On the Equivalence of Import Tariff and Quota: The Case of Rice Import in Taiwan

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Abstract

This paper extends the existing theory on the equivalence of import tariff and quota. If the equivalence is defined on the domestic price level (weak equivalence), then either the zero conjectural variation for domestic country or a perfectly competitive market will be sufficient to support this equivalence. If the equivalence is defined both on the same domestic price level as well as tariff rate (strong equivalence), then the conditions are that either domestic country acts as a Cournot competitor and foreign country is a price taker, or both domestic and foreign country are price takers. An empirical spatial-equilibrium trade model is constructed to simulate the impacts of import tariff and quota. Using Taiwan's rice import as an example, the empirical results show that if Taiwan switches from the quota system to tariff system, the domestic rice price as well as total social welfare can be increased given the same import volume.

1. Introduction

Rice is the major crop in Taiwan agricultural sector. There are about 3.5 million rice farmers cultivating 40 percent of total planting acreage and contributing up to 21 percent of total crop production values in 2001. Rice consumption in Taiwan is about 58 kg per capita per year. The annual total demand is about 1.5 million metric tons, which can be met by domestic supply. Each year, about 100,000metric tons of rice is exported.

After the accession to the World Trade Organization (WTO) on January 2002, Taiwan began to open its rice market to importation. A total of 144,720 metric tons of rice are imported under the quota system annually, which is approximately 10 percent of total rice production in 2000. Because rice is the most important crop and staple food in Taiwan, there is a strong support for maintaining domestic supply essential to food security. After a long period of protection, the opening to importation is predicted to have significant impacts on the 3.4 million rice farmers as well as the viability of the industry.

Due to the similar cultural and production background, Taiwan's rice import policy followed that of Japan in the previous WTO negotiations. However, on 1 April 1999 Japan changed its rice import policy from quota to tariff rate quota (TRQ) system. This has created a strong pressure for Taiwan's government to make the similar change in the on-going WTO negotiations. The purpose to implement trade restriction policy, such as tariff or quota, in most rice importing countries is to maintain price stability once their domestic markets are linked with the global market. The domestic prices under tariff system may not be the same as it is under the quota systems. From the practical standpoint, whether Taiwan should switch from quota to tariff depends on if tariffication could generate a higher domestic price and/or welfare.

The main purpose of this study is to derive a theoretical basis for the comparison of the domestic prices under alternative import regimes. Previous studies on the conditions of equivalence between import tariff and quota in an importing country focused on the market structure and the welfare distribution effects. Taiwan's domestic rice market is perfectly competitive because there are many buyers and

sellers in this market. The quota rents are fairly distributed to all importing firms under the open-bid system. Therefore, the only possible source of non-equivalence between tariff and quota comes from the import market.

The main findings of our theoretical model include:

(a) Weak Equivalence: if the equivalence is defined on domestic price, then the conditions are that either domestic country acts as a Cournot-competitor or as a price-taker;

(b) Strong Equivalence: if the equivalence is defined on both domestic price and tariff rate, then the conditions are that either domestic country acts as a Cournot-competitor and foreign country is a price taker, or both domestic and foreign country are price-takers.

(c) If domestic market behaves collusively, then domestic price under import tariff is higher than it is under quota, and vice versa.

In the empirical analysis, the domestic market structure will be analyzed to evaluate the extent to which tariff and quota are equivalent. The conjectural variation (CV) method will be adopted to measure the degree of competitiveness in the rice import market. A mathematical-programming-based spatial equilibrium model is used to carry out the empirical analysis. Preliminary results show that:

(a) the rice import market is not perfectly competitive, and

(b) if Taiwan switches from quota to tariff, then the domestic rice price and total social welfare will be increased under the same import level.

In the following section, the theory of the equivalence of import tariff and quota will be discussed while the empirical model is illustrated in the third section. The simulation results and economic interpretations are discussed in fourth section followed by the conclusions.

2. Theoretical Analysis

Following Bhagwati, Shibata, and Yadav's definition, the equivalence of import tariff and quota is "*a quota will give rise to an implicit tariff rate which, if alternatively set as a tariff, will generate the same level of imports as the quota*."

According to this definition, the equivalence is held under following three conditions: 1) perfect competition in the domestic market, 2) perfect competition among quota-holders, and 3) price-taking foreign suppliers. However, if the equivalence is defined as the same domestic price under the same import quantity, then the monopolist (Shibata) or monspsony (Yadav) case will hold.

