A Game Theoretic Analysis of U.S. Rice Export Policy:

The case of Japan and Korea

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Introduction

As a result of the Uruguay Round (UR), the impact on the international rice market is dramatic. In addition, another round of the WTO trade negotiations has started and the impacts of potential policy changes on rice trade are unknown. The major U.S. benefit of the UR has been the access to the Japanese market. However, the U.S. share of this import market has been unstable and the share of Korean rice market is nearly zero prior to February 2002.

In December 1998, the Japanese government notified the WTO of its decision to introduce rice tariffication beginning April 1, 1999. Under tariffication, a specific duty of 351.17 yen per kilogram (kg) was applied to imports outside of the MA volume. In and after Japanese fiscal year (JFY) 2000, April to March, a specific duty of 341 yen per kg was applied to imports outside of MA (MAFF, 1999). The result of tariffication is lower import volumes than what would have occurred with the original MA quota, 38 thousand MT less in 1999 and 76 thousand MT less in 2000 (USDA, 2002)

In the meantime, Korea had not imported its MA from the U.S. before February 2002. Korea has not imported high quality rice to avoid table competition. The country imported low quality rice, California no. 3 or lower, to meet its WTO commitments, and use the imported rice for the purpose of processing only. However, Korean government switched its rice import policy in February 2002. In fact, Korea imported 30 thousand MT of California no 1, which is as high quality as Korean rice. This is the first time that Korea imported U.S. rice to meet its WTO commitment since the UR. From the U.S. standpoint, this is a good sign of trading U.S. rice with Korea. Therefore, U.S. rice exporters are expecting to increase their rice exports to Korea. However, traditional leading rice exporters, such as Thailand and the United States, have gradually lost market share to newly emerging exporters, primarily Vietnam and India.

Nevertheless, the U.S. rice industry can potentially increase its market share in Japanese and Korean rice import markets, given that both countries will likely be required to expand their imports in the next round of the WTO negotiations. Expanded market access remains one of the most important issues for rice trade. Both the tariff

level and quota will receive considerable attention in the ongoing negotiations. Similar pressure will be on the MA quota for South Korea along with a push for tariffication (Wailes, 2000; Cramer, et al., 1999; Koo, et al., 1996).

Looking at the historical and recent structural changes in both countries, it is useful for the U.S. rice industry, especially the export market, to examine how much market share the U.S. can potentially obtain in the Japanese and Korean markets. In addition, it is important to examine how changes in Japanese and Korean rice policies, as related to their WTO commitments, will impact U.S. exports.

Japanese and Korean Rice Policy Changes

Japan's current rice policy has its roots in the country's economic development policy following World War II. At that time the government sought to encourage rice production through investment in rural infrastructure, research, and extension, while keeping producer rice prices low. The government's policy was carried out under the Staple Food Control Law (The 42 Act). The purpose of the law was to control food and to carry out the adjustment of supply, demand and prices and also to control distribution in order to secure food for consumers and to ensure stability in the national economy. The 42 Act gave the government exclusive control over the purchase, sale, and pricing of major foods such as rice, wheat, barley, and potatoes (MAFF, 1995; Kako, et al., 1995).

High support prices not only resulted in the accumulation of increasing levels of surplus rice in government stocks, but also contributed to increasing government budget deficits. To cope with excess production, the government sought to divert farmers to other crops and to dispose of surplus government rice stocks. The Japanese Food Agency (JFA) responded to overproduction primarily in two ways: diversion programs and surplus disposal schemes. These efforts failed as rice stocks again doubled by the end of the decade.

Recently, the situation in the Japanese rice industry has been changing drastically because of the implementation of the GATT Uruguay Round agreement. The GATT agreement allows Japan to exempt rice from tariffication for the period 1995-2001. Even this partial opening of Japanese rice market has been shown to a large impact on the domestic and international rice industry (Cramer, *et al.*, 1996).

Besides the MA rice imports, the Japanese rice sector faces several emerging issues. First, domestic rice production costs are far above the international prices due to the small scale of farming, relatively high labor costs, high land costs, and over investment in farm machinery. Second, rice is an inferior good in Japan, and a decrease in rice consumption will likely continue in the future (Ito, 1996). On the other hand, rice supply would increase as a result of the MA rice import and an increase in rice yield. Therefore, the rice diversion program may have to be strengthened in the future in order to maintain a balance between supply and demand. Third, the average age of rice farmers has been increasing because of the decline in the number of young farmers staying on the farm. This is due to the inferior income from rice farming and less favorable working conditions compared with non-agricultural economic activities.

The purpose of rice policy in Korea is to contribute to food security and the stability of the national economy, achieving self-sufficiency of table rice (MAFF, 2000). This policy has the following objectives: efficient production of rice, alignment of demand and supply of rice and maintenance of reasonable prices. In order to achieve its goal of self-sufficiency of table rice, MAFF has strengthened its rice production policy, focusing on improving quality.

From 1990, the rice policy was more concerned with the burdensome rice stocks and a deficit in the government grain account. The government intervened in the rice market and began to sell the government stocks for price stabilization. As a result, the market price of rice declined and the private market system became extremely unstable. At that time, direct management by the government was changed into an indirect management system, including agricultural cooperative associations. The main components of the indirect management system were: 1) allowance of seasonal variation in price, 2) introduction of the deficiency payment system that the government supplements the difference between the purchase and the market prices, and 3) abolition of the rice control fund (MAFF, 1997).

During this period, the full scale import of agricultural products was initiated under pressure by developed countries. For instance, The Super 301' trade legislation in the U.S. forced Korea to open its agricultural markets. Another international legal code

that led to the liberalization of Korean agricultural markets was the Uruguay Round agreement of the GATT. Accordingly, liberalization was made for 234 commodity areas.

Thereafter, the main stream of agricultural policy was transformed from the policy of self-sufficiency to the policy of import liberalization, from price policy to structure policy, and from agricultural income policy to non-agricultural income policy, etc.

