industries. We leave this analysis for other occasions.

Footnotes

1/ For a similar specific factor model and its applicaiton to trade protection, see Deardorff [1986].

2/ In our context of tariff competition, this assumption excludes a possibility of revenue seeking which is analysed by many authors following Bhagwatti and Srinivasan [1980].

3/ Mayer [1984] pointed out these properties at first. Wilson and Wellisz [1986] discussed effects of income share on lobbying activities in the model where tariff seeking competition occurs between an export industry and an import-competing industry. Our proposition 1 is essentially a restatement of their findings.

4/ The idea of voting cost and rational ignorance was introduced in Downs [1957]. For relation between this idea and trade protection, see Baldwin [1982] and Hillman [1989].

5/ $\partial p_1/\partial q_2$ and $\partial p_2/\partial q_1$ may have different signs and it may not be possible to define gross complements or substitutes unambiguously. We shall, however, ignore this possibility in the rest of the paper.

6/ Because the Jacobian of $\mathbf{M}(\mathbf{p})$ does not vanish, the existence of $\mathbf{P}(\mathbf{q})$ is assured. Moreover, as $\dfrac{\partial P_i}{\partial q_j} = -\dfrac{\partial M_i/\partial p_j}{\Delta}$ for $i, j = 1, 2, \quad i \neq j$ where Δ is the Jacobian's determinant, our definition coincides with the usual one if $\Delta > 0$, the condition guaranteed by A.1.

7/ For the more general specific factor model, see Jones [1971]. For more specificated equlibirum concepts see, for example, Ordeshook [1986].

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