Tariff Rate Import Quotas, Domestic Market Structure and Agricultural Support Program – The Case of Taiwanese Rice Import

Hung-Hao Chang
Graduate Researcher
Department of Applied Economics and Management
Cornell University
Ithaca NY 14853-7801
Email: hc248@cornell.edu

Harry de Gorter
Associated Professor
Department of Applied Economics and Management
Cornell University
Ithaca NY 14853-7801
Phone: (607) 255-8076
Email: hd15@cornell.edu

Selected Paper prepared for presentation at the Western Agricultural Economics Association Annual Meeting, Honolulu, Hawaii, June 30-July 2, 2004

Abstract

After joining the WTO in 2002, Taiwan allowed rice imports for the first time by implementing an import quota subject to a special safeguard tariff. In 2003, the import quota was expanded to a two-tier tariff rate import quota system. Although Taiwan maintained land set-asides and domestic support prices for producer sales to the State Trading Enterprise, the latter was limited to importing only 65 percent of the import quota with the rest sold to private traders. This sudden transformation of the Taiwanese import regime and rice market along with the government proposal for a "strategic alliance" amongst traders highlights the importance of studying the effects of policy reforms in the framework of imperfect domestic market structure.

The purpose of this paper is to analyze Taiwanese rice policy reforms using a computational partial equilibrium model. The impact of import controls, price supports, land set-aside and alternative market structures are assessed, including the potential change in regimes within the tariff quota system. Our results show that the "strategic alliance" proposed by the agricultural authority will further distort the domestic market. Elimination of the domestic support price and land set-aside improves social welfare independent of the market structure while a change in the market structure towards competition is always social welfare improving regardless of domestic policy instruments. But the policy regime of the tariff quota (the in-quota tariff versus the out-of-quota tariff versus the quota) and hence social welfare is sensitive to changes in both domestic policy instruments and market structure.

Key words: tariff rate quota, strategic alliance, domestic support, market structure
JEL Classification: Q17, Q18

1. Introduction

For the past four decades, the rice industry in Taiwan had been protected by the Taiwanese agricultural authority with an import ban and domestic price supports with acreage set asides. However, once Taiwan successfully became a member of the WTO in January 2002, policies and market conditions have changed dramatically. Imports are now allowed, reducing domestic prices and forcing policy reforms. A basic import quota was adopted in 2002 along with a special safeguard tariff but was replaced by a two-tier tariff rate import quota (TRQ) in 2003. This paper seeks to analyze the impact of the introduction of imports, the switch to a tariff quota scheme and the implementation of domestic policy reforms under alternative domestic market structures.

The existing literature on TRQs system focused on rent allocation and the final product market based under different assumptions about market structures. Some studies assumed perfect competition to analyze the possible market impact under different scenarios (Boughner et al 2000; Abbott and Paarlberg 1998; Abbott 2002; Skully 1999). Other research used the monopoly model, based on the fact that many importing countries adopt state trading enterprises (STEs) to administrate imports and control the domestic market, such as in the case of Korean rice imports (Hranaiova et al, 2002; Joerin, 2001) and Canadian dairy imports (Schmitz, de Gorter and Schmitz 1995). Recently, Paarlberg and Lee (2001) analyzed the market impact of TRQs on the US lamb market assuming an oligopoly model. The strategies between firms in this paper were assumed to follow Cournot competition behavior. In none of these studies in the literature have changes in domestic support policy been considered.

Although perfect competition assumption is widely used, we consider imperfect competition as alternative domestic market structures for two reasons. First, it is a policy concern to protect the small rice farmers of Taiwan. In 2002, the former President of Counsel of Agriculture, Dr. Chen, recommended that farmers and processors form a “strategic alliance” as a countermeasure for imports which can lead to a change in the domestic market

structure. This is a policy guideline for the next few years and is widely expected to result in a higher price for rice in Taiwan. We seek to determine the net welfare effects of adopting such a possible market structure and determine how sensitive it would be to varying degrees of alliances.

Second, food retailers have some market power of the food chain system already, which implies that the agricultural market structure is more typically oligopolistic (McCorriston, 2002). Currently, the functions of processors are to purchase rice directly from the farm level and shell the raw rice into polished rice, after which it is transported and sold to consumers. Processors are believed to have some market power in the rice producing chain already (Huang, 1995; Yang, 2000). When imports were allowed, processors in the entire vertical market chain system are now to compete with international exporters. For this reason, it is important to analyze the effects of the processor market and possible imperfectly competitive markets.

The unique contribution of our research is combining the vertical domestic market chain structure and the general conjectural variation processor market to analyze the different impacts of domestic policy changes and alternative import regimes. The objectives of this paper are two fold. First, we are interested in the economic impact of the pure quota and tariff rate quota system to see the effects of the policy decision by agricultural authority on market alliances. Second, we are interested in the interactions between the “strategic alliance” proposal and domestic subsidies.

The remainder of the paper is organized as follows: section two provides background information of current domestic policies and trade policies of the Taiwanese rice sector. Section 3 develops the theoretical model of Taiwanese rice industry. Section 4 uses the computational partial equilibrium model to evaluate the market and welfare impacts under different policy scenarios.

2. Background on Domestic Policies and Import Regimes

Domestic policies consist of a price support program and land set asides program under the "Rice Paddy Utilization Adjustment Program" (RPUAP). Trade policy changes occurred in 2002 when an import quota was introduced and expanded to a tariff rate quota in 2003.

To control the rice supply and stabilize a 'reasonable' domestic rice price, the government established the Food Stabilization Fund with a budget of NT$ 3 billion in 1974 to purchase rice from farmers at prices well in excess of world market prices. In the beginning of the price support program between 1974 and 1976, the quantity purchased by the government was unlimited. As a consequence, rice production increased rapidly from 2,254 thousand million tons in 1973 to its historical peak of 2,713 thousand million tons in 1976. A persistent surplus of rice resulted, causing a heavy burden on governmental storage costs and facility capacity.