Starting in 1997 the Korean government introduced a new program, a direct payment system to encourage small and medium-sized rice farmers to retire and transfer productive lands to form larger operations. Productivity would then be enhanced through greater economies of scale (USDA/Attaché report, 1998).

According to the UR agreement, Korea was bound to specified import levels under the minimum access rules. Korea has to increase rice imports under the minimum access rules from 1.0 % in 1995 to 4.0% of base year consumption (1986-1988) by 2004. In 1995, Korea was supposed to import 51 thousand MT of rice for the first year of UR/GATT agreement implementation. However, Korea imported 115 thousand MT in 1995, which is mainly due to production shortfall. In 2000, Korea imported 130 thousand MT of rice as the UR agreement commitment.

Despite protestations from the U.S. government, Korean MAFF has announced that all rice imported during the initial years was for processing purposes only. The U.S. government's position is that this is against the spirit if not the law of the UR agreement.

Among competitors, many local experts expect China to be a major supplier over the long term. China has reportedly developed new varieties of rice to meet Korean taste. This rice is being grown by ethnic Koreans in the northeastern provinces of Jilin, Liaoning and Heilongjinag (USDA, 1998).

The price of Chinese rice is about one-eighth that of similar rice produced in Korea. China also has the obvious advantage of lower transportation cost due to its close proximity to Korea. Vietnam and Thailand are also reportedly making plans to export their long-grain rice. Australia is also aggressively seeking to gain a share of any medium-grain rice imported by Korea. China has been a major rice exporter to Korea. For example, Korea imported 51 thousand MT of Indian rice to meet its MA requirements in 1995. This rice was intended to meet its 1995 obligations. Since then, Korea imported additional 64 thousand MT of medium grain rice from China to meet its

1996 MA requirements in 1997. In addition, Korea imported 81 thousand MT from China and 13 thousand MT from Thailand in 1999 (USDA, 2000).

The WTO Agreement also requires a reduction of domestic production subsidies, which is also leading to a further reduction in rice production in Korea. While the Agreement allows for decoupled income compensation, which means a production-neutral subsidy, Korea is not implementing this direct payment system for all farmers yet (MAFF, 2000).

U. S. Rice Exports

The U.S. is a leading exporter of rice in the international market, accounting for about 12 percent of global rice trade although the U.S. accounts for less than 2 percent of global rice production. The U.S. currently ranks fourth among major exporters, behind Thailand, Vietnam, and China. More than 40 percent of the U.S. rice crop is exported each year, making the U.S. market sensitive to movements in international prices (USDA, 2000).

Most countries produce only one type of rice, but the United States produces both types (japonica in California, and indica in Arkansas, Louisiana, Texas, Mississippi, and Missouri) and is in a unique position in that it can export significant amounts of both types (Song and Carter, 1996).

The total volume of U.S. exports ranged from 2.5 MMT to 2.8 MMT (milled basis) from 1995/96 to 1999/2000. However, this is well below the 1994/95 record of 3.3 MMT. The U.S. was the largest exporter of rice most years from the late 1960s through 1980, with Thailand occasionally out-shipping the U.S. However, Thailand has been the leading exporter of rice every year since 1981, largely due to expanded area. By the mid-1990s, Vietnam had recovered from decades of war and political upheavals to become the second largest exporter. The country had returned as an exporter only in the late 1980s after a 30-year absence. In the late-1990s, China emerged as a major exporter due to declining per capita consumption and several years of bumper crops, making the country the third largest exporter.

From 1967 to 1982, Korea imported 8 million metric tons (MMT) of rice and U.S. rice exports supplied 65% of that market mostly from California (Schnepf and Just, 1995). However, by the mid-1980s, Korea attained self-sufficiency in rice due to

generous government programs, and imports were essentially banned. After losing its largest importer, Korea, in 1983, California accumulated rice stocks, relative to the southern states. Since 1983, the U.S. exported almost no rice to Korea.

In the meantime, Japan accounts for the bulk of U.S. medium grain brown rice exports. In 1999/2000, Japan imported nearly 150 thousand MT of medium grain brown rice from the U.S., down from a year earlier record 250 thousand MT. Japan divides its rice purchases between milled and brown rice, with each type's share varying each year. The U.S. typically supplies half of Japan's total rice purchases. The U.S. exports about 10 thousand to 14 thousand MT of short grain brown rice each year. Japan accounts for two-thirds, most of it sold under the Simultaneous-Buy-Sell (SBS) portion of their total WTO commitments.

There are four types of government programs for U.S. rice exports. First, under PL 480, the U.S. sells rice on concessional credit terms and donates rice to needy countries either bilaterally or through the World Food Program. Second, the USDA provides export credit guarantees (GSM-102) and intermediate Export Credit Guarantee (GSM-103) for commercial financing of U.S. agricultural exports. The programs encourage exports to buyers in countries where credit is necessary to maintain or increase U.S. sales, but where financing may not be available without CCC guarantees.

Third, the Export Enhancement Program (EEP) facilitates U.S. rice sales to markets where the U.S. competes with subsidized exports from other countries. However, 1996 Farm Act terminated EEP. Since then there has been no rice exported through the EEP. Finally, USDA funds the creation, expansion, and maintenance of foreign markets for U.S. agricultural products. The Market Access Program (MAP) forms a partnership between non-profit U.S. agricultural trade associations, U.S. agricultural cooperatives, non-profit State-regional trade groups, small U.S. businesses, and the CCC to share the costs of overseas marketing and promotional activities such as consumer promotions, market research, trade shows, and trade servicing. The Foreign Market Development (FMD) program fosters a trade promotion partnership between USDA and U.S. agricultural producers and processors who are represented by nonprofit commodity or trade associations called Cooperators (Childs and Burdett, 2000).

