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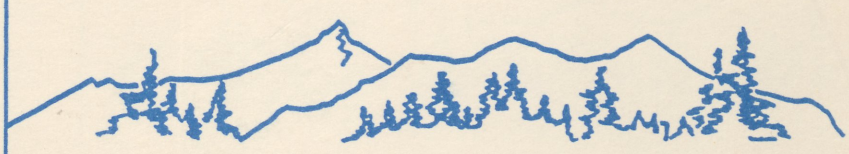

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TOTAL IMPORTS AND IMPORT PATTERNS OF BARLEY INTO JAPAN

Biing-Hwan Lin, Univ. of Idaho
Larry D. Makus, Univ. of Idaho

A two-stage budgeting procedure is employed to estimate the Japanese barley import demand and the allocation of imports by country. The estimated models are combined to forecast Japanese barley imports under two scenarios; when Japanese beef producers face stiff competition after April 1991, and if barley prices are changed.

INTRODUCTION

Japan is the leading export market for Canadian barley, importing more than 800 thousand metric tons, valued at $125 million in 1988. Canada, Australia, and the U.S. were essentially the exclusive suppliers of barley imported into Japan, accounting for, respectively, 60, 30, and 10 percent of the market during the period from 1976 to 1988. Canada and Australia were stable suppliers while U.S. barley exports to Japan were often sporadic, especially for the periods before 1980 and since 1985.

Barley imported into Japan is used as a feed grain mainly by the cattle industry (Coyle). The Japanese cattle industry has been protected by import quotas, a 25 percent ad valorem tariff, and the involvement of the Livestock Industry Promotion Corporation (LIPC), a quasi-government agency which controls about 80 percent of the import quotas. In June 1988, the U.S. and Japan concluded the 1988 Japanese Beef Market Access Agreement. Under the agreement, import quotas and the involvement of the LIPC will be replaced with higher tariffs starting in April 1991. These changes have been predicted to impose appreciable damage to the Japanese beef industry. If the Japanese cattle industry contracts in response to this trade liberalization, the Japanese demand for feed grains, mainly corn and barley, will decline.

The objectives of the study are twofold. The first objective is to investigate factors affecting the Japanese import demand for and import patterns of barley. The second objective involves predicting Japanese total imports and import patterns of barley under two scenarios; when Japanese beef producers face stiff competition after April 1991, and if prices of imported barley are changed.

METHODOLOGY

A two-stage budgeting procedure is employed to analyze Japanese barley import decisions. In the first stage, total import expenditure is allocated among broadly defined groups of goods. The second stage then determines the allocation of group expenditure among different suppliers. In the context of Japanese barley imports, factors affecting total barley imports are considered in the first stage and factors affecting barley imports by country of origin are addressed in the second stage. Specifically, the import demand for barley can be specified as:

(1) $BM = f(PB, PC, CATTLE, SLAUGHTER, Z)$

BM is total barley imports into Japan; PB is the price of imported barley; PC is the price of imported corn; CATTLE is the beginning inventory of the

Japanese cattle herd; SLAUGHTER is the number of cattle slaughtered; and Z is a vector of other demand shifters.

Barley and corn are the main ingredients in the finishing ration used by the Japanese cattle industry. Import demand for barley is therefore affected by prices of imported barley and corn. Import demand for barley and the number of cattle should have a positive relationship. Size of the cattle herd has been surveyed twice a year (February and August) by the Japanese government. Semiannual data (April to September is the first half of the Japanese fiscal year) are constructed from quarterly data for barley imports. The cattle herd size for the preceding February (August) is treated as the beginning cattle inventory for the first (second) half of the year. The number of cattle slaughtered reduces the demand for barley. Japanese domestic production of barley is excluded from both the first- and second-stage modelling, because it is used for human consumption. The use of imported barley for human consumption is prohibited in order to prevent imports from undermining the price support program for domestic barley.