To balance the budget and decrease the inventory of rice, the government adjusted the price support program in 1978 by limiting purchases to a fixed quantity per acre. The current guarantee purchased price is 21 NT$/ kg, with an average per acre purchase of 1,268 kg. (as compared to an average yield per acre of 4,464 kg/ha).

In order to reduce the heavy cost of rice purchases from farmers and to increase the farm level price, the Taiwanese agricultural authority implemented a land set aside program in 1996, called the first round of the RPUAP. Under this program, rice farmers were paid 41,000 NT$ to set aside 30% of their land from production. Currently, a new four year RPUAP is in effect that was put in place in 2001. A special feature of this program was to expand the set aside area with higher direct payments than the first RPUAP. At the same time, the government announced the same price support levels based on political reasons. So the two main domestic rice policies are price supports for government purchases and set asides with direct payments.

2.1 Trade Policy

The first year for rice imports was based on a "special treatment" regulation of the WTO to suspend the request for a tariff rate import quota (TRQ)[2]. As a result, 144,720 tons brown rice basis rice was allowed to be imported by Taiwan in 2002 under a standard import quota. The Taiwanese authority controls 65% of total imports with private traders' accounting for the rest under a First Come First Serve system (FCFS)[3]. The private traders portion of imports (50,652 tons) was sold directly on the domestic market, which, unlike the cases of Japan and Korea, cannot be re-exported or be used as food aid or livestock feed. However, the government is allowed a mark-up on imported price of up to 23.26 NT$/kg (equal to a 281% tariff rate) based on the special safeguard regulation, and the markup price is to decrease every two weeks by 3 NT$/kg if the imported quota is not totally allocated to private traders.

Since January 2003, Taiwan has switched its rice import policy from an import quota to a TRQ based on the following reasons. First, Japan had applied a TRQ system for rice imports in 1999. If Taiwan continues to insist on a pure import quota system, then they may be at a disadvantage in the WTO negotiations for political reasons. Second, if Taiwan continues its import quota system, then the level of quota would need to be negotiated directly with other WTO members while the TRQ commitments are pre-determined and so uncertainty is minimized. Third, the government believes that a TRQ can protect domestic rice farmers more than an import quota system. Besides, TRQs are a popular system adopted by other WTO members.

Tariff rate quota system includes three main components. They are an in-quota tariff

---

[2] According to Annex 5, importing country can request special treatment to protect domestic industry for the purpose of food security or environmental protection, if the import amount of base year is less than the 3% of base year domestic consumption.

[3] 100 tons is the minimum quantity for each private trader who applies for the imported rice, and the maximum is no more than 45% of the total that government announces of each sell.

1. 65 % of government imported is brown rice basis, and 35 % import rice of private trader is polished rice basis.

(t_1), import quota (Q), and an out-of quota tariff (t_2). Resulting from the negotiations, the in-quota tariff rate (t1) is zero, the out-of quota tariff rate (t_2) is 45 NT$/kg (543% tariff rate), and the import quota is 144,720 tons of brown rice for 2003. Similar to the previous import quota system, the government control 65 % of imported rice and only 35% of the total rice import quota will be imported by private traders. The quotas under the TRQ system are allocated by auction.

3. The Theoretical Framework

A key characteristic of the Taiwanese rice market is the element of imperfect competition where rice processors exhibit oligopoly power vis-a-vis consumers. This may be exacerbated if the proposed government initiative of an industry "strategic alliance" is implemented. Our conceptual model of the vertical market structure of the Taiwanese rice market is depicted in Figure 1 with three sub-sectors: farm, processor and consumer market levels. Farm sales of raw rice can be regarded as upstream firms in the vertical structure on the production side while processors buy and transport the raw rice from farmers and sell it to the consumers. This stage can be regarded as the downstream firms in the vertical production process.

3.1 Farm market (upstream firms)

Perfect competitive markets at the farm level is assumed in our model because of the small size farming system with many farms representing the special feature of most East Asian countries due to geographical restrictions and cultural characteristics, including Taiwan. Agricultural activity is centralized in the western part of Taiwan because it is the only area of the island suitable to grow rice. Because the use of agricultural land is limited, it is necessarily the case that rice farms are small and so very difficult for imperfect markets to develop. Second, the average age of labor is above 40 years old because of declining profits in rice farming over time, making it difficult to keep younger generations in farming. As a

result, they rely on old technology and crop independently. With a small farming system and old technology, we believe that rice industry is unlikely to have increasing returns to scale and so is assumed to be a perfectly competitive market.

To maintain the income of rice farmers, the government has intervened in the rice market by implementing price supports and paid acreage set asides. Under these two domestic policies, a representative rice farmer is assumed to maximize profit including government payments and market revenues. The production decision of the representative rice farmer can be described by:

(1) $$\underset{L,Z}{Max} \quad \pi = p_f\{F(\alpha L, Z) - \alpha L\overline{Q}\} + \alpha L\overline{P}\overline{Q} + (1-\alpha)LP_s - P_l L - P_z Z$$

where p_f is the equilibrium market price for rice at the farm level, 1-α is the ratio of mandatory set aside per acre, α L is the acre of land involved in rice production, Z is the purchased inputs used for rice production, $\overline{P}$ is the per unit government support price, $\overline{Q}$ is government purchases per acre, P_s is the per acre subsidy payment for set asides, P_l is the price of land, P_z is the price of purchased inputs and F (.) is the production function.

There are five terms in equation (1). The first term is the revenue from selling rice to processors, and the second term is the revenue from the price support program while the third term is the revenue of RPUAP. The last two terms are the input costs of production.