Theoretical and Empirical Consideration

In this study, the linkage of the Japanese and Korean rice imports and U.S. rice exports are analyzed using a game theoretic approach along with econometric supply and demand models and the Political Preference Function (PPF) determination.

The Japanese and Korean rice economies are analyzed using empirical supply and demand models and the elasticity estimates. For the U.S., the export demand is estimated using an empirical econometric model. The elasticities are estimated as well. For U.S. rice exports, the domestic supply and demand are not estimated because this study focuses on the linkage between the Japanese and Korean imports and U.S. exports, not on the U.S. domestic rice economy. For the reason, only U.S. export demand is estimated.

In addition, a political preference function (PPF) approach is applied to measure the implicit political weights of interest groups of these three countries that represent the policy-influencing powers because rice can be considered one of the political commodities in these countries.

Supply and Demand Specification

Agricultural producers operate in an environment with uncertain yields and prices. Farmers typically make production decisions at the beginning of the season, knowing neither the market price for their products at harvest time or the weather conditions during the season that will determine their yields. Various models could be applied to the commodity markets depending on the objective of research and the market structure. For the purpose of this study, a distributed lag structure is specified to describe the dynamic responses of supply and demand caused by the price expectations and adjustment process. The assumption that the economic system has a distributed lag structure is often justified on the ground that changes in an endogenous variable caused by an exogenous shock may occur through time, and the impacts of exogenous changes on the dependent variable take time to work.

Since rice farmers tend to have a lagged response to market prices due to the fixity of inputs and imperfect information, the partial adjustment model can be hypothesized as an appropriate model for the study. Furthermore, habit formation seems to be a predominant characteristic of agricultural demand behavior, particularly for a national staple food like rice in Japan and Korea. With rice being an important staple food,

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consumers may also buy stable quantities that are different from the equilibrium quantities indicated by their static demand equation. This implies that consumers tend to adjust only partially to changes in optimal purchase quantities. Thus, the partial adjustment model is also thought to be an appropriate model for explaining the dynamic nature of the Korean and Japanese rice consumption. In consumer demand it is assumed that consumers do not adjust their consumption behavior instantaneously to changes in price and income due to habit formation. The dynamic econometric model specified in this study is characterized by a combination of a partial adjustment process both in supply and demand, and cobweb type price expectations in supply response.

Based on the theoretical considerations and the market structure concerning the commodity model in the previous section, the empirical econometric models for the three countries' rice markets are specified for the period 1960-1999. According to economic theory, supply can be influenced by prices, technology, costs and other factors. For domestic consumption, it can be hypothesized to be influenced by prices, income levels, and the price of substitutes according to economic theory. For Japan and Korea, the model is composed of three equations: domestic acreage response, yield, and per capita consumption. Two identities are defined to impose the aggregate domestic production and consumption. Domestic production is defined by acreage response times yield, and domestic consumption is defined by multiplying population times the estimated equation for per capita consumption and adding in other use. The general functional forms and variables for the rice supply and demand estimation are presented as follows:

Japanese Yield:

$$JYIED = f(TECH, D, u_{1t}) \tag{1}$$

Japanese Area Harvested:

$$JARHA = f(JARHA_{t-1}, JPROP_t/CPI_t, JPROC_t/CPI_t, u_{2t}) \tag{2}$$

Japanese Per Capita Consumption:

$$JPCCON = f(JRETP_t/CPI_t, JINCOM_t/CPI_t, JPCCON_{t-1}, u_{3t}) \tag{3}$$

Korean Yield:

$$KYIED = f(TECH, KYIED_{t-1}, D, u_{4t}) \tag{4}$$

Korean Area Harvested:

$$KARHA = f(KARHA_{t-1}, KGPURP_{t-1}/CPI_{t-1}, KPRODC_{t-1}/CPI_{t-1}, u_{5t}) \tag{5}$$

Korean Per Capita Consumption:

$$KPCCON = f(KRETP_t/CPI_t, KINCOM_t/CPI_t, KPCCON_{t-1}, u_{6t}) \qquad (6)$$

U.S. Export Demand:

$$UEXDEM = f(WOLDPJ_t/EXPI_t, UGOEXP_t, WENST_{t-1}, D, u_{7t}) \qquad (7)$$

Production:

$$JPROD = JYIED * JARHA \qquad (8)$$

$$KPROD = KYIED * KARHA \qquad (9)$$

Consumption:

$$JCONP = JPCCON * JPOP + OTHER \qquad (10)$$

$$KCONP = KPCCON * KPOP + OTHER \qquad (11)$$

where TECH = Technology

$JARHA_{t-1}$ = Lagged Japanese Area Harvested (1000 ha)

$JPROP_t$ = Japanese Producer Price (yen/MT)

CPI_t = Consumer Price Index

$JPROC_t$ = Japanese Production Cost (yen/ha)

$JRETP_t$ = Japanese Retail Price (yen/MT)

$JINCOM_t$ = Japanese Income ($)

$JPCCON_{t-1}$ = Lagged Japanese Per Capita Consumption (kg)

$KYIELD_{t-1}$ = Lagged Korean Yield (MT/ha)

$KARHA_{t-1}$ = Lagged Korean Area Harvested (1000 ha)

$KGPURP_{t-1}$ = Lagged Korean Government Purchase Price (won/MT)

$PRODC_{t-1}$ = Lagged Korean Production Costs (won/ha)

$KRETP_t$ = Korean Retail Price (won/MT)

$KINCOM_t$ = Korean Income ($)

$KPCCON_{t-1}$ = Lagged Korean per capita Consumption (kg)

$WOLDPJ_t$ = World Price ($/MT)

$EXPI_t$ = Domestic Rice Price ($/MT)

$UGOEXP_t$ = U.S. Government Export Program (1000 MT)

$WENST_{t-1}$ = Lagged World Ending Stock (1000 MT)

D = Dummy Variables

u_{it} = Error Terms

POP = Population

OTHER = Other Consumption (1000 MT)

The structural model in this study is estimated based upon annual time series data from 1960 to 1999 with all prices and income variables deflated by the Consumer Price Index (CPI). The necessary data was obtained from the USDA, Japanese and Korean MAFF, World Bank, IMF, and International Rice Research Institute (IRRI).