The second-stage budgeting decision is modelled by the almost ideal demand system developed by Deaton and Muellbauer. A dynamic linear approximate almost ideal demand system (LA/AIDS) was specified as below by following Haden's approach:

$$(2) \quad W_i = \alpha_i + \tau_i W_{i,t-1} + \sum_i \gamma_{ij} \ln P_j + \beta_i \ln(X/P^*)$$

W_i is ith country's share of the Japanese import expenditure on barley, P_j is the landed price of country j's barley, X is Japanese total import expenditure on barley, and P* is the Stone geometric price index; $\ln P^* = \Sigma W_i \ln P_i$.

Uncompensated demand price and expenditure elasticities can be calculated from parameter estimates of (2) using the formulas given in Chalfant and Green and Alston. Adding-up, homogeneity, and symmetry conditions, respectively, can be expressed as:

$$\Sigma \alpha_i = 1, \sum_i \gamma_{ij} = 0, \text{ and } \Sigma \beta_i = 0; \quad \sum_j \gamma_{ij} = 0; \quad \text{and } \gamma_{ij} = \gamma_{ji} \quad \forall \text{ i and j}$$

MODEL ESTIMATION

Data Sources

With the exception of the cattle herd size, quarterly data for all variables are collected for the period from the first quarter of 1975 (1975:1) to the first quarter of 1989 (1989:1). Quantities and values of barley and corn imports into Japan by country of origin are taken from *Japan Exports & Imports, Commodity by Country* published by the Ministry of Finance, Japan. Prices of imported barley and corn are derived by taking the ratio of import values to quantities. Size of the cattle herd (dairy and Wagyu which is an indigenous breed) and the number of cattle slaughtered are taken, respectively, from *Livestock Statistics* and *Meat Distribution Statistics*, published by the Ministry of Agriculture, Forestry, and Fisheries, Japan. Because the cattle herd size is reported for February and August in Japan, the import demand for barley is estimated using semiannual data, with the period

from April to September being regarded as the first half of a year. Quarterly data are used to estimate the dynamic LA/AIDS model.

First-Stage Import Demand Equation

The Box-Cox flexible (extended by Zarembka), double-log, and linear functional forms all produced similar results in terms of the log-likelihood function. Results of the double-log functional form reported below are used because of its ease in result interpretation and forecasting.

$$\begin{aligned}(3)\ \ln BM = {} & 6.39 - 0.504 \ln PB + 0.700 \ln PC + 1.149 \ln CATTLE - 0.486 \ln SLAUGHTER \\ & (2.43)\ \ (0.177)\ \ \ (0.166)\ \ \ (0.526)\ \ \ (0.324) \\ & - 0.114 DS - 0.42134 D82 \\ & (0.061)\ \ (0.064)\end{aligned}$$

$R^2 = 0.814$, Adj. $R^2 = 0.748$, $\rho = -0.545$, D-W = 2.16, n = 24.

Numbers in parentheses are standard errors, DS is the seasonal dummy variable (equal to 1 for the first half of the year), D82 is a dummy variable (equal to 1 for October to March, 1982) included to capture the effect of poor barley production in Australia, ρ is the coefficient used for correcting the first-order autocorrelation problem, and n is the number of observations.

All parameter estimates have signs consistent with *a priori* expectations. With the exception of SLAUGHTER, all variables are statistically significant at a 5 percent level. The Japanese import demand for barley is found to be price inelastic with an elasticity of -0.50, and to be positively affected by the price of imported corn with a cross-price elasticity of 0.70. It is known that cattle sectors in Japan or elsewhere exhibit long term cycles such that the herd size gradually builds up (contracts) when producers are optimistic (pessimistic) about market conditions. Consequently, the finding that the beginning herd size (CATTLE) has a coefficient exceeding 1.0 is reasonable. An increase in the number of slaughtered cattle reduces the demand for barley, as expected. There is a seasonal import pattern in favor of the second half of the year after the North American barley crop is harvested.