To derive the optimal conditions of farmers' decisions, we have to solve the first order necessary condition, and second order sufficient condition.

First order necessary condition of an interior solution is:

(2) $$\frac{\partial \pi}{\partial L} = \alpha F_1 p_f + \alpha\overline{Q}(\overline{P} - p_f) + (1-\alpha)P_s - P_l = 0$$

(3) $$\frac{\partial \pi}{\partial Z} = p_f F_2 - P_z = 0$$

The economic intuition behind equation (2) and (3) can be understood by comparing the marginal cost and benefit of each input use. For the land use equation (2), the first term is the

marginal revenue from selling rice to processors; the second term is the marginal payment received from the price support program, and the third term is the marginal payment to set aside land. In summary, an increase in one unit of land can generate three different incomes, depending on the proportion of land allocated to different uses. The first three terms are the marginal revenue of per unit land planted. The fourth term is the cost of per unit land. When benefit is equal to cost, the optimal conditions will be hold.

To check the local or global maximization problem of rice farmers' decision, the second order sufficiency condition is:

$$|H_1| = \pi_{LL} = \alpha^2 p_f F_{11} < 0, \text{ or } |H_1| = \pi_{ZZ} = p_f F_{22} < 0$$

$$|H_2| = \begin{vmatrix} \pi_{LL} & \pi_{LZ} \\ \pi_{ZL} & \pi_{ZZ} \end{vmatrix} = \begin{vmatrix} p_f F_{11}\alpha^2 & p_f F_{12}\alpha \\ p_f F_{21}\alpha & p_f F_{22} \end{vmatrix} = p_f^2 \begin{vmatrix} \alpha^2 F_{11} & \alpha F_{12} \\ \alpha F_{21} & F_{22} \end{vmatrix} = p_f^2 \alpha^2 (F_{11}F_{22} - F_{12}^2) > 0$$

As long as the production function satisfies concave functional form property, which we usually assume in production theory, the second order condition is the sufficient condition. That is, $F_{11}, F_{22} < 0$, and $F_{11}F_{22} - F_{12}^2 > 0$ holds.

From the decision model of a representative farmer above, government policies play an important role in his decision. Without the government intervention, the optimal decision is different from the optimal decision above. A representative farmer would maximize his profit by:

(4) $$\underset{L,Z}{Max} \quad \pi = p_f F(L,Z) - P_l L - P_z Z$$

The first order condition for an interior solution would become:

(5) $$\frac{\partial \pi}{\partial L} = p_f F_l - P_l = 0$$

(6) $$\frac{\partial \pi}{\partial Z} = p_f F_z - P_z = 0$$

The optimal input decisions in equations (5-6) of a farmer are just the standard model of maximizing profit firm behavior. Per unit input (L or Z) use must satisfy the condition that

the marginal benefit is equal to the marginal cost of per unit input price. The revenue no longer comes from the governmental program but only from selling crops to the market.

3.2 The Processors market

There are three roles for processors in the Taiwanese rice market. Processors purchase the raw rice directly from the farm market, convert the raw rice to polished rice, and transport and sell it on wholesale markets. Transportation is the biggest component of total processing margins. Therefore, we simply assume that the production function of retailers is $h(q^h) = q^d$, where the retailers' purchases are fixed proportion of what retailers' sell[4]. We also assume that the domestic rice retailers compete with foreign exporters in quantity competition with general conjectural variation behavior in the wholesale market[5]. Based on this assumption, we can set up the problem for retailers maximizing profits:

Domestic retailer:

(7) $$\underset{q^h, q^d}{Max} \quad \pi = P^h(Q^h)q^h - [p_f + k]q^d - F$$

(8) $$\text{s. t} \qquad h(q^h) \le q^d$$

where q^h is the polished rice supply for wholesale market; q^d is the raw rice demand from farm market; k can be regarded as per unit transportation cost from farm market; F is the fixed cost, such as an equilibrium value. From equation (7), we know that the first term is the revenue of retailers, and the last two terms are the cost to retailers. In particular, the second term shows that retailers have market power toward the raw rice purchases from farm market.

If we assume the technology is efficient (so the constraint is binding), and market conditions hold, then the objective function can be rewritten as follows:

---

[4] Fixed proportion technology is assumed here based on theoretical and empirical assumptions. First, this assumption has been widely used in the literatures, especially for intermediate products (see Spencer and Jones, 1991; Sheldon and McCorriston, 2001). Second, a government report shows that input-output relations of rice in the retailing process is 0.8, corresponding to the clean raw rice to polished rice process (CoA, Taiwan).

[5] Although there are many small size retailers purchasing the rice from farmers, market power is still controlled by some large retailers, which might also be a form of union forsmall size retailers. In general, they have market power both in wholesale markets and farm markets.

(9) $$\underset{q^h}{Max} \quad \pi = P^h(Q^h)q^h - [p_f + c]h(q^h) - F$$

First order necessary condition is:

(10) $$\frac{\partial \pi}{\partial q^h} = p^h + q^h\left(\frac{\partial p^h}{\partial Q^h}\frac{\partial Q^h}{\partial q^h}\right) - \frac{\partial h}{\partial q^h}(p_f + c) = 0$$

Let v_{ij} denote the amount by which retailer i's belief that each retailer j will responds to i's increase. As a result, Q^h will increase by 1+(n-1)v_{ij}, and v_{ij} is also index of the degree of market competition. The term v_{ij} equals to -1 in perfect competition market; 0 in Cournot oligopoly competition, and 1 if retailers have collusive (Monopoly) behavior. Equation (10) can be rewritten as follows with the form of strategy variable:

(11) $$\frac{\partial \pi}{\partial q^h} = p^h + q^h\frac{\partial p^h}{\partial Q^h}(1 + (n-1)v_{ij} - \frac{\partial h}{\partial q^h}(p_f + c) = 0$$

If we define the aggregate conjectural variation variable as:

(12) $$V = \frac{\partial p^h}{\partial Q^h}(1 + (n-1)v_{ij})$$

Combined with equation (12), equation (11) can be rewritten as:

(13) $$\frac{\partial \pi}{\partial q^h} = p^h + Q^h V - \frac{\partial h}{\partial q^h}(p_f + c) = 0$$

From equation (13), we can see the optimal processors' decision change affected by the exogenous variables of the environment. We focus on the two interesting partial effects as follows: Conjectural variations between firms affect the market performance. From equation (13), the equilibrium quantities of the market will increase with an increase in the conjectural variation. However, there are two factors which can cause this variable to change (equation 11). One is a change in the number of firms, and the other is a change in the conjecture variation between firms.

The effect of domestic policy depends on the production relation connected to the policy. Domestic policy can also affect the market equilibrium by changing the cost to the processor, which is the farm price. If the government increases the purchased price in the price support program, the equilibrium farm market price decreases, causing a cost decrease for the

processor. In this case, the equilibrium quantity of the table rice would increase.

Equation (13) is the equilibrium condition under the autarky case. In the small open economy, this condition would change depending on different kinds of trade policy. For the pure tariff case, two outcomes are possible. If the initial domestic market price under autarky is above the world price, the imperfect competition of processors cannot hold under international trade. In this case, the domestic price would be equal to the world price. Equation (13) becomes

(14) $$\frac{\partial \pi}{\partial q^h} = (p_w + t) + Q^h V - \frac{\partial h}{\partial q^h}(p_f + c)$$

where Pw+t is the world price plus the per unit tariff rate. However, there is no trade if the initial domestic price is below the world price. For the pure import quota case, the imperfect competition market structure can hold because the only effect imposed by the quota is to decrease the demand facing the processors. Equation (13) becomes

(15) $$\frac{\partial \pi}{\partial q^h} = p^h (Q^h + M) + Q^h V - \frac{\partial h}{\partial q^h}(p_f + c)$$

where M is the quantity of imports.

For the tariff rate quota case, there are several possible scenarios, depending on which policy is effective (Abbott, 1998; Hranaiova et al, 2002, Abbott, 2002). There are three different scenarios under a TRQ. First, if the domestic market equilibrium price under autarky is above the out-quota-tariff, excess demand curve intersects the excess supply (out of quota tariff) to the right of quota. In this case, market access is greater than the quota commitment and the out of quota tariff is effective. Second, the excess demand curve intersects the excess supply (out of quota tariff) to the left of the quota. In this case, market access is less than the quota and the in-quota tariff is effective. In both of these cases, the TRQ acts like a pure tariff system. Third, if the domestic market equilibrium price under autarky is between the in-quota tariff and out-of quota tariff, the excess demand curve intersects the excess supply curve at the quota commitment. In this case, the quota is binding

and the TRQ acts like a pure quota system. Market access is equal to the quota amount.

4. Empirical Analysis

To illustrate the economic impact of policy changes, a computable partial equilibrium model is constructed for the Taiwanese rice market. This empirical framework is widely used to simulate the aggregate effects of agricultural policies (Gardner, 1987; McCorriston et al 2001). The special feature of this approach is that different markets of the vertical production chain is considered, thus preserving the relevant general equilibrium effects of the entitle industry through the connection of different markets. However, we generalize the flexible market structure in our model, which differs from the studies in the literature. We benchmark our empirical model as the case of perfect competition with domestic support policies under autarky. The following is the model structure of Taiwanese rice market under autarky.

Input supply:

(16) $L = g(P_l) = k_l P_l^{\varepsilon}$

(17) $Z = z(P_z) = k_z P_z^{\eta}$

Input demand:

(18) $\alpha F_l p_f + \alpha \overline{Q}(\overline{P} - p_f) + (1-\alpha)P_s = P_l$

(19) $p_f F_z = P_z$

Equilibrium condition:

(20) $\beta F(\alpha L, Z) = k_f (\alpha L)^{\sigma_1} Z^{\sigma_2} = Q^h = \sum_{i=1}^{n_h} q_h$

Demand of processing firm:

(21) $p^h + Q^h V = \frac{1}{\beta}(p_f + c)$

Consumer demand:

(22) $P^h = a - bQ^h$ -d*M

In the model above, L and Z represent the land and labor inputs. Equation (16,17) are

the market clearing conditions equations for the two inputs, where we assume constant elasticity forms for both supply equations, with supply elasticity of ε and η respectively. Because land is an inelastic input, we choose the elasticity for land of 0.1. Compared to land use, labor is more elastic, so an elasticity of 0.9 is chosen.

Equations (18,19) represent the first order conditions of inputs demand of a profit maximizing farmer with the price support program and land set asides, which are based on our theoretical framework. The term 1-α is the proportion of farmland contributed to mandatory land set-aside program, which is 0.29 based on current data. The per-acre set aside payment is 41,000 NT$, which has been announced in the RPUAP of 2001 (CoA). As for the policy variable of price supports, the guaranteed price per acre subsidy ($\overline{P}$) is equal to 21,000 NT$/ ton, and the per acre purchase from government is chosen as 3.36 ton/ acre (CoA 2001).