The rice yield and area harvested equations are estimated by Two Stage Least Squares (2SLS) and the per capita consumption and U.S. export demand equations are estimated by conventional ordinary least squares (OLS) and the autoregressive degree of one (AR(1)) as an attempt to correct for autocorrelation.

The estimation results of the model are shown in table 1. The consumer price index is omitted for convenience. In addition, the value of the Durbin's h statistic is also given for each equation since the lagged dependent variable appears as an independent variable.

Equations (1) and (4) indicate that yield is a function of technology and a dummy variable for Japan and these two variables with a lagged yield variable for Korea. The dummy variable is used to explain poor weather conditions in 1980 and 1993. A time trend is used as a proxy for technological developments and advancements. Japanese and Korean yield equations have a coefficient of determination of 0.80 and 0.87, respectively. All of the variables are statistically significant at the 5% level of significance. D-W (1.78) and D-h (1.13) statistics show that there is no autocorrelation in the equations.

The results of the acreage response estimation show the expected signs for all explanatory variables that are implied in the theory of production. Except for the constant terms, all parameter estimates are different from zero at the 5% level of significance. The prices received by rice farmers in both countries have a positive impact on the acreage response, as expected. The production costs for Japan and the diversion program for Korea have a negative impact on the supply response. The coefficient estimate of the lagged dependent variables show a stable geometric lag process and supports the existence of a lagged distribution of the dependent variables. The high estimates of the lagged acreage variables for Japan and Korea, 0.84 and 0.93 respectively, imply that it takes time for farmers to change the paddy land for rice cultivation in

response to the price signals. The supply elasticities with respect to the output at the mean for Japan and Korea are 0.11 and 0.13, respectively.

Table 1. Empirical Results of Production and Consumption.

Production:

$JYIED = 3.5579 + 0.0313*TECH - 0.8874*DM8093$
$\qquad$ (54.84) $\qquad$ (11.52) $\qquad$ (-5.96)
$AdjR^2 = 0.80$ D-W = 1.78 Method = 2SLS

$KYIED = 1.546 + 0.468*KYIED_{t-1} + 0.031*TECH - 0.742*DM8093$
$\qquad$ (4.31) $\qquad$ (3.71) $\qquad$ (3.80) $\qquad$ (-3.69)
$AdjR^2 = 0.87$ D-h = 1.13 Method = 2SLS

$JARHV = 294.176 + 0.843*JARHV_{t-1} + 0.175*JPRODP - 0.027*JPRODC$
$\qquad$ (1.63) $\qquad$ (13.07) $\qquad$ (2.35) $\qquad$ (-2.57)
$AdjR^2 = 0.96$ D-h = 0.59 Method = 2SLS

$KARHV = 50.76 + 0.932*KARHV_{t-1} + 0.000059*KGROP - 0.006*KDIVR$
$\qquad$ (0.42) $\qquad$ (10.93) $\qquad$ (2.34) $\qquad$ (-4.34)
$AdjR^2 = 0.96$ D-h = 0.98 Method = 2SLS

Consumption:

$LnJPCCON = 1.8133 + 0.8202*LnJPCCON_{t-1} - 0.0963*LnJRETP - 0.029*LnJINCOM$
$\qquad$ (4.77) $\qquad$ (15.42) $\qquad$ (-3.65) $\qquad$ (-2.15)
$AdjR^2 = 0.99$ D-h = 1.25 Method = OLS/AR(1)

$LnKPCCON = 5.461 + 0.7203*LnKPPCCON_{t-1} - 0.23*LnKRETP$
$\qquad$ (4.1) $\qquad$ (10.27) $\qquad$ (-2.42)
$\qquad$ - 0.56*LnKINCOM + 0.2073*DM1$
$\qquad$ (-3.4) $\qquad$ (2.96)
$AdjR^2 = 0.99$ D-h = 0.72 Method = OLS/AR(1)

U.S. Export Demand:

$LUEXDEM = 2.681 + 0.4902*LWENSTK + 0.036*L(WOLDP/UPRODP)$
$\qquad$ (3.26) $\qquad$ (6.09) $\qquad$ (1.97)
$\qquad$ + 0.031*LUGEXP + 0.274*DM8094$
$\qquad$ (1.72) $\qquad$ (3.2)
$AdjR^2 = 0.84$ D-W = 1.7 Estimator = OLS/AR(1)

Note: the numbers in parentheses are t-values.

Except for the constant terms, all independent variables in the per capita consumption equations show strong statistical significance and expected signs. All coefficient estimates are significant at the 5% level of significance. Rice consumption is negatively related to own price as well as income, which implies that rice is an inferior good in Japan and Korea. This is a phenomenon which has been experienced over the

last decade in Japan and Korea as their income levels have risen. The coefficients on the one year lagged dependent variables are also significant at the 1% level of significance.

These coefficients imply that there have been gradual changes in diet patterns, which impact rice consumption. In fact, the increases in the income levels have transformed the Japanese and Korean diet by substituting rice with consumption of meats, fruits, and vegetables. The price elasticities for Japan and Korea are estimated to be -0.096 and -0.23, respectively. The income elasticities are also computed at -0.029 and -0.56, respectively.

For the equation of U.S. export demand, all of the independent variables are statistically significant at the 5% level except for government export program. U.S. export demand estimation shows the expected signs for all explanatory variables. When the gap between world price and domestic price received by producers are widened, the producers' willingness to export rice tends to be higher. A dummy variable for the years of 1980 and 1994 is used to explain unusual high exports caused by Japan and Korea due to unexpected cold weather in 1980 and 1993. In addition, there is no autocorrelation in the equation (D-W = 1.92).

