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THE IMPACTS OF ALTERNATIVE TRADE LIBERALIZATION POLICIES ON THE KOREAN RICE ECONOMY

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Rice has been and would continue to be the most important crop in Korea. Although other agricultural commodities, such as livestock, fruits, and vegetables, have become important in production and consumption, rice still is a dominant staple in the Korean diet and accounts for a substantial portion of the country's total grain production and farm income.

An important feature of the Korean rice policy has been self-sufficiency. Food shortages during the Korean War have motivated the rice self-sufficiency policy. The Korean government has subsidized and protected the rice industry to encourage rice production through various policy mechanisms.

Introduction of a two-price system under the Food Grain Control Act in 1967 was the most rigorous effort for self-sufficiency. This policy was designed to stimulate rice production and to support farm income. The government purchased rice at a predetermined price right after harvest. The price was above the market price to cover the average production cost. The procured rice was released below market price to hold consumer prices down. Government cost for this policy was the storage cost plus the difference between the purchasing price and release price.

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The rice self-sufficiency policy, though successful in meeting the policy goal, has led to an inefficient resource distribution. Price suppots, together with quantitative restrictions or ban on rice imports, have kept domestic prices of rice above international levels. The consumer price of rice was about three times higher than the world price, on average, in the 1980s.

As long as consumers and taxpayers in Korea are willing to endure welfare losses due to the self-sufficiency policy, inefficiency in production, increases in operational costs of the price support system, and inefficient resource allocation would be domestic matters. However, internal supports tend to distort trade flows and, consequently, are a subject of discussion in the Uruguay Round of the GATT negotiations.

Through the Uruguay Round of the GATT negotiations, some agricultural exporting countries, including the United States, are demanding removal of all domestic policies that distort agricultural trade flows. Regardless of the success of the GATT round, major exporting countries will challenge agricultural protection through bilateral negotiations. Japan recently agreed to open all of its agricultural markets, except rice.

Rice producers in Korea have been selling their crop above the market price. Over 80 percent of Korea's farm income is from rice production. Trade Liberalization may have a tremendous impact on the Korean rice industry and lead to drastic changes in the Korean agricultural sector.

The objective of this study is to determine the impact of trade liberalization on domestic rice production, consumption, imports, and prices in Korea. This study uses a partial equilibrium model to simulate the impact under alternative scenarios.

This paper is organized as follows: The second section develops econometric models for policy simulation. Results and interpretation are presented at the third section. Implications and conclusions are summarized in the last section.

I. Model Development and Procedures

To determine the impact of trade liberalization, this study uses a par-

tial equilibrium model, including consumer, producer and import behaviors. Empirical estimates are used to simulate the impact of policies on prices, consumption, production, and imports.

II. Specification and Estimation of the Korean Rice Model

Koreans consume two different varieties of rice. One is a traditional high-quality variety, Japonica rice (TV), and the other is a low-quality but high-yield variety (HV), which is a hybrid of Japonica and Indica. Since they are not perfect substitutes in consumption, the demand schedule for one variety differs from that of the other. In production, they compete for limited land.

The representative consumer maximizes utility, given a fixed income. The demand schedule is derived by maximizing utility. This study assumes that the per capita demand for variety i is a linear function of income and prices of goods in the consumption bundle as follows:

$$D_{it} = a_0 + a_1 Y_t + a_2 P_{it} + \Sigma_j b_j P_{jt} + \epsilon_{it}, \; i = TV, HV \qquad (1)$$

where Y is per capita disposable income, P_i is the price of the ith variety, P_j is the price of the substitute, and ϵ_{it} is assumed independently and identically distributed normal variate. Income and prices are deflated by the Consumer Price Index to meet the homogeneity condition.

It is further assumed that demand does not adjust instantaneously to changes in real characteristics of the economy, such as taste. To incorporate dynamic adjustment in consumption, we introduce the partial adjustment model (Nerlove) as follows :

$$D_{it}^* = a_0 + a_1 Y_t + a_2 P_{it} + \Sigma_j b_j P_{jt} + \epsilon_{it}, \text{ and} \qquad (2)$$
$$D_{it} - D_{it-1} = \delta \; (D_{it}^* - D_{it-1}), \; 0 < \delta < 1 \; ,$$

where D^* is the equilibrium quantity determined by the static utility maximization condition, and δ is an adjustment coefficient. The adjustment is partial because of some frictions, such as habit formation or lack of information. The reduced form of the partial adjust-

ment model after simplification is (Phlips)

$$D_{it} = \alpha_0 + \alpha_1 Y_t + \alpha_2 P_{it} + \Sigma_j \beta_j P_{jt} + \alpha_3 D_{it-1} + v_{it}. \quad (3)$$

This model is used to estimate domestic demands for the two varieties. TV and HV are substitutes for each other. Other commodities included in the demand models are barley and wheat. Barley has been a close substitute of rice throughout Korean history, while wheat became a substitute in the 1970s.