Equation (20) is the market clearing condition between the farm market and processor market. The demand of processors must be equal to the supply of the farmers. For simplicity, we assume a functional form for the production functions of rice technology to be Cobb-Douglas, which has been proven to be consistent with homothetic hypothesis and found to fit the rice data better (Tsai and Wann 1995). The parameters, σ_1 and σ_2, the cost share of production respect to land and labor, are chosen as 0.19 and 0.81 by averaging the cost share data of rice production published by CoA between 1952-2001. They sum up to one to represent the constant returns to scale production technology. We also assume a fixed proportion relationship between processor demand and farmer production, which can be represented by β, based on two reasons. First, fixed proportion has been widely used in the literature of industrial organization in vertical structures (Sheldon, 2001; Tirole 1988). The second reason is the unavailable information on processors' technology. Based on the conversion published by CoA, one unit of raw rice produced by rice farmers is approximately equal to 0.7 units of polished rice, sold to consumers by processors. We therefore choose β to be 0.7.

Equation (21) is the first order condition for a profit maximizing processor. V represents the general conjectural variation, which varies under different market structures in processor markets. Setting V equal to zero can capture a perfect competitive market; Cournot competition can be represented by setting V equal to b/n. However, we benchmark our model as the case of perfect competition. The parameter c of the processor is per unit cost, including the transportation cost, which is chosen as 4570 NT$/ton (Yang, 2001). Based on the quasi-linear utility function assumption of consumer preference, we can get the simple linear demand function as in equation (22). In order to take into account of the differential product, parameter d is assumed to be 1.1, which captures the substitution effect between import rice and Taiwanese rice. Parameter b can be calculated based on the demand elasticity (assumed to be –0.1).

After calibrating the functional constants (k_l, k_z, k_f, a) based on the observed data and the given parameters, we can solve the seven endogenous variables ($L, Z, P_l, P_z, p^h, Q^h, p_f$), equal to the observed baseline data, simultaneously according to the equation systems (equation 16-22). Table 1 lists the value of the parameters used in the equation system above.

5. The Simulation results

In the empirical part, our results are summarized with three tables (2-4) to provide the answers to the questions posed earlier: Will it increase social welfare if the Taiwanese agriculture authority switches the pure quota system to a TRQ, and what the difference will be if the domestic market departures from perfect competition (table 2)? If domestic policy has to be abolished in order to satisfy WTO commitment, what is the different economic impact for the Taiwanese rice sector (table 3)? If the market access of a TRQ is sensitive to domestic market structure, what will be the critical market structure for the policy regime to change with TRQ (table 4)?

5.1 Potential impact of a move from a pure quota system to a TRQ and alternative market structure

Table 2 summarizes the economic impacts under autarky, pure quota import system, the import policy of 2002, and the tariff rate quota, introduced in 2003. Under the pure quota system, rice farmers will use more land (333,766 ha), 0.47% of the autarky economy, for production in order to get more subsidy from the price support program. At the same time, rice farmers also enroll more land in the set aside program in order to obtain more subsidies. The increase in land use as a result land equilibrium price to rise. However, the effect of an increase use on output is out weighed by the decrease in labor use for rice production, resulting in rice production falling to 1,653,530 tons, 4% less than the autarky. Although domestic rice production falls, the quantity of rice import increases and so dominates the decrease in domestic production, causing the total amount available of table rice for consumer to increase. As a result, the equilibrium consumer market price falls to 30,902 NT$/ton, less than 5% of the autarky.

As for government payments, price supports, land set-asides, and costs for destroying 65% of the imports are included. Government payment for domestic supports increases due to not only the increase of land use for production, but also the more land use for set-aside program. More importantly, there are two effects determining the price support payment; the land use increase and the increase difference in between the equilibrium farm price and the guaranteed price, both of which increase the price support program payments.

Although the minimum commitment of imports under the pure quota system is 144,720 tons in 2002, the Taiwanese agricultural authority controls 65 % and stores it, and then destroys it later, as in South Korea. As a result, the cost of destroying imports is 778,883,040 NT$ under the pure quota import system.

The welfare analysis shows that consumer surplus increases by 1.07 % under 50,652 tons of rice imports because total consumption increases. However, total farmer surplus is

unchanged, as well as processor surplus because of the perfect competition assumption for both markets. By summing consumer surplus, total producer surplus, quota rents and the cost of government domestic supports, the net social welfare will increase by 0.17% compared to autarky. This result shows that the consumer surplus gain is outweighed by the loss in producer surplus and government payments. The Taiwanese rice industry benefits from the pure quota import system, given the current price support and land set aside policies.

The third column of table 2 shows the economic impact under the TRQ with the same import quota, the current regulation of TRQ in the first year under perfect competitive domestic market. By comparing the TRQ and pure quota system, we show that the economic impact is the same under these two different import systems, because of the binding quota regime of TRQ. The reason is that the current out-of quota tariff is so high enough (53,280 NT$/ton) that out of quota imports are prohibited under the TRQ.

If the agricultural authority successfully implements the "strategic alliance" proposal, it is likely that the domestic processor market structure will change. As a result, it is of interest to analyze the different economic impacts under various market structures. Based on the economic theory of imperfect competition, the consumer price will be higher than perfect competition. In addition, the economic analysis will differ between the pure quota and the tariff quota system. Under the pure quota system, the domestic oligopoly situation can be maintained, while the tariff quota may reduce the market power of an oligopoly if the original domestic consumer price is higher than the given tariff rates. One interesting question will be the sensitivity of the policy regime change to different imperfect competition market structure, because the latter determines the different levels of imports.

Column four and fifth of Table2 show the economic impact under several market structures[6] under the TRQ, given the current domestic support, price and land set aside.

[6] For simplicity, we assume the strategic alliance proposal will changes the processor market structure in the form of Cournot competition, although there are some competition behavior can be discussed.