Huang and Mai have shown that the equivalence is held under zero conjectural variation in an oligopoly market if the equivalence is defined as the same domestic price given the same level of import quantity under the quota and tariff systems. Zero conjectural variation means that both sides of the market are price followers. Itoh and Ono have proven that no matter which kind of leader-follower relationship is chosen under the tariff system, a quota always bring about a higher domestic price than the tariff as long as both permit the same amount of imports. This infers that the equivalence condition of tariff and quota is not only dependent on the players' strategies in an oligopoly game, but also on government's trade policies.

Like her neighbors Japan and South Korea, Taiwan government has distorted rice production through price support programs. A guaranteed-price purchasing program is implemented to encourage rice production. Taiwan government has also controlled at least 20 percent of domestic demand in public storage. To prepare for the impact of opening the rice market, the government has let 100,000 hectares of rice fields to lay fallow or convert to other crops. As part of its commitment to the Geneva-based world trade body, Taiwan allows rice imports of 144,720 metric tons in the first year after joining the WTO, and will increase the import by 2 percent each year until the ban is totally abolished. On the 144,720 tons, only 35 percent is imported by private sector (i.e., food companies and rice milling factories). The majority 65 percent is for the government to import. Therefore, in this paper Taiwan's government is assumed to be a sole representative of all domestic rice

growers against foreign imports.

Suppose there exist *n* foreign firms in Taiwan importing rice market and the inverse domestic demand function for rice in Taiwan is $P = f(Q), \quad Q = q_d + \sum_{i=1}^{n} q_i^f$ where q_d and q_i^f represent, respectively, the rice supply quantities from domestic groweres and from the i^{th} foreign country. The following analysis will focus on the comparison of tariff and quota systems.

Case 1. *Import Tariff*:

Suppose Taiwan implements an import tariff on rice and the explicit tariff rate is *t*. The profit function for the i^{th} foreign trading country under import tariff is

$$\pi_i^f = f(Q)q_i^f - C_i^f(q_i^f) - t * q_i^f$$

where $C_i^f(q_i^f)$ is the cost function for foreign country *i*.

The first order condition is

$$\frac{\partial \pi_i^f}{\partial q_i^f} = P + q_i^f(1+\lambda_i^f) f'(Q) - MC_i^f - t = 0 \quad (1)$$

where $\lambda_i^f = \frac{\partial q_d}{\partial q_i^f} + \sum_{i=1, i\neq i'}^{n} \frac{\partial q_{i'}^f}{\partial q_i^f}$ which is a conjectural variation term for country *i* and MC_i^f is the marginal cost.

Similarly, the profit function for domestic country is

$$\pi^d = f(Q)q_d - C_d(q_d)$$

The first order condition is

$$\frac{\partial \pi^d}{\partial q_d} = P + q_d(1+\lambda_d) f' - MC_d = 0 \quad (2)$$

where $\lambda_d = \sum_{i=1}^{n} \frac{\partial q_i^f}{\partial q_d}$ is a conjectural variation term for domestic country.

Case 2. *Quota System*

If Taiwan implements a quota system, the summation of importing quantity for all foreign countries will be a fixed quantity. If the ratio of quota over domestic demand is not too high, foreign country will be a price taker under this quota system. So the optimalization problem for foreign country *i* is

$$\begin{aligned} &\underset{q_i^f}{Max}\, \pi_i^f = f(Q)q_i^f - C_i^f(q_i^f) \\ &s.t. \quad \sum_{i=1}^{n} q_i^f = \bar{q}_f \end{aligned} \tag{3}$$

where $\bar{q}_f$ is the import quota which is a fixed amount.

The equilibrium condition for (3) is

$$\frac{\partial \pi_i^f}{\partial q_i^f} = P - MC_i^f - \mu = 0 \tag{4}$$

where μ is the shadow price when the quota is binding and it represents the implicit tariff rate.

The domestic country's profit function is as follow

$$\bar{\pi}^d = f(q_d + \bar{q}_f)q_d - C_d(q_d)\,. \tag{5}$$

The first order condition of (5) is

$$\frac{\partial \pi^d}{\partial q_d} = P + q_d f' - MC_d = 0 \tag{6}$$

The economic impacts of import tariff and quota on importing countries, especially on domestic prices, could be estimated by comparing equations (4) and (6). Since the level of importing quantity is the same under both the tariff and quota system, we could obtain the following results

$$\begin{matrix} < \\ \bar{P}^* = P_t^* \\ > \end{matrix}, and \begin{matrix} > \\ \bar{Q}^* = Q_t^* \\ < \end{matrix} \quad if \quad \begin{matrix} > \\ \lambda_d = 0 \\ < \end{matrix} \tag{7}$$

where $\bar{P}^*, \bar{Q}^*$ are, respectively, the domestic equilibrium price and quantity under the

quota system, and P_t^*, Q_t^* are the domestic equilibrium price and quantity under the tariff system.