The supply schedule can be derived through the producer's profit maximization as

$$S_i = f(P,W), \; i = \text{TV and HV}, \quad (4)$$

where P is a price vector of output including substitutes and W is the vector of input prices. The two-price system is only applied to HV, i.e., only HV is subsidized. Thus, the government procurement price is used for HV, while the farm price is used for TV. Technically, no other crop is competing with the production of rice in Korea. Thus, P in equation (4) includes only the prices of TV and HV.

Since farm prices of rice are not known at planting time, farmers are assumed to make planting decisions based on the previous year's price(naive expectation). Similarly, the previous year's production costs are used as an information at planting time.

Supply does not respond instantaneously to innovation or policy changes. A dynamic model can capture the friction in adjustment. Dynamics in supply response are introduced, using the partial adjustment process similar to that in the specificatin of demand equation. Consequently, supply response functions to be estimated are

$$S_{it} = \beta_0 + \beta_1 FP_{t-1} + \beta_2 G_{t-1} + \beta_3 W_{it-1} + e_{it}, \; i=TV, HV, \quad (5)$$

where FP_{t-1} is the price of TV received by farmers at time t-1, G_{t-1} is the government procurement price for HV at time t-1, W_{t-1} is the farm input price index at time t-1, and e is i.i.d. normal.

An import demand model for a commodity can be expressed as a function of the domestic and international prices of the commodity. A greater difference between the two prices would bring more import,

assuming traders maximize profit. Rice has not been imported since 1983. Hence, a dummy variable (D_t) is used to differentiate the period when Korea imported rice from the years when imports have not been allowed. The dummy variable modelling technique is used as an alternative for the limited dependent variable model because the limited dependent variable model can not be estimated in the system by using the 3SLS estimator. Equilibrium in trade is made where no arbitrage opportunity exists. Since rice is the basic staple in the diet, this study assumes that import demand is perfectly inelastic with respect to income.

Thus, a linear import demand equation is specified as follows:

$$M_t = \gamma_o + \gamma_1 P_{tvt} + \gamma_2 P_{hvt} + \gamma_3 WP_t + \gamma_4 D_t + \mu_t \quad (6)$$

where WP is the world price, ad μ_t is the disturbance term.

Along with the five behavioral equations, two identity equations were specified:

$$S_{tvt} + M_t = D_{tvt} \quad (7)$$
$$S_{hvt} + ST_{t-1} = D_{hvt} + ST_t \quad (8)$$

where $ST(ST_{t-1})$ is the ending stock (previous year's). The first identity reflects that imported rice only enters into the TV market because they are similar in quality. This equation also indicates that rice is imported only when domestic supply is not large enough to meet domestic demand for TV. The second identity reflects accumulating HV stocks. The second identity implies no stock for TV. Endogenous variables are consumption of both varieties(D_{tv}, D_{HV}), production of both varieties(S_{TV}, S_{HV}) and imports of TV(M_{TV}). All other variables, including the lagged government procurement price(G_{t-1}) and lagged farm prices (FP_{t-1}), are treated as exogenous variables in the model.

The simultaneous equation system was estimated using the three-stage least squares (3SLS) estimator. Past studies similar to this analysis usually used the ordinary least squares (OLS) estimator (e.g., Moon and Kang) and suffered from the simultaneity problem. Moreover, the 3SLS estimator is asymptotically more efficient if errors are correlated across equations, i.e., contemporaneously correlated.

III. Policy Simulations

The impact of trade liberalization on the rice industry is simulated under the following five alternative scenarios:

(1) Model 1 assumes that the existing two-price system and border protection will continue.

(2) Model 2 assumes that the domestic rice market is partially liberalized with an import quota of 5 percent of total domestic consumption under the two-price system.

(3) Model 3 assumes an import quota of 10 percent of total domestic consumption under the two-price system.

(4) Model 4 assumes that the price support system is removed and that the quota restriction is converted into an import tariff of 20 percent.

(5) Model 5 is the same as Model 4 except that this model assumes a 5 percent import tariff.

Model 1 describes the Korean rice industry under current domestic and trade policies (Base model). Results of this model are compared with those of alternative models to evaluate the impacts of alternative trade policies on the Korean rice industry. The impact of trade liberalization is simulated over eight years from 1989 to 1996. This analysis assumes that real disposable income increases at 5 percent annually, which is projected for the seventh five-year economic development plan (1992-1996). Production cost and government purchase price are assumed to increase at 1.5 and 1 percent, respectively. These numbers are based on the annual rates of increase for the 1985 to 1989 period. Import price is assumed to be constant at the 1988~89 level. The farm prices of rice, which are exogenous in the supply equations, are estimated as a linear function of consumer prices and the price equations are used in simulation of models.