Second-Stage Import Allocation Equation

Quarterly data from 1976 to 1988 are used in modelling the second-stage of the Japanese barley import decision. The U.S. is combined with Canada (termed North America) in the estimation for two reasons: 1) during the periods from 1976 to 1981 and since 1985 U.S. barley exports to Japan were often sporadic and small in volume on a quarterly basis and 2) the two markets could be regarded as one by Japanese importers because of similar production and marketing seasons and geographic proximity as compared to the Australian market. Because Japan imports very little barley from other sources, only imports from Australia, Canada, and the U.S. are considered. Because expenditure shares of the North America and Australia sum to 1.0, only one of the two LA/AIDS equations can be estimated and parameters of the other equation can be derived by using the adding-up property of the demand system. The homogeneity condition fails to be rejected using a F test, and the imposition of the homogeneity condition generates the following empirical results:

$$(4)\quad W_{na,t} = \underset{(1.347)}{0.208} - \underset{(0.511)}{1.026}\ln P_{na,t} + \underset{(0.511)}{1.026}\ln P_{au,t} + \underset{(0.105)}{0.018}\ln(X/P) + \underset{(0.129)}{0.396}W_{na,t-1}$$

$$- \underset{(0.046)}{0.104}D_1 - \underset{(0.046)}{0.035}D_2 - \underset{(0.047)}{0.019}D_3$$

$R^2 = 0.335$, Adj. $R^2 = 0.246$, Durbin-h = -0.06, n = 52

$W_{na,t}$ is North American share of the Japanese expenditure on barley imports in time t; P_{na} and P_{au} are landed prices of barley from North America and Australia, respectively; X is the Japanese expenditure on barley imports; and P is the Stone price index for imported barely; and D_i is the i<u>th</u> quarter dummy variable.

The coefficient of the lagged budget share is statistically significant at a 1 percent level, suggesting the adjustment to changes in prices is partial within the period. The expenditure variable (X/P) has a coefficient not significantly different from zero, suggesting that shares of the import expenditure are proportional to the total import enpenditure. The two price coefficients are different from zero at a 5 percent level. The mean own- and cross-price elasticities for North American barley are, respectively, -2.48 and 1.48 in the short run and -4.11 and 2.45 in the long run.

EFFECTS OF THE BEEF TRADE AGREEMENT

During the past two decades, three multilateral agreements on Japanese beef imports have been reached between Japan, Australia, and the U.S. During the often heated and tense trade negotiations, literature on the Japanese demand and supply of beef and the effect of trade liberalization proliferated. It has been recognized that the assumption of substitutability between Japanese (dairy and Wagyu) beef and imported beef is crucial in analyzing the effect of trade liberalization (Dyck). Dairy beef and imported beef have been assumed to be perfect substitutes in the studies by Ohga and Inaba, Wahl et al., and Hayes et al., while imperfect substitution between these two types of beef has been suggested by Mori and Lin; and Ohga.

Other factors further complicate the analysis of the effect of trade liberalization on the Japanese cattle industry. Some of the factors are:
- Japanese beef producers' economic behavior may differ drastically under different trade regimes;
- beef imports into Japan are influenced greatly by, among other factors, exchange rates which are highly volatile;
- price support and subsidy programs available to Japanese beef producers;
- price support programs for milk production because dairy beef, a joint-product of the dairy industry, accounts for over 60 percent of Japanese beef production; and
- Japanese policy pertaining to the exportation of Wagyu genetic materials.

Consequently, a wide range of predictions on the effect of trade liberalization has been generated in the literature. For example, Wahl et al. found that different economic behaviors of Japanese beef producers greatly influence the size of the Japanese cattle industry under trade liberalization. Obviously, sensitivity analysis is warranted in analyzing the effect of trade

liberalization. It is assumed that the Japanese cattle industry will undergo liquidation at different rates starting in April 1991. The herd size and the number of slaughters under different liquidation rates are calculated using the following two formulas:

$$\text{BIRTH RATE}_t = (\text{SLAUGHTER}_t + \text{CATTLE}_t) \div \text{CATTLE}_{t-1} - 1$$
$$\text{SLAUGHTER RATE}_t = \text{SLAUGHTER}_t \div \text{CATTLE}_{t-1}$$

BIRTH RATE measures the percentage increase in herd size due to births and SLAUGHTER RATE measures the percentage of the herd size that is usually slaughtered. Birth and slaughter rates are seasonal on a semiannual basis. The slaughter rate starting from April 1991 is assumed to be zero, 10, 20, 30, and 40 percent above the historical rate while the birth rate is assumed to continue at its historical level. Herd sizes and slaughter numbers for the period from 1988 to 1997 under different liquidation rates and the prices of imported barley and corn that prevailed during the second half of 1987 are fitted into equation (3) to predict the Japanese total barley imports for the period from 1989 to 1995. The forecasted total barley imports and assumed prices are then fitted into equation (4) to predict North American barley exports to Japan, as shown in Table 1.