Equation (7) shows that the equivalence of the import tariff and quota would hold if the domestic country acts as a Cournot-Competitor (i,e, λ_d =0). However, the domestic price is lower under tariff than it is under quota system if the domestic country behaves more competitively than it does in the Cournot case (i,e, λ_d <0). If the conjectural variation term is positive which implies that if the domestic country acts more collusively than it does in the Cournot case, then the domestic price under tariff will be higher than it is under quota. Such results are similar with Hwang and Mai, and Fung.

Although the comparison of domestic price through equations (4) and (6) can be used to determine the equivalence of tariff and quota, the comparison of explicit and implicit tariff rate is still necessary. Shibata has pointed out that the domestic price will be the same for both the tariff and quota under Bhagwati's three conditions, but this is not true between explicit and implicit tariff rates. The explicit tariff rate is not equal to the implicit tariff rate due to quota implementation if the foreign player is a monopolist. The explicit and implicit tariff rates could be compared through equations (1) and (2), which is dependent upon the domestic and foreign firms' behaviors (λ_d and λ_f). Domestic price and quantity are the same under tariff and quota if λ_d =0 and λ_f =0. In other words, implicit tariff rate is higher than explicit tariff rate if both the domestic and foreign countries are Cournot players. If foreign player is a price taker (λ_f =-1) and domestic country plays a Cournot game(λ_d =0) , then the implicit tariff equals the explicit one (i.e., $\mu = t$) . Similarly, implicit tariff rate is smaller than explicit tariff rate ($\mu < t$) if domestic country plays a Cournot

game (λ_d =0) but foreign country plays a collusive game(λ_f >0). All possible results are organized in Table 1. Three propositions can be obtained:

Proposition 1 (Weak Equivalence): Suppose the quota system is fairly distributed in the domestic market. If the equivalence is defined on the same level of domestic price (weak equivalence), then the conditions are that the domestic player acts as either a Cournot competitor (λ_d =0) or a price taker (λ_d =-1).

Proposition 2 (Strong Equivalence): Suppose the quota system is fairly distributed in a domestic market. If the equivalence is defined on the domestic price and the implicit/explicit tariff rate, then the conditions for the equivalence are that domestic player acts either as a Cournot competitor (λ_d =0) and foreign country a price taker (λ_f =-1), or domestic and foreign countries both act as price takers (λ_d =-1, λ_f =-1).

Proposition 3: Suppose the quota system is fairly distributed in a domestic market. If domestic country plays more competition(λ_d <0) or both domestic and foreign country play as Cournot- Competitors(λ_d =0, λ_f =0), then the implicit tariff rate is larger than explicit tariff rate($\mu > t$). However, if domestic country plays a collusive game and foreign country acts as a price taker (λ_d >0, λ_f =-1) or domestic country acts as a Cournot competitor and foreign country plays a collusive game (λ_d =0, λ_f >0), then the implicit tariff rate is smaller than explicit tariff rate ($\mu < t$).

3. The Empirical Model

According to the previous illustrations, the equivalence or non-equivalence of import tariff and quota depends on the conjectural variations (CVs) of both domestic and foreign countries. In this paper, an imperfect spatial equilibrium model is constructed to solve for the CVs using the international rice market as an example. This model is modified from a specific type of spatial equilibrium models as discussed in Nelson and McCarl and implemented by Kawaguchi et al. and Chen at el.

Generally speaking, rice can be separated into two different types, Japonica and Indica, because of its quality and taste differences. The major consumption regions for Japonica rice are in Japan, Korea, China, Taiwan, U.S., and Australia while the consumption areas for Indica are located in U.S., Thailand, India, Pakistan, Indonesia, Vietnam, Philippine, South Asia, and Africa. Following Armington's separable assumption, Japonica and Indica can be viewed as two different kinds of products in international trade. In this study, we will concentrate on Japonica rice, which is the major rice consumed and produced in northeast East Asia.

The major exporting countries for Japonica product are U.S. Australia, and China while the major importing regions are Japan, Taiwan, South Korea, Europe, Africa, and Other Asia regions. The exclusive importers include the Food Agency in Japan, the Ministry of Agriculture in South Korea and Taiwan. Similarly, rice procurement and trade in China are controlled by the Chinese government and COFCO (Ackerman and Dixit).