IV. Results and Analysis

Annual data from 1975 to 1989 were used to estimate the model. Data for personal disposable income were obtained from the Bank of Korea, and the Consumer Price Index were from the Korean Economic Planning Board. Data for rice consumption are taken from the Korean Ministry of Agriculture, Forestry, and Fisheries (KMAFF).

Data for the government procurement price, production cost index, and rice production are obtained from KMAFF. Data for farm prices were taken from the Korean National Agricultural Cooperative Federation. Data for consumer prices by variety and import price were obtained from the Food and Agriculture Organization and KMAFF. Consumer prices and import prices were deflated by CPI and exchange rate, respectively. Import prices for milled rice were converted to a polished basis by multiplying by the official conversion rate of 0.929. Prices of imported rice were determined by adding transport and handling costs after imposing a 5 percent tariff per c.i.f. unit import value.

V. Estimated Model

The estimated equations are presented in Table 1. The demand for TV is positively related to disposable income and negatively related to the own-price as expected. Coefficients for all other prices are positive, indicating substitution in demand. However, none of variables are statistically significant at a 5 percent level. This may be due to multicollinearity among prices.

The demand for HV is negatively related to income, implying that it is an inferior good as expected. Consumers tend to use more TV and less HV as income increases. The demand for HV is inversely related to the prices of barley and wheat. Low-income households tend to consume HV together with barley and wheat. None of variables are significant in the TV demand model.

On the other hand, most variables in the supply equations are statistically significant and have expected relations. In the TV supply model, the coefficient of farm price is positive while that of procurement price is negative, implying TV and HV are competing for limited land. The relations are consistent in the HV model. Also, input price is negative in the two models, which is consistent with theory. Lagged dependent variables are also significantly positive in both models. This implies persistence in production, which may be due to continuous cropping patterns and to fertilizer or pesticides remaining from previous year(s). Table 2 shows income and price elasticities of the demand and supply.

TABLE 1 Estimated Parameters of Rice Demand, Supply, and Import Model(t-values in parentheses)

	Demand		Supply		Import
	D_{TV}	D_{HV}	S_{TV}	S_{HV}	
Intercept	-8397.339	16926	-31.417	2674.035	-7468.057
	(-2.364)	(3.300)	(-0.034)	(4.022)	(-2.537)
PDI	214.988	-275.384			
	(1.001)	(-0.985)			
P_{TV}	-103.156	281.146			564.024
	(-0.167)	(0.337)			(2.380)
P_{HV}	608.131	-725.810			249.255
	(1.154)	(-1.035)			(0.764)
P_b	367.256	-604.261			
	(1.422)	(-1.655)			
P_w	1775.651	-3572.04			
	(1.212)	(-1.827)			
D_{-1TV}	0.297				
	(1.790)				
D_{-1HV}		0.224			
		(1.371)			
WP					168.151
					(0.645)
FP_{-1}			986.374	-619.840	
			(2.339)	(-2.282)	
G_{-1}			-510.455	834.612	
			(-1.359)	(3.406)	
W_{-1}			-468.935	-683.877	
			(-1.477)	(-3.374)	
S_{-1TV}			0.587		
			(4.350)		
S_{-1HV}				0.686	
				(8.587)	
D					1039.311
					(2.779)

D_{TV} = consumption of traditional variety, D_{HV} = Consumption of high-yield variety, PDI = Per capita income, P_{TV} = consumer price of traditional variety rice, P_{HV} = Consumer price of high-yield variety rice, P_b = consumer price of barley, P_w = Consumer price of wheat, WP = Import price of rice, FP_{-1} = Farm price of traditional variety at t-1, G_{-1} = Government purchase price of high-yield variety at t-1, W_{-1} = Farm input costs at t-1, S_{TV} = Production of traditional variety, S_{HV} = Production of high-yield variety, and D=Dummy variable representing years when rice imports were allowed.

TABLE 2 Own-Price, Cross-Price, and Income Elasticities of Demand and Supply at the Means

	TV	HV
Demand:		
Price of		
TV	-0.254	1.274
HV	1.114	-2.444
Barley	0.407	-1.230
Wheat	1.018	-3.767
Income	0.741	-1.747
Supply:		
Price of		
TV	2.377	-2.374
HV	-1.200	3.118

Estimated results of the import model indicate that the consumer price of each variety has the expected positive sign. However, only the price of TV is significant for import demand, mainly because the quality of imported rice is comparable only with TV. Although import price is theoretically important, the estimated coefficient is insignificant.