When the ratio of number of cattle slaughtered to the herd size follows its historical level, the cattle herd size in Japan would start building up. Consequently, an upward trend in the Japanese import demand for barley is predicted. When the Japanese cattle industry is assumed to liquidate its herd under trade liberalization, the demand for barley imports reduces gradually in the initial stage and declines at an increasing rate by the end of 1995. Apparently, the liquidation rate of the Japanese cattle industry under trade liberalization plays a major role in determining future barley imports into Japan. If indeed the Japanese cattle industry contracts and the import demand for barley declines under trade liberalization, price competition in the Japanese imported barley market is likely to intensify. A separate sensitivity analysis addresses the price impact. Results indicate that a 10 percent decrease in the price of North American barley would, on average, increase Japanese barley imports from all sources by 5 percent and from North America by more than 33 percent.

CONCLUSIONS

The 1988 Japanese Beef Market Access Agreement stipulates that import quotas and the involvement of the Livestock Industry Promotion Corporation be replaced with higher tariffs starting in April 1991. As a result, it has been predicted that the trade agreement is likely to have adverse impacts on the Japanese cattle industry. It is, however, difficult to predict the effects of trade liberalization because impacts are dependent upon many economic and policy factors. A two-stage budgeting procedure is employed to estimate the Japanese import demand for barley and the allocation of imports among major suppliers (North America and Australia). The Japanese import demand for barley is found to be price inelastic and is affected by the price of corn, which is a substitute for barley in cattle feeding. Additionally, size of the cattle herd and the number of cattle slaughtered are major determinants of Japanese barley imports. The allocation of barley imports between North America and Australia is modeled by employing a dynamic linear approximate/

almost ideal demand system (LA/AIDS). It is found that the demand for North American barley is quite price elastic and that North American and Australian barley are close substitutes in Japan. Further, the allocation of total Japanese barley imports between North America and Australia is found to be proportional to total imports, provided that prices of barley by country of origin are constant.

The predicted total barley imports are then combined with results of the LA/AIDS model to forecast semiannual North American barley exports to Japan through the year 1995. Since impacts of the 1988 Japanese Beef Market Access Agreement on the Japanese cattle sector are uncertain, several herd liquidation scenarios are analyzed. Additionally, it is estimated that a 10 percent reduction in the price of North American barley would increase the Japanese total imports by 5 percent and increase imports from North America by more than 33 percent. Price competition in the Japanese barley import decision is likely to intensify when the total import demand is reduced as a result of beef trade liberalization.

Table 1. Predicted North American Barley Exports (1000 MT) to Japan.

Year[a]	Cattle Herd Liquidation Rates					Price ↓
	0%	10%	20%	30%	40%	10%
1988:1[b]	394	na[c]	na	na	na	na[d]
1988:2	422	na	na	na	na	na
1989:1	414	na	na	na	na	552
1989:2	468	na	na	na	na	623
1990:1	425	na	na	na	na	566
1990:2	472	na	na	na	na	628
1991:1	432	412	395	380	367	575
1991:2	477	451	428	408	390	635
1992:1	438	410	385	363	343	583
1992:2	482	448	416	389	364	642
1993:1	443	407	375	346	321	590
1993:2	489	444	405	371	340	651
1994:1	449	404	365	330	300	598
1994:2	495	441	395	354	318	659
1995:1	455	401	355	315	280	605
1995:2	501	438	384	337	297	667
Average (semiannual) 1991-1995	466	426	390	359	332	620

a/ Japanese fiscal year on a semiannual basis with 1989:1 spanning from April to September, 1989. b/ 1988:1 and 1988:2 are actual figures. c/ Different liquidation rates were assumed under trade liberalization starting from 1991 only. d/ Price ↓ 10% is a 10 percent price reduction from the conditions underlying the zero rate of liquidation.

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