Suppose there are *m* exporting and *n* importing countries in the rice market. Also suppose that the inverse excess supply function for exporter *i*, *i=1,…,m*, is linear and is defined as

(8) $$P_i = c_i + d_i * E_i$$

where E_i and P_i are the volume exported and export prices and c_i, d_i are intercept

and slope of the inverse excess supply curve. Similarly, the inverse excess demand function in importing country *j, j=1,...,n,* is

(9) $$P_j = a_j - b_j * M_j$$

where P_j and M_j are the import price and quantity, and a_j, b_j are the intercept and slope respectively.

Suppose there exists positive trade between all exporting and importing countries. Let x_{ij} denote the volume shipped from exporting country *i* to importing country *j*. The following equations hold at equilibrium:

(10) $$\sum_{j=1}^{n} x_{ij} = E_i, \sum_{i=1}^{m} x_{ij} = M_j \ .$$

The objective function and constraints are similar to those by Chen et al and they are listed as follows:

(11) $$\underset{x_{ij}}{Max}: OBJ = \sum_j [a_j * M_j - \frac{b_j}{2} M_j^2] - \sum_i [c_i * E_i + \frac{d_i}{2} E_i^2] - \sum_i \sum_j t\cos t_{ij} * x_{ij}$$
$$- \sum_i \sum_j \frac{b_j}{2} x_{ij}^2 * (1 + A_{ij}) - \sum_i \sum_j \frac{d_i}{2} x_{ij}^2 * (1 + B_{ij})$$

s.t. $$M_j - \sum_i x_{ij} \le 0 \quad \forall\, j$$

$$-E_i + \sum_j x_{ij} \le 0 \quad \forall\, i$$

where $t\cos t_{ij}$ is a transportation cost from exporting country *i* to importing country *j*. A_{ij} is the CV for exporting country *i* when selling to country *j* telling how other exporters selling to country *j* react to changes in country *i's* export sales. Mathematically,

(12) $$A_{ij} = \frac{\partial x_{1j}}{\partial x_{ij}} + \frac{\partial x_{2j}}{\partial x_{ij}} + \ldots + \frac{\partial x_{i-1j}}{\partial x_{ij}} + \frac{\partial x_{i+1j}}{\partial x_{ij}} + \ldots + \frac{\partial x_{nj}}{\partial x_{ij}} \ .$$

B_{ij} is the CV for importing country *j* when buying from country *i* telling how other importers buying from country *i* react to changes in country *j's* import purchases.

Mathematically,

$$B_{ij} = \frac{\partial x_{i1}}{\partial x_{ij}} + \frac{\partial x_{i2}}{\partial x_{ij}} + \ldots + \frac{\partial x_{ij-1}}{\partial x_{ij}} + \frac{\partial x_{ij+1}}{\partial x_{ij}} + \ldots + \frac{\partial x_{in}}{\partial x_{ij}}. \tag{13}$$

In this objective function, the first and second terms calculate the areas under the excess demand curves minus the areas under the excess supply curves while the third term subtracts off the transport costs. Collectively, these three terms follow those from the classical spatial equilibrium model (Takayama and Judge) and represent trade under perfect competition (or free trade). The fourth and fifth terms incorporate the CVs and represent the exporting and importing market rents due to imperfect competition.

The Kuhn-Tucker conditions are

$$\frac{\partial OBJ}{\partial x_{ij}} = [a_j - b_j M_j] - [c_i + d_i E_i] - t\cos t_{ij} - b_j(1 + A_{ij})x_{ij} - d_i(1 + B_{ij})x_{ij} \le 0 \tag{14}$$

$x_{ij} \ge 0$, and

$$\frac{\partial OBJ}{\partial x_{ij}} * x_{ij} = 0.$$

Since $P_j = a_j - b_j * M_j$ and $P_i = c_i + d_i * E_i$, equation (14) under a positive trade activity(i.e., x_{ij}>0) can be written as

$$\frac{\partial OBJ}{\partial x_{ij}} = P_j - P_i - t\cos t_{ij} - b_j(1 + A_{ij})x_{ij} - d_i(1 + B_{ij})x_{ij} = 0 \tag{15}$$

If both A_{ij} and B_{ij} equal -1, then exporter *i* and importer *j* would be acting as perfect competitors as in the Takayama and Judge's model. If A_{ij} equals zero while B_{ij} equals -1, then exporting country *i* acts as an imperfect competitor who will not change their exports in response to *i*'s action in a Cournot-Nash context while importer *j* behaves as a price-taker. The CV in equation (11) (i.e., A_{ij} and B_{ij}) could

be linked with equations (1) and (2). A_{ij} is identical with λ_f in equation (1) and B_{ij} is identical with λ_d in equation (2) if index *j* is referred as Taiwan. Therefore, the estimation on A_{ij} and B_{ij} could determine the equivalence of import tariff and quota.