VI. Policy Analysis

Table 3 shows simulated results under the current price support and import ban. Domestic supply of HV gradually decreases while demand for HV falls sharply and eventually becomes nil in 1996. As a result, domestic supply of HV is projected to exceed demand for HV. However, domestic supply of TV is projected to increase by 10 percent between 1989 and 1996, while demand for TV increases by 25 percent. The domestic supply of TV would fall short of demand for TV. The results imply that under current policies, the rice self-sufficiency ratio would be over 100 percent with a surplus of HV and a shortage of TV.

Models under 5 and 10 percent import quotas provide results similar to the results of Model 1 as shown in Table 3. Compared to the results of Model 1, allowing import with quantitative restrictions would decrease production, increase demand, and decrease the prices of both varieties.

With a 5 percent quota, the domestic supply of TV is projected to decrease by 8 percent in 1989 and by 4 percent in 1996, compared to that of Model 1. Production of HV is projected to fall by 30 percent in 1989 and by 70 percent in 1996. However, demand for TV is projected to increase by 10 percent in 1989 and by 0.4 percent in 1996. The demand for HV is projected to drop to zero in 1996. This results in a lower self-sufficiency ratio. Since imports take a small portion of consumption, imports hardly affect the domestic price.

Increasing the quota to 10 percent reduces domestic production of TV and prices, leaving the production of HV almost the same as that of the 5 percent quota model. Rice imports increase twofold, and domestic consumers switch to the cheaper imports.

Trade liberalization with tariffs has a significant impact on prices, production, consumption, and imports (Table 3). Consumer prices are projected to fall significantly, compared to those of partial liberalization under the quota systems. Without import restrictions, the import price would prevail in the domestic market. This would affect domestic production. Production of TV decreases sharply, compared to Model 1 and models under quotas, and HV is not produced. About 85 percent of consumption is supplied by import in 1996. The results of the two different tariffs are similar.

VII. Summary and Conclusions

A five-equation, partial equilibrium model was used to determine the impacts of trade liberalization on the rice market in Korea. A dynamic deterministic simulation was conducted under five alternative scenarios. Important findings are as follows:

First, under the current policies of the two-price system and the import ban, production of the high-yield variety would decrease dramatically, and demand for this variety would be nil in 1996.

TABLE 3 Projections of Rice Production, Consumption, Price and Imports under Alternative Liberalization Policies

	Scenarios				
	1	2	3	4	5
	1,000 ton				
1989 :					
Production					
TV	4,848	4,453	4,410	4,366	4,366
HV	1,206	846	846	0	0
Total	6,054	5,299	5,256	4,366	4,366
Consumption					
TV	4,456	4,906	5,129	5,417	5,417
HV	1,108	863	806	567	570
Total	5,564	5,769	5,935	5,984	5,987
Imports	0	281	562	1,618	1,622
Self-sufficiency(%)	109	92	89	73	73
Consumer price					
TV (won/kg)	1,038	1,037	1,018	401	361
HV (won/kg)	573	550	539	374	358
1996:					
Production					
TV	5,319	5,115	4,728	911	816
HV	388	113	113	0	0
Total	5,707	5,228	4,841	911	816
Consumption					
TV	5,596	5,618	5,680	5,981	5,997
HV	0	0	0	0	0
Total	5,596	5,618	5,680	5,981	5,997
Imports	0	269	544	4,990	5,180
Self-sufficiency(%)	102	91	85	15	14
Consumer price					
TV (won/kg)	1,053	1,037	1,006	401	361
HV (won/kg)	445	445	445	374	358

Second, import quotas do not significantly affect production or prices. However, the self-sufficiency rate would drop to some 90 percent compared to over 100 percent under the current policies.

Third, trade liberalization with tariffs affects production and price significantly. Because of price competitiveness, imports were projected to satisfy 27 percent of total consumption in 1989 and 85 percent in 1996, decreasing domestic production significantly. The self-sufficiency rate would be 73 percent in 1989 and only 14 percent in 1996.

Fourth, consumption patterns change. Demand for TV grows while demand for HV falls and becomes nil by 1996, implying that consumer demand switches to high-quality rice as a result of changes in relative prices and increased income.

Fifth, production of a high-yield variety would disappear from Korean paddy fields under the liberalization with tariffs. The results indicate that the domestic rice sector, particularly HV production, relies heavily on the government subsidy and is not competitive in international trade.

This study does not incorporate feedback effects of the rice market to other farm sectors. The consequences of liberalizing the rice market can affect the performance of the other food markets. In addition, the maintained assumption of this study is that Korean imports do not influence the world rice market. However, in the case of medium-grain rice that Koreans consume, the impact of the Korean market may not be negligible. Imports from Korea may affect the world price. This implies that a world model, including all rice exporting and importing countries, may provide more accurate information regarding production, consumption, and imports of rice in Korea under alternative trade policies.

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