According to Table 2, we can make several conclusions. First, when processors have market power, the quantity sold to consumers will be less than the case under perfect competition, causing the demand at the farm level to decrease. Demand decreases at the farm level results in equilibrium domestic production to decrease and a lower the farm market equilibrium price. Because of the government subsidy for farmland use, farmers will adjust their production strategy by using more land and less labor. So the distortion effect of land use is higher than the autarky case. Second, we show that the larger degree of imperfect competition lowers consumption. Because of the lower equilibrium farm market price and more land input for production, government payments in the price support program and land set aside will be higher than the perfect competition case.

Welfare analysis shows that consumers are worse off, but processors are benefit by having some degree of market power changes in farmer surplus are still zero under the perfect competition market assumption of the farm market. However, the net social welfare declines compared to perfect competition. Surprisingly, the net social welfare both under Cournot 20 and Cournot 10 is less than under the autarky case. This means that the distortion effect from keeping domestic subsidies out weight the consumer surplus gain.

How sensitive is the TRQ policy regime change to various domestic processor market structures? Our results show that the quota is binding under Cournot 20 competition, as well as under the perfect competition case, while the out of quota tariff becomes effective when the processors have more market power (Cournot 10). One should note that domestic oligopolies can no longer exist if the out-of-quota tariff becomes effective. When out of quota tariff becomes effective, the imports increase, which can be shown by the out of quota imports. Under Cournot 10 competition, the out-of quota imports are 109,991 tons.

5.2 The economic impact if domestic supports are abolished

Although domestic market access is an important issue in the WTO negotiations, domestic support reduction is another concern with the current WTO negotiations. The price

support program, amber box policy, has the direct effect on rice production, must be decreased or abolished in the near future. Table 3 shows alternative simulation scenarios of the case if the government abolishes the domestic support policy (both price support and land set-aside programs).

Without government subsidy for land use, there is no incentive for farmers to use more land in rice production. However, the set-aside land will be back to production if the set aside payment is abolished. As a result, the total land use depends on these two effects. Our result shows that total land for production increases, and also land use decreases as the degree of market structure increases.

Most importantly, the net social welfare increases compared to the autarky case even in the imperfect competition case, because domestic policy no longer distorts input use. The increasing of consumer surplus will out weigh the loss in the surplus of the production sector, resulting in net gain to the society. When the processor market becomes more concentrated, net social welfare gain is lower compared to autarky.

By comparing tables 2 and 3, we can see the distortion effect of domestic support policies. Taking perfect competition case as an example, the difference in social welfare is almost 1% of the autarky, which can be regarded as the distortion effect of domestic policy under the pure quota import system.

It is of interest to see the sensitivity of market structure to the policy regime of the TRQ. Table 4 shows that when the market structure changes from Cournot 12 competition to Cournot 11 competition under the case of a domestic support, the policy status changes from an effective out-of-quota to a binding quota. In other words, market power[7] between 0.49-0.46 is the range for policy status switching. For the case without domestic support, market access increases when market structure changes from Cournot 10 competition to

[7] Lerner index is applied as the measurement of market power, although there are other available measurements. The reason is that this is the easy one to be used without more information of processors (Tirole, 1988).

Cournot 11 competition, and the corresponding market power is 0.53, and 0.5.

6. Conclusion

Our analysis shows that consumers benefit from rice imports, as well as society as a whole when imports are allowed into Taiwan. The net social welfare gain will be 0.17 % compared to the autarky case, both under the pure quota and TRQ. In other words, the TRQ acts like the pure quota system if the domestic rice markets, both at the farm market and the processor market, are assumed to be perfect competition markets. In this case, market access will be the same as the quota commitment level. From this point of view, it might be reasonable for the Taiwanese agricultural authority to switch the import policy from a pure quota system to the TRQ.

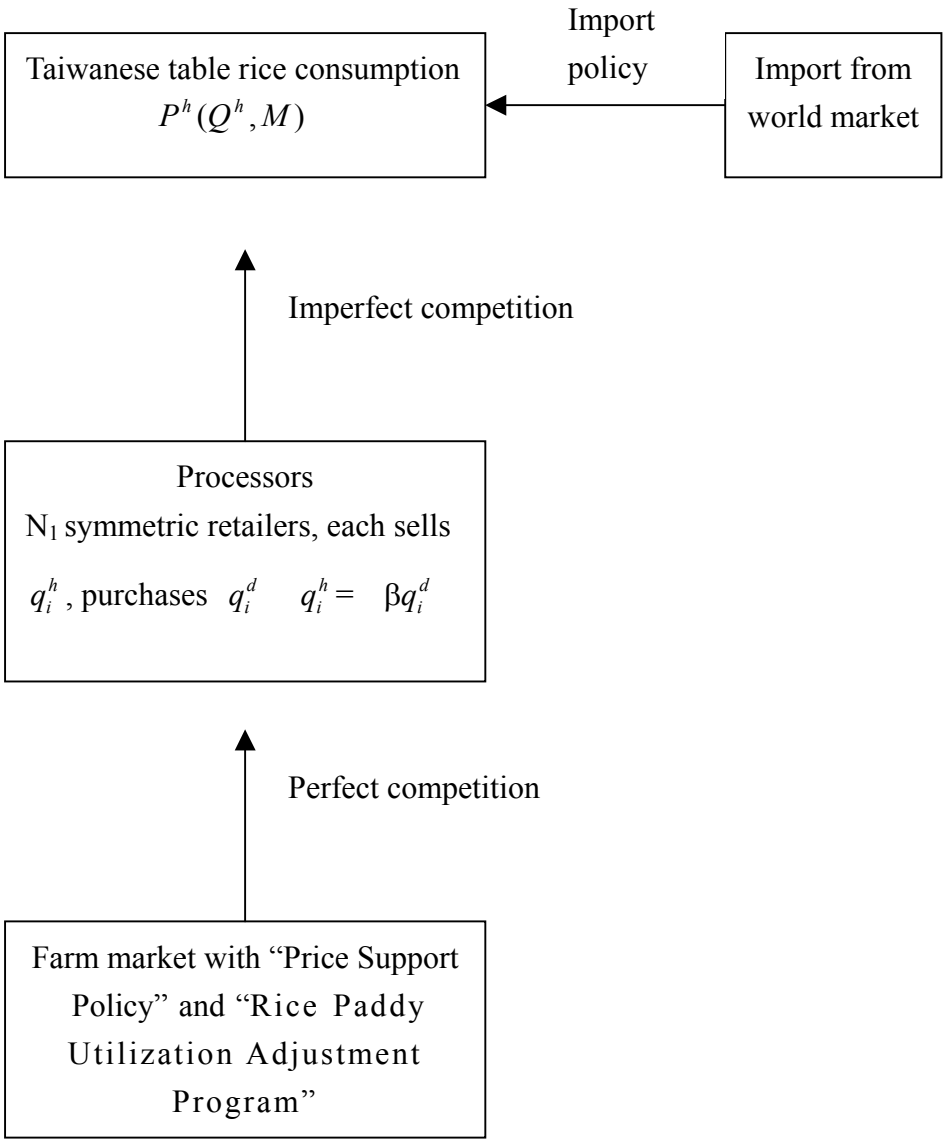
If the domestic processor market structure is changed due of the "strategy alliance" policy proposed by the agricultural authority, our results show that consumers are worse off, and the domestic processors are better off under continuing domestic support. However, the net social welfare falls compared to autarky. Further, the domestic market access is likely sensitive to the degree of imperfect competition. If the degree of market power is less than 0.46 (equal to Cournot 12), quota is binding under the TRQ system. However, the out-of quota tariff is effective once the processor market is less competitive than the Cournot 12 competition.