To build the imperfect spatial equilibrium model, quantity, price, and elasticity for both the importing and exporting countries have to be collected. The empirical model is based on 1998 available statistics. The data are mostly from *Food and Agricultural Organization* (FAO) and *Agricultural Statistic*s of USDA and own calcultion. After the model is built, it has to pass the validation test before policy simulation. A refinement procedure is introduced to adjust the estimation of CVs so that the discrepancies between the observed data and the model solution can be minimized. This procedure involves an initialization phase where initial values for the CVs are computed based on the wedges between the existing prices in each pair of trading partners.

From Table 2, it shows that the deviation of model solutions and observed data are under 7 percent which indicates that the model has passed the validation test. The trading countries' behavior in Japonica markets can be found in Tables 3 and 4. Exporting countries, such as China and Australia, act as a price maker with respect to all importing countries. Another major exporter, the US, behaves as a price taker with respect to European and other Asia countries but a price maker against Japan. All importing countries' CVs are positive which indicates that there may exist highly restrictive import policies in these countries. There exists political and economic incentive to implement trade policy to protect their rice sectors in Asian countries due to the food security concern. Such trade policy will result in higher price difference between the importing price and domestic one. Therefore, the CVs will be positive

numbers in these countries.

4. Simulation Results

The import regime of rice in Taiwan is a quota system according to the GATT agreement. It will be allowed approximately 144,000 metric ton import each year. To simulate the economic impacts of import tariff and quota, the empirical model has to be modified. The equilibrium condition of (11) under an import tariff system is modified as follows:

$$P_j - P_i - t\cos t_{ij} - tar - b_j(1+A_{ij})x_{ij} - d_i(1+B_{ij})x_{ij} = 0, \quad (16)$$

where *tar* is an import tariff. An addition item ($tar * x_{ij}$) should be included into the objective function. The optimal import tariff rate (*tar*) is iterated until the import volume is same as the quota. The simulation result shows that when the import tariff rate is 210% the import volume will be 144,000 metric tons rice. Meanwhile, the CV for Taiwan (λ_d) with respect to China, US, and Australia under import tariff is 1.65, 11.35, and 2.03 respectively. From the comparison results in Table 1, the domestic price under import tariff will be higher than it is under the quota because of the positive CV terms.

To simulate the quota system, a maximal volume constraint is added into the model to bind the import volume at 144,000 metric tons. The shadow price of this binding equation represents the implicit tariff rate. The simulation results (Table 5) under this quota restriction show that the domestic price is $883 per ton, which is lower than the domestic price generated by import tariff ($1,437). This empirical result is in accordance with the theoretical ones listed in Table 1. Although the trade surplus under tariff is smaller than it is under the quota, the total welfare (trade surplus plus the tariff revenue) will be higher under the tariff than the quota case.

The CVs for China, US, and Australia (λ_f) with respect to Taiwan under import

tariff are all positive, while the CVs for Taiwan (λ_d) with respect to these three exporting countries are all positive too. Thus, the comparison of implicit and explicit tariff rate will be ambiguous from Table 1. However, the empirical model shows that the implicit tariff rate is 50% which is much smaller than the explicit tariff rate 210%.

5. Concluding Comments

After the accession to the World Trade Organization (WTO) on January 2002, Taiwan began to open its rice market to importation. A total of 144,000 metric tons of rice are imported under the quota system annually, which is about 8% of the annual consumption. Because rice is the most important crop and staple food in Taiwan, there is a strong support for maintaining domestic supply essential to food security. After a long period of protection, the opening to importation is predicted to have significant impacts on the 340,000 rice farmers as well as the viability of the industry.

Due to the similar cultural and production background, Taiwan's rice import policy followed that of Japan in the previous WTO negotiations. However, on 1 April 1999 Japan changed its rice import policy from quota to tariff rate quota (TRQ) system. This has created a strong pressure for Taiwan's government to make the similar change in the on-going WTO negotiations. From the practical standpoint, whether Taiwan should switch from quota to tariff depends on if tariffication could generate a higher domestic price and/or welfare.