Model Specification and Validation

Tests for detecting error structure in the single equation context are conducted to identify whether the estimators used in the models are appropriate. Statistical tests for autocorrelation, heteroscedasticity, and other specification problems are described.

Based upon various statistical tests for autocorrelation, heteroscedasticity, and normality, the model specification tests are conducted in the single equation context. This study uses two goodness-of-fit measures to evaluate the overall predictive ability of the model: 1) root-mean-square percent error (*rms* %) and 2) Theil's inequality coefficient (U).

The validation statistics show that the models do a good job of representing the rice economies. The *rms* and Theil-U measures indicate that the models simulate the data well over the historical period. The *rms* indicates that the models have *rms* from 0.26% root-mean-square error to 5.01%. And U^M, U^S, U^C and Theil-U illustrate that we are able to use the models to explain the historical rice economies with very low values for U^M reflecting no systematic bias in the models.

Table 2. Specification and Model Validation Test.

Specification Tests

	Autocorrelation (D-W, D-h)	Heteroscadasticity (White, Breusch-Pagan)	Normality (Bera-Jarque)
JYIELD	1.78, na	13.12, 11.23	1.55
JARHA	na, 0.59	11.23, 12.81	1.41
JPCCON	na, 1.25	12.02, 10.65	2.41
KYIELD	na, 1.77	3.51, 1.14	1.42
KARHA	na, 0.97	4.31, 2.06	1.41
KPCCON	na, 0.72	14.51, 4.25	1.50
UEXDEM	1.7, na	8.65, 2.21	0.94

Model Validation Tests

	rms % error	U^M	U^S	U^C	Theil-U1	U
JYIELD	5.01	0.00	0.06	0.94	0.047	0.024
JARHA	3.18	0.00	0.01	0.99	0.030	0.015
JPCONP	0.26	0.00	0.00	1.00	0.003	0.001
KYIELD	4.05	0.00	0.04	0.96	0.065	0.032
KARHA	1.86	0.00	0.03	0.97	0.019	0.009
KPCCON	2.41	0.00	0.00	1.00	0.022	0.011
UEXDEM	1.44	0.00	0.04	0.96	0.014	0.007

Note: we cannot reject the null hypothesis that there is no autocorrelation, heteroscadasticity, and the error terms are distributed normally in all of specification tests at the 5% level of significance.

Political Weight Determination

To derive the political weights of interest groups in the three rice sectors, it is assumed that there are three interest groups: producers, consumers and taxpayers. We are interested in the net effect on producers and consumers of price policies in the threecountries. Hence if P_S and P_D are the prices for producers and consumers, then the net producer benefit from having a price P_S instead of P_W, which is defined as no intervention or border price, is measured by the change in producer surplus. Similarly, the net consumer welfare is measured by the change in consumer surplus. On the other hand, the taxpayers or government net expenditure is defined as: $GS = P_D*Q_D - P_S*Q_S -$

P_W*M; where Q_S, Q_D and M denote the levels of production, consumption, and net imports, respectively. The first term on the right hand side of the equation is the government revenue from selling to consumers, the second term is the cost of purchasing from producers, and the third term is the payment for imported rice.

Now suppose that the policy maker seeks to maximize a political preference function consisting of producer's surplus, consumer's surplus and taxpayer's expenditures by choosing the optimal domestic producer and consumer prices. The political preference function for the policymaker in the three rice sectors is:

$$Maximize_{P_S, P_d} \text{PPF}$$

$$= \lambda_P \int_{P_W}^{P_S} S(P)dP - \lambda_C \int_{P_W}^{P_d} D(p)dp + \lambda_G \{[P_D \, D(P_D) - P_S \, S(P_S)]$$

$$- [P_W(D(P_D) - S(P_S))]\}, \tag{4.2.1}$$

For simplicity, it is assumed that there is no intertemporal storage activity. Assuming no stock changes, the net imported quantity for Japan and South Korea (the net exported quantity for the U.S.) can be expressed as $D(P_D) - S(P_S)$. Consumer and producer prices are the policy variables. Then, the optimal price policy can be obtained by differentiating the political preference function with respect to producer price, P_S and consumer price, P_D, respectively. To solve the optimization problem, the governments must choose the instruments P_S and P_D so as to satisfy the following necessary conditions:

$$\frac{\partial PPF}{\partial P_S} = S(P_S)(\lambda_P - \lambda_G) - S'(P_S)* \lambda_G (P_S - P_W) = 0 \tag{12}$$

$$\frac{\partial PPF}{\partial P_D} = D(P_D)(\lambda_G - \lambda_C) + D'(P_D)* \lambda_G (P_D - P_W) = 0 \tag{13}$$

In addition, we have additional normalization equations such that $\lambda_P + \lambda_C + \lambda_G = 3$ and $\lambda_G = 1$ in order to compare with the social welfare function that has unit equal weight to each interest group ($\lambda_P = \lambda_C = \lambda_G = 1$) and for simplicity.

Once we have established functional relations between the political weights and the levels of rice policies, we can derive the formulas for describing endogenous

domestic prices for producers and consumers. Arranging the above first order conditions, we have the following equations for endogenous price determination:

$$P_S^* = P_W + \frac{\lambda_P - \lambda_G}{\lambda_G} * \frac{S(P_S)}{S'(P_S)} \tag{14}$$

$$P_D^* = P_W + \frac{\lambda_C - \lambda_G}{\lambda_G} * \frac{D(P_D)}{D'(P_D)} \tag{15}$$

From these equations, it is possible to evaluate how political and economic factors contribute to the establishment of endogenous price levels. First, the border price for rice impacts domestic pricing policies. Second, the domestic market situations in terms of the production and consumption functions also have impacts on the formation of producer and consumer prices. Third, the above equations imply that political weights of the producer, consumer and taxpayer are all involved in the process of rice price decisions. For example, a larger political weight for producers relative to taxpayers would increase the producer price. In addition, the difference between producer and consumer prices is not affected by the world price.