If domestic support has to be abolished in order to conform to WTO regulations, then farmers use more land because the set-aside land will be back into production. If the out of quota tariff becomes effective, processors no longer enjoy the oligopoly market power and their surplus decreases. Also, the net social welfare is greater than the autarky case. However, it decreases if the domestic market is more concentrated. To summarize, the strategy alliance policy, which might potentially change the domestic processor market structure, should not be taken for granted in our analysis.

Although the current WTO negotiations focus on market access and domestic support

adjustment, domestic market structure is seldom considered around the WTO members. However, our analysis shows that the effect of market access is sensitive to the domestic market structure. Market access can be increased if domestic markets are highly imperfectly competitive, because of the regime change in the TRQ. This issue should be considered to evaluate the market access negotiations in the WTO.

Figure1: Vertical market structure of Taiwanese rice industry



Source: summarized by authors

Table 1: Parameters and Policy Variables

Symbol	Parameter	Base Value
ε	Supply elasticity of land	0.1
η	Supply elasticity of labor	0.9
α	Proportion of land to land set aside	0.71
β	Ratio of raw rice to polished rice	0.7
σ_1	Production elasticity of land	0.19
σ_2	Production elasticity of labor	0.81
C	Transportation cost of processors	4,570 (NT$/ton)
d	Substitution of import to domestic rice	1.1
V	General conjectural variation variable	0
P_s	Payment for land set aside	41,000 (NT$/ ha)
$\overline{P}$	Government purchase price	21,000 (NT$/ ton)
$\overline{Q}$	Government purchase quantity	3.36 (ton/ ha)

Source: Summarized by Authors

Table 2: Economic Impact of Different Import System With Current Domestic Support

		Perfect Competition		Imperfect Competition	
	Autarky	Open Economy			
		Pure Quota	TRQ	Cournot 20	Cournot 10
		M=50652	T1=0%, T2=543%, M=50652		
Policy Status	**N.A**	**N.A**	**M effective**	**M effective**	**T2 effective**
Total Land (10^3acre)	469	471	471	473	477
Planted Land (10^3acre)	332	334	334	335	338
Labor (10^3person)	231	219	219	207	184
Land Price (10^3NT$/ha)	31	33	33	34	37
Labor Price (10^3NT$/person)	111	104	104	98	86
Consumer Market Price (10^3NT$/ton)	33	31	31	44	53
Farm Market Price (10^3NT$/ton)	18	17	17	16	14
Market Margin (10^3NT$/ton)	14	14	14	28	40
Domestic Production (10^5ton)	17	17	17	16	14
Total Import (10^3ton)	NA*	51	51	51	110
Out-of-Quota Import (10^3ton)	NA*	0	0	0	59
Domestic Consumption (10^5ton)	12	12	12	11	11
Tariff Revenue (NT$)[a]	0	0	0	N.A	27
Quota Rent (10^8NT$) [a]	0	11	11	18	23
Domestic Support Payment (10^8NT$)	86	100	100	114	141
Destroy cost (10^8NT$)	0	8	8	8	8
Consumer Surplus (10^{10} NT$)	20	20	20	18	17
Processor Surplus(10^9NT$)	0	0	0	13	18
Farm Surplus(10^{10}NT$)	3	3	3	3	2
Net Social Welfare(10^{10}NT$)	22	22	22	21	21
Change in Net Social Welfare (%)[b]	0.00	0.17	0.17	-1.63	-4.44

Note: * NA means not available; b: compare to baseline

Table 3: Economic Impact of TRQ of Changing Market Structure Without Domestic Support