The main purpose of this study is to derive a theoretical basis for the comparison of the domestic prices under alternative import regimes. Previous studies on the conditions of equivalence between import tariff and quota in an importing country focused on the market structure and the welfare distribution effects. Taiwan's domestic rice market is perfectly competitive because there are many buyers and sellers in this market. The quota rents are fairly distributed to all importing firms under the open-bid system. Therefore, the only possible source of non-equivalence between tariff and quota comes from the import market.

The main findings of our theoretical model include:

(d) Weak Equivalence: if the equivalence is defined on domestic price, then the conditions are that either domestic country acts as a Cournot competitor or behaves like a price taker;

(e) Strong Equivalence: if the equivalence is defined on both domestic price and tariff rate, then the conditions are that either domestic country acts as a Cournot competitor and foreign country is a price taker, or both domestic and foreign country are price takers.

(f) If domestic market behaves collusively, then domestic price under import tariff is higher than it is under quota, and vice versa.

In the empirical analysis, the conjectural variation (CV) method is intorduced to measure the degree of competitiveness in the rice import market. A mathematical-programming-based spatial equilibrium model is used to carry out the empirical analysis. The results show that:

(a) the rice import market is not perfectly competitive, and

(b) if Taiwan switches from quota to tariff, then the domestic rice price and total social welfare will be increased under the same import level.

Table 1. The Equivalence of Import Tariff Rate by Players' Behaviors

Domestic Firm (λ_d)	Foreign Firm(λ_f)	Price, Quantity, and Tariff Rate
Cournot Competitor	0	$\overline{P}^* = P_t^*, \quad \overline{Q}^* = Q_t^*, \quad \mu > t$
(λ_d=0)	-1	$\overline{P}^* = P_t^*, \quad \overline{Q}^* = Q_t^*, \quad \mu = t$
	>0	$\overline{P}^* = P_t^*, \quad \overline{Q}^* = Q_t^*, \quad \mu < t$
Collusive	0	$\overline{P}^* < P_t^*, \quad \overline{Q}^* > Q_t^*, \quad \mu, t$ ambiguous
(λ_d>0)	-1	$\overline{P}^* < P_t^*, \quad \overline{Q}^* > Q_t^*, \quad \mu < t$
	>0	$\overline{P}^* < P_t^*, \quad \overline{Q}^* > Q_t^*, \quad \mu, t$ ambiguous
Close to Competition	0	$\overline{P}^* > P_t^*, \quad \overline{Q}^* < Q_t^*, \quad \mu > t$
(λ_d<0)	-1	$\overline{P}^* > P_t^*, \quad \overline{Q}^* < Q_t^*, \quad \mu > t$
	>0	$\overline{P}^* > P_t^*, \quad \overline{Q}^* < Q_t^*, \quad \mu > t$
Price Taker (λ_d=-1)	-1	$\overline{P}^* = P_t^*, \quad \overline{Q}^* = Q_t^*, \quad \mu = t$

Table 2. Model Validation by Trade Volume, 1998

Unit: metric ton, %

	Observed Data	Model Solutions	Deviation (%)
U.S.	402,637	374,702	-6.94
Australia	116,463	110,120	-5.45
China	175,900	184,313	4.78
Japan	499,383	461,374	-7.61
South Korea	61,618	65,868	6.90
Other Asia	50,000	52,534	5.07
Europe	34,000	36,359	6.94
Africa	50,000	52,999	6.00

Table 3. Conjectural Variations for Exporting Countries

	U.S.	Australia	China
Japan	0.24	5.68	2.10
South Korea	-0.83	1.98	-0.34
Other Asia	-1.01	1.37	-0.75
Europe	-0.99	1.43	0.02
Africa	-0.11	2.00	0.02

Table 4. Conjectural Variations for Importing Countries

	Japan	South Korea	Other Asia	Europe	Africa
U.S.	14.79	73.53	9.80	144.86	8.56
Australia	2.79	36.74	4.46	76.14	8.56
China	2.31	35.17	4.08	55.12	8.56

Table 5. The Comparison of Import Tariff and Quota in Taiwan

	Importing Price (US$/ton)	Trade Surplus ($1000 US)	Government Revenue ($1000 US)	Total Social Welfare ($1000 US)	Tariff (%)
Quota	883.38	168,363	0	168,363	50%
Import Tariff	1347.29	103,228	68,026	171,254	210%

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