The price difference is purely determined by domestic supply and demand factors, and the relative political weights of producers and consumers to that of taxpayers. In particular, assuming supply and demand elasticities are constant, the optimal price wedges are derived as follows:

$$\alpha = (P_S^* - P_W) / P_S^* = (\lambda_P - \lambda_G)/\lambda_G * (1/\varepsilon) \tag{16}$$

$$\beta = (P_D^* - P_W) / P_D^* = (\lambda_C - \lambda_G)/\lambda_G * (1/\eta) \tag{17}$$

where α and β represent the optimal producer and consumer price wedge, ε and η denote the supply and demand elasticity. The optimal price wedges are simple forms of implicit political weights and elasticities of demand and supply. All of the elements of these optimal conditions, except the political weights, are typically observable either directly or from econometric estimates. Therefore, assuming that policymakers have chosen the optimal level of a given policy tool so as to maximize an implicit political preference, one can easily determine the political weights used by policymakers. (Im, 2000, Gardner, 1987).

Given the estimated elasticities of demand and supply from the domestic production and consumption functions, we can derive the political weights of the three major interest groups in the three rice economies. The estimated results from the rice market models are shown in Table 2. To derive these estimates, supply and demand elasticities were combined with annual producer and consumer price, and world price data from 1960 to 1999.

Table 2. Political Weights for the Three Countries.

	Japan		Korea		U.S.
Year	Producer	Consumer	Producer	Consumer	Exporter
1960	1.08	0.92	1.19	0.81	1.15
1965	1.12	0.88	0.81	1.19	0.84
1970	1.16	0.84	1.04	0.96	1.18
1975	1.16	0.84	1.07	0.93	1.32
1980	1.19	0.81	1.20	0.80	1.17
1985	1.24	0.76	1.38	0.62	1.31
1990	1.26	0.74	1.44	0.56	1.30
1991	1.26	0.74	1.44	0.56	1.29
1992	1.26	0.74	1.44	0.59	1.41
1993	1.26	0.74	1.41	0.55	1.33
1994	1.27	0.73	1.45	0.55	1.31
1995	1.27	0.73	1.44	0.56	1.24
1996	1.26	0.74	1.46	0.54	1.23
1997	1.26	0.74	1.46	0.54	1.23
1998	1.26	0.74	1.45	0.55	1.19
1999	1.25	0.75	1.37	0.63	1.30

The estimated political weights as shown in Table 2 indicate that the Japanese and Korean policies have favored rice producers more than the other interest groups. In the Japanese and Korean rice sectors, the political weights are particularly high for producers, lowest for consumers. The average weights for producers exceed unity while those for consumers are less than unity. Table 2 shows that a political willingness to redistribute income in favor of producers at the expense of consumers and taxpayers. This implies that rice producers have generally been preferred to consumers and taxpayers. In other words, the Japanese and Korean policymakers have placed more weights on the welfare of rice producers rather than those of consumers and taxpayers.

In the meantime, the political weight for the U.S. rice exporters is derived at 1.17 on average. It is higher than the weight for the taxpayers that we normalized at unity in

order to compare with different interest groups. Overall, table 2 illustrates the time trend in the political weight. A change in the political weight could be interpreted as policymaker's preferences changing overtime.

Game Theoretic Procedure

In this section, the econometric estimation and the political weights are incorporated into the game theoretic analysis to obtain the Nash equilibrium as a base. Based upon the base, a scenario analysis is conducted. The base is an analysis with respect to the existing import and export policies in the three countries, which include tariffication and export programs. The goal of this analysis is to look at some possible implications of a change from minimum access to a tariffication of imports for U.S. exports.

The Base

To develop the framework, it is necessary to determine the import tariff equivalents of Japan and Korea. Import tariffs are defined as the difference between the domestic price and the world price. Depending upon the world price path, future domestic prices are likely to decrease because the Japanese and Korean governments will have to reduce the import tariffs annually. The domestic price is the world price plus the tariff equivalent. And the price that producers received is government procurement price plus some type of producer support programs such as direct payments for Japan and Korea. For U.S. price, we consider the price that the world price plus the difference between the loan rate and the world price for the base. The reason is that the target price/deficiency program has been a major policy instrument for supporting producer income by paying directly the amount of deficiency payment to rice farmers during the 1976-1995 period. The level of deficiency payment, the difference between the announced target price and actual market price (or loan rate) for rice, has been much higher than for other program commodities such as wheat and corn. Due to the favorable incentives, the program participation rate has been over 90 percent for rice, which is much higher than for other program commodities. However, the 1996 FAIR Act terminated the target price/deficiency payment program, and the marketing loan program will continue to provide income support to rice producers by allowing them to pay back

their nonrecourse loans at prices below the loan rate when USDA announces world trading prices are less than the loan rate (USDA, 2000, Childs, 1996).

In terms of surplus, this study considers consumer, producer, and government surpluses for Japan and Korea in the base. For the U.S., exporter surplus is considered in the base. The equations are as follows:

$$CSURP_{it} = \int_{Pw}^{Pd} D(p)dP \tag{18}$$

$$PSURP_{it} = \int_{Pw}^{Ps} S(p)dP \tag{19}$$

$$GSURP_{it} = (TARIF_{it}*IMPT_{it}) - \{(GPURP_{it}*GPUR_{it}) + (EQUIL_{it}*GPURP_{it})\} \tag{20}$$