	Perfect competition	Imperfect Competition	
		Cournot 20	Cournot 10
Policy Status	**M effective**	**M effective**	**t2 effective**
Total Land (10^3acre)	424	420	413
Planted Land (10^3acre)	424	420	413
Labor (10^3person)	209	198	183
Land Price (10^3NT$/ha)	11	10	9
Labor Price (10^3NT$/person)	99	93	86
Consumer Market Price (10^3NT$/ton)	28	42	53
Farm Market Price (10^3NT$/ton)	15	14	13
Market Margin (10^3NT$/ton)	13	28	40
Domestic Production (10^5ton)	17	16	15
Total Import (10^3ton)	51	51	80
Out-of-Quota Import (10^3ton)	0	0	29
Domestic Consumption (10^5ton)	12	12	10
Tariff Revenue (10^8NT$)[a]	N.A	N.A	13
Quota Rent (10^8NT$) [a]	10	17	23
Domestic Support Payment (10^8NT$)	0	0	0
Destroy cost (10^8NT$)	8	8	8
Consumer Surplus (10^{10} NT$)	20	19	17
Processor Surplus(10^9NT$)	0	11	20
Farm Surplus(10^{10}NT$)	2	1	1
Net Social Welfare(10^{10}NT$)	22	21	21
Change in Net Social Welfare (%)[b]	1.19	-1.61	-3.73

Note: * NA means not available; b: compare to baseline

Table 4: Sensitive Analysis of Policy Regime Change to Market Structure and Policies

	With domestic Policy		Without Domestic policy	
	Cournot (N=11)	**Cournot (N=12)**	**Cournot (N=10)**	**Cournot (N=11)**
Market power (Lerner index)		**0.46**		**0.50**
Policy Status	**t2 effective**	**M effective**	**t2 effective**	**M effective**
Total Land (10^3acre)	475	474	413	416
Planted Land (10^3acre)	337	336	413	416
Labor (10^3person)	194	200	183	190
Land Price (10^3NT$/ha)	36	35	9	10
Labor Price (10^3NT$/person)	91	94	86	89
Consumer Market Price (10^3NT$/ton)	53	52	53	53
Farm Market Price (10^3NT$/ton)	15	15	13	14
Market Margin (10^3NT$/ton)	39	37	40	39
Domestic Production (10^5ton)	15	15	15	15
Total Import (10^3ton)	70	51	80	51
Out-of-Quota Import (10^3ton)	70	0	29	0
Domestic Consumption (10^5ton)	11	11	10	11

Note: when t2 is effective, processor has no market power

References

Abbott, P.C., and Paarlberg, P.L. "Tariff Rate Quota: Structural and Stability Impacts in Growing Markets". *Agricultural Economics* 19 (1998): 257-267.

Abbott, P.C. "Tariff Rate Quotas: Failed Market Access Instruments". *European Review of Agricultural Economics* 29 (2002): 109-130.

Boughner, D. S., de Gorter, H, and Sheldon, I. "The Economics of Two-Tier Tariff Rate Import Quotas in Agriculture". *Agricultural and Resource Economics Review* 29 (2000): 58-69.

Counsel of Agriculture of Taiwan Internet Publication. http://www.coa.gov.tw

Counsel of Agriculture of Taiwan (2001). *Taiwan Food Statistics Book*. Taipei, Taiwan.

Dixit, A. "Anti-dumping and Countervailing Duties under Oligopoly" *European Economic Review* 32 (1988): 55-68

Gardner, B.L. *The Economics of Agricultural Policies*. New York: Macmillan, 1987

Hranaiova, J., de Gorter, H., and Ingco, M. "The Economic of An Import State Trading Enterprise with Tariff Rate Quotas". Working paper, Cornell University (2002).

Huang, W.C. "The Economic Impact of Taiwanese Processors under WTO" *Taiwanese Economy* 223 (1995): 50-61 (in Chinese)

Harris, R. "Why Voluntary Export Restraint are Voluntary" *Canadian Journal of Economics* 18 (1985): 799-809

Joerin, R. "The Impact of Tariff Rate Quotas and Imperfect Competition on Market Access". Paper presented in International Agricultural Trade Research Consortium Symposium Auckland, New Zealand, 18-18 January, 2001.

McCorriston, S. "Why Should Imperfect Competition Matter to Agricultural Economists" *European Review of Agricultural Economics* 29 (2002): 349-371.

McCorriston, S. "Perspectives on the State Trading Issue in the WTO Negotiations" *European Review of Agricultural Economics* 29 (2002): 131-154.

McCorriston, S., Morgan, C.W., and Rayner, A.J "Price Transmission: the Interaction between Market Power and Return to Scale" *European Review of Agricultural Economics* 28 (2001): 143-159.

Paarlberg, P.L., and Lee, J.G. "U.S Trade Policy on Lamb Meat: Who Gets Fleeced?" *American Journal of Agricultural Economics* 83 (2001): 196-208

Spencer, B.J., and Jones, W "Vertical Foreclosure and International Trade Policy" *Review of Economic Studies* 58 (1991): 153-170

Sheldon, I., Pick, D., and McCorriston, S., "Export Subsidy and Profit-Shifting in Vertical Markets" *Journal of Agricultural and Resource Economics* 26 (2001): 125-141.

Skully, D. W. "The Economics of TRQ Administration". *International Agricultural Trade Research Consortium Working Paper* #99-6 (1999). Washington D.C.

Schmitz, A., H. de Gorter and T. Schmitz "Consequences of Tariffication" in A. Schmitz, G. Coffin and K. Rosaasen (eds.), *Regulation and Protectionism under GATT*, Westview Pub., Co., Boulder Colorado 1995 pages 37-50.

Tsai, S.T., and Wann, J.W. "Selecting Functional Form for Empirical Economic Model - The Case of Taiwan Rice Production Function" Taiwanese Agricultural Economic Review 1 (1995): 187-216.

Tirole, J. *The Theory of Industrial Organization*. MIT (1988)

Yang, M.C "The Competition and Rice Transportation System – Taiwanese Processor Behavior" *Taiwanese Finance Journal* 51 (2000): 98-123 (in Chinese)