For U.S. exporter's surplus, U.S. export revenue from Japan and Korea is taken into account because this study specifically looks at U.S. exports to Japan and Korea only. The export surplus equation is the sum of exporter's surplus from Japan and Korea. The export surplus equation is as follows:

$$UEXSUR_t = \int_{Pw}^{Ps} E_J(p)dP + \int_{Pw}^{Ps} E_K(p)dP \tag{21}$$

where $\int_{Pw}^{Ps} E_J(p)dP$ and $\int_{Pw}^{Ps} E_K(p)dP$ are the U.S. exporter's surplus from Japan and Korea, respectively. In addition, the equilibrium is derived using the empirical econometric estimation equations for aggregated production and consumption for Japan and Korea and export demand for the U.S. The other variables are exogenously given within the equation. The equilibrium equation is as follows:

$$EQUIL_{it} = PROD_{it} + BESTK_{it} + IMPT_{it} - CONP_{it} - EXPOT_{it} - ENSTK_{it} \tag{22}$$

where $CSURP_{it}$ = consumer surplus at time t in country i

$PSURP_{it}$ = producer surplus at time t in country i

$GEXP_{it}$ = government expenditure at time t in country i

$SCOT_{it}$ = social costs at time t in country i

$EQUIL_{it}$ = equilibrium quantity at time t in country i

$PROD_{it}$ = total production at time t in country i

$BESTK_{it}$ = beginning stock at time t in country i

$IMPT_{it}$ = import at time t in country i

$CONP_{it}$ = total consumption at time t in country i

$EXPOT_{it}$ = export at time t in country i

$ENSTK_{it}$ = ending stock at time t in country i

$UEXSUR_t$ = U.S. export surplus at time t

$UEXPOTJ_t$ = U.S. export to Japan at time t

$UEXPOTK_t$ = U.S. export to Korea at time t

$WOLDP_t$ = world price at time t

In economic theory, the equilibrium quantity should be zero to be equilibrium. However, in reality, that has not happened for the last four decades in Korea and Japan. Therefore, we consider the equilibrium quantity as the amount they need to import (export) if the sign is negative (positive). If the sign is positive we consider the amount either to be in year ending stock or for foreign aids. The reason is that there is no country that would be able to import rice from Japan and Korea due to the high prices, which are almost five to ten times higher than the world price. For U.S. equilibrium quantity, we incorporate equation (7) into the equilibrium identity including U.S. exports to Japan and Korea.

Depending upon the surplus and equilibrium, we consider the political weights derived in the previous section for the payoff functions. The payoff functions include surplus, equilibrium quantity, and political weights to obtain the Nash equilibrium for the base.

$$Vp_i = (Wc_i * CSURP_{it} (P_{Di}) + Wp_i * PSURP_{it} (P_{Si}) + Wg_i * GEXP_{it}(S_{Qi})$$
$$*EQUILit) - SCOT_{it} \tag{22}$$

where Vp_i is the political payoff in country i, S_{Qi} is decoupled producer support (or direct payment) in region i. Political weights are Wp_i for producer, Wc_i for consumers, and Wg_i for government (Karp, et. al, 1983).

Using GAMS, the simulation results for the base are presented in Table 3. The base year is 1999 because the important turning point for Japan and South Korea for the next negotiation is the year 1999 and because Japan adopted a tariffication policy in 1999. In the meantime, Korea is assumed to follow the tariffication policy since it has

had tremendous political pressure from the major exporters. As a result, we assume that the two countries' major import policy is the tariffication policy.

Table 3 Simulation Results of the Payoff Functions for the Base.

	Japan	Korea	U.S.
Production (1000MT)	8356	4635	6502
Consumption (1000MT)	8720	4750	3846
Export (1000MT)	200	0	1804*
Import (1000MT)	170**	52**	321
Ending Stock (1000MT)	1210	73	867
Beginning Stock (1000MT)	1302	137	694
Equilibrium Quantity (1000MT)	-22	99	600
Producer Surplus (Million $)	21.133	6.489	5.1***
Consumer Surplus (Million $)	38.25	7.2	N/A
Government Surplus (Million $)	54.853	13.369	N/A
Tariff Equivalent ($/MT)	3428	1385	N/A
Payoffs	2.508	0.572	6.63

*: total U.S. exports.
**: imports from the U.S.
***: U.S. exporter surplus.
N/A: not available.

As seen in Table 3, Japanese and Korean production is estimated at 8356 thousand MT and 4635 thousand MT, respectively. The 200 thousand MT of Japanese export is for foreign aid to North Korea and some countries in Africa. The Japanese and Korean imports are derived at 170 thousand MT and 52 thousand MT, respectively. The imports are from the U.S. only. This study does not take imports from the ROW into account because it focuses on the trade flow between the U.S. and Japan and Korea. The equilibrium quantity for Japan, Korea, and the U.S. are –22 thousand MT, 99 thousand MT, and 600 thousand MT, respectively. The U.S. export quantity is derived at 1804 thousand MT, including exports to Japan, Korea, and the rest of the world (ROW). In the meantime, the payoffs for Japan and Korea are derived at 2.508 and 0.572, respectively. And the U.S. export payoff from U.S. exports to Japan and Korea is derived at 6.63.

The next round of negotiations will likely require that the import requirements be made more transparent through tariffication. Therefore, it is necessary to make several assumptions. According to WTO agreement, Japan has to reduce import tariffs by 36%, and continue to reduce 6% of import tariff annually. However, the tariff reduction will likely change in the next negotiation. The possible range of the reduction would be from 2% to 8% annually. Therefore, we take the possible range of reduction into account for scenario analysis. Under MA, Japan would have increased imports by 8%-12% of domestic consumption, from 2001 to 2006, and 12%-14% by 2010. However, the Japanese government announced that they replaced the existing minimum access policy for tariffication beginning April 1, 1999. Thus, the import policy scenario for Japan focuses on the tariffication. In the meantime, Korean government tends to maintain the minimum access policy until 2004. However, as mentioned earlier, the government has had tremendous political and economical pressure from major exporters such as the U.S. and CAIRNS group. Therefore, tariffication policy is considered in the scenario analysis for Korea as well. For the U.S., the existing CCC Credit Guarantee Programs (CCC), Market Access Program (MAP), and Foreign Market Development Program (FMDP) are considered in the scenario analysis to obtain the Nash equilibrium.

The scenarios analyzed are as follows:

1) CCC with 2% to 8% reduction in Japan and Korea.

2) MAP with 2% to 8% reduction in Japan and Korea.

3) FMDP with 2% to 8% reduction in Japan and Korea.

4) CCC and MAP with 2% to 8% reduction in Japan and Korea.

5) CCC and FMDP with 2% to 8% reduction in Japan and Korea.

6) MAP and FMDP with 2% to 8% reduction in Japan and Korea.

The simulation results for these scenarios are summarized in Table 4. For policy comparison, the payoffs for the three countries are presented and the Nash equilibrium is obtained. In addition, since Japan and Korea have similar current import policies and circumstances, sum of Japanese and Korean payoffs are presented so that we can consider the two countries as an export market from the standpoint of the United States of America.

Moreover, ten-year average political weights are used, five years prior to WTO agreement implementation and five years after the implementation. The political weights used for Japan are 1.261 and 0.739 for producer group and consumer group, respectively. For Korea, 1.436 and 0.564 for producer group and consumer group, respectively, are used for the scenario analysis. The political weight for U.S. exporter group is 1.283.

Each sub-game (where the U.S. scenario is fixed) has a unique Nash equilibrium. Table 4 shows that overall Nash equilibrium is 6% reduction under U.S. Market Development Program, including Market Access Program and Foreign Market Development Program.

Table 4. Payoff Summary.

	Action	T2$_C$	T4$_C$	T6$_C$	T8$_C$
			J & K*		
	CCC$_{US}$	5.42 ; 1.62	5.53 ; 1.98	5.92 ; 2.0	6.14 ; 2.61
	MAP$_{US}$	15.1 ; 15.3	15.7 ; 18.0	16.2 ; 19.5	16.4 ; 19.7
U.S.	FDP$_{US}$	52.2 ; 20.5	53.4 ; 20.3	54.7 ; 17.5	56.0 ; 20.1
	CMP$_{US}$	30.8 ; 12.2	31.4 ; 16.3	32.7 ; 25.7	32.7 ; 19.6
	CFP$_{US}$	68.1 ; 19.7	69.8 ; 20.4	71.3 ; 19.8	73.0 ; 19.9
	MFP$_{US}$	137.4 ; 42.3	**140.6 ; 59.7**	143.8 ; 57.6	147.1 ; 52.5

*: represents sum of Japanese and Korean payoffs.

For Japan and Korea, a dominant strategy is 4% reduction with the payoff of 59.7. Since they have tried to protect their import markets, they would try to keep their tariff rates as high as possible to restrict their import markets. U.S. welfare increases as Japan and Korea move toward 8% reduction with the payoff of 147.1. It is preferable for the U.S. to export to Japan and Korea with lower tariff rates as the higher tariff rates would result in lower U.S. exports to Japan and Korea.

Under the MAP and FMDP programs, the U.S. can advertise U.S. rice through the Japanese telecommunication channels, such as national television and radio commercials (USDA, 2000). That means the U.S. rice federation can promote U.S. rice throughout the nation, which increases opportunities for U.S. rice exports to Japan. Unfortunately, promotional activities are not yet allowed in Korea. However, the main question for U.S. exports to Japan and Korea is how to handle heavy competition with major exporters

such as Australia, China, and other exporters in both markets and how to penetrate Japanese and Korean domestic markets and consumer table competition.

Conclusion

This study has analyzed the impacts of Japanese and Korean import policies on U.S. exports, including various changes in Japanese and Korean tariff rates. In addition, it has analyzed the possible policy options for U.S. exports with respect to the changes in Japanese and Korean tariff rates, incorporating econometric estimation and political weights for the interest groups into a game theoretic analysis.

Both Korea and Japan strictly implemented the WTO commitments on rice. However, several issues arose from how these countries managed rice imported. The State Trading Enterprises (STEs) of both countries kept most imported rice away from domestic consumers. The Food Agency of Japan allocated rice across national suppliers with results roughly mimicking commercial trade. Japan also used markups to keep imported rice away from domestic consumers. In Korea, rice has been imported through tenders where the lowest bidder wins. This results in low-quality rice imports from suppliers who were unlikely to have been successful in commercial trade. As a result, consumer benefits are reduced, and allocation across import suppliers has been affected. The next round of WTO negotiations will face these issues if quantitative market access is to improve in the interim while tariffs are reduced. Subsequent meetings will also face STE issues regarding possible manipulations within approved market methods and the ways to encourage market results through market mechanisms.

The best export policy option from the scenario analysis turned out to be the combination of MAP and FMDP for U.S. exports to Japan and Korea. However, it depends on how the policies are implemented by the U.S. in Japanese and Korean domestic markets. There are many obstacles in the two markets such as STEs and implicit trade barriers. The implicit trade barriers are even worse than STEs because the consumers are willing to buy domestic rice at a higher price than the border price due to cultural and traditional backgrounds. To overcome those obstacles, the U.S. has to investigate some new marketing strategies in the domestic markets, including wide variety of advertisements and private commercial contract with franchise restaurants and convenient stores along with political and economic pressures on the Japanese and

Korea governments. However, the U.S. could not be able to export any rice to Korea since 1980s. Korea has imported its WTO commitments mostly from India and China because of lower prices and transportation costs. Many international trade experts have expected that China will be a major exporter to Korea. However, according to WTO agreement, Korea is supposed to import from 154 thousand MT in 2002 to 205 thousand MT in 2004. That means that every rice exporters still have chances to export to Korea, including the U.S.

In addition, the uncertain factors in Korea, in terms of potential U.S. rice exports, are Korea's stock and political situations. How these factors will affect future U.S. exports is still uncertain at this time. In the past, in terms of stock, the Korean government has kept a minimum four-month reserve for both price stabilization and food/military security reasons and the policy-making process in rice trade is a politically sensitive matter.

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